US009798967C1

(12) EX PARTE REEXAMINATION CERTIFICATE (11358th)

United States Patent
McAllister

(10) **Number: US 9,798,967 C1**
(45) **Certificate Issued: *Jul. 30, 2018**

(54) **SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS**

(71) Applicant: **ADASA INC.**, Eugene, OR (US)

(72) Inventor: **Clarke W. McAllister**, Eugene, OR (US)

(73) Assignee: **ADASA INC.**, Eugene, OR (US)

Reexamination Request:
No. 90/014,052, Nov. 29, 2017

Reexamination Certificate for:
Patent No.: **9,798,967**
Issued: **Oct. 24, 2017**
Appl. No.: **15/042,993**
Filed: **Feb. 12, 2016**

(*) Notice: This patent is subject to a terminal disclaimer.

Related U.S. Application Data

(63) Continuation of application No. 13/526,520, filed on Jun. 19, 2012, now Pat. No. 9,272,805, which is a continuation-in-part of application No. 12/820,109, filed on Jun. 21, 2010, now Pat. No. 8,228,198, which is a continuation-in-part of application No. 11/465,712, filed on Aug. 18, 2006, now Pat. No. 7,830,258, said application No. 12/820,109 is a continuation-in-part of application No. 12/124,768, filed on May 21, 2008, now abandoned.

(60) Provisional application No. 60/709,713, filed on Aug. 19, 2005, provisional application No. 60/939,603, filed on May 22, 2007.

(51) **Int. Cl.**

H04Q 5/22	(2006.01)
G06K 19/077	(2006.01)
B65C 9/18	(2006.01)
B65C 11/00	(2006.01)
B65C 9/40	(2006.01)
B65C 9/00	(2006.01)
G06K 17/00	(2006.01)

(52) **U.S. Cl.**
CPC ***G06K 19/07716*** (2013.01); ***B65C 9/1865*** (2013.01); ***B65C 11/006*** (2013.01); ***G06K 19/077*** (2013.01); *B65C 2009/0003* (2013.01); *B65C 2009/404* (2013.01); *G06K 2017/0041* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

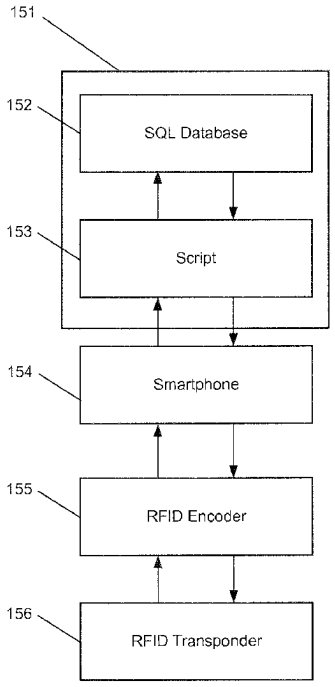
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/014,052, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Christina Y Leung

(57) **ABSTRACT**

In one embodiment the present invention comprises a smartphone and encoders for commissioning RFID transponders. The present invention further includes novel systems, devices, and methods for commissioning RFID transponders with unique object class instance numbers without requiring a realtime connection to a serialization database.



r-pac-1004
IPR2024-01416

EX PARTE REEXAMINATION CERTIFICATE

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

Claims **1**, **13** and **16** are determined to be patentable as amended.

Claims **2-12**, **14**, **15** and **17-20**, dependent on an amended claim, are determined to be patentable.

1. An RFID transponder comprising:
a substrate;
an antenna structure formed on the substrate; and
an RFID integrated circuit chip which is electrically coupled to the antenna structure,
wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,
wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits,
wherein the unique serial number space comprises the limited number of most significant bits *uniquely* corresponding to *the limited number of most significant bits of* the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance.

13. A RFID transponder comprising:
a substrate;
an antenna structure formed on the substrate; and
an RFID integrated circuit chip which is electrically coupled to the antenna structure,
wherein the RFID integrated circuit chip is encoded with a global trade item number including a unique object number, the unique object number comprising an object class information space including a block of at least 50 bits and a unique serial number space including a block of at least 38 bits,
wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and
wherein the unique serial number space comprises at least 3 most significant bits *uniquely* corresponding to *the limited number of most significant bits of* the allocated block.

16. An integrated circuit, comprising:
a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator;
control logic; and
a memory,
wherein the memory is configured with a unique object number space, the unique object number space comprising an object class information space and a unique serial number space,
wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits,
wherein the unique serial number space comprises the limited number of most significant bits *uniquely* corresponding to *the limited number of most significant bits of* the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance.

* * * * *

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
90/014,052	11/29/2017	9798967	029101.6	4770

30636 7590 07/05/2018
FAY KAPLUN & MARCIN, LLP
150 BROADWAY, SUITE 702
NEW YORK, NY 10038

EXAMINER
LEUNG, CHRISTINA Y

ART UNIT	PAPER NUMBER
3992	

MAIL DATE	DELIVERY MODE
07/05/2018	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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EX PARTE REEXAMINATION COMMUNICATION TRANSMITTAL FORM

REEXAMINATION CONTROL NO. *90/014,052*.

PATENT NO. *9,789,967*.

ART UNIT *3992*.

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above identified *ex parte* reexamination proceeding (37 CFR 1.550(f)).

Where this copy is supplied after the reply by requester, 37 CFR 1.535, or the time for filing a reply has passed, no submission on behalf of the *ex parte* reexamination requester will be acknowledged or considered (37 CFR 1.550(g)).

Notice of Intent to Issue Ex Parte Reexamination Certificate	Control No. 90/014,052	Patent Under Reexamination 9798967	
	Examiner Christina Y. Leung	Art Unit 3992	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

1. ☒ Prosecution on the merits is (or remains) closed in this *ex parte* reexamination proceeding. This proceeding is subject to reopening at the initiative of the Office or upon petition. *Cf.* 37 CFR 1.313(a). A Certificate will be issued in view of
   (a) ☒ Patent owner's communication(s) filed: *15 June 2018*.
   (b) ☐ Patent owner's failure to file an appropriate timely response to the Office action mailed: _____.
   (c) ☐ Patent owner's failure to timely file an Appeal Brief (37 CFR 41.31).
   (d) ☐ The decision on appeal by the ☐ Board of Patent Appeals and Interferences ☐ Court dated _____
   (e) ☐ Other: _____.
2. The Reexamination Certificate will indicate the following:
   (a) Change in the Specification: ☐ Yes ☒ No
   (b) Change in the Drawing(s): ☐ Yes ☒ No
   (c) Status of the Claim(s):
      (1) Patent claim(s) confirmed: _____.
      (2) Patent claim(s) amended (including dependent on amended claim(s)): *1-20*
      (3) Patent claim(s) canceled: _____.
      (4) Newly presented claim(s) patentable: _____.
      (5) Newly presented canceled claims: _____.
      (6) Patent claim(s) ☐ previously ☐ currently disclaimed: _____
      (7) Patent claim(s) not subject to reexamination: _____.
3. ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.
4. ☒ Note the attached statement of reasons for patentability and/or confirmation. Any comments considered necessary by patent owner regarding reasons for patentability and/or confirmation must be submitted promptly to avoid processing delays. Such submission(s) should be labeled: "Comments On Statement of Reasons for Patentability and/or Confirmation."
5. ☐ Note attached NOTICE OF REFERENCES CITED (PTO-892).
6. ☐ Note attached LIST OF REFERENCES CITED (PTO/SB/08 or PTO/SB/08 substitute).
7. ☐ The drawing correction request filed on _____ is: ☐ approved ☐ disapproved.
8. ☐ Acknowledgment is made of the priority claim under 35 U.S.C. § 119(a)-(d) or (f).
   a)☐ All b)☐ Some* c)☐ None of the certified copies have
   ☐ been received.
   ☐ not been received.
   ☐ been filed in Application No. _____.
   ☐ been filed in reexamination Control No. _____.
   ☐ been received by the International Bureau in PCT Application No. _____.
   * Certified copies not received: _____.
9. ☐ Note attached Examiner's Amendment.
10. ☒ Note attached Interview Summary (PTO-474).
11. ☐ Other: _____.

All correspondence relating to this reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of this Office action.

/Christina Y. Leung/
Primary Examiner, Art Unit 3992

cc: Requester (if third party requester)

STATEMENT OF REASONS FOR PATENTABILITY AND/OR CONFIRMATION

Claims 1-20 (all claims) of US 9,798,967 B2 ("967 Patent") are being reexamined in this proceeding.

Claims 1-20 are patentable.

The following is an examiner's statement of reasons for patentability and/or confirmation of the claims found patentable in this reexamination proceeding:

The claim amendment filed on June 15, 2018 has been entered. The response filed by Patent Owner on June 15, 2018 has been fully considered and is persuasive in view of the claim amendment.

The prior art of record, including 684 Publication, 200 Patent, 545 Patent, and 2006 EPC Standard, does not specifically disclose or fairly teach an RFID transponder (or an integrated circuit with an RF circuit) including all of the elements and limitations recited in claims 1-20 (and including all of the limitations of any respective parent claims), particularly including:

a unique serial number space encoded with one serial number instance from an allocated block of serial numbers,

the allocated block being assigned a limited number of most significant bits,

wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block.

Any comments considered necessary by PATENT OWNER regarding the above statement must be submitted promptly to avoid processing delays. Such submission by the patent owner should be labeled: "Comments on Statement of Reasons for Patentability and/or Confirmation" and will be placed in the reexamination file.

All correspondence relating to this ex parte reexamination proceeding should be directed:

By mail to: Mail Stop *Ex Parte* Reexam
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Alexandria, VA 22313-1450

By fax to: (571) 273-9900
Central Reexamination Unit

By hand to: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Any inquiry concerning this communication should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

/Christina Y. Leung/

Primary Examiner, Art Unit 3992

Conferees:

/Albert J Gagliardi/

Primary Examiner, Art Unit 3992

/James Menefee/

Primary Examiner, Art Unit 3992

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90014052	9798967
	Examiner	Art Unit
	CHRISTINA Y LEUNG	3992

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
Reviewed patent file's prosecution history.	12-14-17	/CL/
Reviewed cited references and prosecution history.	1-29-18	/CL/
Reviewed cited references and prosecution history.	6-21-18	/CL/

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

	/CHRISTINA Y LEUNG/ Primary Examiner.Art Unit 3992

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90014052	9798967
	Examiner	**Art Unit**
	CHRISTINA Y LEUNG	3992

CPC						
Symbol					**Type**	**Version**
G06K		19	/	07716	F	2013-01-01
G06K		19	/	077	I	2013-01-01
B65C		9	/	1865	I	2013-01-01
B65C		11	/	006	I	2013-01-01
B65C		2009	/	404	A	2013-01-01
G06K		2017	/	0041	A	2013-01-01
B65C		2009	/	0003	A	2013-01-01
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CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHRISTINA Y LEUNG/ Primary Examiner.Art Unit 3992	06/21/2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	15

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90014052	9798967
	Examiner	**Art Unit**
	CHRISTINA Y LEUNG	3992

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
340	10.510

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
-	-				

INTERNATIONAL CLASSIFICATION					
CLAIMED					**NON-CLAIMED**
H	0	4	Q	5 / 22 (2006.01.01)	
G	0	6	K	19 / 077 (2006.01.01)	
B	6	5	C	9 / 18 (2006.01.01)	
B	6	5	C	11 / 00 (2006.01.01)	
B	6	5	C	9 / 40 (2006.01.01)	
B	6	5	C	9 / 00 (2006.01.01)	
G	0	6	K	17 / 00 (2006.01.01)	

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHRISTINA Y LEUNG/ Primary Examiner.Art Unit 3992	06/21/2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	15

U.S. Patent and Trademark Office

Part of Paper No. 20180619

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90014052	9798967
	Examiner	**Art Unit**
	CHRISTINA Y LEUNG	3992

☒ **Claims renumbered in the same order as presented by applicant** ☐ **CPA** ☐ **T.D.** ☐ **R.1.47**

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/CHRISTINA Y LEUNG/ Primary Examiner.Art Unit 3992 (Primary Examiner)	06/21/2018 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 15

U.S. Patent and Trademark Office

Part of Paper No. 20180619

Entry approved. Please enter.

Claims 1, 13, and 16 are amended.
Claims 2-12, 14, 15, and 17-20 are original.

/CL/ 6-21-18

IN THE CLAIMS

1. (Amended) An RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits,

wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance.

2. The RFID transponder of claim 1, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

3. The RFID transponder of claim 1, wherein the unique object number is a portion of a serialized global trade item number.

4. The RFID transponder of claim 3, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

5. The RFID transponder of claim 1, wherein the unique serial number space is at least 38 bits.

6. The RFID transponder of claim 1, wherein the allocated block is defined by at least 3 most significant bits.

7. The RFID transponder of claim 1, wherein the allocated block is one of a plurality of allocations intermittently received by an encoder.

8. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of silicon.

9. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of polymer.

10. The RFID transponder of claim 1, wherein the substrate, antenna structure, and RFID integrated circuit chip are covered by a face stock material.

11. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is disposed on the substrate.

12. The RFID transponder of claim 1, wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.

13. (Amended) A RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a global trade item number including a unique object number, the unique object number comprising an object class information space including a block of at least 50 bits and a unique serial number space including a block of at least 38 bits,

wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises at least 3 most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block.

14. The RFID transponder of claim 13, wherein the unique serial number space further comprises remaining bits of lesser significance that together with the at least 3 most significant bits comprise the one serial number instance.

15. The RFID transponder of claim 13, wherein the at least 3 most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.

16. (Amended) An integrated circuit, comprising:

a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator;

control logic; and

a memory,

wherein the memory is configured with a unique object number space, the unique object number space comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits,

wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance.

17. The integrated circuit of claim 16, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

18. The integrated circuit of claim 16, wherein the unique object number is a portion of a serialized global trade item number.

19. The integrated circuit of claim 18, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

20. The integrated circuit of claim 16, wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the memory of the integrated circuit.

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BIB DATA SHEET

CONFIRMATION NO. 4770

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
90/014,052	11/29/2017	340	3992	029101.6

APPLICANTS

INVENTORS

9798967, Residence Not Provided;
ADASA INC., EUGENE, OR;
AVERY DENNISON INC. (3RD PTY REQ.), MENTOR, OH;
HOGAN LOVELLS US LLP IP GROUP, WASHINGTON, DC

**** CONTINUING DATA ***************************

This application is a REX of 15/042,993 02/12/2016 PAT 9798967
which is a CON of 13/526,520 06/19/2012 PAT 9272805
which is a CIP of 12/820,109 06/21/2010 PAT 8228198 *
which is a CIP of 11/465,712 08/18/2006 PAT 7830258
which claims benefit of 60/709,713 08/19/2005
and said 12/820,109 06/21/2010
is a CIP of 12/124,768 05/21/2008 ABN
which claims benefit of 60/939,603 05/22/2007
(*)Data provided by applicant is not consistent with PTO records.

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /CHRISTINA Y LEUNG/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
				20	3

ADDRESS

FAY KAPLUN & MARCIN, LLP
150 BROADWAY, SUITE 702
NEW YORK, NY 10038
UNITED STATES

TITLE

SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS

FILING FEE RECEIVED		
12000	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

BIB (Rev. 05/07).

Ex Parte Reexamination Interview Summary	**Control No.**	**Patent Under Reexamination**
	90/014,052	9798967
	Examiner	**Art Unit**
	Christina Y. Leung	3992

All participants (USPTO personnel, patent owner, patent owner's representative):

(1) *Christina Y. Leung*	(3) *Clarke McAllister*
(2) *Michael Marcin*	(4) *James Menefee*

Date of Interview: *12 June 2018*

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal (copy given to: 1)☐ patent owner 2)☐ patent owner's representative)

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____

Agreement with respect to the claims f)☐ was reached. g)☒ was not reached. h)☐ N/A.
Any other agreement(s) are set forth below under "Description of the general nature of what was agreed to…"

Claim(s) discussed: *1-20*.

Identification of prior art discussed: *US 7,827,200 B2 and US 8,373,545 B2*.

Description of the general nature of what was agreed to if an agreement was reached, or any other comments:
See Continuation Sheet.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims patentable, if available, must be attached. Also, where no copy of the amendments that would render the claims patentable is available, a summary thereof must be attached.)

A FORMAL WRITTEN RESPONSE TO THE LAST OFFICE ACTION MUST INCLUDE PATENT OWNER'S STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. (See MPEP § 2281). IF A RESPONSE TO THE LAST OFFICE ACTION HAS ALREADY BEEN FILED, THEN PATENT OWNER IS GIVEN **ONE MONTH** FROM THIS INTERVIEW DATE TO PROVIDE THE MANDATORY STATEMENT OF THE SUBSTANCE OF THE INTERVIEW (37 CFR 1.560(b)). THE REQUIREMENT FOR PATENT OWNER'S STATEMENT CAN NOT BE WAIVED. **EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.550(c).**

/Christina Y. Leung/ Primary Examiner, Art Unit 3992		

cc: Requester (if third party requester)

Continuation of Description of the general nature of what was agreed to if an agreement was reached, or any other comments:

Patent Owner (PO) and Examiners discussed the arguments in the final Office action. PO asserted that the recited serial number's structure comes from the recited allocated block and that the limitations in the claims are structural. PO also asserted that the allocated block in the invention is based on the binary numbers in the range having the same MSBs while the cited prior art's allocation is based on decimal numbers without regard to the resulting MSBs after decimal-to-binary conversion. Although PO acknowledged that the cited prior art also generally discloses an RFID tag with a binary serial number (wherein the serial number also necessarily has some MSBs), PO asserted that the allocated decimal ranges taught by the cited prior art result in arbitrary binary number ranges and therefore do not suggest the clean binary number ranges with MSBs uniquely corresponding to blocks of numbers.

PO suggested amending the claims to clarify that the MSB of the serial number uniquely corresponds to the allocated block and/or that all of the serial numbers in the recited allocated block share the same MSBs. No agreement was reached during the interview, but Examiner agreed to fully consider PO's arguments in view of such an amendment..

Reexamination	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90/014,052	9798967
	Certificate Date	Certificate Number
		C1

Requester Correspondence Address: ☐ **Patent Owner** ☒ **Third Party**

HOGAN LOVELLS US LLP IP GROUP
COLUMBIA SQUARE
555 THIRTEENTH STREET, NW
WASHINGTON, DC 20004

LITIGATION REVIEW ☒	/CL/ (examiner initials)	**6-21-18** (date)
Case Name		Director Initials
6:17cv1685, Adasa Inc. v. Avery Dennison Corporation		

COPENDING OFFICE PROCEEDINGS	
TYPE OF PROCEEDING	**NUMBER**
1. none	
2.	
3.	
4.	

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FACSIMILE COVER SHEET

FAX NO	:	571-273-3023
TO	:	Commissioner for Patents Attn: Examiner Leung
FROM	:	Michael J. Marcin, Esq. of Fay Kaplun & Marcin, LLP
DATE	:	June 11, 2018
SUBJECT	:	U.S. Patent No. 9,798,967 Control No. 90/014,052 for *Systems, Methods, and Devices for Commissioning Wireless Sensors* Inventor(s): McAllister et al. Our Ref.: 30139/00105

NUMBER OF PAGES INCLUDING COVER : 3

MESSAGE:

Please see attached.

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PAGE 1/3 * RCVD AT 6/11/2018 4:16:57 PM [Eastern Daylight Time] * SVR:W-PTOFAX-002/15 * DNIS:2733023 * CSID:2126190276 * DURATION (mm-ss):01-10

AGENDA FOR 90/014,052 INTERVIEW

Date/Time:

Tuesday, June 12 3:00 pm (Eastern)

Participants for Patentee:

Michael Marcin (48198) – 212-619-6000 x204

Clarke McAllister (Inventor) -- 541-359-1677 x102

Discussion Topics:

1. The Examiner asserted that "none of the claims are even directed to a method for encoding an RFID transponder."

   The patentee would like to discuss cases such as In re Nordt Dev. Co., LLC, 881 F.3d 1371 (Fed. Cir. 2018), Hazani v. U.S. Int'l Trade Comm'n, 126 F.3d 1473, 1479 (Fed. Cir. 1997), 3M Innovative Props. Co. v. Avery Dennison Corp., and Gemtron Corp. v. Saint-Gobain Corp., 572 F.3d 1371, 1379 (Fed. Cir. 2009) that generally stand for the proposition that if a process limitation connotes structure, that structure should be considered.

   The Patentee asserts that the recitation of "the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits" connotes a structure of the tag and should be examined as such.

2. The Examiner provided an example of numbers that can be used as most significant bits.

   The Patentee would like to demonstrate that the examples do not teach the general principle of using the most significant bits in a tag.

   Example used: another block assigned to a second manufacturing division can be 3,456,789 (i.e., "a number in the range three to four million"), represented as 00011010010111111100010101.

   Now instead, choose a second number from the same range three to four million 3,056,789 represented as 00010111010100100100010101 having a different value for the

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five MSBs. This would produce an invalid outcome for a brand owner using the most significant bits to allocate blocks, so therefore it would not have been obvious to use MSBs to allocate blocks of serial numbers.

Furthermore, a third number 4,056,789, a number in the range four to five million represented as 00011110111100111011010101 has 00011 as its most significant bits. This 5-bit number exactly matches the five MSB's from the Examiner's first example above (i.e. 3,456,789). Therefore using the MSBs to allocate blocks would result in duplication of serial numbers, which violates the requirements for uniquely numbered EPC RFID tags as set for in the EPCglobal Tag Data Standard. It would therefore have been obvious to one having ordinary skill in the art to NOT mix binary block allocation with decimal block allocation. This is what our expert, in speaking to others skilled in the art, correctly describes as mixing apples with oranges (Williams Declaration, paragraph 57).

To this end, the patentee would like to propose the following amendments to claim 1 to show this difference:

Option 1:

wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance

Option 2:

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block ~~being~~ having been assigned a limited number of most significant bits to ensure uniqueness of the serial numbers in the allocated block, and

PAGE 3/3 * RCVD AT 6/11/2018 4:16:57 PM [Eastern Daylight Time] * SVR:W-PTOFAX-002/15 * DNIS:2733023 * CSID:2126190276 * DURATION (mm-ss):01-10

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 90/014,052	Filing Date 11/27/2017	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	12000
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	12000

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)		
AMENDMENT	06/15/2018	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	=	X $100 =	
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	-	X $460 =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0.00

		(Column 1)		(Column 2)	(Column 3)		
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexaminaton of:	)	
	)	
U.S. Patent No. **9,798,967**	)	
	)	
Control No.: 90/014,052	)	Group Art Unit: 3992
	)	
Filed: November 29, 2017	)	Examiner: Christina Y. Leung
	)	
For: SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS	)	
	)	
Confirmation No.: 4770	)	

Mail Stop: *Ex Parte* Reexamination
Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT IN RESPONSE TO FINAL OFFICE ACTION

DATED MAY 14, 2018

In response to the Final Office Action mailed May 14, 2018 in the above-referenced reexamination, please enter the following amendments and consider the following remarks.

IN THE CLAIMS

1. (Amended) An RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits,

wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance.

2. The RFID transponder of claim 1, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

3. The RFID transponder of claim 1, wherein the unique object number is a portion of a serialized global trade item number.

4. The RFID transponder of claim 3, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

5. The RFID transponder of claim 1, wherein the unique serial number space is at least 38 bits.

6. The RFID transponder of claim 1, wherein the allocated block is defined by at least 3 most significant bits.

7. The RFID transponder of claim 1, wherein the allocated block is one of a plurality of allocations intermittently received by an encoder.

8. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of silicon.

9. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of polymer.

10. The RFID transponder of claim 1, wherein the substrate, antenna structure, and RFID integrated circuit chip are covered by a face stock material.

11. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is disposed on the substrate.

12. The RFID transponder of claim 1, wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.

13. (Amended) A RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a global trade item number including a unique object number, the unique object number comprising an object class information space including a block of at least 50 bits and a unique serial number space including a block of at least 38 bits,

wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises at least 3 most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block.

14. The RFID transponder of claim 13, wherein the unique serial number space further comprises remaining bits of lesser significance that together with the at least 3 most significant bits comprise the one serial number instance.

15. The RFID transponder of claim 13, wherein the at least 3 most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.

16. (Amended) An integrated circuit, comprising:

a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator;

control logic; and

a memory,

wherein the memory is configured with a unique object number space, the unique object number space comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits,

wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance.

17. The integrated circuit of claim 16, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

18. The integrated circuit of claim 16, wherein the unique object number is a portion of a serialized global trade item number.

19. The integrated circuit of claim 18, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

20. The integrated circuit of claim 16, wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the memory of the integrated circuit.

REMARKS

Claims 1, 13 and 16 have been amended to more accurately recite the claimed subject matter. The claim amendments are supported by at least column 8, lines 4-36 of the '967 patent. No new matter has been added. Claims 1-20 are currently pending in this application. Based on the arguments presented below, the patent owner respectfully submits that all pending claims are allowable over the prior art relied on in the Final Office Action.

The patent under reexamination, U.S. Patent No. 9,798,967 ("the '967 patent") has been asserted in a proceeding captioned *Adasa Inc. v. Avery Dennison Corporation*, 6:17-cv-01685 (D. OR).

The patent owner thanks the Examiner for the productive interview on June 12, 2018. A summary of the interview is being submitted with this Response according to the rules governing *ex parte* reexaminations. This Response is in accordance with the statements and arguments presented by the patent owner during the interview.

The Examiner's Rejections

Claims 1-20 are each rejected twice under 35 U.S.C. 103 as follows:

Claims 1, 6-12, 16, and 20 stand rejected under 35 U.S.C. 103 as being unpatentable over US 2007/0040684 Al to McAllister ("the '684 publication") in view of US 7,827,200 B2 to Rowe ("the '200 patent"). *See* Office Action, p. 3.

Claims 2-5, 13-15, and 17-19 stand rejected under 35 U.S.C. 103 as being unpatentable over the '684 publication in view of the '200 patent and EPCglobal Tag Data Standards, Version 1.3, March 8, 2006 ("the 2006 EPC Standard"). *See* Office Action, p. 3.

Claims 1, 6-12, 16, and 20 stand rejected under 35 U.S.C. 103 as being unpatentable over the '684 publication in view of US 8,373,545 B2 to Traub ("the '545 patent). *See* Office Action, p. 3.

Claims 2-5, 13-15, and 17-19 stand rejected under 35 U.S.C. 103 as being unpatentable over the '684 publication in view of the '545 patent and the 2006 EPC Standard. *See* Office Action, p. 3.

Summary of the Arguments

In response to the Examiner's assertions in the Final Office Action, the patent owner will demonstrate: (1) that the encoding of the limited number of most significant bits in the recited RFID transponder should be considered a structural limitation of the claims; and (2) the encoded limited number of most significant bits in binary is neither disclosed nor suggested by the prior art's teaching that serial numbers may be assigned based on a series of decimal numbers.

The Independent Claims of the '967 Patent

Independent Claim 1 of the '967 patent recites:

> An RFID transponder comprising:
>
> a substrate;
>
> an antenna structure formed on the substrate; and
>
> an RFID integrated circuit chip which is electrically coupled to the antenna structure,
>
> wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

Independent Claim 13 of the '967 patent recites:

A RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a global trade item number including a unique object number, the unique object number comprising an object class information space including a block of at least 50 bits and a unique serial number space including a block of at least 38 bits,

wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises at least 3 most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block.

Independent Claim 16 of the '967 patent recites:

An integrated circuit, comprising:

a radio frequency circuit configured to backscatter a return link

signal for processing by an RFID interrogator;

control logic; and

a memory,

wherein the memory is configured with a unique object number space, the unique object number space comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance.

While the independent claims are not identical, the highlighted claim language as shown above is similar enough that the arguments presented below with reference to claim 1, are equally applicable to claims 13 and 16.

The Proper Construction of Claim 1 of the '967 Patent

In the Final Office Action, the Examiner has asserted that "none of the claims are even directed to a method for encoding RFID transponders." *See* Office Action, pp. 33-34. The patent owner generally disagrees with the Examiner's statement. While the claims are not directed to a method, the patent owner asserts that certain recitations in the claims include process limitations that connote structure, and, as such, that structure should be considered when examining the claims. As will be described below, this assertion is based on the plain meaning of the claim recitations and the guidance of the Federal Circuit with respect to process limitations that connote

structure.

Specifically, claim 1 recites an RFID transponder that includes an RFID integrated circuit chip that includes a unique object number having an object class information space and a unique serial number space. Further, "the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits." That is, the serial number space of the recited RFID integrated circuit is encoded with a serial number. However, the serial number is not any random number, but is rather "one serial number instance" from an allocated block of serial numbers. Moreover, the allocated block is also not just any block, but has a specific form that is recited in the claim. That form is that the allocated block is "assigned a limited number of most significant bits." Thus, the patent owner asserts that claim 1 should be interpreted to include the structural limitation that the encoded serial number space must include a serial number instance that was selected from an allocated block that was specifically assigned (or allocated) based on a limited number of most significant bits.

This interpretation is further supported by the next element of claim 1 that recites "wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and remaining bits of lesser significance that together comprise the one serial number instance." The patent owner has amended this element to make it clear that the limited number of most significant bits that are encoded in the serial number space ***uniquely*** correspond to the limited number of most significant bits of the allocated block. That is, there is a direct correlation between the encoded bits and the allocated bits.

The first implication of this recitation is that the unique serial number space is specifically partitioned into two portions, a first portion that is the most significant bits and a second portion that are the bits of lesser significance. This partitioning is again, not a random selection of bits, but an intentional partition between most significant bits and bits of lesser significance. The second implication of this recitation is this intentional partitioning is based on the allocated block because the "unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block." As stated above, this partitioning of the unique serial number space is based on the limited number of most significant bits of the allocated block. The amendment makes it clear that the encoded limited number of most significant bits are the allocated limited number of most significant bits. That is, without the specific form of the allocated block (*i.e.*, the limited number of most significant bits assigned to the allocated block), there could be no meaningful partition of the unique serial number space as recited in the claims. The process limitation of allocating the limited number of most significant bits is a structural limitation of the RFID transponder because the representation of those allocated limited number of most significant bits is exactly what is encoded on the RFID transponder in the unique serial number space. Within the context of the claim, this unique correspondence between the allocated bits and the encoded bits is a meaningful structural limitation. Therefore, the patent owner asserts that the process limitation of the allocated block being assigned a limited number of most significant bits is, in fact, a structural limitation on the RFID transponder because the unique serial number space must uniquely correspond to this allocated block assignment as recited in claim 1.

The patent owner refers the Examiner to *In re Nordt Dev. Co., LLC*, 881 F.3d 1371, 1374 (Fed. Cir. 2018) where the court stated, "[i]f the process limitation connotes specific structure and

may be considered a structural limitation, however, that structure should be considered." The court went on to state, "words of limitation that can connote with equal force a structural characteristic of the product or a process of manufacture are commonly and by default interpreted in their structural sense, unless the patentee has demonstrated otherwise." *Id.* at 1375, *citing*, *3M Innovative Props. Co. v. Avery Dennison Corp.*, 350 F.3d 1365, 1371-72 (Fed. Cir. 2003). Thus, the court interpreted the term "injection molded" to be a structural limitation rather than a product by process limitation. Similarly, the court has held the same for multiple other process type limitations. *See e.g., Hazani v. U.S. Int'l Trade Comm'n*, 126 F.3d 1473, 1479 (Fed. Cir. 1997) ("chemically engraved surface" is not a process term because it describes the structure of the surface rather than the process used to obtain it); *3M Innovative Props. Co. v. Avery Dennison Corp.*, 350 F.3d 1365, 1371-72 (Fed. Cir. 2003) ("multiple embossed patterns" that are "superimposed" was improperly construed to convert to a product by process claim requiring the first and second patterns being created sequentially, rather this describes only the structural relationship of the embossing patterns); and *Gemtron Corp. v. Saint-Gobain Corp.*, 572 F.3d 1371, 1379 (Fed. Cir. 2009) ("snap-secure[d]" describes the structural relationship between the glass panel and the frame, which is possessed by the claimed shelf because of the structural characteristics of the individual components).

The common thread in each of these cases is that the structural element connoted by these process-type limitations show a structural difference between the recited product and the prior art. As will be described in greater detail below, the RFID transponder of claim 1, when properly construed exhibits this same structural difference between it and the prior art. Specifically, none of the prior art includes a unique serial number space that is partitioned into most significant bits and bits of lesser significance such that it is encoded with "the limited number of most significant

bits uniquely corresponding to the limited number of most significant bits of the allocated block."

Accordingly, the proper interpretation of claim 1 requires that the serial number space must include a serial number instance that was selected from an allocated block that was specifically assigned (or allocated) based on a limited number of most significant bits and the serial number space is encoded with this data such that the limited number of most significant bits ***uniquely*** corresponds to the limited number of most significant bits of the allocated block.

The Differences Between the Claims of the '967 Patent and the Cited References

Initially, the Examiner has admitted that the '684 publication does not disclose the above highlighted claim elements of the '967 patent. *See* Office Action, pp. 5 and 18-19. However, the Examiner has asserted that both the '200 patent and the '545 patent cure these deficiencies of the '684 publication. *See* Office Action, pp. 5-6 and 19-22. The patent owner respectfully disagrees.

The patent owner will discuss each of the references individually below. However, the patent owner can summarize the teachings of the '200 patent and the '545 patent as the selection of a series of decimal ranges to be used for the serial numbers. Further, from the Examiner's rejection and the discussion held with the Examiner, it appears to the patent owner that the Examiner's argument is that one could select a decimal range that corresponds to the most significant bits recited in the claim and therefore, it would be obvious, to encode the most significant bits as recited in the claims.

The patent owner disagrees with this analysis. As described above, the properly interpreted claims of the '967 patent require a serial number instance that was selected from an allocated block that was specifically assigned (or allocated) based on a limited number of most significant bits. Selecting a series of decimal numbers is not the same as assigning an allocated block based on a

limited number of most significant bits. In the prior art, a range of decimal numbers is selected and then the decimal numbers in the range are converted from decimal to binary for storage on the RFID tag. However, the only consideration of the binary numbers is the conversion from the decimal. The patent owner asserts that assigning a range of decimal numbers in no way discloses or suggests assigning an allocated block based on a limited number of most significant bits. With respect to the prior art, there would be no reason to assign a series of sequential serial numbers based on a binary system. It would not provide any different outcome from the decimal range. Whereas, in contrast, the entire point of claim 1 is to require a serial number instance that was selected from an allocated block that was specifically assigned (or allocated) based on a limited number of most significant bits and the serial number space is encoded with this data such that the limited number of most significant bits ***uniquely*** corresponds to the limited number of most significant bits of the allocated block.

The mere fact that a highly unlikely scenario exists where one could randomly pick a series of decimal numbers that corresponds to some number of most significant bits in binary is irrelevant. The question is why would such numbers be picked. What would be the motivation for selecting numbers in such a way. The patent owner cannot think of any motivation within the prior art that suggests such a selection method. As described above, the recitations of the '967 patent are nonobvious because of the unique manner of partitioning the serial number space into most significant bits and bits of lesser significance. Once this is done, as recited in the claims, then allocating blocks based on the most significant bits becomes useful. The prior art neither teaches nor suggests such a scheme of having RFID transponders encoded.

The Specific Differences Between the '200 Patent and the Recited Claims

The '200 patent describes a method for managing serialization of Electronic Product Codes (EPCs). '200 Patent, Abstract. The EPCs are described as including a nonserialized portion 112 and a serialized portion 114. '200 Patent 3/56-58. The nonserialized portion 112 is described as specifying, for example, a manufacturer and an object classification. '200 Patent 3/65-66. The serialized portion 114 is specifically associated with an object. '200 Patent 4/8-9. The combination of the serialized portion 114 and the nonserialized portion 112 results in a unique identifier for an object. '200 Patent 4/9-11. The '200 patent states that "[t]he serialized values can be stored in [a] database table 126. '200 Patent 4/11-12. The assignment of the serialized values is described as follows:

> [D]ifferent manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated. ***For example, a serial number generation function used by a first division can sequentially assign odd serial numbers, while a different serial number generation function used by a second division can sequentially assign even serial numbers. In another example, a first division can assign serial numbers in the range of one to a million and the second division can assign serial numbers in a range of three to four million.*** It should be appreciated that the different divisions can be communicatively linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification.
>
> '200 patent, 5/7-22 (emphasis added).

Thus, the '200 patent describes various examples of ranges of decimal serial numbers, *e.g.*, even and odd numbers; 1 – 1,000,000; 3,000,000 – 4,000,000. There is no hint or suggestion within the '200 patent to allocate blocks based on the most significant bits, or even that the serial numbers from the allocated block and the correspondingly encoded serial numbers in the RFID transponder should be partitioned in any manner. Again, as described above, until the present

patent taught that the serial number space could be partitioned into most significant bits and bits of lesser significance, there was no advantage of allocating blocks based on most significant bits.

Accordingly, the '200 patent neither teaches nor discloses "wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and remaining bits of lesser significance that together comprise the one serial number instance," as recited in claim 1.

Moreover, neither the '684 publication nor the 2006 EPC Standard cures these deficiencies of the '200 patent. Thus, the patent owner respectfully requests the Examiner withdraw the rejections under 35 U.S.C. 103 of claims 1-12 based on these refences.

Claim 13 recites, *inter alia*, "wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises at least 3 most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block." Accordingly, for the same reasons described above with reference to claim 1, the patent owner respectfully requests the withdrawal of the 35 U.S.C. 103 rejections of claims 13-15 based on the '200 patent, the '684 publication and the 2006 EPC Standard.

Claim 16 recites, *inter alia*, "wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited

number of most significant bits of the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance." Accordingly, for the same reasons described above with reference to claim 1, the patent owner respectfully requests the withdrawal of the 35 U.S.C. 103 rejections of claims 16-20 based on the '200 patent, the '684 publication and the 2006 EPC Standard references.

The Specific Differences Between the '545 Patent and the Recited Claims

The '545 patent describes an "EPC provisioning system comprising a EPC server [that] dynamically provide[s] EPC code blocks for one product to multiple client sites. The EPC server can use business rules to determine the EPC codes for the multiple client sites." '545 patent, Abstract. The entire thrust of the '545 patent is directed at a centralized server system to manage the EPC codes. For example, the '545 patent states, "an EPC server 402 [is] adapted to dynamically provide EPC code blocks 404 and 406 for one product to multiple client sites. The EPC server 402 can use business rules to determine the EPC codes for the multiple client sites 408 and 410." '545 patent, 3/67 – 4/4. This centralized control over the EPC codes is implemented via "a computer implemented method using business rules to determine EPC code blocks for multiple client sites and providing the EPC code blocks to the multiple client sites." '545 patent, 4/12-15.

As the Examiner asserts, the '545 patent shows in Figs 13E-G that EPC codes can be divided into blocks of about five or ten million. *See* Office Action, pp. 20-21 and '545 patent, Figs 13E-G. These are ranges of decimal numbers. In fact, Figs. 13E-G show a standard decimal entry GUI for entering the EPC code ranges. Again, there is no hint or suggestion in the '545 patent that the EPC code ranges can or should be entered in binary or that one should select decimal numbers

that correspond to specific significant bits in binary. As described extensively above, the motivation for allocating blocks based on a limited number of most significant bits is the realization by the inventor of the present patent that the unique serial number field can be partitioned into the most significant bits and the bits of lesser significance.

Accordingly, the '545 patent neither teaches nor discloses "wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and remaining bits of lesser significance that together comprise the one serial number instance," as recited in claim 1.

Moreover, neither the '684 publication nor the 2006 EPC Standard cures these deficiencies of the '545 patent. Thus, the patent owner respectfully requests the Examiner withdraw the rejections under 35 U.S.C. 103 of claims 1-12 based on these refences.

Claim 13 recites, *inter alia*, "wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises at least 3 most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block." Accordingly, for the same reasons described above with reference to claim 1, the patent owner respectfully requests the withdrawal of the 35 U.S.C. 103 rejections of claims 13-15 based on the '545 patent, the '684 publication and the 2006 EPC Standard.

Claim 16 recites, *inter alia*, "wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being

assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance." Accordingly, for the same reasons described above with reference to claim 1, the patent owner respectfully requests the withdrawal of the 35 U.S.C. 103 rejections of claims 16-20 based on the '545 patent, the '684 publication and the 2006 EPC Standard references.

It is respectfully submitted that the presently pending claims are novel, nonobvious and useful and that the present application is in condition for allowance. A prompt and favorable action on the merits is earnestly solicited. The Examiner is invited to contact the undersigned to discuss any matter concerning this application.

Respectfully submitted,

Dated: June 15, 2018

By: /Michael J. Marcin/
Michael J. Marcin (Reg. No. 48,198)

Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, NY 10038
Phone: 212-619-6000
Fax: 212-619-0276

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexaminaton of:	)	
	)	
U.S. Patent No. **9,798,967**	)	
	)	
Control No.: 90/014,052	)	Group Art Unit: 3992
	)	
Filed: November 29, 2017	)	Examiner: Christina Y. Leung
	)	
For: SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS	)	
	)	
Confirmation No.: 4770	)	

Mail Stop: *Ex Parte* Reexamination
Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PATENT OWNER'S INTERVIEW SUMMARY IN
***EX PARTE* REEXAMINATION PURSUANT TO 37 CFR 1.560**

Dear Sir:

The patent owner conducted an Examiner Interview in the above-referenced *ex parte* reexamination on June 12, 2018. The following is the patent owner's statement of the interview as required by 37 CFR 1.560.

REMARKS

The patent under reexamination, U.S. Patent No. 9,798,967 ("the '967 patent") has been asserted in a proceeding captioned *Adasa Inc. v. Avery Dennison Corporation*, 6:17-cv-01685 (D. OR).

The interview was conducted telephonically on June 12, 2018 and the participants were as follows:

Christina Y. Leung – USPTO and Examiner in this proceeding

James A. Menefee -- USPTO

Michael Marcin (48,198) – Patent Owner Representative

Clarke McAllister-- Inventor

The patent owner asserted two arguments to counter the Examiner's rejection. First, the recitations of the independent claim connote structure of the tag and should be examined as such. Second, the examples of decimal numbers provided by the Examiner do not teach the general principle of encoding the most significant bits in a tag as recited in the claims. No agreement was reached.

The Examiner suggested filing the response to the Office Action by Friday, June 15, 2018 so the Examiner can review the response and provide feedback to the patent owner prior to the July 14, 2018 date for filing an appeal. The patent owner agreed to this course of action.

Respectfully submitted,

Date: June 15, 2018

By: __/Michael J. Marcin/_____

Michael J. Marcin (Reg. No 48,198)
Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, NY 10038
Tel: (212) 619-6000
Fax: (212) 619-0276

PATENT
Attorney Docket No.: 30139/00105

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexaminaton of:	)	
	)	
U.S. Patent No. **9,798,967**	)	
	)	
Control No.: 90/014,052	)	Group Art Unit: 3992
	)	
Filed: November 29, 2017	)	Examiner: Christina Y. Leung
	)	
For: SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS	)	
	)	
Confirmation No.: 4770	)	

Mail Stop: *Ex Parte* Reexamination
Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
CERTIFICATE OF SERVICE

I hereby certify on this 15th day of June, 2018, that a true and correct copy of the **"AMENDMENT IN RESPONSE TO FINAL OFFICE ACTION DATED MAY 14, 2018"** and the "PATENT OWNER'S INTERVIEW SUMMARY IN EX PARTE REEXAMINATION PURSUANT TO 37 CFR 1.560," both of which were filed on June 15, 2018 and attached hereto were sent by first-class mail, postage paid, to:

Hogan Lovells US LLP IP Group
Columbia Square
555 Thirteenth Street, NW
Washington, D.C. 20004

Respectfully submitted,

Date: June 15, 2018

By: ___/Michael J. Marcin/_____
Michael J. Marcin (Reg. No. 48,198)
Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, NY 10038
Tel: (212) 619-6000
Fax:(212) 619-0276

Electronic Acknowledgement Receipt

EFS ID:	32911064
Application Number:	90014052
International Application Number:	
Confirmation Number:	4770
Title of Invention:	SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS
First Named Inventor/Applicant Name:	9798967
Customer Number:	30636
Filer:	Oleg F. Kaplun/Carolisa Chen
Filer Authorized By:	Oleg F. Kaplun
Attorney Docket Number:	029101.6
Receipt Date:	15-JUN-2018
Filing Date:	29-NOV-2017
Time Stamp:	14:02:01
Application Type:	Reexam (Patent Owner)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		00105AMDToFAOandIntSumm CertServ15Jun18.pdf	3196404 d4d9d6cad257ea1c74473bfa3bc5592c654f 1328	yes	24

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	1
	Response After Final Action	2	21
	Applicant summary of interview with examiner	22	23
	Reexam Certificate of Service	24	24
Warnings:			
Information:			
	Total Files Size (in bytes):	3196404	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent No.	:	9,798,967
Control No.	:	90/014,052
Filed	:	November 29, 2017
Title	:	Systems, Methods, And Devices For Commissioning Wireless Sensors
Group Art Unit	:	3992
Confirmation No.	:	4770
Examiner	:	Christina Y. Leung

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Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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I hereby certify that this correspondence is being deposited via facsimile, electronically or with U.S. Postal Services as first class mail in an envelope addressed to:

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571-273-8300

By: _____ Date: June 15, 2018
Michael J. Marcin (Reg. No. 48,198)

TRANSMITTAL

Transmitted herewith please find an Amendment in response to the Final-Office Action mailed on May 14, 2018 along with a Patent Owner's Interview Summary In Ex-Parte Reexamination under 37 C.F.R. 1.560 and a Certificate of Service for filing in the above-identified application. No fees are believed to be required. However, the Commissioner is hereby authorized to charge any additional required fees to the Deposit Account of **Fay Kaplun & Marcin, LLP No. 50-1492**.

Respectfully submitted,

Dated: June 15, 2018

By: _____
Michael J. Marcin, Reg. No. 48,198

Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, New York 10038
Tel: (212) 619-6000
Fax: (212) 619-0276

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
90/014,052	11/29/2017	9798967	029101.6	4770

30636 7590 05/14/2018
FAY KAPLUN & MARCIN, LLP
150 BROADWAY, SUITE 702
NEW YORK, NY 10038

EXAMINER
LEUNG, CHRISTINA Y

ART UNIT	PAPER NUMBER
3992	

MAIL DATE	DELIVERY MODE
05/14/2018	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

HOGAN LOVELLS US LLP IP GROUP

COLUMBIA SQUARE

555 THIRTEENTH STREET, NW

WASHINGTON, DC 20004

EX PARTE REEXAMINATION COMMUNICATION TRANSMITTAL FORM

REEXAMINATION CONTROL NO. *90/014,052*.

PATENT NO. *9,798,967* .

ART UNIT *3992*.

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above identified *ex parte* reexamination proceeding (37 CFR 1.550(f)).

Where this copy is supplied after the reply by requester, 37 CFR 1.535, or the time for filing a reply has passed, no submission on behalf of the *ex parte* reexamination requester will be acknowledged or considered (37 CFR 1.550(g)).

DETAILED ACTION

Reexamination

1. On December 20, 2017, *ex parte* reexamination was ordered for claims 1-20 (all claims) of US 9,798,967 B2 ("967 Patent"). **Claims 1-20** (all claims) of 967 Patent are being reexamined in this proceeding.

References and Documents Cited in this Action

967 Patent (US 9,798,967 B2)

684 Publication (US 2007/0040684 A1 to McAllister)

200 Patent (US 7,827,200 B2 to Rowe)

545 Patent (US 8,373,545 B2 to Traub)

2006 EPC Standard (EPCglobal Tag Data Standards, Version 1.3, March 8, 2006)

PO Response (response filed by Patent Owner [PO] on April 2, 2018)

Williams Declaration (declaration of Charles B. Williams filed by PO on April 2, 2018)

3PR Request (request for *ex parte* reexamination filed by Third-Party Requester [3PR] on November 29, 2017)

Parent Applications and Effective Filing Date

2. 967 Patent issued on October 24, 2017 from application 15/042,993 filed on February 12, 2016, which is a continuation of parent application 13/526,520 filed on June 19, 2012. 13/526,520 is a continuation-in-part of 12/820,109, filed on June 21, 2010, which is a continuation-in-part of 11/465,712, filed on August 18, 2006, and a continuation-in-part of 12/124,768, filed on May 21, 2008. 967 Patent also claims priority to two provisional applications: 60/709,713, filed on August 19, 2005; and 60/939,603, filed on May 22, 2007.

3. A review of the specifications of these applications indicates that 12/124,768, filed on May 21, 2008, appears to be the earliest disclosure that contains support for the claim limitations directed to a unique object number (e.g., including a unique serial number space encoded with one serial number instance from an allocated block of serial numbers that is assigned a limited number of most significant bits). Therefore, the effective filing date of claims 1-20 (all claims) in 967 Patent is May 21, 2008.

4. Furthermore, the present application is being examined under the pre-AIA first to invent provisions.

Summary of Rejections

5. Claims 1-20 are each rejected twice under 35 U.S.C. 103 as follows.

Claims 1, 6-12, 16, and 20 are rejected under 35 U.S.C. 103 as being unpatentable over 684 Publication in view of 200 Patent.

Claims 2-5, 13-15, and 17-19 are rejected under 35 U.S.C. 103 as being unpatentable over 684 Publication in view of 200 Patent and 2006 EPC Standard.

Claims 1, 6-12, 16, and 20 are rejected under 35 U.S.C. 103 as being unpatentable over 684 Publication in view of 545 Patent.

Claims 2-5, 13-15, and 17-19 are rejected under 35 U.S.C. 103 as being unpatentable over 684 Publication in view of 545 Patent and 2006 EPC Standard.

Claim Rejections - 35 USC § 103

6. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made

to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

35 USC § 103 Rejections based on 200 Patent

7. **Claims 1, 6-12, 16, and 20** are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over **684 Publication** in view of **200 Patent**.

Regarding **claim 1**, 684 Publication discloses an RFID transponder 50 (Figures 2 and 3; paragraphs [0003]-[0004], [0041], and [0049]) comprising:

a substrate 58 (paragraph [0049]);

an antenna structure formed on the substrate (i.e., antenna layer 54; paragraph [0049]); and

an RFID integrated circuit chip 56, which is electrically coupled to the antenna structure (paragraph [0049]),

wherein the RFID integrated circuit chip is encoded with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

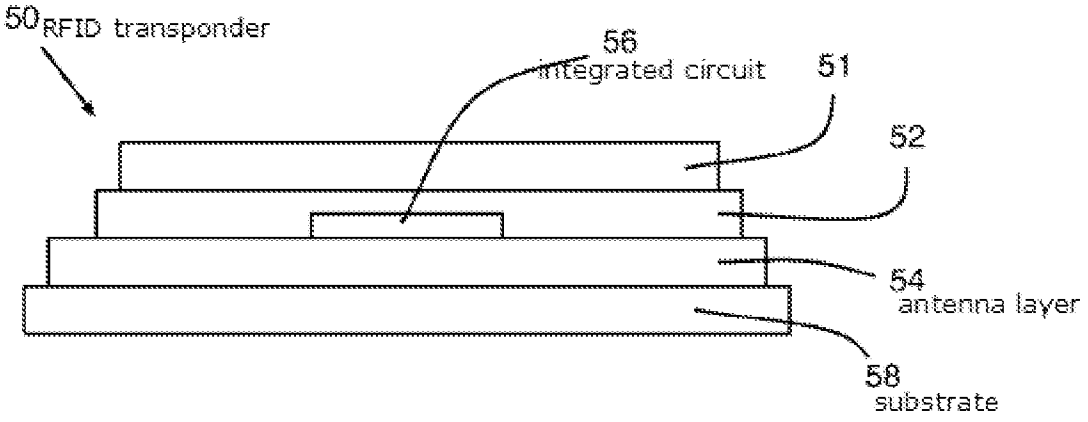
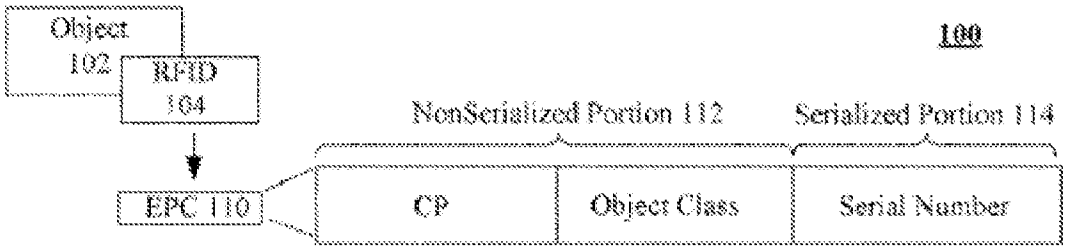


FIG. 3 (684 Publication, annotated)

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

However, 200 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag 104 with a unique object number (i.e., an Electronic Product Code [EPC] identifier 110; Figure 1; column 1, lines 12-46; and column 3, lines 19-29). 200 Patent further teaches that the unique object number comprises an object class information space (i.e., Object Class in Non Serialized Portion 112) and a unique serial number space (i.e., Serial Number in Serialized Portion 114; Figure 1; column 3, lines 56-67; and column 4, lines 1-12).

(portion of **FIG. 1** of 200 Patent)



200 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining

bits of lesser significance that together comprise the one serial number instance. More specifically, 200 Patent teaches that for example, 25 bits can be allocated to the serial number (column 6, lines 3-8) and that

> "In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated….In another example, a first division can assign serial numbers in the range of one to a million and a second division can assign serial numbers in a range of three to four million."

See column 5, lines 7-22. It would be well understood in the art that a block of one million serial numbers would require at least 20 bits in binary, and that in a serial number space having a total of 25 bits (such as taught by 200 Patent), a first block of numbers from "one to a million" would be expressed as 25-bit binary numbers 00000000000000000000000001 to about 00000111111111111111111111. A different block of numbers in a range of about "three to four million" can be expressed as binary numbers 00011000000000000000000000 to 00011111111111111111111111, for example[1].

Thus 200 Patent teaches that an allocated block of serial numbers is assigned a limited number of most significant bits because in a 25-bit serial number, the five most significant bits (e.g., "00000," "00011," etc.) correspond to a particular block containing about a million serial numbers and therefore also correspond to a particular manufacturer division as taught by 200 Patent. 200 Patent further teaches that the limited number of most significant bits (e.g., the five most significant bits) and the remaining bits of lesser significance (e.g., the 20 least significant bits) comprise the one serial number instance having 25 bits in all.

[1] More precisely, 00000111111111111111111111 (binary) is 1,048,575 (decimal). 00011000000000000000000000 is 3,145,728. 00011111111111111111111111 is 4,194,303.

Regarding claim 1, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 200 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

Regarding **claim 6**, in the system suggested by 684 Publication in view of 200 Patent, 200 Patent further teaches that the allocated block is defined by at least three most significant bits (e.g., five most significant bits, in the example discussed above with regard to claim 1).

Regarding **claim 7**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 200 Patent teaches a plurality of allocations associated with different manufacturer divisions as discussed above with regard to claim 1. 200 Patent further teaches that the allocated block is one of a plurality of allocations intermittently received by an encoder at least in the sense that 200 Patent teaches that encoders in different manufacturing divisions are "linked to a centralized system that assigns serial numbers" (200 Patent, column 5, lines 18-22) and each encoder identifies its corresponding pool or block of allocated numbers, then encodes serial numbers from that pool (i.e., steps 325, 335, and 350 in Figure 3; column 6, lines 37-58).

Regarding **claim 8**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses that the RFID integrated circuit chip is comprised of silicon (paragraphs [0005]-[0006]).

Regarding **claim 9**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses that the RFID integrated circuit chip is comprised of polymer (paragraphs [0005]-[0006]).

Regarding **claim 10**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses that the substrate 58, antenna structure 54, and RFID integrated circuit chip 56 are covered by a face stock material 51 (Figure 3; paragraph [0049]).

Regarding **claim 11**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses that the RFID integrated circuit chip 56 is disposed on the substrate 58 (Figure 3; paragraph [0049]).

Regarding **claim 12**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 200 Patent teaches a plurality of allocations associated with different manufacturer divisions as discussed above with regard to claim 1. 200 Patent further teaches that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 200 Patent teaches that encoders in different manufacturing divisions are "linked to a centralized system that assigns serial numbers" (200 Patent, column 5, lines 18-22) and each encoder identifies its corresponding pool or block of allocated numbers, then encodes serial numbers from that pool (i.e., steps 325, 335, and 350 in Figure 3; column 6, lines 37-58). As discussed above with regard to claim 1, the limited number of most significant bits taught by 200 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different manufacturer divisions that use the particular blocks of numbers. It would have been obvious to a person of

ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 200 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

Regarding **claim 16**, 684 Publication discloses an integrated circuit (Figures 2 and 3, paragraphs [0003]-[0004], [0041], and [0049]), comprising:

a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator; control logic; and a memory (i.e., 684 Publication discloses passive RFID transponders that backscatter a return link signal including a radio frequency circuit, control logic, and memory; paragraphs [0003]-[0004]);

wherein the memory is configured with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

However, 200 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag 104 with a unique object number (i.e., an Electronic Product

Code [EPC] identifier 110; Figure 1; column 1, lines 12-46; and column 3, lines 19-29). 200 Patent further teaches that the unique object number comprises an object class information space (i.e., Object Class in Non Serialized Portion 112) and a unique serial number space (i.e., Serial Number in Serialized Portion 114; Figure 1; column 3, lines 56-67; and column 4, lines 1-12).

200 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance. More specifically, 200 Patent teaches that for example, 25 bits can be allocated to the serial number (column 6, lines 3-8) and that

"In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated....In another example, a first division can assign serial numbers in the range of one to a million and a second division can assign serial numbers in a range of three to four million."

See column 5, lines 7-22. It would be well understood in the art that a block of one million serial numbers would require at least 20 bits in binary, and that in a serial number space having a total of 25 bits (such as taught by 200 Patent), a first block of numbers from "one to a million" would be expressed as 25-bit binary numbers 00000000000000000000000001 to about 00000111111111111111111111. A different block of numbers in a range of about "three to four

million" can be expressed as binary numbers 00011000000000000000000000 to 00011111111111111111111111, for example[2].

Thus 200 Patent teaches that an allocated block of serial numbers is assigned a limited number of most significant bits because in a 25-bit serial number, the five most significant bits (e.g., "00000," "00011," etc.) correspond to a particular block containing about a million serial numbers and therefore also correspond to a particular manufacturer division as taught by 200 Patent. 200 Patent further teaches that the limited number of most significant bits (e.g., the five most significant bits) and the remaining bits of lesser significance (e.g., the 20 least significant bits) comprise the one serial number instance having 25 bits in all.

Regarding claim 16, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 200 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

Regarding **claim 20**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 200 Patent teaches a plurality of allocations associated with different manufacturer divisions as discussed above with regard to claim 1. 200 Patent further teaches that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 200 Patent teaches that

[2] Again, more precisely, 00000111111111111111111111 (binary) is 1,048,575 (decimal). 00011000000000000000000000 is 3,145,728. 00011111111111111111111111 is 4,194,303.

encoders in different manufacturing divisions are "linked to a centralized system that assigns serial numbers" (200 Patent, column 5, lines 18-22) and each encoder identifies its corresponding pool or block of allocated numbers, then encodes serial numbers from that pool (i.e., steps 325, 335, and 350 in Figure 3; column 6, lines 37-58). As discussed above with regard to claim 16, the limited number of most significant bits taught by 200 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different manufacturer divisions that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 200 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

8. **Claims 2-5, 13-15, and 17-19** are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over **684 Publication** in view of **200 Patent** and **2006 EPC Standard**.

Regarding **claims 2-5 and 17-19**, 684 Publication in view of 200 Patent suggests a system as discussed above with regard to claim 1 or claim 16, including a unique object number comprising an Electronic Product Code (EPC) identifier 100 with an object class information space (i.e., Object Class in Non Serialized Portion 112) as taught by 200 Patent (Figure 1; column 1, lines 12-46; and column 3, lines 19-29).

684 Publication in view of 200 Patent does not specifically teach that the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value; that the unique object number is a portion of a serialized

global trade item number, wherein the serialized global trade item number is an EPC SGTIN-96 encoding; or that the unique serial number space is at least 38 bits.

However, 2006 EPC Standard teaches a system that is related to the one described by 684 Publication in view of 200 Patent, including RFID tags having associated EPCs (2006 EPC Standard, page 8). 2006 EPC Standard further teaches that the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value; that the unique object number is a portion of a serialized global trade item number, wherein the serialized global trade item number is an EPC SGTIN-96 encoding; and that the unique serial number space is at least 38 bits (2006 EPC Standard, pages 25-26). Regarding claims 2-5 and 17-19, it would have been obvious to provide an object class information space and a serialized global trade item number as taught by 2006 EPC Standard, in the RFID transponder suggested by 684 Publication in view of 200 Patent, in order to provide standardized identification information about the tagged object that can be universally read and understood.

Regarding **claim 13**, as similarly discussed above with regard to claim 1, 684 Publication discloses an RFID transponder 50 (Figures 2 and 3; paragraph [0041]) comprising:

a substrate 58 (paragraph [0049]);

an antenna structure formed on the substrate (i.e., antenna layer 54; paragraph [0049]); and

an RFID integrated circuit chip 56, which is electrically coupled to the antenna structure (paragraph [0049]),

wherein the RFID integrated circuit chip is encoded with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises at least three most significant bits corresponding to the allocated block.

However, 200 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag 104 with a unique object number (i.e., an Electronic Product Code [EPC] identifier 110; Figure 1; column 1, lines 12-46; and column 3, lines 19-29). 200 Patent further teaches that the unique object number comprises an object class information space (i.e., Object Class in Non Serialized Portion 112) and a unique serial number space (i.e., Serial Number in Serialized Portion 114; Figure 1; column 3, lines 56-67; and column 4, lines 1-12).

200 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises at least three most significant bits corresponding to the allocated block. More specifically, 200 Patent teaches that for example, 25 bits can be allocated to the serial number (column 6, lines 3-8) and that

"In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of

unassigned numbers to ensure that unique serial numbers are always generated….In another example, a first division can assign serial numbers in the range of one to a million and a second division can assign serial numbers in a range of three to four million."

See column 5, lines 7-22. It would be well understood in the art that a block of one million serial numbers would require at least 20 bits in binary, and that in a serial number space having a total of 25 bits (such as taught by 200 Patent), a first block of numbers from "one to a million" would be expressed as 25-bit binary numbers 00000000000000000000000001 to about 00000111111111111111111111. A different block of numbers in a range of about "three to four million" can be expressed as binary numbers 00011000000000000000000000 to 00011111111111111111111111, for example[3].

Thus 200 Patent teaches that an allocated block of serial numbers is assigned a limited number of most significant bits because in a 25-bit serial number, the five most significant bits (e.g., "00000," "00011," etc.) correspond to a particular block containing about a million serial numbers and therefore also correspond to a particular manufacturer division as taught by 200 Patent. 200 Patent further teaches that wherein the unique serial number space comprises at least three most significant bits corresponding to the allocated block (e.g., five most significant bits in the example above).

Regarding claim 13, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 200 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for

[3] Again, more precisely, 00000111111111111111111111 (binary) is 1,048,575 (decimal). 00011000000000000000000000 is 3,145,728. 00011111111111111111111111 is 4,194,303.

objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

Further regarding claim 13, 684 Publication in view of 200 Patent does not further suggest a global trade item number or that the object class information space includes a block of at least 50 bits and the unique serial number space includes a block of at least 38 bits.

However, 2006 EPC Standard teaches a system that is related to the one described by 684 Publication in view of 200 Patent, including RFID tags having associated EPCs (2006 EPC Standard, page 8). 2006 EPC Standard further teaches a global trade item number and that the object class information space includes a block of at least 50 bits and the unique serial number space includes a block of at least 38 bits (2006 EPC Standard, pages 25-26). Regarding claims 13, it would have been obvious to provide a global trade item number, an object class information space of at least 50 bits, and a unique serial number space of at least 38 bits as taught by 2006 EPC Standard, in the RFID transponder suggested by 684 Publication in view of 200 Patent, in order to provide standardized identification information about the tagged object that can be universally read and understood.

Regarding **claim 14**, in the system suggested by 684 Publication in view of 200 Patent and 2006 EPC Standard, 200 Patent further teaches that the unique serial number space further comprises remaining bits of lesser significance (e.g., the 20 least significant bits) that together with the at least three most significant bits (e.g., the five most significant bits) comprise the one serial number instance (having 25 bits in all in the example discussed above with regard to claim 13).

Regarding **claim 15**, in the system suggested by 684 Publication in view of 200 Patent and 2006 EPC Standard, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 200 Patent teaches a plurality of allocations associated with different manufacturer divisions as discussed above with regard to claim 13. 200 Patent further teaches that the at least three most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 200 Patent teaches that encoders in different manufacturing divisions are "linked to a centralized system that assigns serial numbers" (200 Patent, column 5, lines 18-22) and each encoder identifies its corresponding pool or block of allocated numbers, then encodes serial numbers from that pool (i.e., steps 325, 335, and 350 in Figure 3; column 6, lines 37-58). As discussed above with regard to claim 13, the at least three most significant bits taught by 200 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different manufacturer divisions that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 200 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

35 USC § 103 Rejections Based on 545 Patent

9. **Claims 1, 6-12, 16, and 20** are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over **684 Publication** in view of **545 Patent**.

Regarding **claim 1**, 684 Publication discloses an RFID transponder 50 (Figures 2 and 3; paragraphs [0003]-[0004], [0041], and [0049]) comprising:

a substrate 58 (paragraph [0049]);

an antenna structure formed on the substrate (i.e., antenna layer 54; paragraph [0049]); and

an RFID integrated circuit chip 56, which is electrically coupled to the antenna structure (paragraph [0049]),

wherein the RFID integrated circuit chip is encoded with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

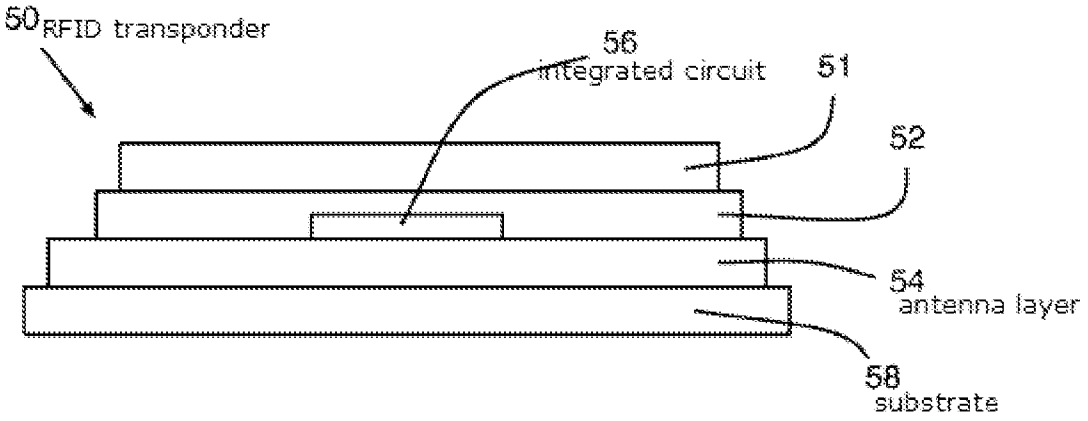


FIG. 3
(684 Publication, annotated)

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited

number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

However, 545 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag with a unique object number (i.e., RFID tags 420-426 with EPC codes 412-418; Figure 4A; column 1, lines 20-38; column 3, lines 34-39). 545 Patent further teaches that the unique object number comprises an object class information space (including a Stock Keeping Unit [SKU] or "product id" in an EPC code as shown in Figure 4B; column 1, lines 32-38) and a unique serial number space (i.e., "serial number" in an EPC code as shown in Figure 4B).

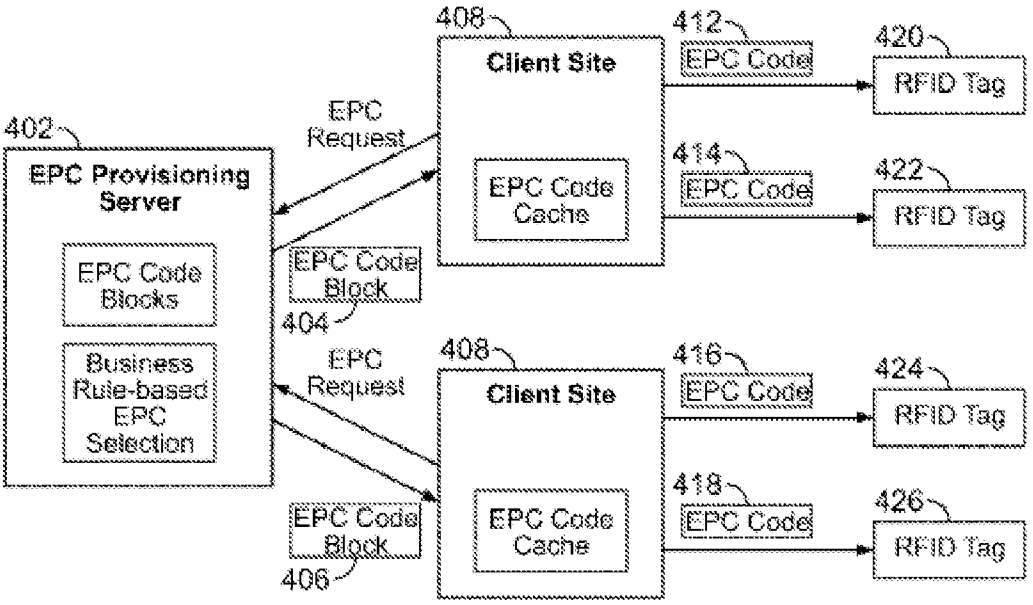


FIG. 4A (545 Patent)

(and portion of **FIG. 4B**)



545 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance. More specifically, 545 Patent teaches that EPC server 402 dynamically provides EPC code blocks 404 and 406 to multiple client sites 408 that encode EPC codes from the blocks onto the RFID tags (Figure 4A; column 3, lines 34-39; and column 4, lines 5-12). 545 Patent further teaches that for

example, 45 million total available EPC codes can be divided into blocks or pools of about five or ten million EPC codes (e.g., from 10 to 15 million, or from 30 to 40 million; Figures 13E-G).

It would be well understood in the art that a total of 45 million serial numbers (such as taught by 545 Patent) would require at least 26 bits in binary. In a serial number space having 26 bits, a block of numbers from one to about one million would be expressed as 26-bit binary numbers 00000000000000000000000001 to about 00000011111111111111111111. Another exemplary block of numbers from about 10 to 15 million would be expressed as binary numbers from about 00101000000000000000000000 to about 00111100000000000000000000. Yet another exemplary block of numbers from about 30 to 40 million would be expressed as binary numbers from about 01111000000000000000000000 to about 10100000000000000000000000[4].

Thus 545 Patent teaches that an allocated block or range of serial numbers is assigned a limited number of most significant bits because in a 26-bit serial number, the six most significant bits (e.g., "000000," "001010," etc.) correspond to a particular block containing over a million serial numbers and therefore also correspond to a particular client site as taught by 545 Patent. 545 Patent further teaches that the limited number of most significant bits (e.g., the six most significant bits) and the remaining bits of lesser significance (e.g., the 20 least significant bits) comprise the one serial number instance having 26 bits in all.

Regarding claim 1, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 545 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for

[4] More precisely, 00000011111111111111111111 (binary) is 1,048,575 (decimal). 00101000000000000000000000 is 10,485,760. 00111100000000000000000000 is 15,728,640. 01111000000000000000000000 is 31,457,280. 10100000000000000000000000 is 41,943,040.

objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Regarding **claim 6**, in the system suggested by 684 Publication in view of 545 Patent, 545 Patent further teaches that the allocated block is defined by at least three most significant bits (e.g., six most significant bits, in the example discussed above with regard to claim 1).

Regarding **claim 7**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 545 Patent teaches a plurality of allocations associated with different client sites as discussed above with regard to claim 1. 545 Patent further teaches that the allocated block is one of a plurality of allocations intermittently received by an encoder at least in the sense that 545 Patent teaches that encoders in different client sites receive corresponding pools of allocated numbers from an EPC provisioning server 402, then encode serial numbers from that pool (Figure 4A; column 3, lines 34-67; column 4, lines 1-19).

Regarding **claim 8**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses that the RFID integrated circuit chip is comprised of silicon (paragraphs [0005]-[0006]).

Regarding **claim 9**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses that the RFID integrated circuit chip is comprised of polymer (paragraphs [0005]-[0006]).

Regarding **claim 10**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses that the substrate 58, antenna structure 54, and RFID integrated circuit chip 56 are covered by a face stock material 51 (Figure 3; paragraph [0049]).

Regarding **claim 11**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses that the RFID integrated circuit chip 56 is disposed on the substrate 58 (Figure 3; paragraph [0049]).

Regarding **claim 12**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 545 Patent teaches a plurality of allocations associated with different client sites as discussed above with regard to claim 1. 545 Patent further teaches that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 545 Patent teaches that encoders in different client sites receive corresponding pools of allocated numbers from an EPC provisioning server 402, then encode serial numbers from that pool (Figure 4A; column 3, lines 34-67; column 4, lines 1-19). As discussed above with regard to claim 1, the limited number of most significant bits taught by 545 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different client sites that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 545 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Regarding **claim 16**, 684 Publication discloses an integrated circuit (Figures 2 and 3, paragraphs [0003]-[0004], [0041], and [0049]), comprising:

a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator; control logic; and a memory (i.e., 684 Publication discloses passive RFID transponders that backscatter a return link signal including a radio frequency circuit, control logic, and memory; paragraphs [0003]-[0004]);

wherein the memory is configured with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

However, 545 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag with a unique object number (i.e., RFID tags 420-426 with EPC codes 412-418; Figure 4A; column 1, lines 20-38; column 3, lines 34-39). 545 Patent further teaches that the unique object number comprises an object class information space (including a Stock Keeping Unit [SKU] or "product id" in an EPC code as shown in Figure 4B; column 1, lines 32-38) and a unique serial number space (i.e., "serial number" in an EPC code as shown in Figure 4B).

545 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance. More specifically, 545 Patent teaches that EPC server 402 dynamically provides EPC code blocks 404 and 406 to multiple client sites 408 that encode EPC codes from the blocks onto the RFID tags (Figure 4A; column 3, lines 34-39; and column 4, lines 5-12). 545 Patent further teaches that for example, 45 million total available EPC codes can be divided into blocks or pools of about five or ten million EPC codes (e.g., from 10 to 15 million, or from 30 to 40 million; Figures 13E-G).

It would be well understood in the art that a total of 45 million serial numbers (such as taught by 545 Patent) would require at least 26 bits in binary. In a serial number space having 26 bits, a block of numbers from one to about one million would be expressed as 26-bit binary numbers 000000000000000000000001 to about 000000111111111111111111. Another exemplary block of numbers from about 10 to 15 million would be expressed as binary numbers from about 001010000000000000000000 to about 001111000000000000000000. Yet another exemplary block of numbers from about 30 to 40 million would be expressed as binary numbers from about 011110000000000000000000 to about 101000000000000000000000[5].

Thus 545 Patent teaches that an allocated block or range of serial numbers is assigned a limited number of most significant bits because in a 26-bit serial number, the six most significant bits (e.g., "000000," "001010," etc.) correspond to a particular block containing over a million

[5] Again, more precisely, 00000011111111111111111111 (binary) is 1,048,575 (decimal). 00101000000000000000000000 is 10,485,760. 00111100000000000000000000 is 15,728,640. 01111000000000000000000000 is 31,457,280. 10100000000000000000000000 is 41,943,040.

serial numbers and therefore also correspond to a particular client site as taught by 545 Patent. 545 Patent further teaches that the limited number of most significant bits (e.g., the six most significant bits) and the remaining bits of lesser significance (e.g., the 20 least significant bits) comprise the one serial number instance having 26 bits in all.

Regarding claim 16, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 545 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Regarding **claim 20**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 545 Patent teaches a plurality of allocations associated with different client sites as discussed above with regard to claim 16. 545 Patent further teaches that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 545 Patent teaches that encoders in different client sites receive corresponding pools of allocated numbers from an EPC provisioning server 402, then encode serial numbers from that pool (Figure 4A; column 3, lines 34-67; column 4, lines 1-19). As discussed above with regard to claim 16, the limited number of most significant bits taught by 545 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different client sites that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks

further corresponding to encoders as taught by 545 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

10. **Claims 2-5, 13-15, and 17-19** are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over **684 Publication** in view of **200 Patent** and **2006 EPC Standard**.

Regarding **claims 2-5 and 17-19**, 684 Publication in view of 545 Patent suggests a system as discussed above with regard to claim 1 or claim 16, including a unique object number comprising an Electronic Product Code (EPC) identifier 100 with an object class information space as taught by 545 Patent (including a Stock Keeping Unit [SKU] or "product id" in an EPC code as shown in Figure 4B; column 1, lines 32-38).

684 Publication in view of 545 Patent does not specifically teach that the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value; that the unique object number is a portion of a serialized global trade item number, wherein the serialized global trade item number is an EPC SGTIN-96 encoding; or that the unique serial number space is at least 38 bits.

However, 2006 EPC Standard teaches a system that is related to the one described by 684 Publication in view of 545 Patent, including RFID tags having associated EPCs (2006 EPC Standard, page 8). 2006 EPC Standard further teaches that the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value; that the unique object number is a portion of a serialized global trade item number, wherein the serialized global trade item number is an EPC SGTIN-96 encoding; and that the

unique serial number space is at least 38 bits. (2006 EPC Standard, pages 25-26). Regarding claims 2-5 and 17-19, it would have been obvious to provide an object class information space and a serialized global trade item number as taught by 2006 EPC Standard, in the RFID transponder suggested by 684 Publication in view of 545 Patent, in order to provide standardized identification information about the tagged object that can be universally read and understood.

Regarding **claim 13**, as similarly discussed above with regard to claim 1, 684 Publication discloses an RFID transponder 50 (Figures 2 and 3; paragraph [0041]) comprising:

a substrate 58 (paragraph [0049]);

an antenna structure formed on the substrate (i.e., antenna layer 54; paragraph [0049]); and

an RFID integrated circuit chip 56, which is electrically coupled to the antenna structure (paragraph [0049]),

wherein the RFID integrated circuit chip is encoded with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises at least three most significant bits corresponding to the allocated block.

However, 545 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag with a unique object number (i.e., RFID tags 420-426 with EPC codes 412-418; Figure 4A; column 1, lines 20-38; column 3, lines 34-39). 545 Patent further teaches that the unique object number comprises an object class information space (including a Stock Keeping Unit [SKU] or "product id" in an EPC code as shown in Figure 4B; column 1, lines 32-38) and a unique serial number space (i.e., "serial number" in an EPC code as shown in Figure 4B).

545 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance. More specifically, 545 Patent teaches that EPC server 402 dynamically provides EPC code blocks 404 and 406 to multiple client sites 408 that encode EPC codes from the blocks onto the RFID tags (Figure 4A; column 3, lines 34-39; and column 4, lines 5-12). 545 Patent further teaches that for example, 45 million total available EPC codes can be divided into blocks or pools of about five or ten million EPC codes (e.g., from 10 to 15 million, or from 30 to 40 million; Figures 13E-G).

It would be well understood in the art that a total of 45 million serial numbers (such as taught by 545 Patent) would require at least 26 bits in binary. In a serial number space having 26 bits, a block of numbers from one to about one million would be expressed as 26-bit binary numbers 00000000000000000000000001 to about 00000011111111111111111111. Another exemplary block of numbers from about 10 to 15 million would be expressed as binary numbers

from about 001010000000000000000000000 to about 001111000000000000000000000. Yet another exemplary block of numbers from about 30 to 40 million would be expressed as binary numbers from about 011110000000000000000000000 to about 101000000000000000000000000[6].

Thus 545 Patent teaches that an allocated block or range of serial numbers is assigned a limited number of most significant bits because in a 26-bit serial number, the six most significant bits (e.g., "000000," "001010," etc.) correspond to a particular block containing over a million serial numbers and therefore also correspond to a particular client site as taught by 545 Patent. 545 Patent further teaches that wherein the unique serial number space comprises at least three most significant bits corresponding to the allocated block (e.g., six most significant bits in the example above).

Regarding claim 13, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 545 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Further regarding claim 13, 684 Publication in view of 545 Patent does not further suggest a global trade item number or that the object class information space includes a block of at least 50 bits and the unique serial number space includes a block of at least 38 bits.

However, 2006 EPC Standard teaches a system that is related to the one described by 684 Publication in view of 545 Patent, including RFID tags having associated EPCs (2006 EPC

[6] More precisely, 00000011111111111111111111 (binary) is 1,048,575 (decimal). 00101000000000000000000000 is 10,485,760. 00111100000000000000000000 is 15,728,640. 01111000000000000000000000 is 31,457,280. 10100000000000000000000000 is 41,943,040.

Standard, page 8). 2006 EPC Standard further teaches a global trade item number and that the object class information space includes a block of at least 50 bits and the unique serial number space includes a block of at least 38 bits (2006 EPC Standard, pages 25-26). Regarding claims 13, it would have been obvious to provide a global trade item number, an object class information space of at least 50 bits, and a unique serial number space of at least 38 bits as taught by 2006 EPC Standard, in the RFID transponder suggested by 684 Publication in view of 545 Patent, in order to provide standardized identification information about the tagged object that can be universally read and understood.

Regarding **claim 14**, in the system suggested by 684 Publication in view of 545 Patent and 2006 EPC Standard, 545 Patent further teaches that the unique serial number space further comprises remaining bits of lesser significance (e.g., the 20 least significant bits) that together with the at least three most significant bits (e.g., the six most significant bits) comprise the one serial number instance (having 26 bits in all in the example discussed above with regard to claim 13).

Regarding **claim 15**, in the system suggested by 684 Publication in view of 545 Patent and 2006 EPC Standard, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 545 Patent teaches a plurality of allocations associated with different client sites as discussed above with regard to claim 13. 545 Patent further teaches that the at least three most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 545 Patent teaches that encoders in different client sites receive corresponding pools of allocated numbers from an EPC provisioning server 402, then encode serial numbers from that pool (Figure 4A;

column 3, lines 34-67; column 4, lines 1-19). As discussed above with regard to claim 13, the at least three most significant bits taught by 545 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different client sites that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 545 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Response to Arguments

11. PO Response and Williams Declaration have been fully considered but are not persuasive. Examiner maintains all of the rejections of the previous Office action.

12. PO does not appear to dispute the teachings of 684 Publication and 2006 EPC Standard that are relied upon in the rejections and acknowledges that "The primary focus of the patent owner's arguments is based on the asserted teachings of the '200 patent and the '545 patent" (PO Response, page 3). In brief, 684 Publication teaches the physical components of the RFID transponder recited in independent claims 1 and 13 including a substrate, an antenna, and RFID integrated circuit chip; and the integrated circuit recited in independent claim 16 including a radio frequency circuit, control logic, and a memory. 2006 EPC Standard teaches a system including RFID tags having associated Electronic Product Codes (EPC) with standardized identification information about the tagged objects as discussed above with regard to claims 2-5, 13-15, and 17-19.

13. Regarding 200 Patent and 545 Patent, PO argues that the methods for encoding serial numbers taught by 200 Patent and 545 Patent differ from the invention in 967 Patent. PO asserts that in 200 Patent, "without the communication to the database of the centralized system, there is no manner of ensuring that the serial numbers are unique," and that 545 Patent similarly teaches "a central EPC server that controls all assignments of the EPCs to ensure that the assigned EPCs are unique." PO Response, pages 12-13. PO further asserts that unlike 200 Patent and 545 Patent, the invention in 967 Patent provides a "hardware-based encoding method" without requiring "a continuous wireless connection to a host database." PO Response, page 13. See also Williams Declaration, paragraphs 37-53.

Examiner acknowledges that 200 Patent and 545 Patent include a database and/or a server. However, Examiner disagrees with PO's assertion that 200 Patent and 545 Patent do not disclose or suggest the limitations recited by the claims.

In response to PO's argument that the references fail to show certain features of PO's invention, it is noted that the features upon which PO relies (i.e., "a distinct hardware-based approach" that includes "active management and assignment of the MSBs [most significant bits] of the binary encoding of the serial number" and does not require continuous wireless connection to a host database; PO Response, pages 13-14 and 19) are not recited in the rejected claims. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Not only do the claims omit any details with respect to hardware-based, "active" management of the MSBs or the serial numbers, but none of the claims are even directed to a

method for encoding RFID transponders. The claims are also not directed to an RFID printer or an apparatus for encoding transponders. Instead, all of the claims are directed to an RFID transponder itself. The claims recite an RFID transponder encoded with a serial number. 200 Patent and 545 Patent are each relied upon to teach, among other things, an RFID transponder encoded with a serial number from an allocated block of serial numbers.

Furthermore, in response to PO's assertion that "While the conventional approaches will result in an RFID tag encoded with a binary encoding in the SGTIN-96 format as would be the case with the '967 Patent, the way such a result is achieved by the claimed subject matter of the '967 Patent is decidedly different" (PO Response, page 13), Examiner notes that the patentability of a product does not depend on its method of production. Insofar as the claims recite "the allocated block being assigned a limited number of most significant bits," the allocation of the block of numbers is merely a part of the process by which the individual serial number instance is encoded onto the RFID transponder. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 777 F.2d 695,698, 227 USPQ 964, 966 (Fed. Cir. 1985). See also MPEP 2113.

Examiner disagrees with PO's assertion that 200 Patent and 545 Patent do not suggest that EPC codes could be split into "a limited number of most significant bits" and "remaining bits of lesser significance" (PO Response, pages 18-20). On the contrary, Examiner notes that the 25-bit or 26-bit numbers disclosed by 200 Patent and 545 Patent inherently include bits that are most significant and bits that are of lesser significance. This is simply an inherent quality of a

multi-bit binary number regardless of whether the binary number was converted from decimal or not.

Examiner also disagrees with PO's assertion that the rejections attempt "to shoehorn a random selection of decimal numbers into the assignment of binary bits as recited in the claims" (PO Response, page 21) or that "mixing binary MSB block allocations with decimal numbers is like mixing apples with oranges" (Williams Declaration, paragraph 57).

Examiner acknowledges that the decimal number range one to one million (for example) does not directly correspond to binary numbers 00000000000000000000000001 to 00000111111111111111111111. However, the claims do not recite particular number ranges or a method for allocating particular numbers. Instead, the claims are directed to an RFID transponder with a serial number from a block of numbers, which is what 200 Patent and 545 Patent each teach.

More specifically, 200 Patent and 545 Patent each teach RFID transponders encoded with serial numbers from different large number ranges of more than a million numbers. The individual serial numbers that fall in different large number ranges inherently have different most significant bits. Therefore, 200 Patent and 545 Patent each also disclose blocks of serial numbers that have different most significant bits.

One of ordinary skill in the art would understand that 200 Patent and 545 Patent provide specific numbers only as examples, and that other numbers can be used. However, to use the particular example in 200 Patent, column 5, lines 7-22, one serial number from a block assigned to a first manufacturing division can be 123,456 (i.e., a number "in the range of one to a million") and another serial number from another block assigned to a second manufacturing

division can be 3,456,789 (i.e., "a number in a range of three to four million"). 123,456 (decimal) represented as a 25-bit binary number is 00000000111100010010000000. 3,456,789 (decimal) represented as a 25-bit binary number is 00011010010111111100010101. These numbers have different most significant bits.

In the example given in 545 Patent, Figures 13F-13G, one serial number from a block assigned to one client site can be 12,345,678 (i.e., a number between 10 and 15 million) and another serial number from a block assigned to a different client site can be 34,567,890 (i.e., a number between 30 and 40 million). 12,345,678 (decimal) represented as a 26-bit binary number is 00101111000110000101001110. 34,567,890 (decimal) represented as a 26-bit binary number is 10000011110111011011010010. These numbers in binary also have different most significant bits.

More importantly, in the context of the actual claim language, 200 Patent and 545 Patent each teach an RFID transponder that has a serial number from a block that can be "assigned" one group of numbers that has different most significant bits from some other group of numbers. Examiner disagrees with PO's assertion that "The fact that one could pick some subset of blocks of serial numbers with common MSBs after the sequential decimal serial numbers are converted to binary is of no consequence." PO Response, pages 18 and 20. On the contrary, because the claims are all directed to an RFID transponder having a number, instead of a method or apparatus for encoding RFID transponders, Examiner maintains that 200 Patent and 545 Patent each teach the recited claim limitations.

Conclusion

14. **THIS ACTION IS MADE FINAL.**

A shortened statutory period for response to this action is set to expire two months from the mailing date of this action.

Extensions of time under 37 CFR 1.136(a) do not apply in reexamination proceedings. The provisions of 37 CFR 1.136 apply only to "an applicant" and not to parties in a reexamination proceeding. Further, in 35 U.S.C. 305 and in 37 CFR 1.550(a), it is required that reexamination proceedings "will be conducted with special dispatch within the Office."

Extensions of time in reexamination proceedings are provided for in 37 CFR 1.550(c). A request for extension of time must specify the requested period of extension and it must be accompanied by the petition fee set forth in 37 CFR 1.17(g). Any request for an extension in a third party requested ex parte reexamination must be filed on or before the day on which action by the patent owner is due, and the mere filing of a request will not effect any extension of time. A request for an extension of time in a third party requested ex parte reexamination will be granted only for sufficient cause, and for a reasonable time specified.

The filing of a timely first response to this final rejection will be construed as including a request to extend the shortened statutory period for an additional two months. In no event, however, will the statutory period for response expire later than SIX MONTHS from the mailing date of the final action. See MPEP § 2265.

15. **All** correspondence relating to this ex parte reexamination proceeding should be directed:

By mail to: Mail Stop *Ex Parte* Reexam
Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By fax to: (571) 273-9900

Central Reexamination Unit

By hand to: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Any inquiry concerning this communication should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

/Christina Y. Leung/

Primary Examiner, Art Unit 3992

Conferees:

/Albert J Gagliardi/

Primary Examiner, Art Unit 3992

/James Menefee/

Acting SPE, Art Unit 3992

Office Action in Ex Parte Reexamination	Control No. 90/014,052	Patent Under Reexamination 9798967	
	Examiner Christina Y. Leung	Art Unit 3992	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

a. ☒ Responsive to the communication(s) filed on *April 2, 2018* .
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

b. ☒ This action is made FINAL.

c. ☐ A statement under 37 CFR 1.530 has not been received from the patent owner.

A shortened statutory period for response to this action is set to expire *2* month(s) from the mailing date of this letter. Failure to respond within the period for response will result in termination of the proceeding and issuance of an *ex parte* reexamination certificate in accordance with this action. 37 CFR 1.550(d). **EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.550(c).** If the period for response specified above is less than thirty (30) days, a response within the statutory minimum of thirty (30) days will be considered timely.

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ☐ Notice of References Cited by Examiner, PTO-892.
2. ☐ Information Disclosure Statement, PTO/SB/08.
3. ☐ Interview Summary, PTO-474.
4. ☐ _____.

Part II SUMMARY OF ACTION

1a. ☒ Claims *1-20* are subject to reexamination.
1b. ☐ Claims _____ are not subject to reexamination.
2. ☐ Claims _____ have been canceled in the present reexamination proceeding.
3. ☐ Claims _____ are patentable and/or confirmed.
4. ☒ Claims *1-20* are rejected.
5. ☐ Claims _____ are objected to.
6. ☐ The drawings, filed on _____ are acceptable.
7. ☐ The proposed drawing correction, filed on _____ has been (7a) ☐ approved (7b) ☐ disapproved.
8. ☐ Acknowledgment is made of the priority claim under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the certified copies have
   1 ☐ been received.
   2 ☐ not been received.
   3 ☐ been filed in Application No. _____ .
   4 ☐ been filed in reexamination Control No. _____.
   5 ☐ been received by the International Bureau in PCT application No. _____.
   * See the attached detailed Office action for a list of the certified copies not received.
9. ☐ Since the proceeding appears to be in condition for issuance of an *ex parte* reexamination certificate except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte* Quayle, 1935 C.D. 11, 453 O.G. 213.
10. ☐ Other: _____

cc: Requester (if third party requester)

Reexamination	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90/014,052	9798967
	Certificate Date	Certificate Number

Requester Correspondence Address: ☐ **Patent Owner** ☒ **Third Party**

HOGAN LOVELLS US LLP IP GROUP
COLUMBIA SQUARE
555 THIRTEENTH STREET, NW
WASHINGTON, DC 20004

LITIGATION REVIEW ☒	/CL/ (examiner initials)	**5-11-18** (date)
Case Name		Director Initials
6:17cv1685, Adasa Inc. v. Avery Dennison Corporation		

COPENDING OFFICE PROCEEDINGS	
TYPE OF PROCEEDING	**NUMBER**
1. none	
2.	
3.	
4.	

PATENT
Attorney Docket No.: 30139/00105

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexaminaton of:	)	
	)	
U.S. Patent No. **9,798,967**	)	
	)	
Control No.: 90/014,052	)	Group Art Unit: 3992
	)	
Filed: November 29, 2017	)	Examiner: Christina Y. Leung
	)	
For: SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS	)	
	)	
Confirmation No.: 4770	)	

Mail Stop: *Ex Parte* Reexamination
Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NON-FINAL OFFICE ACTION DATED FEBRUARY 1, 2018

In response to the Non-Final Office Action mailed February 1, 2018 in the above-referenced reexamination, please consider the following remarks.

REMARKS

Original patent claims 1 – 20 remain unchanged and are now pending in the above-referenced *ex parte* reexamination. Based on the arguments presented below, the patent owner respectfully submits that all pending claims are allowable over the prior art relied on in the non-final office action.

The patent under reexamination, U.S. Patent No. 9,798,967 ("the '967 patent") has been asserted in a proceeding captioned *Adasa Inc. v. Avery Dennison Corporation*, 6:17-cv-01685 (D. OR).

The Examiner's Rejections

Claims 1-20 are each rejected twice under 35 U.S.C. 103 as follows:

Claims 1, 6-12, 16, and 20 stand rejected under 35 U.S.C. 103 as being unpatentable over US 2007/0040684 Al to McAllister ("the '684 publication") in view of US 7,827,200 B2 to Rowe ("the '200 patent"). *See* Office Action, p. 3.

Claims 2-5, 13-15, and 17-19 stand rejected under 35 U.S.C. 103 as being unpatentable over the '684 publication in view of the '200 patent and EPCglobal Tag Data Standards, Version 1.3, March 8, 2006 ("the 2006 EPC Standard"). *See* Office Action, p. 3.

Claims 1, 6-12, 16, and 20 stand rejected under 35 U.S.C. 103 as being unpatentable over the '684 publication in view of US 8,373,545 B2 to Traub ("the '545 patent). *See* Office Action, p. 3.

Claims 2-5, 13-15, and 17-19 stand rejected under 35 U.S.C. 103 as being unpatentable over the '684 publication in view of the '545 patent and the 2006 EPC Standard. *See* Office Action, p. 3.

Summary of the Arguments

The primary focus of the patent owner's arguments is based on the asserted teachings of the '200 patent and the '545 patent. Both the '200 patent and the '545 patent require a fully connected central database to ensure that the EPCs that are assigned by encoder are unique. Without such a connection to a central database, the systems and methods disclosed by the '200 patent and the '545 patent cannot ensure that each of the assigned EPCs are unique. In contrast, the claims of the '967 patent provide a hardware-based numbering scheme ensuring the assigned EPCs are unique without requiring a continuous connection to a central database. Thus, contrary to the Examiner's assertions, the central database schemes disclosed in both the '200 patent and the '545 patent do not disclose or suggest the hardware-based numbering scheme of the '967 Patent as recited in, for example, claim 1 as "wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits," and "wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance."

Furthermore, the patent owner will also demonstrate that the Examiner's use of a decimal numbering system assigned by central databases as taught by the '200 patent and the '545 patent

are not analogous to the binary bit-based numbering system recited in the claims of the '967 patent. Specifically, the allocation approach disclosed in the prior art references is for the encoders to obtain each decimal (corresponding to the EPC or serial number) from the central database and convert it for encoding the object. This centralized approach is exactly what the invention of the '967 Patent avoids by partitioning the serial number at the bit level and allocating the most significant bits to allow unique encoding by the encoders without being connected to a database. Thus, the decimal examples provided by the Examiner do not meet the Examiner's *prima facie* burden of demonstrating why such a conversion from decimal to binary is obvious within the context of the subject matter recited in the '967 patent.

The Independent Claims of the '967 Patent

Independent Claim 1 of the '967 patent recites:

> An RFID transponder comprising:
>
> a substrate;
>
> an antenna structure formed on the substrate; and
>
> an RFID integrated circuit chip which is electrically coupled to the antenna structure,
>
> wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,
>
> ***wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and***
>
> ***wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated***

block and remaining bits of lesser significance that together comprise the one serial number instance.

Independent Claim 13 of the '967 patent recites:

A RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a global trade item number including a unique object number, the unique object number comprising an object class information space including a block of at least 50 bits and a unique serial number space including a block of at least 38 bits,

wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block.

Independent Claim 16 of the '967 patent recites:

An integrated circuit, comprising:

a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator;

control logic; and

a memory,

wherein the memory is configured with a unique object number space, the unique object number space comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

While the independent claims are not identical, the highlighted claim language as shown above is similar enough that the arguments presented below with reference to claim 1, are equally applicable to claims 13 and 16.

General Background for Encoding an EPC within an RFID Tag

For merchandise tracking applications, the memory bank of an RFID tag is encoded with an Electronic Product Code ("EPC"), which is an identifier for an item in the supply chain to uniquely identify that particular item. The EPC can be encoded in accordance with one of various EPC tag data standards set by GS1 for a serialized identifier, such as a Serialized Global Trade Item Number (SGTIN) number, includes a combination of object class information and a serial number. *See,* DECLARATION OF CHARLES B. WILLIAMS UNDER 37 C.F.R. §1.132, ¶¶ 13-16, (hereinafter Williams Decl., attached hereto as Exhibit A)

Within the object class information of the EPC, each brand owner is provided with a company prefix to identify the brand owner and an item reference code to identify the class of the items being tagged. As such, all the EPCs within a particular class for a particular brand owner will have the same object class information but will be different from other classes of

items provided by that same brand owner or other classes of items from other companies. This information correlates to that of a GTIN as would be contained within a barcode. For RFID applications, this information would be written in decimal form and referred to as an unserialized identity Uniform Resource Identifier ("URI") for an EPC. For example, the unserialized identity URI of the EPC may read as:

EPC Pure URI
urn:epc:id:sgtin:012345.67890

See, Williams Decl. ¶ 17.

A serial number is then issued for a particular item within the class of items for that brand owner as an integer in decimal form. By issuing a unique serial number for each item, the serialized EPC of each item within the class for that brand owner will be unique. However, the EPC is only truly unique if the brand owner ensures that the serial number of the EPC is unique within all of the tags encoded for the class of items. The GS1 serialization guideline states that it is the brand owner's responsibility to make ensure that each serial number, and therefore each EPC, is unique. *See*, Williams Decl. ¶ 18.

The serial number is then combined with the object class information from the unserialized URI to provide a serialized identity URI of an EPC. The serialized identity URI of the EPC may read as:

EPC Pure URI
urn:epc:id:sgtin:012345.67890.10479832

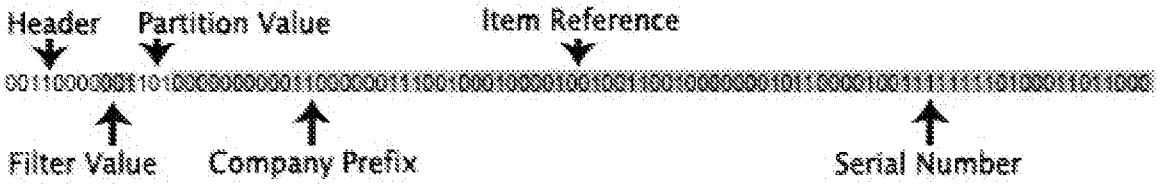
See, Williams Decl. ¶ 19.

This serialized identity of the EPC is provided from the database to the encoder either in decimal or hexadecimal form, and the encoder then converts the EPC to its binary format for encoding to the RFID tag. The binary format of the EPC may be SGTIN-96, which includes 8 bits for the header identifying the EPC format, 50 bits for object class information including a filter value, partition value, company prefix, and item reference number, and 38 bits for a serial number.

A typical EPC SGTIN-96 Structure:

Header	Filter / Object Type	Partition	Company Prefix	Item Ref and Indicator	Serial
8 bits	3 bits	3 bits	20- 40 bits	24 - 4 bits	38 bits

EPC SGTIN-96 Binary



See, Williams Decl. ¶ 20.

Conventional/Prior Art Management of Encoding Unique EPCs

The use of the EPC framework will always result in an EPC being encoded to the RFID tag's memory, but there are different approaches for managing and assigning EPCs.

The process of providing the EPC to the encoder is typically performed by a software application that uses a database to retrieve the base values required to encode a RFID tag as well as saving the values of the generated RFID tag IDs. For some of the encoding standards, one of

the fields is a serial number. The serial numbers are typically stored and tracked in the database in decimal form and can be retrieved individually or in blocks by the software that generates the tag IDs that need to be encoded into a collection of RFID tags. *See*, Williams Decl. ¶ 21.

In most cases, one serial number or a set of serial numbers is retrieved from the database at any given time, and in most cases an encoder is only encoding tags for one specific product (identified by a GTIN, which is also encoded in the object class information of the tag ID.) *See*, Williams Decl. ¶ 22. A second process to encode RFID tags involves using a barcode scan to read a UPC, software to convert the UPC to a GTIN, use the GTIN to lookup the next serial number in the database and use those two values to encode the RFID tag. This process involves fetching one serial number at a time from the database and then updating the database with the resulting RFID tag ID. *See*, Williams Decl. ¶ 23. However, neither of these conventional processes for assigning EPCs or serial numbers provide for a disconnected or semiautonomous operation. Rather, all components of the ecosystem (reader/encoder, software application and database) must be running and connected for the encoding of the RFID tags to take place. *See*, Williams Decl. ¶ 24.

As will be described in greater detail below, both the '200 patent and the '545 patent describe systems that operate in this generally conventional manner of encoding unique EPCs. That is, the entire EPC itself (as in the '545 patent) and/or serial number of the EPC (as in the '200 patent) is issued directly from a database which manages assignment of the EPCs. Both references disclose dividing the EPCs or the serial numbers into pools or blocks that are assigned different sites and these divisions are managed by a central database. *See*, Williams Decl. ¶ 37.

Under each of these conventional approaches, unless all encoders receive the EPC or serial number for each tag from the same database, there is no way to fully ensure uniqueness of the EPC. In real-world situations, the encoding of tags is performed by encoders from different assembly lines, different facilities, and different parties at different levels within the stream of commerce (*i.e.*, manufacturer, distributor, retail warehouse, retail store, or third-party encoder). Using the conventional or prior art systems and methods, including those disclosed in the '200 patent and the '545 patent, unless all of these encoders are all linked to the same centralized database to receive the EPCs, it is possible to that different encoders may encode duplicate EPCs or serial numbers. The use of the central database to control the EPCs is crucial in the prior art systems.

The '200 Patent

The '200 patent describes a method for managing serialization of Electronic Product Codes (EPCs). '200 Patent, Abstract. The EPCs are described as including a nonserialized portion 112 and a serialized portion 114. '200 Patent 3/56-58. The nonserialized portion 112 is described as specifying, for example, a manufacturer and an object classification. '200 Patent 3/65-66. The serialized portion 114 is specifically associated with an object. '200 Patent 4/8-9. The combination of the serialized portion 114 and the nonserialized portion 112 results in a unique identifier for an object. '200 Patent 4/9-11. The '200 patent states that "[t]he serialized values can be stored in [a] database table 126. '200 Patent 4/11-12.

A method of managing the EPCs is described with respect to Fig. 3. The method is described as follows:

> Method 300 can begin in step 305, where multiple pools of numbers and/or number assignment functions can be associated with values for nonserialized portions of EPCs. In step 310, a new taggable object can be identified that needs an EPC. In step 315, a classification for the new object can be determined. In step 320, an unserialized portion of the EPC can be constructed from the classification information, in step 325, a pool of numbers and/or a number assignment function associated with the unserialized portion can be identified. In step 330, a last previously allocated serial number in the identified pool can be located. In step 335, the next unallocated serial number can be extracted from the pool and used as the serialized portion of the EPC. In step 340, the new EPC can be assigned to the new taggable object. In step 345, variables associated with the pool or function used to generate the assigned number can be updated to ensure that the assigned serial number is not reassigned to a different object having the same unserialized portion of an EPC. In step 350, the assigned EPC can be encoded into an RFID tag that can be physically linked to the object.
>
> '200 patent, 6/37-58.

The pool of numbers referred to in the above method of the '200 patent is described as follows:

> [D]ifferent manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated. For example, a serial number generation function used by a first division can sequentially assign odd serial numbers, while a different serial number generation function used by a second division can sequentially assign even serial numbers. In another example, a first division can assign serial numbers in the range of one to a million and the second division can assign serial numbers in a range of three to four million. ***It should be appreciated that the different divisions can be communicatively linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification.***

'200 patent, 5/7-22 (emphasis added).

Thus, the '200 patent describes that the serialized portion of the EPC number is assigned by central database to which the "the different divisions can be communicatively linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification." '200 Patent, 5/18-22. That is, without the communication to the database of the centralized system, there is no manner of ensuring that the serial numbers are unique. *See*, Williams Decl. ¶¶ 38-41.

The '545 Patent

The '545 patent describes an "EPC provisioning system comprising a EPC server [that] dynamically provide[s] EPC code blocks for one product to multiple client sites. The EPC server can use business rules to determine the EPC codes for the multiple client sites." '545 patent, Abstract. The entire thrust of the '545 patent is directed at a centralized server system to manage the EPC codes. For example, the '545 patent states, "an EPC server 402 [is] adapted to dynamically provide EPC code blocks 404 and 406 for one product to multiple client sites. The EPC server 402 can use business rules to determine the EPC codes for the multiple client sites 408 and 410." '545 patent, 3/67 – 4/4. This centralized control over the EPC codes is implemented via "a computer implemented method using business rules to determine EPC code blocks for multiple client sites and providing the EPC code blocks to the multiple client sites." '545 patent, 4/12-15.

The '545 patent describes the provisioning service for controlling EPCs. '545 patent, 35/1-67. First, the EPC Pool is defined as "[a] named list of EPCs maintained in the provisioning system." '545 patent, 35/4-5. The EPCs may be checked out or checked in to the pool by outside applications. '545 patent, 35/5-6. Using this paradigm, the '545 patent states:

> Tag writing systems can use a central authority from which they can receive unique EPCs. The EPC Provisioning Service is designed to satisfy this need. In addition to providing a service to give out unique EPCs, a design goal is also to make it easy for administrators to define and maintain pools.
>
> '545 patent, 35/14-18.

The EPC Provisioning Service described in the '545 patent is implemented by the central EPC server 402 because it is the central authority for distributing the unique EPCs. The Provisioning Service is described as "a web service that will provide generic provisioning related operations like administering EPC pools, checkout or check-in from EPC pools, etc." '545 patent 35/54-57. Thus, the EPC Provisioning Service described in the '545 patent is a central EPC server that controls all assignments of the EPCs to ensure that the assigned EPCs are unique. *See*, Williams Decl. ¶¶ 45-48.

Hardware-Based Encoding of the '967 Patent

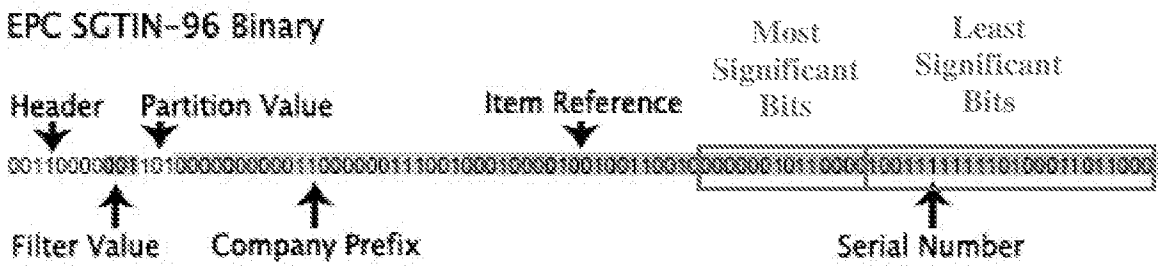
The claimed invention of the '967 Patent provides a distinct hardware-based approach within the greater context of managing the encoding of EPCs. While the conventional approaches will result in an RFID tag encoded with a binary encoding in the SGTIN-96 format as would be the case with the '967 Patent, the way such a result is achieved by the claimed subject matter of the '967 Patent is decidedly different. *See*, Williams Decl. ¶¶ 26-27.

The '967 Patent focuses on the binary bits of the serial number of the EPC to impart information that provides for control of the assignment of serial numbers into each encoder and the memory structure of the RFID tag. This hardware-based approach of the '967 Patent manages assignment of the serial number at the binary bit level by partitioning the bits of the serial number space into a limited number of most significant bits ("MSB") and a remaining number of least significant bits ("LSB"). '967 Patent, 8/4-51 and 33/14-58. *See also*, Williams Decl. ¶ 28.

As described in the specification of the '967 Patent, pre-authorized blocks of object class serial numbers are provided by subdividing the entire object class serial number space into sectors that are defined by a limited number of MSB's (Most Significant Bits) of the serial number field. '967 Patent, 8/12-15. The remaining bits, the least significant bits, may then be used to represent unique serial number values. '967 Patent, 8/21-31. Thus, as described in the '967 Patent, "[e]ach allocated block of serial numbers represents authority for encoding objects of an object class that can either be used by an encoder for encoding transponders, or allocated to a lower level in the authority hierarchy." '967 Patent, 8/32-36. The '967 Patent describes that the result of using this hardware-based encoding method is that a ***"[c]ontinuous wireless connection to a host database is not required*** for ongoing tag commissioning process." '967 Patent 7/57-59 (emphasis added). *See also*, Williams Decl. ¶ 29.

Thus, using the claimed invention of the '967 patent, each encoder may be assigned a set of MSBs to use for a particular class of item for a particular brand owner. The encoder encodes the assigned MSBs for each item of that particular class into the leading bits of the serial number

space and generates a serial number that is encoded in the in the remaining bits of the serial number space. The technical expert, Charles B. Williams, provides an example of how the binary bit-based encoding according to the claims of the '967 Patent would be positioned within a SGTIN-96 format EPC:



See, Williams Decl. ¶ 34.

Generally, at its core, the tag encoding process is the same from the point of when the RFID tag data reaches the encoder. That is: Tag ID to encoder => encoder to chip in RFID tag. However, the way the tag ID itself is created differs greatly from system to system and this is where the hardware-based system of the claimed invention of the '967 Patent differentiates itself from the conventional methods. The partitioned serial number approach in the '967 Patent manages assignment of the serial number at the binary bit level, rather than sequential allocation of decimal or hexadecimal number strings from a database. *See*, Williams Decl. ¶ 35.

By partitioning the leading bits of the serial number and assigning fixed MSBs for an object class to encoders from different assembly lines, facilities, or parties, the brand owner can enable each of the encoders to operate semi-autonomously to encode tags for items of a particular class without being connected to the same EPC issuing database, the uniqueness of the serial number is ensured within and across the ranges of numbers that are assigned to each

encoder throughout the stream of commerce.

The Differences Between the Claims of the '967 Patent and the Cited References

As described above, the '967 Patent is directed to a hardware-based encoding at the bit level. This is recited in claim 1 as:

> ***wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and***
>
> ***wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.***

Thus, as described above, the allocated block of serial numbers is "assigned a limited number of most significant bits" and the serial number space then comprises "the limited number of most significant bits … and remaining bits of lesser significance." This formulation of the hardware-based encoding allows for discontinuous connection to any database or central server, while still ensuring unique EPCs.

The Examiner has admitted that the '684 publication does not disclose the above recited claim elements. *See* Office Action, pp. 4 and 17. However, the Examiner has asserted that both the '200 patent and the '545 patent cure these deficiencies of the '684 publication. *See* Office Action, pp. 4-6 and 17-19. The patent owner respectfully disagrees.

With respect to the '200 patent, the Examiner asserts that the above-recited claim language is disclosed because 25 bits can be allocated to the serial number and because the '200

patent states,

> In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated. … In another example, a first division can assign serial numbers in the range of one to a million and the second division can assign serial numbers in a range of three to four million.
>
> *See* Office Action, p. 5 (internal citations omitted).

The patent owner respectfully disagrees with the Examiner's interpretation of this disclosure. This disclosure merely states that the serial number space may be 25 bits and that a division of sequential decimal serial numbers can be assigned. However, the claim language states, "*the allocated block being assigned a limited number of most significant bits.*" There is no assignment of a limited number of significant bits disclosed in the '200 patent. There is a disclosure of sequential decimal serial numbers (or in another example, sequential odd or even decimal serial numbers). The Examiner provides a purported example of how this relates to the bit level by converting the sequential decimal serial numbers to binary, but this is irrelevant to the claim language. In a subsequent section, the patent owner will describe in detail why the Examiner's example is incorrect and unworkable within the context of the '967 patent, but at this point, the fact that the conversion is performed by the prior art systems including the system of the '200 patent is irrelevant. The relevant question is whether the '200 patent discloses or suggests "*the allocated block being assigned a limited number of most significant bits.*" It does not.

The '200 patent is unconcerned with the bit level assigning of serial numbers. It is concerned with the assignment of sequential decimal serial numbers. There is no discussion of significant bits within the serial number of '200 patent, whether most significant or least significant. There is no discussion of a limited number of most significant bits. The only number mentioned for the serial number space is 25 bits as asserted by the Examiner. There is no hint or suggestion that these 25 bits could be split into "a limited number of most significant bits" and "remaining bits of lesser significance." The reason is simple, the system of the '200 patent assigns the of sequential decimal serial numbers under the continuous control of the central database and the conversion to the binary for storage in the tag is an inconsequential operation because it has no function in ensuring that the serial numbers are unique, that function is fulfilled by the central database. The serial number contains no information to give it any meaning outside of relationships associated with it in a database. Thus, there is no suggestion within the '200 patent, that allocated blocks should be assigned on the bit level.

The fact that one could pick some subset of blocks of serial numbers with common MSBs after the sequential decimal serial numbers are converted to binary is of no consequence. This is a backdoor analysis looking only at the end result. The claim language does not state that the allocated block "comprises" or "includes" a limited number of MSBs. The claim language is "the allocated block being ***assigned*** a limited number of most significant bits." That is, the limited number of MSBs is not happenstance or random like it would be when converting decimal serial numbers to binary. Rather, as recited in claim 1, the limited number of MSBs are specifically assigned. This assignment is important within the context of the '967 Patent because

the active management and assignment of the MSBs of the binary encoding of the serial number ensures uniqueness on the front end. Thus, it is the way the serial number that is created and managed by assigning MSBs at the binary level that distinguishes the claimed invention of the '967 Patent over the '200 patent.

In contrast, in the system disclosed in the '200 patent, unless all encoders receive the serial number for each tag from the same database, there is no way to fully ensure uniqueness of the EPC. The encoding of tags performed by encoders from different assembly lines, different facilities, and different parties at different levels within the stream of commerce could not be performed unless all of these encoders were all linked to the same centralized database to receive the serial numbers. *See*, Williams Decl. ¶¶ 42-44.

Thus, the patent owner respectfully submits that the '200 patent neither discloses nor suggests the above-highlighted language of claim 1.

With respect to the '545 patent, the Examiner asserts that the above-recited claim language is disclosed because "45 million total available EPC codes can be divided into blocks or pools of about five or ten million EPC codes." *See* Office Action, p. 18.

The patent owner respectfully disagrees with the Examiner's interpretation of this disclosure of the '545 patent for the same reasons as described above with reference to the '200 patent. Specifically, this disclosure merely states that EPC codes can be divided into blocks of sequential decimal numbers. There is no disclosure related to an assignment of a limited number of significant bits, either most or least significant. Again, there is no hint or suggestion that the EPC codes could be split into "a limited number of most significant bits" and "remaining bits of

lesser significance," as recited in claim 1. Just like for the '200 patent, the reason is simple, the system of the '545 patent assigns the sequential decimal serial numbers under the continuous control of the central EPC server 402 acting as the EPC Provisioning Service and the conversion to the binary for storage in the tag is an inconsequential operation because it has no function in ensuring that the serial numbers are unique, that function is fulfilled by the EPC server. The serial number contains no information to give it any meaning outside of relationships associated with it in a database. Also, for the same reasons as described above for the '200 patent, the fact that one could pick some subset of blocks of serial numbers with common MSBs after the sequential decimal EPC codes are converted to binary is of no consequence. Thus, there is also no suggestion within the '545 patent, that allocated blocks should be assigned on the bit level.

In the '545 patent, unless all encoders receive the EPC directly from the central EPC server, there is no way to fully ensure uniqueness of the EPC. The encoding of tags performed by encoders from different assembly lines, different facilities, and different parties at different levels within the stream of commerce could not be performed unless all of these encoders were all linked to the same centralized database to receive the serial numbers. *See*, Williams Decl. ¶¶ 49-51.

Accordingly, for at least the reasons described above, neither the '200 patent nor the '545 patent disclose or suggest "wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining

bits of lesser significance that together comprise the one serial number instance," as recited in claim 1. Neither the '684 publication nor the 2006 EPC Standard cure these deficiencies of the '200 patent and the '545 patent.

Thus, the patent owner respectfully requests that the 35 U.S.C. § 103(a) rejections of claim 1 and its dependent claims 2-12 be withdrawn.

As described above, the independent claims 13 and 16 recite substantilayy similar subject matter as independent claim 1, thus, the 35 U.S.C. § 103(a) rejections of claim 13, its dependent claims 14-15, and claim 16, its dependent claims 17-20 should also be withdrawn.

Sequential Decimal Generated Blocks of Serial Numbers Do Not Align with Blocks of MSBs at Binary Level

On pages 5 and 18 of the Office Action, the Examiner provides several examples that purportedly show that it would be obvious to convert a block of decimal numbers to binary. Office Action, p. 5 and 18. The patent owner's expert has described in detail why these examples are incorrect in the context of the claimed subject matter of the '967 Patent. *See*, Williams Decl. ¶¶ 54-60. In summary, the expert has demonstrated that the examples provided by the Examiner are essentially a *post hoc* example that is attempting to shoehorn a random selection of decimal numbers into the assignment of binary bits as recited in the claims of the '967 Patent.

Thus, the examples illustrate the fallacy of the Examiner's rejection. That is, there is no suggestion within either the '200 patent or the '545 patent that serial numbers or EPC codes should be assigned at the bit level. Attempting to shoehorn various decimal numbers to fit a

binary level numbering scheme is practically the definition of impermissible hindsight. The Examiner is engaging in the faulty examples because of the teachings of the '967 Patent. This is illustrated by the fact that the examples fall apart because of the misalignment as shown by the expert. That is, if one were to use the examples of the serial numbers in decimal form as disclosed in the prior art, it simply would not work within the scheme of the claims of the '967 Patent. The entire point of the hardware-based solution provided by the '967 patent is that the assignment of the MSBs eliminates the need to be concerned with the decimal versions of the serial numbers. Neither the '200 patent nor the '545 patent disclose or suggest such a binary assignment method.

While the patent owner does not wish to engage in hyperbole, the patent owner can see no reason why one skilled in the art would take the disclosure of the sequential decimal serial numbers in the asserted references to suggest that the allocated block should be "***assigned*** a limited number of most significant bits" and "wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance," as recited in claim 1. If the Examiner were to maintain the rejection, the patent owner respectfully requests the Examiner to elaborate on the purported suggestion with the cited references concerning this issue.

Accordingly, for these additional reasons, the that the 35 U.S.C. § 103(a) rejections of claim 1, its dependent claims 2-12, claim 13, its dependent claims 14-15, and claim 16, its dependent claims 17-20, should also be withdrawn.

CONCLUSION

For the reasons set forth above, the patent owner respectfully requests that the Patent Office withdraw all the rejections of the claims and allow claims 1- 20.

Respectfully submitted,

Date: April 2 2018

By: __/Michael J. Marcin/_____
Michael J. Marcin (Reg. No. 48,198)

Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, NY 10038
Tel: (212) 619-6000
Fax: (212) 619-0276

EXHIBIT A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Ex Parte Reexaminaton of:	)	
	)	
U.S. Patent No. 9,798,967	)	
	)	
Control No.: 90/014,052	)	Group Art Unit: 3992
	)	
Filed: November 29, 2017	)	Examiner: Christina Y. Leung
	)	
For: SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS	)	
	)	
Confirmation No.: 4770	)	

DECLARATION OF CHARLES B. WILLIAMS UNDER 37 C.F.R. §1.132

I, Charles B. Williams, hereby declare as follows:

1. I have been retained by ADASA, INC. ("ADASA") as a technical expert for the above captioned reexamination. I am over twenty-one years of age and of sound mind. The facts stated herein are known to me of my own personal knowledge. If called upon, I would to testify to as to the matters stated herein and I am competent to do so.

2. I understand that this reexamination involves U.S. Patent No. 9,798,967 ("the '967 Patent" which resulted from Application 15/042,993, filed on February 12, 2016 and names Clarke W. McAllister as the sole inventor. I understand that each of the claims 1-20 of the '967 Patent is subject to reexamination. I further understand that the '967 Patent is currently assigned to ADASA.

3. I have reviewed the Office Action dated February 1, 2018 issued by the United States Patent and Trademark Office ("USPTO") in this reexamination. I understand that each of the claims of the '967 Patent is subject to two separate rejections under pre-AIA 35 U.S.C. §

103(a). The rejections are as follows:

a. Claims 1, 6-12, 16, and 20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over US 2007/0040684 Al to McAllister ("the '684 publication") in view of US 7,827,200 B2 to Rowe ("the '200 patent").

b. Claims 2-5, 13-15, and 17-19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the '684 publication in view of the '200 patent and EPCglobal Tag Data Standards, Version 1.3, March 8, 2006 ("the 2006 EPC Standard").

c. Claims 1, 6-12, 16, and 20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the '684 publication in view of US 8,373,545 B2 to Traub ("the '545 patent).

d. Claims 2-5, 13-15, and 17-19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the '684 publication in view of the '545 patent and the 2006 EPC Standard.

4. I have reviewed each of the references cited above.

5. I am familiar with the provisions of pre-AIA 35 U.S.C. § 103(a), which states:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 , if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. I have been asked to provide my opinion regarding whether or not a person of ordinary skill in the art at the time of invention defined by claims 1-20 of the '967 Patent would understand the various combinations of the above references to render these claims obvious. For the reasons set forth below, it is my opinion that a person of ordinary skill in the art would not

have found claims 1-20 of the '967 Patent to be obvious over the above combinations of references.

7. I understand that the priority date of the subject matter of claims 1-20 of the '967 Patent is May 21, 2008 and my analysis considers this date the time of invention.

QUALIFICATIONS

8. My curriculum vitae ("CV") is attached hereto as Exhibit 1 and is incorporated by reference. It sets forth the details of my educational history, work history, patents, and other related experience. A brief summary of some of my relevant background is provided below.

9. I have a BS from Dickinson College (1984), some advanced degree work at George Mason University (not completed) and numerous professional courses. I have been employed as a software engineer, holding various titles and responsibilities since 1984. I was a co-founder and CTO of epcSolutions in 2003. epcSolutions developed a RFID application and platform that I designed and architected and largely implemented. epcSolutions sold over 300 copies of our RFIDTagManager software and worked on over 50 custom RFID projects. The RFID application grew into a complete RFID platform capable of managing any type of asset with a RFID tag. In 2008, I authored a Patent Application that combined RFID with Biometric Facial Recognition for identification purposes that was granted but never issued due to non-payment of fees required to issue the patent. In 2010, epcSolutions became the sole RFID provider for iGPS and built the largest RFID track/trace system managing over 15 million reusable black plastic pallets. I have remained active in the RFID industry and I am currently building a new RFID platform based on the work I did at epcSolutions.

MY UNDERSTANDING OF OBVIOUSNESS

10. It is my understanding that a claimed invention is unpatentable if the differences between the claimed invention and the prior art are such that the subject matter as a whole would

have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains.

11. It is my understanding that "obviousness" is a question of law based on underlying factual issues including the content of the prior art and the level of skill in the art. I understand that for a combination of references to render the claimed invention obvious, there must be some reason why a person of ordinary skill in the art would have arrived at the claims by modifying, combining or otherwise applying the teachings of the applied references.

12. I also understand that when considering the obviousness of a patent claim, one should consider whether a teaching, suggesting or motivation to combine the references exists so as to avoid impermissibly applying hindsight when considering the prior art. I understand that this test should not be rigidly applied, but that the test can be important to avoiding such hindsight.

BACKGROUND OF RFID TECHNOLOGY

13. RFID technology has been in use since World War II where it was first used as Friend or Foe identification technology. The first consumer uses of RFID happened in the 1990's, where Mobile's Speedpass technology initially utilized near-field RFID. The first uses of the Electronic Product Code ("EPC") Gen2 RFID for item tracking, inventorying, warehousing, and other applications occurred in the early 2000's and began to take off when Walmart and the U.S. Department of Defense mandated their use around 2003.

14. RFID tags, or transponders, are affixed to items to identify and track those items as they move through the stream of commerce. RFID has become preferable and is slowly augmenting the prior art tagging systems, such as bar codes, because RFID can accommodate specific identification of the item to which it is affixed, rather than merely identifying items by class or type. Due to the item-specific nature of RFID tagging, a critical aspect to proper function

of RFID systems, therefore, is ensuring that every RFID transponder, throughout the entirety of the stream of commerce, is assigned a unique EPC.

15. EPC Gen2 RFID tags have a memory bank that is encoded with a tag ID of either 96 or 128 binary bits (0's and 1's) that are represented as 24 or 32 hexadecimal characters to enable humans to read them and compare with other values. The pattern of bits encoded into tags is specified in RFID tag encoding standards written and maintained by EPCGlobal under the auspices of GS1.

16. For merchandise tracking applications, the memory bank of an RFID tag is encoded with a tag ID known as an EPC, which is an identifier for an item in the supply chain to uniquely identify that particular item. The EPC can be encoded in accordance with one of various EPC tag data standards set by GS1 for a serialized identifier, such as a Serialized Global Trade Item Number ("SGTIN") number, which includes a combination of object class information and a serial number.

17. Within the object class information of the EPC, each brand owner is provided with a company prefix to identify the brand owner and an item reference code to identify the class of the items being tagged. As such, all the EPCs within a particular class for a particular brand owner will have the same object class information but will be different from other classes of items provided by that same brand owner or other classes of items from other companies. This information correlates to that of a Global Trade Item Number ("GTIN") as would be contained within a barcode. For RFID applications, this information would be written in decimal form and referred to as an unserialized identity Uniform Resource Identifier ("URI") for an EPC. For example, the unserialized identity URI of the EPC may read as:

EPC Pure URI
urn:epc:id:sgtin:012345.67890

18. A serial number is then issued for a particular item within the class of items for that brand owner as an integer in decimal form. By issuing a unique serial number for each item, the serialized EPC of each item within the class for that brand owner will be unique. However, the EPC is only truly unique if the brand owner ensures that the serial number of the EPC is unique within all the tags encoded for the class of items. The GS1 serialization guideline states that it is the brand owner's responsibility to ensure that each serial number, and therefore each EPC, is unique.

19. The serial number is then combined with the object class information from the unserialized URI to provide a serialized identity URI of an EPC (e.g., the SGTIN). The serialized identity URI of the EPC may read as:

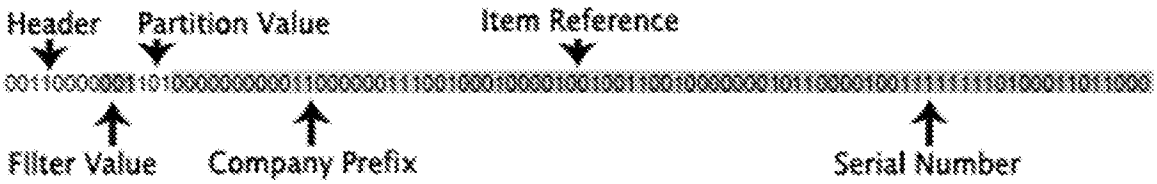
EPC Pure URI
urn:epc:id:sgtin:012345.67890.10479832

20. This serialized identity of the EPC is provided from the database to the encoder, which converts the EPC to binary format in which the bits of each field are concatenated in the proper order for the chosen format of the EPC for encoding to the RFID tag. The binary format of the EPC may be SGTIN-96, which includes 8 bits for the header identifying the EPC format, 50 bits for object class information including a filter value, partition value, company prefix, and item reference number, and 38 bits for a serial number.

A typical EPC SGTIN-96 Structure:

Header	Filter / Object Type	Partition	Company Prefix	Item Ref and Indicator	Serial
8 bits	3 bits	3 bits	20- 40 bits	24 - 4 bits	38 bits

EPC SGTIN-96 Binary



21. Typically, the process of providing the EPC to the encoder is performed by a software application that uses a database to retrieve the base values required to encode a RFID tag as well as saving the values of the generated RFID tag IDs. For some of the encoding standards, one of the fields is a serial number. The serial numbers are typically stored and tracked in the database in decimal form and can be retrieved individually or in blocks by the software that generates the tag IDs that need to be encoded into a collection of RFID tags.

22. In most cases, one serial number or a set of serial numbers is retrieved from the database at any given time, and in most cases an encoder is only encoding tags for one specific product (identified by a GTIN, which is also encoded in the object class information of the tag ID.)

23. A second process to encode RFID tags involves using a barcode scan to read a UPC, software to convert the UPC to a GTIN, use the GTIN to lookup the next serial number in the database and use those two values to encode the RFID tag. This process involves fetching one serial number at a time from the database and then updating the database with the resulting RFID tag ID.

24. Neither of these scenarios provide for disconnected or semiautonomous operation.

This means that all components of the ecosystem (reader/encoder, software application and database) must be running and connected for the encoding RFID tags to take place.

25. One of the larger challenges to using RFID to track inventory in the supply chain is item level tagging. The initial Walmart and U.S. Department of Defense RFID mandate focused on using RFID tags on cases and pallets of goods being shipped to either entity. Item level tagging places an RFID tag on every individual item, not just the cases and pallets. The benefit of item level tagging is that it allows front-of-store inventory to be done much faster as the shelves would only need to be scanned with an RFID reader and not have each item hand counted.

THE SUBJECT MATTER OF THE '967 PATENT

26. In the mid 2000's, epcSolutions and ADASA worked together on an Item Level Tagging project for Walmart Canada. The project would use epcSolutions' RFID Tag Manager software and ADASA's RFID printer encoder to achieve an item level tagging solution for Walmart Canada.

27. One of the requirements for this project was the ability to print/encode RFID item tags while disconnected from the network. To meet this requirement, ADASA developed the capability for the ADASA printer/encoder to store a block of serial numbers for multiple different products (Batch mode), as well the capability to encode independently for ad hoc items that did not have a block of reserved serial numbers (Ad Hoc mode). This Ad Hoc mode is the essence of the '967 Patent as I understand it. *See e.g.,* '967 Patent. Col. 8, lines 4-51 (hereinafter 8/4-51).

28. For Ad Hoc mode, as in accordance with the '967 Patent, the printer/encoder may be assigned a binary number having "a limited number of MSB's (Most Significant Bits)" that was unique to that printer/encoder within a company, enterprise, or location. '967 Patent 8/9-15. For items that were not the type of one of the selected classes for which blocks of serial numbers were

stored, the printer/encoder can then self-generate an EPC in SGTIN-96 format, which includes object class information read from the bar code and a serial number in which the most significant bits are assigned the unique number of that printer/encoder. '967 Patent 8/16-25. The trailing bits of the serial number utilize a first serial number of the block allocated for that printer/encoder. The count of the serial numbers of this block may then be incremented and stored in the printer/encoder's memory. For additional items of that same type that are encountered, the printer/encoder can generate an SGTIN-96 utilizing the next stored serial number in the allocated block. '967 Patent 8/27-31.

29. The benefit of Ad Hoc mode, as described in '967 Patent, is that a "[c]ontinuous wireless connection to a host database is not required for ongoing tag commissioning process." '967 Patent 7/57-59. For example, using the Ad Hoc mode, the items of unselected classes could be tagged in the front of the store or in the back of the store and the encoding would still be ensured to be unique due to the unique number assigned to the printer/encoder. If there was not an available means to uniquely encode/print tags, the items would need to be removed from the shelf and taken to a different location to be tagged or the people tagging the items would need to be able to properly place pre-printed/encoded tags on the proper items. This is time consuming and fraught with risk, as there would not be any checks and balances to ensure the correct tags were placed on the proper items.

30. Independent Claim 1 of the '967 patent recites:

> An RFID transponder comprising:
>
> a substrate;
>
> an antenna structure formed on the substrate; and
>
> an RFID integrated circuit chip which is electrically coupled to the antenna structure,

> wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,
>
> ***wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and***
>
> ***wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.***

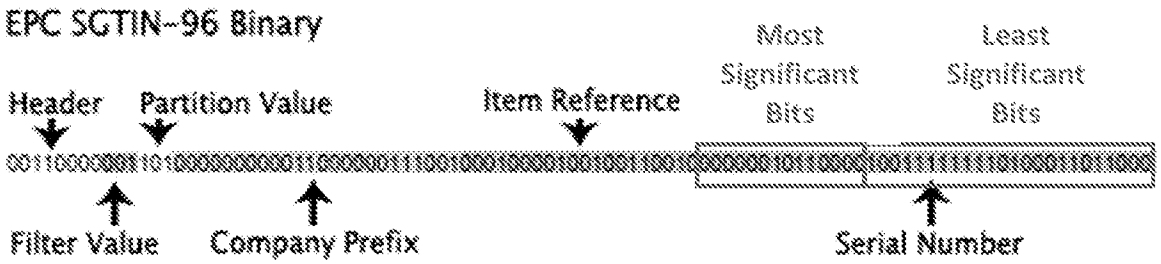
31. The other independent claims 13 and 16 of the '967 Patent recite substantially the same subject matter as recited above for claim 1.

32. Thus, as reflected in the '967 Patent and with Ad Hoc mode, the claimed invention is directed to RFID tags which are commissioned using a partitioned serial number portion of a binary representation of the EPC to ensure uniqueness of the EPC encoded in the tag without the need to maintain constant communication with a database. The partitioned serial number portion includes a first section of a limited number of most significant bits and a second section of bits of lesser significance. The most significant bits are assigned a unique string of binary bits to define a block of serial numbers to be used for a particular encoder and the second section of bits of lesser significance are generated by the encoder to complete a unique serial number. I understand this to be specifically claimed in the '967 Patent based on the above highlighted portion of claim 1.

33. This concept described in the '967 Patent of assigning the most significant bits of the serial number space for ensuring uniqueness can be applied to in-store encoding equipment (such as with Ad Hoc mode) but can also be implemented for encoders of different manufacturing lines, manufacturing facilities, distribution facilities, retail stores, and by third party encoders

across the stream of commerce.

34. An example of a partitioned serial number of an EPC comprising 14 "most significant bits" and the remaining 24 comprising the "least significant bits" according to the '967 Patent is shown below:



35. Generally, at its core, the tag encoding process is the same from the point of when the RFID tag data reaches the encoder. That is: Tag ID to encoder => encoder to chip in RFID tag. However, the way the tag ID itself is created differs greatly from system to system and this is where the hardware-based system of the claimed invention of the '967 Patent differentiates itself from the conventional methods. The partitioned serial number approach in the '967 Patent manages assignment of the serial number *at the binary bit* level, rather than sequential allocation of decimal or hexadecimal number strings from a database.

THE REFERENCES PROVIDED BY THE EXAMINER

36. I have reviewed all of the references cited by the Examiner, but the following discussion will focus on the '200 patent and the '545 patent as it is my understanding that the Examiner has asserted that these references teach the above highlighted claim language of claim 1 and the corresponding language of claims 13 and 16.

37. Prior to discussing the references individually, it may be generally stated that at the time of invention of the '967 Patent, the '200 patent and the '545 patent would have been considered the conventional manner of approaching the assignment of EPCs. Specifically, both

references divide the EPCs or the serial numbers into pools or blocks that are assigned different sites and these divisions are managed by a central database.

38. The '200 patent describes a method for managing serialization of ELECTRONIC PRODUCT CODES (EPCs). '200 Patent, Abstract.

39. Fig. 3 shows a method 300 for managing the EPCs and is described as follows:

> Method 300 can begin in step 305, where multiple pools of numbers and/or number assignment functions can be associated with values for nonserialized portions of EPCs. In step 310, a new taggable object can be identified that needs an EPC. In step 315, a classification for the new object can be determined. In step 320, an unserialized portion of the EPC can be constructed from the classification information, in step 325, a pool of numbers and/or a number assignment function associated with the unserialized portion can be identified. In step 330, a last previously allocated serial number in the identified pool can be located. In step 335, the next unallocated serial number can be extracted from the pool and used as the serialized portion of the EPC. In step 340, the new EPC can be assigned to the new taggable object. In step 345, variables associated with the pool or function used to generate the assigned number can be updated to ensure that the assigned serial number is not reassigned to a different object having the same unserialized portion of an EPC. In step 350, the assigned EPC can be encoded into an RFID tag that can be physically linked to the object.
>
> '200 patent, 6/37-58.

40. The pool of numbers referred to in the above method of the '200 patent is described as follows:

> [D]ifferent manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated. For example, a serial number generation function used by a first division can sequentially assign odd serial numbers, while a different serial number generation function used by a second division can sequentially assign even serial numbers. In another example, a first division can assign serial numbers in the range of one to a million and the second division can assign serial numbers in a range of three to four million. It should be appreciated that the different divisions can be communicatively

> linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification.
>
> '200 patent, 5/7-22.

41. Thus, the '200 patent requires that "the different divisions can be communicatively linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification." '200 Patent, 5/18-22.

42. This method of having to communicate with a central database to ensure that serial numbers are uniquely assigned is wholly different from the Ad Hoc method described and claimed by the '967 Patent. In the '200 patent, unless all encoders receive the serial number for each tag from the same database, there is no way to fully ensure uniqueness of the EPC. The encoding of tags performed by encoders from different assembly lines, different facilities, different parties at different levels within the stream of commerce could not be performed unless all of these encoders were all linked to the same centralized database to receive the serial numbers.

43. As described above, the claimed subject matter of the '967 Patent allows the encoder to be disconnected from the host database. In direct contrast, the '200 patent requires there to be a continuous connection so that serial numbers are not repeated. Thus, it is my opinion that the '200 patent does not disclose the above recited claim language of the '967 Patent.

44. Further, it is my opinion that combining the subject matter of the '200 patent with the other references provided by the Examiner, the '684 publication and the 2006 EPC Standard would not result in the claimed subject matter of the '967 Patent because any such combination of the references would still result in the system having to remain connected to a central database to ensure that unique serial numbers were being assigned.

45. The '545 patent describes an "EPC provisioning system comprising a EPC server [that] dynamically provide[s] EPC code blocks for one product to multiple client sites. The EPC server can use business rules to determine the EPC codes for the multiple client sites." '545 patent, Abstract.

46. The entirety of the '545 patent is directed to "an EPC server 402 adapted to dynamically provide EPC code blocks 404 and 406 for one product to multiple client sites. The EPC server 402 can use business rules to determine the EPC codes for the multiple client sites 408 and 410." '545 patent, 3/67 – 4/4.

47. The manner of controlling the EPC codes is "a computer implemented method using business rules to determine EPC code blocks for multiple client sites and providing the EPC code blocks to the multiple client sites." '545 patent, 4/12-15.

48. Thus, the '545 patent uses a central server that implements business rules to determine the entire EPC and issue these EPCs as a manner of managing the assignment of the EPC. In fact, the '545 patent specifically states:

> Tag writing systems can use a central authority from which they can receive unique EPCs. The EPC Provisioning Service is designed to satisfy this need. In addition to providing a service to give out unique EPCs, a design goal is also to make it easy for administrators to define and maintain pools.
>
> '545 patent, 35/14-18.

49. Similar to the '200 patent, this method of having to communicate with a central server to ensure that EPCs are uniquely assigned is wholly different from the Ad Hoc method described and claimed by the '967 Patent. In the '545 patent, unless all encoders receive the EPC directly from the central server, there is no way to fully ensure uniqueness of the EPC. The encoding of tags performed by encoders from different assembly lines, different facilities, different

parties at different levels within the stream of commerce could not be performed unless all of these encoders were all linked to the same centralized database to receive the serial numbers.

50. As described above, the claimed subject matter of the '967 Patent allows the encoder to be disconnected from the host database. In direct contrast, the '545 patent requires the central server to assign each unique EPC. Thus, it is my opinion that the '545 patent does not disclose the above recited claim language of the '967 Patent.

51. Further, it is my opinion that combining the subject matter of the '545 patent with the other references provided by the Examiner, the '684 publication and the 2006 EPC Standard would not result in the claimed subject matter of the '967 Patent because any such combination of the references would still result in the system having to remain connected to a central server to ensure that unique serial numbers were being assigned.

52. In summary, each of the references used by the Examiner require all encoders receive the EPC or serial number for each tag from the same database, as there is no other way to fully ensure uniqueness of the EPC. This is completely different from the Ad Hoc method that is described and claimed in the '967 Patent. Thus, it is my opinion that the combination of references used by the Examiner does not render the claims of the '967 Patent obvious.

53. In conclusion, none of the references cited by the Examiner disclose or suggest, "wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits" and "wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance," as recited in each of the independent claims of the '967 Patent.

TECHNICAL ERROR IN THE OFFICE ACTION

54. In reviewing the Office Action, the Examiner provides several examples that purportedly show that it would be obvious to convert a block of decimal numbers to binary. Office Action, p. 5 and 18. In one specific example, a block of one million serial numbers in decimal form is asserted to require 20 bits in binary form. Office Action, p. 5. However, it is my opinion that the examples provided by the Examiner are technically incorrect because they do not provide a proper correlation between binary numbers and decimal numbers. Specifically, the decimal numbers in such blocks would not properly align with the bits when doing such a conversion and would not solve the problem at hand when assigning numbers according to the claims of the '967 Patent.

55. The example provided on page 5 of the Office Action and expanded upon is as follows:

> Decimal: 0 to 1 million
> Hexadecimal: FFFFF (hex), which is 0 to 1,048,575 (decimal)
> Binary: FFFFF (hex) converts to 11111111111111111111 (binary)

56. This misalignment between decimal and binary would be reflected in the inability to assign a single set of binary MSBs to set off a block of decimal serial number blocks. The decimal serial number may have overlapping binary MSBs. For example, the blocks 0 to 1 million and 1 to 2 million overlap into the binary MSB space called 00001. Overlaps would also occur at each other higher boundary between decimal blocks that are divisible by 1 million, as follows:

> 0 to 999,999 (decimal): 0x00000 to 0xF423F (hex) MSB's: 00000
> 1,000,000 to 1,999,999 (decimal): 0xF4240 to 0x1E847F (hex) MSB's: 00000 and 00001
> 2,000,000 to 2,999,999(decimal): 0x1E8480 to 0x2DC6BF (hex) MSB's 00001 and 00010
> 3,000,000 to 3,999,999 (decimal): 0x2DC6C0 to 0x3D08FF (hex) MSB's: 00010 and 00011

57. These examples illustrate that the Examiner's example falls apart when subsequent blocks are assigned based on even increments 1 million (decimal). The above number blocks show that the 5-bit MSB's sometimes require more than one value to allocate numbering space to accommodate the decimal-based blocks. Therefore, mixing binary MSB block allocations with decimal numbers is like mixing apples with oranges.

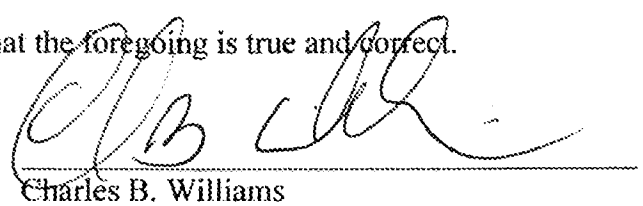
58. It is my understanding that the Examiner has provided these examples because neither the '200 patent nor the '545 patent disclose the binary bit-based number assignment as recited in the claims of the '967 Patent and the Examiner is using these examples to assert that it would be obvious to make such a conversion.

59. In my opinion, this is not correct as the decimal numbers disclosed by the references do not lend themselves to the binary bit-based number assignment recited in the claims of the '967 Patent for the reasons described above. The entire point of the hardware based solution provided by the '967 patent is that it eliminates the need for such a conversion as all assignments are based on the MSBs. Neither the '200 patent nor the '545 patent disclose or suggest such a binary assignment method or the fact that MSBs solve the conversion issue.

60. Thus, in addition to the reasons described above, it is also my opinion that the prior art references used by the Examiner that rely on generating serial numbers in decimal form and presenting the EPC to the encoder in hexadecimal form as the pure identity URI of the EPC do not render the claims of the '967 Patent obvious.

I declare under penalty of perjury that the foregoing is true and correct.

Executed: March 30, 2018.



Charles B. Williams

EXHIBIT 1

Nashua, NH
Phone 703-338-5162 (cell)
E-mail cbwilliamsva@gmail.com

Charles B. Williams

Overview

Experienced software engineer with 30+ years of experience in project management, Agile software development, software architecture, design and implementation who desires to use his customer facing and technical skills in an exciting dynamic company.

Education

1980 – 1984 Dickinson College, Carlisle, PA
BS Computer Science

Professional Experience

November 2017 – Present – Rightpoint
Contractor

- Responsible for backend design/development/implementation for a Java/Play Framework application for a medical data management application.

July 2017 – Present – rfidCollect
Chief Technology Officer

- Responsible for all software development for a RFID application to manage time out of environment for items that have temperature sensitivity.
- Responsible for technical aspects of all projects.
- Responsible for SoW development and proposal responses.

August 2014 – November 2017 – Metova Federal, LLC
Senior Software Engineer

- Responsible for growing Metova's presence and capabilities in the RFID space. Focus is on inventory tracking and asset management. Initial RFID capabilities were purchased from epcSolutions' Bankruptcy Trustee by Metova. RFID capabilities are built on the solid and proven technology base from epcSolutions. Currently working with several commercial and federal government customers to provide RFID solutions.
- Mobile application development on Android (Java) and iOS (Swift) platforms.
- Web application development in Sinatra (build on Ruby on Rails) and Rails
- Java Team Lead for SEAS Education's SEAS Reimbursement platform. Platform focuses on Medicaid claims processing and reimbursement for various school systems across the country.
- SEAS Maintenance for several VB.net web applications. Responsible for completing and tracking JIRA bug reports for SmartEval and ARM applications.
- Deployment of solutions AWS and management of AWS resources, EC2, storage, automatic scaling and other AWS components.

August 2011 – August 2014 – EBSCO Information Services
Software Architect

- Architected, desiged and implemented EIS' Production Automation

Framework. The framework is responsible for building and publishing all customer facing databases under the ebscohost.com website. Production currently processes over 20 TB of data from hundreds of different publishers worldwide. Framework is built with Automic, Inc.'s One Automation platform.

- Certified SCRUM Master Professional

October 2003 – April 2011 – epcSolutions, Inc. (no longer in business)

Chief Technology Officer

- Responsible for all engineering and pre-sales/post-sales activities for epcSolutions' RFID products. Managed a team of 15 developers to produce a suite of end-user RFID products. Closed 300+ deals, many of which included professional services for product integration with existing back-end systems. RFID products were built with **Java**, **SQL Server** and include hooks for integration to backend systems such as **Oracle Applications**, **SAP** and other **ERP/WMS** systems. The platform includes a hardware interface layer which makes extensive use of **TCP/IP Sockets/Socket Servers** to communicate with networked devices.
- Architected, Designed and Implemented RFID platform that in today's terms would be considered a **PaaS system**. System collected and analyzed RFID and other sensor based data and applied in-context business rules to the various collected data elements. Currently working on a new iteration of this platform.
- Closed task order contract with large reusable plastic pallet pool company to deploy and manage a distributed network to control the pallet supply chain. Contract value exceeded $5,000,000. Architected and implemented the system which is built with **Java**, **J2EE** and other **Java Technologies Platform** components and makes extensive use of **EDI**, **XML**, **AS2**, **SQL Server, Glassfish** and **Web 2.0** technologies.
- Closed company's initial contract worth $1,500,000 to develop and deploy a Fortune 100 company's RFID compliance platform
- Managed all technical aspects of epcSolutions' product platform including architecture, design and implementation.

February 2001 – September 2003 - Vitria Technology, Inc.

Lead Architect – Doc Switch Team

- Lead Architect for the Doc Switch Team. Responsible for overall system architecture, design, implementation, testing and documentation of the Vitria Document Switch solution. The Vitria Document Switch provides document-based Inter-Enterprise Integration (IEI) between trading partners and Enterprise Application Integration (EAI) to back office systems. Responsible for all pre-sales and post-sales technical activities for the Document Switch product. DocSwitch was built on the BusinessWare platform with integration hooks into many popular ERP/WMS systems.
- Responsible for the technical content of sales opportunities for EDI/B2B Collaboration working with the Doc Switch Team. Responsible for both pre & post sales activities, demonstrations, presentations, prototype development, project management, implementation, and documentation using the BusinessWare product family.
- Completed several projects over a 15 month period. Lead all aspects of the project including Proof of Concept, project management, system architecture, implementation, testing and documentation. Projects involved small teams of three to six people including developers/programmers, database admins, web developers and technical writers.

August 1999 – January 2001 - ObjectSpace, Inc.

Senior Systems Engineer

- Lead Proof of Concept team for developing enterprise-wide integration projects for several large clients. Lead small teams of two to three people on Proof of Concept efforts. Architected enterprise systems and worked with customers to complete the implementation and delivery of the system.
- Lead SE for the North America Sales Force. Responsible for the technical content of sales opportunities in deals working together with Account Managers. Responsible for both pre and post sales activities, demonstrations, presentations, prototype development, team building, and interviewing new SE candidates.

April 1995 – May 1999 - Template Software, Inc.

Director, Federal Pre-Sales

- Responsible for all aspects of the Federal SE Team including hiring decisions, resource planning, resource allocation, demonstration planning and design, technical presentations, and proposal responses. Moved to Federal group after building commercial team from scratch to a team of six SE's then built the Federal SE team to four.

1993 – March 1995 - Virtual Software Factory (No longer in business)

Chief Consultant

- Lead SE for the US sales force. Responsible for the technical content of sales opportunities in the United States working together with Account Managers. Responsible for both pre and post sales activities, demonstrations, presentations, and prototype development. Became second US employee and helped build the US operation to a team of eight.

Technologies

Swift, Objective-C, Android, Flex, JavaScript, Spring Framework, Atlassian Suite (JIRA, Confluence, BitBucket, HipChat), SOA, SaaS, Ruby on Rails, Ruby, Cloud Computing, RFID, GWT, Google App Engine, Vitria BusinessWare, Java, J2EE, Glassfish, WebLogic, WebSphere, JBoss, Apache Tomcat, XML, SNAP, Windows(Windows, 10, Windows7, Vista, XP), Unix, Linux, SQL, PostgreSQL, MySQL, Oracle, MS SQL Server, HTTP, XSL, XSD, EDI, B2B, Portals, Eclipse, netBeans

Patents and Publications

"Use Cases Combined With Booch/OMT/UML: Process and Products" – Prentice Hall Professional Technical Reference Series 1998

RFID & Biometric Facial Recognition – Patent approved, but abandoned (company did not pay fees to complete the patent process.)

References

Available upon request

PATENT
Attorney Docket No.: 30139/00105

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexaminaton of:	)	
	)	
U.S. Patent No. **9,798,967**	)	
	)	
Control No.: 90/014,052	)	Group Art Unit: 3992
	)	
Filed: November 29, 2017	)	Examiner: Christina Y. Leung
	)	
For: SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS	)	
	)	
Confirmation No.: 4770	)	

Mail Stop: *Ex Parte* Reexamination
Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
CERTIFICATE OF SERVICE

I hereby certify on this 16th day of February, 2018, that a true and correct copy of the **"RESPONSE TO NON-FINAL OFFICE ACTION DATED FEBRUARY 1, 2018"** filed on April 2, 2018 and attached hereto was sent by first-class mail, postage paid, to:

Hogan Lovells US LLP IP Group
Columbia Square
555 Thirteenth Street, NW
Washington, D.C. 20004

Respectfully submitted,

Date: April 2, 2018

By: ___/Michael J. Marcin/_____
Michael J. Marcin (Reg. No. 48,198)
Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, NY 10038
Tel: (212) 619-6000
Fax:(212) 619-0276

Electronic Acknowledgement Receipt

EFS ID:	32223139
Application Number:	90014052
International Application Number:	
Confirmation Number:	4770
Title of Invention:	SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS
First Named Inventor/Applicant Name:	9798967
Customer Number:	30636
Filer:	Oleg F. Kaplun/sandy gellineau
Filer Authorized By:	Oleg F. Kaplun
Attorney Docket Number:	029101.6
Receipt Date:	02-APR-2018
Filing Date:	29-NOV-2017
Time Stamp:	16:22:33
Application Type:	Reexam (Patent Owner)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		CompleteResponsetoFeb12018NFOA.pdf	1335344 db2abc0a9bee678d10a660b9099a361b5235f184	yes	47

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	1
	Amendment/Req. Reconsideration-After Non-Final Reject	2	25
	Miscellaneous Incoming Letter	26	42
	Miscellaneous Incoming Letter	43	46
	Reexam Change in Pwr Atty for Third Party Requester	47	47

Warnings:	
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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent No.	:	9,798,967
Control No.	:	90/014,052
Filed	:	November 29, 2017
Title	:	Systems, Methods, And Devices For Commissioning Wireless Sensors
Group Art Unit	:	3992
Confirmation No.	:	4770
Examiner	:	Christina Y. Leung

Mail Stop: Mail Stop: Ex-Parte Reexamination
Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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Alexandria, VA 22313-1450
571-273-8300

By: Date: April 2, 2018
Michael J. Marcin (Reg. No. 48,198)

TRANSMITTAL

Transmitted herewith please find a Response to the Non-Final Office Action mailed on February 1, 2018 and a Certificate of Service for filing in the above-identified application. No fees are believed to be required. However, the Commissioner is hereby authorized to charge any additional required fees to the Deposit Account of **Fay Kaplun & Marcin, LLP No. 50-1492.**

Respectfully submitted,

Dated: April 2, 2018

By:_____
Michael J. Marcin, Reg. No. 48,198

Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, New York 10038
Tel: (212) 619-6000
Fax: (212) 619-0276

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PATENT
Attorney Docket No.: 30139/00105

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexaminaton of:	
U.S. Patent No. **9,798,967**	
Control No.: 90/014,052	Group Art Unit: 3992
Filed: November 29, 2017	Examiner: Christina Y. Leung
For: SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS	
Confirmation No.: 4770	

Mail Stop: *Ex Parte* Reexamination
Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PATENT OWNER'S INTERVIEW SUMMARY IN *EX PARTE* REEXAMINATION PURSUANT TO 37 CFR 1.560

Dear Sir:

The patent owner conducted an Examiner Interview in the above-referenced *ex parte* reexamination on January 16, 2018. The following is the patent owner's statement of the interview as required by 37 CFR 1.560.

PAGE 3/5 * RCVD AT 2/16/2018 4:40:03 PM [Eastern Standard Time] * SVR:W-PTOFAX-001/42 * DNIS:2738300 * CSID:2126190276 * DURATION (mm-ss):00-57

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REMARKS

Original patent claims 1 – 20 remain unchanged and are now pending in the above-referenced *ex parte* reexamination.

The patent under reexamination, U.S. Patent No. 9,798,967 ("the '967 patent") has been asserted in a proceeding captioned *Adasa Inc. v. Avery Dennison Corporation*, 6:17-cv-01685 (D. OR).

The interview was conducted telephonically on January 16, 2018 and the participants were as follows:

Michael Marcin (48,198) – Patent Owner Representative

Christina Y. Leung – USPTO and Examiner in this proceeding

The sole purpose of the interview was for the patent owner to waive its right to file a Patent Owner's statement under 37 CFR 1.530 in response to the Order.

Respectfully submitted,

Date: February 16, 2018

By: _____
Michael J. Marcin (Reg. No. 48,198)

Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, NY 10038
Tel: (212) 619-6000
Fax: (212) 619-0276

PAGE 4/5 * RCVD AT 2/16/2018 4:40:03 PM [Eastern Standard Time] * SVR:W-PTOFAX-001/42 * DNIS:2738300 * CSID:2126190276 * DURATION (mm-ss):00-57

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PATENT
Attorney Docket No.: 30139/00105

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexaminaton of:	)	
	)	
U.S. Patent No. **9,798,967**	)	
	)	
Control No.: 90/014,052	)	Group Art Unit: 3992
	)	
Filed: November 29, 2017	)	Examiner: Christina Y. Leung
	)	
For: SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS	)	
	)	
Confirmation No.: 4770	)	

Mail Stop: *Ex Parte* Reexamination
Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
CERTIFICATE OF SERVICE

I hereby certify on this 16th day of February, 2018, that a true and correct copy of the **"PATENT OWNER'S INTERVIEW SUMMARY IN EX PARTE REEXAMINATION PURSUANT TO 37 CFR 1.560"** filed on February 16, 2018 and attached hereto was sent by first-class mail, postage paid, to:

Hogan Lovells US LLP IP Group
Columbia Square
555 Thirteenth Street, NW
Washington, D.C. 20004

Respectfully submitted,

Date: February 16, 2018 By: _____

Michael J. Marcin (Reg. No. 48,198)
Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, NY 10038
Tel: (212) 619-6000
Fax:(212) 619-0276

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FAY KAPLUN & MARCIN, LLP
INTELLECTUAL PROPERTY LAW

150 BROADWAY, SUITE 702
NEW YORK, NEW YORK 10038
PHONE: (212) 619-6000
FAX: (212) 619-0276
WWW.FKMIPLAW.COM

FACSIMILE COVER SHEET

FAX NO	:	(571) 273-8300
TO	:	Commissioner for Patents Attention: Examiner Christina Y. Leung
FROM	:	Michael J. Marcin, Esq. of Fay Kaplun & Marcin, LLP
DATE	:	February 16, 2018
SUBJECT	:	Ex-Parte Reexamination U.S. Patent Control. No. 90/014,052 of 9,798,967 for *Systems, Methods, And Devices For Commissioning Wireless Sensor* Our Ref.: 30139/00105

NUMBER OF PAGES INCLUDING COVER: 5

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Please see attached.

Thank you.

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Attorney Docket No. 30139/00105

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Filed	:	November 29, 2017
Title	:	Systems, Methods, And Devices For Commissioning Wireless Sensors
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By: Date: February 16, 2018
Michael J. Marcin (Reg. No. 48,198)

TRANSMITTAL

Transmitted herewith please find a Patent Owner's Interview Summary In Ex-Parte Reexamination under 37 C.F.R. 1.560 and a Certificate of Service for filing in the above-identified application. No fees are believed to be required. However, the Commissioner is hereby authorized to charge any additional required fees to the Deposit Account of **Fay Kaplun & Marcin, LLP No. 50-1492**.

Respectfully submitted,

Dated: February 16, 2018

By: _____
Michael J. Marcin, Reg. No. 48,198

Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, New York 10038
Tel: (212) 619-6000
Fax: (212) 619-0276

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
90/014,052	11/29/2017	9798967	029101.6	4770

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FAY KAPLUN & MARCIN, LLP
150 BROADWAY, SUITE 702
NEW YORK, NY 10038

EXAMINER
LEUNG, CHRISTINA Y

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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EX PARTE REEXAMINATION COMMUNICATION TRANSMITTAL FORM

REEXAMINATION CONTROL NO. *90/014,052*.

PATENT NO. *9798967*.

ART UNIT *3992*.

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above identified *ex parte* reexamination proceeding (37 CFR 1.550(f)).

Where this copy is supplied after the reply by requester, 37 CFR 1.535, or the time for filing a reply has passed, no submission on behalf of the *ex parte* reexamination requester will be acknowledged or considered (37 CFR 1.550(g)).

Office Action in Ex Parte Reexamination	Control No. 90/014,052	Patent Under Reexamination 9798967	
	Examiner Christina Y. Leung	Art Unit 3992	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

a. ☒ Responsive to the communication(s) filed on *November 29, 2017* .
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

b. ☐ This action is made FINAL.

c. ☒ A statement under 37 CFR 1.530 has not been received from the patent owner.

A shortened statutory period for response to this action is set to expire *2* month(s) from the mailing date of this letter. Failure to respond within the period for response will result in termination of the proceeding and issuance of an *ex parte* reexamination certificate in accordance with this action. 37 CFR 1.550(d). **EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.550(c).** If the period for response specified above is less than thirty (30) days, a response within the statutory minimum of thirty (30) days will be considered timely.

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ☐ Notice of References Cited by Examiner, PTO-892.
2. ☐ Information Disclosure Statement, PTO/SB/08.
3. ☒ Interview Summary, PTO-474.
4. ☐ _____.

Part II SUMMARY OF ACTION

1a. ☒ Claims *1-20* are subject to reexamination.
1b. ☐ Claims _____ are not subject to reexamination.
2. ☐ Claims _____ have been canceled in the present reexamination proceeding.
3. ☐ Claims _____ are patentable and/or confirmed.
4. ☒ Claims *1-20* are rejected.
5. ☐ Claims _____ are objected to.
6. ☐ The drawings, filed on _____ are acceptable.
7. ☐ The proposed drawing correction, filed on _____ has been (7a) ☐ approved (7b) ☐ disapproved.
8. ☐ Acknowledgment is made of the priority claim under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the certified copies have
   1 ☐ been received.
   2 ☐ not been received.
   3 ☐ been filed in Application No. _____ .
   4 ☐ been filed in reexamination Control No. _____.
   5 ☐ been received by the International Bureau in PCT application No. _____.
   * See the attached detailed Office action for a list of the certified copies not received.
9. ☐ Since the proceeding appears to be in condition for issuance of an *ex parte* reexamination certificate except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte* Quayle, 1935 C.D. 11, 453 O.G. 213.
10. ☐ Other: _____

cc: Requester (if third party requester)

DETAILED ACTION

Reexamination

1. On December 20, 2017, *ex parte* reexamination was ordered for claims 1-20 (all claims) of US 9,798,967 B2 ("967 Patent"). **Claims 1-20** (all claims) of 967 Patent are being reexamined in this proceeding.

2. On January 16, 2018, Patent Owner (PO) informed Examiner that PO waives the right to file a PO Statement under 37 CFR 1.530 in response to the Order.

References and Documents Cited in this Action

967 Patent (US 9,798,967 B2)

684 Publication (US 2007/0040684 A1 to McAllister)

200 Patent (US 7,827,200 B2 to Rowe)

545 Patent (US 8,373,545 B2 to Traub)

2006 EPC Standard (EPCglobal Tag Data Standards, Version 1.3, March 8, 2006)

3PR Request (request for *ex parte* reexamination filed by Third-Party Requester [3PR] on November 29, 2017)

Parent Applications and Effective Filing Date

3. 967 Patent issued on October 24, 2017 from application 15/042,993 filed on February 12, 2016, which is a continuation of parent application 13/526,520 filed on June 19, 2012. 13/526,520 is a continuation-in-part of 12/820,109, filed on June 21, 2010, which is a continuation-in-part of 11/465,712, filed on August 18, 2006, and a continuation-in-part of 12/124,768, filed on May 21, 2008. 967 Patent also claims priority to two provisional applications: 60/709,713, filed on August 19, 2005; and 60/939,603, filed on May 22, 2007.

4. A review of the specifications of these applications indicates that 12/124,768, filed on May 21, 2008, appears to be the earliest disclosure that contains support for the claimed limitations directed to a unique object number (e.g., including a unique serial number space encoded with one serial number instance from an allocated block of serial numbers that is assigned a limited number of most significant bits). Therefore, the effective filing date of claims 1-20 (all claims) in 967 Patent is May 21, 2008.

5. Furthermore, the present application is being examined under the pre-AIA first to invent provisions.

Summary of Rejections

6. Claims 1-20 are each rejected twice under 35 U.S.C. 103 as follows.

Claims 1, 6-12, 16, and 20 are rejected under 35 U.S.C. 103 as being unpatentable over 684 Publication in view of 200 Patent.

Claims 2-5, 13-15, and 17-19 are rejected under 35 U.S.C. 103 as being unpatentable over 684 Publication in view of 200 Patent and 2006 EPC Standard.

Claims 1, 6-12, 16, and 20 are rejected under 35 U.S.C. 103 as being unpatentable over 684 Publication in view of 545 Patent.

Claims 2-5, 13-15, and 17-19 are rejected under 35 U.S.C. 103 as being unpatentable over 684 Publication in view of 545 Patent and 2006 EPC Standard.

Claim Rejections - 35 USC § 103

7. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made

to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. **Claims 1, 6-12, 16, and 20** are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over **684 Publication** in view of **200 Patent**.

Regarding **claim 1**, 684 Publication discloses an RFID transponder 50 (Figures 2 and 3; paragraphs [0003]-[0004], [0041], and [0049]) comprising:

a substrate 58 (paragraph [0049]);

an antenna structure formed on the substrate (i.e., antenna layer 54; paragraph [0049]); and

an RFID integrated circuit chip 56, which is electrically coupled to the antenna structure (paragraph [0049]),

wherein the RFID integrated circuit chip is encoded with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

However, 200 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag 104 with a unique object number (i.e., an Electronic Product

Code [EPC] identifier 110; Figure 1; column 1, lines 12-46; and column 3, lines 19-29). 200 Patent further teaches that the unique object number comprises an object class information space (i.e., Object Class in Non Serialized Portion 112) and a unique serial number space (i.e., Serial Number in Serialized Portion 114; Figure 1; column 3, lines 56-67; and column 4, lines 1-12).

200 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance. More specifically, 200 Patent teaches that for example, 25 bits can be allocated to the serial number (column 6, lines 3-8) and that

> "In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated....In another example, a first division can assign serial numbers in the range of one to a million and a second division can assign serial numbers in a range of three to four million."

See column 5, lines 7-22. It would be well understood in the art that a block of one million serial numbers would require 20 bits in binary, and that in a serial number space having a total of 25 bits (such as taught by 200 Patent), a first block of numbers from 0 to about 1,000,000 (decimal) would be expressed as binary numbers 00000000000000000000000000 to about 00000111111111111111111111. Another block of a million serial numbers can be expressed as binary numbers 00011000000000000000000000 to 00011111111111111111111111. Therefore, 200 Patent teaches that an allocated block or range of serial numbers is assigned a limited number of most significant bits (e.g., when the serial number space has 25 bits in all, the five

most significant bits, e.g., "00000," "00011," etc., correspond to a particular block containing about a million serial numbers and therefore correspond to a particular manufacturer division as taught by 200 Patent). 200 Patent further teaches that the limited number of most significant bits (e.g., the five most significant bits) and the remaining bits of lesser significance (e.g., the 20 least significant bits) comprise the one serial number instance having 25 bits in all.

Regarding claim 1, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 200 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

Regarding **claim 6**, in the system suggested by 684 Publication in view of 200 Patent, 200 Patent further teaches that the allocated block is defined by at least 3 most significant bits (e.g., five most significant bits, in the example discussed above with regard to claim 1).

Regarding **claim 7**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 200 Patent teaches a plurality of allocations associated with different manufacturer divisions as discussed above with regard to claim 1. 200 Patent further teaches that the allocated block is one of a plurality of allocations intermittently received by an encoder at least in the sense that 200 Patent teaches that encoders in different manufacturing divisions are "linked to a centralized system that assigns serial numbers" (200 Patent, column 5, lines 18-22) and each

encoder identifies its corresponding pool or block of allocated numbers, then encodes serial numbers from that pool (i.e., steps 325, 335, and 350 in Figure 3; column 6, lines 37-58).

Regarding **claim 8**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses that the RFID integrated circuit chip is comprised of silicon (paragraphs [0005]-[0006]).

Regarding **claim 9**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses that the RFID integrated circuit chip is comprised of polymer (paragraphs [0005]-[0006]).

Regarding **claim 10**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses that the substrate 58, antenna structure 54, and RFID integrated circuit chip 56 are covered by a face stock material 51 (Figure 3; paragraph [0049]).

Regarding **claim 11**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses that the RFID integrated circuit chip 56 is disposed on the substrate 58 (Figure 3; paragraph [0049]).

Regarding **claim 12**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 200 Patent teaches a plurality of allocations associated with different manufacturer divisions as discussed above with regard to claim 1. 200 Patent further teaches that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 200 Patent teaches that encoders in different manufacturing divisions are "linked to a centralized system that assigns serial numbers" (200 Patent, column 5, lines 18-22) and each encoder identifies its

corresponding pool or block of allocated numbers, then encodes serial numbers from that pool (i.e., steps 325, 335, and 350 in Figure 3; column 6, lines 37-58). As discussed above with regard to claim 1, the limited number of most significant bits taught by 200 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different manufacturer divisions that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 200 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

Regarding **claim 16**, 684 Publication discloses an integrated circuit (Figures 2 and 3, paragraphs [0003]-[0004], [0041], and [0049]), comprising:

a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator; control logic; and a memory (i.e., 684 Publication discloses passive RFID transponders that backscatter a return link signal including a radio frequency circuit, control logic, and memory; paragraphs [0003]-[0004]);

wherein the memory is configured with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited

number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

However, 200 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag 104 with a unique object number (i.e., an Electronic Product Code [EPC] identifier 110; Figure 1; column 1, lines 12-46; and column 3, lines 19-29). 200 Patent further teaches that the unique object number comprises an object class information space (i.e., Object Class in Non Serialized Portion 112) and a unique serial number space (i.e., Serial Number in Serialized Portion 114; Figure 1; column 3, lines 56-67; and column 4, lines 1-12).

200 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance. More specifically, 200 Patent teaches that for example, 25 bits can be allocated to the serial number (column 6, lines 3-8) and that

"In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated….In another example, a first division can assign serial numbers in the range of one to a million and a second division can assign serial numbers in a range of three to four million."

See column 5, lines 7-22. It would be well understood in the art that a block of one million serial numbers would require 20 bits in binary, and that in a serial number space having a total of 25 bits (such as taught by 200 Patent), a first block of numbers from 0 to about 1,000,000

(decimal) would be expressed as binary numbers 00000000000000000000000000 to about 00000111111111111111111111. Another block of a million serial numbers can be expressed as binary numbers 00011000000000000000000000 to 00011111111111111111111111. Therefore, 200 Patent teaches that an allocated block or range of serial numbers is assigned a limited number of most significant bits (e.g., when the serial number space has 25 bits in all, the five most significant bits, e.g., "00000," "00011," etc., correspond to a particular block containing about a million serial numbers and therefore correspond to a particular manufacturer division as taught by 200 Patent). 200 Patent further teaches that the limited number of most significant bits (e.g., the five most significant bits) and the remaining bits of lesser significance (e.g., the 20 least significant bits) comprise the one serial number instance having 25 bits in all.

Regarding claim 16, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 200 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

Regarding **claim 20**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 200 Patent teaches a plurality of allocations associated with different manufacturer divisions as discussed above with regard to claim 1. 200 Patent further teaches that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 200 Patent teaches that

encoders in different manufacturing divisions are "linked to a centralized system that assigns serial numbers" (200 Patent, column 5, lines 18-22) and each encoder identifies its corresponding pool or block of allocated numbers, then encodes serial numbers from that pool (i.e., steps 325, 335, and 350 in Figure 3; column 6, lines 37-58). As discussed above with regard to claim 16, the limited number of most significant bits taught by 200 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different manufacturer divisions that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 200 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

9. **Claims 2-5, 13-15, and 17-19** are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over **684 Publication** in view of **200 Patent** and **2006 EPC Standard**.

Regarding **claims 2-5 and 17-19**, 684 Publication in view of 200 Patent suggests a system as discussed above with regard to claim 1 or claim 16, including a unique object number comprising an Electronic Product Codes (EPC) identifier 100 with an object class information space (i.e., Object Class in Non Serialized Portion 112) as taught by 200 Patent (Figure 1; column 1, lines 12-46; and column 3, lines 19-29).

684 Publication in view of 200 Patent does not specifically teach that the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value; that the unique object number is a portion of a serialized

global trade item number, wherein the serialized global trade item number is an EPC SGTIN-96 encoding; or that the unique serial number space is at least 38 bits.

However, 2006 EPC Standard teaches a system that is related to the one described by 684 Publication in view of 200 Patent, including RFID tags having associated EPCs (2006 EPC Standard, page 8). 2006 EPC Standard further teaches that the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value; that the unique object number is a portion of a serialized global trade item number, wherein the serialized global trade item number is an EPC SGTIN-96 encoding; and that the unique serial number space is at least 38 bits. (2006 EPC Standard, pages 25-26). Regarding claims 2-5 and 17-19, it would have been obvious to provide an object class information space and a serialized global trade item number as taught by 2006 EPC Standard, in the RFID transponder suggested by 684 Publication in view of 200 Patent, in order to provide standardized identification information about the tagged object that can be universally read and understood.

Regarding **claim 13**, 684 Publication discloses an RFID transponder 50 (Figures 2 and 3; paragraph [0041]) comprising:

a substrate 58 (paragraph [0049]);

an antenna structure formed on the substrate (i.e., antenna layer 54; paragraph [0049]); and

an RFID integrated circuit chip 56, which is electrically coupled to the antenna structure (paragraph [0049]),

wherein the RFID integrated circuit chip is encoded with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block.

However, 200 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag 104 with a unique object number (i.e., an Electronic Product Code [EPC] identifier 110; Figure 1; column 1, lines 12-46; and column 3, lines 19-29). 200 Patent further teaches that the unique object number comprises an object class information space (i.e., Object Class in Non Serialized Portion 112) and a unique serial number space (i.e., Serial Number in Serialized Portion 114; Figure 1; column 3, lines 56-67; and column 4, lines 1-12).

200 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block. More specifically, 200 Patent teaches that for example, 25 bits can be allocated to the serial number (column 6, lines 3-8) and that

"In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of

unassigned numbers to ensure that unique serial numbers are always generated….In another example, a first division can assign serial numbers in the range of one to a million and a second division can assign serial numbers in a range of three to four million."

See column 5, lines 7-22. It would be well understood in the art that a block of one million serial numbers would require 20 bits in binary, and that in a serial number space having a total of 25 bits (such as taught by 200 Patent), a first block of numbers from 0 to about 1,000,000 (decimal) would be expressed as binary numbers 00000000000000000000000000 to about 00000111111111111111111111. Another block of a million serial numbers can be expressed as binary numbers 00011000000000000000000000 to 00011111111111111111111111. Therefore, 200 Patent teaches that an allocated block or range of serial numbers is assigned a limited number of most significant bits (e.g., when the serial number space has 25 bits in all, the five most significant bits, e.g., "00000," "00011," etc., correspond to a particular block containing about a million serial numbers and therefore correspond to a particular manufacturer division as taught by 200 Patent). 200 Patent further teaches that wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block (e.g., five most significant bits in the example above).

Regarding claim 13, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 200 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

Further regarding claim 13, 684 Publication in view of 200 Patent does not further suggest a global trade item number or that the object class information space includes a block of at least 50 bits and the unique serial number space includes a block of at least 38 bits.

However, 2006 EPC Standard teaches a system that is related to the one described by 684 Publication in view of 200 Patent, including RFID tags having associated EPCs (2006 EPC Standard, page 8). 2006 EPC Standard further teaches a global trade item number or that the object class information space includes a block of at least 50 bits and the unique serial number space includes a block of at least 38 bits (2006 EPC Standard, pages 25-26). Regarding claims 13, it would have been obvious to provide a global trade item number, an object class information space of at least 50 bits, and a unique serial number space of at least 38 bits as taught by 2006 EPC Standard, in the RFID transponder suggested by 684 Publication in view of 200 Patent, in order to provide standardized identification information about the tagged object that can be universally read and understood.

Regarding **claim 14**, in the system suggested by 684 Publication in view of 200 Patent and 2006 EDC Standard, 200 Patent further teaches that the unique serial number space further comprises remaining bits of lesser significance (e.g., the 20 least significant bits) that together with the at least 3 most significant bits (e.g., the five most significant bits) comprise the one serial number instance (having 25 bits in all in the example discussed above with regard to claim 13).

Regarding **claim 15**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 200 Patent teaches a plurality of allocations associated with different manufacturer

divisions as discussed above with regard to claim 13. 200 Patent further teaches that the at least 3 most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 200 Patent teaches that encoders in different manufacturing divisions are "linked to a centralized system that assigns serial numbers" (200 Patent, column 5, lines 18-22) and each encoder identifies its corresponding pool or block of allocated numbers, then encodes serial numbers from that pool (i.e., steps 325, 335, and 350 in Figure 3; column 6, lines 37-58). As discussed above with regard to claim 13, the at least 3 most significant bits taught by 200 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different manufacturer divisions that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 200 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced by different manufacturer divisions as taught by 200 Patent.

10. **Claims 1, 6-12, 16, and 20** are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over **684 Publication** in view of **545 Patent**.

Regarding **claim 1**, 684 Publication discloses an RFID transponder 50 (Figures 2 and 3; paragraphs [0003]-[0004], [0041], and [0049]) comprising:

a substrate 58 (paragraph [0049]);

an antenna structure formed on the substrate (i.e., antenna layer 54; paragraph [0049]); and

an RFID integrated circuit chip 56, which is electrically coupled to the antenna structure (paragraph [0049]),

wherein the RFID integrated circuit chip is encoded with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

However, 545 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag with a unique object number (i.e., RFID tags 420-426 with EPC codes 412-418; Figure 4A; column 1, lines 20-38; column 3, lines 34-39). 545 Patent further teaches that the unique object number comprises an object class information space (including a Stock Keeping Unit [SKU] or "product id" in an EPC code as shown in Figure 4B; column 1, lines 32-38) and a unique serial number space (i.e., "serial number" in an EPC code as shown in Figure 4B).

545 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises

the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance. More specifically, 545 Patent teaches that EPC server 402 dynamically provides EPC code blocks 404 and 406 to multiple client sites 408 that encode EPC codes from the blocks onto the RFID tags (Figure 4A; column 3, lines 34-39; and column 4, lines 5-12). 545 Patent further teaches that for example, 45 million total available EPC codes can be divided into blocks or pools of about five or ten million EPC codes (e.g., from ten to fifteen million or from 30 to 40 million; Figures 13E-G).

It would be well understood in the art that a 45 million serial numbers would require 26 bits in binary and a block of one million serial numbers would require 20 bits in binary. In a serial number space having a total of 26 bits (such as taught by 545 Patent), a block of numbers from 0 to about 1,000,000 (decimal) would be expressed as binary numbers 00000000000000000000000000 to about 00000011111111111111111111. An exemplary block of numbers from about 10,000,000 to about 15,000,000 (decimal) would be expressed as binary numbers from about 00101000000000000000000000 to about 00111100000000000000000000. Another exemplary block of numbers from about 30,000,000 to about 40,000,000 (decimal) would be expressed as binary numbers from about 01111000000000000000000000 to about 10100000000000000000000000. Therefore, 545 Patent teaches that an allocated block or range of serial numbers is assigned a limited number of most significant bits (e.g., when the serial number space has 26 bits in all, the six most significant bits, e.g., "000000," "001010," etc., correspond to a particular block containing over a million serial numbers and therefore correspond to a particular client site as taught by 545 Patent). 545 Patent further teaches that the

limited number of most significant bits (e.g., the six most significant bits) and the remaining bits of lesser significance (e.g., the 20 least significant bits) comprise the one serial number instance having 26 bits in all.

Regarding claim 1, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 545 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Regarding **claim 6**, in the system suggested by 684 Publication in view of 545 Patent, 545 Patent further teaches that the allocated block is defined by at least 3 most significant bits (e.g., six most significant bits, in the example discussed above with regard to claim 1).

Regarding **claim 7**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 545 Patent teaches a plurality of allocations associated with different client sites as discussed above with regard to claim 1. 545 Patent further teaches that the allocated block is one of a plurality of allocations intermittently received by an encoder at least in the sense that 545 Patent teaches that encoders in different client sites receive corresponding pools of allocated numbers from an EPC provisioning server 402, then encode serial numbers from that pool (Figure 4A; column 3, lines 34-67; column 4, lines 1-19).

Regarding **claim 8**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses that the RFID integrated circuit chip is comprised of silicon (paragraphs [0005]-[0006]).

Regarding **claim 9**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses that the RFID integrated circuit chip is comprised of polymer (paragraphs [0005]-[0006]).

Regarding **claim 10**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses that the substrate 58, antenna structure 54, and RFID integrated circuit chip 56 are covered by a face stock material 51 (Figure 3; paragraph [0049]).

Regarding **claim 11**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses that the RFID integrated circuit chip 56 is disposed on the substrate 58 (Figure 3; paragraph [0049]).

Regarding **claim 12**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 545 Patent teaches a plurality of allocations associated with different client sites as discussed above with regard to claim 1. 545 Patent further teaches that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 545 Patent teaches that encoders in different client sites receive corresponding pools of allocated numbers from an EPC provisioning server 402, then encode serial numbers from that pool (Figure 4A; column 3, lines 34-67; column 4, lines 1-19). As discussed above with regard to claim 1, the limited number of most significant bits taught by 545 Patent correspond to blocks of allocated numbers, which in turn

correspond to the encoders in the different client sites that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 545 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Regarding **claim 16**, 684 Publication discloses an integrated circuit (Figures 2 and 3, paragraphs [0003]-[0004], [0041], and [0049]), comprising:

a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator; control logic; and a memory (i.e., 684 Publication discloses passive RFID transponders that backscatter a return link signal including a radio frequency circuit, control logic, and memory; paragraphs [0003]-[0004]);

wherein the memory is configured with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

However, 545 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag with a unique object number (i.e., RFID tags 420-426 with EPC codes 412-418; Figure 4A; column 1, lines 20-38; column 3, lines 34-39). 545 Patent further teaches that the unique object number comprises an object class information space (including a Stock Keeping Unit [SKU] or "product id" in an EPC code as shown in Figure 4B; column 1, lines 32-38) and a unique serial number space (i.e., "serial number" in an EPC code as shown in Figure 4B).

545 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance. More specifically, 545 Patent teaches that EPC server 402 dynamically provides EPC code blocks 404 and 406 to multiple client sites 408 that encode EPC codes from the blocks onto the RFID tags (Figure 4A; column 3, lines 34-39; and column 4, lines 5-12). 545 Patent further teaches that for example, 45 million total available EPC codes can be divided into blocks or pools of about five or ten million EPC codes (e.g., from ten to fifteen million or from 30 to 40 million; Figures 13E-G).

It would be well understood in the art that a 45 million serial numbers would require 26 bits in binary and a block of one million serial numbers would require 20 bits in binary. In a serial number space having a total of 26 bits (such as taught by 545 Patent), a block of numbers from 0 to about 1,000,000 (decimal) would be expressed as binary numbers

000000000000000000000000 to about 000000111111111111111111. An exemplary block of numbers from about 10,000,000 to about 15,000,000 (decimal) would be expressed as binary numbers from about 001010000000000000000000000 to about 001111000000000000000000000. Another exemplary block of numbers from about 30,000,000 to about 40,000,000 (decimal) would be expressed as binary numbers from about 011110000000000000000000000 to about 101000000000000000000000000. Therefore, 545 Patent teaches that an allocated block or range of serial numbers is assigned a limited number of most significant bits (e.g., when the serial number space has 26 bits in all, the six most significant bits, e.g., "000000," "001010," etc., correspond to a particular block containing over a million serial numbers and therefore correspond to a particular client site as taught by 545 Patent). 545 Patent further teaches that the limited number of most significant bits (e.g., the six most significant bits) and the remaining bits of lesser significance (e.g., the 20 least significant bits) comprise the one serial number instance having 26 bits in all.

Regarding claim 16, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 545 Patent, in the RFID transponder disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Regarding **claim 20**, in the system suggested by 684 Publication in view of 545 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 545 Patent teaches a plurality of allocations associated with different client sites as

discussed above with regard to claim 16. 545 Patent further teaches that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 545 Patent teaches that encoders in different client sites receive corresponding pools of allocated numbers from an EPC provisioning server 402, then encode serial numbers from that pool (Figure 4A; column 3, lines 34-67; column 4, lines 1-19). As discussed above with regard to claim 16, the limited number of most significant bits taught by 545 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different client sites that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 545 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

11. **Claims 2-5, 13-15, and 17-19** are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over **684 Publication** in view of **200 Patent** and **2006 EPC Standard**.

Regarding **claims 2-5 and 17-19**, 684 Publication in view of 545 Patent suggests a system as discussed above with regard to claim 1 or claim 16, including a unique object number comprising an Electronic Product Codes (EPC) identifier 100 with an object class information space as taught by 545 Patent (including a Stock Keeping Unit [SKU] or "product id" in an EPC code as shown in Figure 4B; column 1, lines 32-38).

684 Publication in view of 545 Patent does not specifically teach that the object class information space is encoded with information comprising a company prefix, an item reference,

a partition value, and a filter value; that the unique object number is a portion of a serialized global trade item number, wherein the serialized global trade item number is an EPC SGTIN-96 encoding; or that the unique serial number space is at least 38 bits.

However, 2006 EPC Standard teaches a system that is related to the one described by 684 Publication in view of 545 Patent, including RFID tags having associated EPCs (2006 EPC Standard, page 8). 2006 EPC Standard further teaches that the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value; that the unique object number is a portion of a serialized global trade item number, wherein the serialized global trade item number is an EPC SGTIN-96 encoding; and that the unique serial number space is at least 38 bits. (2006 EPC Standard, pages 25-26). Regarding claims 2-5 and 17-19, it would have been obvious to provide an object class information space and a serialized global trade item number as taught by 2006 EPC Standard, in the RFID transponder suggested by 684 Publication in view of 545 Patent, in order to provide standardized identification information about the tagged object that can be universally read and understood.

Regarding **claim 13**, 684 Publication discloses an RFID transponder 50 (Figures 2 and 3; paragraph [0041]) comprising:

a substrate 58 (paragraph [0049]);

an antenna structure formed on the substrate (i.e., antenna layer 54; paragraph [0049]); and

an RFID integrated circuit chip 56, which is electrically coupled to the antenna structure (paragraph [0049]),

wherein the RFID integrated circuit chip is encoded with a unique object number (e.g., specific information associated with a specific object so that the specific object is associated with a unique RFID transponder; paragraph [0003]).

684 Publication generally discloses a unique object number but does not specifically disclose that the unique object number comprises an object class information space and a unique serial number space, wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block.

However, 545 Patent teaches a system that is related to the one disclosed by 684 Publication, including an RFID tag with a unique object number (i.e., RFID tags 420-426 with EPC codes 412-418; Figure 4A; column 1, lines 20-38; column 3, lines 34-39). 545 Patent further teaches that the unique object number comprises an object class information space (including a Stock Keeping Unit [SKU] or "product id" in an EPC code as shown in Figure 4B; column 1, lines 32-38) and a unique serial number space (i.e., "serial number" in an EPC code as shown in Figure 4B).

545 Patent further teaches that the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block. More specifically, 545 Patent teaches that EPC server 402 dynamically provides EPC code blocks 404 and 406 to multiple client sites 408 that encode EPC codes from the blocks onto the RFID tags (Figure 4A; column

3, lines 34-39; and column 4, lines 5-12). 545 Patent further teaches that for example, 45 million total available EPC codes can be divided into blocks or pools of about five or ten million EPC codes (e.g., from ten to fifteen million or from 30 to 40 million; Figures 13E-G).

It would be well understood in the art that a 45 million serial numbers would require 26 bits in binary and a block of one million serial numbers would require 20 bits in binary. In a serial number space having a total of 26 bits (such as taught by 545 Patent), a block of numbers from 0 to about 1,000,000 (decimal) would be expressed as binary numbers 00000000000000000000000000 to about 00000011111111111111111111. An exemplary block of numbers from about 10,000,000 to about 15,000,000 (decimal) would be expressed as binary numbers from about 00101000000000000000000000 to about 00111100000000000000000000. Another exemplary block of numbers from about 30,000,000 to about 40,000,000 (decimal) would be expressed as binary numbers from about 01111000000000000000000000 to about 10100000000000000000000000. Therefore, 545 Patent teaches that an allocated block or range of serial numbers is assigned a limited number of most significant bits (e.g., when the serial number space has 26 bits in all, the six most significant bits, e.g., "000000," "001010," etc., correspond to a particular block containing over a million serial numbers and therefore correspond to a particular client site as taught by 545 Patent). 545 Patent further teaches that wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block (e.g., six most significant bits in the example above).

Regarding claim 13, it would have been obvious to a person of ordinary skill in the art to provide a unique serial number space encoded with one serial number instance from an allocated block of serial numbers as taught by 545 Patent, in the RFID transponder disclosed by 684

Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Further regarding claim 13, 684 Publication in view of 545 Patent does not further suggest a global trade item number or that the object class information space includes a block of at least 50 bits and the unique serial number space includes a block of at least 38 bits.

However, 2006 EPC Standard teaches a system that is related to the one described by 684 Publication in view of 545 Patent, including RFID tags having associated EPCs (2006 EPC Standard, page 8). 2006 EPC Standard further teaches a global trade item number or that the object class information space includes a block of at least 50 bits and the unique serial number space includes a block of at least 38 bits (2006 EPC Standard, pages 25-26). Regarding claims 13, it would have been obvious to provide a global trade item number, an object class information space of at least 50 bits, and a unique serial number space of at least 38 bits as taught by 2006 EPC Standard, in the RFID transponder suggested by 684 Publication in view of 545 Patent, in order to provide standardized identification information about the tagged object that can be universally read and understood.

Regarding **claim 14**, in the system suggested by 684 Publication in view of 545 Patent and 2006 EDC Standard, 545 Patent further teaches that the unique serial number space further comprises remaining bits of lesser significance (e.g., the 20 least significant bits) that together with the at least 3 most significant bits (e.g., the six most significant bits) comprise the one serial number instance (having 26 bits in all in the example discussed above with regard to claim 13).

Regarding **claim 15**, in the system suggested by 684 Publication in view of 200 Patent, 684 Publication further discloses an encoder 30 (684 Publication, Figure 3; paragraphs [0038]-[0039]), and 545 Patent teaches a plurality of allocations associated with different client sites as discussed above with regard to claim 13. 545 Patent further teaches that the at least 3 most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder at least in the sense that 545 Patent teaches that encoders in different client sites receive corresponding pools of allocated numbers from an EPC provisioning server 402, then encode serial numbers from that pool (Figure 4A; column 3, lines 34-67; column 4, lines 1-19). As discussed above with regard to claim 13, the at least 3 most significant bits taught by 545 Patent correspond to blocks of allocated numbers, which in turn correspond to the encoders in the different client sites that use the particular blocks of numbers. It would have been obvious to a person of ordinary skill in the art to provide allocated blocks further corresponding to encoders as taught by 545 Patent, in the system disclosed by 684 Publication, in order to advantageously ensure that unique serial numbers are generated even for objects that have the same object classification but are produced at different client sites as taught by 545 Patent.

Conclusion

12. In order to ensure full consideration of any amendments, affidavits or declarations, or other documents as evidence of patentability, such documents must be submitted in response to this Office action. Submissions after the next Office action, which is intended to be a final action, will be governed by the requirements of 37 CFR 1.116, after final rejection and 37 CFR 41.33 after appeal, which will be strictly enforced.

13. The patent owner is reminded of the continuing responsibility under 37 CFR 1.565(a) to apprise the Office of any litigation activity, or other prior or concurrent proceeding, involving US 9,798,967 B2 throughout the course of this reexamination proceeding. The third party requester is also reminded of the ability to similarly apprise the Office of any such activity or proceeding throughout the course of this reexamination proceeding. See MPEP §§ 2207, 2282 and 2286.

14. **All** correspondence relating to this ex parte reexamination proceeding should be directed:

By mail to: Mail Stop *Ex Parte* Reexam
Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By fax to: (571) 273-9900
Central Reexamination Unit

By hand to: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Any inquiry concerning this communication should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

/Christina Y. Leung/

Primary Examiner, Art Unit 3992

Conferees:

/Albert J Gagliardi/
Primary Examiner, Art Unit 3992

/Timothy M. Speer/
SPRS, AU 3992

Reexamination	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90/014,052	9798967
	Certificate Date	Certificate Number

Requester Correspondence Address: ☐ **Patent Owner** ☒ **Third Party**

HOGAN LOVELLS US LLP IP GROUP
COLUMBIA SQUARE
555 THIRTEENTH STREET, NW
WASHINGTON, DC 20004

LITIGATION REVIEW ☒	/CL/ (examiner initials)	**1-29-18** (date)
Case Name		Director Initials
6:17cv1685, Adasa Inc. v. Avery Dennison Corporation		

COPENDING OFFICE PROCEEDINGS	
TYPE OF PROCEEDING	**NUMBER**
1. none	
2.	
3.	
4.	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90014052	9798967
	Examiner	Art Unit
	CHRISTINA Y LEUNG	3992

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
Reviewed patent file's prosecution history.	12-14-17	/CL/
Reviewed cited references and prosecution history.	1-29-18	/CL/

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

	/CHRISTINA Y LEUNG/ Primary Examiner.Art Unit 3992

Ex Parte Reexamination Interview Summary	**Control No.**	**Patent Under Reexamination**
	90/014,052	9798967
	Examiner	**Art Unit**
	Christina Y. Leung	3992

All participants (USPTO personnel, patent owner, patent owner's representative):

(1) *Christina Y. Leung*	(3) _____
(2) *Michael Marcin*	(4) _____

Date of Interview: *16 January 2018*

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal (copy given to: 1)☐ patent owner 2)☐ patent owner's representative)

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____

Agreement with respect to the claims f)☐ was reached. g)☐ was not reached. h)☒ N/A.
Any other agreement(s) are set forth below under "Description of the general nature of what was agreed to…"

Claim(s) discussed: *n/a*.

Identification of prior art discussed: *n/a*.

Description of the general nature of what was agreed to if an agreement was reached, or any other comments:
Patent Owner's representative informed Examiner that PO waives the right to file a PO statement under 37 CFR 1.530 in response to the Order.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims patentable, if available, must be attached. Also, where no copy of the amendments that would render the claims patentable is available, a summary thereof must be attached.)

A FORMAL WRITTEN RESPONSE TO THE LAST OFFICE ACTION MUST INCLUDE PATENT OWNER'S STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. (See MPEP § 2281). IF A RESPONSE TO THE LAST OFFICE ACTION HAS ALREADY BEEN FILED, THEN PATENT OWNER IS GIVEN **ONE MONTH** FROM THIS INTERVIEW DATE TO PROVIDE THE MANDATORY STATEMENT OF THE SUBSTANCE OF THE INTERVIEW (37 CFR 1.560(b)). THE REQUIREMENT FOR PATENT OWNER'S STATEMENT CAN NOT BE WAIVED. **EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.550(c).**

/Christina Y. Leung/ Primary Examiner, Art Unit 3992		

cc: Requester (if third party requester)

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
90/014,052	11/29/2017	9798967	029101.6	4770

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FAY KAPLUN & MARCIN, LLP
150 BROADWAY, SUITE 702
NEW YORK, NY 10038

EXAMINER
LEUNG, CHRISTINA Y

ART UNIT	PAPER NUMBER
3992	

MAIL DATE	DELIVERY MODE
12/20/2017	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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WASHINGTON, DC 20004

EX PARTE REEXAMINATION COMMUNICATION TRANSMITTAL FORM

REEXAMINATION CONTROL NO. *90/014,052*.

PATENT NO. *9798967*.

ART UNIT *3992*.

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above identified *ex parte* reexamination proceeding (37 CFR 1.550(f)).

Where this copy is supplied after the reply by requester, 37 CFR 1.535, or the time for filing a reply has passed, no submission on behalf of the *ex parte* reexamination requester will be acknowledged or considered (37 CFR 1.550(g)).

DECISION GRANTING EX PARTE REEXAMINATION

Decision on the Request

The present request for *ex parte* reexamination raises a substantial new question of patentability with respect to claims 1-20 of United States Patent 9,798,967 to McAllister ("**967 Patent**").

References Cited in the Request

684 Publication (US 2007/0040684 A1 to McAllister)

200 Patent (US 7,827,200 B2 to Rowe)

545 Patent (US 8,373,545 B2 to Traub)

2006 EPC Standard (EPCglobal Tag Data Standards, Version 1.3, March 8, 2006)

Issues Raised by the Request

Issue 1

The request alleges that 684 Publication in view of either 200 Patent or 545 Patent raises a substantial new question of patentability with respect to claims 1, 6-12, 16, and 20

Issue 2

The request alleges that 684 Publication in view of either 200 Patent or 545 Patent, and further in view of 2006 EPC Standard raises a substantial new question of patentability with respect to claims 2-5, 13-15, and 17-19.

The 967 Patent

967 Patent is generally directed to a system for commissioning RFID transponders with unique object numbers. Claim 1 is representative:

1. An RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

Prosecution History

967 Patent issued on October 24, 2017 from application 15/042,993 filed on February 12, 2016, which is a continuation of parent application 13/526,520 filed on June 19, 2012. 13/526,520 is a continuation-in-part of 12/820,109, filed on June 21, 2010, which is a continuation-in-part of 11/465,712, filed on August 18, 2006, and a continuation-in-part of 12/124,768, filed on May 21, 2008. 967 Patent also claims priority to two provisional applications: 60/709,713, filed on August 19, 2005; and 60/939,603, filed on May 22, 2007.

Parent application 13/526,520

June 19, 2012: Applicant filed original claims 1-16.

May 2, 2014: In a non-final Office action, Examiner rejected claims 1-16 under 35 U.S.C. 112, second paragraph, and on the ground of nonstatutory double patenting over various claims of US 8,228,198 B2.

August 3, 2014: Applicant amended claims 1, 2, 4, 6, 7, 9, and 11-16.

August 22, 2014: In a final Office action, Examiner rejected claims 1-16 under 35 U.S.C. 112, first paragraph, and on the ground of nonstatutory double patenting over various claims of US 8,228,198 B2.

February 20, 2015: Applicant filed a Request for Continued Examination.

May 1, 2015: Applicant amended claims 1, 2, 4, 6, 7, 9, 15, and 16.

May 27, 2015: In a non-final Office action, Examiner rejected claims 1-16 on the ground of nonstatutory double patenting over various claims of US 8,228,198 B2.

July 29, 2015: Applicant canceled claims 1-16 and added new claims 17-36. In an interview between Examiner and Applicant's representatives, Examiner indicated that the new claims appeared to overcome the 35 U.S.C. 112 issues of the original claims (see interview summary mailed on August 3, 2015).

November 27, 2015: Examiner allowed claims 17-36 without an explicit statement of reasons for allowance.

March 1, 2016: Application 13/526,520 issued as US 9,272,805 B2 with renumbered claims 1-20.

Application 15/042,993

February 12, 2016: In a preliminary amendment, Applicant canceled claims 1-16 and filed new claims 17-36.

February 14, 2017: In a non-final Office action, Examiner rejected claims 17-36 on the ground of nonstatutory double patenting over claims of US 9,272,805 B2.

April 28, 2017: Applicant filed an approved terminal disclaimer with respect to US 9,272,805 B2.

June 7, 2017: Examiner allowed claims 17-36, stating that "the present claims only slightly differ from the allowed claims of [parent application 13/526,520, i.e., US 9,272,805 B2]…and therefore are considered allowable for the same reason(s) as the '520 claims."[1]

June 26, 2017: Applicant filed an amendment after allowance.

July 18, 2017: Examiner denied entry of the June 26, 2017 amendment.

August 10, 2017: Applicant filed a Request for Continued Examination and amended claims 17 and 30-32; canceled claims 18, 24, and 33; and added new claims 37-39.

September 8, 2017: Examiner allowed claims 17, 19-23, 25-32, and 34-39 without an explicit statement of reasons for allowance.

October 24, 2017: Application 15/052,993 issued as US 9,798,967 B2 with renumbered claims 1-20.

Detailed Analysis

Claims 1-20 will be reexamined.

During the prosecution of 15/042,993 and parent application 13/526,520, Examiner did not cite or discuss any prior art on the record and did not explicitly state reasons for allowance. In view of the prosecution history, a substantial new question of patentability is raised by the evaluation of a prior art reference (or a combination of prior art references) that teaches the

[1] However, as noted above, Examiner did not explicitly state reasons for allowance during the prosecution of 13/526,520.

limitations found in the claims, such as an RFID integrated circuit encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

967 Patent claims priority to a number of parent and provisional applications as discussed above. A review of the specifications of these applications indicates that 12/124,768, filed on May 21, 2008, appears to be the earliest disclosure that contains support for the claimed limitations directed to a unique object number (e.g., including a unique serial number space encoded with one serial number instance from an allocated block of serial numbers that is assigned a limited number of most significant bits). Therefore, the effective filing date of the claims in 967 Patent is May 21, 2008.

Issues 1 and 2

684 Publication, 200 Patent, 545 Patent, and 2006 EPC Standard are all new prior art because they were not cited or discussed on the record during the prosecution of 967 Patent. **684 Publication** teaches, among other things, an RFID transponder comprising a substrate; an antenna structure formed on the substrate; and an RFID integrated circuit chip (paragraphs [0003] and [0041]). **200 Patent** teaches, among other things, an RFID transponder (column 3,

lines 19-25) with a unique serial number space encoded with one serial number instance from an allocated block of serial numbers (column 4, lines 57-67; column 5, lines 1-22). **545 Patent** teaches, among other things, an RFID transponder (column 1, lines 25-38) with a unique serial number space encoded with one serial number instance from an allocated block of serial numbers (column 3, lines 40-47; column 40, lines 12-32; Figures 13D-13G). **2006 EPC Standard** teaches, among other things, an RFID transponder with an object class information space encoded with a company prefix, an item reference, a partition value, and a filter value (see page 25, "Section 3.5.1").

Since these teachings are directly related to subject matter considered the basis for allowability of claims 1-20, a reasonable examiner would consider evaluation of 684 Publication, in view of either 200 Patent or 545 Patent; or 684 Publication, in view of either 200 Patent or 545 patent, and further in view of 2006 EPC Standard, important in determining the patentability of the claims. Therefore, 684 Publication, in view of either 200 Patent or 545 Patent raises a substantial new question of patentability with respect to 1, 6-12, 16, and 20; and 684 Publication, in view of either 200 Patent or 545 patent, and further in view of 2006 EPC Standard raises a substantial new question of patentability with respect to claims 2-5, 13-15, and 17-19.

Conclusion

Extensions of time under 37 CFR 1.136(a) will not be permitted in these proceedings because the provisions of 37 CFR 1.136 apply only to "an applicant" and not to parties in a reexamination proceeding. Additionally, 35 U.S.C. 305 requires that *ex parte* reexamination proceedings "will be conducted with special dispatch" (37 CFR 1.550(a)). Extensions of time in *ex parte* reexamination proceedings are provided for in 37 CFR 1.550(c).

The patent owner is reminded of the continuing responsibility under 37 CFR 1.565(a) to apprise the Office of any litigation activity, or other prior or concurrent proceeding, involving Patent No. 9,798,967 throughout the course of this reexamination proceeding. The third party requester is also reminded of the ability to similarly apprise the Office of any such activity or proceeding throughout the course of this reexamination proceeding. See MPEP §§ 2207, 2282 and 2286.

All correspondence relating to this *ex parte* reexamination proceeding should be directed:

By mail to: Mail Stop *Ex Parte* Reexam
Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By fax to: (571) 273-9900
Central Reexamination Unit

By hand to: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Any inquiry concerning this communication should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

/Christina Y. Leung/

Primary Examiner, Art Unit 3992

Conferees:

/Albert J Gagliardi/
Primary Examiner, Art Unit 3992

/Timothy M. Speer/
SPRS, AU 3992

Order Granting Request For Ex Parte Reexamination	Control No.	Patent Under Reexamination
	90/014,052	9798967
	Examiner	Art Unit
	Christina Y. Leung	3992

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

The request for *ex parte* reexamination filed *29 November 2017* has been considered and a determination has been made. An identification of the claims, the references relied upon, and the rationale supporting the determination are attached.

Attachments: a)☐ PTO-892, b)☒ PTO/SB/08, c)☐ Other: _____

1. ☒ The request for *ex parte* reexamination is GRANTED.

RESPONSE TIMES ARE SET AS FOLLOWS:

For Patent Owner's Statement (Optional): TWO MONTHS from the mailing date of this communication (37 CFR 1.530 (b)). **EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.550(c).**

For Requester's Reply (optional): TWO MONTHS from the **date of service** of any timely filed Patent Owner's Statement (37 CFR 1.535). **NO EXTENSION OF THIS TIME PERIOD IS PERMITTED.** If Patent Owner does not file a timely statement under 37 CFR 1.530(b), then no reply by requester is permitted.

cc:Requester (if third party requester)

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90014052	9798967
	Examiner	Art Unit
	CHRISTINA Y LEUNG	3992

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
Reviewed patent file's prosecution history.	12-14-17	/CL/

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

	/CHRISTINA Y LEUNG/ Primary Examiner.Art Unit 3992

Reexamination	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90/014,052	9798967
	Certificate Date	Certificate Number

Requester Correspondence Address: ☐ **Patent Owner** ☒ **Third Party**

HOGAN LOVELLS US LLP IP GROUP
COLUMBIA SQUARE
555 THIRTEENTH STREET, NW
WASHINGTON, DC 20004

LITIGATION REVIEW ☒	/CL/ (examiner initials)	**12-14-17** (date)
Case Name		Director Initials
6:17cv1685, Adasa Inc. v. Avery Dennison Corporation		

COPENDING OFFICE PROCEEDINGS	
TYPE OF PROCEEDING	**NUMBER**
1. none	
2.	
3.	
4.	

PTO/SB/08a (07-09)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet | | of | |

Complete if Known	
Application Number	90/014052
Filing Date	
First Named Inventor	
Art Unit	3992
Examiner Name	Christina Leung
Attorney Docket Number	

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/CL/		US- 2007/0040684	02/22/2007	McAllister	
/CL/		US- 7,827,200	11/02/2010	Rowe	filed 07/14/2006
/CL/		US- 8,373,545	02/12/2013	Traub	filed 01/29/2007
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
~~/CL/~~		EPCglobal Tag Data Standards Version 1.3	03/08/2006	2006 EPC Standard		

Examiner Signature	/CHRISTINA Y. LEUNG/	Date Considered	12/14/2017

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

REEXAM CONTROL NUMBER	FILING OR 371 (c) DATE	PATENT NUMBER
90/014,052	11/29/2017	9798967

CONFIRMATION NO. 4770

HOGAN LOVELLS US LLP IP GROUP
COLUMBIA SQUARE
555 THIRTEENTH STREET, NW
WASHINGTON, DC 20004

REEXAMINATION REQUEST NOTICE

OC000000095934920

Date Mailed: 12/07/2017

NOTICE OF REEXAMINATION REQUEST FILING DATE

(Third Party Requester)

Requester is hereby notified that the filing date of the request for reexamination is 11/29/2017, the date that the filing requirements of 37 CFR § 1.510 were received.

A decision on the request for reexamination will be mailed within three months from the filing date of the request for reexamination. (See 37 CFR 1.515(a)).

A copy of the Notice is being sent to the person identified by the requester as the patent owner. Further patent owner correspondence will be the latest attorney or agent of record in the patent file. (See 37 CFR 1.33). Any paper filed should include a reference to the present request for reexamination (by Reexamination Control Number).

cc: Patent Owner
30636
FAY KAPLUN & MARCIN, LLP
150 BROADWAY, SUITE 702
NEW YORK, NY 10038

/vdrogers/

Legal Instruments Examiner
Central Reexamination Unit 571-272-7705; FAX No. 571-273-9900

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

REEXAM CONTROL NUMBER	FILING OR 371 (c) DATE	PATENT NUMBER
90/014,052	11/29/2017	9798967

CONFIRMATION NO. 4770

REEXAM ASSIGNMENT NOTICE

30636
FAY KAPLUN & MARCIN, LLP
150 BROADWAY, SUITE 702
NEW YORK, NY 10038

OC000000095934922

Date Mailed: 12/07/2017

NOTICE OF ASSIGNMENT OF REEXAMINATION REQUEST

The above-identified request for reexamination has been assigned to Art Unit 3992. All future correspondence to the proceeding should be identified by the control number listed above and directed to the assigned Art Unit.

A copy of this Notice is being sent to the latest attorney or agent of record in the patent file or to all owners of record. (See 37 CFR 1.33(c)). If the addressee is not, or does not represent, the current owner, he or she is required to forward all communications regarding this proceeding to the current owner(s). An attorney or agent receiving this communication who does not represent the current owner(s) may wish to seek to withdraw pursuant to 37 CFR 1.36 in order to avoid receiving future communications. If the address of the current owner(s) is unknown, this communication should be returned within the request to withdraw pursuant to Section 1.36.

NOTICE OF USPTO EX PARTE REEXAMINATION PATENT OWNER STATEMENT WAIVER PROGRAM

The USPTO has implemented a pilot program where, after a reexamination proceeding has been granted a filing date and before the examiner begins his or her review, the patent owner may orally waive the right to file a patent owner's statement. See *"Pilot Program for Waiver of Patent Owner's Statement in Ex Parte Reexamination Proceedings,"* 75 FR 47269 (August 5, 2010). One goal of the pilot program is to reduce the pendency of reexamination proceedings and improve the efficiency of the reexamination process.

Ordinarily when ex parte reexamination is ordered, the USPTO must wait until after the receipt of the patent owner's statement and the third party requester's reply, or after the expiration of the time period for filing the statement and reply (a period that can be as long as 5 to 6 months), before mailing a first determination of patentability. The USPTO's first determination of patentability is usually a first Office action on the merits or a Notice of Intent to Issue Reexamination Certificate (NIRC).

Under the pilot program, the patent owner's oral waiver allows the USPTO to act on the first determination of patentability immediately after determining that reexamination will be ordered, and in a suitable case issue the reexamination order and the first determination of patentability (which could be a NIRC if the claims under reexamination are confirmed) at the same time.

Benefits to the Patent Owner for participating in this pilot program include reduction in pendency.

To participate in this pilot program, Patent Owners may contact the USPTO's Central Reexamination Unit (CRU) at 571-272-7705. The USPTO will make the oral waiver of record in the reexamination file in an interview summary and a copy will be mailed to the patent owner and any third party requester.

cc: Third Party Requester(if any)
HOGAN LOVELLS US LLP IP GROUP
COLUMBIA SQUARE
555 THIRTEENTH STREET, NW
WASHINGTON, DC 20004

/vdrogers/

Legal Instruments Examiner
Central Reexamination Unit 571-272-7705; FAX No. 571-273-9900

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
90/014,052	11/29/2017	Clarke W. McAllister 9,798,967	029101.6	4770

7590 12/06/2017

FAY KAPLUN & MARCIN, LLP
150 BROADWAY, SUITE 702
NEW YORK NY 10038

EXAMINER	
ART UNIT	PAPER NUMBER

MAIL DATE	DELIVERY MODE
12/06/2017	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

DO NOT USE IN PALM PRINTER

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

HOGAN LOVELLS US LLP
IP GROUP, COLUMBIA SQUARE
555 THIRTEENTH STREET, NW
WASHINGTON, DC 20004

EX PARTE REEXAMINATION COMMUNICATION TRANSMITTAL FORM

REEXAMINATION CONTROL NO. *90/014,052*.

PATENT NO. *9,798,967*.

ART UNIT *3999*.

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above identified *ex parte* reexamination proceeding (37 CFR 1.550(f)).

Where this copy is supplied after the reply by requester, 37 CFR 1.535, or the time for filing a reply has passed, no submission on behalf of the *ex parte* reexamination requester will be acknowledged or considered (37 CFR 1.550(g)).

Ex Parte Reexamination Interview Summary – Pilot Program for Waiver of Patent Owner's Statement	Control No. 90/014,052	Patent For Which Reexamination is Requested 9,798,967
	Examiner	Art Unit 3992

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

All participants (USPTO official and patent owner):

(1) Michael Marcin, 48,198 (3)

(2) Renee Preston, CRU Paralegal (4)

Date of Telephonic Interview: 12/05/2017.

The USPTO official requested waiver of the patent owner's statement pursuant to the pilot program for waiver of patent owner's statement in *ex parte* reexamination proceedings.*

☐ The patent owner **agreed** to waive its right to file a patent owner's statement under 35 U.S.C. 304 in the event reexamination is ordered for the above-identified patent.

☒ The patent owner **did not agree** to waive its right to file a patent owner's statement under 35 U.S.C. 304 at this time.

The patent owner is not required to file a written statement of this telephone communication under 37 CFR 1.560(b) or otherwise. However, any disagreement as to this interview summary must be brought to the immediate attention of the USPTO, and no later than one month from the mailing date of this interview summary. Extensions of time are governed by 37 CFR 1.550(c).

*For more information regarding this pilot program, see *Pilot Program for Waiver of Patent Owner's Statement in Ex Parte Reexamination Proceedings*, 75 *Fed. Reg.* 47269 (August 5, 2010), available on the USPTO Web site at http://www.uspto.gov/patents/law/notices/2010.jsp.

☐ USPTO personnel were unable to reach the patent owner.

The patent owner may contact the USPTO personnel at the telephone number provided below if the patent owner decides to waive the right to file a patent owner's statement under 35 U.S.C. 304.

Renee Preston Renee Preston (571) 272-1607
Signature and telephone number of the USPTO official who contacted or attempted to contact the patent owner.

cc: Requester (if third party requester)

Patent Assignment Abstract of Title

Total Assignments: 1

Application #: 13526520 **Filing Dt:** 06/19/2012 **Patent #:** 9272805 **Issue Dt:** 03/01/2016
PCT #: NONE **Intl Reg #:** **Publication #:** US20120256732 **Pub Dt:** 10/11/2012
Inventor: Clarke William McAllister
Title: SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS

Assignment: 1

Reel/Frame: 037854 / 0923 **Received:** 02/29/2016 **Recorded:** 02/29/2016 **Mailed:** 03/01/2016 **Pages:** 3
Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).
Assignor: MCALLISTER, CLARKE **Exec Dt:** 02/29/2016
Assignee: ADASA INC.
4060 SUNRIDGE DRIVE
EUGENE, OREGON 97405
Correspondent: MICHAEL J. MARCIN, ESQ.
150 BROADWAY, SUITE 702
NEW YORK, NY 10038

Search Results as of: 12/06/2017 03:12 PM

If you have any comments or questions concerning the data displayed, contact PRD / Assignments at 571-272-3350. v.2.5
Web interface last modified: Aug 20, 2015 v.2.5

Litigation Search Report CRU 3999

Reexam Control No. 90/014,052

To: Examiner Location: CRU Art Unit: 3992 Date: 11/30/2017	From: Renee Preston Location: CRU 3999 MDE 04B15 Phone: (571) 272-1607 Renee.preston@uspto.gov

Search Notes

U.S. Patent No. 9,798,967

1) I performed a KeyCite Search in Westlaw, which retrieves all history on the patent including any litigation.

2) I performed a search on the patent in Lexis CourtLink for any open dockets or closed cases.

3) I performed a search in Lexis in the Federal Courts and Administrative Materials databases for any cases found.

4) I performed a search in Lexis in the IP Journal and Periodicals database for any articles on the patent.

5) I performed a search in Lexis in the news databases for any articles about the patent or any articles about litigation on this patent.

Litigation: Cases found

Status	Description	Court	Docket Number
Open	Adasa Inc. v. Avery Dennison Corporation	US-DIS-ORD	6:17cv1685

References Cited Items (13)

Title	Date	Type
1. AUXILIARY FRAME WITH PROPULSION AND STEERING MEANS FOR ATTACHMENT TO WHEELCHAIR Out Of Pass US PAT 5899476	Dec 08, 1997	Patents
2. SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS Out Of Pass US PAT APP 20120256732	Jun 19, 2012	Patents
3. PERFORMANCE OPTIMIZED SMART LABEL PRINTER Out Of Pass US PAT 6246326	May 05, 1999	Patents
4. SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS. Out Of Pass US PAT APP 20100283584	Jun 21, 2010	Patents
5. MULTI-LAYER METHOD OF ACCOMMODATING CODE COLLISIONS FROM MULTIPLE SURFACE ACOUSTIC WAVE IDENTIFICATION TAGS Out Of Pass US PAT APP 20050007238	Jul 08, 2003	Patents
6. RADIO FREQUENCY ANIMAL TRACKING SYSTEM Out Of Pass US PAT APP 20070103314	Nov 02, 2006	Patents
7. SYSTEMS, METHODS, AND DEVICES FOR REPLICATION OF DATA ONTO WIRELESS SENSORS Out Of Pass US PAT APP 20090314829	May 21, 2008	Patents
8. SYSTEMS, METHODS, AND DEVICES FOR CONVERTING AND COMMISSIONING WIRELESS SENSORS Out Of Pass US PAT APP 20070040684	Aug 18, 2006	Patents
9. EFFICIENT PROTOCOL FOR READING RFID TAGS Out Of Pass US PAT APP 20040046644	Sep 05, 2002	Patents
10. SYSTEMS, METHODS, AND DEVICES FOR CONVERTING AND COMMISSIONING WIRELESS SENSORS Out Of Pass US PAT 7830258	Aug 18, 2006	Patents
11. SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS Out Of Pass US PAT 8228198	Jun 21, 2010	Patents
12. RFID TAG AND PRINTER SYSTEM Out Of Pass US PAT 7066667	Aug 18, 2005	Patents
13. SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS Out Of Pass US PAT 9272805	Jun 19, 2012	Patents

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Citing References (3)

Treatment	Title	Date	Type	Depth	Headnote(s)
Cited by	1. Systems, methods, and devices for commissioning wireless sensors LitAlert P2017-43-65	Oct. 24, 2017	Lit Alert		—
—	2. RADIO-FREQUENCY IDENTIFICATION (RFID) TRANSPONDER FOR COMMISSIONING WIRELESS SENSORS, HAS UNIQUE SERIAL NUMBER SPACE WITH ALLOCATED BLOCK STORED AND DEFINED BY LIMITED NUMBER OF MOST SIGNIFICANT BITS OF UNIQUE SERIAL NUMBER SPACE Out Of Plan DWPI 2016-34364T	Aug. 19, 2005	DWPI	—	—
—	3. PatStat 9798967	2017	Patent Status Files	—	—

US District Court Civil Docket

U.S. District - Oregon
(Eugene 6)

6:17cv1685

Adasa Inc. v. Avery Dennison Corporation

This case was retrieved from the court on Thursday, November 30, 2017

Date Filed:	10/24/2017
Assigned To:	Magistrate Judge Thomas M. Coffin
Referred To:	
Nature of suit:	Patent (830)
Cause:	Patent Infringement
Lead Docket:	None
Other Docket:	None
Jurisdiction:	Federal Question
Class Code:	OPEN
Closed:	
Statute:	35:271
Jury Demand:	Plaintiff
Demand Amount:	$0
NOS Description:	Patent

Litigants	Attorneys
Adasa Inc. Plaintiff	Brett M. Pinkus LEAD ATTORNEY; PRO HAC VICE; ATTORNEY TO BE NOTICED Friedman, Suder & Cooke 604 E. 4th Street, Suite 200 Ft. Worth , TX 76102 USA (817) 334-0400 Fax: (817) 344-0401 Email: Pinkus@fsclaw.Com Glenn S. Orman LEAD ATTORNEY; PRO HAC VICE; ATTORNEY TO BE NOTICED Friedman, Suder & Cooke 604 E. 4th Street, Suite 200 Ft. Worth , TX 76102 USA (817) 334-0400 Fax: (817) 344-0401 Email: Orman@fsclaw.Com Johnathan E. Mansfield LEAD ATTORNEY; ATTORNEY TO BE NOTICED Harris Bricken McVay, LLP 511 Se 11th Ave Suite 201 Portland , OR 97214 USA

503-207-7313
Email: John@harrisbricken.Com

Jonathan T. Suder
LEAD ATTORNEY; PRO HAC VICE; ATTORNEY TO BE NOTICED
Friedman Suder & Cooke
604 E. 4th Street Suite 200
Fort Worth , TX 76102
USA
(817) 334-0400
Fax: (817) 334-0401
Email: Jts@fsclaw.Com

Avery Dennison Corporation
Defendant

Date	#	Proceeding Text	Source
10/24/2017	1	Complaint. Filing fee in the amount of $400 collected. Agency Tracking ID: 0979-5197798 Filer is subject to the requirements of Fed. R. Civ. P. 7.1. Jury Trial Requested: Yes. Included patents/trademarks: 9798967--10/24/2017--ADASA INC.. Filed by ADASA INC. against AVERY DENNISON CORPORATION (Attachments: # 1 Civil Cover Sheet, # 2 Exhibit, # 3 Proposed Summons). (Mansfield, Johnathan) (Entered: 10/24/2017)	
10/25/2017	2	Notice of Case Assignment to Magistrate Judge Thomas M. Coffin and Discovery and Pretrial Scheduling Order. NOTICE: Counsel shall print and serve the summonses and all documents issued by the Clerk at the time of filing upon all named parties in accordance with Local Rule 3-5. Discovery is to be completed by 2/22/2018. Joint Alternate Dispute Resolution Report is due by 3/26/2018. Pretrial Order is due by 3/26/2018. Ordered by Magistrate Judge Thomas M. Coffin. (Attachments: # 1 Summons Issued) (kf) (Entered: 10/25/2017)	
10/25/2017	3	Notice of Appearance of Johnathan E. Mansfield appearing on behalf of ADASA INC. Filed by on behalf of ADASA INC.. (Mansfield, Johnathan) (Entered: 10/25/2017)	
10/25/2017	4	Patent Report: This report is submitted pursuant to 35 U.S.C. section 290, which requires the clerks of the courts of the United States, within one month after the filing of an action under this title shall give notice thereof in writing to the Commissioner, setting forth so far as known the names and addresses of the parties, name of the inventor, and the designating number of the patent upon which the action has been brought. If any other patent is subsequently included in the action he shall give like notice thereof. Within one month after the decision is rendered or a judgment issued the clerk of the court shall give notice thereof to the Director. The Director shall, on receipt of such notices, enter the same in the file of such patent.. (kf) (Entered: 10/25/2017)	
10/25/2017	5	Motion for Leave to Appear Pro Hac Vice for Attorney Glenn S. Orman . Filing fee in the amount of $300 collected; Agency Tracking ID: 0979-5199034. Filed by Adasa Inc.. (Mansfield, Johnathan) (Entered: 10/25/2017)	
10/25/2017	6	Motion for Leave to Appear Pro Hac Vice for Attorney Brett M. Pinkus . Filing fee in the amount of $300 collected; Agency Tracking ID: 0979-5199066. Filed by Adasa Inc.. (Mansfield, Johnathan) (Entered: 10/25/2017)	
10/25/2017	7	Motion for Leave to Appear Pro Hac Vice for Attorney Jonathan T. Suder . Filing fee in the amount of $300 collected; Agency Tracking ID: 0979-	

		5199081. Filed by Adasa Inc.. (Mansfield, Johnathan) (Entered: 10/25/2017)
10/30/2017	8	ORDER: Granting Application for Special Admission Pro Hac Vice of Jonathan T. Suder for Adasa Inc. Application Fee in amount of $300 collected. Receipt No. 0979-5199081 issued. Ordered by Magistrate Judge Thomas M. Coffin. (cp) Modified on 10/30/2017 to correct Judge Name - Resent NEF(cp). (Entered: 10/30/2017)
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1 of 1 DOCUMENT

UNITED STATES PATENT AND TRADEMARK OFFICE GRANTED PATENT

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Link to Claims Section

October 24, 2017

Systems, methods, and devices for commissioning wireless sensors

REEXAM-LITIGATE:

NOTICE OF LITIGATION

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INVENTOR: McAllister, Clarke W. - Eugene, Oregon, United States of America (US)

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20040046644, March 11, 2004, Bauhahn, United States of America (US), 340#10.42
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20070103314, May 10, 2007, Geissler, United States of America (US), 340#572.8

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EPCTM Tag Data Standards Version 1.1 Rev.1.23, Last Call Working Draft on Feb. 16, 2004, pp. 11, 19-25.
RFID for Dummies, 5 pps., 2005.

CORE TERMS: transponder, encoder, mobile, wireless, tag, sensor, bar code, encoding, layer, cartridge, antenna, interrogator, container, serial number, computer, optical, encoded, reel, commissioning, database, inlay, authorization, adhesive, peel, transport, network, label, remote, target, tape

ENGLISH-ABST:

In one embodiment the present invention comprises a smartphone and encoders for commissioning RFID transponders. The present invention further includes novel systems, devices, and methods for commissioning RFID transponders with unique object class instance numbers without requiring a realtime connection to a serialization

database.

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EXMPL-CLAIM: 1

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PARENT-PAT-INFO:

RELATED APPLICATIONS

[0001]The present application is a continuation application based on U.S. application Ser. No. 13/526,520, filed on Jun. 19, 2012, now U.S. Pat. No. 9,272,805, which is a continuation-in-part application based on U.S. application Ser. No. 12/820,109, filed on Jun. 21, 2010, now U.S. Pat. No. 8,228,198, which is a continuation-in-part application of U.S. application Ser. No. 11/465,712, filed on Aug. 18, 2006, now U.S. Pat. No. 7,830,258, which claims the benefit of U.S. Provisional Application No. 60/709,713 filed on Aug. 19, 2005, and a continuation-in-part application of U.S. application Ser. No. 12/124,768, filed on May 21, 2008, now abandoned, which claims the benefit of U.S. Provisional Application No. 60/939,603 filed on May 22, 2007. The present application claims priority from these applications, the disclosures of which are hereby expressly incorporated herein by reference.

SUMMARY:

BACKGROUND

[0002]The present invention relates to a system, including methods and devices, utilizing wireless sensor devices and RFID (radio-frequency identification) transponders. Specifically, the present invention relates to a system incorporating novel devices and methods that enable point-of-use and on-demand commissioning of RFID transponder-equipped wireless sensors.

[0003]Radio-frequency identification (RFID) transponders enable improved identification and tracking of objects by encoding data electronically in a compact tag or label. And, advantageously, the compact tag or label does not need external, optically recognizable or human-readable markings. In fact, using the Gen2 EPC specification, a three-meter read-distance for RFID transponders is common--even on high-speed material handling lines.

[0004]Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder.

[0005]Current classes of RFID transponders rank into two primary categories: active RFID transponders and passive RFID transponders. Active RFID transponders include an integrated power source capable of self-generating

signals, which may be used by other, remote reading devices to interpret the data associated with the transponder. Active transponders include batteries and, historically, are considered considerably more expensive than passive RFID transponders. Passive RFID transponders backscatter incident RF energy to specially designed remote devices such as interrogators.

[0006]Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces.

[0007]Wireless sensors, made using silicon circuits, polymer circuits, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave (SAW) materials to affect radio frequency or other signaling methods, communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods.

[0008]Generating a unique serial number is imperative, and is required for EPCglobal RFID tagging implementations. Serialization requires a central issuing authority of numbers for manufacturers, products, and items to guarantee uniqueness and to avoid duplication of numbers. Blocks of numbers are distributed to remote locations globally. Unless a product (or SKU) is serialized at one location, the numbering space is usually partitioned according to some method, or each remote location receives each number one-by-one. Either way, there is eventually a reconciliation of serial number usage with a granularity of either one or several numbers at a time.

[0009]A preferred method of generating unique serial numbers is to assign unique numbers in a central location, such as in a label converter facility where unique bar coded labels are printed. Each unique label is then packed and shipped to remote locations, usually either in sheets or rolls. Upon arrival at a manufacturing facility, rolls are loaded onto high speed label applicators that apply one serialized label onto each carton. As those serialized cartons move through the supply chain, they may eventually arrive at a case pick location, a receiving dock, or similar location where a serialized carton is selected for having an RFID transponder applied to it. Using a bar code scanner to read one or more bar codes sufficient information can be collected to uniquely encode that data into an RFID transponder and apply it to that carton.

[0010]The uniqueness of an identifier is critical to the success of almost any tracking system. Assuring uniqueness is not necessarily simple. A generically descriptive bar code can be matched to authorizations for selected numbering systems that provide additional data fields including a unique serial number or using algorithms that assure uniqueness through numerical representations of time and space.

[0011]Certain prior art systems use printer encoders to merge the printing and RFID transponder encoding operations into a single atomic transaction. This method is more expensive in every respect. It requires mobile distributed printing with nearly perfect networking implementations in order to achieve a smooth, easy, and regular manual transponder application process. This all comes at a higher price, size, and weight. Prior art implementations tend not to be mobile, as represented by U.S. Pat. No. 7,066,667 issued to Chapman et al. on 27 Jun. 2006 and include U.S. Pat. No. 5,899,476 issued to Barrus et al. on 31 May 2005, or by U.S. Pat. No. 6,246,326 issued to Wiklof et al. on 12 Jun. 2001, describe a device that commissions an RFID transponder with a printed label. This approach, however, introduces unnecessary waste, cost, and propensities for error. There is a growing category of applications that do not require anything other than a custom-encoded RFID transponder. This prior art calls for the inclusion of label printer hardware and related consumable materials that are not necessary for many RFID applications. Unneeded printer mechanisms create unnecessary complexities, size, and weight. In some instances this additional bulk hinders practical mobile applications. The result is that tagging solutions that include printing result in a higher total cost of ownership

than a pure RF tag encoding system.

[0012]So, despite recent advances in RFID technology, the state-of-the-art does not fully address the needs of simple, efficient, economical, high-volume, reliable deployment and commissioning of RFID transponders and wireless sensors. Large-scale adoption of RFID transponders depends on systems utilizing reliable, low-cost transponders deployed at thousands of distributed locations that implement simple and efficient manual transponder commissioning means. Such systems should further include processes for efficient commissioning of batches of RFID transponders, without the need for realtime wireless connectivity.

SUMMARY OF THE INVENTION

[0013]The present invention overcomes the shortcomings of the prior-art attempts and, accordingly, provides systems, methods, and devices that commission RFID transponders on-demand and at a point-of-use utilizing wireless data transfer in a compact package that is well-suited to portable, mobile, or fixed use in multiple applications. The present invention is used for reading data from or encoding data onto wireless transponder data carriers with no external authorizations or queries required on a transponder-by-transponder basis. Additionally this invention teaches a preferred method and apparatus for commissioning RFID transponders without requiring continuous use of a screen or keypad to control operations. Further advantages of the present invention will be well-appreciated by those skilled in the art upon reading this disclosure including the appended figures of the drawing.

[0014]Authorizations for one or more classes of objects are preferably loaded into the encoder; where such authorizations include data fields such as manufacturer ID, item reference, manufacturer code lengths, filter values (that designate packaging levels such as item, case, pallet, etc.), serial number starting point for a block, and other pre-determined parameters. Such information is preferably loaded into the memory of the encoder in advance of tag commissioning operations. Thus if loaded with information for more than one object class, the encoder does not have sufficient information to proceed with encoding a transponder until a single object class is selected for the present RFID transponder to receive; an ambiguity therefore exists that is preferably resolved with information entered by an operator using either a keypad or a bar code scanner. Reading printed indicia such as a bar code is a preferred method to resolve the ambiguity as to which object class the next RFID transponder is to receive a number from. Bar codes are used to eliminate errors and ambiguities that enable the encoder to locally generate or replicate data for encoding into a data carrier such as an RFID transponder.

[0015]This type of data production and/or replication process is very fast and efficient. There is no absolute need to query a database in real time; hence there is no need for continuous wireless network connectivity. This simplification eliminates the possibilities for non-deterministic network delays. Non-deterministic delays are delays that cannot be guaranteed, usually due to the probabilistic nature of packet collisions that are common in Ethernet and WiFi. By eliminating the need to access a network database, the variable non-deterministic delays caused by changing database sizes, changing record counts, and database user load fluctuations are completely circumvented. Reduction or outright elimination of non-deterministic delays helps manual labor operate at maximum efficiency, allowing them to achieve a regular and dependable cadence in their transponder application processes.

[0016]For example, in one embodiment the present invention consists of an encoder for commissioning RFID transponders. The encoder consists of an RFID interrogator module adapted to enable encoding predetermined data according to a commissioning algorithm and communicating with an internal antenna, the antenna being adapted to encode the predetermined data on the RFID transponder; a memory storage device for storing at least a portion of the predetermined data; a processing means for controlling and communicating with the memory storage device, the RFID interrogator and the internal antenna; a means for providing a supply of RFID transponders, the transponders configured for tensile extraction from the encoder or, preferably from means for providing a supply of RFID transponders comprising a cartridge; and a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable encoding of the predetermined data.

[0017]In further embodiments, the present invention includes a method for commissioning RFID transponders comprising: providing a roll or sheet of RFID transponders; providing a cartridge or other pre-packaged self-contained supply of RFID transponders; providing an encoder; inserting the roll or sheet in the cartridge or other pre-packaged self-contained supply of RFID transponders; coupling the cartridge to the encoder; acquiring information to encode from printed indicia; encoding the information on at least one RFID transponder; and adapting the process of attachment of the encoded transponder to the target surface along a vector that is nearly parallel to the target surface based upon real time feedback from the surrounding environment.

DRWDESC:

DRAWINGS

[0018]FIG. 1 is a block diagram of the system and environment according to one embodiment of the present invention.

[0019]FIG. 2 is a top view of a possible RFID transponder according to one embodiment of the present invention.

[0020]FIG. 3 is a schematic end-view of the RFID transponder of FIG. 2.

[0021]FIG. 4 is a top view schematic drawing of a sheet or roll of a plurality of RFID transponders of FIG. 3.

[0022]FIG. 5 is an offset orthogonal view of a mobile encoder according to one embodiment of the present invention.

[0023]FIG. 6 is a schematic block diagram showing some components of the mobile encoder of FIG. 5.

[0024]FIG. 7 is a schematic cross section view showing electro-mechanical components of one embodiment of a mobile encoder.

[0025]FIG. 8 is a schematic cross section of an encoder according to the present invention.

[0026]FIG. 9 is a frontal-offset view of a hand-held, mobile encoder according to the present invention.

[0027]FIG. 10 is a schematic cross section of another encoder according to the present invention.

[0028]FIG. 11 is a flow chart of a smartphone scan and transponder encode method according to the present invention.

[0029]FIG. 12 is a flow chart of a tagging method according to the present invention.

[0030]FIG. 13 is a flow chart of a commissioning method according to the present invention.

[0031]FIG. 14 is a diagram of a serialization method according to the present invention.

[0032]FIG. 15 is a system block diagram according to the present invention.

[0033]FIG. 16 is a flow chart of a biometric authentication method according to the present invention.

[0034]FIG. 17 is a block diagram of the system and environment according to one embodiment of the present invention.

[0035]FIG. 18 is a top view of a possible RFID transponder according to one embodiment of the present invention.

[0036]FIG. 19 is a material stack specification of an RFID transponder according to one embodiment of the present invention.

[0037]FIG. 20 is a side view of a web of release liner containing RFID transponders, provided on a source roll, stretched tight around a peel device, and advanced forward onto a take-up reel according to one embodiment of the present invention.

[0038]FIG. 21 is a side view of a handheld mobile encoder with an integrated bar code scanner according to one embodiment of the present invention.

[0039]FIG. 22 is a diagram of a smartphone with FIPS 140-2 module and near field couplers according to one embodiment of the present invention.

[0040]FIG. 23 is a flow chart of a first method according to the present invention.

DETDESC:

DESCRIPTION OF THE INVENTION

[0041]Making reference to various figures of the drawing, possible embodiments of the present invention are described and those skilled in the art will understand that alternative configurations and combinations of components may be substituted without subtracting from the invention. Also, in some figures certain components are omitted to more clearly illustrate the invention. In some figures similar features share common reference numbers.

[0042]To clarify certain aspects of the present invention, certain embodiments are described in a possible environment--as identification means for containers. In these instances, certain methods make reference to containers such as loaded pallets, paperboard boxes, corrugated cartons, pharmaceutical containers, and conveyable cases, but other containers may be used by these methods. Certain embodiments of the present invention are directed for use with steel drums, commercial corrugated shipping cartons, tagged pallet-loads of shrink-wrapped cases, consumer-goods packaging, consumer goods, automobile windshields, industrial components, or other methods of identifying objects using RFID transponders or wireless sensors, or both. In certain embodiments the target surface to which a transponder will be attached is a container. In some applications the target surface is moving while the encoder device is stationary. Furthermore the moving target surface may be objects on a conveyor. In yet other embodiments the target surface may be a web of release liner from which encoded transponders will be later removed and applied to an object for identification.

[0043]Some terms are used interchangeably as a convenience and, accordingly, are not intended as a limitation. For example, transponders is a term for wireless sensors that is often used interchangeably with the term tags and the term inlay, which is used interchangeably with inlet. This document generally uses the term tag or RF tag to refer to passive inlay transponders, which do not include a battery, but include an antenna structure coupled to an RFID chip to form an inlay which is generally thin and flat and substantially co-planar and may be constructed on top of a layer of foam standoff, a dielectric material, or a folded substrate. One common type of passive inlay transponder further includes a pressure-sensitive adhesive backing positioned opposite an inlay carrier layer. However, certain aspects of the present invention work equally well with active inlay transponders. A third type: a battery-assist tag is a hybrid RFID transponder that uses a battery to power the RFID chip and a backscatter return link to the interrogator. Further, this document uses programmable RFID transponders interchangeably with RFID transponders. Programmable transponders enable data to be written or stored more than once.

[0044]Suitable environments or applications for certain aspects of the present invention include: traditional conveyor line or other high-speed machinery with automated transponder printing, encoding, and attachment; hand

attachment of transponders (a method that often is referred to as "slap and ship"); and a novel category of mobile transponder encoders (as will be more fully described herein); shipside receiving of automobiles; case picking operations that include selective tagging process steps; and receiving untagged cartons into an RFID-enabled retail store or a manufacturing plant.

[0045]The systems, methods, and devices of the present invention utilize an RFID transponder or wireless sensors as a component. Certain RFID transponders and wireless sensors operate at Low Frequencies (LF), High Frequencies (HF), Ultra High Frequencies (UHF), and microwave frequencies. HF is the band of the electromagnetic spectrum that is centered around 13.56 MHz. UHF for RFID applications spans globally from about 860 MHz to 960 MHz. Transponders and tags responsive to these frequency bands generally have some form of antenna. For LF or HF there is typically an inductive loop. For UHF there is often an inductive element and one or more dipoles or a microstrip patch or other microstrip elements in their antenna structure. Such RFID transponders and wireless sensors utilize any range of possible modulation schemes including: amplitude modulation, amplitude shift keying (ASK), double-sideband ASK, phase-shift keying, phase-reversal ASK, frequency-shift keying (FSK), phase jitter modulation, time-division multiplexing (TDM), or Ultra Wide Band (UWB) method of transmitting radio pulses across a very wide spectrum of frequencies spanning several gigahertz of bandwidth. Modulation techniques may also include the use of Orthogonal Frequency Division Multiplexing (OFDM) to derive superior data encoding and data recovery from low power radio signals. OFDM and UWB provide a robust radio link in RF noisy or multi-path environments and improved performance through and around RF absorbing or reflecting materials compared to narrowband, spread spectrum, or frequency-hopping radio systems. Wireless sensors are reused according to certain methods disclosed herein. UWB wireless sensors may be combined with narrowband, spread spectrum, or frequency-hopping inlays or wireless sensors.

[0046]System and Encoder Overview

[0047]Referring to FIG. 1 the present invention includes a system for commissioning wireless sensors at a point of use and on-demand. For example, in one embodiment, the present invention incorporates a mobile encoder device **30**, which may be attached to a belt of an operator and powered by rechargeable batteries **60**. The mobile encoder is in wireless communication with a remotely located host computer. The operator can selectively (on-demand) enable the mobile encoder to commission a transponder based on various criteria, including input received from a mobile bar code scanner, for example.

[0048]FIG. 1 shows one system **10** according to the present invention in a typical environment, such as a packaging facility wherein a collection of entities with visual external labels **15** exist and a sub-set (or all entities) need to be associated with a wireless RFID transponder, tag, or label. The object **17** needing an RFID transponder could be a packing container having an assorted collection of entities **15**. As entities **15** are pulled from collection **176**, a traditional optical reader **13** (human or machine) interprets the visual external label. Information from the external, visual label is correlated to information stored in a centralized location, represented by a network computer **11** having a database. The information taken by the optical reader **13** is transmitted to the network computer **11**. System **10** includes a wireless connection between the remote computer **20** and the mobile encoder **30** either directly or through a common wireless access point. Additionally, a wireless connection could occur between the remote computer **20** and the host computer **11**, and in this embodiment, the remote computer **20** is in physical connection with the mobile encoder. In yet another embodiment, the remote computer **20** wirelessly connects to both the mobile encoder **30** and the host computer **11**. Optionally, the optical reader **13** can be incorporated in the encoder **30**.

[0049]Referring to FIGS. 3 and 4, in further embodiments, the present invention incorporates a mobile encoder device **175**, **30**, or **220** which may be held in the hand of an operator. Mobile encoder device **175**, **30**, or **220** is preferably powered by rechargeable batteries or a fuel cell. System **170** includes at least four possible intermittently connected entities if they are present and connected: mobile encoder **175**, remote computer or mobile phone **154**, optical reader **173**, and headset **174**. A preferred short range wireless connection means **175**A such as a WLAN (Wireless Local Area Network) or PAN (Personal Area Network) may be established from time to time between mobile encoder **175** and remote computer or mobile phone **154**, optical reader **173**, and/or headset **174**. There is a preference for low power

wireless connection apparatus within mobile encoder **175** so as to realize the greatest possible battery life in light weight mobile encoder **175**. Mobile encoder **175**, **30**, or **220** is in intermittent wireless communication with a mobile phone or computer **154** typically at close range through wireless communication means **175A**. Database and associated host computer **171** may be housed at a remotely located facility that may optionally be accessed over a large distance through remote computer or mobile phone **154**. A mobile phone is a preferred bridge between two or more wireless networks, for example a PAN and a wireless subscriber network that supports wireless data services for ultra mobile and remote tagging applications. Continuous wireless connection to a host database is not required for ongoing tag commissioning process steps disclosed herein.

[0050]RFID tags such as those using EPCglobal numbers requires uniqueness of the numbers that are encoded. GS1 is a central authority that prescribes a set of hierarchies for each key type (type of identity such as an SGTIN) whereby GS1 designates itself as the central issuing authority for each key type. Authority is passed down in a hierarchical manner to member companies. Each member company has the authority to further allocate numbers from its upper level database to as many lower database levels as it deems necessary to distribute number authority throughout its enterprise.

[0051]Quasi-autonomous RFID transponder encoding authority is achieved when an external number issuance authority allocates to the encoder blocks of numbers for specific object classes. A preferred embodiment for quasi-autonomous transponder encoding authority is realized when large pre-authorized blocks of serial numbers are made available to encoder **175** or **30** to utilize on object classes as objects of a class are presented for tagging. A preferred method of providing pre-authorized blocks of object class serial numbers is to subdivide the entire object class serial number space into sectors that are defined by a limited number of MSB's (Most Significant Bits) of the serial number field. The object class serial number space is defined by the number of serial number bits that are used in a specific standard, such as a particular EPCglobal key type, for example an SGTIN-96 and is defined in a corresponding specification such as the GS1 EPCglobal EPC Tag Data Standard. Again using the SGTIN-96 as an example, there are a total of 38 bits used to define the entire serial number space which contains $2^{(38)}$ unique numbers. For example the upper 14 bits could be designated as the most significant bits for a particular embodiment. In that case the object class serial number space would be comprised of 16,384 sectors. Since in this example there are 14 most significant bits within a 38 bit serial number field, there must be 38 minus 14 bits of lesser significance, which equals 24 bits. Therefore the lower 24 bits represent 16,777,216 unique serial number values. Once a sector is allocated to a lower level within an authority hierarchy, it is referred to as a block. Each allocated block of serial numbers represents authority for encoding objects of an object class that can either be used by an encoder for encoding transponders, or allocated to a lower level in the authority hierarchy.

[0052]In a preferred embodiment serial number block sizes are sufficient to operate encoder **175** or **30** for extended periods of time without any further external authorization steps. For example autonomous operation for a week or more is possible with sufficiently large block sizes. In the previous example the encoder could encode over 16 million objects of an object class without the need to reconnect with a higher level authority. If 10,000 objects of an object class are encoded each day, then the encoder could operate in a quasi-autonomous mode for up to 1677 days or over four years without receiving further authorizations from a higher level authority. Block allocations are preferably assigned with reference to how many encoders **175** or **30** are authorized to operate within the facilities of the owner of certain object class numbers.

[0053]Authorizations for one or more classes of objects are preferably loaded into encoder **175**, **30**, or **220** from an external authority where such authorizations include data fields such as manufacturer ID, item reference, manufacturer code lengths, filter values (that designate packaging levels such as item, case, pallet, etc.), serial number starting point for a block, and other pre-determined parameters. Such information is preferably loaded into the memory of the encoder in advance of tag commissioning operations. Thus if loaded with information for more than one object class, encoder **175**, **30**, or **220** does not have sufficient information to proceed with encoding a transponder until a single object class is selected for the present RFID transponder to receive; an ambiguity therefore exists that is preferably resolved with information entered by an operator using either a keypad or a bar code scanner. Reading printed indicia such as a bar

code is a preferred method to resolve the ambiguity as to which object class the next RFID transponder is to receive a number from. Bar codes are used to eliminate errors and ambiguities that enable encoder **175**, **30**, or **220** to locally generate or replicate data for encoding into a data carrier such as an RFID transponder.

[0054]GS1 is a leading global organization dedicated to the design and implementation of global standards and solutions to improve the efficiency and visibility of supply and demand chains. GS1 defines EPCglobal SGTIN number fields as having a company prefix, an item reference, a partition value, and a filter value that comprise the object class information. A unique serial number is then added to that information to create each unique instance within each object class.

[0055]In a preferred embodiment, a block is allocated and managed using three numbers: a starting number that is the first serialized instance of a block, a block size which represents the total number of instances in the block, and a counter or index that represents how much of the block has been used during an encoding process. Using these three numbers and an optional lock bit, a simple database of object class authorizations can be built.

[0056]A preferred embodiment utilizes RFID authorization transponder **178**A and a printed substrate **178**B to physically handle object class serial number issuance authorizations. Authorization transponder **178**A is interrogated by transponder reading/encoding means **175**H. Preferred embodiments use the 96-bit EPC memory bank for specifying the block starting number, including the company prefix, item reference, partition value, filter value, and base serial number. The User Memory bank is used to hold and transfer the block size (preferably 16-bits), counter or index value (preferably 16-bits), a 16-bit header to identify the transponder as a valid member of a class of authorization transponder, a lock bit, and a CRC value to detect errors in all of the data fields. For example a CRC error would detect errors in storage, transponder selection, or data transmission. In preferred embodiments reading of data blocks from more than one RFID transponder would be avoided by selecting a transponder, checking that it is the correct type, contains valid authorization data, contains a valid header that signifies that it is an RFID authorization transponder **178**A, and that all data read correctly verifies with a dedicated error detection field such as a CRC.

[0057]RFID authorization transponder **178**A is preferably adhered to printed substrate **178**B so that an operator can visually identify what object class or SKU is managed by the affixed authorization transponder **178**A. A picture, icon, bar code, or human readable symbols are all useful for identifying the object class. An operator presses a button or scans a bar code that prompts encoder **175** to read and store the tagging authorization held by authorization transponder **178**A. Once read, authorization transponder **178**A is preferably electronically marked as 'consumed' or 'locked' by transponder encoding means **175**H. EPC transponder ID fields that identify a specific type of chip are preferred for selecting the proper transponder, even when other RFID transponders are within range of the antenna or near field coupler of transponder encoding means **175**H.

[0058]A collection of authorization transponders **178**A comprises a database that can be physically transported without the need for a wireless communications link to encoder **175**. Once read, database records are preferably stored in internal memory means **175**G. In a preferred embodiment 12 to 14 bytes of Flash memory is used for each record to allocate 250 to 65536 instances of an object class, whereby the first byte of an EPC number is a fixed header value can be replaced in Flash memory by 8 bits of the allowable block size. One or two bytes in RAM are used to count or index through the block allocation as it is used. Thousands of data records of this type can easily fit into the memory space of an economical 8-bit microcontroller. In a preferred embodiment, where the GS1 SGTIN-96 header is replaced in memory with an 8-bit block size authorization, 300 records for authorizing up to 255 instances per record, can be used to safely manage at least 500,000 tagging records using 24,000 bytes of Flash memory and 2000 bytes of RAM. Other embodiments using more bits to authorize and control larger blocks of numbers is possible at a slightly larger expense of memory.

[0059]A preferred embodiment uses a computer, preferably a smartphone such as an iPhone from Apple Inc. of Cupertino, Calif. as a lower database level to transfer encoding authorizations from upper level database authorities to RFID encoders. A smartphone such as the iPhone or an Android phone using software from Google would be a

preferred embodiment of a lower database level and or an encoder using an antenna or near field coupler similar to near field coupler **224A2** of FIG. 21 or 238*a* or **238***b* of FIG. 22 to couple with RFID transponders for encoding and verification. The iPhone also has cellular data transmission radios and software stack to enable the iPhone to access remotely located servers in a cloud computing architecture.

[0060]The smartphone establishes a connection with a cloud-based server using JavaScript, ASP, JSP, PHP, Perl, Tcl or Python scripts to access a database such as mySQL that is available from Oracle Corporation of Redwood Shores, Calif. Using structured query language, SQL database tables are preferably used to store tag commissioning data, configuration information, and serial number block allocation records. SQL queries provide information from database tables to the script, passing the result over the Internet, to the smartphone, which also then routes information to designated RFID encoders. Encoders are preferably identified by their media access control (MAC) address or a UUID which is guaranteed to be unique and is used by the smartphone as a lower database level to transfer encoding authorization to a specific encoder.

[0061]Preferred embodiments of encoder **175**, **30**, or **220** will encode all of the GS1 identity types. Such types include the General Identifier (GID-96), Serialized Global Trade Item Number (SGTIN), Serial Shipping Container Code (SSCC), Serialized Global Location Number (SGLN), Global Returnable Asset Identifier (GRAD, and the Global Individual Asset Identifier (GIAI). Other preferred embodiments are used to encode numbers that are a part of other numbering systems.

[0062]Data records are preferably loaded and stored through commands that are transmitted over wireless communication means **175**A. In preferred embodiments, batch mode commands can be used in any of three ways: (1) to immediately affect the current operation by starting a batch tagging process for a specified SKU or object class; (2) to store authorizations in memory means **175**G; and (3) to store authorizations in stored-value RFID transponder **178**A.

[0063]When external connection is necessary, wired or wireless communication with an external host or numbering authority is established. Wireless communication means **175**A is preferably a Wi-Fi or Bluetooth connection. A wireless node of a Bluetooth personal area network is used according one embodiment of the present invention. Model 100-SER manufactured by EmbeddedBlue of Poway, Calif. and the BISMS02 from EZURiO Ltd., a subsidiary of Laird Technologies, Inc. of Chesterfield, Mo. are examples of preferred OEM Serial Bluetooth modules. Other wireless interfaces may alternatively be used to achieve Serial Port Profile and other types of connectivity between encoder **175** and remote computer or mobile phone **154** and/or optical reader **173**.

[0064]Other preferred embodiments of mobile encoder **175** and system **170** replace wireless communication means **175**A with a cable, resulting in an embodiment of mobile encoder **175** with a tethered bar code scanner. A key advantage of an alternative embodiment of system **170** that utilizes a wired connection to optical reader **173** instead of wireless communication means **175**A is a very simple solution having virtual immunity to any surrounding RF interference that might raise the noise floor hindering wireless communications.

[0065]The operator can cause mobile encoder **175**, **30**, or **220** to commission a transponder by scanning certain printed bar code symbols received through optical reader **173** which is connected to encoder **175** through wireless communication means **175**A. Or alternatively internal optical reader **175**F is used to scan printed bar code symbols. In either case data from optical reader **173** or **175**F is delivered to processing means **175**B. Certain preferred embodiments of system **170** use optical scanners with self-contained symbol decoding capabilities to deliver decoded symbol information to processing means **175**B. Certain other embodiments of system **170** relies on processing means **175**B to conduct some or all decoding operations to derive information from scanned symbols.

[0066]The information derived from the optical reader **173** or **175**F is used by mobile encoder **175** to either directly or indirectly encode data into RF transponder **178** while it is still physically within mobile encoder **175**. Mobile encoder **30** uses external optical reader **173**, and alternatively mobile encoder **220** uses internal optical reader **175**F, as embodied in reader **226** of FIG. 21. Preferred embodiments of optical reader **226** are mechanically aligned relative to transponder

encoding means **175**H or more specifically with the antenna or near field coupler of RFID interrogator **224**A. Spatial alignment assures that an operator will be able to comfortably scan bar codes and then encode and apply RFID transponders along a line of movement such that the operator can easily assure proper placement of encoded transponders.

[0067]Symbol decoding functions may be physically, electrically, or logically separated from symbol scanning operations. One preferred embodiment of optical reader **173** is a model CHS-7M, CHS-7P, CRS-9M or CRS-9P Bluetooth ring scanner.

[0068]Processing scanned commands involves a processing step to determine that a bar code should be interpreted as a command or configuration instructions rather than as bar code **179** that identifies an object that is to be tagged. Commands are used to alter the flow and operation of mobile encoder **175**.

[0069]FIG. 21 is a preferred embodiment of a mobile encoder wherein optical reader **226** is an OEM bar code scanner manufactured by such companies as Intermec or Motorola and is a preferred embodiment of optional internal optical reader **175**F shown in FIG. 17.

[0070]In a preferred embodiment one or more bar codes are pre-printed and applied as symbol **179** on entity **177** in a manufacturing facility or other suitable location. Such bar codes are described in ISO/IEC draft document PDTR 24729-1 and are more generally referred to as one or more bar codes having Application Identifiers (AI) 01 and 21 encoded into them, and preferably include header information and other control bits that are required for certain protocols. AI 01 is used to represent the Stock Keeping Unit (SKU) as a GS1 Global Trade Item Number (GTIN). AI 21 is used to serialize the SKU. Together the two AI's are used to specify a GS1 serialized GTIN (SGTIN). Bar codes can also be used to specify data payloads that use numbering systems other than the EPC numbering system. The Application Family Identifier (AFI) also plays an important role in designating alternative numbering authorities.

[0071]This preferred method that is described by the flow chart in FIG. 23 will allow batch mode operation where there are at best intermittent connections with remote computer **154**. This preferred method allows existing label application and/or printing hardware located on existing manufacturing lines to provide in printed symbolic form all data that would be encoded into an RF transponder. By providing printed symbols, manufacturers do not have to incur either the cost of that transponder or the special equipment that is required to encode and apply RF transponders.

[0072]Optical reader **173** or **226** is described above and is used as the primary source of real time data input for the mobile encoding system that uses an embodiment such as mobile encoder **30** or **220**. Optical reader **173** or **226** is also preferably used to scan special bar codes that instruct mobile encoder **175**, **30**, or **220** to perform certain prescribed functions which will be described below.

[0073]Certain preferred embodiments of system **170** include headset **174** which may be a headset worn by the operator or a Bluetooth-linked loud speaker that is mounted to a pallet jack or fork lift truck. Headset **174** is optionally used by system **170** to give instructions, confirmation signals, or warnings to the operator. Synthesized speech or audible tones are used to interact with the operator through headset **174**.

[0074]In these aforementioned embodiments, the mobile encoder **30** is a portable device that can be easily mounted in a fixed location, carried such as mobile encoder **220**, or worn by a human operator such as mobile encoder **30**, or hung from a suspended retractable tool cable. As such, the mobile encoder **30** includes an internal power source **175**E such as a rechargeable lithium-ion battery and would further include a handle or a belt-clip for ease of use. In another embodiment, the mobile encoder can be attached to a high-speed conveyor line. In such an application, the on-board battery could be replaced or augmented by a physical connection to a remote power source. Further, the computer **20** could have wired connects to the host network **11**. Further details of possible configurations of the mobile encoder will be further detailed in subsequent sections of this disclosure.

[0075]In the system **10** of FIG. 1, the mobile encoder **30** carries a supply of un-commissioned (or blank), or

securely encodable RFID transponders **175**J, **185**, **42**, or **221**E. Once the desired data is accumulated and presented to the encoder **30** from the computer **20**, the encoder commissions an RFID transponder, using transponder transport means **175**C and transponder encoding means **175**H and any one of several preferred encoding algorithms to program, creating an RFID tag or label **50** for the object **177**. Transponder separation means **175**D is used to separate a properly encoded transponder **178** from release liner conveyance web **182** by breaking the bond at adhesive layer **181**D on the leading edge of transponder **178**. Transponder separation means **175**D is preferably a peel device **183** as shown in FIG. 20 or peel device **222**B in mobile encoder **220**. Peel devices **183** or **222**B are preferably made from anti-static plastic, metal, or other material that will conduct electrostatic charge away from transponder **178** and release liner **182**. The commissioned tag or label **50** can then be applied, linked, or otherwise associated with the object by known means including a human operator or a machine transfer.

[0076]RFID Transponders

[0077]FIG. 2 shows a preferred embodiment of an RFID transponder **50**. RFID transponders, in some embodiments, comprise an RFID integrated circuit (IC) device (or "chip") **56** of FIG. 3 or 180 of FIG. 18 bonded to an antenna apparatus, formed on a substrate that is often plastic such as Mylar[#174], polyester, or PET. One way to form an antenna structure is to etch copper from a substrate. An alternate printed transponder includes printing multiple layers of conductive ink onto a substrate. One additional method includes stamping UHF antennae from thin sheets of aluminum, or by selective aluminum deposition onto a substrate. In certain embodiments, RFID transponders and wireless sensors are recovered from waste streams for reconditioning, reprogramming, and reuse.

[0078]Other suitable RFID transponders include designs that combine a dielectric spacer behind the antenna by separating the metallic antenna inlay **181**C from surrounding metals that may detune it, or liquids that may absorb RF energy from it. The dielectric spacer creates a transponder that performs well over a broad range of packaging conditions. The dielectric material is a foam standoff material or an expanding mechanical structure that provides lift from the target object and also a more robust design also includes features to protect the transponder from damage.

[0079]In certain embodiments, the RFID transponder is both programmable and mechanically configured for tensile extraction from a protective enclosure.

[0080]In preferred embodiments, hundreds or thousands of instances of RFID transponder **178** are manufactured on a continuous web of flexible material with a spatial separation between them, preferably at regular intervals. Certain preferred embodiments use adhesive-backed transponders **178** adhered to release liner **182** as shown in FIG. 20, while other embodiments use the transponder material as its own conveyance that is severed from the rest of the web at predetermined locations, preferably after encoding and verifying transponder **178** is properly functioning.

[0081]In preferred embodiments of the present invention, the face stock material has a physical outline that is not much larger than the physical outline of the inlay itself. This is in contrast to labels which can have at least twice the surface area of the inlay or a direct-printed antenna structure in order to provide space for printed information. By having a label outline that is so much larger than the inlay surface area, there are a many possible combinations of inlay placement within the boundaries of a large printable label. This creates a problem and a challenge for printer/encoders that have to find and locate an inlay before attempting to encode it. By contrast, the present invention uses the detectable optical characteristics of the tag's minimal physical outline to position the transponder for encoding. This transponder positioning method is superior and an improvement over prior art that uses printed label stock as a carrier for RFID inlays wherein the physical dimensions of printed labels are not in any way a reliable indication of the location of the RFID inlay within the label. This is another example of how demand label printing further complicates RFID transponder encoding.

[0082]In one embodiment that is an exception to the minimal outline transponder design and positioning method described above, transponders that have a very long physical shape can be used to create a loop to secure an encoded transponder to a tree, a bush, or the handle of a piece of luggage. Preferred embodiments of such transponders are

folded or rolled in order to package them onto a dispensing roll or packaged into a magazine or cartridge in a fan fold pattern. The resulting bundle of back-and-forth 'Z' folded or fan folded face stock material results in a compact package that minimizes the amount of release liner that needs to be wasted for each tag. Each z-folded transponder is then easily encoded and dispensed from encoder **175**, **30** or **220**. Transponders that can be encoded, verified, dispensed, and unfolded are advantageously used in forestry, ornamental nurseries, and airline baggage tracking applications where manual tagging is required.

[0083]In another embodiment, transponder **178** is pushed out of encoder **175** instead of being pulled out through tensile extraction. A transport mechanism for pushing transponders utilizes a gripping method such as friction or teeth that penetrate the webbing. Although there is a risk of jamming or mutilating the webbing, the advantage is that there is no need for a release liner to pull the transponder supply through encoder **175** using tensile extraction. A preferred 'tractor feed' embodiment mitigates the risk of web mutilation by utilizing a regular pattern of precut holes along one or both edges of the webbing, into which cog members of a drive mechanism engage to advance the webbing. A tractor feed embodiment is part of Transponder Transport Means **175**C of FIG. 17 whereby a motor and gear train delivers drive torque to the web through friction rollers, penetrating teeth, cogs, or other mechanical engagement means. In such an embodiment, the preferred transponder separation means is a web cutter that is used to separate encoded transponders from unencoded tags. A web cutter can be either active or passive, in other words cutting force can originate with a motorized mechanism or with an operator's handling during dispensing and transponder detachment. A row of plastic or metal saw teeth is a preferred embodiment of a passive transponder separation device.

[0084]In another preferred embodiment, transponder **178** is manufactured on a high speed press, a bar code is printed onto face stock of transponder **178** and information that is representative of that bar coded information is also encoded into microchip **180**. Then encoder **30** or encoder **220** preferably read that information from RFID microchip **180** and associate it with a transponder commissioning process that may or may not include the programming of additional information into RFID microchip **180**. This is a novel method of reading bar coded information on transponder **178** without using a bar code scanner to do so within encoder **30** or **220**.

[0085]In one embodiment, additional transponder layers include a thin and flexible energy cell comprising two non-toxic, widely-available commodities: zinc and manganese dioxide. One suitable energy cell is developed by Power Paper Ltd. of 21 Yegia Kapayim Street, Kiryat Arye, Petah Tikva, P.O.B. 3353, ISRAEL 49130, and incorporates an innovative process that enables the printing of caseless, thin, flexible and environment-friendly energy cells on a polymer film substrate, by means of a simple mass-printing technology and proprietary inks. The cathode and anode layers are fabricated from proprietary ink-like materials that can be printed onto virtually any substrate, including specialty papers. The cathode and anode are produced as different mixes of ink, so that the combination of the two creates a 1.5-volt battery that is thin and flexible. Unlike conventional batteries, this type of power source does not require casing.

[0086]A top layer of an RFID transponder assembly optionally comprises a paper face-stock **181**A, which is a very low-cost material but also is the least environmentally resilient. UV-resistant plastic face-stock **181**A generally provides the best survivability in outdoor and rough-service environments, and also provides the best protection for the RFID transponder assembly.

[0087]A bottom layer of pressure-sensitive adhesive (PSA) **181**D often is used for attachment of transponders to objects and often is referred to as a wet inlay or a wet tag or a wet transponder because of adhesion layer **181**B. Alternatively, a layer of clear, translucent, or opaque adhesive-backed film or tape is used to attach the transponder or wireless sensor to object or container. The tape, any thin, low cost, flexible material with a self-adhesive backing, such as a conventional packing tape, is well-suited for this method of attachment. The tape may be formed into various shapes to achieve the requirements of this method. Certain embodiments may use tape that is preprinted with certain logos, marks, symbols, bar codes, colors, and designs. Suitable adhesive-backed tape must not--or at least minimally--absorb radio frequencies within the range of frequencies used by the transponder or tag. The tape material, also, must not corrode the device or otherwise hamper its functionality.

[0088]Certain embodiments use a type of packing manufactured specifically for a given encoder. Packing tape can be single-coated pressure-sensitive adhesive tape or, alternatively, media constructed with multiple layers including a backing layer. Certain backing layers are constructed on a plastic film having one or more layers. Certain backing layers are made from plastic resins such as polypropylene (PP), polyethylene (PE), or copolymers of PP, PE, PVC, polyesters, or vinyl acetates. Certain embodiments of PP are mono-axially oriented polypropylene (MOPP), bi-axially oriented polypropylene (BOPP), or sequentially and bi-axially oriented polypropylene (SBOPP). Certain backing layers are biodegradable. Certain backing layers are coated with a pressure sensitive adhesive on one side and a low adhesion release coating on the other side to reduce the amount of power required for the encoder to unroll the tape for application.

[0089]FIG. 3 shows a possible embodiment of an RFID transponder **50** that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer **52** bonds with antenna layer **54** that is bonded to inlay substrate layer **58** and integrated circuit **56**. Inlay substrate layer **58** and face-stock layer **51** provide resistance against electrostatic discharge (ESD) into antenna layer **54** or chip **56**.

[0090]Other constructions for RFID transponders include one or more additional layers of high-dielectric material that encapsulate or substantially cover the inlay. In general, the thicker the dielectric layer the higher the voltage must be to initiate a flow of electrons through a dielectric layer. This results in higher ESD voltage ratings. Also, it is well known to those skilled in the art that thicker dielectric layers between antenna layer **54** and any other metal or liquid also tends to reduce parasitic loading of the antenna whereby maintaining antenna tuning for proper coupling to interrogators within a specified UHF band. In such embodiments, the integrated circuit chip and antenna bond to an adhesive layer and are protected from a discharge path through the tape layer by its particular thickness of dielectric material. A second dielectric layer bonds to the inlay substrate by a second adhesive layer, so that a low voltage discharge path is nonexistent around the two layers of tape substrate.

[0091]In another possible embodiment of an RFID transponder, the inlay substrate provides a second layer of ESD resistance against a discharge path through an outward-facing tape layer and associated adhesive layer. This construction protects the antenna and chip from electrostatic discharge originating from any direction. The encapsulation tape layer bonds to the antenna and chip via an adhesive layer and provides no adhesive bond to the transport container when the transponder is commissioned, and therefore depends on separate adhesive zones to attach to the container of interest.

[0092]In another possible embodiment, an RFID transponder includes multiple layers of ESD resistant material. For example, an outer layer substrate bonds to an inner substrate by an intermediate adhesive layer. A second adhesive layer bonds with the chip and antenna. The inlay substrate faces inward and presses against a transport container when the transponder is commissioned.

[0093]The contemplated adhesives in the various RFID transponder embodiments create strong and permanent bonds between tapes and inlay layers over a certain practical range of operating temperatures.

[0094]Because RFID transponders are designed to adhere to a container, one face of an external layer includes a pressure-sensitive adhesive. This external adhesive, however, must not cause mechanisms associated with the commissioning devices to jam. To prevent unwanted sticking of the RFID transponder, a transport layer protects the sticky, external adhesive. The transport layer is either a release liner such as a silicone-treated paper liner or a net (or mesh) web. A net or mesh web offers two principal advantages: less weight and being recyclable or reusable. A comparison of the weight of a net with a higher percentage of open area to a typical sheet of release liner reveals that the netting is lighter for any given section of comparable size. Environmental problems of disposal of release liner are well known. Mesh or netting, comprised of recyclable resins, is recovered after each use so that the mesh or net can be either reused or recycled for its constituent materials.

[0095]In one possible embodiment the mesh or netting is made of plastic such as nylon, polypropylene,

polyethylene, HDPE, Teflon, or other resins. In other embodiments the mesh or netting is fabricated from metal or carbon-impregnated plastic to provide a conductive path to bleed electric charge away from points of accumulation.

[0096]Other advantages of a net or mesh transport layer include a substantial percentage of the adhesive not in contact with anything during storage and commissioning. When stored in a roll, a small percentage of the adhesive layer makes contact with the backside of the roll through the openings in the mesh. Thus, a small amount of energy is required to unroll the spool during transponder commissioning, yet there exists a certain amount of adhesion to prevent a converted spool from unraveling.

[0097]In other possible embodiments, the RFID transponders can include a surface suitable for human or machine readable, visible, external markings including bar-code symbols or alpha-numeric sequences.

[0098]FIG. 4 shows another embodiment of RFID transponders **50** grouped on sheet stock **59** such as rolls or z-folded sheets that enables a plurality of transponders to be carried on a continuous web or traditional release liner. Other certain embodiments use transponders that are stacked and loaded into magazines for transport, handling, and automated dispensing. In certain embodiments, the magazines contain metallic shielding to protect transponders and inlays from electrostatic discharges (ESD).

[0099]In certain embodiments an RFID encoder is combined with a sensor suite **218** as shown in FIG. 10 to enable semi-automated tag application to desired objects. In one embodiment, a semi-automatic encoder/applicator is created by integrating a single sensor device. The sensor responds to changes in light, capacitance, pressure, acoustics, or optical path length to a transport container. In another embodiment a suite of sensors are used to detect the attachment location of a commissionable transponder.

[0100]For example, changes in capacitance are detectable using certain QProx charge transfer capacitance sensors available from Quantum Research Group Ltd. of Hamble, England. Ultrasonic range sensors are available from supplier such as muRata Manufacturing Co., Ltd. of Kyoto Japan under the trade name Piezotite. Optical path length sensors are available from Keyence Corporation of Osaka, Japan. Sharp manufactures a compact distance-measuring sensor GP2D02 that is responsive in the range from 5 to 100 cm. Thus, when a predetermined set of conditions is realized, the sensor triggers, enables, or selects a desired action. In one embodiment, proximity or contact of sensor suite with the targeted transport container causes a second type of Trigger Event, resulting in the commissioning and dispensing of a transponder by an encoder.

[0101]In other embodiments, sensor **218** is designed to determine the distance an encoder resides from an object that is to be tagged. Range information is acquired and processed in real time to determine if the encoder is in Close Proximity, Near, or Far from a transport container. In certain embodiments a controller is programmed to alter threshold distances between each range category and to associate a function with each range. In certain embodiments, range category Close Proximity is associated with transponder programming and application functions. For example, the range category Near is reserved for transponder verification and/or reading functions; and Far is reserved for bar code scanning functions to verify that bar code information aligns properly with RFID transponder data.

[0102]In other embodiments a sensor suite is responsive to certain colors or patterns and uses that information to instruct the placement or detect the correct locations for applying good transponders and separate locations for discharging bad transponders.

[0103]FIG. 20 also shows how transponders **178** are rolled onto reels in preparation for encoding. Source roll **185** contains a supply of transponders ready for encoding. Release liner **182** conveys transponders **178** around peel device **183**. Unless transponders **178** are mechanically prevented from rotating around peel device **183**, they are conveyed onto take-up roll **184**. Take-up reel **184** advances forward while source roll **185** lags behind due to drag created by a clutch, brake, motor or other back-torque generating device. Opposing torques of take-up reel **184** and source reel **185** result in tension in release liner web **182**. Shape memory in face stock **181**A preferably prevents transponder **178** from remaining

adhered to release liner **182** as it passes over peel device **183**, resulting in the leading edge lifting off and separating from webbing **182**. If take-up reel **184** continues to advance, and transponder **178** does not collide with another object, its attachment to release liner **182** on its trailing edge will result in that transponder being passed completely around peel device **183** onto take-up reel **184**. Full path rotation is preferably reserved for transponders that fail to properly encode desired information; and is therefore intended to be a reject process for failed transponders. Preferred embodiments result in tension created in web **182** in a process of tensile extraction of transponders from a source reel and selective transfer of good transponders onto an object or a person's finger. Mobile encoder **30** depends on a person's finger to prevent transponders **178** from rotating around peel device **183**. Mobile encoder **220** depends on a target object such as carton face **228** to prevent transponder **223**B from rotating around peel plate **222**B on a path toward take-up reel **221**J.

[0104]When the conveyance of RFID transponders results in the positioning of a transponder relative to a near field coupler within a signal null, the transponder and transport webbing are preferably nudged forward or backward to improve the signal coupling. This is preferably accomplished by momentarily activating the motor and transponder transport means **175**C.

[0105]Mobile Encoder

[0106]FIG. 17 shows a system **170** according to one embodiment of the present invention including a mobile encoder **175**. FIG. 5 shows a preferred embodiment for a mobile encoder. Mobile encoder **30** is comprised of housing **32**, belt clip **34**, antenna **36**, on/off switch **33**, system ready LED **37**, data ready LED **38**, and transponder ready LED **39**. It is further comprised of auxiliary switch **40**, and charger plug **41**. A cartridge or other pre-packaged self-contained supply of transponders **42** is preferably latched, snapped, clicked, popped, inserted, slid, or releasably mounted to the body of housing **32**. The cartridge preferably includes a take-up reel **44** for non-dispensed RFID transponders, and a port through which blank or securely encodable transponders emerge from source reel **43**. The source reel is preferably comprised of a core which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge **42** to form an axle around which release liner and transponders are wound and subsequently unwound.

[0107]In certain preferred embodiments source reel or roll **43** is constructed using materials such as non-petroleum-based plastics, laminated paper layers, and materials primarily comprised of natural fibers. In another preferred embodiment the entire pre-packaged self-contained supply of unused transponders is transported to mobile encoder **175**, loaded into it, consumed, and disposed of preferably without generating landfill waste.

[0108]A key aspect of this invention is a complete pre-packaged, pre-assembled, pre-threaded, self-contained supply of encodable transponders, preferably unlocked with cryptographic access methods. The supply is preferably configured for efficient transportation and shipping, conveyance to a work site, and easy loading into mobile encoder **175**, preferably in a single fluid motion.

[0109]FIG. 21 is a preferred embodiment of system **170** wherein printed symbols are optically scanned by internal optical reader **226**. The embodiment shown in FIG. 21 uses a preferred method of sensing the linear motion of mobile encoder **220** across a target surface by using an optical mouse sensor **225**. Such devices are commonly used to track the hand movements of the operator of a computer. Motion in either the X or Y direction is translated into numerical displacement representations which when timed are converted into linear velocities. Tracking and processing the primary axis of motion parallel to the major axis of the release liner, the web speed is preferably controlled by processing means **175**B and transponder transport means **1750** such that transponder **223**A advances at a rate of speed that matches the velocity of the entire mobile encoder across the target surface. Optical mouse **225** tracks displacement across the target surface and also acts as a tamp head to strengthen the adhesive bond of each freshly applied tag. The process of attachment of the encoded transponder to the target surface is along a vector that is nearly parallel to the target surface at a speed that is based on real time feedback from the surrounding environment as sensed by the optical mouse or other sensor. Optical mouse sensor **225** preferably illuminates its target surface with either a LED (Light

Emitting Diode) or a laser. Avago Technologies of San Jose, Calif. manufactures a variety of mouse sensors, both LED-based and laser-based. Laser illumination provides smooth and accurate motion sensing across a variety of surfaces. The model ADNS-6150 small form factor lens working in conjunction with the ADNS-6530 integrated chip-onboard laser sensor and single-mode vertical-cavity surface emitting laser can be used to not only detect motion in the X and Y directions, but also to some degree in the Z direction. Displacement along the Z (depth) vector is reported by the decrease in the number of resolvable features within the field of view as the target surface fades away from the optical focal point. That measurement is reported in the surface quality (SQUAL) register.

[0110]Optical mouse sensor **224**B is used to measure the linear velocity of transponders as they move along the path of the release liner toward peel device **222**B, as well as sense the gaps and edges between transponders **223**A and those adjacent to them. The physical outline **178** of transponders **223**A are a reliable indication of the location of RFID inlay **181**C located within each transponder **223**A and enhance system performance with reliable positioning relative to near field coupler **224**A2. The angular velocity of motor **227**B and gear train **227**A are controlled to achieve a linear transponder velocity that matches the velocity of the mobile encoder itself as it moves across the target surface. Therefore an operator with a fast hand motion is just as successful as a person with a slower hand motion, both will result in a transponder that lays flat, co-planar with the target surface, void of kinks or wrinkles that are characteristic of a poorly controlled transponder application process. In either case, transponder dispensing by transponder transport means **175**C will not initiate until optical mouse sensor **225** preferably illuminates the target surface and detects a minimum number of valid features as reported by the SQUAL register internal to the ADNS-6530.

[0111]RFID Interrogator **224**A encodes RF transponders using either LF (Low Frequency), HF (High Frequency), UHF (Ultra High Frequency), or microwave radio energy. Transponders may be powered by radio energy, light, or stored energy from a source such as a battery. RF coupling is preferably through a near field coupler, an inductive loop or other suitable transducer **224**A2 connected to interrogator **224**A to focus RF energy on a small area within mobile encoder **175**, **30**, or **220**.

[0112]Certain preferred mobile encoder embodiments will not encode RF transponders that fail authenticity tests. In a like manner, RF transponders will preferably not allow themselves to be programmed unless the interrogator can successfully unlock its secured memory banks. This is a preferred method of protecting transponder cartridge and mobile encoder supply chains from counterfeits and knock-offs. Mobile encoder **175** and the transponders loaded into it will only be successful in exchanging certain data if certain data encryption and challenge response protocols are adhered to. In a preferred embodiment each authorized RFID transponder converter company uses one or more encryption keys to generate passwords that lock the RF tags, whereby preventing them from being programmed unless they are unlocked using the same password. Passwords of this type are specified in the EPC Gen 2 specification and in ISO standards. The passwords are preferably generated by processing means **175**B using a public key from publicly readable data such as an asset number or a transponder serial number. A shared private key is then used by an encryption algorithm such as AES in order to create a password or a collection of passwords that can be used to lock or unlock one or several RF tags. Other methods may be used that provide a high degree of certainty that the both the transponders and the mobile encoders are from legitimate sources. Individual failures or patterns of authentication failures are preferably reported to a central database through wireless communications means **175**A for subsequent fraud investigation.

[0113]Peel device **222**B is part of the mobile encoder and preferably rotates or pivots about pivot point **222**A into position **222**C and a corresponding position (not shown) in FIG. 21. Peg **221**K helps guide the web to peel device **222**B. When cartridge **221** is inserted into applicator body **227**F the web is held in a non-interfering position by guide post **221**F and its accompanying cartridge guide post such that peel device **222**C can self-thread around the transport web without human effort. This is an improvement over prior art where a peel device is an integral part of the pre-packaged self-contained supply of transponders and requires threading during the cartridge manufacturing process.

[0114]Peel device **222**B preferably contains a shield on the outer face of the blade, through which radio energy will not pass to encode or interact with a rejected transponder **223**B. The dielectric material of the peel device **222**B provides

sufficient separation from a transponder within the encoding zone and the shield on the back side of the peel device. This is another advantage over a peel device that is part of the cartridge, where the cost sensitivity is much more acute. The shielding on the back side of peel device **222**B may be any suitable metal attached or adhered in any reliable or economical manner against the non-conductive dielectric structure of the peel device.

[0115]Rejecting transponder **223**B requires that mobile encoder transponder peel device **222**B have sufficient clearance from target surface **228** as determined by optical mouse sensor **225** using either the SQUAL reading or the shutter readings. Such readings are used to determine if there is sufficient space to advance and rotate a bad transponder **223**B around the distal end of peel device **222**B.

[0116]FIG. 1 shows a system **10** according to one embodiment of the present invention including a mobile encoder **30**. And, FIG. 5 details one possible mobile encoder **30**. In this embodiment, the encoder can attach to the belt of an operator, accordingly, mounted on the housing **32** is a belt mounting means such as belt-clip **34**, which easily adjusts for left-handed or right-handed operation and corresponding mounting on the belt (not shown) of the operator. An external antenna **36** enhances wireless connectivity to a host or network computer (not shown in this view), or to a remote-mounted computer device such as a PDA or bar code reader. Several operator indicator lights **227**E including a system-ready LED **37**, data-ready LED **38**, and tag-ready LED **39** mounted on the housing enabling the operator an easy view of the device status.

[0117]Also included on the exterior of the housing are an external, power-cord receptacle **41** so that the on-board lithium-ion, nickel metal hydride, or other appropriate battery **227**D may be charged as required. A combination on/off-next switch **33** enables the operator to selectively power up the encoder. A reset port, such as a recessed reset button (not shown in this view), enables an operator to reset the software settings of the device circuitry on control board **227**C as may be required.

[0118]A cartridge **42** containing a plurality of RFID transponders releasably mounts to a face of the housing **32**. The cartridge further includes a take-up reel **44** for non-dispensed RFID transponders, a port **46** (above take-up reel **44** but not shown in FIG. 5) for dispensing commissioned transponders, and a supply reel **43** for holding blank RFID transponders prior to commissioning.

[0119]In further embodiments, a cartridge **221** containing a plurality of RFID transponders releasably mounts to the body of housing **227**F. The cartridge further includes a take-up reel **221**J for collecting release liner and non-dispensed RFID transponders, and a port through which blank or securely encodable transponders emerge from source reel **221**E. The source reel is comprised of core **221**A which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge **221** to form axle **221**B around which core **221**A rotates. Brake shoes **221**C create drag, resulting in back torque on the source core, the magnitude of which is controlled by screw **221**D which with a knob (not shown) is used to adjust the force applied by brake shoes **221**C. The back torque for cartridge **221** is alternatively developed through a motor or an expandable friction coupling into a brake mechanism attached to encoder body **227**F.

[0120]Take-up core **221**H is driven by a tight coupling with drive hub **221**G. This tight coupling is achieved through a combination or selection of tight fit, expandable coupling, and sharp teeth. The result is a hub that will easily slide in or out of core **221**H with little effort, but still be capable of delivering a substantial amount of drive torque through that connection without slippage. Drive torque is delivered from gear motor **227**B to hub **221**G through drive gear **227**A the teeth of which engage with each other as cartridge **221** is set into position and locked into place.

[0121]In a preferred embodiment, mobile encoder **30** cryptographically unlocks, encodes, and verifies each transponder one by one. In preferred embodiments, transponders are verified more than once. One time immediately after programming with a desired data payload, and then again a second time after encoder **220** automatically dispenses an RFID transponder **223**A onto target surface **228**. This second verification step insures that the properties of target surface **228** or other nearby materials do not adversely affect the performance of transponder **223**A.

[0122]In another preferred embodiment, encoder **220** is used to encode and dispense a pattern of several transponders **223**A onto a target surface **228** at regular intervals in order to map the surface of a container for example in order to determine an optimal location for a placement of transponders. This information is then preferably used for engineering and planning purposes for high-volume transponder application in a production or distribution facility. Transponders may be designed for operation in any or all of the UHF, HF, LF, or microwave frequency bands.

[0123]In one alternative embodiment, the mobile encoder **64** includes a handle (as FIG. 9 shows, for example) for hand operation of the encoder. In another contemplated embodiment, the mobile encoder is fixed to an assembly line in a stationary manner. Accordingly, the stationary-mounted encoder further includes machine-controlled devices for extracting a commissioned RFID transponder from the encoder and places the transponder on the container of interest by means well understood in the art.

[0124]In the aforementioned embodiments of the mobile encoder **30** (or hand-held encoder **64** of FIG. 8 or FIG. 9, for example) key features commonly shared include means for enable Gent EPC or ISO standards compliance and multiple printer-emulation modes. On-board power source **60**, such as a rechargeable lithium-ion, Nickel Metal Hydride, or other battery enables freedom of movement as does means for wireless connectivity to a data network, such as the 802.11 wireless LAN (Wi-Fi), Bluetooth, or other standards-based communications protocol. However, a conventional power source that requires connectivity to a power-grid and a cable-based data network connectivity link would work under certain circumstances.

[0125]Further, in contemplated embodiments, the fixed or mobile encoder enables selective mounting to a magazine or cartridge filled with un-commissioned RFID transponders, which facilitates rapid and easy loading of the encoder with ready-to-use RFID transponders and further enables re-use, re-commissioning, and recycling of un-dispensed transponders and the associated cartridge. The mobile encoder can be monitored and controlled by virtually any handheld or mobile device, a host computer in a central location, or over the Internet.

[0126]Certain features and methods described and explained with relation to handheld applicators are also relevant to non-mobile RFID tag applicators that use a magazine, cartridge, reel, or roll to handle, transport, and dispense RFID tags, inlays, transponders, or wireless sensors. Magazines, cartridges, reels, and rolls are preferably capable of carrying either new or used tags and are preferably capable of being used in either mobile or non-mobile applicators. Magazines, cartridges, and reels are preferably refilled and reused. Magazines and cartridges preferably protect RFID tags from ESD.

[0127]Cartridges preferably indicate their empty/full status with a visible indicator such as: an LED, an LCD, a mechanical flag, a window with a view into the source reel, or other such indicators that help an operator choose which cartridge from which to next consume tags.

[0128]The mobile encoder **30** is activated (turned on) when an operator selectively depresses the combination on/off-next switch **33**. However, depressing the on/off-next switch for about three seconds or longer results in a sleep-mode cycle that can be interrupted by re-pressing the on/off-next switch. In sleep mode the operator indicators (LEDS **37**, **38**, and **39**) will turn off. If active, the mobile encoder system-ready LED **37** illuminates and connects to the assigned network. Network connectivity results in the illumination of both the system-ready LED **37** and the data-ready LED **38**.

[0129]Mobile encoders **175** and **30** optionally receive commands and data via the wireless link from the remote computer **154** or optical reader **173**. Special bar code commands are scanned by optical reader **173**, passed through wireless communication means **175**A, and interpreted by processing means **175**B mobile encoder **175** to perform certain pre-programmed functions. Commands originating from either computer **154**, optical reader **173**, or internal bar code scanner **226** (also designated in FIG. 1 as internal optical reader **175**F) perform functions in categories that include power management, data management, wireless configuration, security, configuration options, and utilization of internal resources.

[0130]The encoder receives commands and data via the wireless link from the remote computer **20** or host network computer **11** (of FIG. 1). The data represents information to be encoded on an RFID transponder. The information is stored in the encoder's on-board memory and the tag-ready LED **39** or **175**K rapidly blinks green (cycles on/off to pulsate). An RFID transponder is moved from within the cartridge **42** to a position on the top edge of the cartridge for encoding in the encoder and the transponder is encoded with the appropriate information. The transponder is tested and if it is good--contains the data and encoding was successful--all three indicator LEDs indicate a solid-green color. The operator removes the encoded RFID transponder from the encoder and places it on the container of interest.

[0131]In the event that the encoding process failed, the bad transponder is detected and retained by the encoder, where it remains on the take up reel **44** inside the cartridge **42**. The take up reel also collects the release liner as the encoder **30** dispenses good transponders (properly encoded RFID transponders). The take up reel returns to a re-cycling center where components are re-used or recycled as necessitated. Further, the re-cycling center can perform failure analysis on returned transponders.

[0132]FIG. 7 is a schematic diagram of additional electro-mechanical components **70** (as generally referred to in FIG. 6) and logic components of a possible encoder **30**. An RFID Module **63**, such as a MP9311 UHF reader module available from Sirit Technologies, 1321 Valwood Parkway, Suite 620, Carrollton, Tex., 75006, USA, communicates with a vertical polarized YAGI antenna **62** with a downward side lobe to low-power program (commission) RFID transponders to create an RFID transponder, and the same downward side lobe and verify transponders at low power also can read far-field transponders at a higher, second power. Additional components include a mechanical paddle trigger **86** for operator-selected override of the reel of RFID transponder stored in the supply or source reel **43** in the cartridge **42**. A drive motor **76** coupled to a dual output shaft gearbox drives the source transponder reel **43** via an intermediate take-up reel gear interface **78** at the cartridge mouth. Another gear assembly along with a spring couple **85** advances and positions the tag feeder paddle **84** with feedback from paddle position sensor **88**. A tag sensor **74** detects the location of the RFID transponder to-be commissioned by the YAGI antenna **62**. As the reel of RFID transponder advances inside the encoder, the lead edge passes the ratchet post **82**. If the now-commissioned transponder is read by the antenna **62** as "good", a ratcheting-back torque spring **83** enables a peel device, such as the shield and tag peel edge **73**, to engage, forcing the commissioned tag to peel away from the carrier layer, which continues on to the take up reel **44**. In the event of a "bad" tag--that is, the antenna **62** reads the RFID transponder and determines an error has occurred--the shield **73** does not engage, allowing the defective transponder to remain on the carrier layer and proceed to the take-up reel. Once the good transponder is removed from the encoder, the tag sensor **74** detects the condition and enables the encoder to stand-by for the next event. Transponders are read, written, and verified when an operator initiates an action such pulling a trigger **86**, pushing a button, or some other command sequence.

[0133]Certain protective enclosures, such as cartridges **42** or magazines, are part of a family of interchangeable magazines of similar size, shape, and functionality, which are capable of housing and dispensing certain types, styles, shapes, and sizes of new or used RFID transponders. Transponder sizes typically range from 4 mm-thick foam-backed transponders measuring 12 mm wide down to thin transponders that are 15 mm wide on 19 mm pitch.

[0134]In at least one embodiment, the magazine or cartridge **42** includes a unique and embedded, RFID transponder which enables automatic interrogation and tracking of cartridge **42**. In certain embodiments, to minimize interference, the cartridge-specific and unique RFID tag or RFID transponder operates in a frequency band that is different than the supply of RFID transponders contained within the protective enclosure. Alternatively, other embodiments selectively interrogate cartridge identification transponders that operate in the same band as transponders within the cartridge that are to be applied.

[0135]Certain encoders require replenishment of the battery or other internal, on-board power source **60**, such as a fuel cell, or other energy storage technology. Accordingly, in some embodiments, an encoder **30** (or encoder **64** or encoder **210** of FIGS. 8, 9, and 10) further includes a remote, selectively coupling base unit. The base unit enables a replenishment of magazines or cartridges, provides replaceable power sources, recharges the on-board power source, serves as a communications gateway, and provides a user interface for programming and maintenance of the encoder.

For example, spare transponder magazines/cartridges are retained in cartridge pockets where they are protected from damage. Cartridges indicate their empty/full status with a visible indicator such as: an LED, an LCD, a mechanical flag, a window with a view into the source reel, or other such indicators that help an operator choose which cartridge from which to next consume transponders. The encoder, also, is retained by a protective pocket to prevent damage and to make any required electrical or mechanical connections to the base unit. In some embodiments a base unit mounts to diverse operating locations including various models of fork lift trucks. In such applications, the base unit includes a variety of wired and wireless communications options to enable omni directional communication with the encoder, cartridges, a host computer, vehicle mount terminal, a fork truck computer, or other relevant computing devices. The base unit includes a power system that is suitable for the application, including power filtering and energy storage capabilities such as batteries or fuel cells.

[0136]As with all ESD-sensitive equipment, care must be taken to avoid a build-up of damaging electrostatic charges. Accordingly, in certain embodiments charge is removed using a variety of conduction methods including wiping, air, and humidity controls, or use of special materials that contain short conductive elements optionally arranged within a flexible elastic cord.

[0137]In some embodiments, the encoder adapts to use a particular type of RFID transponder. One type of suitable RFID transponder is model number AD-220 from Avery Dennison of Brea, Calif. or, alternatively, Raflatac model 300846 from Tampere, Finland, or a Spider transponder or FT-33 FAT tag from RSI ID Technologies of Chula Vista, Calif. Such a transponder is die cut and adhered to release liner. Additionally, wireless sensors are manufactured to specifications that are compatible with the specific encoder, including such specifications as core diameter, outer diameter, and web width. Alternatively, certain steps are required to prepare a standard roll of ALL-9338-02 tags for use in an automated encoder, including unrolling from a large roll (up to about 6-inches in core diameter) onto several smaller rolls having a smaller core diameter (of about 1-inch to about 2-inches in core diameter).

[0138]Encoder **30** communicates with a remote computer and includes options to physically, electrically, and communicatively integrate with a portable data terminal (PDT) or a mobile computing platform. Certain PDT's have a variety of wireless connections including PAN and WLAN. Certain PDT's include a bar code scanner comprising a laser, an imager, or other means. In other suitable PDT's an RFID interrogator and antenna are built-in, while certain others have a card slot manufactured to a standard such as PCMCIA, CompactFlash, or Secure Digital, into which interrogator/antenna is plugged into. An example of such a card is the MPR 5000 that plugs into a PCMCIA Type II slot and is available from WJ Communications of San Jose, Calif. The MPR 5000 is compatible with handheld computers such as the Hewlett Packard iPAQ5550 or other models that accommodate smaller card-form factors, enabling them to read and write EPCglobal or ISO 18000 compatible UHF RFID transponders.

[0139]Other events, information, and status--such as changes in transponder readiness, transponders remaining on the source roll, remaining charge in the battery, changes in range-status between certain predefined states such as Close, Near, and Far--are communicated to the associated PDT. Other possible information, including certain power management functions, commands, status, and data-to-be-encoded into each readied transponder, is provided to the PDT over a wireless connection. Such a configuration puts the encoder in the role of a peripheral device to the PDT **219**, with PDT **219** managing the primary user interface and most computation functions.

[0140]In some embodiments the encoder adapts to exchange information with a host device, including a PDT, in either a batch-mode or through a real time connection. Batch mode uses a periodically connected data transfer channel such as a wired connection. Certain wired connections include serial data, infrared, optical, Universal Serial Bus, a parallel port, or other physical data connection. Certain real-time connections include wireless data links including Personal Area Network (PAN), Wireless Local Area Network (WLAN), and Wide Area Network (WAN). Certain PAN connections include Bluetooth and Zigbee. Certain suitable WLAN connections include IEEE 802.11a, IEEE 802.11b, and IEEE 802.11g.

[0141]For certain encoder embodiments passwords are encoded into transponders or wireless sensors when they are

commissioned. Passwords are safeguarded using cloaking, obfuscation, cryptographic techniques, secure and trusted channels, locked memory, and other methods that are commonly used to protect confidential information. Passwords are generated or retrieved from data encoded in an RFID transponder to generate an index into one or more databases that contain a one dimensional array of passwords, a two dimensional array of passwords, a multidimensional array of passwords, or an array of actual or pointers to algorithms used to generate passwords from transponder data, for example. Alternatively, cryptographic algorithms are used to generate passwords from transponder data.

[0142]Although this disclosure makes specific reference to a mobile encoder, it is understood that the encoder can easily adapt and be readily configured to a fixed operating environment. For example, it can be mounted to a forklift truck or a high-speed conveyer line and maintain advantages of wireless communication, rapid change-over and other qualities as discussed and developed more fully in this disclosure.

[0143]Interrogator Apparatus

[0144]Working as a stand-alone device, or combined with an encoder, certain embodiments of the present invention include an RFID transponder reader, also called an interrogator. The interrogator, in one embodiment, is a physically separate device that is solely in wireless communication with the encoder. In another embodiment the interrogator includes a wired connection to the encoder. In yet another embodiment, the interrogator connects to the encoder via an intermediate processor, such as a remote computer, or some other intermediate device. In yet another embodiment, the intermediate device is a shared processor in a physically integrated encoder/interrogator apparatus.

[0145]Regardless of the physical configuration of the interrogator, its function is to encode and/or verify a RFID transponder's (including wireless sensors) functionality. Certain embodiments use a mobile handheld reader to verify transponder functionality after carton attachment. Certain handheld readers also read bar codes that either partially or completely specify the data that is to be programmed into a transponder. Accordingly, an optical path from the interrogator to a location for reading bar code labels is used to identify certain information about the objects or containers that are to be tagged. Additional transponder encoding instructions and data is acquired through an integral network interface or a batch mode memory in the interrogator.

[0146]In certain embodiments, a shield structure incorporated in a combined interrogator/encoder prevents RF fields from interrogating or reprogramming RFID transponders yet-to-be-commissioned that are resident in the combined interrogator/encoder device.

[0147]In one embodiment, shown as a cross-sectional schematic in FIG. 8, a contact image sensor (CIS) **90** or a linear optical array is used to scan along the length of an RFID transponder before it is applied to a container. CIS **90** produces a video stream that is decoded and then interpreted and stored by an on-board Computer **61**. CIS or a similar linear array sensor is capable of reading both linear and two-dimensional bar codes. In certain embodiments, CIS reads two-dimensional bar codes before attachment to inlay or transponder. The on-board computer creates a logical association between bar codes and the commissioned RFID transponder. Encoder **64** reads and associates all bar code symbols on a single segment with the RFID transponder or inlay adhered to it.

[0148]In FIG. 10 when an operator pulls the trigger **86**, which is either a mechanical trigger or an electro-mechanical device, the on-demand commissioning of the RFID transponder occurs and nearly simultaneously is pressed against a container within a fraction of a second. In certain embodiments, mechanisms internal to encoder **64** transfer mechanical force to the RFID transponder tag through the use of air, springs, motors, plungers, elastomers, or other energy storing or delivering methods. Reloading of the next tag (next transponder) and readying of the system are performed within a time interval that is acceptable to the operator and enables a high degree of productivity for tagging cartons, pallets, or other transport containers.

[0149]In certain embodiments of a combined interrogator/application, a trigger **86** couples to an electrical switch having one or more stable positions that are detectable by a controller. In certain modes of operation trigger-switch state

is coupled with range information from a sensor suite **218** to execute functions at predetermined ranges at predetermined times. The result is a trigger that functions based upon detected range from a container or other object of interest. This advantageously improves operator efficiency and productivity as one trigger executes several different functions that are typically involved with RFID tagging including the tagging of bar-coded cartons that have been selected to receive wireless sensors.

[0150]Verification of bar code occurs either before or after an RFID transponder is commissioned and the tag applied to the container by merely stepping back to a point where the sweep angle of a laser beam or field of view of an imager can read a bar code label. In certain embodiments ranges shorter than that, but not in Close Proximity, are used for sweeping a radio frequency interrogation signal across the faces of multiple cartons to assure that the correct tags, the correct number of transponders, and the correct data within that transponders were all properly programmed.

[0151]In certain embodiments Close Proximity range is reserved exclusively for programming, applying, and verifying one transponder, all in a single pull of trigger. In other embodiments, the interrogator includes programmable conditions that enable Trigger Events to interact with external devices or nearby equipment. For example, at a predetermined range from the interrogator, activation of the trigger causes the encoder to transmit a coded signal to an external device as an indication of an operator action: at a Far-range the signal to requests an external device to read a bar code and the bar code information is decoded and transmitted back to encoder. In another embodiment, decoded barcode information is processed by a portable data terminal (PDT), a vehicle mount terminal, or other computing device.

[0152]The on-board computer **61** controls the operation of the RFID Interrogator Module **63** to read, write, and verify RFID tags, inlays, transponders, and wireless sensors that are applied or are within range of the interrogation fields produced by antenna **62**. The encoder **30**, capable of reading multiple RFID transponders near it, can, in certain embodiments, produce a linearly polarized radio field via the internal antenna **62**. In another embodiment, the internal antenna produces a horizontally polarized RF field. A commissioned transponder can be read both before and after it is applied to a transport container. When multiple transponders are within the interrogation field of the encoder **30** with an interrogator module **63** the on-board computer **61** determines which transponders are commissioned and dispensed versus those transponder that have not. In certain embodiments, the on-board computer maintains records of transponders recently applied in order to properly determine how to interact with each transponder in the field of the internal antenna or other antennae under the control of RFID Interrogator.

[0153]In one possible embodiment, the interrogator/encoder utilizes preprinted information on a set of RFID transponders. The pre-printed information includes one or more logos, an EPC-global Seal, and other informative alpha-numeric or bar-code data. Certain preferred embodiments of encoder/applicators **30**, **64**, and **210** correlate RFID tag data with data encoded in certain preferred bar codes. In certain preferred embodiments, applicators such as applicator **30** read the bar code preferably using a sensor such as OS **90** as the tape is unrolled from a spool. In certain other preferred embodiments, an RFID tag is located on cartridge **42** and contains a numerical value that is directly or indirectly representative of the numerical values optically encoded into the bar codes preferably at least indicating the starting numerical values of a number sequence. Other additional information is also encoded in the RFID tag in certain preferred embodiments, including the number of tag positions, the number of good tags, the ending sequence number, the date, time and place of tag conversion or other preferred commercial, logistic, or manufacturing information. In certain preferred embodiments of applicators **30**, or **210** certain wireless tags attached to cartridge **42** are capable of being read. In certain preferred embodiments the interrogator such as interrogator **63** is capable of reading an RFID tag mounted to the loaded cartridge, and is also preferably capable of filtering out its response to interrogation or programming of RFID tags.

[0154]Certain embodiments have a motorized tape drive and dispensing system. Certain embodiments contain some or all of the following: a rechargeable battery, an operator display, a wireless interface, a network stack, an IP address, a PCMCIA port, a Compact Flash port, a USB cable, a serial cable, a dock port, a window to allow the operator to view the transponder attachment process, or a bar code scanner.

[0155]One suitable interrogator includes model MP9311 available from Sirit Technologies of 1321 Valwood Parkway, Suite 620 Carrollton, Tex. 75006, USA. Other RFID transponder or wireless sensor interrogator modules with other feature sets are also possible for use in the interrogator/encoder.

[0156]FIGS. 8 and 9 show one possible interrogator/encoder **64** according to the present invention. The interrogator/encoder **64** comprises a housing **65** having a user input device **67**, such as a key pad or key board, and a user output device, such as an LCD screen **68**, for displaying optically scanned label data, RF interrogated data from a transponder, and other information including on-board diagnostic functions, bios status, and external information provided from a remote computer as sent over a wireless network, for example. A handle structure **66** enables point-of-use deployment while cartridge **42** enables on-demand commissioning of RFID transponders, which are dispensed from the transponder port **46**. In this embodiment, an integrated YAGI antenna **62** creates a large forward-looking main lobe of radio frequency energy for interrogation of commissioned RFID transponders. The internal antenna also produces side lobes of RF energy that although attenuated from the main lobe by several dB, couple enough power into nearby readied transponder to interrogate and write to it.

[0157]As further depicted in FIG. 10, a reflector **219***b* passively reflects RF signals from an upper side lobe downward toward readied tag **216***f*. Backscatter from tag **216***f* propagates to both antenna **219***a* and reflector **219***b* for processing by the interrogator. Having such an antenna embedded in PDT **219** and mounted to the structure of the encoder housing enables the PDT **219** to encode and verify readied transponder **216***f* while commanding the encoder to commission and dispense a tag when a particular Trigger Event or a predetermined range status change occurs.

[0158]An antenna, or alternatively, leaky coax **212***a* or a near-field coupler is located outside of protective enclosure of cartridge **42** in a location very close to the tag attachment zone in front of a tamp head or tag application roller and holding rollers **216***d* or hammer **216***a*.

[0159]In some embodiments antenna **212***b* is a patch antenna with a radiation pattern toward the tag attachment zone. In other embodiments the antenna is a near field coupler. Alternatively, leaky coax, a type of coaxial cable having slits, slots, or perforations that allow radio frequencies to leak in or out, is used in encoders according to the present invention. A coupled-mode cable, which does not radiate as well as radiating-mode cable, is constructed with closely spaced slots in a corrugated outer conductor. Radiating-mode cable typically has a foil outer conductor with non-uniformly spaced slots arranged in a periodic pattern. Coupled-mode cable is a slow-wave structure. In free space its external fields are closely bound to the cable and do not radiate, except for minor end effects according to "Prediction of Indoor Wireless Coverage by Leaky Coaxial Cable Using Ray Tracing" by Samuel P. Morgan of Bell Laboratories, Lucent Technologies.

[0160]In certain embodiments an interrogator drives a signal into a leaky coax that is terminated in a purely resistive load of about 50 ohms. An RF-switch selects between radiating and non-radiating loads including an antenna or leaky coax and, therefore, avoids mismatched load impedance.

[0161]In other embodiments internal antenna **212***b* or **212***c* is a patch antenna with its strongest lobes oriented toward the tag holding and placement area in the region of holding rollers **216***d*. Antenna **212***c* or leaky coax **212***a* work with an interrogator to produce electromagnetic fields to interrogate, program, and verify wireless sensors. Shield **217***e* prevents interrogation or programming of RFID transponders until they arrive at separation roller or tag peel edge **217***d*. A reflector is used in certain embodiments to reflect RF radiation toward a readied transponder. In the event that verification fails, the operator is informed that the bad tag (or inoperable transponder) is to be discharged onto a surface of a third object other than the encoder or the transport container, for post-mortem analysis.

[0162]Referring to FIG. 10 drive motor **76** is preferably located inside the center of source reel **43** within the circular walls of applicator housing **211***b*, around which cartridge **42** is nested when mated to interrogator/encoder/applicator **210**.

[0163]Motor **76** is mounted to the structural frame of applicator **210** and preferably transfers mechanical power to certain drive points preferably using gears, belts, or drive shafts within applicator housing **201***a* or **211***a*. In certain preferred embodiments of applicator **210** certain preferred drive points include take-up reel **44**, source reel **43**, or hammer arm **216***a*.

[0164]Trigger **86**, preferably embedded within trigger handle **66** is actuated by an operator, preferably causing a Trigger Event. In certain preferred embodiments, there is more than one kind of Trigger Event. In certain preferred embodiments of applicator **210** certain types of either mechanical or electromechanical actuators are preferably used to cause hammer mechanism **216***a* to trip, being driven toward readied tag **216***f*, through port **46** for placement on a transport container at the face of bulkhead **211***a*.

[0165]Another means of electromechanical actuation from a Trigger Event initiated by sensor suite **218** is illustrated in FIG. 10 whereby DC motor **215***c* runs in a reverse direction causing ratchet **216***b* to become disengaged, allowing hammer **216***a* to accelerate toward tag **216***f* due to the torque exerted by spring **216***c*. Hammer **216***a* passes between holding rollers **216***d* to press tag **216***f* against the face of a transport container.

[0166]Interrogator **212***d* is preferably capable of working with controller **213***b* to recognize which tags have been recently programmed or applied so as to filter out their response to interrogations of other tags, especially those tags that are being prepared for attachment. Interrogator **212***d* is preferably capable of modulating its transmitted radio power to affect the range and signal to noise ratio of its coupling to wireless tags.

[0167]Method of Using Smartphone for Encoding

[0168]FIG. 11 shows a method for using a smartphone for encoding RFID tags by using the built-in camera as a barcode scanner. In step **111** a smartphone is positioned to capture the image of a barcode. The barcode can be 1D or 2D, it can carry GTIN or other information. It can already have a serial number such as a serialized Data Matrix barcode for a pharmaceutical item or container. In step **112** the image is decoded and processed by software. In step **113** the payload for a transponder is computed, preferably using serialization algorithms that are presently described. In step **114** a transponder is encoded with the transponder data payload. The transponder encoding apparatus is either built into the smartphone or attached to it as a peripheral device.

[0169]Referring to FIG. 22, smartphone **154** is shown as an Apple iPhone with a peripheral encoding device attached to the accessory port. A peripheral device such as this is one embodiment, in other embodiments the components described herein are contained with the enclosure of smartphone **154**. Near field couplers **238***a* and **238***b* are used to couple magnetic fields with a nearby transponder for RFID transponder and wireless sensor authentication. Certain preferred embodiments use one coupler to transmit and the other to receive. Such embodiments therefore require close proximity of both couplers to a transponder in order to read or write transponder data, or to verify transponder authenticity. FIPS 140-2 module **239** has a cryptographic boundary that is preferably compliant with U.S. Government Federal Information Processing Standard 140-2 which is incorporated by reference herein. Module **239** detects temperature variations that are outside of upper and lower temperature limits which is one possible mode of cryptographic attack. It also has tamper detection that detect a physical breach of a mesh or other detection barrier. FIPS 140-2 compliant cryptographic module **239** is used to hold cryptographic keys and to perform cryptographic functions. If the module detects an attack, the memory for storing cryptographic keys is immediately cleared. Module **239** preferably uses non-imprinting memory and therefore leaves no trace of the cryptographic information after being cleared.

[0170]Method of Tagging Containers

[0171]FIG. 12 is a block diagram representing a second method according to the present invention including applying RFID transponders to objects of interest. One suitable object of interest comprises transport containers such as corrugated cartons or shrink-wrapped cases on a shipping pallet, which is inadequately addressed by the prior-art,

particularly for solutions for manually operated automatic encoding and attachment to a container.

[0172]Block **121** represents a process step including the identification and selection of a container to be tagged with an RFID transponder or wireless sensor. In one embodiment this step includes a manual selection and verification processes that consists of manual handling, visual sighting, and scanning bar codes with a hand-held optical reader device. This method contemplates that a transponder encoding scheme is ready in advance and synchronized with a pick list, customer purchase order, advanced shipping notice, and other such records to assure that goods are properly moved and accounted for. Preferred bar code scanners include those that allow an operator to freely handle cartons with two hands. Such scanners include laser bar code scanners or imagers that are worn on either that back of the operator's hand or near the top knuckle of a finger. Such scanners are described above, and preferably have a Bluetooth or similar wireless interface to connect to mobile encoder **175** or **30**. Bar code scanner **226** of FIG. 21 is a preferred embodiment of an alternative device that combines manual bar code scanning and RFID transponder encoding into a single handheld device. The operator may choose to scan bar codes that contain data, application identifiers, commands, or other elements commonly found in automatic data capture applications.

[0173]Block **122** represents the process step of processing bar code information to derive the underlying data. Depending on the type of bar code, how it is encoded, and its purpose, different processing steps will be used. In preferred embodiments the bar code may contain SKU information, a GTIN, an SGTIN, EPC data structures, a military UID, an SSSC, an asset number, a file identifier, or other such identifying information. In certain preferred embodiments, the bar code (either one or two dimensional) contains a partial or complete description of the data that is to be encoded into the RF transponder. Such bar codes are described in ISO/IEC draft document PDTR 24729-1. Application identifiers 01 and 21 are combined with additional encoded printed information to fully specify a serialized GTIN (or SGTIN). Using such bar codes does not require the use of additional data in order to generate RF transponder payload data. Mobile encoder **175** may therefore independently receive and process the RF transponder payload information. One type of bar code is used to signal mobile encoder **175**, **30**, or **220** that it should enter a mode whereby it performs a serialization algorithm without using an AI 21 bar code. This process step of identifying the information to be encoded may be included in the step represented by Block **121**. In this step (Block **122**), an operator may use a bar code reader or an encoder/interrogator of this disclosure. Alternatively, the operator may receive instructions delivered to a hand-held PDT or other mobile data terminal connected to a wireless network. This information is delivered to an encoder, such as encoder **30**.

[0174]Block **123** represents another process step whereby, using a mobile encoder, the operator then commissions an RFID transponder with the information of the previous step (Block **122**). Optionally, successful commissioning of the RFID transponder is verified by the encoder. In one embodiment, the encoder tests the next transponder and determines if it is operating within certain predefined specifications including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. If the encoder determines that the transponder is not likely to result in a successful transponder deployment as may be determined by failure on multiple encoding and verification attempts or due to either physical or electronic deficiencies or abnormalities, then the operator is informed and the failed or bad transponder is discarded automatically or when an operator pulls a trigger under an operator-acknowledged transponder failure condition.

[0175]This step (Block **123**) also includes processes to read or determine by dead reckoning the information encoded into certain preprinted optically encoded symbols on the outward facing non-adhesive surface of the adhesive tape. In certain embodiments the adhesive tape is printed with information. In other embodiments the printed information is a machine-readable symbol such as a bar-code symbol. For example, one or more machine-readable symbols are read when the tape is prepared for use in an automated encoder or, alternatively, during the inlay conversion process and conveyed to an encoder through other data storage means, such as an RFID transponder. In one embodiment, an information encoding method uses either one-dimensional or two-dimensional bar codes. In some embodiments a linear imager is used to read either linear or two-dimensional bar codes as the tape is being unrolled from a spool. Some encoding schemes preprint machine-readable symbols at regular intervals along the length of a roll of adhesive tape. In certain embodiments the spacing of the preprinted symbols is at an interval of one half of the

nominal length of each section of adhesive tape. In certain embodiments, the encoded information is used as a reference to one or more data storage locations. In other embodiments the data storage locations are accessible through a computer network. In some embodiments, the encoded information is a series of sequential numbers. Information relating to data stored in the RFID transponder is stored in data storage locations that are referenced by one or more of the preprinted symbols. In an alternative embodiment more than one type of machine-readable symbols can be read from the surface of a segment of tape. In certain embodiments, more than one machine-readable symbol is used as a reference to the same or closely related data records of information stored in the RFID transponder or inlay, and either can be successfully used to access stored data.

[0176]In some encoders used in this step (Block **123**) a Trigger Event occurs, which results in the verification that a particular commissioned RFID transponder has been tagged and associated with a specific container. This Trigger Event occurs, in certain embodiments, when an operator pulls a trigger on the encoder. In other embodiments the Trigger Event occurs when certain sensors detect preprogrammed conditions relating to the proximity of the encoder face to an object that is to be tagged.

[0177]Finally, (Block **124**) the operator applies the RFID transponder on the container and, thus, commissions the transponder. In certain embodiments, the location of the targeted placement of the RFID transponder or wireless sensor on the container is stored in a database, which is referenced or pointed to by information that is stored in the memory of the encoder. In one embodiment, the operator holds the encoder against the face of the container based on the tagging requirements for that particular container. The tagging requirements including the location and orientation of the RFID transponder to be placed is conveyed visually or aurally. For example, the operator receives visual information via a screen or display on the encoder. In certain embodiments, physical indicators are attached to the encoder and extend from its body in a direction and manner so as to assist the operator in the positioning of the transponder onto the carton. In other embodiments, transponders are applied to the interior of a carton, before it is sealed.

[0178]Method of Commissioning RFID Transponders Using a Mobile Applicator.

[0179]FIG. 13 is a block diagram showing a method according to the present invention for commissioning RFID transponders using an encoder, such as the encoder **30**, couples to a cartridge or protective enclosure containing a plurality of RFID transporters releasably mounted on a transport sheet or roll. The encoder enables the roll of RFID transponders to advance one position (Block **131**), placing the Next Tag in a test 1 position. The Next Tag is tested (Block **133**) to ensure that it performs within predetermined parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. One possible method includes encoding a transponder using only a minimal amount of radio-frequency energy. Since transponder encoding requires more energy than reading a transponder, this low power test constitutes a basic test of both minimal activation energy and backscatter signal strength.

[0180]An RFID transponder that fails this test (Block **133**) results in a "Bad Tag" status and proceeds to the take-up reel of the encoder (Block **135**). Thus, any failed transponder remains captive in the cartridge and cannot be released from the encoder by an operator. Optionally, the operator is notified of the failed transponder so the operator can request a newly encoded transponder (Block **137**). However, in one embodiment, the notification step occurs automatically, and a newly encoded next transponder is generated without input from the operator.

[0181]Block **132** shows that a "good" transponder is positioned in the encoder for the encoding process. The RFID transponder that passes the test 1 position is commissioned with predetermined data based on the container to be tagged. Methods of obtaining, storing, encoding, and commissioning this information on the RFID transponder are discussed elsewhere in this disclosure.

[0182]The commissioned transponder undergoes a verification process (Block **134**) to determine if the intended information was successfully encoded on the RFID transponder. Certain embodiments combine the verification step with the encoding step to gain operational efficiencies. If this verification test results in a fail condition, the transponder

remains in the encoder and ultimately winds on the take-up reel in the cartridge for subsequent post-mortem failure analysis.

[0183]Block **136** represents a pass condition. The encoder removes the commissioned RFID transponder from the transport web or release liner, enabling the operator to retrieve the transponder from the encoder and in Block **138** apply the transponder to the container. In an alternative embodiment for Block **138**, the operator or a fixture holds the encoder against a surface of the container and the encoder places the commissioned RFID transponder directly on the container without operator intervention.

[0184]FIG. 14 is a system diagram that illustrates a preferred serial number allocation system according to the present invention. Blocks of serial numbers are allocated to RFID printers and encoding devices such as RFID encoder **155** of FIG. 15 as described in more detail below. Each object class, represented in FIG. 14 as GTIN's, has its own separate serial numbering space. As described above, the entire object class serial number space is subdivided into sectors that are defined by a limited number of most significant bits of the serial number field. In the case of a GS1 SGTIN-96 key type, the serial number field is 38 bits long.

[0185]To show how this is accomplished in Serial Number Database **140**, a representative object class is managed by Table GTIN A **141** and is shown to have three serial number block sizes of lengths 10, 11, and 12 bits. Within table **141** are three rows, or tuples **141***a-c*. Each row or tuple contains two columns or attributes: a starting serial number and the amount of remaining space until the next serial number block. In preferred embodiments, the remaining space is expressed in units of blocks of the selected block size.

[0186]Now by way of a more detailed example, allocation of blocks of serial numbers of different sizes is shown as requests are encountered over a period of time. An initial request is made for serial number Block **0144** for GTIN A that is 10-bits long. At that time then all of the rows of table **141** show the same starting number of 000000. When the initial request for a 10-bit block is granted for block **144**, the starting number for the next block of that size is increased to the end of the first 10-bit block and the remaining blocks is computed based on the following algorithm: the starting point for the 11-bit block **141***b* is adjusted to the next greatest unused number that contains all zeros in the bits that represent the next assignable block of that size. The same is done for 12-bit block **141***c* and so forth unless those blocks have already been assigned to an RFID encoder **155** using for example Block **1145**, in which case they are not changed. The remaining counts values for each block will remain at zero for each block that is not bounded on the upper side by an assigned block of another size. If a serial number block is bounded, then the remaining count value is adjusted to accurately describe the number of serial number blocks that can be assigned. If additional blocks of that size are subsequently required, then, space permitting, a new block starting number is assigned and the process continues until the entire serial numbering space is fully allocated.

[0187]In preferred embodiments, a request is made by smartphone **154** as shown in FIG. 15. The smartphone preferably performs biometric authentication as shown in step **161** of FIG. 16. In step **162**, using smartphone **154** devices such as camera **237** of FIG. 22 a biometric match for a face, iris, voice, or fingerprints breaks the retry loop with an authorization to continue to step **163**. In step **163** transponder encoding is enabled and smartphone **154** is authorized to request, as a lower database level, blocks of serial numbers for specific object classes, such as certain GTIN's. RFID printers and encoders **155** are preferably then readied for encoding. Biometric security enables brand owners to enforce security procedures within their own plants and at contract manufacturing locations all over the world.

[0188]Table GTIN B **142** and Table GTIN C **143** show that each GTIN is managed separately to provide unique serial number blocks such as Block **2146**, possibly according to different rules. In fact since GTIN's are typically purchased and owned by brand owners, and database **140** may be used to manage serial number allocation for multiple brand owners, then the rules that are applied to the various GTIN object classes in FIG. 14 may be different. Retail brand owners may want linear serial number assignments within each block while a pharmaceutical brand owner may want to have randomly assigned serial numbers within each serial number block. In a preferred embodiment allocated block **141***c* is issued to a lower database level or directly to an encoder's internal memory for commissioning

transponders with randomly assigned serial numbers from within the range of numbers that are defined by that allocate block **141**c.

[0189]Brand owner A with GTIN A may also have serial number blocks managed with a finer granularity than brand owner C with GTIN C. Furthermore a possible reason for brand owner C to select very large block sizes as shown in Table GTIN C **143** is to allow serial number allocation to be managed according to a different method such as chip-based serialization from chip manufacturers Impinj, Alien, or NXP for example.

[0190]FIG. 15, a block diagram, shows the essential parts of a system to manage unique serial numbers on a global scale using smartphones as mobile remote computers. Server **151** is a computer running a server application such as an Apache HTTP web server on an operating system such as Unix, FreeBSD, Linux, Solaris, Novell NetWare, Mac OS X, Microsoft Windows, OS/2, or TPF. Web server **151** can be owned, borrowed, or rented by the slice from cloud service providers.

[0191]SQL database **152** preferably conforms to ISO/IEC 9075 and its various parts. In other embodiments, a database other than SQL is used to perform the data storage and retrieval functions described herein. SQL queries are preferably performed with the declarative SELECT statement which retrieves data from one or more tables, or expressions.

[0192]Script **153** preferably executes on server **151** and is written in a general-purpose server-side scripting language such as PHP to produce dynamic web pages.

[0193]A segment of PHP code that is used to store RFID tag commissioning data is:

[0194]$stmt=$this→db→prepare("INSERT INTO SGTINs (CommissioningReport_EncStatus_SessionNum, SGTIN, GTIN) VALUES (?, ?, ?, ?)");

[0195]$strnt→bind_param("ssii", $attrSession, $sgtinN, $attrGtin);

[0196]$stmt→execute( );

[0197]$stmt→close( );

[0198]Smartphone **154** preferably uses asynchronous data transfer techniques in a multi-threaded computing environment to communicate with script **153** in server **151** to prevent thread-blocking that gives the appearance of the program seizing up while waiting for a database transaction to be completed. Certain preferred embodiments use ASIHTTPRequest on Apple iOS smartphones to request a transaction with a remote database without blocking a major program thread. Below is an example of an iOS function to store an XML commissioning report from RFID encoder **155**:

[0199]

Search terms may have been found within the contents of this table. Please see the table in the original document.

[0200]The method startAsynchronous is used on the request to start a database transfer on a separate computing thread. This is one important aspect of asynchronous data transfer in periodically connected system nodes. Another example is in the collection of XML report data from RFID encoder **155**, piece by piece to assemble a complete string. The iOS code line [scanner.readRecentString appendString:trimStr]; illustrates how trimStr is appended onto a string, in this case named readRecentString that is an NSMutableString that is allocated as part of an instance that coordinates communications with a particular RFID encoder. Once the end tag is received, then iOS program assembles a request to store tag commissioning data. The iOS program is also ready to receive authorizations from server **151** as responses are

returned from it. The authorizations are preferably able to be stored and retrieved when the same RFID encoder **155** reconnects with smartphone **154**. This system design therefore illustrates a preferred method for collecting commissioning data, storing it in an SQL database, and delivering new encoding authorizations to RFID encoders like RFID encoder **155** without requiring any realtime connections to a remote database.

[0201]RFID Transponder **156** receives and stores a globally unique identifier such as an SGTIN-96 through an intermittently connected chain of computers and programs as described above and as illustrated in FIG. 15.

[0202]In FIG. 23, Block **240** is used to scan a barcode, such as a GTIN. In Block **241** the RFID transponder payload is computed, preferably using serialization algorithms and methods that are disclosed herein.

[0203]Block **242** represents the process step whereby mobile encoder **175**, **30**, or **220** encodes an RFID transponder with the information of the previous step (Block **241**).

[0204]Successful commissioning of the RFID transponder is preferably verified by the encoder as shown in Block **243**. In one embodiment, the encoder tests the immediate transponder and determines if it is operating within certain predefined specifications including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder.

[0205]If in Block **244** the encoder determines that the transponder is not likely to result in a successful transponder deployment as may be determined by failure on multiple encoding and verification attempts or due to other evidence of physical or electronic deficiencies or abnormalities, then the operator is optionally informed and the failed or bad transponder is discarded automatically as shown in Block **245**.

[0206]Block **246** is the process of using motor **227**B and/or transponder transport means **175**C to pull release liner **182** tighter and tighter such that webbing **182** advances forward to the point that the leading edge of transponder **178** extends past the distal end of peel device **183** or **222**B.

[0207]In Block **247** web **182** is pulled forward to the point that transponder **178** or **223**A begins to rotate around peel device **183** or **222**B. It is in this step that either a human finger or some target object needs to be presented in the rotational path of the tipping transponder **178** or **223**A must be located. In the case of mobile encoder **30** where the operator is required to handle the encoded tag, it is important that their finger be present as transponder **178** begins to tip, allowing adhesive layer **181**D of transponder **178** to make contact and be removed for placement on a target object such as a shipping container, trackable asset, automobile windshield, or other object of interest. In cases where the operator scans a bar code and applies encoded transponder **178** in a single motion, mobile encoder **220** is preferred, wherein as transponder **178** tips as it rotates around peel device **222**B adhesive layer **181**D sticks directly onto target surface **228**. In either case, encoded transponder **178** is caught mid-rotation and adhesive layer **181**D provides adhesive forces sufficient to completely detach transponder **178** from release liner **182**, thus completing the function of Block **247** where work flow returns to Block **240** for another transponder encoding cycle to begin.

[0208]While the invention has been particularly shown and described with reference to certain embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

ENGLISH-CLAIMS:

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I claim:

1. An RFID transponder comprising:

- -

a substrate;

- -

an antenna structure formed on the substrate; and

- -

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

- -

wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,

- -

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

- -

wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

2. The RFID transponder of claim 1, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

3. The RFID transponder of claim 1, wherein the unique object number is a portion of a serialized global trade item number.

4. The RFID transponder of claim 3, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

5. The RFID transponder of claim 1, wherein the unique serial number space is at least 38 bits.

6. The RFID transponder of claim 1, wherein the allocated block is defined by at least 3 most significant bits.

7. The RFID transponder of claim 1, wherein the allocated block is one of a plurality of allocations intermittently received by an encoder.

8. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of silicon.

9. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of polymer.

10. The RFID transponder of claim 1, wherein the substrate, antenna structure, and RFID integrated circuit chip are

covered by a face stock material.

11. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is disposed on the substrate.

12. The RFID transponder of claim 1, wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.

13. A RFID transponder comprising:

- a substrate;
- an antenna structure formed on the substrate; and
- an RFID integrated circuit chip which is electrically coupled to the antenna structure,
- wherein the RFID integrated circuit chip is encoded with a global trade item number including a unique object number, the unique object number comprising an object class information space including a block of at least 50 bits and a unique serial number space including a block of at least 38 bits,
- wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and
- wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block.

14. The RFID transponder of claim 13, wherein the unique serial number space further comprises remaining bits of lesser significance that together with the at least 3 most significant bits comprise the one serial number instance.

15. The RFID transponder of claim 13, wherein the at least 3 most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.

16. An integrated circuit, comprising:

- a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator;
-

control logic; and

- -

a memory,

- -

wherein the memory is configured with a unique object number space, the unique object number space comprising an object class information space and a unique serial number space,

- -

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

- -

wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

17. The integrated circuit of claim 16, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

18. The integrated circuit of claim 16, wherein the unique object number is a portion of a serialized global trade item number.

19. The integrated circuit of claim 18, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

20. The integrated circuit of claim 16, wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the memory of the integrated circuit.

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Documents (11)

1. *US Patent Issued to ADASA on Oct. 24 for "Systems, methods, and devices for commissioning wireless sensors" (Oregon Inventor)*
   Client/Matter: -None-
   Search Terms: 9798967 or 9,798,967
   Search Type: Terms and Connectors
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Content Type	Narrowed by
News	-None-

2. *Head Line: US Patent granted to ADASA INC. (Oregon) on October 24, 2017 titled as "Systems, methods, and devices for commissioning wireless sensors"*
   Client/Matter: -None-
   Search Terms: 9798967 or 9,798,967
   Search Type: Terms and Connectors
   Narrowed by:

Content Type	Narrowed by
News	-None-

3. *Adasa Inc Granted Patent for Systems, Methods and Devices for Commissioning Wireless Sensors*
   Client/Matter: -None-
   Search Terms: 9798967 or 9,798,967
   Search Type: Terms and Connectors
   Narrowed by:

Content Type	Narrowed by
News	-None-

4. *Universal Scientific Industrial Shanghai - A Share lifts 3.0%, 2 days' volume in a day August 10, 2017 15:30 CST*
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   Search Type: Terms and Connectors
   Narrowed by:

Content Type	Narrowed by
News	-None-

5. *Monthly: Enbridge Energy Management down 5.1% in June, lowest amongst Pipelines sector*

Client/Matter: -None-

Search Terms: 9798967 or 9,798,967

Search Type: Terms and Connectors

Narrowed by:

Content Type	Narrowed by
News	-None-

6. *ERGEBNISSE IM ÜBERBLICK o ERGEBNISSE IM ÜBERBLICK o ERGEBNISSE IM ÜBERBLICK*

Client/Matter: -None-

Search Terms: 9798967 or 9,798,967

Search Type: Terms and Connectors

Narrowed by:

Content Type	Narrowed by
News	-None-

7. *AVX Releases an Innovative Interconnect Sample Kit for Consumer, Medical, Industrial, IoT ...*

Client/Matter: -None-

Search Terms: 9798967 or 9,798,967

Search Type: Terms and Connectors

Narrowed by:

Content Type	Narrowed by
News	-None-

8. *AVX Releases an Innovative Interconnect Sample Kit for Consumer, Medical, Industrial, IoT ...*

Client/Matter: -None-

Search Terms: 9798967 or 9,798,967

Search Type: Terms and Connectors

Narrowed by:

Content Type	Narrowed by
News	-None-

9. *AVX Releases an Innovative Interconnect Sample Kit for Consumer, Medical, Industrial, IoT Applications*

Client/Matter: -None-

Search Terms: 9798967 or 9,798,967

Search Type: Terms and Connectors

Narrowed by:

Content Type	Narrowed by
News	-None-

10. *China PBT plants average run rates rise to 50% from 29%*

Client/Matter: -None-

Search Terms: 9798967 or 9,798,967

Search Type: Terms and Connectors

Narrowed by:

Content Type	Narrowed by
News	-None-

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11. *No Headline In Original*

Client/Matter: -None-

Search Terms: 9798967 or 9,798,967

Search Type: Terms and Connectors

Narrowed by:

Content Type	Narrowed by
News	-None-

US Patent Issued to ADASA on Oct. 24 for "Systems, methods, and devices for commissioning wireless sensors" (Oregon Inventor)

US Fed News

October 24, 2017 Tuesday 3:54 PM EST

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Length: 182 words

Dateline: ALEXANDRIA, Va.

Body

ALEXANDRIA, Va., Oct. 24 -- United States Patent no. ***9,798,967***, issued on Oct. 24, was assigned to ADASA INC. (Eugene, Ore.).

"Systems, methods, and devices for commissioning wireless sensors" was invented by ADASA INC. (Eugene, Ore.). According to the abstract* released by the U.S. Patent & Trademark Office: "In one embodiment the present invention comprises a smartphone and encoders for commissioning RFID transponders. The present invention further includes novel systems, devices, and methods for commissioning RFID transponders with unique object class instance numbers without requiring a realtime connection to a serialization database." The patent was filed on Feb. 12, 2016, under Application No. 15/042,993. *For further information, including images, charts and tables, please visit: *http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1&f=G&l=50&co1=AND&d=PTXT&s1=9798967&OS=9798967&RS=9798967* For any query with respect to this article or any other content requirement, please contact Editor at *content.services@htlive.com*

Load-Date: October 24, 2017

End of Document

Head Line: US Patent granted to ADASA INC. (Oregon) on October 24, 2017 titled as "Systems, methods, and devices for commissioning wireless sensors"

Plus Patent News

October 27, 2017 Friday

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Length: 129 words

Dateline: New York

Body

ALEXANDRIA, Va: United States Patent and Trademark Office has granted patent no. ***9,798,967*** on October 24, 2017, to ADASA INC. (Oregon) titled as "Systems, methods, and devices for commissioning wireless sensors"

Inventors: McAllister; Clarke W. (Eugene, OR)

Assignee: ADASA INC. (Eugene, OR) (Oregon)

According to the abstract released by the U.S. Patent & Trademark Office: "In one embodiment the present invention comprises a smartphone and encoders for commissioning RFID transponders. The present invention further includes novel systems, devices, and methods for commissioning RFID transponders with unique object class instance numbers without requiring a realtime connection to a serialization database."

The patent was filed on February 12, 2016 Application No. 15/042,993

Load-Date: October 28, 2017

End of Document

Adasa Inc Granted Patent for Systems, Methods and Devices for Commissioning Wireless Sensors

Global IP News. Electronics Patent News

October 24, 2017 Tuesday

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Length: 242 words

Dateline: New Delhi

Body

FULL TEXT

Publication Name: Electronics Patent News**Patent Application Number:** 15/042,993**Patent Publication Number:** *9,798,967***International Patent Classification Codes:** G06K 19/07716 (20130101), B65C 9/1865 (20130101), B65C 11/006 (20130101), G06K 19/077 (20130101), G06K 2017/0041 (20130101), B65C 2009/0003 (20130101), B65C 2009/404 (20130101)**Patent Status:** Granted

Alexandria, Oct. 24 -- Adasa Inc has been granted a patent for systems, methods and devices for commissioning wireless sensors. Mcallister Clarke W developed the invention. The patent application number is 15/042,993. The International Patent Classification codes are H04Q 5/22 (20060101), G06K 19/077 (20060101), B65C 9/18 (20060101), B65C 11/00 (20060101), B65C 9/40 (20060101), B65C 9/00 (20060101) and G06K 17/00 (20060101). Cooperative Patent Classification codes are G06K 19/07716 (20130101), B65C 9/1865 (20130101), B65C 11/006 (20130101), G06K 19/077 (20130101), G06K 2017/0041 (20130101), B65C 2009/0003 (20130101) and B65C 2009/404 (20130101).

The abstract released by U.S. Patent and Trademark Office states, "In one embodiment the present invention comprises a smartphone and encoders for commissioning RFID transponders. The present invention further includes novel systems, devices, and methods for commissioning RFID transponders with unique object class instance numbers without requiring a realtime connection to a serialization database."

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Load-Date: October 26, 2017

End of Document

Universal Scientific Industrial Shanghai - A Share lifts 3.0%, 2 days' volume in a day August 10, 2017 15:30 CST

News Bites - Asia: China

August 10, 2017 Thursday

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Section: STOCK

Length: 1493 words

Body

CHINESE DAILY STOCK REPORT

Universal Scientific Industrial Shanghai Co Ltd - A Share (SS:601231), Shanghai's largest Software company by market cap, has lifted 42.0 fen (3.0%) from its last trading session of August 09 to close at CNY14.50. Compared with the SSE 180 Index which fell 89.6 points (1.1%) in the day, the relative price increase was 4.1%. The rise has been propped up by robust volume of 1.7 times the average daily volume of 9.6 million shares.

SECTION 1

UNIVERSAL SCIENTIFIC INDUSTRIAL SHANGHAI - A SHARE BULLISH SIGNALS

1.1 Fundamentals:

Undervaluation [compared with sector average]:

+ Dividend yield of 0.8% [0.7%].

1.2 Technicals:

+ In the last three months the stock has hit a new 52-week high seven times, pointing to a significant uptrend.

+ The present value of CNY1,000 (PV1000) invested one year ago in Universal Scientific Industrial Shanghai - A Share is CNY1,376, comprising a capital gain of CNY365 and dividend reinvested of CNY11.

PV1000	1-week	1-month	1-year
601231.SS	1,005	989	1,376
SSE 180 Index	987	996	1,164

+ The present value of CNY1,000 (PV1000) invested five years ago in Universal Scientific Industrial Shanghai - A Share is CNY2,511, including a capital gain of CNY1,415 and dividend reinvested of CNY96.

+ 5 years Multiplier in CNY = 2.511x

+ Compound Annual Growth Rate (CAGR) in CNY = 20.2%

Present Value of USD1,000 invested 5 years ago:

+ The present value of USD1,000 (PV1000) invested five years ago in Universal Scientific Industrial Shanghai - A Share is $US2,392, including a capital gain of $US1,300 and dividend reinvested of $US92.

+ 5 years ago USD 1 equalled CNY 6.3573

+ 5 years Multiplier in USD = 2.392x

+ Compound Annual Growth Rate (CAGR) in USD = 19.1%

Aug 10, 2017: USD 1 equals CNY 6.68

1.3 High Performance Indicators:

Description	Value	Rank In Market
Price Change %	3.0	In Top 7%
Price/MAP200	1.21	In Top 8%

SECTION 2

UNIVERSAL SCIENTIFIC INDUSTRIAL SHANGHAI - A SHARE BEARISH SIGNALS

2.1 Fundamentals:

+ The relative yield of the stock, defined by its yield of 0.8%, divided by average yield of dividend yielding stocks in the SSE 180 Index of 2.6% is 31.3%. This suggests the stock is overvalued in dividend yield terms.

2.2 Technicals:

+ The price decreased 1.1% in the last month. The fall has been exacerbated by firm volume of 1.3 times average for the month.

2.3 Low Performance Indicator:

Description	Value	Rank In Market
Volatility %	4.2	In Bottom Quartile

SECTION 3

PRICE VOLUME DYNAMICS

3.1 Technicals:

+ Volume: there were 16,060,000 shares worth CNY232.9 million (US$34.9 million) traded today. In the past week, volume was 1.3 times average and the shares were up 0.5%.

+ Universal Scientific Industrial Shanghai - A Share is at a discount of 10.9% to its 12-month high of CNY16.28 on June 26. It is also at a premium of 50.1% to the 12-month low of CNY9.66 on January 13.

3.2 Performance Indicator:

Description	Value	Rank In Market
Today's Turnover	CNY232.9 million (US$34.9 million)	In 3rd Quartile

3.3 Moving Annual Return

601231	Close (CNY)	Dividends (CNY)	Capital Gain / (Loss) %	% Yield	Annual Return %
August 10	14.5	0.12	36.5	1.1	37.6
1 Yr ago	10.62	0.1	(30.8)	0.7	(30.2)
2 Yrs ago	15.36	0.1	(0.4)	0.6	0.3
3 Yrs ago	15.42	0.08	53.4	0.8	54.3
4 Yrs ago	10.05	0.1	67.3	1.6	68.9

3.4 Turnover Rate & Turnover Period:

+ The turnover rate in the 12 months to date was 89.3% (or a turnover period of 1 year 44 days). This average length of ownership of the stock at 0.9 times the average holding period of 1 year 3 months for stocks in the SSE 180 Index suggests a larger number of speculators on the share register, making it less safe for long-term investors.

3.5 Month-on-Month Comparison (Trailing Month - ended 9th)

	09 Aug	07 Jul	09 Jun	09 May	07 Apr	09 Mar
Price 09 Aug (CNY)	14.08	14.61	14.5	12.15	12.12	10.46
% Price Change	-4	0.7	19.3	4.6	14.7	2.9
Avg Daily Volume	9,532,280	10,059,615	10,149,006	***9,798,967***	10,011,085	9,287,327
VWP (CNY)	14.25	13.61	12.69	11.47	11.05	10.31
Price Range (CNY)	12.7 - 15.18	13.79 - 16.28	11.71 - 15.65	11.71 - 12.25	12.02 - 12.36	10.4 - 10.55
Relative Price Change %	-7.1	-2.1	12.9	8.7	13.4	2.9
Volatility %	19.5	18.1	33.6	21.6	20.2	6.1

SECTION 4

PEER GROUP ANALYSIS & RANKING

4.1 Global Peer Group Analysis (all figures in USD)

Name	Relative Str. (6 mo)	M Cap	PV $1000 (1 yr)	Revenue	Net Profit	Total Assets
Computershare	75	6.2B	1,620.4	1.6B	124.5M	3.1B
Tableau Software	86	5.5B	1,319.4	829.1M	(144.4M)	1.3B
Guidewire Software	87	5.2B	1,144.0	649M	15M	916.2M
TripAdvisor	28	5.2B	663.5	1.5B	120M	2.2B
Universal Scientific Industrial Shanghai - A Share	91	4.7B	1,373.2	3.1B	101.5M	2.1B
Pegasystems	93	4.4B	2,299.4	750.3M	27M	654.7M
LS telcom	43	4.3B	884.1	37.6M	967,436.5	45M
Epam Systems	84	4.2B	1,226.3	1.2B	99.3M	925.8M
Blackbaud	91	4.2B	1,290.3	730.8M	41.5M	1.3B

Global Peer Group Analysis (continued)

Code	Country	Last Price	P/E	P/S	P/Book	Turnover Rate (%)	% Disc to 52-w Hi
CPU	AU	AUDA14.46	50.7	4.0		67.7	6.0
DATA	US	$US69.86		6.6	7.0	364.6	2.3
GWRE	US	$US70.22		11.0	7.1	123.8	4.3

TRIP	US	$US40.54	49.4	3.5	8.7	592.8	38.7
601231	CN	CNY14.08				91.7	13.5
PEGA	US	$US58.30		5.9	20.4	71.0	10.1
LSX	DE	EUR5.96	38.5	113.2		0.1	20.6
EPAM	US	$US81.81	43.8	3.6	6.8	156.5	7.0
BLKB	US	$US86.66	98.5	5.7		139.3	7.6

4.2 Global Rank [out of 47,537 stocks] and Rank in the Asia Region [out of 22,089 stocks]

Description	Value	Global Rank	In Asia Region
MCap (US$)	4.7B	2,758	949
Total Assets (US$)	2.1B	6,444	2,421
Revenue (US$)	3.1B	3,106	1,118
Net Profit (US$)	101.5M	4,872	1,761
Return on Equity %	9.9	12,926	6,773
Net Profit Margin %	3.2	20,557	11,386
Yield %	0.8	17,015	8,559
PV$1000 (1Year) US$*	1,373	11,192	5,298
US$* Change (1Year) %	32.7	10,735	5,097

* 1 year ago USD 1 = CNY 6.66

Aug 10, 2017: USD 1 equals CNY 6.68

4.3 Rank in the Total Shanghai Market [out of 1299 stocks]

Description	Value	In Total Shanghai Market
MCap (CNY)	31.6B	155
Total Assets (CNY)	14.5B	329
Revenue (CNY)	21.3B	140
Net Profit (CNY)	690.5M	190
Return on Equity %	9.9	316
Net Profit Margin %	3.2	655
Yield %	0.8	488
PV1000 (1Year)	1,376	107

SECTION 5

DIVIDENDS

Dividend History

Date	Value (fen)	Type
08 Jun 2017	11.8	Cash
Tr 12 Months	11.8	
08 Jun 2016	10	Cash
2015 - 2016	10	

23 Jun 2015	9.7	Cash
2014 - 2015	9.7	
20 Jun 2014	8.4	Cash
2013 - 2014	8.4	
20 Jun 2013	9.6	Cash
2012 - 2013	9.6	

SECTION 6

UNIVERSAL SCIENTIFIC INDUSTRIAL SHANGHAI - A SHARE PROFILE

6.1 Activities

Universal Scientific Industrial (Shanghai) Company Limited develops, procures, manufactures, provides logistics and maintenance services. The Company's main product types include communications, computer and storage, consumer electronics, industrial, and other related types.

6.2 Industry & Sector

Classification Level	Name of Sector
Business Sector	Software & IT Services
Industry Group	Software & IT Services
Industry	Software
Economic Sector	Technology

6.3 Issued Capital

Based on 2,176,000,000 issued shares the market capitalisation is CNY31.6 billion (US$4.7 billion).

SECTION 7

STOCK BUZZ

Corporate Wire

To view Recent Company Headlines, click *http://www.buysellsignals.net/BuySellSignals/report/Shanghai/Stock/Daily/Link/Announcements_994.html*

June 06: Universal Scientific Industrial Shanghai - A Share: Announcement on Implementation of Rights and Interests Distribution in 2016

The Company implements the scheme of rights and interests distribution in 2016 as follows: a cash dividend of RMB0.118 (taxes included) per A share.

Record date: June 7, 2017

Ex-dividend date: June 8, 2017

Cash dividend payable date: June 8, 2017

June 02: Universal Scientific Industrial Shanghai - A Share announces dividend

Universal Scientific Industrial Shanghai - A Share today announced a cash dividend of 11.80 fen per share. The ex dividend date is Thursday, June 08, 2017 and the record date is Wednesday, June 07, 2017 and it is payable on Thursday, June 08.

April 26: Universal Scientific Industrial Shanghai - A Share: Announcement on Resolutions of Annual General Meeting of 2016

The Company held the Annual General Meeting of 2016 on April 17, 2017, which discussed and approved issues including the proposal of "Annual Report of 2016 and Its Abstract", the proposal of "Scheme of Profit Distribution for 2016" and the proposal of renewing engagement of auditor for financial affairs.

April 03: Universal Scientific Industrial Shanghai - A Share: Notice of Convening Annual General Meeting of 2016

The Company's directorate decided to hold the Annual General Meeting of 2016 by way of combination of on-the-spot and online voting at 13:30 on April 17, 2017 to discuss issues including the proposal of "Annual Report of 2016 and Its Abstract", the proposal of "Profit Distribution Scheme for 2016" and the proposal of renewing engagement of its financial auditor.

April 03: Universal Scientific Industrial Shanghai - A Share: Announcement on Major Financial Indicators in 2016

Basic earning per share (yuan) 0.37

Weighted average return on net assets (%) 11.27

Contact: 021-5896-8418

Physical Address: Zhang Dong Rd No 1558 Zhang Jian High Tech China

State/Province/Country: SHA, China

Country of Incorporation: China

Exchange: Shanghai Stock Exchange (SSE)

ISIN: CNE100001BZ8

SS:601231; SHA:601231; CH:601231; 601231.SS

Universal Scientfc Industrl Shngh Co Ltd, Universal Scientific Industrial (Shanghai) Co Ltd, Universal Scientific Industrial Shanghai Co Ltd

Source: www.BuySellSignals.com

Load-Date: August 10, 2017

End of Document

Monthly: Enbridge Energy Management down 5.1% in June, lowest amongst Pipelines sector

News Bites US Markets

June 30, 2017 Friday

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Length: 1156 words

Body

AMERICAN MONTHLY STOCK REPORT

Enbridge Energy Management (NYSE:EEQ), NYSE's 18th largest Pipeline company by market cap, has decreased 83.0c (or 5.1%) in the month ended June 30 to close at $US15.41. This loss makes the stock the biggest decliner in the Pipelines sector which is up 3.7%. The volume in the month was 1.3 times the average trading of 7.4 million shares per month. Compared with the S&P 500 Index which rose 11.6 points (or 0.5%) in the month, this represented a relative price change of -5.6%. In the past month the market cap has declined $US56.3 million.

Price Change %	1-month	6-month	3-year
EEQ	-5.1%	-37.1%	-32.2%
Pipelines	3.71%	-1.07%	-2.83%
S&P 500	0.48%	8.24%	22.8%

SECTION 1 MONTH IN REVIEW: CORPORATE ANNOUNCEMENTS FOR ENBRIDGE ENERGY MANAGEMENT

1.1 Corporate Wire

1.1.1 8-K other news

To view all 8-K Other news click here, *http://www.buysellsignals.net/BuySellSignals/report/Usnyse/Stock/Daily/Link/Announcements_8K_othersnews523.html*

SECTION 2 ENBRIDGE ENERGY MANAGEMENT PROFILE

2.1 Stock Identifiers

ISIN: US29250X1037

PermID: 4295905237

Central Index Key (CIK): 1173911

CUSIP: 29250X103

2.2 Contact details

Website	http://www.enbridgemanagement.com
Physical Address	1100 Louisiana Street,Suite 3300,Houston,TX,77002
Phone	+1 713 821-2000
Fax	+1 713 821-2230
Email	eeq@enbridge.com

2.3 Stock Summary

Last	$US15.41
Trailing Month's Volume	10,132,167
Volume Index (1 is avg)	1.3
Market Cap	$US1.3 billion
Trailing Month's Range	$US14.45 - $US16.73
52-Week Range	$US14.45 - $US25.08
Shares Outstanding	83,983,810
Relative Strength in NYSE market (1 mo)	11

2.4 Activities

Enbridge Energy Management, L.L.C. (Enbridge Management) is a limited partner in Enbridge Energy Partners, L.P. (the Partnership) through ownership of i-units, a special class of the Partnership's limited partner interests. The Company manages the Partnership's business and affairs under a delegation of control agreement, the Partnership and its general partner, Enbridge Energy Company, Inc. (the General Partner). The General Partner is an indirect, wholly owned subsidiary of Enbridge Inc., an energy company located in Calgary, Alberta, Canada.

SECTION 3 REPORTED HOLDINGS

3.1 Top 20 Institutional Holdings

Institutional Shareholder	No. of Shares	% Held	Value USD
ENERGY INCOME PARTNERS LLC	9,541,977	11.36	144.9 M
KAYNE ANDERSON CAPITAL ADVISORS LP	9,200,546	10.96	139.8 M
ADVISORY RESEARCH INC	6,522,761	7.77	99.1 M
SALIENT CAPITAL ADVISORS LLC	5,497,732	6.55	83.5 M
EAGLE GLOBAL ADVISORS LLC	2,888,745	3.44	43.9 M
OPPENHEIMERFUNDS INC.	2,635,840	3.14	40 M
MORGAN STANLEY	2,632,233	3.13	40 M
AMP CAPITAL INVESTORS LTD	2,617,529	3.12	39.8 M
DEUTSCHE BANK AG\	2,480,686	2.95	37.7 M
MAPLE-BROWN ABBOTT LTD	2,039,735	2.43	31 M
TORTOISE CAPITAL ADVISORS L.L.C.	1,669,152	1.99	25.4 M
COHEN & STEERS INC	1,156,601	1.38	17.6 M
MACQUARIE GROUP LTD	1,050,004	1.25	15.9 M
VANGUARD GROUP INC	942,452	1.12	14.3 M
BOLLARD GROUP LLC	921,628	1.1	14 M
ROYAL BANK OF CANADA	833,222	0.99	12.7 M
BROOKFIELD ASSET MANAGEMENT INC.	790,605	0.94	12 M

NEUBERGER BERMAN GROUP LLC	541,133	0.64	8.2 M
RUSSELL INVESTMENTS GROUP LTD.	500,138	0.6	7.6 M
CITADEL ADVISORS LLC	466,348	0.56	7.1 M
Total	54,929,067	65.4	834.4 M

SECTION 4 STOCK BUZZ

4.1 Analyst Recommendation: Trailing Month

Date	Brokerage	Action	Past Rating	Current Rating
Jun 15, 2017	Morgan Stanley	Downgrades	Overweight	Equal Weight

SECTION 5 BOARD OF DIRECTORS

Name	Designation
Mark A. Maki	President
Jeffrey A. Connelly	Chairman
M. A. Maki	Director
J. A. Connelly	Director
Guy Jarvis	Director
J. H. England	Director
Rebecca B. Roberts	Director
Dan A. Westbrook	Director
C. Gregory Harper	Director
John Whelen	Director
B.A. Stevenson	Company Secretary

SECTION 6 PRICE VOLUME DYNAMICS

The stock traded between an intra-month high of $US16.73 and a 15-month low of $US14.45.

There were ***9,798,967*** shares worth $US150.6 million traded. The turnover rate in the 12 months to date was 124.5% (or a turnover period of 9 months).

It is at a discount of 38.5% to the 12-month high of $US25.08 on 12 Jan, 2017. It is also at a premium of 6.6% to the 12-month low of $US14.45 on 20 Jun, 2017.

SECTION 7 RANKING

7.1 Global Rank [out of 47,472 stocks] and Rank in the American Region [out of 12,866 stocks]

Description	Value	Global Rank	In Am Region
MCap (US$)	1.3B	6,941	2,220
Total Assets (US$)	800,000	39,826	8,973
Net Profit (US$)	(120.1M)	40,997	10,136
Price to Book	1,618.8	34,256	6,552
Yield %	7.5	1,807	600
PV$1000 (1Year) US$	807	31,743	7,990
US$ Change (1Year) %	-22.4	32,583	8,094

7.2 Rank in the Total NYSE Market [out of 2188 stocks] and Rank in the Pipelines sector [out of 20 stocks]

Description	Value	In Total NYSE Market	In Pipelines sector
MCap (USD)	1.3B	1,148	18

Total Assets (USD)	800,000	1,893	20
Net Profit (USD)	(120.1M)	1,729	17
Yield %	7.5	299	9
PV1000 (1Year)	807	1,908	18

SECTION 8 BULLISH SIGNALS

Enbridge Energy Management vs Pipelines sector [Pipelines sector Average in Brackets]

+ Better than Sector Average: Yield of 7.5% [4.9%].

8.1 Technicals:

+ The price increased 1.4% in the last week. This has been propped up by average volume 1.02 times average for the week.

+ Its price percentile rank in the NYSE market was 11 for the month.

+ Breakout: in the last six months the stock has hit a new 52-week high once.

+ The value of $US1,000 invested five years ago is $US1,319, including a capital loss of $US128 and dividend reinvested of $US447.

PV$US1000	1-month	6-month	5-years
EEQ	$US949	$US649	$US1,319
Pipelines	$US1,015	$US989	$US1,686
S&P 500	$US997	$US1,091	$US1,779

SECTION 9 BEARISH SIGNALS

9.1 Technicals:

+ The price to 200-day MAP ratio is 0.78, a bearish indicator.

+ In the past 200 days this ratio has been under 0.78 twelve times suggesting further downside.

+ The stock is trading below both its MAPs and the 50-day MAP of $US16.57 is lower than the 200-day MAP of $US19.88, a bearish indicator.

+ The 200-day MAP has decreased to $US19.88. A decrease is another bearish indicator.

+ Falls to Rises: in the last six months the number of monthly falls outnumbered rises 4:2 or 2.0:1.

+ In the NYSE market of 1,863 stocks & 347 units traded today, the stock has a 6-month relative strength of 4 indicating it is trailing 96.0% of the market.

+ Breakdown: in the last six months the stock has hit a new 52-week low twice. The stock traded at a 15-day low of $US14.45 this month. The bears are maintaining control with price open, high, low and close being below yesterday's levels.

+ The price is at a discount of 8.3% to the 6-month volume weighted average price of $US16.80, which may appeal as a value proposition.

SECTION 10 ENBRIDGE ENERGY MANAGEMENT FINANCIALS

10.1 Financials Summary

Year ended	Dec 2016	Dec 2015	Dec 2014
Pretax (USD M)	(121.9)	(379.7)	43.7
Net (USD M)	(120.1)	(512.4)	27.1
EPS (USD)	(1.501)	(6.4988)	0.3578

10.2 ANNUAL REPORT: KEY PARAMETERS

Annual Report: Enbridge Energy Management reports Loss of $US120m

Monthly: Enbridge Energy Management down 5.1% in June, lowest amongst Pipelines sector

Enbridge Energy Management (NYSE:EEQ) reported loss for the year-ended 31 December 2016 of $US120m.
Highlights
- Loss $US120.1m
- EPS of -$US1.54
- Losses in 3 years out of the last 5 years
- EBIT to total assets of -15,237.5%

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Wormser Zeitung (Germany)

Dienstag 23. Februar 2010

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Wormser Zeitung
Unsere Zeitung!

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HSC Ingelheim - HGC Bad Kreuznach 23:25

Tore für Ingelheim: Döhn (2), Herrmann (8/5), Pallara (3), Hefner (2), Rösch (5/1), Fortenbacher (1), D. Matczak (1), Hofmann (1); für Bad Kreuznach: Maaß (2), Endler (3), Hasselwander (3), Waidner (1), Werner (5), Haas (2/1), Muth (1), Hertel (4/2), Rohrbacher (2), Steig (1), Schlamp (1).

TuS Wörrstadt - TSG Ober-Hilbersh.18:34

Tore für Wörrstadt: Lutz (1), Mussel (1), Ohl (3), Rosche (4), Steil (1), Schirmer (5/3), A. Schmand (3); für Ober-Hilbersheim: Köhler (2), Mi. Hessinger (8/3), Hoch (3), Dorwagen (3), Jost (2), Linck (3), Dönsdorf (7), Ma. Hessinger (2), Kappel (4).

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SC Bellheim - TSV Schott Mainz III4,0:4,0

Schachfr. Heidesheim II - SK Dahn4,0:4,0

SC Schifferstadt - Schachhaus Lu'hafen2,5:5,5

SK Landau II - SC Landskrone3,5:4,5

1. SC Landskrone7 5 0 2 35,5:20,5 10:4

2. SH Lu'hafen6 3 2 1 27,5:20,5 8:4

3. SK Landau II7 3 2 2 30,5:25,5 8:6

4. Sfr. Heidesheim II7 3 2 2 28,0:28,0 8:6

5. Schott Mainz III7 3 2 2 28,0:28,0 8:6

6. Kreuznacher SV6 2 3 1 26,5:21,5 7:5

7. SC Bellheim7 3 1 3 25,0:31,0 7:7

8. SK Dahn7 2 2 3 25,5:30,5 6:8

9. SC Schifferstadt7 2 0 5 22,5:33,5 4:10

10. SK Ludwigshafen II7 1 0 6 23,0:33,0 2:12

Zweite Verbandsliga

SC Budenheim - SV Bodenheim II4,0:4,0

Schott Mainz VII - Schachfr. Mainz IV2,5:5,5

Multatuli Ingelheim - SV Osthofen5,5:2,5

Schachfr. Heidesheim IV - SK Bingen III6,0:2,0

Vorw. Orient Mainz IV - SV Mombach III3,5:4,5

1. Ingelheim7 6 0 1 34,0:22,0 12:2

2. SC Budenheim7 4 2 1 36,0:20,0 10:4

3. Schachfr. Mainz IV6 4 1 1 28,5:19,5 9:3

4. Sfr. Heidesheim IV8 4 0 4 27,5:36,5 8:8

5. Schott Mainz VII7 3 1 3 28,0:28,0 7:7

6. SV Osthofen7 3 0 4 28,0:28,0 6:8

7. SV Bodenheim II7 2 2 3 27,0:29,0 6:8

8. SV Mombach III7 2 0 5 24,5:31,5 4:10

9. Orient Mainz IV7 2 0 5 24,0:32,0 4:10

10. SK Bingen III7 1 2 4 22,5:33,5 4:10

Bezirksliga Rheinhessen

SV Pfeddersheim II - SV Bodenheim III5,5:1,5

Schachfr. Heidesh. V - SC Lörzweiler II5,5:2,5

Gau-Algesheim V - SC Landskrone IV2,5:5,5

1. SC Landskrone IV8 8 0 0 46,5:17,5 16:0

2. SV Pfeddersheim II8 6 0 2 41,5:21,5 12:4

3. Gau-Algesheim V8 5 0 3 38,0:25,0 10:6

4. Sfr. Heidesheim V8 4 0 4 30,0:34,0 8:8

5. SC Lörzweiler II8 0 1 7 17,5:45,5 1:15

6. SV Bodenheim III8 0 1 7 16,5:46,5 1:15

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AVX Releases an Innovative Interconnect Sample Kit for Consumer, Medical, Industrial, IoT ...

GuruFocus.com

October 6, 2016 Thursday 2:47 AM EST

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Length: 2508 words

Body

Oct 06, 2016(GuruFocus.com: http://www.gurufocus.com/ Delivered by Newstex) ; (GuruFocus.com) By Press Release. Available as a Physical Sample That Enables Two Active Demonstrations ... an Interactive Online Simulation, AVX's New Interconnect Sample Kit Presents a Broad Range of Connector Solutions Ideal for Applications in Which Small Size ...-Rel Performance Are Mission CriticalFOUNTAIN INN, SC--(Marketwired - October 5, ----6) - AVX Corporation[1] (NYSE: AVX), a leading manufacturer of passive components and interconnect solutions, has released an innovative new sample kit that showcases a broad range of connectors ideal for use in consumer, medical, industrial, and IoT applications in which small size and high-reliability performance are mission critical. Available as both a physical sample and as an interactive online simulation[2], the new interconnect sample kit consists of a PCB loaded with -5 examples of board-to-board, wire-to-board, battery, and pogo pin connectors, including several of the STRIPTâbdquo;¢[3] UL-approved, insulator-less single contacts AVX pioneered to deliver complete connector performance with lower costs and profiles. The physical version of the sample kit features a white lid designed to simulate a replaceable or disposable module, and offers two active demonstrations.

Using the lid, physical users can experience how AVX's new vertical-mate battery connectors[4] eliminate angular insertion in pluggable module applications, as well as how easily pogo pin contacts[5] mate with modules in cradle and docking applications, where they can function as the charging, data transfer, or programming interface to a portable device. The virtual interconnect sample kit[6] allows users to navigate the board with their cursor, and provides brief descriptions of each connector category, summary information about each series, and convenient links to each product page. "The connectors featured in our new shirt-pocket sample kit are designed to meet an encompassing range of stringent size, cost, and performance objectives in a wide range of consumer, medical, industrial, and IoT applications, including: smart home devices like thermostats and security systems, commercial building controls, machine controls, industrial electronic modules, connected medical devices, such as patient monitoring and drug dispensing equipment, and smart grid meters, breakers, and panels, amongst many others," said Tom Anderson, connector product manager at AVX. Components featured in the new interconnect sample kit include:Board-to-Board Connectors[7]: AVX's board-to-board connector product portfolio includes two-piece connectors, individual contacts, single-piece card edge connectors, and compression connectors designed to satisfy a wide variety of signal and power requirements. Featuring minimal pitches, low stacking heights, a broad range of pin heights, and several robust options that can withstand even extreme shock and vibration, this product family provides ideal packaging solutions for perpendicular, parallel, and coplanar applications. Four representative series are included in the sample kit: 9-55 Series[8] low-profile single contacts, 9-88 Series[9] staggered stacker connectors, 9-58 Series[10] dual-row stacker connectors, and 9—58 Series[11] ultralow profile stacker connectors. Battery Connectors[12]: AVX offers the broadest portfolio of standard battery connectors on the market. Available in both horizontal and vertical options, these robust connectors are ideal for board-to-board connections and battery pack integration. One example, a 9-55-8 Series[13] vertical mate —.mm pitch battery connector, is included in the

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Four representative series are included in the sample kit: 9-76-4 Series[20] single IDC contacts, 9-76-5 Series[21] single IDC contacts, -9-75 Series[22] single-contact IDC connectors, and 9-76-65 Series[23] single-tine IDC connectors.Pogo Pin Contacts[24]: Designed to provide high cycle life in industrial and medical applications that demand robustness and reliability, AVX's pogo pin contacts are designed to mate with gold plated PCB pads or flat contacts in docking and cradle applications, are available with contact heights spanning —.mm - 5.5mm to provide off-the-shelf solutions for a wide variety of applications, and deliver high reliability and signal integrity for over -, mating cycles. Three 7-9-5 Series[25] parallel/stacking pogo pin contacts are included in the sample kit. For more information about AVX's new interconnect sample kit for consumer, medical, industrial, and IoT applications that demand small size and high-reliability performance, please visit http://www.avx.com/resources/technical-info-papers/interconnect-kit/[26] to access the interactive online kit, and any of the many embedded links above for more information about specific connector series. For all other inquiries, please visit www.avx.com[27], call 864-967——5, or write to One AVX Boulevard, Fountain Inn, S.C. —9644.About AVX AVX Corporation[28] is a leading international manufacturer and supplier of electronic passive components and interconnect solutions with — manufacturing and warehouse facilities in -- countries around the world. AVX offers a broad range of devices including capacitors, resistors, filters, timing and circuit protection devices, and connectors. The company is publicly traded on the New York Stock Exchange (NYSE: AVX).A member of the Kyocera Group since -99, AVX is also the only company authorized to supply Kyocera's electronic devices to the Americas and Europe. Established in -959 and based in Kyoto, Japan, Kyocera Corporation is a leading international supplier of connectors, capacitors, ceramic resonators, surface acoustic wave (SAW) filters and duplexers, and crystal oscillators and timing devices.Image Available: http://www.marketwire.com/library/MwGo/——6/-/4/--G--695/Images/AVX69_Interconnect_Sample_Kit_PR-9657a——8—acba—b94dbabd96d/5ab9.jpg[29] For more information, contact: Tom Anderson Connector Product Manager AVX 84'—4———79 tom.anderson@avx.com[30] ;Christine Stieglitz PR Executive BtB Marketing 9-9-87—8-7—christine.stieglitz@btbmarketing.com[31];Originally published on GuruFocus.com, link: http://www.gurufocus.com/news/447913/avx-releases-an-innovative-interconnect-sample-kit-for-consumer-medical-industrial--iot-applications/newstex [1]: http://clt.marketwire.com/?release=%E2%80%93%E2%80%93G%E2%80%93%E2%80%93695%E2%80%98-%E2%80%A6%E2%80%A6%E2%80%93..979896%E2%80%93..e=%E2%80%A6..=http://www.avx.com/ [2]: http://clt.marketwire.com/?release=%E2%80%93%E2%80%93G%E2%80%93%E2%80%93695%E2%80%98-%E2%80%A6%E2%80%A6%E2%80%93..9798964..e=%E2%80%A6..=http://www.avx.com/resources/technical-info-papers/interconnect-kit/ [3]: http://clt.marketwire.com/?release=%E2%80%93%E2%80%93G%E2%80%93%E2%80%93695%E2%80%98-%E2%80%A6%E2%80%A6%E2%80%93..9798967..e=%E2%80%A6..=http://www.avx.com/products/connectors/contacts/ [4]: http://clt.marketwire.com/?release=%E2%80%93%E2%80%93G%E2%80%93%E2%80%93695%E2%80%98-%E2%80%A6%E2%80%A6%E2%80%93..979897%E2%80%A6..e=%E2%80%A6..=http://www.avx.com/products/connectors/specialty/vertical-mate-%E2%80%94-%E2%80%A6mm-pitch-9%E2%80%9355-8%E2%80%A6%E2%80%A6/ [5]: http://clt.marketwire.com/?release=%E2%80%93%E2%80%93G%E2%80%93%E2%80%93695%E2%80%98-%E2%80%A6%E2%80%A6%E2%80%93..979897%E2%80%98..e=%E2%80%A6..=http://www.avx.com/products/connectors/board-to-board/pogo-pin-single-contact-7%E2%80%A6-9%E2%80%935%E2%80%A6/ [6]: http://clt.marketwire.com/?release=%E2%80%93%E2%80%93G%E2%80%93%E2%80%93695%E2%80%98-%E2%80%A6%E2%80%A6%E2%80%93..9798976..e=%E2%80%A6..=http://www.avx.com/resources/technical-info-papers/interconnect-kit/ [7]: http://clt.marketwire.com/?release=%E2%80%93%E2%80%93G%E2%80%93%E2%80%93695%E2%80%98-

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AVX Releases an Innovative Interconnect Sample Kit for Consumer, Medical, Industrial, IoT ...

BioMedReports

October 5, 2016 Wednesday 5:14 PM EST

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Oct 05, 2016(BioMedReports: http://biomedreports.com/ Delivered by Newstex) Available as a Physical Sample That Enables Two Active Demonstrations ... an Interactive Online Simulation, AVX's New Interconnect Sample Kit Presents a Broad Range of Connector Solutions Ideal for Applications in Which Small Size ...-Rel Performance Are Mission Critical FOUNTAIN INN, SC--(Marketwired - October 05, 2016) -AVX Corporation[1] (NYSE: AVX[2]), a leading manufacturer of passive components and interconnect solutions, has released an innovative new sample kit that showcases a broad range of connectors ideal for use in consumer, medical, industrial, and IoT applications in which small size and high-reliability performance are mission critical. Available as both a physical sample and as an interactive online simulation[3], the new interconnect sample kit consists of a PCB loaded with 15 examples of board-to-board, wire-to-board, battery, and pogo pin connectors, including several of the STRIPT™[4] UL-approved, insulator-less single contacts AVX pioneered to deliver complete connector performance with lower costs and profiles. The physical version of the sample kit features a white lid designed to simulate a replaceable or disposable module, and offers two active demonstrations. Using the lid, physical users can experience how AVX's new vertical-mate battery connectors[5] eliminate angular insertion in pluggable module applications, as well as how easily pogo pin contacts[6] mate with modules in cradle and docking applications, where they can function as the charging, data transfer, or programming interface to a portable device.

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Wire-to-Board IDC Connectors[20]: AVX's portfolio of wire-to-board insulation displacement connectors (IDCs), which also features several STRIPT designs, are tested to automotive levels of shock, vibration, and temperature cycling, and provide gas-tight connections to PCBs for long-term reliability. Four representative series are included in the sample kit: 9176-400 Series[21] single IDC contacts, 9176-500 Series[22] single IDC contacts, 00-9175 Series[23] single-contact IDC connectors, and 9176-650 Series[24] single-tine IDC connectors. 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For all other inquiries, please visit www.avx.com[28], call 864-967-2150, or write to One AVX Boulevard, Fountain Inn, S.C. 29644. About AVX AVX Corporation[29] is a leading international manufacturer and supplier of electronic passive components and interconnect solutions with 20 manufacturing and warehouse facilities in 11 countries around the world. AVX offers a broad range of devices including capacitors, resistors, filters, timing and circuit protection devices, and connectors. The company is publicly traded on the New York Stock Exchange (NYSE: AVX[30]). A member of the Kyocera Group since 1990, AVX is also the only company authorized to supply Kyocera's electronic devices to the Americas and Europe. Established in 1959 and based in Kyoto, Japan, Kyocera Corporation is a leading international supplier of connectors, capacitors, ceramic resonators, surface acoustic wave (SAW) filters and duplexers, and crystal oscillators and timing devices. 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AVX Releases an Innovative Interconnect Sample Kit for Consumer, Medical, Industrial, IoT Applications

Financial Buzz

October 5, 2016 Wednesday 9:28 PM EST

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Length: 1974 words

Body

Oct 05, 2016(Financial Buzz: http://www.financialbuzz.com Delivered by Newstex) Available as a Physical Sample That Enables Two Active Demonstrations ... an Interactive Online Simulation, AVX's New Interconnect Sample Kit Presents a Broad Range of Connector Solutions Ideal for Applications in Which Small Size ...-Rel Performance Are Mission CriticalFOUNTAIN INN, SC--(Marketwired - October 05, 2016) - AVX Corporation[1] (NYSE: AVX), a leading manufacturer of passive components and interconnect solutions, has released an innovative new sample kit that showcases a broad range of connectors ideal for use in consumer, medical, industrial, and IoT applications in which small size and high-reliability performance are mission critical. Available as both a physical sample and as an interactive online simulation[2], the new interconnect sample kit consists of a PCB loaded with 15 examples of board-to-board, wire-to-board, battery, and pogo pin connectors, including several of the STRIPT™[3] UL-approved, insulator-less single contacts AVX pioneered to deliver complete connector performance with lower costs and profiles. The physical version of the sample kit features a white lid designed to simulate a replaceable or disposable module, and offers two active demonstrations. Using the lid, physical users can experience how AVX's new vertical-mate battery connectors[4] eliminate angular insertion in pluggable module applications, as well as how easily pogo pin contacts[5] mate with modules in cradle and docking applications, where they can function as the charging, data transfer, or programming interface to a portable device.

The virtual interconnect sample kit[6] allows users to navigate the board with their cursor, and provides brief descriptions of each connector category, summary information about each series, and convenient links to each product page. "The connectors featured in our new shirt-pocket sample kit are designed to meet an encompassing range of stringent size, cost, and performance objectives in a wide range of consumer, medical, industrial, and IoT applications, including: smart home devices like thermostats and security systems, commercial building controls, machine controls, industrial electronic modules, connected medical devices, such as patient monitoring and drug dispensing equipment, and smart grid meters, breakers, and panels, amongst many others," said Tom Anderson, connector product manager at AVX. Components featured in the new interconnect sample kit include: Board-to-Board Connectors[7]: AVX's board-to-board connector product portfolio includes two-piece connectors, individual contacts, single-piece card edge connectors, and compression connectors designed to satisfy a wide variety of signal and power requirements. Featuring minimal pitches, low stacking heights, a broad range of pin heights, and several robust options that can withstand even extreme shock and vibration, this product family provides ideal packaging solutions for perpendicular, parallel, and coplanar applications. Four representative series are included in the sample kit: 9155 Series[8] low-profile single contacts, 9188 Series[9] staggered stacker connectors, 9158 Series[10] dual-row stacker connectors, and 9258 Series[11] ultralow profile stacker connectors. Battery Connectors[12]: AVX offers the broadest portfolio of standard battery connectors on the market. Available in both horizontal and vertical options, these robust connectors are ideal for board-to-board connections and battery pack integration. One example, a 9155-800 Series[13] vertical mate 2.0mm pitch battery connector, is included in the sample kit. Wire-to-Board Poke-Home Connectors[14]: Featuring several innovative STRIPT products, which were

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For more information about AVX's new interconnect sample kit for consumer, medical, industrial, and IoT applications that demand small size and high-reliability performance, please visit http://www.avx.com/resources/technical-info-papers/interconnect-kit[26] to access the interactive online kit, and any of the many embedded links above for more information about specific connector series. For all other inquiries, please visit www.avx.com[27], call 864-967-2150, or write to One AVX Boulevard, Fountain Inn, S.C. 29644. About AVX AVX Corporation[28] is a leading international manufacturer and supplier of electronic passive components and interconnect solutions with 20 manufacturing and warehouse facilities in 11 countries around the world. AVX offers a broad range of devices including capacitors, resistors, filters, timing and circuit protection devices, and connectors. The company is publicly traded on the New York Stock Exchange (NYSE: AVX). 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Load-Date: October 5, 2016

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China PBT plants average run rates rise to 50% from 29%

ICIS Chemical News

July 8, 2014 Tuesday

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Length: 109 words

Body

SINGAPORE (ICIS)--Operating rates at polybutylene terephthalate (PBT) plants in China rose to an average of 50% on Tuesday from 29% a week ago, according to ICIS data.

The increase was partly attributed to the restart of Xinjiang Lanshan Tun He's [1]60,000 tonne/year PBT unit in late June.

Lacklustre demand and a supply overhang in northeast Asia have kept Chinese producers running their facilities at [2]reduced capacity.

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No Headline In Original

GlobalAdSource (French)

Vendredi 1 Avril 2011

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Length: 39 words

Body

ID	9798967
Description	DECORS ET FLAMMES CAMPAGNE AFFICHAGE
Price	$23.0 USD
Media Type	Outdoor
Country	France
Source	CLEAR CHANNEL GRAND FORMAT
Product	DECORS ET FLAMMES
Productbrand	DECORS ET FLAMMES
Productcompany	DECORS ET FLAMMES

Preview

Order

Ad Detail

Load-Date: October 3, 2012

End of Document

EXHIBIT

1

US009798967B2

(12) **United States Patent**
McAllister

(10) **Patent No.: US 9,798,967 B2**
(45) **Date of Patent: *Oct. 24, 2017**

(54) **SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS**

(71) Applicant: **ADASA INC.**, Eugene, OR (US)

(72) Inventor: **Clarke W. McAllister**, Eugene, OR (US)

(73) Assignee: **ADASA INC.**, Eugene, OR (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/042,993**

(22) Filed: **Feb. 12, 2016**

(65) **Prior Publication Data**

US 2016/0162773 A1 Jun. 9, 2016

Related U.S. Application Data

(63) Continuation of application No. 13/526,520, filed on Jun. 19, 2012, now Pat. No. 9,272,805, which is a continuation-in-part of application No. 12/820,109, filed on Jun. 21, 2010, now Pat. No. 8,228,198, which is a continuation-in-part of application No. 11/465,712, filed on Aug. 18, 2006, now Pat. No. 7,830,258, and a continuation-in-part of application

(Continued)

(51) **Int. Cl.**

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G06K 19/077	(2006.01)
B65C 9/18	(2006.01)
B65C 11/00	(2006.01)
B65C 9/00	(2006.01)
B65C 9/40	(2006.01)
G06K 17/00	(2006.01)

(52) **U.S. Cl.**

CPC ***G06K 19/07716*** (2013.01); ***B65C 9/1865*** (2013.01); ***B65C 11/006*** (2013.01); ***G06K 19/077*** (2013.01); *B65C 2009/0003* (2013.01); *B65C 2009/404* (2013.01); *G06K 2017/0041* (2013.01)

(58) **Field of Classification Search**

CPC ... G06K 2017/0045; G06K 2017/0051; G06K 19/077; G06K 19/07716; B65C 9/1865; B65C 11/006

USPC 340/572.1–572.9, 10.1–10.6; 709/217; 705/28

See application file for complete search history.

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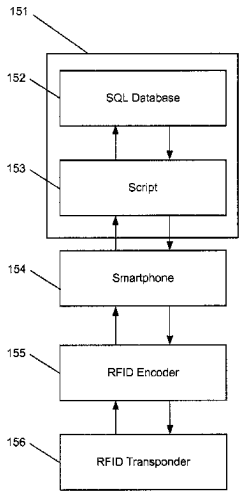
Primary Examiner — Thomas Mullen

(74) *Attorney, Agent, or Firm* — Fay Kaplun & Marcin, LLP

(57) **ABSTRACT**

In one embodiment the present invention comprises a smartphone and encoders for commissioning RFID transponders. The present invention further includes novel systems, devices, and methods for commissioning RFID transponders with unique object class instance numbers without requiring a realtime connection to a serialization database.

20 Claims, 19 Drawing Sheets



Related U.S. Application Data

No. 12/124,768, filed on May 21, 2008, now abandoned.

(60) Provisional application No. 60/709,713, filed on Aug. 19, 2005, provisional application No. 60/939,603, filed on May 22, 2007.

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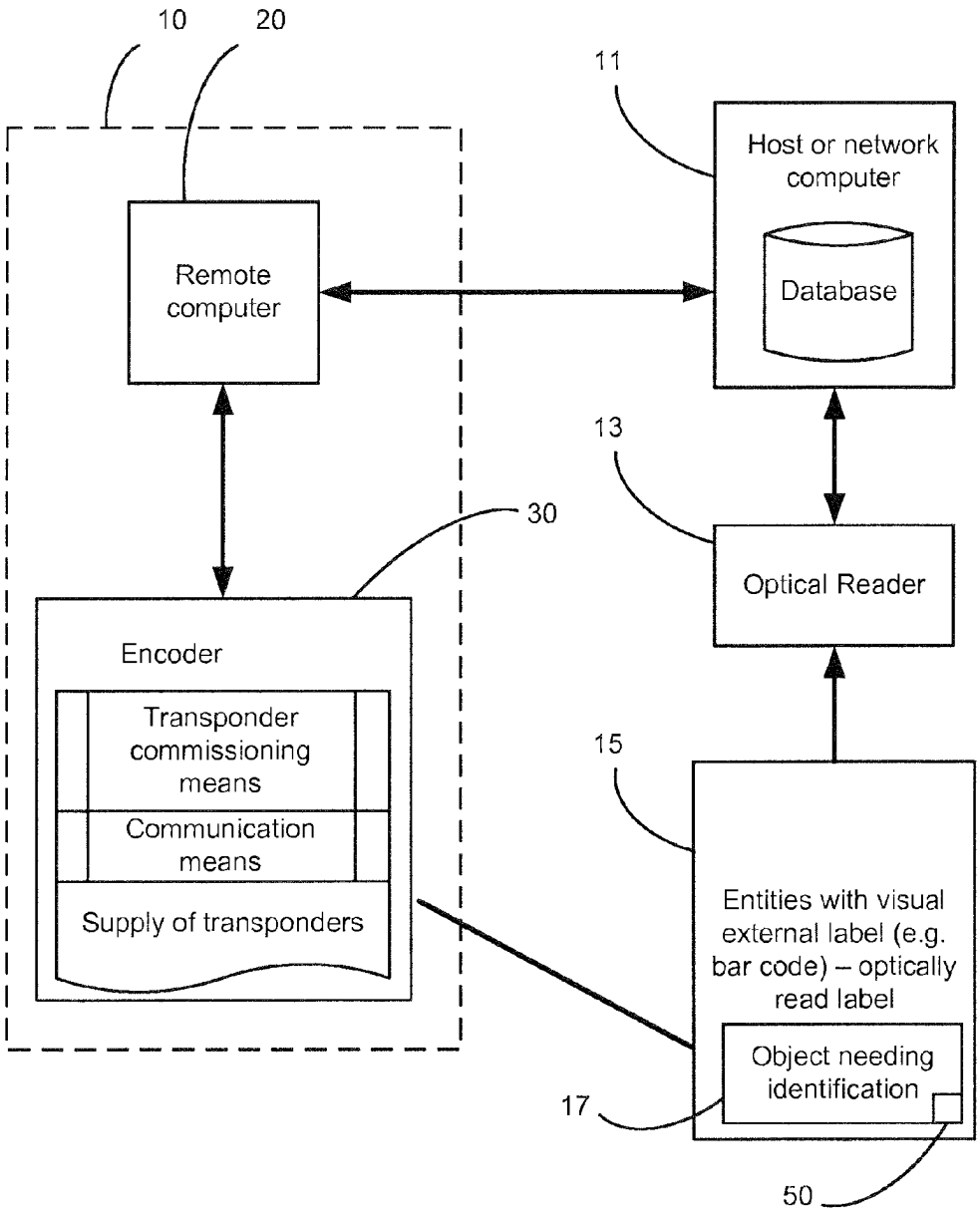

10
20
11
Host or network computer
Database
Remote computer
13
30
Optical Reader
Encoder
Transponder commissioning means
Communication means
Supply of transponders
15
Entities with visual external label (e.g. bar code) – optically read label
Object needing identification
17
50

FIG. 1

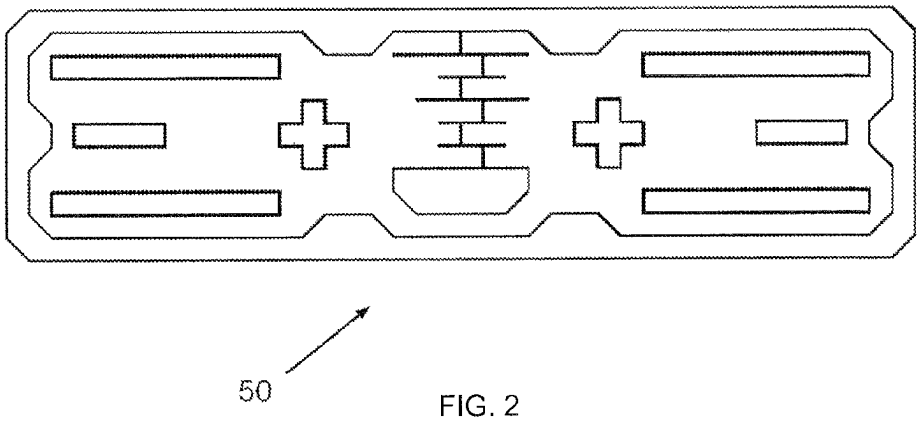


FIG. 2

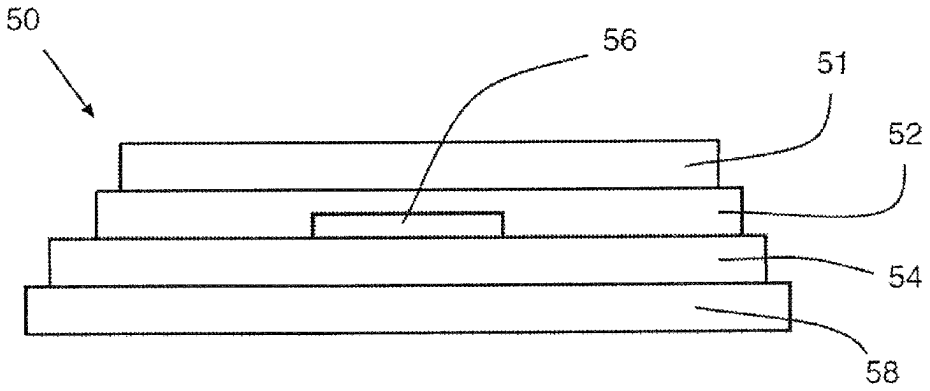


FIG. 3

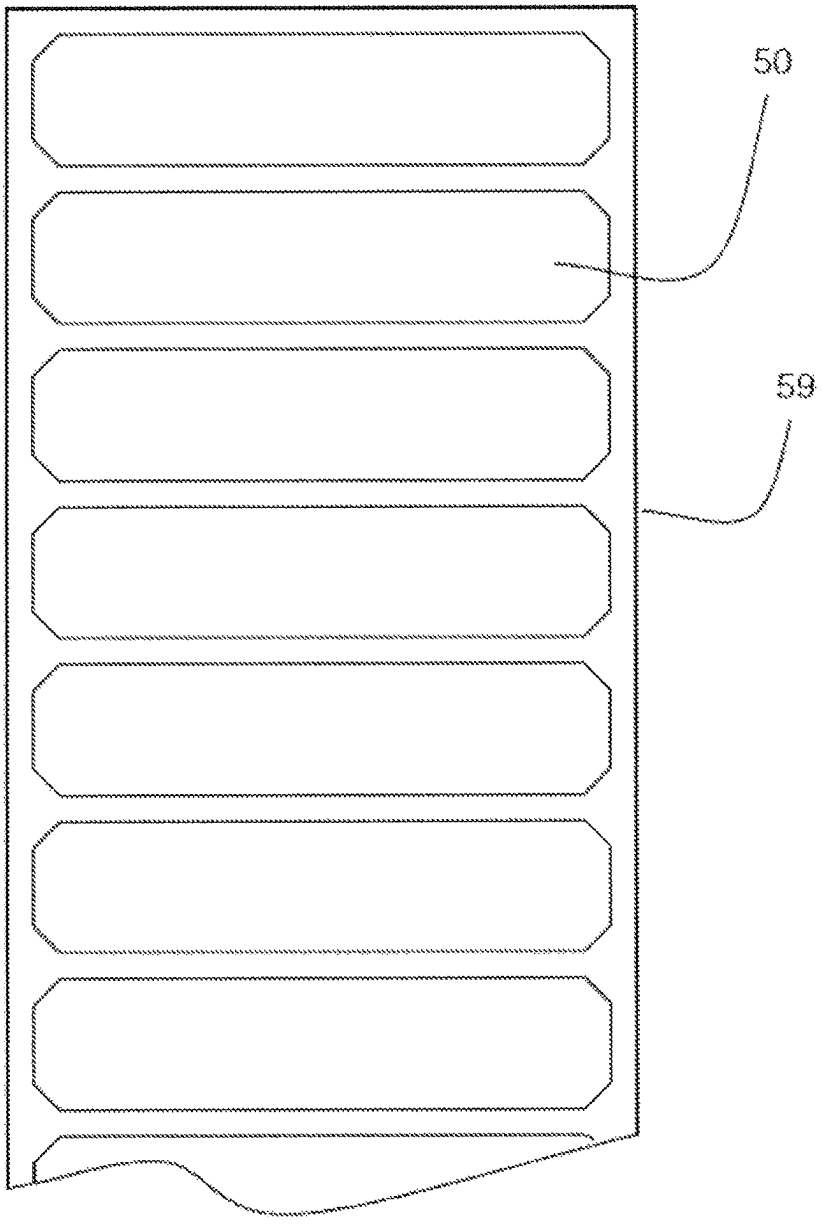


FIG. 4

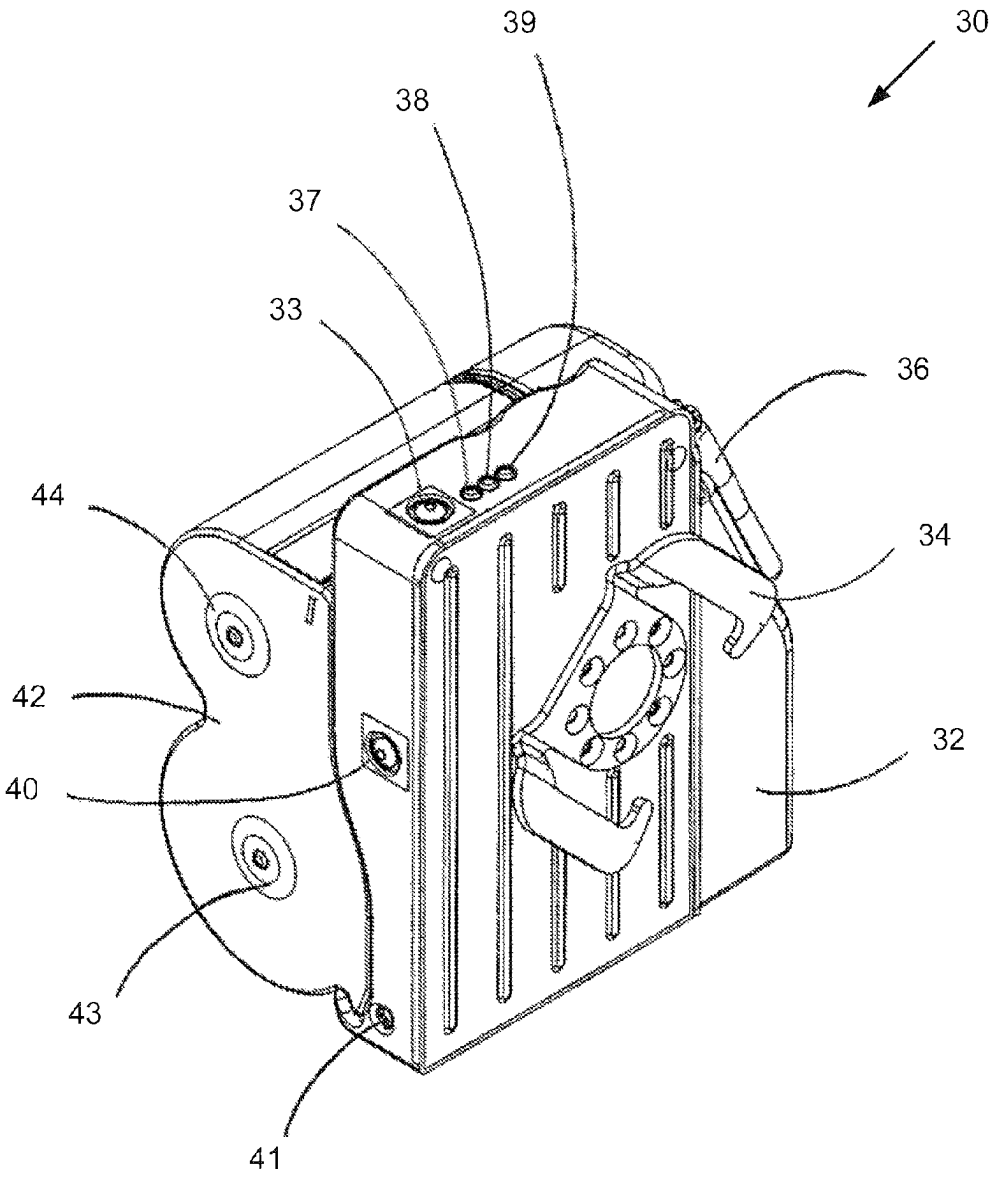


FIG 5

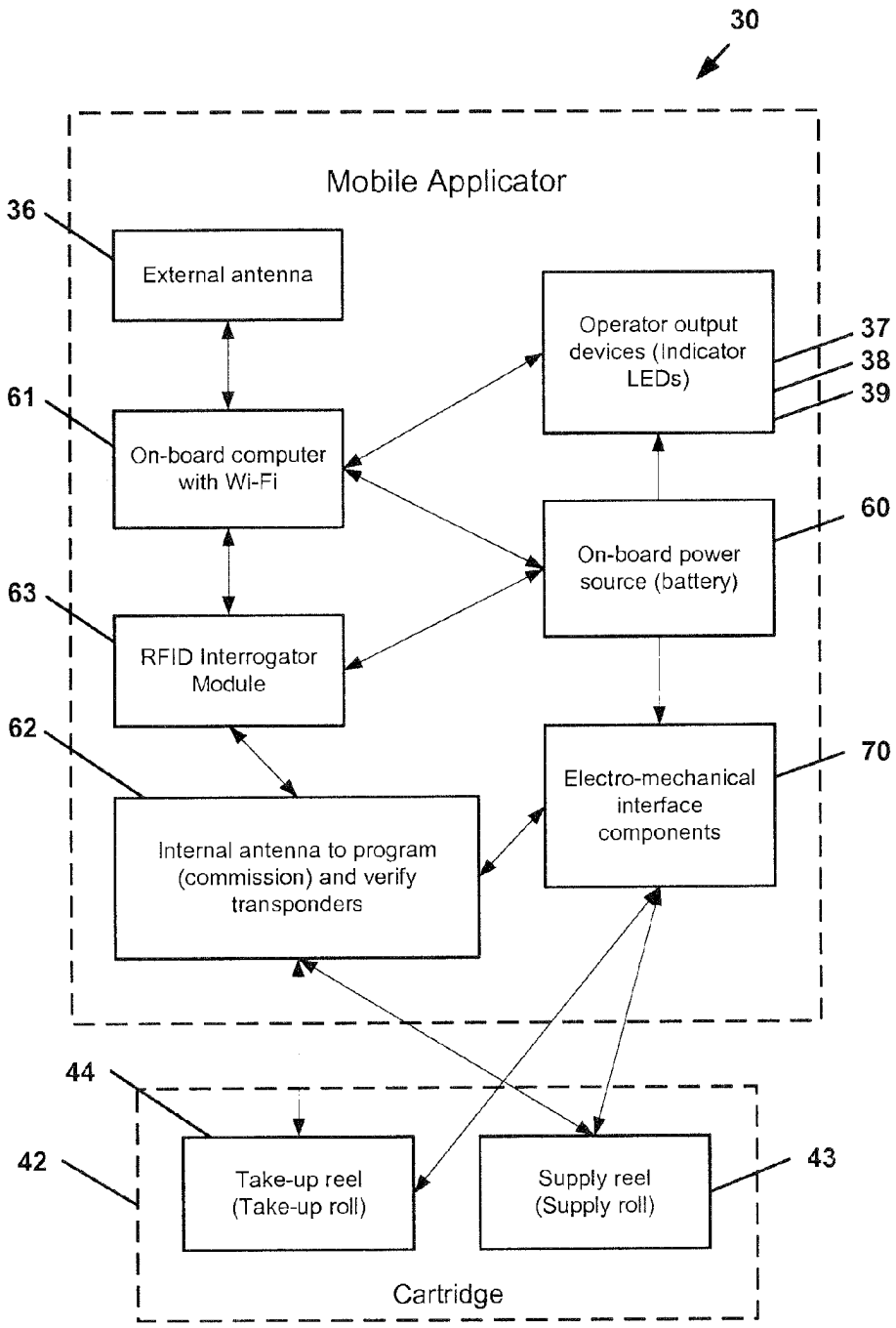

30
Mobile Applicator
36
External antenna
61
On-board computer with Wi-Fi
63
RFID Interrogator Module
62
Internal antenna to program (commission) and verify transponders
Operator output devices (Indicator LEDs)
37
38
39
On-board power source (battery)
60
Electro-mechanical interface components
70
44
42
Take-up reel (Take-up roll)
Supply reel (Supply roll)
43
Cartridge

FIG. 6

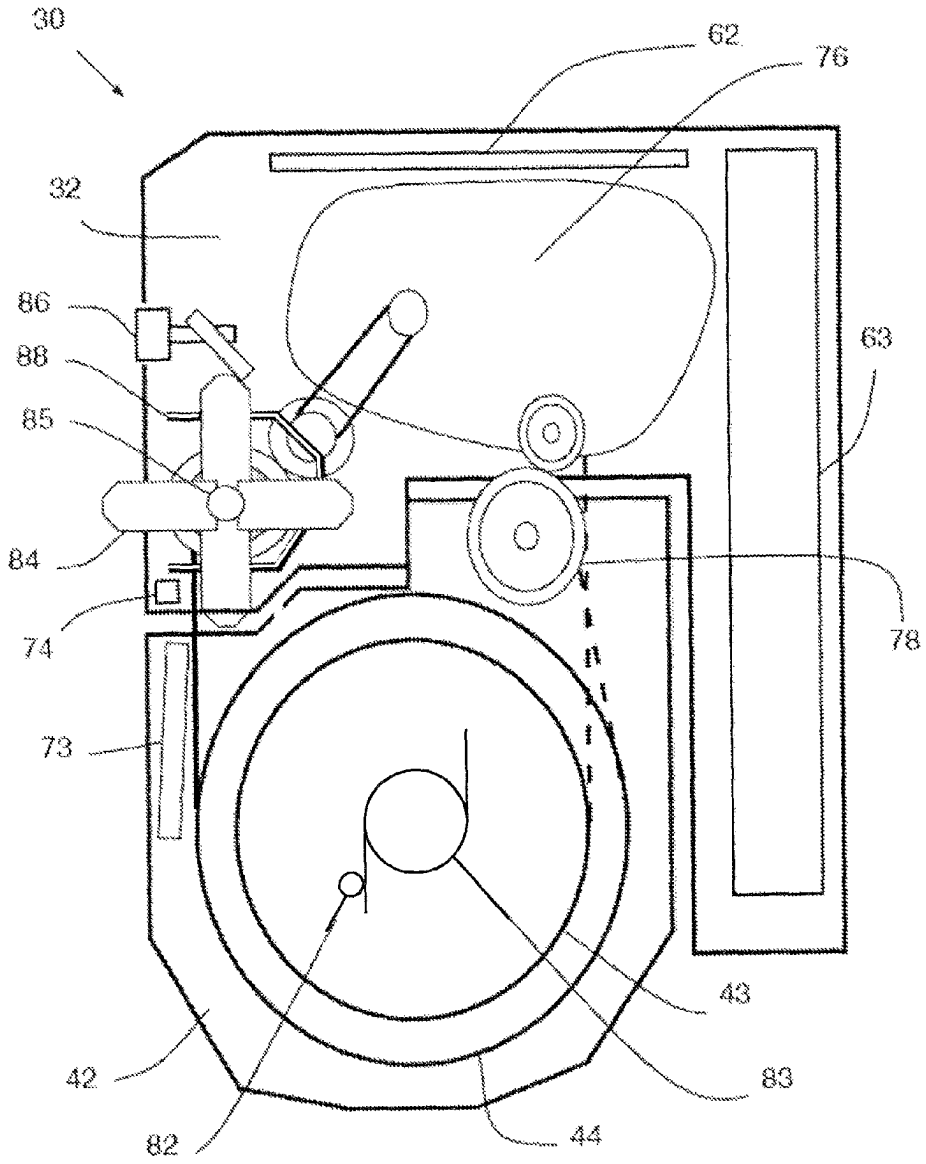


FIG. 7

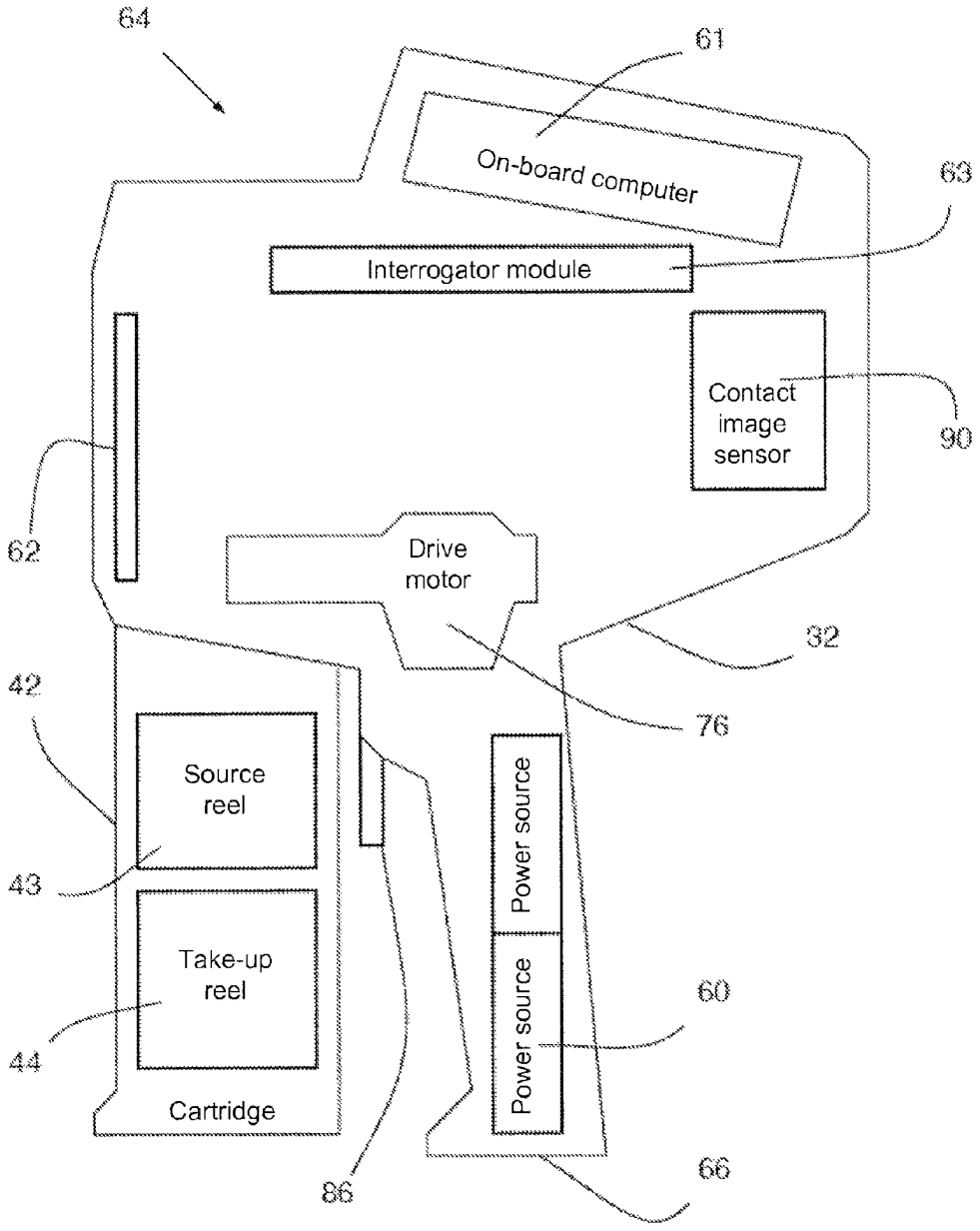

64
61
On-board computer
63
Interrogator module
Contact image sensor
90
62
Drive motor
32
42
76
Source reel
43
Take-up reel
44
Cartridge
Power source
Power source
60
66
86

FIG. 8

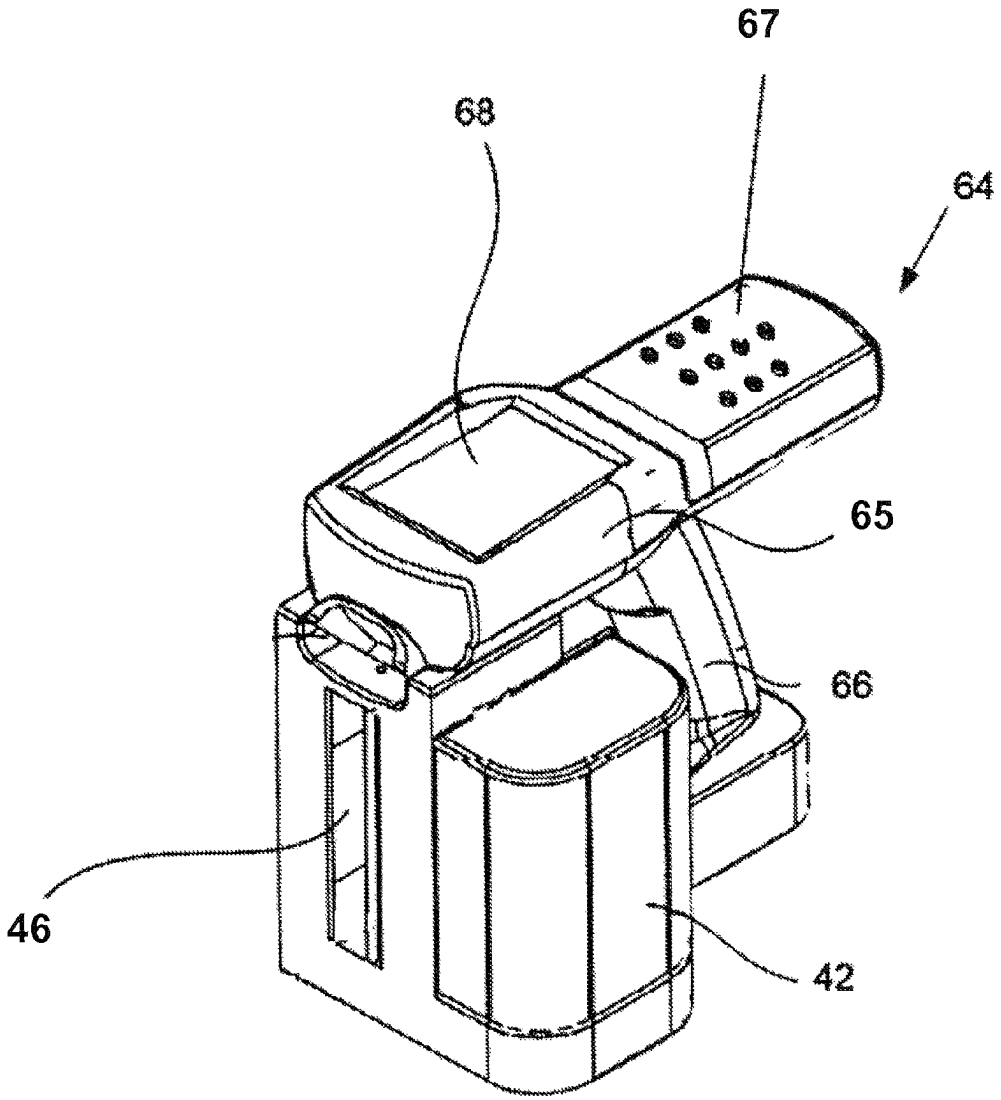


Fig. 9

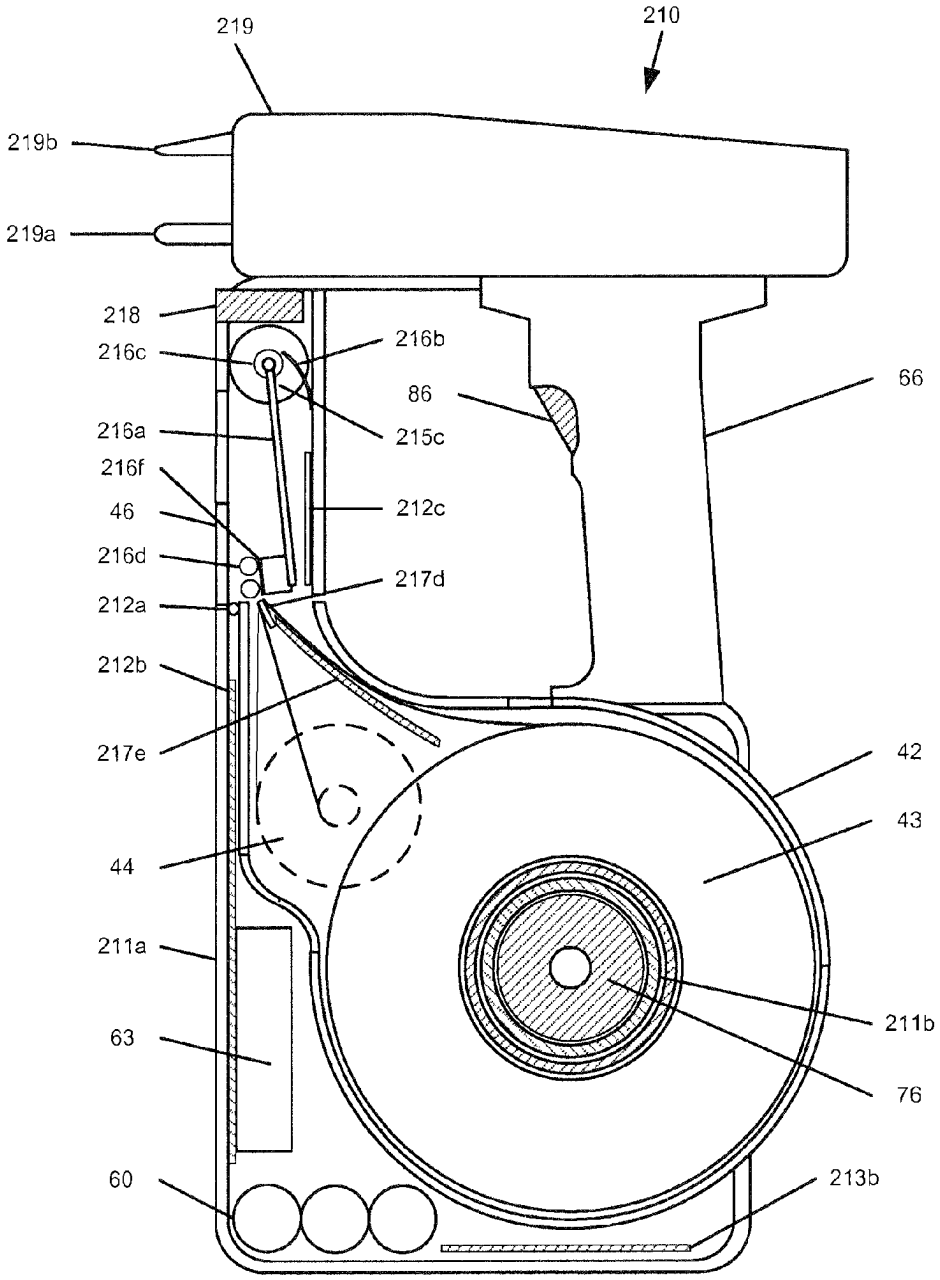

219
210
219b
219a
218
216c
216b
86
66
215c
216a
216f
46
212c
216d
217d
212a
212b
217e
42
43
44
211a
211b
63
76
60
213b

FIG. 10

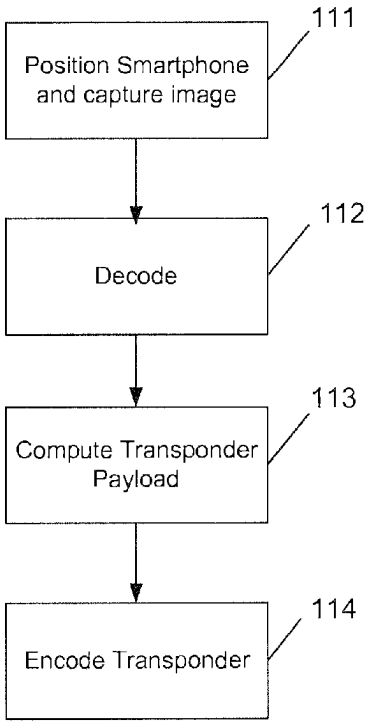

Position Smartphone and capture image
111
Decode
112
Compute Transponder Payload
113
Encode Transponder
114

Fig. 11

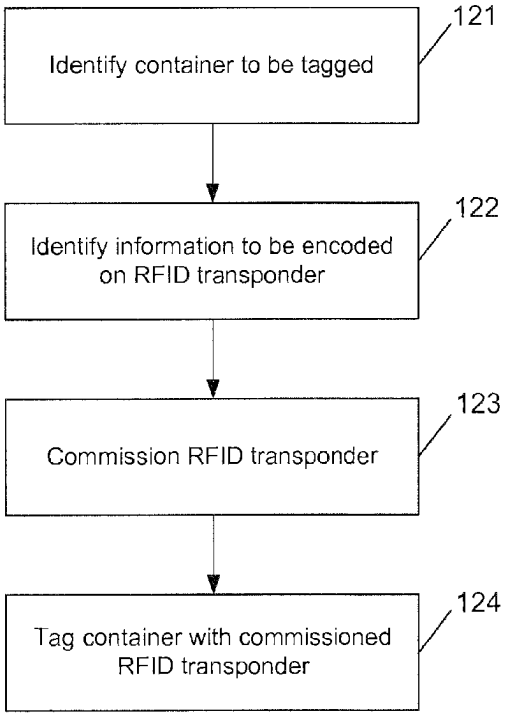

Identify container to be tagged
121
Identify information to be encoded on RFID transponder
122
Commission RFID transponder
123
Tag container with commissioned RFID transponder
124

Fig. 12

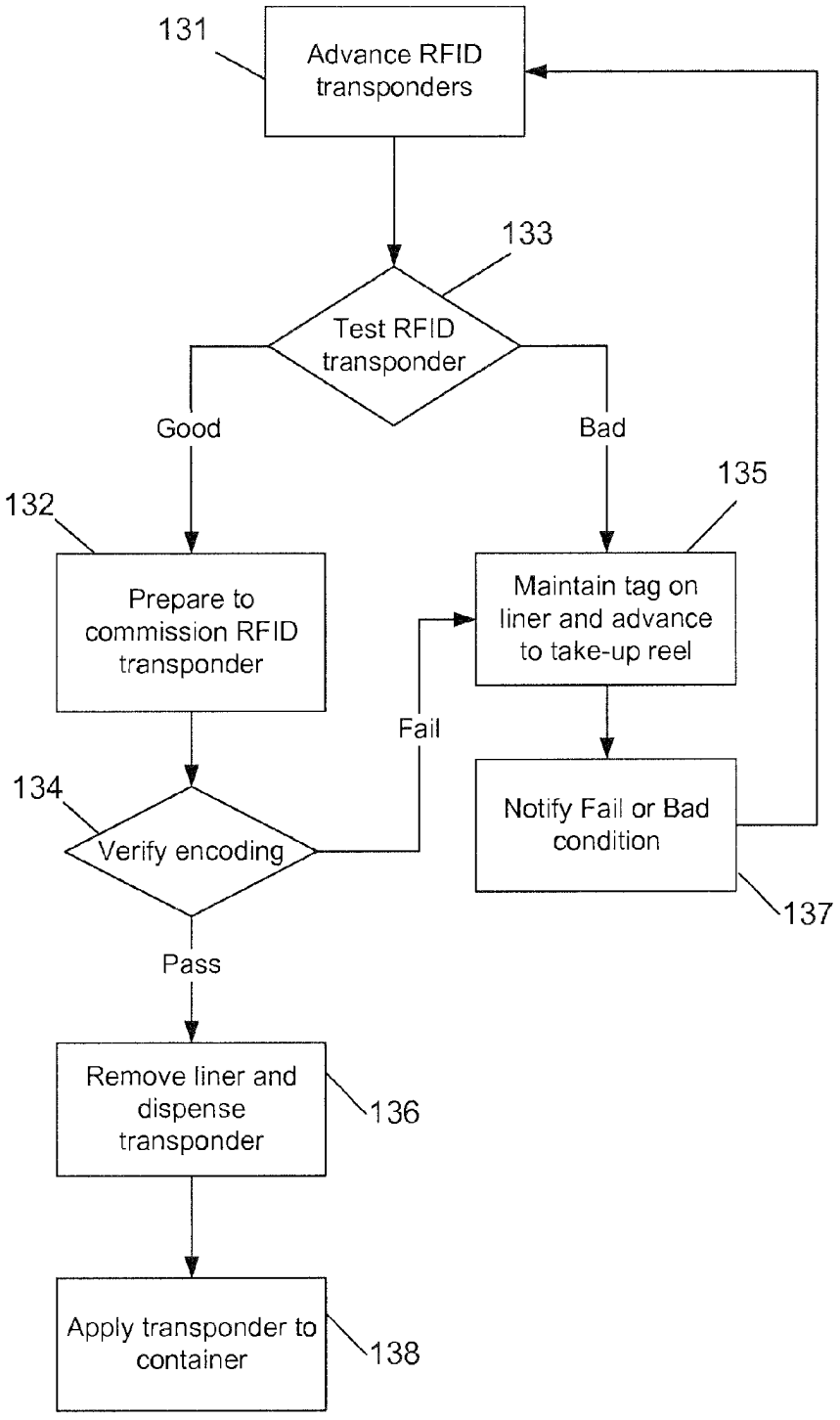

131
Advance RFID transponders
133
Test RFID transponder
Good
Bad
132
Prepare to commission RFID transponder
135
Maintain tag on liner and advance to take-up reel
Fail
134
Verify encoding
Notify Fail or Bad condition
137
Pass
Remove liner and dispense transponder
136
Apply transponder to container
138

Fig. 13

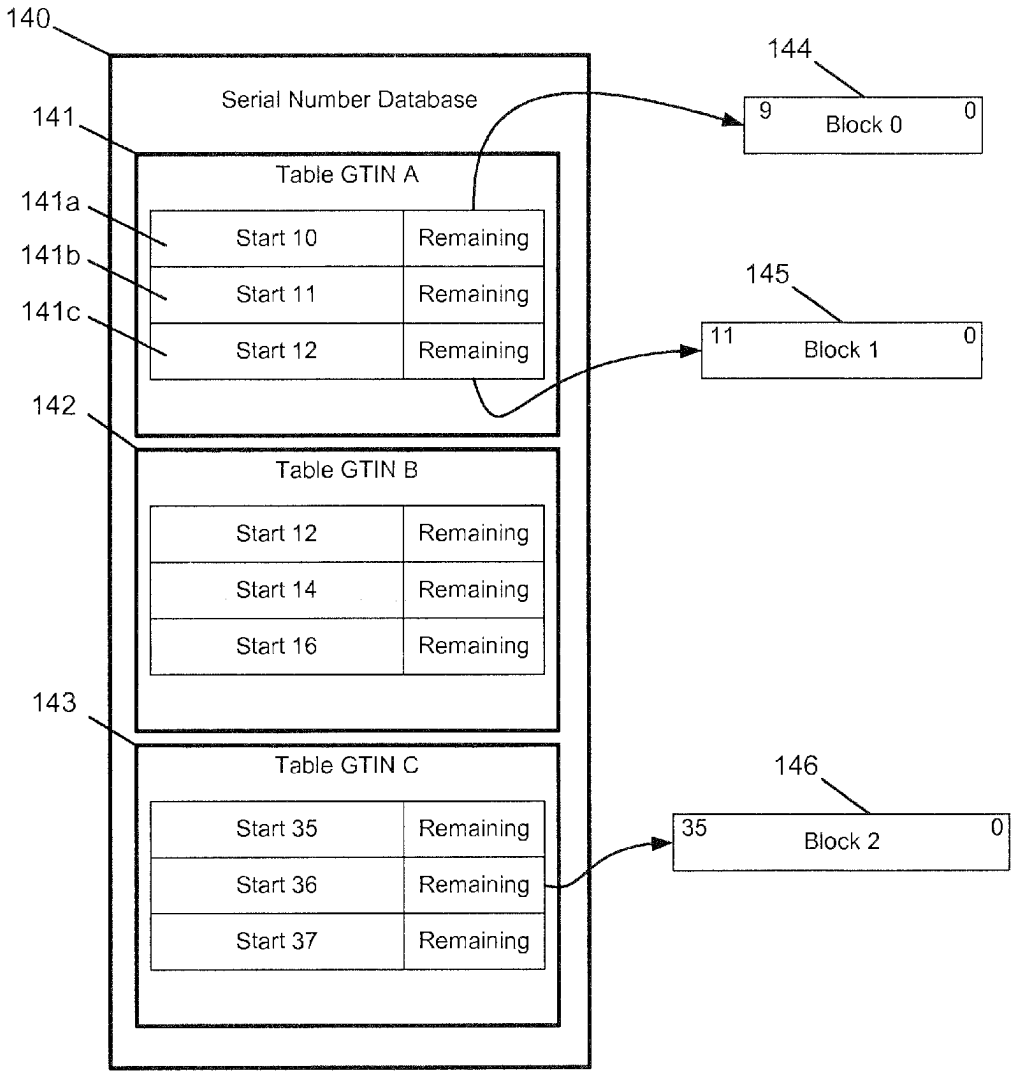

140
Serial Number Database
141
Table GTIN A
141a
141b
141c
Start 10
Remaining
Start 11
Remaining
Start 12
Remaining
142
Table GTIN B
Start 12
Remaining
Start 14
Remaining
Start 16
Remaining
143
Table GTIN C
Start 35
Remaining
Start 36
Remaining
Start 37
Remaining
144
9
Block 0
0
145
11
Block 1
0
146
35
Block 2
0

Fig. 14

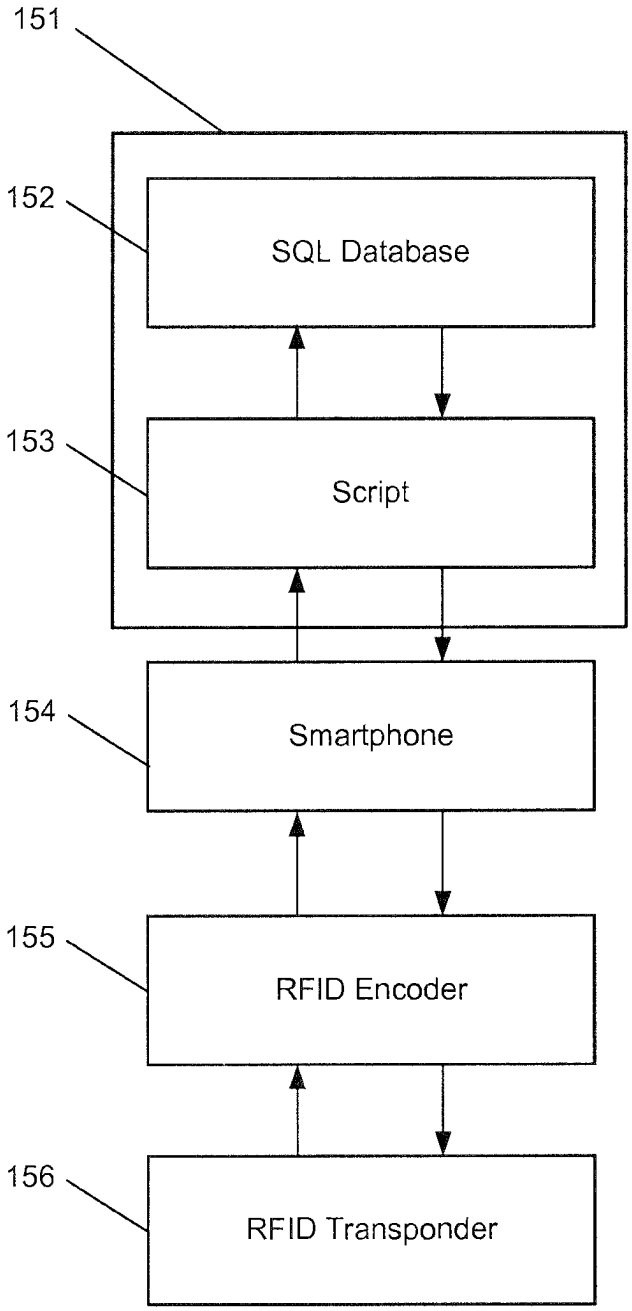

151
152
SQL Database
153
Script
154
Smartphone
155
RFID Encoder
156
RFID Transponder

FIG. 15

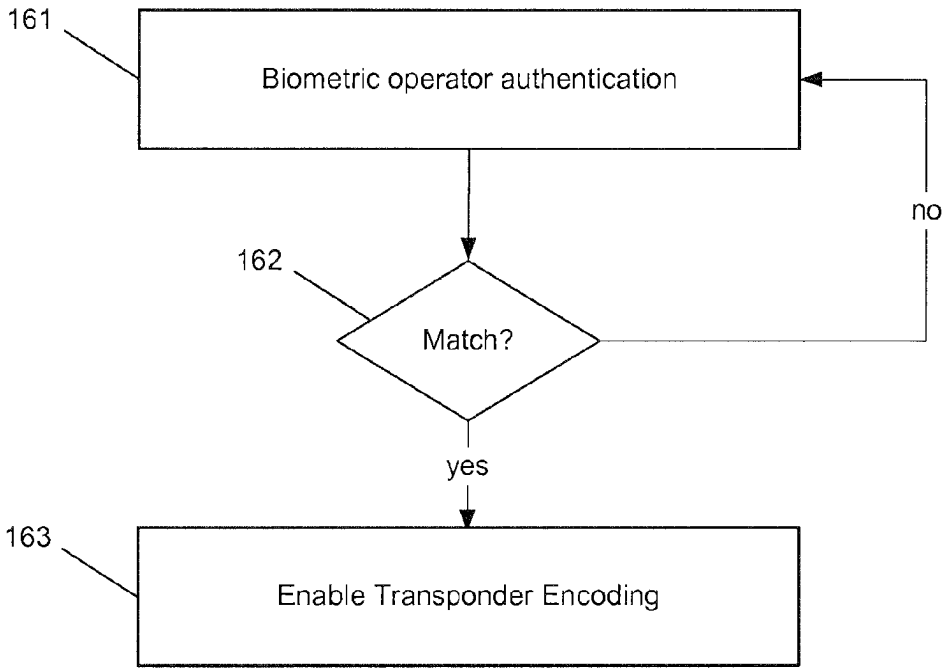

161
Biometric operator authentication
no
162
Match?
yes
163
Enable Transponder Encoding

FIG. 16

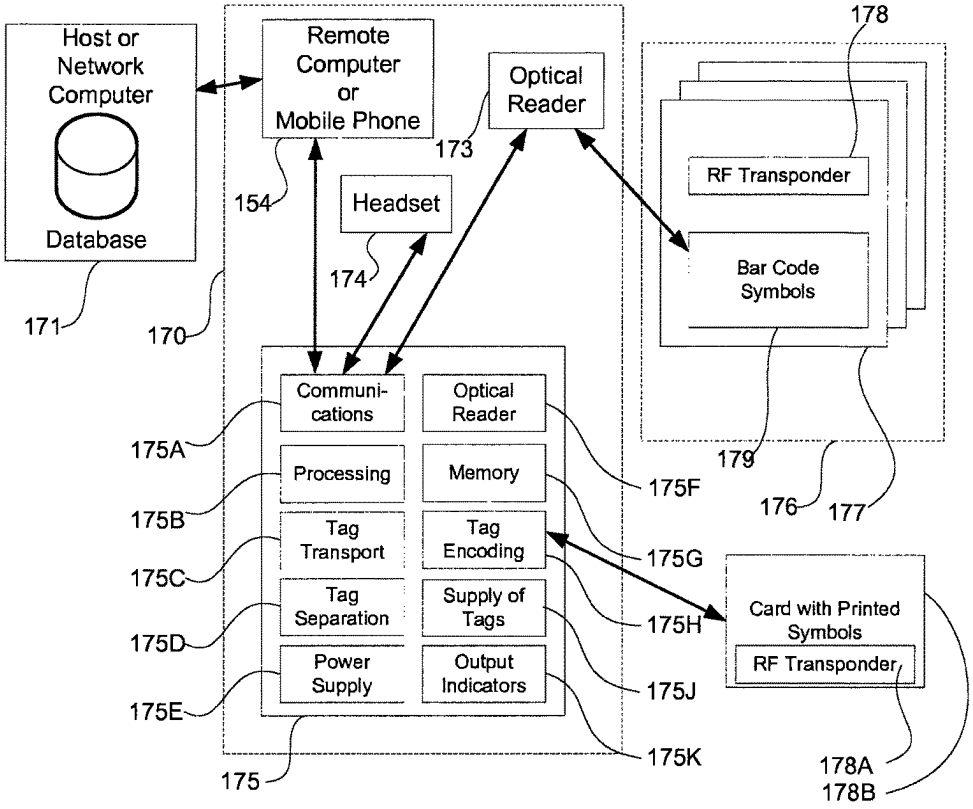

Host or Network Computer
Database
171
Remote Computer or Mobile Phone
154
Headset
174
170
Optical Reader
173
178
RF Transponder
Bar Code Symbols
179
176
177
Communi-cations
Optical Reader
Processing
Memory
Tag Transport
Tag Encoding
Tag Separation
Supply of Tags
Power Supply
Output Indicators
175A
175B
175C
175D
175E
175
175F
175G
175H
175J
175K
Card with Printed Symbols
RF Transponder
178A
178B

FIG. 17

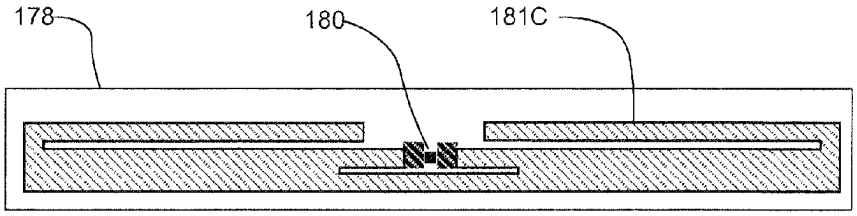


FIG 18

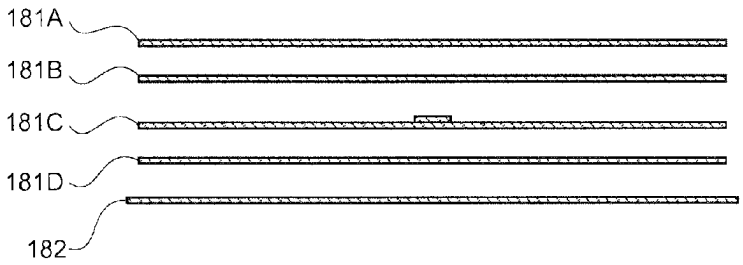


FIG 19

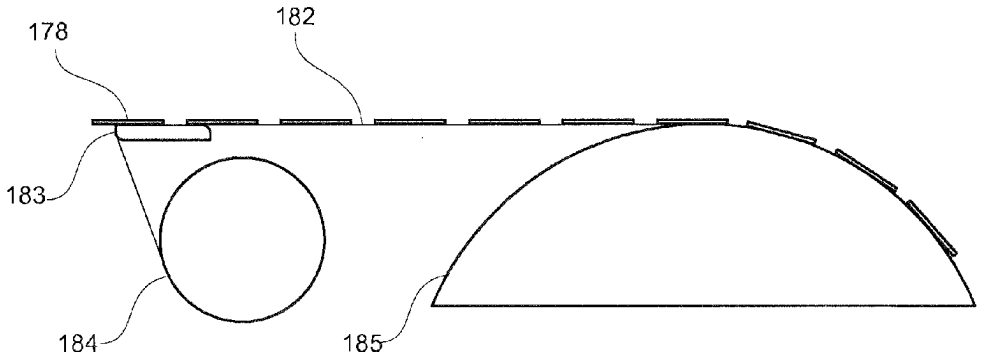


FIG 20

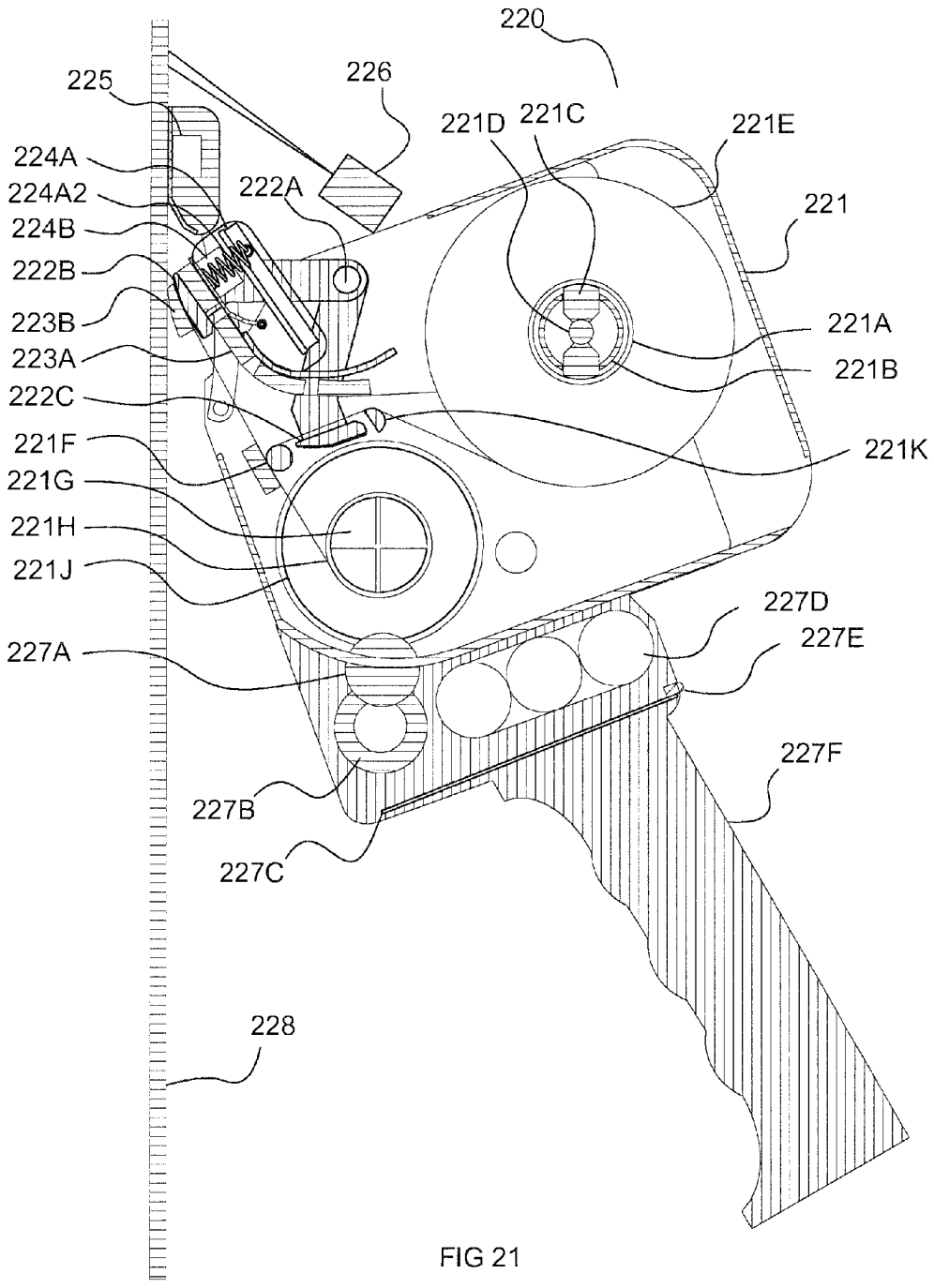

220
225
226
221D
221C
221E
224A
224A2
222A
221
224B
222B
223B
221A
223A
221B
222C
221K
221F
221G
221H
221J
227D
227A
227E
227F
227B
227C
228

FIG 21

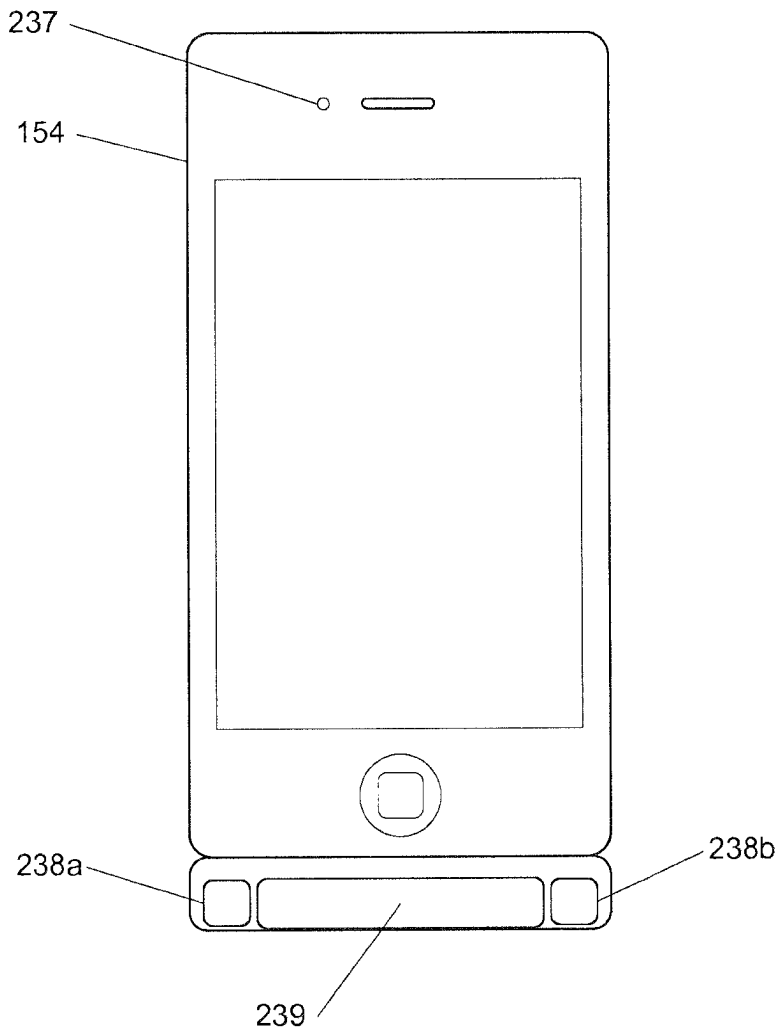


FIG. 22

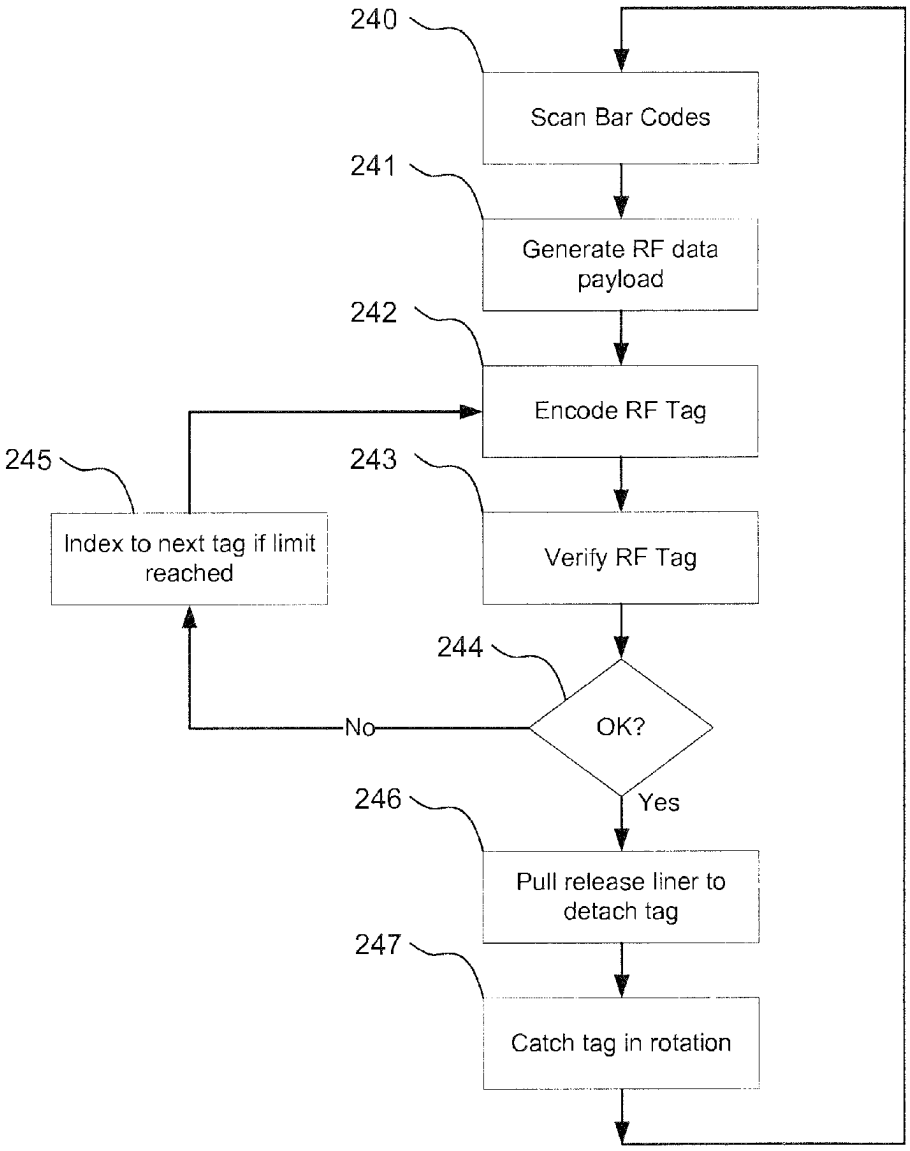

240
Scan Bar Codes
241
Generate RF data payload
242
Encode RF Tag
243
Verify RF Tag
244
OK?
No
Yes
245
Index to next tag if limit reached
246
Pull release liner to detach tag
247
Catch tag in rotation

FIG 23

SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS

RELATED APPLICATIONS

The present application is a continuation application based on U.S. application Ser. No. 13/526,520, filed on Jun. 19, 2012, now U.S. Pat. No. 9,272,805, which is a continuation-in-part application based on U.S. application Ser. No. 12/820,109, filed on Jun. 21, 2010, now U.S. Pat. No. 8,228,198, which is a continuation-in-part application of U.S. application Ser. No. 11/465,712, filed on Aug. 18, 2006, now U.S. Pat. No. 7,830,258, which claims the benefit of U.S. Provisional Application No. 60/709,713 filed on Aug. 19, 2005, and a continuation-in-part application of U.S. application Ser. No. 12/124,768, filed on May 21, 2008, now abandoned, which claims the benefit of U.S. Provisional Application No. 60/939,603 filed on May 22, 2007. The present application claims priority from these applications, the disclosures of which are hereby expressly incorporated herein by reference.

BACKGROUND

The present invention relates to a system, including methods and devices, utilizing wireless sensor devices and RFID (radio-frequency identification) transponders. Specifically, the present invention relates to a system incorporating novel devices and methods that enable point-of-use and on-demand commissioning of RFID transponder-equipped wireless sensors.

Radio-frequency identification (RFID) transponders enable improved identification and tracking of objects by encoding data electronically in a compact tag or label. And, advantageously, the compact tag or label does not need external, optically recognizable or human-readable markings. In fact, using the Gen2 EPC specification, a three-meter read-distance for RFID transponders is common—even on high-speed material handling lines.

Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder.

Current classes of RFID transponders rank into two primary categories: active RFID transponders and passive RFID transponders. Active RFID transponders include an integrated power source capable of self-generating signals, which may be used by other, remote reading devices to interpret the data associated with the transponder. Active transponders include batteries and, historically, are considered considerably more expensive than passive RFID transponders. Passive RFID transponders backscatter incident RF energy to specially designed remote devices such as interrogators.

Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces.

Wireless sensors, made using silicon circuits, polymer circuits, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave (SAW) materials to affect radio frequency or other signaling methods, communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods.

Generating a unique serial number is imperative, and is required for EPCglobal RFID tagging implementations. Serialization requires a central issuing authority of numbers for manufacturers, products, and items to guarantee uniqueness and to avoid duplication of numbers. Blocks of numbers are distributed to remote locations globally. Unless a product (or SKU) is serialized at one location, the numbering space is usually partitioned according to some method, or each remote location receives each number one-by-one. Either way, there is eventually a reconciliation of serial number usage with a granularity of either one or several numbers at a time.

A preferred method of generating unique serial numbers is to assign unique numbers in a central location, such as in a label converter facility where unique bar coded labels are printed. Each unique label is then packed and shipped to remote locations, usually either in sheets or rolls. Upon arrival at a manufacturing facility, rolls are loaded onto high speed label applicators that apply one serialized label onto each carton. As those serialized cartons move through the supply chain, they may eventually arrive at a case pick location, a receiving dock, or similar location where a serialized carton is selected for having an RFID transponder applied to it. Using a bar code scanner to read one or more bar codes sufficient information can be collected to uniquely encode that data into an RFID transponder and apply it to that carton.

The uniqueness of an identifier is critical to the success of almost any tracking system. Assuring uniqueness is not necessarily simple. A generically descriptive bar code can be matched to authorizations for selected numbering systems that provide additional data fields including a unique serial number or using algorithms that assure uniqueness through numerical representations of time and space.

Certain prior art systems use printer encoders to merge the printing and RFID transponder encoding operations into a single atomic transaction. This method is more expensive in every respect. It requires mobile distributed printing with nearly perfect networking implementations in order to achieve a smooth, easy, and regular manual transponder application process. This all comes at a higher price, size, and weight. Prior art implementations tend not to be mobile, as represented by U.S. Pat. No. 7,066,667 issued to Chapman et al. on 27 Jun. 2006 and include U.S. Pat. No. 5,899,476 issued to Barrus et al. on 31 May 2005, or by U.S. Pat. No. 6,246,326 issued to Wiklof et al. on 12 Jun. 2001, describe a device that commissions an RFID transponder

with a printed label. This approach, however, introduces unnecessary waste, cost, and propensities for error. There is a growing category of applications that do not require anything other than a custom-encoded RFID transponder. This prior art calls for the inclusion of label printer hardware and related consumable materials that are not necessary for many RFID applications. Unneeded printer mechanisms create unnecessary complexities, size, and weight. In some instances this additional bulk hinders practical mobile applications. The result is that tagging solutions that include printing result in a higher total cost of ownership than a pure RF tag encoding system.

So, despite recent advances in RFID technology, the state-of-the-art does not fully address the needs of simple, efficient, economical, high-volume, reliable deployment and commissioning of RFID transponders and wireless sensors. Large-scale adoption of RFID transponders depends on systems utilizing reliable, low-cost transponders deployed at thousands of distributed locations that implement simple and efficient manual transponder commissioning means. Such systems should further include processes for efficient commissioning of batches of RFID transponders, without the need for realtime wireless connectivity.

SUMMARY OF THE INVENTION

The present invention overcomes the shortcomings of the prior-art attempts and, accordingly, provides systems, methods, and devices that commission RFID transponders on-demand and at a point-of-use utilizing wireless data transfer in a compact package that is well-suited to portable, mobile, or fixed use in multiple applications. The present invention is used for reading data from or encoding data onto wireless transponder data carriers with no external authorizations or queries required on a transponder-by-transponder basis. Additionally this invention teaches a preferred method and apparatus for commissioning RFID transponders without requiring continuous use of a screen or keypad to control operations. Further advantages of the present invention will be well-appreciated by those skilled in the art upon reading this disclosure including the appended figures of the drawing.

Authorizations for one or more classes of objects are preferably loaded into the encoder; where such authorizations include data fields such as manufacturer ID, item reference, manufacturer code lengths, filter values (that designate packaging levels such as item, case, pallet, etc.), serial number starting point for a block, and other predetermined parameters. Such information is preferably loaded into the memory of the encoder in advance of tag commissioning operations. Thus if loaded with information for more than one object class, the encoder does not have sufficient information to proceed with encoding a transponder until a single object class is selected for the present RFID transponder to receive; an ambiguity therefore exists that is preferably resolved with information entered by an operator using either a keypad or a bar code scanner. Reading printed indicia such as a bar code is a preferred method to resolve the ambiguity as to which object class the next RFID transponder is to receive a number from. Bar codes are used to eliminate errors and ambiguities that enable the encoder to locally generate or replicate data for encoding into a data carrier such as an RFID transponder.

This type of data production and/or replication process is very fast and efficient. There is no absolute need to query a database in real time; hence there is no need for continuous wireless network connectivity. This simplification eliminates the possibilities for non-deterministic network delays. Non-deterministic delays are delays that cannot be guaranteed, usually due to the probabilistic nature of packet collisions that are common in Ethernet and WiFi. By eliminating the need to access a network database, the variable non-deterministic delays caused by changing database sizes, changing record counts, and database user load fluctuations are completely circumvented. Reduction or outright elimination of non-deterministic delays helps manual labor operate at maximum efficiency, allowing them to achieve a regular and dependable cadence in their transponder application processes.

For example, in one embodiment the present invention consists of an encoder for commissioning RFID transponders. The encoder consists of an RFID interrogator module adapted to enable encoding predetermined data according to a commissioning algorithm and communicating with an internal antenna, the antenna being adapted to encode the predetermined data on the RFID transponder; a memory storage device for storing at least a portion of the predetermined data; a processing means for controlling and communicating with the memory storage device, the RFID interrogator and the internal antenna; a means for providing a supply of RFID transponders, the transponders configured for tensile extraction from the encoder or, preferably from means for providing a supply of RFID transponders comprising a cartridge; and a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable encoding of the predetermined data.

In further embodiments, the present invention includes a method for commissioning RFID transponders comprising: providing a roll or sheet of RFID transponders; providing a cartridge or other pre-packaged self-contained supply of RFID transponders; providing an encoder; inserting the roll or sheet in the cartridge or other pre-packaged self-contained supply of RFID transponders; coupling the cartridge to the encoder; acquiring information to encode from printed indicia; encoding the information on at least one RFID transponder; and adapting the process of attachment of the encoded transponder to the target surface along a vector that is nearly parallel to the target surface based upon real time feedback from the surrounding environment.

DRAWINGS

FIG. **1** is a block diagram of the system and environment according to one embodiment of the present invention.

FIG. **2** is a top view of a possible RFID transponder according to one embodiment of the present invention.

FIG. **3** is a schematic end-view of the RFID transponder of FIG. **2**.

FIG. **4** is a top view schematic drawing of a sheet or roll of a plurality of RFID transponders of FIG. **3**.

FIG. **5** is an offset orthogonal view of a mobile encoder according to one embodiment of the present invention.

FIG. **6** is a schematic block diagram showing some components of the mobile encoder of FIG. **5**.

FIG. **7** is a schematic cross section view showing electromechanical components of one embodiment of a mobile encoder.

FIG. **8** is a schematic cross section of an encoder according to the present invention.

FIG. **9** is a frontal-offset view of a hand-held, mobile encoder according to the present invention.

FIG. **10** is a schematic cross section of another encoder according to the present invention.

FIG. **11** is a flow chart of a smartphone scan and transponder encode method according to the present invention.

FIG. **12** is a flow chart of a tagging method according to the present invention.

FIG. **13** is a flow chart of a commissioning method according to the present invention.

FIG. **14** is a diagram of a serialization method according to the present invention.

FIG. **15** is a system block diagram according to the present invention.

FIG. **16** is a flow chart of a biometric authentication method according to the present invention.

FIG. **17** is a block diagram of the system and environment according to one embodiment of the present invention.

FIG. **18** is a top view of a possible RFID transponder according to one embodiment of the present invention.

FIG. **19** is a material stack specification of an RFID transponder according to one embodiment of the present invention.

FIG. **20** is a side view of a web of release liner containing RFID transponders, provided on a source roll, stretched tight around a peel device, and advanced forward onto a take-up reel according to one embodiment of the present invention.

FIG. **21** is a side view of a handheld mobile encoder with an integrated bar code scanner according to one embodiment of the present invention.

FIG. **22** is a diagram of a smartphone with FIPS 140-2 module and near field couplers according to one embodiment of the present invention.

FIG. **23** is a flow chart of a first method according to the present invention.

DESCRIPTION OF THE INVENTION

Making reference to various figures of the drawing, possible embodiments of the present invention are described and those skilled in the art will understand that alternative configurations and combinations of components may be substituted without subtracting from the invention. Also, in some figures certain components are omitted to more clearly illustrate the invention. In some figures similar features share common reference numbers.

To clarify certain aspects of the present invention, certain embodiments are described in a possible environment—as identification means for containers. In these instances, certain methods make reference to containers such as loaded pallets, paperboard boxes, corrugated cartons, pharmaceutical containers, and conveyable cases, but other containers may be used by these methods. Certain embodiments of the present invention are directed for use with steel drums, commercial corrugated shipping cartons, tagged pallet-loads of shrink-wrapped cases, consumer-goods packaging, consumer goods, automobile windshields, industrial components, or other methods of identifying objects using RFID transponders or wireless sensors, or both. In certain embodiments the target surface to which a transponder will be attached is a container. In some applications the target surface is moving while the encoder device is stationary. Furthermore the moving target surface may be objects on a conveyor. In yet other embodiments the target surface may be a web of release liner from which encoded transponders will be later removed and applied to an object for identification.

Some terms are used interchangeably as a convenience and, accordingly, are not intended as a limitation. For example, transponders is a term for wireless sensors that is often used interchangeably with the term tags and the term inlay, which is used interchangeably with inlet. This document generally uses the term tag or RF tag to refer to passive inlay transponders, which do not include a battery, but include an antenna structure coupled to an RFID chip to form an inlay which is generally thin and flat and substantially co-planar and may be constructed on top of a layer of foam standoff, a dielectric material, or a folded substrate. One common type of passive inlay transponder further includes a pressure-sensitive adhesive backing positioned opposite an inlay carrier layer. However, certain aspects of the present invention work equally well with active inlay transponders. A third type: a battery-assist tag is a hybrid RFID transponder that uses a battery to power the RFID chip and a backscatter return link to the interrogator. Further, this document uses programmable RFID transponders interchangeably with RFID transponders. Programmable transponders enable data to be written or stored more than once.

Suitable environments or applications for certain aspects of the present invention include: traditional conveyor line or other high-speed machinery with automated transponder printing, encoding, and attachment; hand attachment of transponders (a method that often is referred to as "slap and ship"); and a novel category of mobile transponder encoders (as will be more fully described herein); shipside receiving of automobiles; case picking operations that include selective tagging process steps; and receiving untagged cartons into an RFID-enabled retail store or a manufacturing plant.

The systems, methods, and devices of the present invention utilize an RFID transponder or wireless sensors as a component. Certain RFID transponders and wireless sensors operate at Low Frequencies (LF), High Frequencies (HF), Ultra High Frequencies (UHF), and microwave frequencies. HF is the band of the electromagnetic spectrum that is centered around 13.56 MHz. UHF for RFID applications spans globally from about 860 MHz to 960 MHz. Transponders and tags responsive to these frequency bands generally have some form of antenna. For LF or HF there is typically an inductive loop. For UHF there is often an inductive element and one or more dipoles or a microstrip patch or other microstrip elements in their antenna structure. Such RFID transponders and wireless sensors utilize any range of possible modulation schemes including: amplitude modulation, amplitude shift keying (ASK), double-sideband ASK, phase-shift keying, phase-reversal ASK, frequency-shift keying (FSK), phase jitter modulation, time-division multiplexing (TDM), or Ultra Wide Band (UWB) method of transmitting radio pulses across a very wide spectrum of frequencies spanning several gigahertz of bandwidth. Modulation techniques may also include the use of Orthogonal Frequency Division Multiplexing (OFDM) to derive superior data encoding and data recovery from low power radio signals. OFDM and UWB provide a robust radio link in RF noisy or multi-path environments and improved performance through and around RF absorbing or reflecting materials compared to narrowband, spread spectrum, or frequency-hopping radio systems. Wireless sensors are reused according to certain methods disclosed herein. UWB wireless sensors may be combined with narrowband, spread spectrum, or frequency-hopping inlays or wireless sensors.

System and Encoder Overview

Referring to FIG. **1** the present invention includes a system for commissioning wireless sensors at a point of use and on-demand. For example, in one embodiment, the present invention incorporates a mobile encoder device **30**, which may be attached to a belt of an operator and powered by rechargeable batteries **60**. The mobile encoder is in wireless communication with a remotely located host com-

puter. The operator can selectively (on-demand) enable the mobile encoder to commission a transponder based on various criteria, including input received from a mobile bar code scanner, for example.

FIG. **1** shows one system **10** according to the present invention in a typical environment, such as a packaging facility wherein a collection of entities with visual external labels **15** exist and a sub-set (or all entities) need to be associated with a wireless RFID transponder, tag, or label. The object **17** needing an RFID transponder could be a packing container having an assorted collection of entities **15**. As entities **15** are pulled from collection **176**, a traditional optical reader **13** (human or machine) interprets the visual external label. Information from the external, visual label is correlated to information stored in a centralized location, represented by a network computer **11** having a database. The information taken by the optical reader **13** is transmitted to the network computer **11**. System **10** includes a wireless connection between the remote computer **20** and the mobile encoder **30** either directly or through a common wireless access point. Additionally, a wireless connection could occur between the remote computer **20** and the host computer **11**, and in this embodiment, the remote computer **20** is in physical connection with the mobile encoder. In yet another embodiment, the remote computer **20** wirelessly connects to both the mobile encoder **30** and the host computer **11**. Optionally, the optical reader **13** can be incorporated in the encoder **30**.

Referring to FIGS. **3** and **4**, in further embodiments, the present invention incorporates a mobile encoder device **175**, **30**, or **220** which may be held in the hand of an operator. Mobile encoder device **175**, **30**, or **220** is preferably powered by rechargeable batteries or a fuel cell. System **170** includes at least four possible intermittently connected entities if they are present and connected: mobile encoder **175**, remote computer or mobile phone **154**, optical reader **173**, and headset **174**. A preferred short range wireless connection means **175**A such as a WLAN (Wireless Local Area Network) or PAN (Personal Area Network) may be established from time to time between mobile encoder **175** and remote computer or mobile phone **154**, optical reader **173**, and/or headset **174**. There is a preference for low power wireless connection apparatus within mobile encoder **175** so as to realize the greatest possible battery life in light weight mobile encoder **175**. Mobile encoder **175**, **30**, or **220** is in intermittent wireless communication with a mobile phone or computer **154** typically at close range through wireless communication means **175**A. Database and associated host computer **171** may be housed at a remotely located facility that may optionally be accessed over a large distance through remote computer or mobile phone **154**. A mobile phone is a preferred bridge between two or more wireless networks, for example a PAN and a wireless subscriber network that supports wireless data services for ultra mobile and remote tagging applications. Continuous wireless connection to a host database is not required for ongoing tag commissioning process steps disclosed herein.

RFID tags such as those using EPCglobal numbers requires uniqueness of the numbers that are encoded. GS1 is a central authority that prescribes a set of hierarchies for each key type (type of identity such as an SGTIN) whereby GS1 designates itself as the central issuing authority for each key type. Authority is passed down in a hierarchical manner to member companies. Each member company has the authority to further allocate numbers from its upper level database to as many lower database levels as it deems necessary to distribute number authority throughout its enterprise.

Quasi-autonomous RFID transponder encoding authority is achieved when an external number issuance authority allocates to the encoder blocks of numbers for specific object classes. A preferred embodiment for quasi-autonomous transponder encoding authority is realized when large pre-authorized blocks of serial numbers are made available to encoder **175** or **30** to utilize on object classes as objects of a class are presented for tagging. A preferred method of providing pre-authorized blocks of object class serial numbers is to subdivide the entire object class serial number space into sectors that are defined by a limited number of MSB's (Most Significant Bits) of the serial number field. The object class serial number space is defined by the number of serial number bits that are used in a specific standard, such as a particular EPCglobal key type, for example an SGTIN-96 and is defined in a corresponding specification such as the GS1 EPCglobal EPC Tag Data Standard. Again using the SGTIN-96 as an example, there are a total of 38 bits used to define the entire serial number space which contains 2^{38} unique numbers. For example the upper 14 bits could be designated as the most significant bits for a particular embodiment. In that case the object class serial number space would be comprised of 16,384 sectors. Since in this example there are 14 most significant bits within a 38 bit serial number field, there must be 38 minus 14 bits of lesser significance, which equals 24 bits. Therefore the lower 24 bits represent 16,777,216 unique serial number values. Once a sector is allocated to a lower level within an authority hierarchy, it is referred to as a block. Each allocated block of serial numbers represents authority for encoding objects of an object class that can either be used by an encoder for encoding transponders, or allocated to a lower level in the authority hierarchy.

In a preferred embodiment serial number block sizes are sufficient to operate encoder **175** or **30** for extended periods of time without any further external authorization steps. For example autonomous operation for a week or more is possible with sufficiently large block sizes. In the previous example the encoder could encode over 16 million objects of an object class without the need to reconnect with a higher level authority. If 10,000 objects of an object class are encoded each day, then the encoder could operate in a quasi-autonomous mode for up to 1677 days or over four years without receiving further authorizations from a higher level authority. Block allocations are preferably assigned with reference to how many encoders **175** or **30** are authorized to operate within the facilities of the owner of certain object class numbers.

Authorizations for one or more classes of objects are preferably loaded into encoder **175**, **30**, or **220** from an external authority where such authorizations include data fields such as manufacturer ID, item reference, manufacturer code lengths, filter values (that designate packaging levels such as item, case, pallet, etc.), serial number starting point for a block, and other pre-determined parameters. Such information is preferably loaded into the memory of the encoder in advance of tag commissioning operations. Thus if loaded with information for more than one object class, encoder **175**, **30**, or **220** does not have sufficient information to proceed with encoding a transponder until a single object class is selected for the present RFID transponder to receive; an ambiguity therefore exists that is preferably resolved with information entered by an operator using either a keypad or a bar code scanner. Reading printed indicia such as a bar

code is a preferred method to resolve the ambiguity as to which object class the next RFID transponder is to receive a number from. Bar codes are used to eliminate errors and ambiguities that enable encoder **175**, **30**, or **220** to locally generate or replicate data for encoding into a data carrier such as an RFID transponder.

GS1 is a leading global organization dedicated to the design and implementation of global standards and solutions to improve the efficiency and visibility of supply and demand chains. GS1 defines EPCglobal SGTIN number fields as having a company prefix, an item reference, a partition value, and a filter value that comprise the object class information. A unique serial number is then added to that information to create each unique instance within each object class.

In a preferred embodiment, a block is allocated and managed using three numbers: a starting number that is the first serialized instance of a block, a block size which represents the total number of instances in the block, and a counter or index that represents how much of the block has been used during an encoding process. Using these three numbers and an optional lock bit, a simple database of object class authorizations can be built.

A preferred embodiment utilizes RFID authorization transponder **178**A and a printed substrate **178**B to physically handle object class serial number issuance authorizations. Authorization transponder **178**A is interrogated by transponder reading/encoding means **175**H. Preferred embodiments use the 96-bit EPC memory bank for specifying the block starting number, including the company prefix, item reference, partition value, filter value, and base serial number. The User Memory bank is used to hold and transfer the block size (preferably 16-bits), counter or index value (preferably 16-bits), a 16-bit header to identify the transponder as a valid member of a class of authorization transponder, a lock bit, and a CRC value to detect errors in all of the data fields. For example a CRC error would detect errors in storage, transponder selection, or data transmission. In preferred embodiments reading of data blocks from more than one RFID transponder would be avoided by selecting a transponder, checking that it is the correct type, contains valid authorization data, contains a valid header that signifies that it is an RFID authorization transponder **178**A, and that all data read correctly verifies with a dedicated error detection field such as a CRC.

RFID authorization transponder **178**A is preferably adhered to printed substrate **178**B so that an operator can visually identify what object class or SKU is managed by the affixed authorization transponder **178**A. A picture, icon, bar code, or human readable symbols are all useful for identifying the object class. An operator presses a button or scans a bar code that prompts encoder **175** to read and store the tagging authorization held by authorization transponder **178**A. Once read, authorization transponder **178**A is preferably electronically marked as 'consumed' or 'locked' by transponder encoding means **175**H. EPC transponder ID fields that identify a specific type of chip are preferred for selecting the proper transponder, even when other RFID transponders are within range of the antenna or near field coupler of transponder encoding means **175**H.

A collection of authorization transponders **178**A comprises a database that can be physically transported without the need for a wireless communications link to encoder **175**. Once read, database records are preferably stored in internal memory means **175**G. In a preferred embodiment 12 to 14 bytes of Flash memory is used for each record to allocate 250 to 65536 instances of an object class, whereby the first byte of an EPC number is a fixed header value can be replaced in Flash memory by 8 bits of the allowable block size. One or two bytes in RAM are used to count or index through the block allocation as it is used. Thousands of data records of this type can easily fit into the memory space of an economical 8-bit microcontroller. In a preferred embodiment, where the GS1 SGTIN-96 header is replaced in memory with an 8-bit block size authorization, 300 records for authorizing up to 255 instances per record, can be used to safely manage at least 500,000 tagging records using 24,000 bytes of Flash memory and 2000 bytes of RAM. Other embodiments using more bits to authorize and control larger blocks of numbers is possible at a slightly larger expense of memory.

A preferred embodiment uses a computer, preferably a smartphone such as an iPhone from Apple Inc. of Cupertino, Calif. as a lower database level to transfer encoding authorizations from upper level database authorities to RFID encoders. A smartphone such as the iPhone or an Android phone using software from Google would be a preferred embodiment of a lower database level and or an encoder using an antenna or near field coupler similar to near field coupler **224**A**2** of FIG. **21** or **238***a* or **238***b* of FIG. **22** to couple with RFID transponders for encoding and verification. The iPhone also has cellular data transmission radios and software stack to enable the iPhone to access remotely located servers in a cloud computing architecture.

The smartphone establishes a connection with a cloud-based server using JavaScript, ASP, JSP, PHP, Perl, Tcl or Python scripts to access a database such as mySQL that is available from Oracle Corporation of Redwood Shores, Calif. Using structured query language, SQL database tables are preferably used to store tag commissioning data, configuration information, and serial number block allocation records. SQL queries provide information from database tables to the script, passing the result over the Internet, to the smartphone, which also then routes information to designated RFID encoders. Encoders are preferably identified by their media access control (MAC) address or a UUID which is guaranteed to be unique and is used by the smartphone as a lower database level to transfer encoding authorization to a specific encoder.

Preferred embodiments of encoder **175**, **30**, or **220** will encode all of the GS1 identity types. Such types include the General Identifier (GID-96), Serialized Global Trade Item Number (SGTIN), Serial Shipping Container Code (SSCC), Serialized Global Location Number (SGLN), Global Returnable Asset Identifier (GRAD, and the Global Individual Asset Identifier (GIAI). Other preferred embodiments are used to encode numbers that are a part of other numbering systems.

Data records are preferably loaded and stored through commands that are transmitted over wireless communication means **175**A. In preferred embodiments, batch mode commands can be used in any of three ways: (1) to immediately affect the current operation by starting a batch tagging process for a specified SKU or object class; (2) to store authorizations in memory means **175**G; and (3) to store authorizations in stored-value RFID transponder **178**A.

When external connection is necessary, wired or wireless communication with an external host or numbering authority is established. Wireless communication means **175**A is preferably a Wi-Fi or Bluetooth connection. A wireless node of a Bluetooth personal area network is used according one embodiment of the present invention. Model 100-SER manufactured by EmbeddedBlue of Poway, Calif. and the BISMS02 from EZURiO Ltd., a subsidiary of Laird Tech-

nologies, Inc. of Chesterfield, Mo. are examples of preferred OEM Serial Bluetooth modules. Other wireless interfaces may alternatively be used to achieve Serial Port Profile and other types of connectivity between encoder **175** and remote computer or mobile phone **154** and/or optical reader **173**.

Other preferred embodiments of mobile encoder **175** and system **170** replace wireless communication means **175**A with a cable, resulting in an embodiment of mobile encoder **175** with a tethered bar code scanner. A key advantage of an alternative embodiment of system **170** that utilizes a wired connection to optical reader **173** instead of wireless communication means **175**A is a very simple solution having virtual immunity to any surrounding RF interference that might raise the noise floor hindering wireless communications.

The operator can cause mobile encoder **175**, **30**, or **220** to commission a transponder by scanning certain printed bar code symbols received through optical reader **173** which is connected to encoder **175** through wireless communication means **175**A. Or alternatively internal optical reader **175**F is used to scan printed bar code symbols. In either case data from optical reader **173** or **175**F is delivered to processing means **175**B. Certain preferred embodiments of system **170** use optical scanners with self-contained symbol decoding capabilities to deliver decoded symbol information to processing means **175**B. Certain other embodiments of system **170** relies on processing means **175**B to conduct some or all decoding operations to derive information from scanned symbols.

The information derived from the optical reader **173** or **175**F is used by mobile encoder **175** to either directly or indirectly encode data into RF transponder **178** while it is still physically within mobile encoder **175**. Mobile encoder **30** uses external optical reader **173**, and alternatively mobile encoder **220** uses internal optical reader **175**F, as embodied in reader **226** of FIG. **21**. Preferred embodiments of optical reader **226** are mechanically aligned relative to transponder encoding means **175**H or more specifically with the antenna or near field coupler of RFID interrogator **224**A. Spatial alignment assures that an operator will be able to comfortably scan bar codes and then encode and apply RFID transponders along a line of movement such that the operator can easily assure proper placement of encoded transponders.

Symbol decoding functions may be physically, electrically, or logically separated from symbol scanning operations. One preferred embodiment of optical reader **173** is a model CHS-7M, CHS-7P, CRS-9M or CRS-9P Bluetooth ring scanner.

Processing scanned commands involves a processing step to determine that a bar code should be interpreted as a command or configuration instructions rather than as bar code **179** that identifies an object that is to be tagged. Commands are used to alter the flow and operation of mobile encoder **175**.

FIG. **21** is a preferred embodiment of a mobile encoder wherein optical reader **226** is an OEM bar code scanner manufactured by such companies as Intermec or Motorola and is a preferred embodiment of optional internal optical reader **175**F shown in FIG. **17**.

In a preferred embodiment one or more bar codes are pre-printed and applied as symbol **179** on entity **177** in a manufacturing facility or other suitable location. Such bar codes are described in ISO/IEC draft document PDTR 24729-1 and are more generally referred to as one or more bar codes having Application Identifiers (AI) 01 and 21 encoded into them, and preferably include header information and other control bits that are required for certain protocols. AI 01 is used to represent the Stock Keeping Unit (SKU) as a GS1 Global Trade Item Number (GTIN). AI 21 is used to serialize the SKU. Together the two AI's are used to specify a GS1 serialized GTIN (SGTIN). Bar codes can also be used to specify data payloads that use numbering systems other than the EPC numbering system. The Application Family Identifier (AFI) also plays an important role in designating alternative numbering authorities.

This preferred method that is described by the flow chart in FIG. **23** will allow batch mode operation where there are at best intermittent connections with remote computer **154**. This preferred method allows existing label application and/or printing hardware located on existing manufacturing lines to provide in printed symbolic form all data that would be encoded into an RF transponder. By providing printed symbols, manufacturers do not have to incur either the cost of that transponder or the special equipment that is required to encode and apply RF transponders.

Optical reader **173** or **226** is described above and is used as the primary source of real time data input for the mobile encoding system that uses an embodiment such as mobile encoder **30** or **220**. Optical reader **173** or **226** is also preferably used to scan special bar codes that instruct mobile encoder **175**, **30**, or **220** to perform certain prescribed functions which will be described below.

Certain preferred embodiments of system **170** include headset **174** which may be a headset worn by the operator or a Bluetooth-linked loud speaker that is mounted to a pallet jack or fork lift truck. Headset **174** is optionally used by system **170** to give instructions, confirmation signals, or warnings to the operator. Synthesized speech or audible tones are used to interact with the operator through headset **174**.

In these aforementioned embodiments, the mobile encoder **30** is a portable device that can be easily mounted in a fixed location, carried such as mobile encoder **220**, or worn by a human operator such as mobile encoder **30**, or hung from a suspended retractable tool cable. As such, the mobile encoder **30** includes an internal power source **175**E such as a rechargeable lithium-ion battery and would further include a handle or a belt-clip for ease of use. In another embodiment, the mobile encoder can be attached to a high-speed conveyor line. In such an application, the on-board battery could be replaced or augmented by a physical connection to a remote power source. Further, the computer **20** could have wired connects to the host network **11**. Further details of possible configurations of the mobile encoder will be further detailed in subsequent sections of this disclosure.

In the system **10** of FIG. **1**, the mobile encoder **30** carries a supply of un-commissioned (or blank), or securely encodable RFID transponders **175**J, **185**, **42**, or **221**E. Once the desired data is accumulated and presented to the encoder **30** from the computer **20**, the encoder commissions an RFID transponder, using transponder transport means **175**C and transponder encoding means **175**H and any one of several preferred encoding algorithms to program, creating an RFID tag or label **50** for the object **177**. Transponder separation means **175**D is used to separate a properly encoded transponder **178** from release liner conveyance web **182** by breaking the bond at adhesive layer **181**D on the leading edge of transponder **178**. Transponder separation means **175**D is preferably a peel device **183** as shown in FIG. **20** or peel device **222**B in mobile encoder **220**. Peel devices **183** or **222**B are preferably made from anti-static plastic, metal, or other material that will conduct electrostatic charge away from transponder **178** and release liner **182**. The commis-

sioned tag or label **50** can then be applied, linked, or otherwise associated with the object by known means including a human operator or a machine transfer.

RFID Transponders

FIG. **2** shows a preferred embodiment of an RFID transponder **50**. RFID transponders, in some embodiments, comprise an RFID integrated circuit (IC) device (or "chip") **56** of FIG. **3** or **180** of FIG. **18** bonded to an antenna apparatus, formed on a substrate that is often plastic such as Mylar®, polyester, or PET. One way to form an antenna structure is to etch copper from a substrate. An alternate printed transponder includes printing multiple layers of conductive ink onto a substrate. One additional method includes stamping UHF antennae from thin sheets of aluminum, or by selective aluminum deposition onto a substrate. In certain embodiments, RFID transponders and wireless sensors are recovered from waste streams for reconditioning, reprogramming, and reuse.

Other suitable RFID transponders include designs that combine a dielectric spacer behind the antenna by separating the metallic antenna inlay **181**C from surrounding metals that may detune it, or liquids that may absorb RF energy from it. The dielectric spacer creates a transponder that performs well over a broad range of packaging conditions. The dielectric material is a foam standoff material or an expanding mechanical structure that provides lift from the target object and also a more robust design also includes features to protect the transponder from damage.

In certain embodiments, the RFID transponder is both programmable and mechanically configured for tensile extraction from a protective enclosure.

In preferred embodiments, hundreds or thousands of instances of RFID transponder **178** are manufactured on a continuous web of flexible material with a spatial separation between them, preferably at regular intervals. Certain preferred embodiments use adhesive-backed transponders **178** adhered to release liner **182** as shown in FIG. **20**, while other embodiments use the transponder material as its own conveyance that is severed from the rest of the web at predetermined locations, preferably after encoding and verifying transponder **178** is properly functioning.

In preferred embodiments of the present invention, the face stock material has a physical outline that is not much larger than the physical outline of the inlay itself. This is in contrast to labels which can have at least twice the surface area of the inlay or a direct-printed antenna structure in order to provide space for printed information. By having a label outline that is so much larger than the inlay surface area, there are a many possible combinations of inlay placement within the boundaries of a large printable label. This creates a problem and a challenge for printer/encoders that have to find and locate an inlay before attempting to encode it. By contrast, the present invention uses the detectable optical characteristics of the tag's minimal physical outline to position the transponder for encoding. This transponder positioning method is superior and an improvement over prior art that uses printed label stock as a carrier for RFID inlays wherein the physical dimensions of printed labels are not in any way a reliable indication of the location of the RFID inlay within the label. This is another example of how demand label printing further complicates RFID transponder encoding.

In one embodiment that is an exception to the minimal outline transponder design and positioning method described above, transponders that have a very long physical shape can be used to create a loop to secure an encoded transponder to a tree, a bush, or the handle of a piece of luggage. Preferred embodiments of such transponders are folded or rolled in order to package them onto a dispensing roll or packaged into a magazine or cartridge in a fan fold pattern. The resulting bundle of back-and-forth 'Z' folded or fan folded face stock material results in a compact package that minimizes the amount of release liner that needs to be wasted for each tag. Each z-folded transponder is then easily encoded and dispensed from encoder **175**, **30** or **220**. Transponders that can be encoded, verified, dispensed, and unfolded are advantageously used in forestry, ornamental nurseries, and airline baggage tracking applications where manual tagging is required.

In another embodiment, transponder **178** is pushed out of encoder **175** instead of being pulled out through tensile extraction. A transport mechanism for pushing transponders utilizes a gripping method such as friction or teeth that penetrate the webbing. Although there is a risk of jamming or mutilating the webbing, the advantage is that there is no need for a release liner to pull the transponder supply through encoder **175** using tensile extraction. A preferred 'tractor feed' embodiment mitigates the risk of web mutilation by utilizing a regular pattern of precut holes along one or both edges of the webbing, into which cog members of a drive mechanism engage to advance the webbing. A tractor feed embodiment is part of Transponder Transport Means **175**C of FIG. **17** whereby a motor and gear train delivers drive torque to the web through friction rollers, penetrating teeth, cogs, or other mechanical engagement means. In such an embodiment, the preferred transponder separation means is a web cutter that is used to separate encoded transponders from unencoded tags. A web cutter can be either active or passive, in other words cutting force can originate with a motorized mechanism or with an operator's handling during dispensing and transponder detachment. A row of plastic or metal saw teeth is a preferred embodiment of a passive transponder separation device.

In another preferred embodiment, transponder **178** is manufactured on a high speed press, a bar code is printed onto face stock of transponder **178** and information that is representative of that bar coded information is also encoded into microchip **180**. Then encoder **30** or encoder **220** preferably read that information from RFID microchip **180** and associate it with a transponder commissioning process that may or may not include the programming of additional information into RFID microchip **180**. This is a novel method of reading bar coded information on transponder **178** without using a bar code scanner to do so within encoder **30** or **220**.

In one embodiment, additional transponder layers include a thin and flexible energy cell comprising two non-toxic, widely-available commodities: zinc and manganese dioxide. One suitable energy cell is developed by Power Paper Ltd. of 21 Yegia Kapayim Street, Kiryat Arye, Petah Tikva, P.O.B. 3353, ISRAEL 49130, and incorporates an innovative process that enables the printing of caseless, thin, flexible and environment-friendly energy cells on a polymer film substrate, by means of a simple mass-printing technology and proprietary inks. The cathode and anode layers are fabricated from proprietary ink-like materials that can be printed onto virtually any substrate, including specialty papers. The cathode and anode are produced as different mixes of ink, so that the combination of the two creates a 1.5-volt battery that is thin and flexible. Unlike conventional batteries, this type of power source does not require casing.

A top layer of an RFID transponder assembly optionally comprises a paper face-stock **181**A, which is a very low-cost material but also is the least environmentally resilient.

UV-resistant plastic face-stock **181**A generally provides the best survivability in outdoor and rough-service environments, and also provides the best protection for the RFID transponder assembly.

A bottom layer of pressure-sensitive adhesive (PSA) **181**D often is used for attachment of transponders to objects and often is referred to as a wet inlay or a wet tag or a wet transponder because of adhesion layer **181**B. Alternatively, a layer of clear, translucent, or opaque adhesive-backed film or tape is used to attach the transponder or wireless sensor to object or container. The tape, any thin, low cost, flexible material with a self-adhesive backing, such as a conventional packing tape, is well-suited for this method of attachment. The tape may be formed into various shapes to achieve the requirements of this method. Certain embodiments may use tape that is preprinted with certain logos, marks, symbols, bar codes, colors, and designs. Suitable adhesive-backed tape must not—or at least minimally—absorb radio frequencies within the range of frequencies used by the transponder or tag. The tape material, also, must not corrode the device or otherwise hamper its functionality.

Certain embodiments use a type of packing manufactured specifically for a given encoder. Packing tape can be single-coated pressure-sensitive adhesive tape or, alternatively, media constructed with multiple layers including a backing layer. Certain backing layers are constructed on a plastic film having one or more layers. Certain backing layers are made from plastic resins such as polypropylene (PP), polyethylene (PE), or copolymers of PP, PE, PVC, polyesters, or vinyl acetates. Certain embodiments of PP are mono-axially oriented polypropylene (MOPP), bi-axially oriented polypropylene (BOPP), or sequentially and bi-axially oriented polypropylene (SBOPP). Certain backing layers are biodegradable. Certain backing layers are coated with a pressure sensitive adhesive on one side and a low adhesion release coating on the other side to reduce the amount of power required for the encoder to unroll the tape for application.

FIG. **3** shows a possible embodiment of an RFID transponder **50** that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer **52** bonds with antenna layer **54** that is bonded to inlay substrate layer **58** and integrated circuit **56**. Inlay substrate layer **58** and face-stock layer **51** provide resistance against electrostatic discharge (ESD) into antenna layer **54** or chip **56**.

Other constructions for RFID transponders include one or more additional layers of high-dielectric material that encapsulate or substantially cover the inlay. In general, the thicker the dielectric layer the higher the voltage must be to initiate a flow of electrons through a dielectric layer. This results in higher ESD voltage ratings. Also, it is well known to those skilled in the art that thicker dielectric layers between antenna layer **54** and any other metal or liquid also tends to reduce parasitic loading of the antenna whereby maintaining antenna tuning for proper coupling to interrogators within a specified UHF band. In such embodiments, the integrated circuit chip and antenna bond to an adhesive layer and are protected from a discharge path through the tape layer by its particular thickness of dielectric material. A second dielectric layer bonds to the inlay substrate by a second adhesive layer, so that a low voltage discharge path is nonexistent around the two layers of tape substrate.

In another possible embodiment of an RFID transponder, the inlay substrate provides a second layer of ESD resistance against a discharge path through an outward-facing tape layer and associated adhesive layer. This construction protects the antenna and chip from electrostatic discharge originating from any direction. The encapsulation tape layer bonds to the antenna and chip via an adhesive layer and provides no adhesive bond to the transport container when the transponder is commissioned, and therefore depends on separate adhesive zones to attach to the container of interest.

In another possible embodiment, an RFID transponder includes multiple layers of ESD resistant material. For example, an outer layer substrate bonds to an inner substrate by an intermediate adhesive layer. A second adhesive layer bonds with the chip and antenna. The inlay substrate faces inward and presses against a transport container when the transponder is commissioned.

The contemplated adhesives in the various RFID transponder embodiments create strong and permanent bonds between tapes and inlay layers over a certain practical range of operating temperatures.

Because RFID transponders are designed to adhere to a container, one face of an external layer includes a pressure-sensitive adhesive. This external adhesive, however, must not cause mechanisms associated with the commissioning devices to jam. To prevent unwanted sticking of the RFID transponder, a transport layer protects the sticky, external adhesive. The transport layer is either a release liner such as a silicone-treated paper liner or a net (or mesh) web. A net or mesh web offers two principal advantages: less weight and being recyclable or reusable. A comparison of the weight of a net with a higher percentage of open area to a typical sheet of release liner reveals that the netting is lighter for any given section of comparable size. Environmental problems of disposal of release liner are well known. Mesh or netting, comprised of recyclable resins, is recovered after each use so that the mesh or net can be either reused or recycled for its constituent materials.

In one possible embodiment the mesh or netting is made of plastic such as nylon, polypropylene, polyethylene, HDPE, Teflon, or other resins. In other embodiments the mesh or netting is fabricated from metal or carbon-impregnated plastic to provide a conductive path to bleed electric charge away from points of accumulation.

Other advantages of a net or mesh transport layer include a substantial percentage of the adhesive not in contact with anything during storage and commissioning. When stored in a roll, a small percentage of the adhesive layer makes contact with the backside of the roll through the openings in the mesh. Thus, a small amount of energy is required to unroll the spool during transponder commissioning, yet there exists a certain amount of adhesion to prevent a converted spool from unraveling.

In other possible embodiments, the RFID transponders can include a surface suitable for human or machine readable, visible, external markings including bar-code symbols or alpha-numeric sequences.

FIG. **4** shows another embodiment of RFID transponders **50** grouped on sheet stock **59** such as rolls or z-folded sheets that enables a plurality of transponders to be carried on a continuous web or traditional release liner. Other certain embodiments use transponders that are stacked and loaded into magazines for transport, handling, and automated dispensing. In certain embodiments, the magazines contain metallic shielding to protect transponders and inlays from electrostatic discharges (ESD).

In certain embodiments an RFID encoder is combined with a sensor suite **218** as shown in FIG. **10** to enable semi-automated tag application to desired objects. In one embodiment, a semi-automatic encoder/applicator is created by integrating a single sensor device. The sensor responds to

changes in light, capacitance, pressure, acoustics, or optical path length to a transport container. In another embodiment a suite of sensors are used to detect the attachment location of a commissionable transponder.

For example, changes in capacitance are detectable using certain QProx charge transfer capacitance sensors available from Quantum Research Group Ltd. of Hamble, England. Ultrasonic range sensors are available from supplier such as muRata Manufacturing Co., Ltd. of Kyoto Japan under the trade name Piezotite. Optical path length sensors are available from Keyence Corporation of Osaka, Japan. Sharp manufactures a compact distance-measuring sensor GP2D02 that is responsive in the range from 5 to 100 cm. Thus, when a predetermined set of conditions is realized, the sensor triggers, enables, or selects a desired action. In one embodiment, proximity or contact of sensor suite with the targeted transport container causes a second type of Trigger Event, resulting in the commissioning and dispensing of a transponder by an encoder.

In other embodiments, sensor **218** is designed to determine the distance an encoder resides from an object that is to be tagged. Range information is acquired and processed in real time to determine if the encoder is in Close Proximity, Near, or Far from a transport container. In certain embodiments a controller is programmed to alter threshold distances between each range category and to associate a function with each range. In certain embodiments, range category Close Proximity is associated with transponder programming and application functions. For example, the range category Near is reserved for transponder verification and/or reading functions; and Far is reserved for bar code scanning functions to verify that bar code information aligns properly with RFID transponder data.

In other embodiments a sensor suite is responsive to certain colors or patterns and uses that information to instruct the placement or detect the correct locations for applying good transponders and separate locations for discharging bad transponders.

FIG. **20** also shows how transponders **178** are rolled onto reels in preparation for encoding. Source roll **185** contains a supply of transponders ready for encoding. Release liner **182** conveys transponders **178** around peel device **183**. Unless transponders **178** are mechanically prevented from rotating around peel device **183**, they are conveyed onto take-up roll **184**. Take-up reel **184** advances forward while source roll **185** lags behind due to drag created by a clutch, brake, motor or other back-torque generating device. Opposing torques of take-up reel **184** and source reel **185** result in tension in release liner web **182**. Shape memory in face stock **181**A preferably prevents transponder **178** from remaining adhered to release liner **182** as it passes over peel device **183**, resulting in the leading edge lifting off and separating from webbing **182**. If take-up reel **184** continues to advance, and transponder **178** does not collide with another object, its attachment to release liner **182** on its trailing edge will result in that transponder being passed completely around peel device **183** onto take-up reel **184**. Full path rotation is preferably reserved for transponders that fail to properly encode desired information; and is therefore intended to be a reject process for failed transponders. Preferred embodiments result in tension created in web **182** in a process of tensile extraction of transponders from a source reel and selective transfer of good transponders onto an object or a person's finger. Mobile encoder **30** depends on a person's finger to prevent transponders **178** from rotating around peel device **183**. Mobile encoder **220** depends on a target object such as carton face **228** to prevent transponder **223**B from rotating around peel plate **222**B on a path toward take-up reel **221**J.

When the conveyance of RFID transponders results in the positioning of a transponder relative to a near field coupler within a signal null, the transponder and transport webbing are preferably nudged forward or backward to improve the signal coupling. This is preferably accomplished by momentarily activating the motor and transponder transport means **175**C.

Mobile Encoder

FIG. **17** shows a system **170** according to one embodiment of the present invention including a mobile encoder **175**. FIG. **5** shows a preferred embodiment for a mobile encoder. Mobile encoder **30** is comprised of housing **32**, belt clip **34**, antenna **36**, on/off switch **33**, system ready LED **37**, data ready LED **38**, and transponder ready LED **39**. It is further comprised of auxiliary switch **40**, and charger plug **41**. A cartridge or other pre-packaged self-contained supply of transponders **42** is preferably latched, snapped, clicked, popped, inserted, slid, or releasably mounted to the body of housing **32**. The cartridge preferably includes a take-up reel **44** for non-dispensed RFID transponders, and a port through which blank or securely encodable transponders emerge from source reel **43**. The source reel is preferably comprised of a core which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge **42** to form an axle around which release liner and transponders are wound and subsequently unwound.

In certain preferred embodiments source reel or roll **43** is constructed using materials such as non-petroleum-based plastics, laminated paper layers, and materials primarily comprised of natural fibers. In another preferred embodiment the entire pre-packaged self-contained supply of unused transponders is transported to mobile encoder **175**, loaded into it, consumed, and disposed of preferably without generating landfill waste.

A key aspect of this invention is a complete pre-packaged, pre-assembled, pre-threaded, self-contained supply of encodable transponders, preferably unlocked with cryptographic access methods. The supply is preferably configured for efficient transportation and shipping, conveyance to a work site, and easy loading into mobile encoder **175**, preferably in a single fluid motion.

FIG. **21** is a preferred embodiment of system **170** wherein printed symbols are optically scanned by internal optical reader **226**. The embodiment shown in FIG. **21** uses a preferred method of sensing the linear motion of mobile encoder **220** across a target surface by using an optical mouse sensor **225**. Such devices are commonly used to track the hand movements of the operator of a computer. Motion in either the X or Y direction is translated into numerical displacement representations which when timed are converted into linear velocities. Tracking and processing the primary axis of motion parallel to the major axis of the release liner, the web speed is preferably controlled by processing means **175**B and transponder transport means **1750** such that transponder **223**A advances at a rate of speed that matches the velocity of the entire mobile encoder across the target surface. Optical mouse **225** tracks displacement across the target surface and also acts as a tamp head to strengthen the adhesive bond of each freshly applied tag. The process of attachment of the encoded transponder to the target surface is along a vector that is nearly parallel to the target surface at a speed that is based on real time feedback from the surrounding environment as sensed by the optical

mouse or other sensor. Optical mouse sensor **225** preferably illuminates its target surface with either a LED (Light Emitting Diode) or a laser. Avago Technologies of San Jose, Calif. manufactures a variety of mouse sensors, both LED-based and laser-based. Laser illumination provides smooth and accurate motion sensing across a variety of surfaces. The model ADNS-6150 small form factor lens working in conjunction with the ADNS-6530 integrated chip-onboard laser sensor and single-mode vertical-cavity surface emitting laser can be used to not only detect motion in the X and Y directions, but also to some degree in the Z direction. Displacement along the Z (depth) vector is reported by the decrease in the number of resolvable features within the field of view as the target surface fades away from the optical focal point. That measurement is reported in the surface quality (SQUAL) register.

Optical mouse sensor **224**B is used to measure the linear velocity of transponders as they move along the path of the release liner toward peel device **222**B, as well as sense the gaps and edges between transponders **223**A and those adjacent to them. The physical outline **178** of transponders **223**A are a reliable indication of the location of RFID inlay **181**C located within each transponder **223**A and enhance system performance with reliable positioning relative to near field coupler **224**A**2**. The angular velocity of motor **227**B and gear train **227**A are controlled to achieve a linear transponder velocity that matches the velocity of the mobile encoder itself as it moves across the target surface. Therefore an operator with a fast hand motion is just as successful as a person with a slower hand motion, both will result in a transponder that lays flat, co-planar with the target surface, void of kinks or wrinkles that are characteristic of a poorly controlled transponder application process. In either case, transponder dispensing by transponder transport means **175**C will not initiate until optical mouse sensor **225** preferably illuminates the target surface and detects a minimum number of valid features as reported by the SQUAL register internal to the ADNS-6530.

RFID Interrogator **224**A encodes RF transponders using either LF (Low Frequency), HF (High Frequency), UHF (Ultra High Frequency), or microwave radio energy. Transponders may be powered by radio energy, light, or stored energy from a source such as a battery. RF coupling is preferably through a near field coupler, an inductive loop or other suitable transducer **224**A**2** connected to interrogator **224**A to focus RF energy on a small area within mobile encoder **175**, **30**, or **220**.

Certain preferred mobile encoder embodiments will not encode RF transponders that fail authenticity tests. In a like manner, RF transponders will preferably not allow themselves to be programmed unless the interrogator can successfully unlock its secured memory banks. This is a preferred method of protecting transponder cartridge and mobile encoder supply chains from counterfeits and knock-offs. Mobile encoder **175** and the transponders loaded into it will only be successful in exchanging certain data if certain data encryption and challenge response protocols are adhered to. In a preferred embodiment each authorized RFID transponder converter company uses one or more encryption keys to generate passwords that lock the RF tags, whereby preventing them from being programmed unless they are unlocked using the same password. Passwords of this type are specified in the EPC Gen 2 specification and in ISO standards. The passwords are preferably generated by processing means **175**B using a public key from publicly readable data such as an asset number or a transponder serial number. A shared private key is then used by an encryption algorithm such as AES in order to create a password or a collection of passwords that can be used to lock or unlock one or several RF tags. Other methods may be used that provide a high degree of certainty that the both the transponders and the mobile encoders are from legitimate sources. Individual failures or patterns of authentication failures are preferably reported to a central database through wireless communications means **175**A for subsequent fraud investigation.

Peel device **222**B is part of the mobile encoder and preferably rotates or pivots about pivot point **222**A into position **222**C and a corresponding position (not shown) in FIG. **21**. Peg **221**K helps guide the web to peel device **222**B. When cartridge **221** is inserted into applicator body **227**F the web is held in a non-interfering position by guide post **221**F and its accompanying cartridge guide post such that peel device **222**C can self-thread around the transport web without human effort. This is an improvement over prior art where a peel device is an integral part of the pre-packaged self-contained supply of transponders and requires threading during the cartridge manufacturing process.

Peel device **222**B preferably contains a shield on the outer face of the blade, through which radio energy will not pass to encode or interact with a rejected transponder **223**B. The dielectric material of the peel device **222**B provides sufficient separation from a transponder within the encoding zone and the shield on the back side of the peel device. This is another advantage over a peel device that is part of the cartridge, where the cost sensitivity is much more acute. The shielding on the back side of peel device **222**B may be any suitable metal attached or adhered in any reliable or economical manner against the non-conductive dielectric structure of the peel device.

Rejecting transponder **223**B requires that mobile encoder transponder peel device **222**B have sufficient clearance from target surface **228** as determined by optical mouse sensor **225** using either the SQUAL reading or the shutter readings. Such readings are used to determine if there is sufficient space to advance and rotate a bad transponder **223**B around the distal end of peel device **222**B.

FIG. **1** shows a system **10** according to one embodiment of the present invention including a mobile encoder **30**. And, FIG. **5** details one possible mobile encoder **30**. In this embodiment, the encoder can attach to the belt of an operator, accordingly, mounted on the housing **32** is a belt mounting means such as belt-clip **34**, which easily adjusts for left-handed or right-handed operation and corresponding mounting on the belt (not shown) of the operator. An external antenna **36** enhances wireless connectivity to a host or network computer (not shown in this view), or to a remote-mounted computer device such as a PDA or bar code reader. Several operator indicator lights **227**E including a system-ready LED **37**, data-ready LED **38**, and tag-ready LED **39** mounted on the housing enabling the operator an easy view of the device status.

Also included on the exterior of the housing are an external, power-cord receptacle **41** so that the on-board lithium-ion, nickel metal hydride, or other appropriate battery **227**D may be charged as required. A combination on/off-next switch **33** enables the operator to selectively power up the encoder. A reset port, such as a recessed reset button (not shown in this view), enables an operator to reset the software settings of the device circuitry on control board **227**C as may be required.

A cartridge **42** containing a plurality of RFID transponders releasably mounts to a face of the housing **32**. The cartridge further includes a take-up reel **44** for non-dis-

pensed RFID transponders, a port **46** (above take-up reel **44** but not shown in FIG. **5**) for dispensing commissioned transponders, and a supply reel **43** for holding blank RFID transponders prior to commissioning.

In further embodiments, a cartridge **221** containing a plurality of RFID transponders releasably mounts to the body of housing **227**F. The cartridge further includes a take-up reel **221**J for collecting release liner and non-dispensed RFID transponders, and a port through which blank or securely encodable transponders emerge from source reel **221**E. The source reel is comprised of core **221**A which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge **221** to form axle **221**B around which core **221**A rotates. Brake shoes **221**C create drag, resulting in back torque on the source core, the magnitude of which is controlled by screw **221**D which with a knob (not shown) is used to adjust the force applied by brake shoes **221**C. The back torque for cartridge **221** is alternatively developed through a motor or an expandable friction coupling into a brake mechanism attached to encoder body **227**F.

Take-up core **221**H is driven by a tight coupling with drive hub **221**G. This tight coupling is achieved through a combination or selection of tight fit, expandable coupling, and sharp teeth. The result is a hub that will easily slide in or out of core **221**H with little effort, but still be capable of delivering a substantial amount of drive torque through that connection without slippage. Drive torque is delivered from gear motor **227**B to hub **221**G through drive gear **227**A the teeth of which engage with each other as cartridge **221** is set into position and locked into place.

In a preferred embodiment, mobile encoder **30** cryptographically unlocks, encodes, and verifies each transponder one by one. In preferred embodiments, transponders are verified more than once. One time immediately after programming with a desired data payload, and then again a second time after encoder **220** automatically dispenses an RFID transponder **223**A onto target surface **228**. This second verification step insures that the properties of target surface **228** or other nearby materials do not adversely affect the performance of transponder **223**A.

In another preferred embodiment, encoder **220** is used to encode and dispense a pattern of several transponders **223**A onto a target surface **228** at regular intervals in order to map the surface of a container for example in order to determine an optimal location for a placement of transponders. This information is then preferably used for engineering and planning purposes for high-volume transponder application in a production or distribution facility. Transponders may be designed for operation in any or all of the UHF, HF, LF, or microwave frequency bands.

In one alternative embodiment, the mobile encoder **64** includes a handle (as FIG. **9** shows, for example) for hand operation of the encoder. In another contemplated embodiment, the mobile encoder is fixed to an assembly line in a stationary manner. Accordingly, the stationary-mounted encoder further includes machine-controlled devices for extracting a commissioned RFID transponder from the encoder and places the transponder on the container of interest by means well understood in the art.

In the aforementioned embodiments of the mobile encoder **30** (or hand-held encoder **64** of FIG. **8** or FIG. **9**, for example) key features commonly shared include means for enable Gent EPC or ISO standards compliance and multiple printer-emulation modes. On-board power source **60**, such as a rechargeable lithium-ion, Nickel Metal Hydride, or other battery enables freedom of movement as does means for wireless connectivity to a data network, such as the 802.11 wireless LAN (Wi-Fi), Bluetooth, or other standards-based communications protocol. However, a conventional power source that requires connectivity to a power-grid and a cable-based data network connectivity link would work under certain circumstances.

Further, in contemplated embodiments, the fixed or mobile encoder enables selective mounting to a magazine or cartridge filled with un-commissioned RFID transponders, which facilitates rapid and easy loading of the encoder with ready-to-use RFID transponders and further enables re-use, re-commissioning, and recycling of un-dispensed transponders and the associated cartridge. The mobile encoder can be monitored and controlled by virtually any handheld or mobile device, a host computer in a central location, or over the Internet.

Certain features and methods described and explained with relation to handheld applicators are also relevant to non-mobile RFID tag applicators that use a magazine, cartridge, reel, or roll to handle, transport, and dispense RFID tags, inlays, transponders, or wireless sensors. Magazines, cartridges, reels, and rolls are preferably capable of carrying either new or used tags and are preferably capable of being used in either mobile or non-mobile applicators. Magazines, cartridges, and reels are preferably refilled and reused. Magazines and cartridges preferably protect RFID tags from ESD.

Cartridges preferably indicate their empty/full status with a visible indicator such as: an LED, an LCD, a mechanical flag, a window with a view into the source reel, or other such indicators that help an operator choose which cartridge from which to next consume tags.

The mobile encoder **30** is activated (turned on) when an operator selectively depresses the combination on/off-next switch **33**. However, depressing the on/off-next switch for about three seconds or longer results in a sleep-mode cycle that can be interrupted by re-pressing the on/off-next switch. In sleep mode the operator indicators (LEDS **37**, **38**, and **39**) will turn off. If active, the mobile encoder system-ready LED **37** illuminates and connects to the assigned network. Network connectivity results in the illumination of both the system-ready LED **37** and the data-ready LED **38**.

Mobile encoders **175** and **30** optionally receive commands and data via the wireless link from the remote computer **154** or optical reader **173**. Special bar code commands are scanned by optical reader **173**, passed through wireless communication means **175**A, and interpreted by processing means **175**B mobile encoder **175** to perform certain pre-programmed functions. Commands originating from either computer **154**, optical reader **173**, or internal bar code scanner **226** (also designated in FIG. **1** as internal optical reader **175**F) perform functions in categories that include power management, data management, wireless configuration, security, configuration options, and utilization of internal resources.

The encoder receives commands and data via the wireless link from the remote computer **20** or host network computer **11** (of FIG. **1**). The data represents information to be encoded on an RFID transponder. The information is stored in the encoder's on-board memory and the tag-ready LED **39** or **175**K rapidly blinks green (cycles on/off to pulsate). An RFID transponder is moved from within the cartridge **42** to a position on the top edge of the cartridge for encoding in the encoder and the transponder is encoded with the appropriate information. The transponder is tested and if it is good—contains the data and encoding was successful—all three indicator LEDs indicate a solid-green color. The opera-

tor removes the encoded RFID transponder from the encoder and places it on the container of interest.

In the event that the encoding process failed, the bad transponder is detected and retained by the encoder, where it remains on the take up reel **44** inside the cartridge **42**. The take up reel also collects the release liner as the encoder **30** dispenses good transponders (properly encoded RFID transponders). The take up reel returns to a re-cycling center where components are re-used or recycled as necessitated. Further, the re-cycling center can perform failure analysis on returned transponders.

FIG. **7** is a schematic diagram of additional electromechanical components **70** (as generally referred to in FIG. **6**) and logic components of a possible encoder **30**. An RFID Module **63**, such as a MP9311 UHF reader module available from Sirit Technologies, 1321 Valwood Parkway, Suite 620, Carrollton, Tex., 75006, USA, communicates with a vertical polarized YAGI antenna **62** with a downward side lobe to low-power program (commission) RFID transponders to create an RFID transponder, and the same downward side lobe and verify transponders at low power also can read far-field transponders at a higher, second power. Additional components include a mechanical paddle trigger **86** for operator-selected override of the reel of RFID transponder stored in the supply or source reel **43** in the cartridge **42**. A drive motor **76** coupled to a dual output shaft gearbox drives the source transponder reel **43** via an intermediate take-up reel gear interface **78** at the cartridge mouth. Another gear assembly along with a spring couple **85** advances and positions the tag feeder paddle **84** with feedback from paddle position sensor **88**. A tag sensor **74** detects the location of the RFID transponder to-be commissioned by the YAGI antenna **62**. As the reel of RFID transponder advances inside the encoder, the lead edge passes the ratchet post **82**. If the now-commissioned transponder is read by the antenna **62** as "good", a ratcheting-back torque spring **83** enables a peel device, such as the shield and tag peel edge **73**, to engage, forcing the commissioned tag to peel away from the carrier layer, which continues on to the take up reel **44**. In the event of a "bad" tag—that is, the antenna **62** reads the RFID transponder and determines an error has occurred—the shield **73** does not engage, allowing the defective transponder to remain on the carrier layer and proceed to the take-up reel. Once the good transponder is removed from the encoder, the tag sensor **74** detects the condition and enables the encoder to stand-by for the next event. Transponders are read, written, and verified when an operator initiates an action such pulling a trigger **86**, pushing a button, or some other command sequence.

Certain protective enclosures, such as cartridges **42** or magazines, are part of a family of interchangeable magazines of similar size, shape, and functionality, which are capable of housing and dispensing certain types, styles, shapes, and sizes of new or used RFID transponders. Transponder sizes typically range from 4 mm-thick foam-backed transponders measuring 12 mm wide down to thin transponders that are 15 mm wide on 19 mm pitch.

In at least one embodiment, the magazine or cartridge **42** includes a unique and embedded, RFID transponder which enables automatic interrogation and tracking of cartridge **42**. In certain embodiments, to minimize interference, the cartridge-specific and unique RFID tag or RFID transponder operates in a frequency band that is different than the supply of RFID transponders contained within the protective enclosure. Alternatively, other embodiments selectively interrogate cartridge identification transponders that operate in the same band as transponders within the cartridge that are to be applied.

Certain encoders require replenishment of the battery or other internal, on-board power source **60**, such as a fuel cell, or other energy storage technology. Accordingly, in some embodiments, an encoder **30** (or encoder **64** or encoder **210** of FIGS. **8**, **9**, and **10**) further includes a remote, selectively coupling base unit. The base unit enables a replenishment of magazines or cartridges, provides replaceable power sources, recharges the on-board power source, serves as a communications gateway, and provides a user interface for programming and maintenance of the encoder. For example, spare transponder magazines/cartridges are retained in cartridge pockets where they are protected from damage. Cartridges indicate their empty/full status with a visible indicator such as: an LED, an LCD, a mechanical flag, a window with a view into the source reel, or other such indicators that help an operator choose which cartridge from which to next consume transponders. The encoder, also, is retained by a protective pocket to prevent damage and to make any required electrical or mechanical connections to the base unit. In some embodiments a base unit mounts to diverse operating locations including various models of fork lift trucks. In such applications, the base unit includes a variety of wired and wireless communications options to enable omni directional communication with the encoder, cartridges, a host computer, vehicle mount terminal, a fork truck computer, or other relevant computing devices. The base unit includes a power system that is suitable for the application, including power filtering and energy storage capabilities such as batteries or fuel cells.

As with all ESD-sensitive equipment, care must be taken to avoid a build-up of damaging electrostatic charges. Accordingly, in certain embodiments charge is removed using a variety of conduction methods including wiping, air, and humidity controls, or use of special materials that contain short conductive elements optionally arranged within a flexible elastic cord.

In some embodiments, the encoder adapts to use a particular type of RFID transponder. One type of suitable RFID transponder is model number AD-220 from Avery Dennison of Brea, Calif. or, alternatively, Raflatac model 300846 from Tampere, Finland, or a Spider transponder or FT-33 FAT tag from RSI ID Technologies of Chula Vista, Calif. Such a transponder is die cut and adhered to release liner. Additionally, wireless sensors are manufactured to specifications that are compatible with the specific encoder, including such specifications as core diameter, outer diameter, and web width. Alternatively, certain steps are required to prepare a standard roll of ALL-9338-02 tags for use in an automated encoder, including unrolling from a large roll (up to about 6-inches in core diameter) onto several smaller rolls having a smaller core diameter (of about 1-inch to about 2-inches in core diameter).

Encoder **30** communicates with a remote computer and includes options to physically, electrically, and communicatively integrate with a portable data terminal (PDT) or a mobile computing platform. Certain PDT's have a variety of wireless connections including PAN and WLAN. Certain PDT's include a bar code scanner comprising a laser, an imager, or other means. In other suitable PDT's an RFID interrogator and antenna are built-in, while certain others have a card slot manufactured to a standard such as PCMCIA, CompactFlash, or Secure Digital, into which interrogator/antenna is plugged into. An example of such a card is the MPR 5000 that plugs into a PCMCIA Type II slot and is

available from WJ Communications of San Jose, Calif. The MPR 5000 is compatible with handheld computers such as the Hewlett Packard iPAQ5550 or other models that accommodate smaller card-form factors, enabling them to read and write EPCglobal or ISO 18000 compatible UHF RFID transponders.

Other events, information, and status—such as changes in transponder readiness, transponders remaining on the source roll, remaining charge in the battery, changes in range-status between certain predefined states such as Close, Near, and Far—are communicated to the associated PDT. Other possible information, including certain power management functions, commands, status, and data-to-be-encoded into each readied transponder, is provided to the PDT over a wireless connection. Such a configuration puts the encoder in the role of a peripheral device to the PDT **219**, with PDT **219** managing the primary user interface and most computation functions.

In some embodiments the encoder adapts to exchange information with a host device, including a PDT, in either a batch-mode or through a real time connection. Batch mode uses a periodically connected data transfer channel such as a wired connection. Certain wired connections include serial data, infrared, optical, Universal Serial Bus, a parallel port, or other physical data connection. Certain real-time connections include wireless data links including Personal Area Network (PAN), Wireless Local Area Network (WLAN), and Wide Area Network (WAN). Certain PAN connections include Bluetooth and Zigbee. Certain suitable WLAN connections include IEEE 802.11a, IEEE 802.11b, and IEEE 802.11g.

For certain encoder embodiments passwords are encoded into transponders or wireless sensors when they are commissioned. Passwords are safeguarded using cloaking, obfuscation, cryptographic techniques, secure and trusted channels, locked memory, and other methods that are commonly used to protect confidential information. Passwords are generated or retrieved from data encoded in an RFID transponder to generate an index into one or more databases that contain a one dimensional array of passwords, a two dimensional array of passwords, a multidimensional array of passwords, or an array of actual or pointers to algorithms used to generate passwords from transponder data, for example. Alternatively, cryptographic algorithms are used to generate passwords from transponder data.

Although this disclosure makes specific reference to a mobile encoder, it is understood that the encoder can easily adapt and be readily configured to a fixed operating environment. For example, it can be mounted to a forklift truck or a high-speed conveyer line and maintain advantages of wireless communication, rapid change-over and other qualities as discussed and developed more fully in this disclosure.

Interrogator Apparatus

Working as a stand-alone device, or combined with an encoder, certain embodiments of the present invention include an RFID transponder reader, also called an interrogator. The interrogator, in one embodiment, is a physically separate device that is solely in wireless communication with the encoder. In another embodiment the interrogator includes a wired connection to the encoder. In yet another embodiment, the interrogator connects to the encoder via an intermediate processor, such as a remote computer, or some other intermediate device. In yet another embodiment, the intermediate device is a shared processor in a physically integrated encoder/interrogator apparatus.

Regardless of the physical configuration of the interrogator, its function is to encode and/or verify a RFID transponder's (including wireless sensors) functionality. Certain embodiments use a mobile handheld reader to verify transponder functionality after carton attachment. Certain handheld readers also read bar codes that either partially or completely specify the data that is to be programmed into a transponder. Accordingly, an optical path from the interrogator to a location for reading bar code labels is used to identify certain information about the objects or containers that are to be tagged. Additional transponder encoding instructions and data is acquired through an integral network interface or a batch mode memory in the interrogator.

In certain embodiments, a shield structure incorporated in a combined interrogator/encoder prevents RF fields from interrogating or reprogramming RFID transponders yet-to-be-commissioned that are resident in the combined interrogator/encoder device.

In one embodiment, shown as a cross-sectional schematic in FIG. **8**, a contact image sensor (CIS) **90** or a linear optical array is used to scan along the length of an RFID transponder before it is applied to a container. CIS **90** produces a video stream that is decoded and then interpreted and stored by an on-board Computer **61**. CIS or a similar linear array sensor is capable of reading both linear and two-dimensional bar codes. In certain embodiments, CIS reads two-dimensional bar codes before attachment to inlay or transponder. The on-board computer creates a logical association between bar codes and the commissioned RFID transponder. Encoder **64** reads and associates all bar code symbols on a single segment with the RFID transponder or inlay adhered to it.

In FIG. **10** when an operator pulls the trigger **86**, which is either a mechanical trigger or an electro-mechanical device, the on-demand commissioning of the RFID transponder occurs and nearly simultaneously is pressed against a container within a fraction of a second. In certain embodiments, mechanisms internal to encoder **64** transfer mechanical force to the RFID transponder tag through the use of air, springs, motors, plungers, elastomers, or other energy storing or delivering methods. Reloading of the next tag (next transponder) and readying of the system are performed within a time interval that is acceptable to the operator and enables a high degree of productivity for tagging cartons, pallets, or other transport containers.

In certain embodiments of a combined interrogator/application, a trigger **86** couples to an electrical switch having one or more stable positions that are detectable by a controller. In certain modes of operation trigger-switch state is coupled with range information from a sensor suite **218** to execute functions at predetermined ranges at predetermined times. The result is a trigger that functions based upon detected range from a container or other object of interest. This advantageously improves operator efficiency and productivity as one trigger executes several different functions that are typically involved with RFID tagging including the tagging of bar-coded cartons that have been selected to receive wireless sensors.

Verification of bar code occurs either before or after an RFID transponder is commissioned and the tag applied to the container by merely stepping back to a point where the sweep angle of a laser beam or field of view of an imager can read a bar code label. In certain embodiments ranges shorter than that, but not in Close Proximity, are used for sweeping a radio frequency interrogation signal across the faces of multiple cartons to assure that the correct tags, the correct number of transponders, and the correct data within that transponders were all properly programmed.

In certain embodiments Close Proximity range is reserved exclusively for programming, applying, and verifying one transponder, all in a single pull of trigger. In other embodiments, the interrogator includes programmable conditions that enable Trigger Events to interact with external devices or nearby equipment. For example, at a predetermined range from the interrogator, activation of the trigger causes the encoder to transmit a coded signal to an external device as an indication of an operator action: at a Far-range the signal to requests an external device to read a bar code and the bar code information is decoded and transmitted back to encoder. In another embodiment, decoded barcode information is processed by a portable data terminal (PDT), a vehicle mount terminal, or other computing device.

The on-board computer **61** controls the operation of the RFID Interrogator Module **63** to read, write, and verify RFID tags, inlays, transponders, and wireless sensors that are applied or are within range of the interrogation fields produced by antenna **62**. The encoder **30**, capable of reading multiple RFID transponders near it, can, in certain embodiments, produce a linearly polarized radio field via the internal antenna **62**. In another embodiment, the internal antenna produces a horizontally polarized RF field. A commissioned transponder can be read both before and after it is applied to a transport container. When multiple transponders are within the interrogation field of the encoder **30** with an interrogator module **63** the on-board computer **61** determines which transponders are commissioned and dispensed versus those transponder that have not. In certain embodiments, the on-board computer maintains records of transponders recently applied in order to properly determine how to interact with each transponder in the field of the internal antenna or other antennae under the control of RFID Interrogator.

In one possible embodiment, the interrogator/encoder utilizes preprinted information on a set of RFID transponders. The pre-printed information includes one or more logos, an EPC-global Seal, and other informative alphanumeric or bar-code data. Certain preferred embodiments of encoder/applicators **30**, **64**, and **210** correlate RFID tag data with data encoded in certain preferred bar codes. In certain preferred embodiments, applicators such as applicator **30** read the bar code preferably using a sensor such as OS **90** as the tape is unrolled from a spool. In certain other preferred embodiments, an RFID tag is located on cartridge **42** and contains a numerical value that is directly or indirectly representative of the numerical values optically encoded into the bar codes preferably at least indicating the starting numerical values of a number sequence. Other additional information is also encoded in the RFID tag in certain preferred embodiments, including the number of tag positions, the number of good tags, the ending sequence number, the date, time and place of tag conversion or other preferred commercial, logistic, or manufacturing information. In certain preferred embodiments of applicators **30**, or **210** certain wireless tags attached to cartridge **42** are capable of being read. In certain preferred embodiments the interrogator such as interrogator **63** is capable of reading an RFID tag mounted to the loaded cartridge, and is also preferably capable of filtering out its response to interrogation or programming of RFID tags.

Certain embodiments have a motorized tape drive and dispensing system. Certain embodiments contain some or all of the following: a rechargeable battery, an operator display, a wireless interface, a network stack, an IP address, a PCMCIA port, a Compact Flash port, a USB cable, a serial cable, a dock port, a window to allow the operator to view the transponder attachment process, or a bar code scanner.

One suitable interrogator includes model MP9311 available from Sirit Technologies of 1321 Valwood Parkway, Suite 620 Carrollton, Tex. 75006, USA. Other RFID transponder or wireless sensor interrogator modules with other feature sets are also possible for use in the interrogator/encoder.

FIGS. **8** and **9** show one possible interrogator/encoder **64** according to the present invention. The interrogator/encoder **64** comprises a housing **65** having a user input device **67**, such as a key pad or key board, and a user output device, such as an LCD screen **68**, for displaying optically scanned label data, RF interrogated data from a transponder, and other information including on-board diagnostic functions, bios status, and external information provided from a remote computer as sent over a wireless network, for example. A handle structure **66** enables point-of-use deployment while cartridge **42** enables on-demand commissioning of RFID transponders, which are dispensed from the transponder port **46**. In this embodiment, an integrated YAGI antenna **62** creates a large forward-looking main lobe of radio frequency energy for interrogation of commissioned RFID transponders. The internal antenna also produces side lobes of RF energy that although attenuated from the main lobe by several dB, couple enough power into nearby readied transponder to interrogate and write to it.

As further depicted in FIG. **10**, a reflector **219***b* passively reflects RF signals from an upper side lobe downward toward readied tag **216***f*. Backscatter from tag **216***f* propagates to both antenna **219***a* and reflector **219***b* for processing by the interrogator. Having such an antenna embedded in PDT **219** and mounted to the structure of the encoder housing enables the PDT **219** to encode and verify readied transponder **216***f* while commanding the encoder to commission and dispense a tag when a particular Trigger Event or a predetermined range status change occurs.

An antenna, or alternatively, leaky coax **212***a* or a near-field coupler is located outside of protective enclosure of cartridge **42** in a location very close to the tag attachment zone in front of a tamp head or tag application roller and holding rollers **216***d* or hammer **216***a*.

In some embodiments antenna **212***b* is a patch antenna with a radiation pattern toward the tag attachment zone. In other embodiments the antenna is a near field coupler. Alternatively, leaky coax, a type of coaxial cable having slits, slots, or perforations that allow radio frequencies to leak in or out, is used in encoders according to the present invention. A coupled-mode cable, which does not radiate as well as radiating-mode cable, is constructed with closely spaced slots in a corrugated outer conductor. Radiating-mode cable typically has a foil outer conductor with non-uniformly spaced slots arranged in a periodic pattern. Coupled-mode cable is a slow-wave structure. In free space its external fields are closely bound to the cable and do not radiate, except for minor end effects according to "Prediction of Indoor Wireless Coverage by Leaky Coaxial Cable Using Ray Tracing" by Samuel P. Morgan of Bell Laboratories, Lucent Technologies.

In certain embodiments an interrogator drives a signal into a leaky coax that is terminated in a purely resistive load of about 50 ohms. An RF-switch selects between radiating and non-radiating loads including an antenna or leaky coax and, therefore, avoids mismatched load impedance.

In other embodiments internal antenna **212***b* or **212***c* is a patch antenna with its strongest lobes oriented toward the tag holding and placement area in the region of holding

rollers **216***d*. Antenna **212***c* or leaky coax **212***a* work with an interrogator to produce electromagnetic fields to interrogate, program, and verify wireless sensors. Shield **217***e* prevents interrogation or programming of RFID transponders until they arrive at separation roller or tag peel edge **217***d*. A reflector is used in certain embodiments to reflect RF radiation toward a readied transponder. In the event that verification fails, the operator is informed that the bad tag (or inoperable transponder) is to be discharged onto a surface of a third object other than the encoder or the transport container, for post-mortem analysis.

Referring to FIG. **10** drive motor **76** is preferably located inside the center of source reel **43** within the circular walls of applicator housing **211***b*, around which cartridge **42** is nested when mated to interrogator/encoder/applicator **210**.

Motor **76** is mounted to the structural frame of applicator **210** and preferably transfers mechanical power to certain drive points preferably using gears, belts, or drive shafts within applicator housing **201***a* or **211***a*. In certain preferred embodiments of applicator **210** certain preferred drive points include take-up reel **44**, source reel **43**, or hammer arm **216***a*.

Trigger **86**, preferably embedded within trigger handle **66** is actuated by an operator, preferably causing a Trigger Event. In certain preferred embodiments, there is more than one kind of Trigger Event. In certain preferred embodiments of applicator **210** certain types of either mechanical or electromechanical actuators are preferably used to cause hammer mechanism **216***a* to trip, being driven toward readied tag **216***f*, through port **46** for placement on a transport container at the face of bulkhead **211***a*.

Another means of electromechanical actuation from a Trigger Event initiated by sensor suite **218** is illustrated in FIG. **10** whereby DC motor **215***c* runs in a reverse direction causing ratchet **216***b* to become disengaged, allowing hammer **216***a* to accelerate toward tag **216***f* due to the torque exerted by spring **216***c*. Hammer **216***a* passes between holding rollers **216***d* to press tag **216***f* against the face of a transport container.

Interrogator **212***d* is preferably capable of working with controller **213***b* to recognize which tags have been recently programmed or applied so as to filter out their response to interrogations of other tags, especially those tags that are being prepared for attachment. Interrogator **212***d* is preferably capable of modulating its transmitted radio power to affect the range and signal to noise ratio of its coupling to wireless tags.

Method of Using Smartphone for Encoding

FIG. **11** shows a method for using a smartphone for encoding RFID tags by using the built-in camera as a barcode scanner. In step **111** a smartphone is positioned to capture the image of a barcode. The barcode can be 1D or 2D, it can carry GTIN or other information. It can already have a serial number such as a serialized Data Matrix barcode for a pharmaceutical item or container. In step **112** the image is decoded and processed by software. In step **113** the payload for a transponder is computed, preferably using serialization algorithms that are presently described. In step **114** a transponder is encoded with the transponder data payload. The transponder encoding apparatus is either built into the smartphone or attached to it as a peripheral device.

Referring to FIG. **22**, smartphone **154** is shown as an Apple iPhone with a peripheral encoding device attached to the accessory port. A peripheral device such as this is one embodiment, in other embodiments the components described herein are contained with the enclosure of smartphone **154**. Near field couplers **238***a* and **238***b* are used to couple magnetic fields with a nearby transponder for RFID transponder and wireless sensor authentication. Certain preferred embodiments use one coupler to transmit and the other to receive. Such embodiments therefore require close proximity of both couplers to a transponder in order to read or write transponder data, or to verify transponder authenticity. FIPS 140-2 module **239** has a cryptographic boundary that is preferably compliant with U.S. Government Federal Information Processing Standard 140-2 which is incorporated by reference herein. Module **239** detects temperature variations that are outside of upper and lower temperature limits which is one possible mode of cryptographic attack. It also has tamper detection that detect a physical breach of a mesh or other detection barrier. FIPS 140-2 compliant cryptographic module **239** is used to hold cryptographic keys and to perform cryptographic functions. If the module detects an attack, the memory for storing cryptographic keys is immediately cleared. Module **239** preferably uses non-imprinting memory and therefore leaves no trace of the cryptographic information after being cleared.

Method of Tagging Containers

FIG. **12** is a block diagram representing a second method according to the present invention including applying RFID transponders to objects of interest. One suitable object of interest comprises transport containers such as corrugated cartons or shrink-wrapped cases on a shipping pallet, which is inadequately addressed by the prior-art, particularly for solutions for manually operated automatic encoding and attachment to a container.

Block **121** represents a process step including the identification and selection of a container to be tagged with an RFID transponder or wireless sensor. In one embodiment this step includes a manual selection and verification processes that consists of manual handling, visual sighting, and scanning bar codes with a hand-held optical reader device. This method contemplates that a transponder encoding scheme is ready in advance and synchronized with a pick list, customer purchase order, advanced shipping notice, and other such records to assure that goods are properly moved and accounted for. Preferred bar code scanners include those that allow an operator to freely handle cartons with two hands. Such scanners include laser bar code scanners or imagers that are worn on either that back of the operator's hand or near the top knuckle of a finger. Such scanners are described above, and preferably have a Bluetooth or similar wireless interface to connect to mobile encoder **175** or **30**. Bar code scanner **226** of FIG. **21** is a preferred embodiment of an alternative device that combines manual bar code scanning and RFID transponder encoding into a single handheld device. The operator may choose to scan bar codes that contain data, application identifiers, commands, or other elements commonly found in automatic data capture applications.

Block **122** represents the process step of processing bar code information to derive the underlying data. Depending on the type of bar code, how it is encoded, and its purpose, different processing steps will be used. In preferred embodiments the bar code may contain SKU information, a GTIN, an SGTIN, EPC data structures, a military UID, an SSSC, an asset number, a file identifier, or other such identifying information. In certain preferred embodiments, the bar code (either one or two dimensional) contains a partial or complete description of the data that is to be encoded into the RF transponder. Such bar codes are described in ISO/IEC draft document PDTR 24729-1. Application identifiers 01 and 21 are combined with additional encoded printed information to fully specify a serialized GTIN (or SGTIN). Using such bar codes does not require the use of additional data in order to

generate RF transponder payload data. Mobile encoder **175** may therefore independently receive and process the RF transponder payload information. One type of bar code is used to signal mobile encoder **175**, **30**, or **220** that it should enter a mode whereby it performs a serialization algorithm without using an AI 21 bar code. This process step of identifying the information to be encoded may be included in the step represented by Block **121**. In this step (Block **122**), an operator may use a bar code reader or an encoder/interrogator of this disclosure. Alternatively, the operator may receive instructions delivered to a hand-held PDT or other mobile data terminal connected to a wireless network. This information is delivered to an encoder, such as encoder **30**.

Block **123** represents another process step whereby, using a mobile encoder, the operator then commissions an RFID transponder with the information of the previous step (Block **122**). Optionally, successful commissioning of the RFID transponder is verified by the encoder. In one embodiment, the encoder tests the next transponder and determines if it is operating within certain predefined specifications including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. If the encoder determines that the transponder is not likely to result in a successful transponder deployment as may be determined by failure on multiple encoding and verification attempts or due to either physical or electronic deficiencies or abnormalities, then the operator is informed and the failed or bad transponder is discarded automatically or when an operator pulls a trigger under an operator-acknowledged transponder failure condition.

This step (Block **123**) also includes processes to read or determine by dead reckoning the information encoded into certain preprinted optically encoded symbols on the outward facing non-adhesive surface of the adhesive tape. In certain embodiments the adhesive tape is printed with information. In other embodiments the printed information is a machine-readable symbol such as a bar-code symbol. For example, one or more machine-readable symbols are read when the tape is prepared for use in an automated encoder or, alternatively, during the inlay conversion process and conveyed to an encoder through other data storage means, such as an RFID transponder. In one embodiment, an information encoding method uses either one-dimensional or two-dimensional bar codes. In some embodiments a linear imager is used to read either linear or two-dimensional bar codes as the tape is being unrolled from a spool. Some encoding schemes preprint machine-readable symbols at regular intervals along the length of a roll of adhesive tape. In certain embodiments the spacing of the preprinted symbols is at an interval of one half of the nominal length of each section of adhesive tape. In certain embodiments, the encoded information is used as a reference to one or more data storage locations. In other embodiments the data storage locations are accessible through a computer network. In some embodiments, the encoded information is a series of sequential numbers. Information relating to data stored in the RFID transponder is stored in data storage locations that are referenced by one or more of the preprinted symbols. In an alternative embodiment more than one type of machine-readable symbols can be read from the surface of a segment of tape. In certain embodiments, more than one machine-readable symbol is used as a reference to the same or closely related data records of information stored in the RFID transponder or inlay, and either can be successfully used to access stored data.

In some encoders used in this step (Block **123**) a Trigger Event occurs, which results in the verification that a particular commissioned RFID transponder has been tagged and associated with a specific container. This Trigger Event occurs, in certain embodiments, when an operator pulls a trigger on the encoder. In other embodiments the Trigger Event occurs when certain sensors detect preprogrammed conditions relating to the proximity of the encoder face to an object that is to be tagged.

Finally, (Block **124**) the operator applies the RFID transponder on the container and, thus, commissions the transponder. In certain embodiments, the location of the targeted placement of the RFID transponder or wireless sensor on the container is stored in a database, which is referenced or pointed to by information that is stored in the memory of the encoder. In one embodiment, the operator holds the encoder against the face of the container based on the tagging requirements for that particular container. The tagging requirements including the location and orientation of the RFID transponder to be placed is conveyed visually or aurally. For example, the operator receives visual information via a screen or display on the encoder. In certain embodiments, physical indicators are attached to the encoder and extend from its body in a direction and manner so as to assist the operator in the positioning of the transponder onto the carton. In other embodiments, transponders are applied to the interior of a carton, before it is sealed.

Method of Commissioning RFID Transponders Using a Mobile Applicator.

FIG. **13** is a block diagram showing a method according to the present invention for commissioning RFID transponders using an encoder, such as the encoder **30**, couples to a cartridge or protective enclosure containing a plurality of RFID transporters releasably mounted on a transport sheet or roll. The encoder enables the roll of RFID transponders to advance one position (Block **131**), placing the Next Tag in a test 1 position. The Next Tag is tested (Block **133**) to ensure that it performs within predetermined parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. One possible method includes encoding a transponder using only a minimal amount of radio-frequency energy. Since transponder encoding requires more energy than reading a transponder, this low power test constitutes a basic test of both minimal activation energy and backscatter signal strength.

An RFID transponder that fails this test (Block **133**) results in a "Bad Tag" status and proceeds to the take-up reel of the encoder (Block **135**). Thus, any failed transponder remains captive in the cartridge and cannot be released from the encoder by an operator. Optionally, the operator is notified of the failed transponder so the operator can request a newly encoded transponder (Block **137**). However, in one embodiment, the notification step occurs automatically, and a newly encoded next transponder is generated without input from the operator.

Block **132** shows that a "good" transponder is positioned in the encoder for the encoding process. The RFID transponder that passes the test 1 position is commissioned with predetermined data based on the container to be tagged. Methods of obtaining, storing, encoding, and commissioning this information on the RFID transponder are discussed elsewhere in this disclosure.

The commissioned transponder undergoes a verification process (Block **134**) to determine if the intended information was successfully encoded on the RFID transponder. Certain embodiments combine the verification step with the encod-

ing step to gain operational efficiencies. If this verification test results in a fail condition, the transponder remains in the encoder and ultimately winds on the take-up reel in the cartridge for subsequent post-mortem failure analysis.

Block **136** represents a pass condition. The encoder removes the commissioned RFID transponder from the transport web or release liner, enabling the operator to retrieve the transponder from the encoder and in Block **138** apply the transponder to the container. In an alternative embodiment for Block **138**, the operator or a fixture holds the encoder against a surface of the container and the encoder places the commissioned RFID transponder directly on the container without operator intervention.

FIG. **14** is a system diagram that illustrates a preferred serial number allocation system according to the present invention. Blocks of serial numbers are allocated to RFID printers and encoding devices such as RFID encoder **155** of FIG. **15** as described in more detail below. Each object class, represented in FIG. **14** as GTIN's, has its own separate serial numbering space. As described above, the entire object class serial number space is subdivided into sectors that are defined by a limited number of most significant bits of the serial number field. In the case of a GS1 SGTIN-96 key type, the serial number field is 38 bits long.

To show how this is accomplished in Serial Number Database **140**, a representative object class is managed by Table GTIN A **141** and is shown to have three serial number block sizes of lengths 10, 11, and 12 bits. Within table **141** are three rows, or tuples **141***a-c*. Each row or tuple contains two columns or attributes: a starting serial number and the amount of remaining space until the next serial number block. In preferred embodiments, the remaining space is expressed in units of blocks of the selected block size.

Now by way of a more detailed example, allocation of blocks of serial numbers of different sizes is shown as requests are encountered over a period of time. An initial request is made for serial number Block **0 144** for GTIN A that is 10-bits long. At that time then all of the rows of table **141** show the same starting number of 000000. When the initial request for a 10-bit block is granted for block **144**, the starting number for the next block of that size is increased to the end of the first 10-bit block and the remaining blocks is computed based on the following algorithm: the starting point for the 11-bit block **141***b* is adjusted to the next greatest unused number that contains all zeros in the bits that represent the next assignable block of that size. The same is done for 12-bit block **141***c* and so forth unless those blocks have already been assigned to an RFID encoder **155** using for example Block **1 145**, in which case they are not changed. The remaining counts values for each block will remain at zero for each block that is not bounded on the upper side by an assigned block of another size. If a serial number block is bounded, then the remaining count value is adjusted to accurately describe the number of serial number blocks that can be assigned. If additional blocks of that size are subsequently required, then, space permitting, a new block starting number is assigned and the process continues until the entire serial numbering space is fully allocated.

In preferred embodiments, a request is made by smartphone **154** as shown in FIG. **15**. The smartphone preferably performs biometric authentication as shown in step **161** of FIG. **16**. In step **162**, using smartphone **154** devices such as camera **237** of FIG. **22** a biometric match for a face, iris, voice, or fingerprints breaks the retry loop with an authorization to continue to step **163**. In step **163** transponder encoding is enabled and smartphone **154** is authorized to request, as a lower database level, blocks of serial numbers for specific object classes, such as certain GTIN's. RFID printers and encoders **155** are preferably then readied for encoding. Biometric security enables brand owners to enforce security procedures within their own plants and at contract manufacturing locations all over the world.

Table GTIN B **142** and Table GTIN C **143** show that each GTIN is managed separately to provide unique serial number blocks such as Block **2 146**, possibly according to different rules. In fact since GTIN's are typically purchased and owned by brand owners, and database **140** may be used to manage serial number allocation for multiple brand owners, then the rules that are applied to the various GTIN object classes in FIG. **14** may be different. Retail brand owners may want linear serial number assignments within each block while a pharmaceutical brand owner may want to have randomly assigned serial numbers within each serial number block. In a preferred embodiment allocated block **141***c* is issued to a lower database level or directly to an encoder's internal memory for commissioning transponders with randomly assigned serial numbers from within the range of numbers that are defined by that allocate block **141***c*.

Brand owner A with GTIN A may also have serial number blocks managed with a finer granularity than brand owner C with GTIN C. Furthermore a possible reason for brand owner C to select very large block sizes as shown in Table GTIN C **143** is to allow serial number allocation to be managed according to a different method such as chip-based serialization from chip manufacturers Impinj, Alien, or NXP for example.

FIG. **15**, a block diagram, shows the essential parts of a system to manage unique serial numbers on a global scale using smartphones as mobile remote computers. Server **151** is a computer running a server application such as an Apache HTTP web server on an operating system such as Unix, FreeBSD, Linux, Solaris, Novell NetWare, Mac OS X, Microsoft Windows, OS/2, or TPF. Web server **151** can be owned, borrowed, or rented by the slice from cloud service providers.

SQL database **152** preferably conforms to ISO/IEC 9075 and its various parts. In other embodiments, a database other than SQL is used to perform the data storage and retrieval functions described herein. SQL queries are preferably performed with the declarative SELECT statement which retrieves data from one or more tables, or expressions.

Script **153** preferably executes on server **151** and is written in a general-purpose server-side scripting language such as PHP to produce dynamic web pages.

A segment of PHP code that is used to store RFID tag commissioning data is:

```
$stmt=$this→db→prepare("INSERT INTO SGTINs
(CommissioningReport_EncStatus_SessionNum, SGTIN,
GTIN) VALUES (?, ?, ?, ?)");
$strnt→bind_param("ssii", $attrSession, $sgtinN, $attrGtin);
$stmt→execute( );
$stmt→close( );
```

Smartphone **154** preferably uses asynchronous data transfer techniques in a multi-threaded computing environment to communicate with script **153** in server **151** to prevent thread-blocking that gives the appearance of the program seizing up while waiting for a database transaction to be completed. Certain preferred embodiments use ASIHTTPRequest on Apple iOS smartphones to request a transaction with a remote database without blocking a major

program thread. Below is an example of an iOS function to store an XML commissioning report from RFID encoder **155**:

```
-(void)SQLStoreRecentTaggingForString:(NSString *)recentTagging
{
   NSURL *url = [NSURL
URLWithString:@"http://www.adasainc.com/update.php"];
   ASIFormDataRequest *request = [ASIFormDataRequest
requestWithURL:url];
   NSString *comTagStrTrimPhp =[recentTagging
stringByReplacingOccurrencesOfString:@" " withString:@""];
   NSLog(@"SQLStoreRecentTaggingForString: '%@'",
comTagStrTrimPhp);
   [request setPostValue:comTagStrTrimPhp forKey:@"comTags"];
   [request setDelegate:self];
   [request startAsynchronous];
}
```

The method startAsynchronous is used on the request to start a database transfer on a separate computing thread. This is one important aspect of asynchronous data transfer in periodically connected system nodes. Another example is in the collection of XML report data from RFID encoder **155**, piece by piece to assemble a complete string. The iOS code line [scanner.readRecentString appendString:trimStr]; illustrates how trimStr is appended onto a string, in this case named readRecentString that is an NSMutableString that is allocated as part of an instance that coordinates communications with a particular RFID encoder. Once the end tag is received, then iOS program assembles a request to store tag commissioning data. The iOS program is also ready to receive authorizations from server **151** as responses are returned from it. The authorizations are preferably able to be stored and retrieved when the same RFID encoder **155** reconnects with smartphone **154**. This system design therefore illustrates a preferred method for collecting commissioning data, storing it in an SQL database, and delivering new encoding authorizations to RFID encoders like RFID encoder **155** without requiring any realtime connections to a remote database.

RFID Transponder **156** receives and stores a globally unique identifier such as an SGTIN-96 through an intermittently connected chain of computers and programs as described above and as illustrated in FIG. **15**.

In FIG. **23**, Block **240** is used to scan a barcode, such as a GTIN. In Block **241** the RFID transponder payload is computed, preferably using serialization algorithms and methods that are disclosed herein.

Block **242** represents the process step whereby mobile encoder **175**, **30**, or **220** encodes an RFID transponder with the information of the previous step (Block **241**).

Successful commissioning of the RFID transponder is preferably verified by the encoder as shown in Block **243**. In one embodiment, the encoder tests the immediate transponder and determines if it is operating within certain predefined specifications including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder.

If in Block **244** the encoder determines that the transponder is not likely to result in a successful transponder deployment as may be determined by failure on multiple encoding and verification attempts or due to other evidence of physical or electronic deficiencies or abnormalities, then the operator is optionally informed and the failed or bad transponder is discarded automatically as shown in Block **245**.

Block **246** is the process of using motor **227**B and/or transponder transport means **175**C to pull release liner **182** tighter and tighter such that webbing **182** advances forward to the point that the leading edge of transponder **178** extends past the distal end of peel device **183** or **222**B.

In Block **247** web **182** is pulled forward to the point that transponder **178** or **223**A begins to rotate around peel device **183** or **222**B. It is in this step that either a human finger or some target object needs to be presented in the rotational path of the tipping transponder **178** or **223**A must be located. In the case of mobile encoder **30** where the operator is required to handle the encoded tag, it is important that their finger be present as transponder **178** begins to tip, allowing adhesive layer **181**D of transponder **178** to make contact and be removed for placement on a target object such as a shipping container, trackable asset, automobile windshield, or other object of interest. In cases where the operator scans a bar code and applies encoded transponder **178** in a single motion, mobile encoder **220** is preferred, wherein as transponder **178** tips as it rotates around peel device **222**B adhesive layer **181**D sticks directly onto target surface **228**. In either case, encoded transponder **178** is caught mid-rotation and adhesive layer **181**D provides adhesive forces sufficient to completely detach transponder **178** from release liner **182**, thus completing the function of Block **247** where work flow returns to Block **240** for another transponder encoding cycle to begin.

While the invention has been particularly shown and described with reference to certain embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

I claim:

1. An RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

2. The RFID transponder of claim **1**, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

3. The RFID transponder of claim **1**, wherein the unique object number is a portion of a serialized global trade item number.

4. The RFID transponder of claim **3**, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

5. The RFID transponder of claim **1**, wherein the unique serial number space is at least 38 bits.

6. The RFID transponder of claim **1**, wherein the allocated block is defined by at least 3 most significant bits.

7. The RFID transponder of claim **1**, wherein the allocated block is one of a plurality of allocations intermittently received by an encoder.

8. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of silicon.

9. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of polymer.

10. The RFID transponder of claim 1, wherein the substrate, antenna structure, and RFID integrated circuit chip are covered by a face stock material.

11. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is disposed on the substrate.

12. The RFID transponder of claim 1, wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.

13. A RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a global trade item number including a unique object number, the unique object number comprising an object class information space including a block of at least 50 bits and a unique serial number space including a block of at least 38 bits,

wherein the unique serial number space has one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block.

14. The RFID transponder of claim 13, wherein the unique serial number space further comprises remaining bits of lesser significance that together with the at least 3 most significant bits comprise the one serial number instance.

15. The RFID transponder of claim 13, wherein the at least 3 most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.

16. An integrated circuit, comprising:

a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator;

control logic; and

a memory,

wherein the memory is configured with a unique object number space, the unique object number space comprising an object class information space and a unique serial number space,

wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and

wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.

17. The integrated circuit of claim 16, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

18. The integrated circuit of claim 16, wherein the unique object number is a portion of a serialized global trade item number.

19. The integrated circuit of claim 18, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

20. The integrated circuit of claim 16, wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the memory of the integrated circuit.

* * * * *

EXHIBIT

2

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(54) SYSTEMS, METHODS, AND DEVICES FOR CONVERTING AND COMMISSIONING WIRELESS SENSORS

(76) Inventor: **Clarke W. McAllister**, Eugene, OR (US)

Correspondence Address:
PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201 (US)

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(22) Filed: **Aug. 18, 2006**

Related U.S. Application Data

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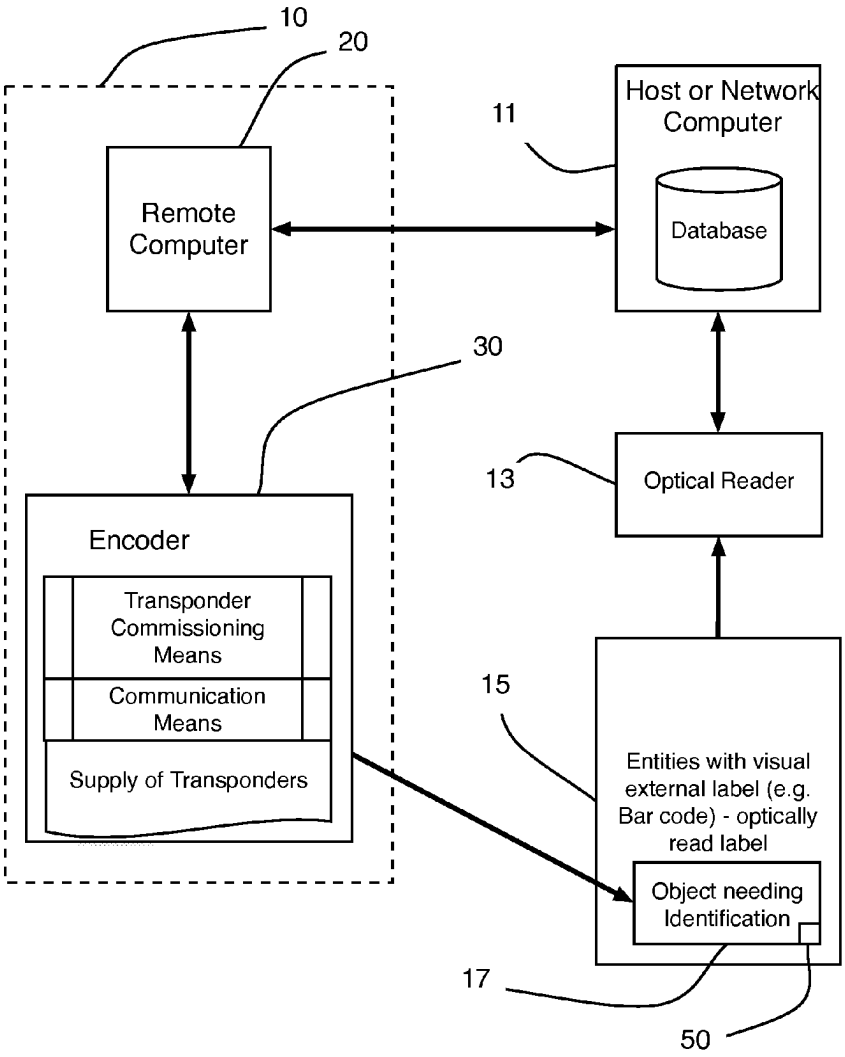
Publication Classification

(51) **Int. Cl.**
G08B 13/14 (2006.01)

(52) **U.S. Cl.** **340/572.1**; 340/10.51; 340/572.8

(57) **ABSTRACT**

In one embodiment the present invention is an encoder for commissioning RFID transponders and includes a housing encasing a motor assembly, wireless communication means for transferring instructions and data from and to a remote host, on-board memory, a processor, and an antenna with corresponding mechanism to encode and verify a programmable RFID transponder within a protective enclosure. The present invention further includes novel methods for commissioning RFID transponders, as well as methods for recycling and reusing various components including the protective enclosure and RFID transponders.



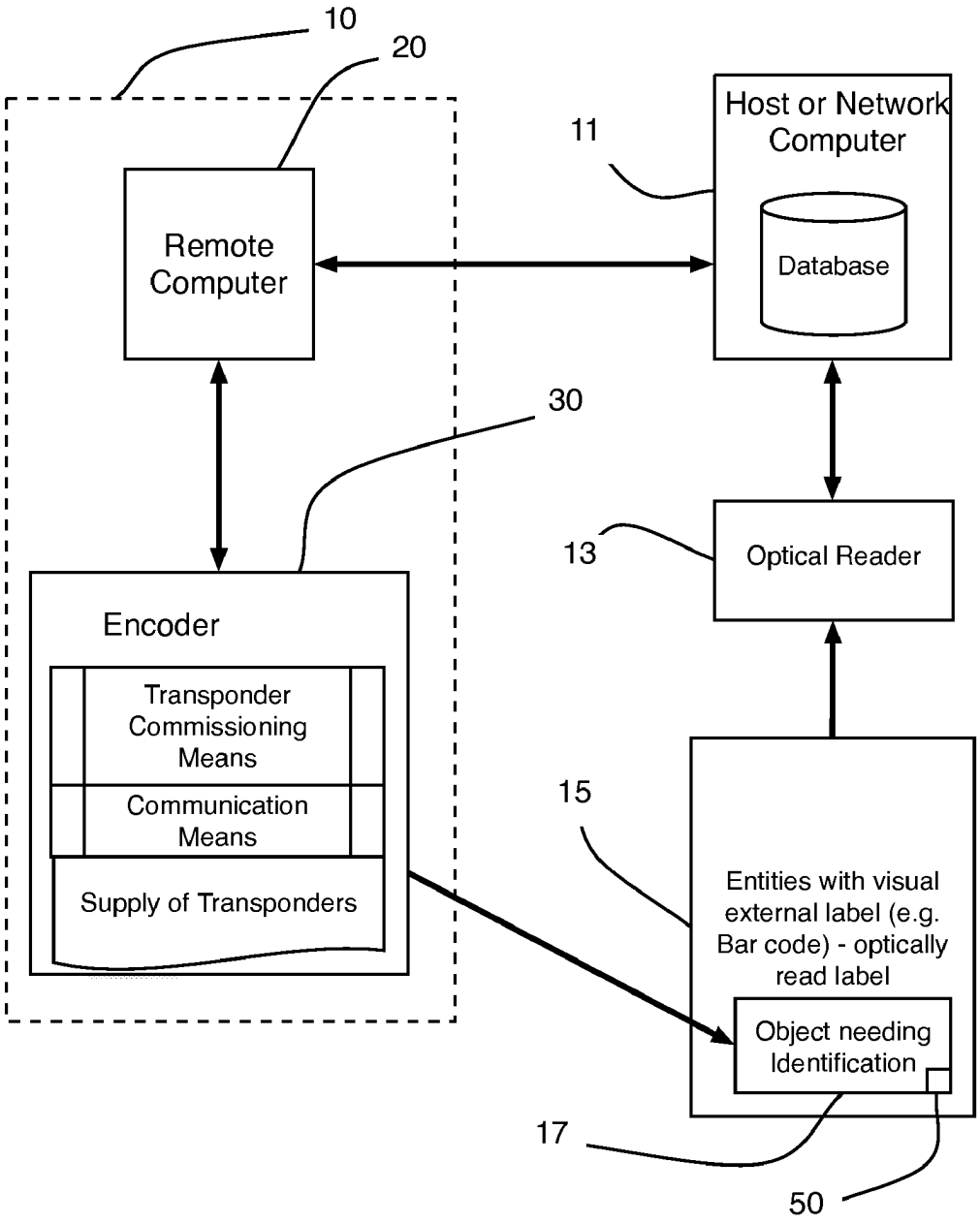
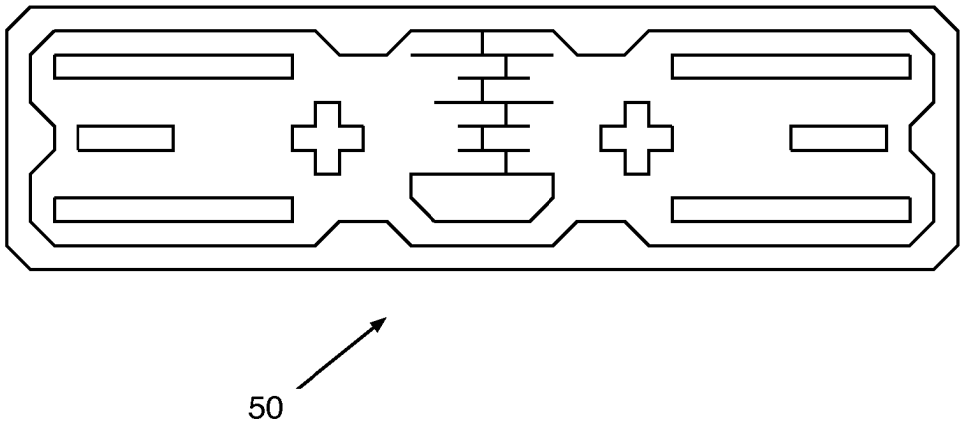

10
20
Host or Network Computer
11
Remote Computer
Database
30
13
Optical Reader
Encoder
Transponder Commissioning Means
Communication Means
Supply of Transponders
15
Entities with visual external label (e.g. Bar code) - optically read label
Object needing Identification
17
50

FIG. 1

FIG. 2



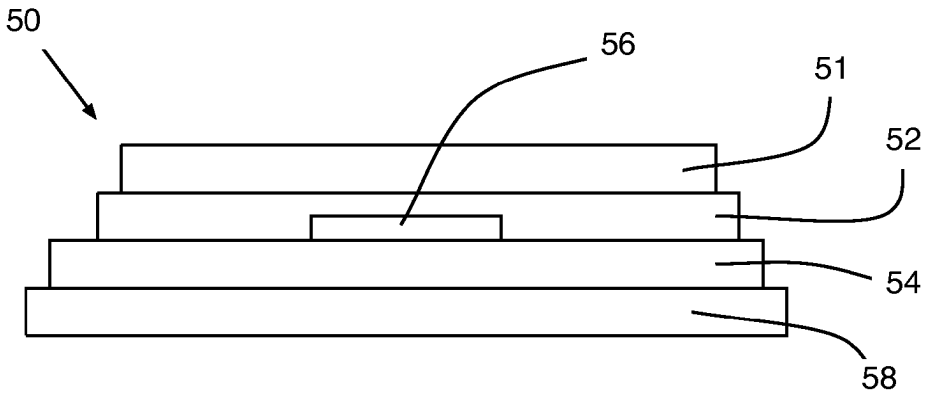


FIG. 3

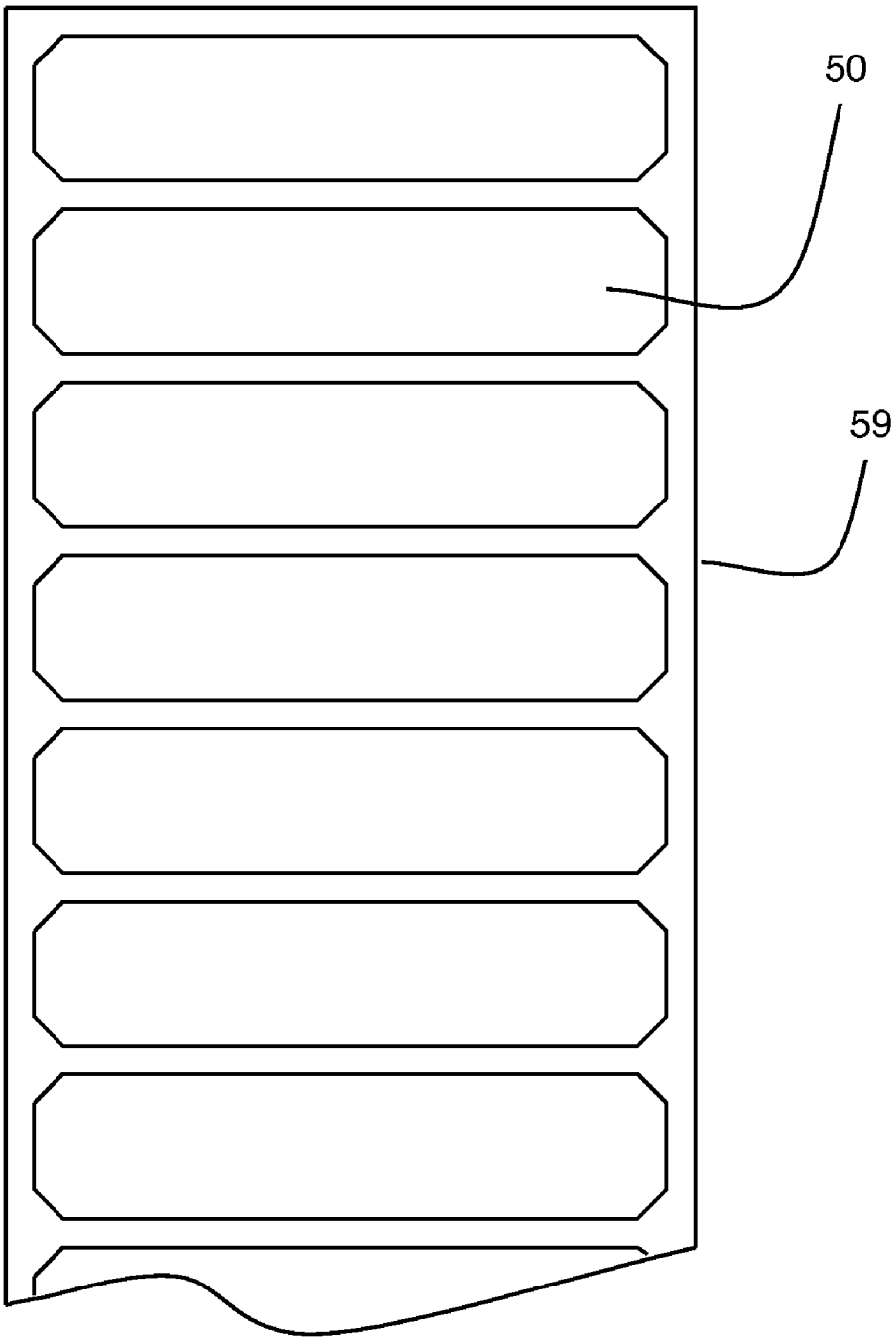
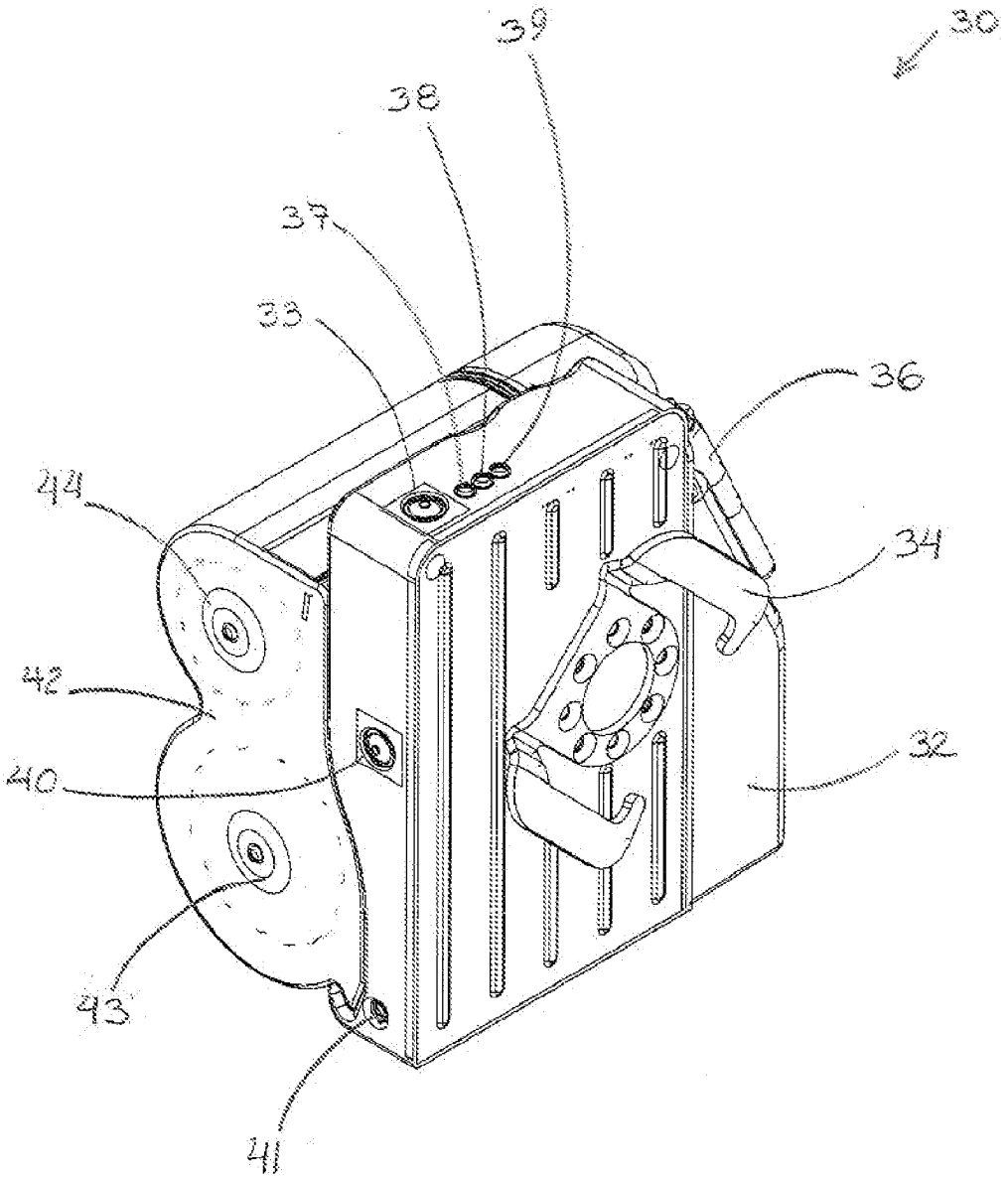


FIG. 4

FIG. 5



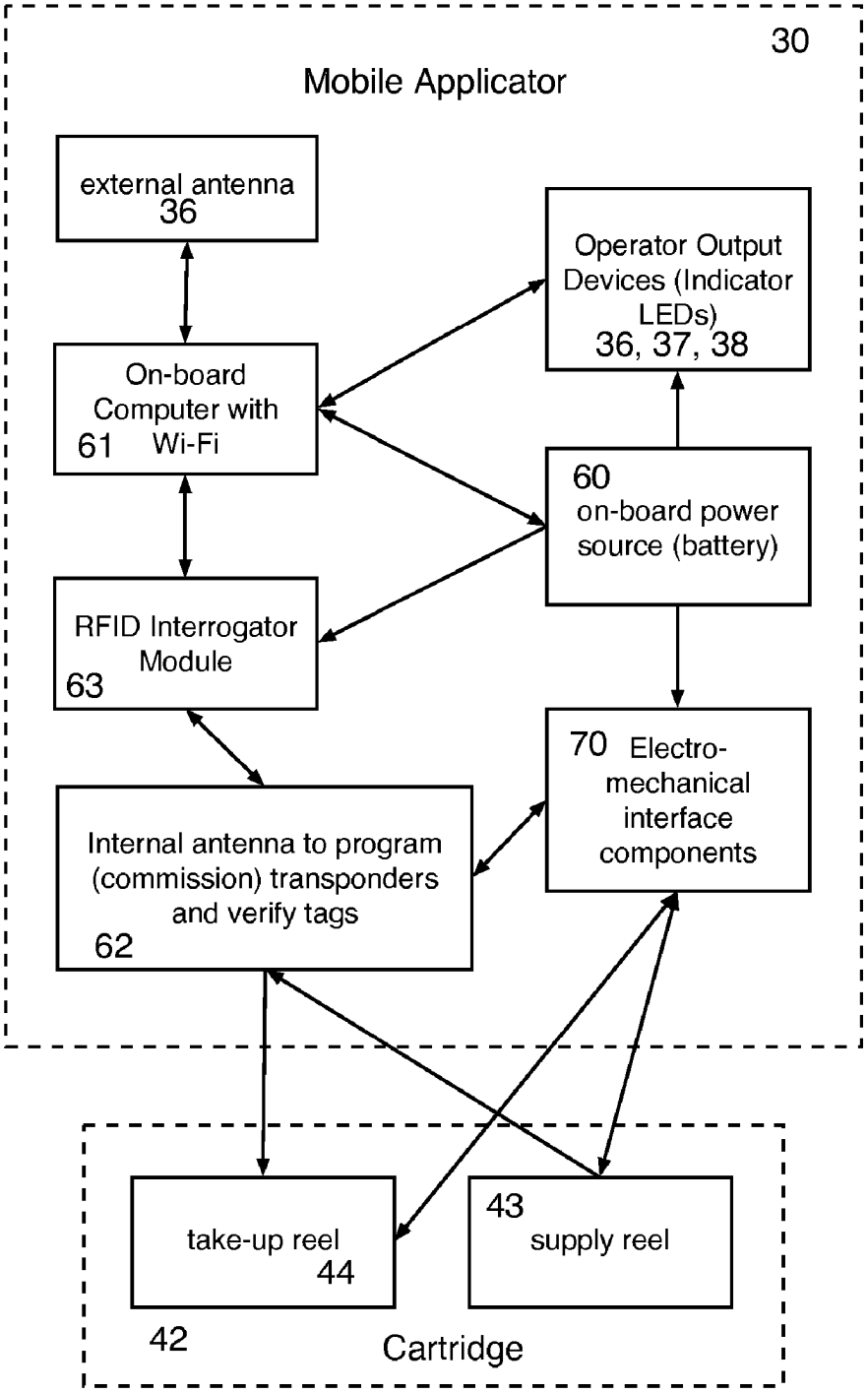

30
Mobile Applicator
external antenna
36
Operator Output Devices (Indicator LEDs)
36, 37, 38
On-board Computer with
61 Wi-Fi
60
on-board power source (battery)
RFID Interrogator Module
63
70 Electro-mechanical interface components
Internal antenna to program (commission) transponders and verify tags
62
take-up reel
44
43
supply reel
42
Cartridge

FIG. 6

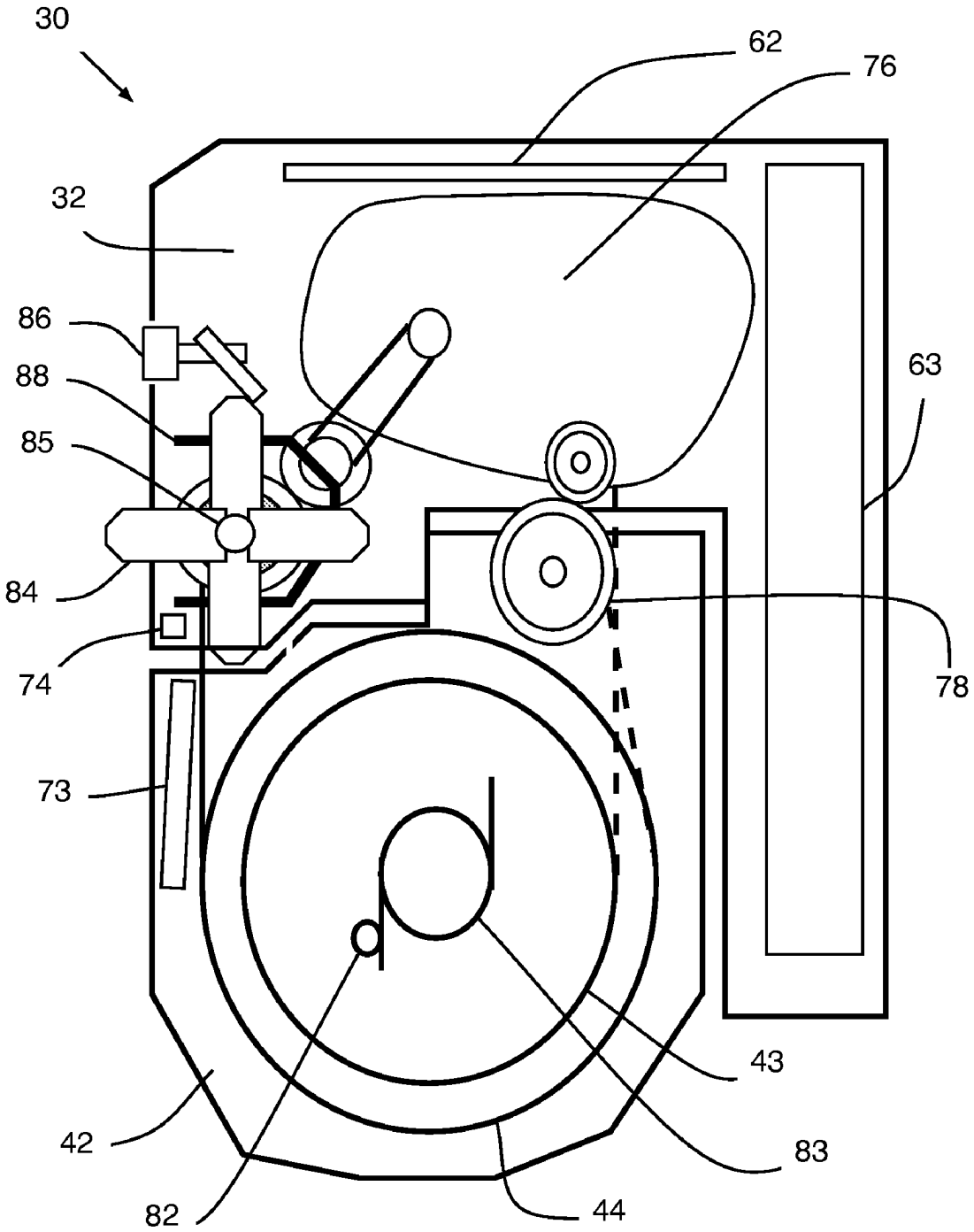


FIG. 7

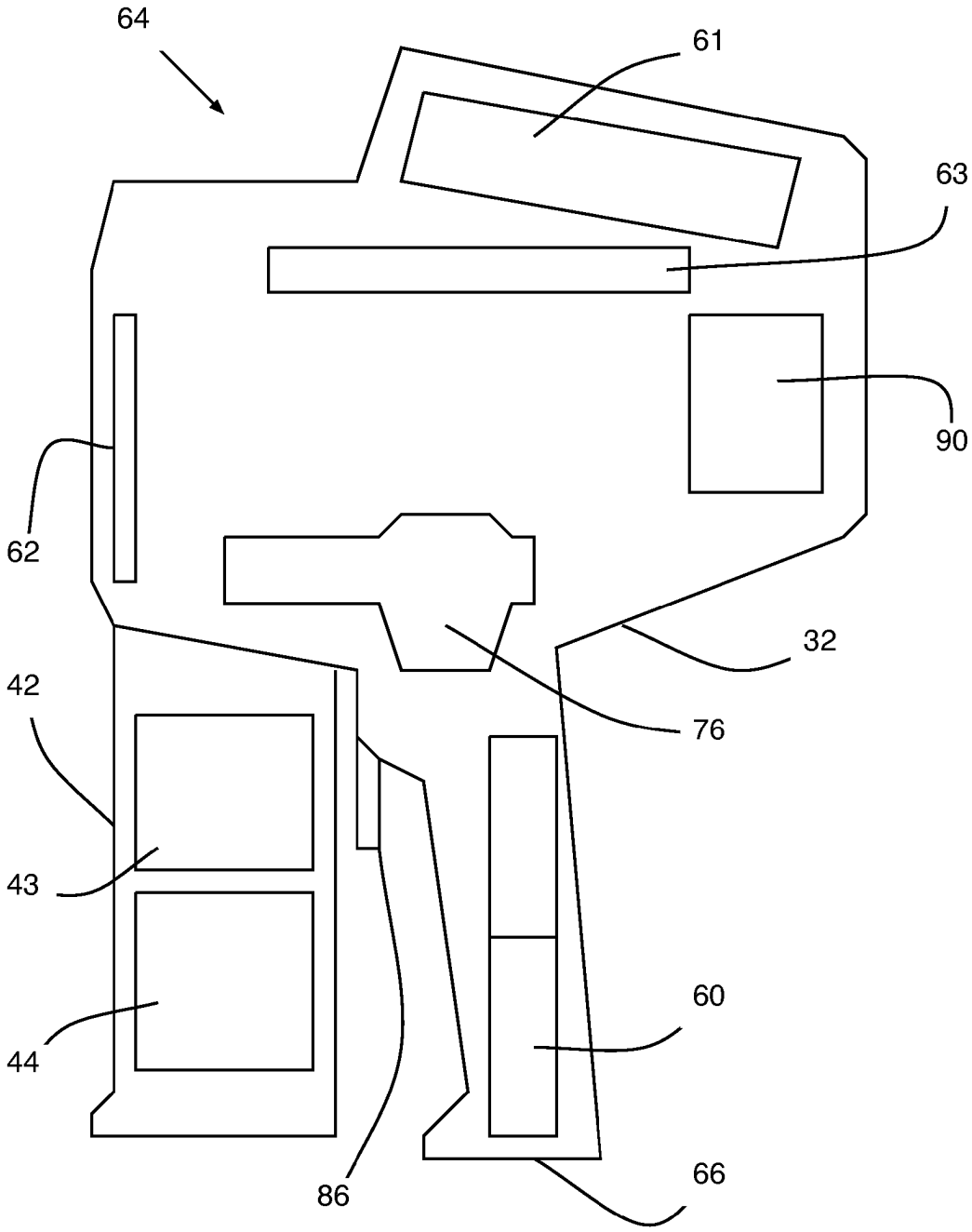


FIG. 8

Fig. 9

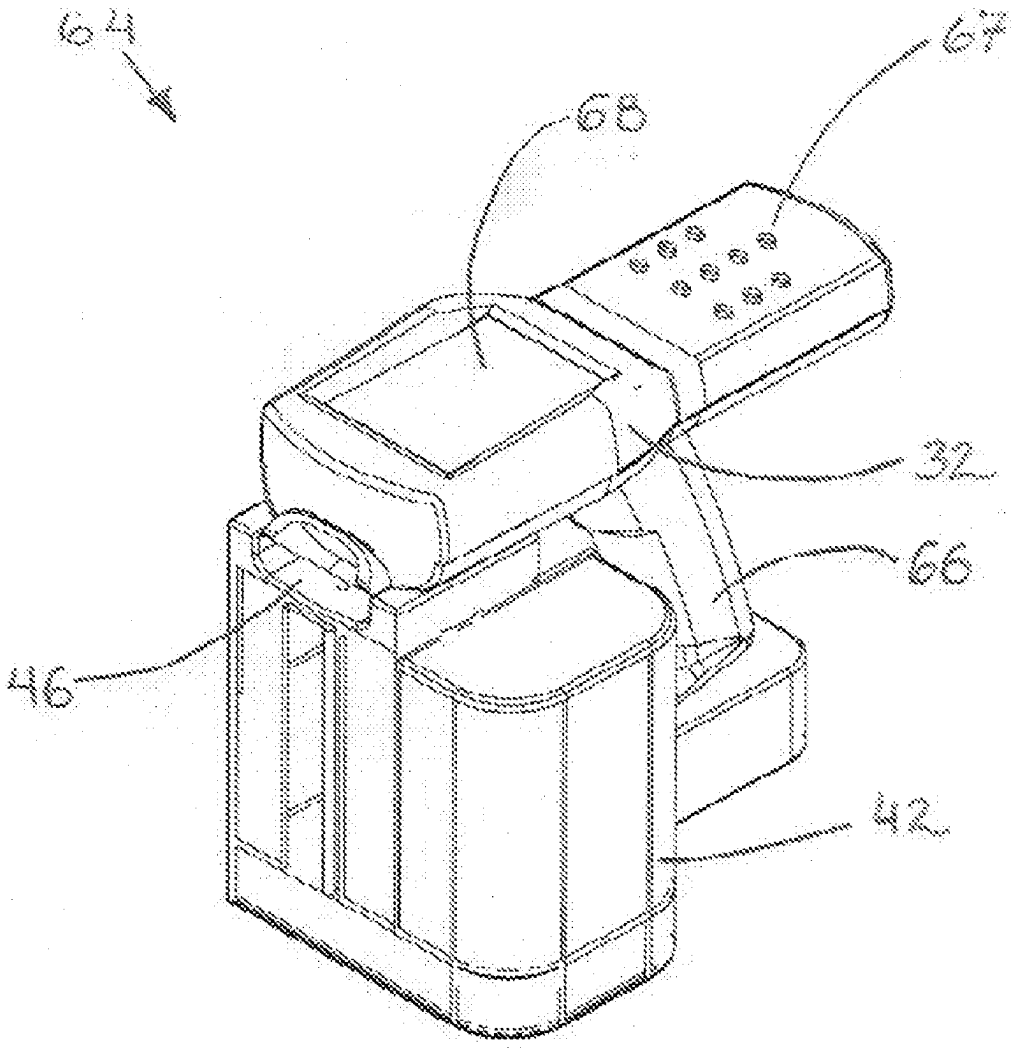
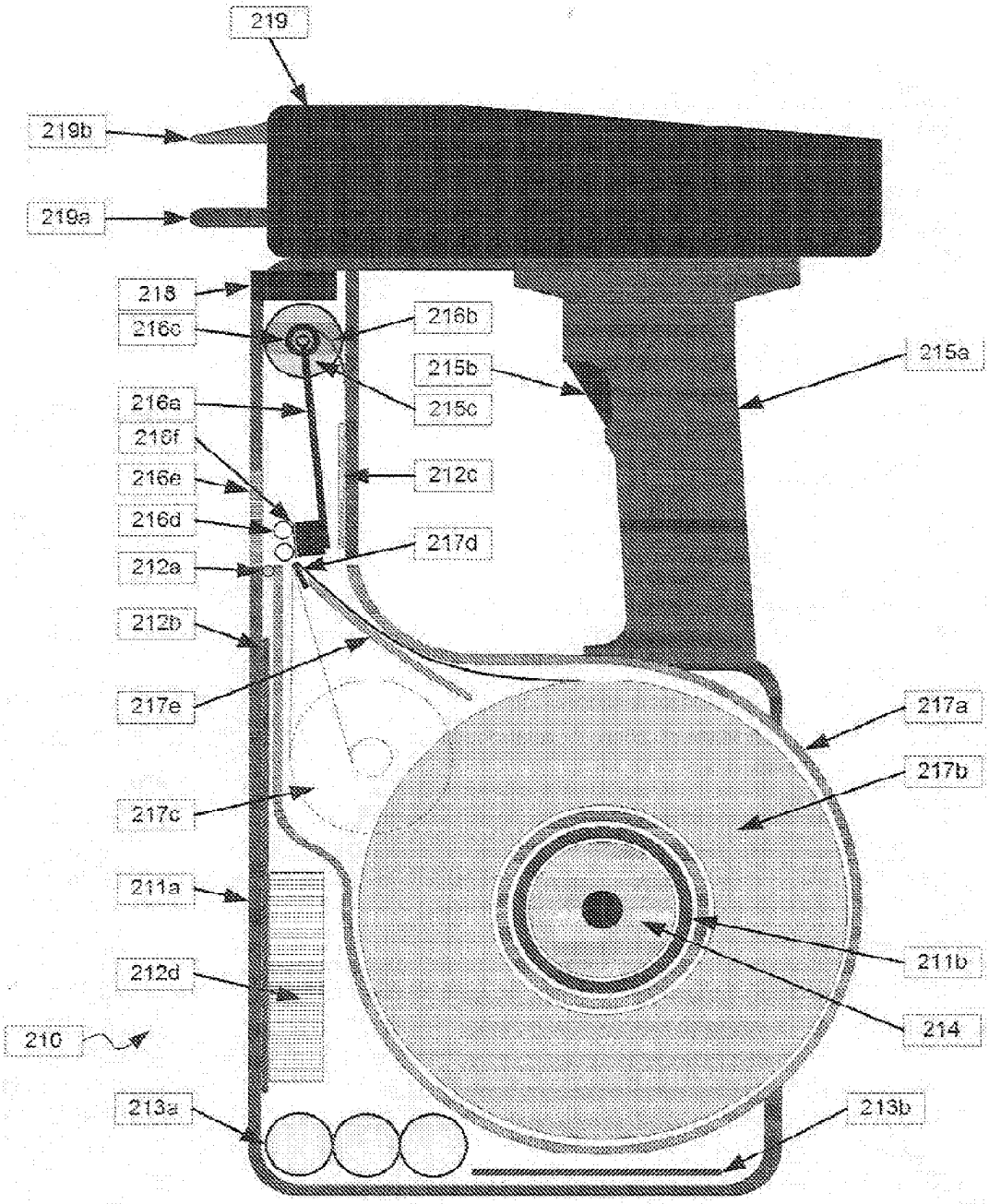


FIG. 10


219
219b
219a
218
216c
216b
215b
215c
215a
216a
216f
216e
216d
212a
212c
217d
212b
217e
217a
217b
217c
211a
212d
211b
214
210
213a
213b

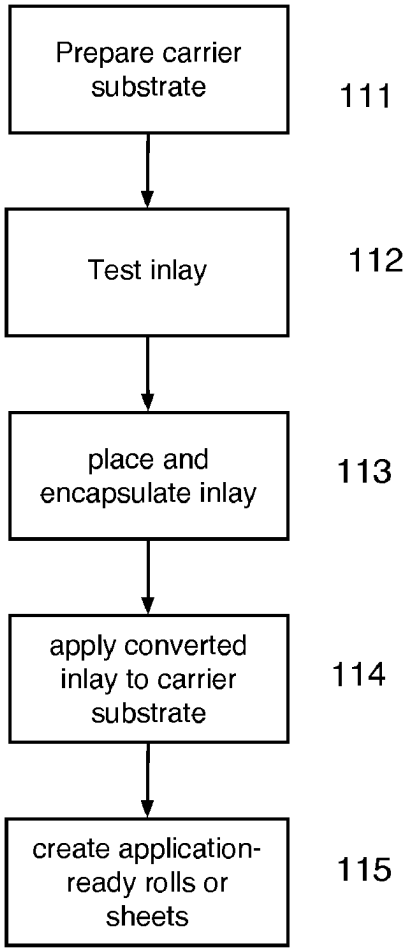

Prepare carrier substrate
111
Test inlay
112
place and encapsulate inlay
113
apply converted inlay to carrier substrate
114
create application-ready rolls or sheets
115

FIG. 11

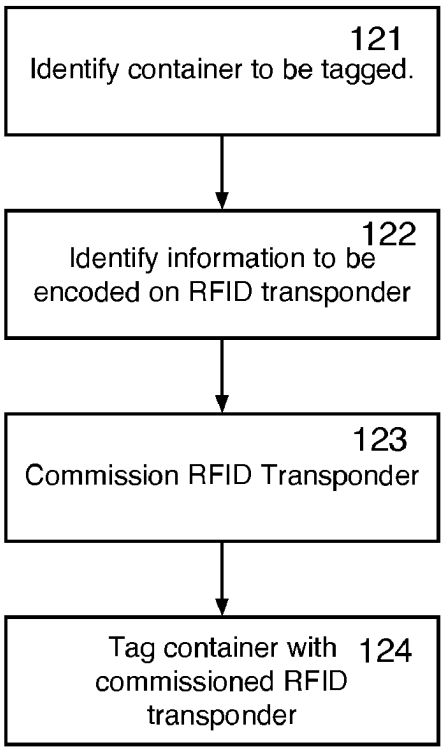

121
Identify container to be tagged.
122
Identify information to be encoded on RFID transponder
123
Commission RFID Transponder
Tag container with commissioned RFID transponder
124

FIG. 12

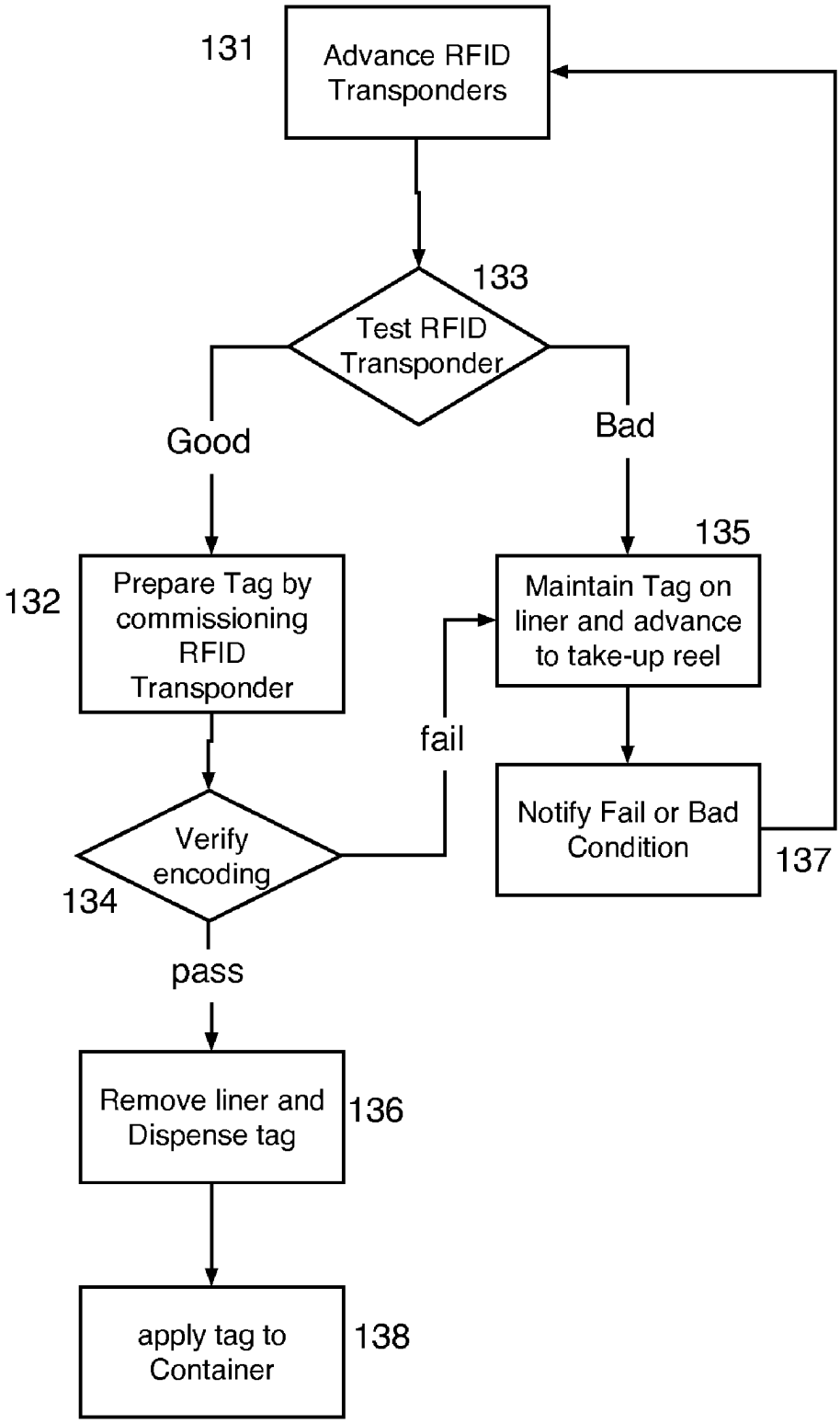

131
Advance RFID Transponders
133
Test RFID Transponder
Good
Bad
132
Prepare Tag by commissioning RFID Transponder
135
Maintain Tag on liner and advance to take-up reel
fail
Verify encoding
134
Notify Fail or Bad Condition
137
pass
Remove liner and Dispense tag
136
apply tag to Container
138

FIG. 13

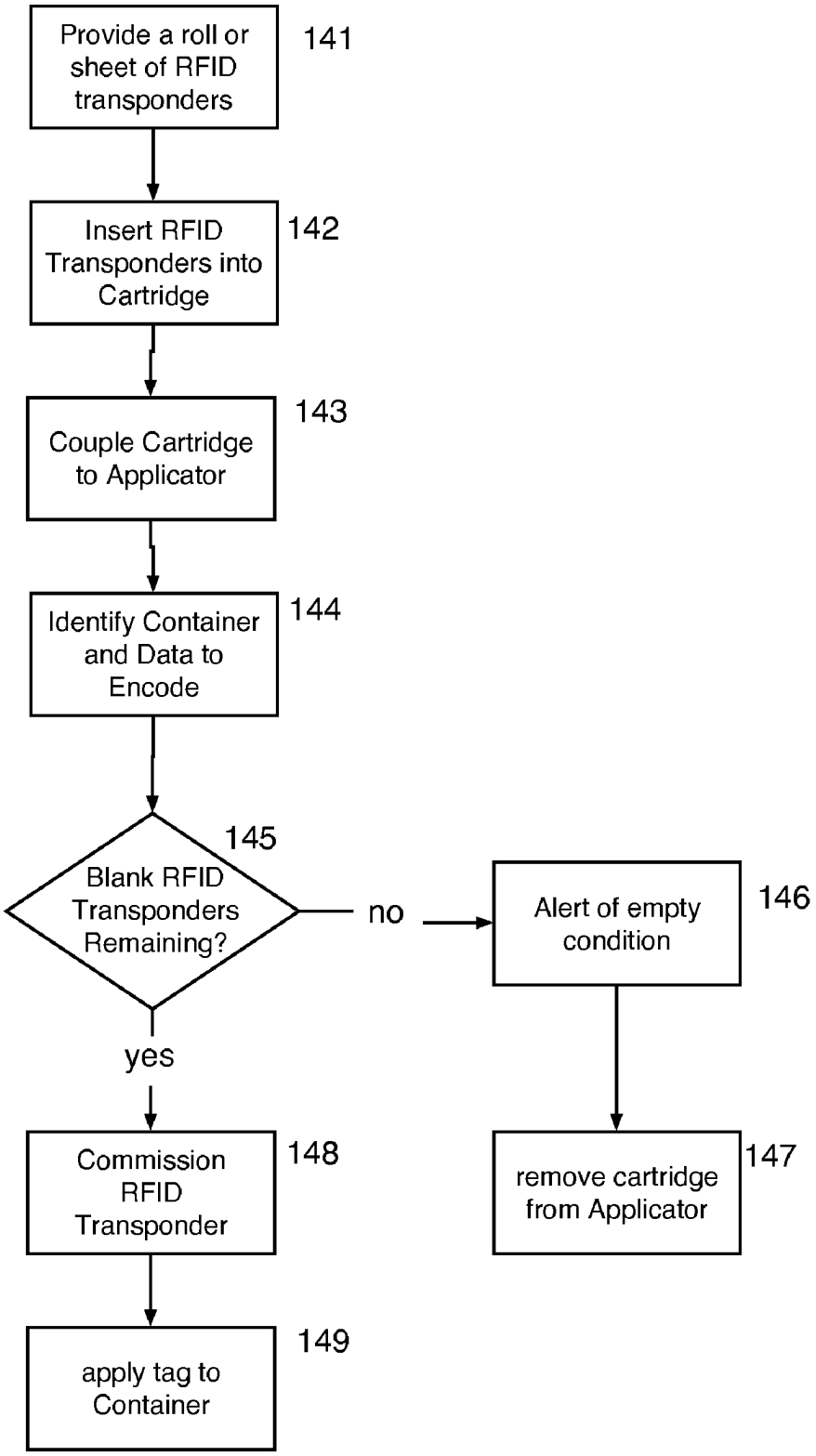

Provide a roll or sheet of RFID transponders
141
Insert RFID Transponders into Cartridge
142
Couple Cartridge to Applicator
143
Identify Container and Data to Encode
144
Blank RFID Transponders Remaining?
145
no
Alert of empty condition
146
yes
Commission RFID Transponder
148
remove cartridge from Applicator
147
apply tag to Container
149

FIG. 14

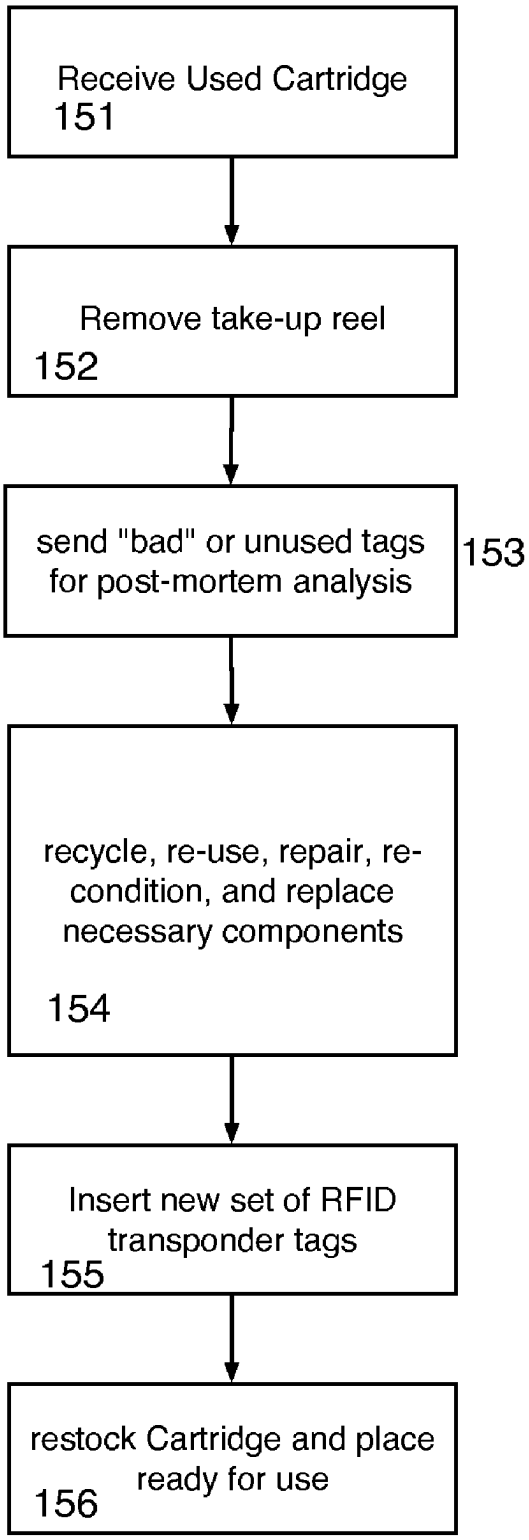

Receive Used Cartridge
151
Remove take-up reel
152
send "bad" or unused tags for post-mortem analysis
153
recycle, re-use, repair, re-condition, and replace necessary components
154
Insert new set of RFID transponder tags
155
restock Cartridge and place ready for use
156

FIG. 15

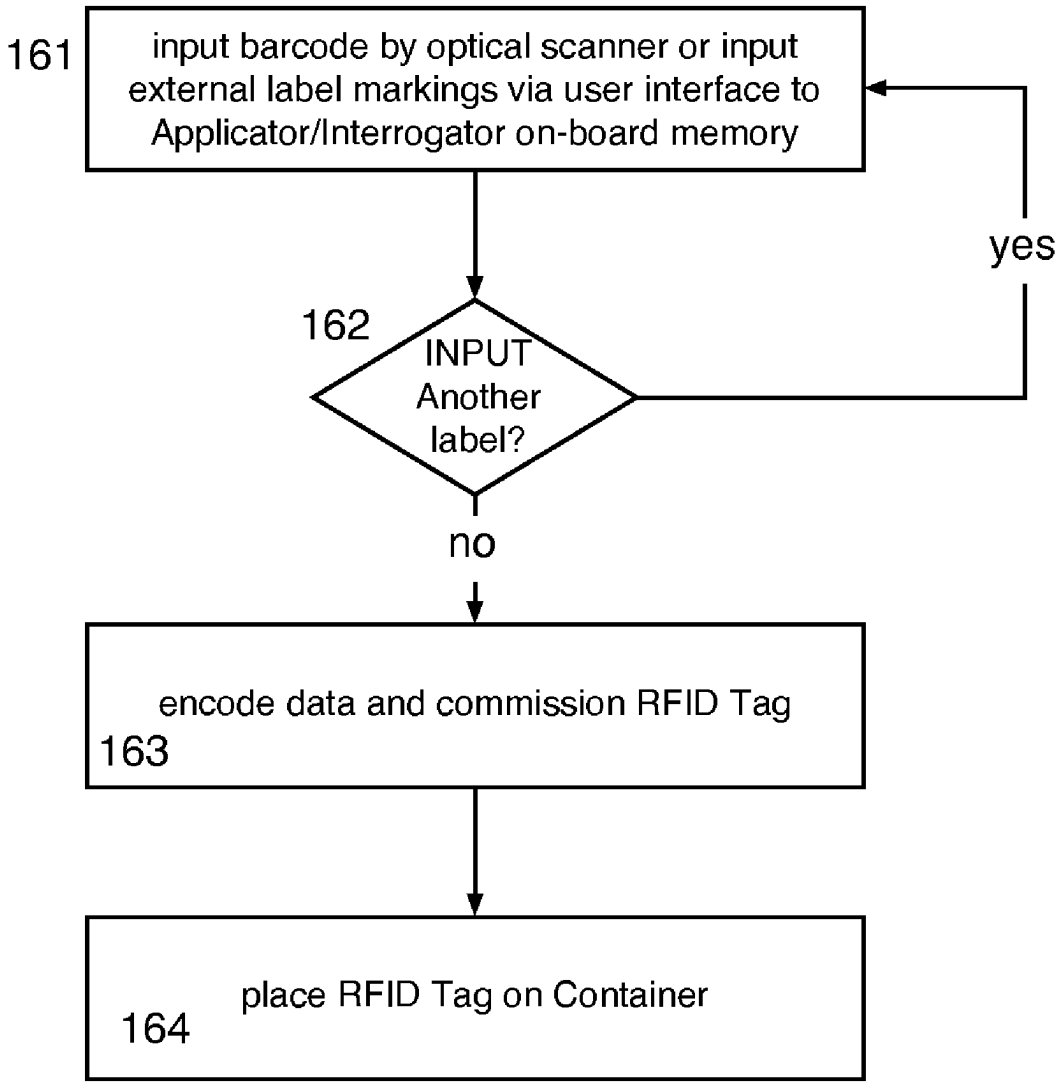

161
input barcode by optical scanner or input external label markings via user interface to Applicator/Interrogator on-board memory
yes
162
INPUT Another label?
no
encode data and commission RFID Tag
163
place RFID Tag on Container
164

FIG. 16

SYSTEMS, METHODS, AND DEVICES FOR CONVERTING AND COMMISSIONING WIRELESS SENSORS

RELATED APPLICATIONS

[0001] This document claims priority and benefit for all purposes of U.S. provisional patent application No. 60/709,713 filed on 19 Aug. 2005, entitled "Systems, Methods, and Apparatus for Converting and Commissioning Wireless Sensors" by the same inventor.

BACKGROUND

[0002] The present invention relates to a system, including methods and devices, utilizing wireless sensor devices and RFID (radio-frequency identification) transponders. Specifically, the present invention relates to a system incorporating novel devices and methods that enable point-of-use and on-demand commissioning of RFID transponder-equipped wireless sensors. Radio-frequency identification (RFID) transponders enable improved identification and tracking of objects by encoding data electronically in a compact tag or label. And, advantageously, the compact tag or label does not need external, optically recognizable or human-readable markings. In fact, using the Gen2 EPC specification, a three-meter read-distance for RFID transponders is common—even on high-speed material handling lines.

[0003] Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder.

[0004] Current classes of RFID transponders rank into two primary categories: active RFID transponders and passive RFID transponders. Active RFID transponders include an integrated power source capable of self-generating signals, which may be used by other, remote reading devices to interpret the data associated with the transponder. Active transponders include batteries and, historically, are considered considerably more expensive than passive RFID transponders. Passive RFID transponders backscatter incident RF energy to specially designed remote devices such as interrogators.

[0005] Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces.

[0006] Wireless sensors, made using silicon circuits, polymer circuits, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods.

[0007] Additional examples of RFID transponders, wireless tags, and wireless sensors are more fully discussed this inventor's co-pending U.S. Patent Application Publication No. 2006/0080819, entitled "Systems and Methods for Deployment and Recycling of RFID Tags, Wireless Sensors, and the Containers Attached thereto," published on 20 Apr. 2006, which is incorporated by reference for all purposes in this document.

[0008] One problem of prior-art systems, such as conventional print labels or barcode systems, includes a requirement for line of sight and an overdependence on the optical quality of the label. Many factors can render such a label unreadable including printing errors, excess ink, insufficient ink, physical destruction of the markings, obstruction of the markings due to foreign matter, and, in extreme cases, outright deception by placing an altered label over the top of such a print label.

[0009] RFID transponder labeling eliminates the need for an optically readable print label and overcomes all of the shortcomings related to print quality and the need for line of sight to scan the label. Moreover, RFID transponder labels enable secure data encryption, making outright deception considerably less likely to occur. However, current RFID label systems have their own limitations as well.

[0010] For example, certain prior art systems, as represented by U.S. Pat. No. 7,066,667 issued to Chapman et al. on 27 Jun. 2006 and include U.S. Pat. No. 5,899,476 issued to Barrus et al. on 31 May 2005, or by U.S. Pat. No. 6,246,326 issued to Wiklof et al. on 12 Jun. 2001, describe a device that commissions an RFID transponder with a printed label. This approach, however, introduces unnecessary waste, cost, and propensities for error. There is a growing category of applications that do not require anything other than a custom-encoded RFID transponder. This prior art calls for the inclusion of label printer hardware and related consumable materials that are not necessary for many RFID applications. Unneeded printer mechanisms create unnecessary complexities, size, and weight. In some instances this additional bulk hinders practical mobile applications.

[0011] United States Patent Application No. 2003/0227528 by Hohberger et al. published on 11 Dec. 2003 describes another attempt at improving demand-print labels by providing a device that combines two standard, die-cut rolls of media, one of which may be a roll of RFID transponders, and the second, print-label stock, in an attempt to provide on-demand smart labels. As with the aforementioned references, this approach adds unnecessary cost and complexity by combining RFID transponders with demand-printed labels.

[0012] So, despite recent advances in RFID technology, the state-of-the-art does not fully address the needs of efficient, economical, high-volume, cost-effective, reliable deployment and commissioning of RFID transponders and wireless sensors. And, large-scale adoption and deployment of RFID transponders depends on systems utilizing reliable, low-cost transponders and efficient commissioning means. Such systems should further include compliance with Gen2 EPC specifications or ISO standards, enable a plurality of printer-emulation modes, enable wireless connectivity—for example, in accordance with the IEEE 802.11b wireless LAN standards-based communications—provide various levels of WLAN security, efficient replenishment of programmable transponder supplies, and enable secure software re-programming to adapt to future demands and improvements.

SUMMARY OF THE INVENTION

[0013] The present invention overcomes the shortcomings of the prior-art attempts and, accordingly, provides systems, methods, and devices that commission RFID transponders on-demand and at a point-of-use utilizing wireless data transfer in a compact package that is well-suited to portable, mobile, or fixed use in multiple applications. Further advantages of the present invention will be well-appreciated by those skilled in the art upon reading this disclosure including the appended figures of the drawing.

[0014] For example, in one embodiment the present invention consists of an encoder for commissioning RFID transponders. The encoder consists of an RFID interrogator module adapted to enable encoding predetermined data according to a commissioning algorithm and communicating with an internal antenna, the antenna being adapted to encode the predetermined data on the RFID transponder; a memory storage device for storing at least a portion of the predetermined data; a processing means for controlling and communicating with the memory storage device, the RFID interrogator and the internal antenna; a means for providing a supply of RFID transponders, the transponders configured for tensile extraction from the encoder or, preferably from means for providing a supply of RFID transponder comprising a cartridge; and a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable encoding of the predetermined data.

DRAWING

[0015] FIG. **1** is a block diagram of the system and environment according to one embodiment of the present invention.

[0016] FIG. **2** is a top view of a possible RFID transponder according to one embodiment of the present invention.

[0017] FIG. **3** is a schematic end-view of the RFID transponder of FIG. **2**.

[0018] FIG. **4** is a top view schematic drawing of a sheet or roll of a plurality of RFID transponders of FIG. **3**.

[0019] FIG. **5** is an offset orthogonal view of a mobile encoder according to one embodiment of the present invention.

[0020] FIG. **6** is a schematic block diagram showing some components of the mobile encoder of FIG. **5**.

[0021] FIG. **7** is a schematic cross section view showing electro-mechanical components of one embodiment of a mobile encoder.

[0022] FIG. **8** is a schematic cross section of an encoder according to the present invention.

[0023] FIG. **9** is a frontal-offset view of a hand-held, mobile encoder according to the present invention.

[0024] FIG. **10** is a schematic cross section of another encoder according to the present invention.

[0025] FIG. **11** is a flow chart of a first method according to the present invention.

[0026] FIG. **12** is a flow chart of a second method according to the present invention.

[0027] FIG. **13** is a flow chart of a third method according to the present invention.

[0028] FIG. **14** is a flow chart of a fourth method according to the present invention.

[0029] FIG. **15** is a flow chart of a fifth method according to the present invention.

[0030] FIG. **16** is a flow chart of a sixth method according to the present invention.

DESCRIPTION OF THE INVENTION

[0031] Making reference to various figures of the drawing, possible embodiments of the present invention are described and those skilled in the art will understand that alternative configurations and combinations of components may be substituted without subtracting from the invention. Also, in some figures certain components are omitted to more clearly illustrate the invention. In some figures similar features share common reference numbers.

[0032] To clarify certain aspects of the present invention, certain embodiments are described in a possible environment—as identification means for containers. In these instances, certain methods make reference to containers such as loaded pallets, paperboard boxes, corrugated cartons, pharmaceutical containers, and conveyable cases, but other containers may be used by these methods. Certain embodiments of the present invention are directed for use with commercial corrugated shipping cartons, tagged palletloads of shrink-wrapped cases, consumer-goods packaging, consumer goods, or other methods of identifying objects using RFID transponders or wireless sensors, or both.

[0033] Some terms are used interchangeably as a convenience and, accordingly, are not intended as a limitation. For example, transponders are used interchangeably with the term tags and the term inlay is used interchangeably with inlet. This document generally uses the term tag to refer to passive inlay transponders, which do not include a battery, but include an antenna structure coupled to an RFID chip which are generally a thin and flat and substantially coplanar and located on a substrate. One common type of passive inlay transponder further includes a pressure-sensitive adhesive backing positioned opposite an inlay carrier layer. However, certain aspects of the present invention work equally well with active inlay transponders. A third type: a battery-assist tag is a hybrid RFID transponder that uses a battery to power the RFID chip and a backscatter

return link to the interrogator. Further, this document uses programmable RFID transponders interchangeably with RFID transponders. Programmable transponders enable data to be written or stored more than once.

[0034] Suitable environments or applications for certain aspects of the present invention include: Traditional conveyor line or other high-speed machinery with automated transponder printing, encoding, and attachment; Hand attachment of transponders (a method that often is referred to as "slap and ship"; and a novel category of mobile transponder encoders as will be more fully described herein.

[0035] The systems, methods, and devices of the present invention utilize an RFID transponder or wireless sensors as a component. Certain RFID transponders and wireless sensors operate at Ultra High Frequencies (UHF), the band of the electromagnetic spectrum that, for RFID applications, spans from about 860 MHz to 960 MHz. Transponders and tags responsive to this frequency band generally have some form of one or more dipoles in their antenna structure. Such RFID transponders and wireless sensors utilize any range of possible modulation schemes including amplitude modulation, amplitude shift keying (ASK), double-sideband ASK, phase-shift keying, phase-reversal ASK, frequency-shift keying (FSK), time-division multiplexing (TDM), or Ultra Wide Band (UWB) method of transmitting radio pulses across a very wide spectrum of frequencies spanning several gigahertz of bandwidth. Modulation techniques may also include the use of Orthogonal Frequency Division Multiplexing (OFDM) to derive superior data encoding and data recovery from low power radio signals. OFDM and UWB provide a robust radio link in RF noisy or multi-path environments and improved performance through and around RF absorbing or reflecting materials compared to narrowband, spread spectrum, or frequency-hopping radio systems. Wireless sensors are reused according to certain methods disclosed herein. UWB wireless sensors may be combined with narrowband, spread spectrum, or frequency-hopping inlays or wireless sensors.

[0036] A. System Overview

[0037] The present invention includes a system for commissioning wireless sensors at a point of use and on-demand. For example, in one embodiment, the present invention incorporates a mobile encoder device, which may be attached to a belt of an operator and powered by rechargeable batteries. The mobile encoder is in wireless communication with a remotely located host computer. The operator can selectively (on-demand) enable the mobile encoder to commission a transponder based on various criteria, including input received from a mobile bar-code scanner, for example.

[0038] FIG. **1** shows one system **10** according to the present invention in a typical environment, such as a packaging facility wherein a collection of entities with visual external labels **15** exist and a sub-set (or all entities) need to be associated with a wireless RFID transponder, tag, or label. The object **17** needing an RFID transponder could be a packing container having an assorted collection of entities **15**. As entities **15** are pulled from the collection, a traditional optical reader **13** (human or machine) interprets the visual external label. Information from the external, visual label is correlated to information stored in a centralized location, represented by a network computer **11** having a database. The information taken by the optical reader **13** is transmitted to the network computer **11**. System **10** includes a wireless connection between the remote computer **20** and the mobile encoder **30** either directly or through a common wireless access point. Additionally, a wireless connection could occur between the remote computer **20** and the host computer **11**, and in this embodiment, the remote computer **20** is in physical connection with the mobile encoder. In yet another embodiment, the remote computer **20** wirelessly connects to both the mobile encoder **30** and the host computer **11**. Optionally, the optical reader **13** can be incorporated in the encoder **30**. In these aforementioned embodiments, the mobile encoder **30** is a portable device that can be easily carried by a human operator. As such, the mobile encoder **30** includes an internal power source such as a rechargeable lithium-ion battery and would further include a handle or a belt-clip for ease of use. In another embodiment, the mobile encoder can be attached to a high-speed conveyor line. In such an application, the on-board battery could be replaced or augmented by a physical connection to a remote power source. Further, the computer **20** could have wired connects to the host network **11**. Further details of possible configurations of the mobile encoder will be further detailed in subsequent sections of this disclosure.

[0039] In the system **10** of FIG. **1**, the mobile encoder **30** carries a supply of un-commissioned (or blank) RFID transponders. Once the desired data is accumulated and presented to the encoder **30** from the computer **20**, the encoder commissions an RFID transponder, creating an RFID tag or label **50** for the object **17**. The commissioned tag or label **50** can then be applied, linked, or otherwise associated with the object by known means including a human operator or a machine transfer.

[0040] B. RFID Transponders

[0041] FIG. **2** shows a possible RFID transponder **50**. RFID transponders, essentially, comprise an RFID integrated circuit (IC) device (or "chip") bonded to an antenna apparatus, formed on a substrate that is often plastic such as Mylar®, polyester, or PET. One way to form an antenna structure is to etch copper from a substrate. An alternate way includes printing multiple layers of conductive ink onto a substrate. One additional method includes stamping UHF antennae from thin sheets of aluminum. In certain embodiments, RFID transponders and wireless sensors are recovered from waste streams for reconditioning, reprogramming, and reuse.

[0042] Other suitable RFID transponders include designs that combine a dielectric spacer behind the antenna to create a transponder that performs well over a broad range of packaging conditions. A robust design also includes features to protect the transponder from damage.

[0043] In certain embodiments, the RFID transponder is both programmable and mechanically configured for tensile extraction from a protective enclosure.

[0044] In one embodiment, additional transponder layers include a thin and flexible energy cell comprising two non-toxic, widely-available commodities: zinc and manganese dioxide. One suitable energy cell is developed by Power Paper Ltd. of 21 Yegia Kapayim Street, Kiryat Arye, Petah Tikva, P.O.B. 3353, ISRAEL 49130, and incorporates an innovative process that enables the printing of caseless,

thin, flexible and environment-friendly energy cells on a polymer film substrate, by means of a simple mass-printing technology and proprietary inks.

[0045] The cathode and anode layers are fabricated from proprietary ink-like materials that can be printed onto virtually any substrate, including specialty papers. The cathode and anode are produced as different mixes of ink, so that the combination of the two creates a 1.5-volt battery that is thin and flexible. Unlike conventional batteries, this type of power source does not require casing.

[0046] A top layer of an RFID transponder assembly comprises a paper face-stock, which is a very low-cost material but also is the least environmentally resilient. UV-resistant plastic face-stock generally provide the best survivability in outdoor and rough-service environments, and also provide the best protection for the RFID transponder assembly.

[0047] A bottom layer of pressure-sensitive adhesive (PSA) often is used for attachment of transponders to objects and often is referred to as a wet inlay or a wet tag or a wet transponder. Alternatively, a layer of clear, translucent, or opaque adhesive-backed film or tape is used to attach the transponder or wireless sensor to object or container. The tape, any thin, low cost, flexible material with a self-adhesive backing, such as a conventional packing tape, is well-suited for this method of attachment. The tape may be formed into various shapes to achieve the requirements of this method. Certain embodiments may use tape that is preprinted with certain logos, marks, symbols, bar codes, colors, and designs. Suitable adhesive-backed tape must not—or at least minimally—absorb radio frequencies within the range of frequencies used by the transponder or tag. The tape material, also, must not corrode the device or otherwise hamper its functionality.

[0048] Certain embodiments use a type of packing manufactured specifically for a given encoder. Packing tape can be single-coated pressure-sensitive adhesive tape or, alternatively, media constructed with multiple layers including a backing layer. Certain backing layers are constructed on a plastic film having one or more layers. Certain backing layers are made from plastic resins such as polypropylene (PP), polyethylene (PE), or copolymers of PP, PE, PVC, polyesters, or vinyl acetates. Certain embodiments of PP are mono-axially oriented polypropylene (MOPP), bi-axially oriented polypropylene (BOPP), or sequentially and bi-axially oriented polypropylene (SBOPP). Certain backing layers are biodegradable. Certain backing layers are coated with a pressure sensitive adhesive on one side and a low adhesion release coating on the other side to reduce the amount of power required for the encoder to unroll the tape for application.

[0049] FIG. **3** shows a possible embodiment of an RFID transponder **50** that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer **52** bonds with antenna layer **54** that is bonded to inlay substrate layer **58** and integrated circuit **56**. Inlay substrate layer **58** and face-stock layer **51** provide resistance against electrostatic discharge (ESD) into antenna layer **54** or chip **56**.

[0050] Other constructions for RFID transponders include one or more additional layers of high-dielectric material that encapsulate or substantially cover the inlay. In general, the thicker the dielectric layer the higher the voltage must be to initiate a flow of electrons through a dielectric layer. This results in higher ESD voltage ratings. Also, it is well known to those skilled in the art that thicker dielectric layers between antenna layer **54** and any other metal or liquid also tends to reduce parasitic loading of the antenna whereby maintaining antenna tuning for proper coupling to interrogators within a specified UHF band. In such embodiments, the integrated circuit chip and antenna bond to an adhesive layer and are protected from a discharge path through the tape layer by its particular thickness of dielectric material. A second dielectric layer bonds to the inlay substrate by a second adhesive layer, so that a low voltage discharge path is non existent around the two layers of tape substrate.

[0051] In another possible embodiment of an RFID transponder, the inlay substrate provides a second layer of ESD resistance against a discharge path through an outward-facing tape layer and associated adhesive layer. This construction protects the antenna and chip from electrostatic discharge originating from any direction. The encapsulation tape layer bonds to the antenna and chip via an adhesive layer and provides no adhesive bond to the transport container when the transponder is commissioned, and therefore depends on separate adhesive zones to attach to the container of interest.

[0052] In another possible embodiment, an RFID transponder includes multiple layers of ESD resistant material. For example, an outer layer substrate bonds to an inner substrate by an intermediate adhesive layer. A second adhesive layer bonds with the chip and antenna. The inlay substrate faces inward and presses against a transport container when the transponder is commissioned.

[0053] The contemplated adhesives in the various RFID transponder embodiments create strong and permanent bonds between tapes and inlay layers over a certain practical range of operating temperatures.

[0054] Because RFID transponders are designed to adhere to a container, one face of an external layer includes a pressure-sensitive adhesive. This external adhesive, however, must not cause mechanisms associated with the commissioning devices to jam. To prevent unwanted sticking of the RFID transponder, a transport layer protects the sticky, external adhesive. The transport layer is either a release liner such as a silicone-treated paper liner or a net (or mesh) web. A net or mesh web offers two principal advantages: less weight and are recyclable or reusable. A comparison of the weight of a net with a higher percentage of open area to a typical sheet of release liner reveals that the netting is lighter for any given section of comparable size. Environmental problems of disposal of release liner are well known. Mesh or netting, comprised of recyclable resins, is recovered after each use so that the mesh or net can be either reused or recycled for its constituent materials.

[0055] In one possible embodiment the mesh or netting is made of plastic such as nylon, polypropylene, polyethylene, HDPE, Teflon, or other resins. In other embodiments the mesh or netting is fabricated from metal or carbon-impregnated plastic to provide a conductive path to bleed electric charge away from points of accumulation.

[0056] Other advantages of a net or mesh transport layer include a substantial percentage of the adhesive not in

contact with anything during storage and commissioning. When stored in a roll, a small percentage of the adhesive layer makes contact with the backside of the roll through the openings in the mesh. Thus, a small amount of energy is required to unroll the spool during transponder commissioning, yet there exists a certain amount of adhesion to prevent a converted spool from unraveling.

[0057] In other possible embodiments, the RFID transponders can include a surface suitable for human or machine readable, visible, external markings including bar-code symbols or alpha-numeric sequences.

[0058] FIG. **4** shows another embodiment of RFID transponders **50** grouped on sheet stock **59** such as rolls or z-folded sheets that enables a plurality of transponders to be carried on a continuous web or traditional release liner. Other certain embodiments use transponders that are stacked and loaded into magazines for transport, handling, and automated dispensing. In certain embodiments, the magazines contain metallic shielding to protect transponders and inlays from electrostatic discharges (ESD).

[0059] In certain embodiments an RFID encoder is combined with a sensor suite to enable semi-automated tag application to desired objects. In one embodiment, a semi-automatic encoder/applicator is created by integrating a single sensor device. The sensor responds to changes in light, capacitance, pressure, acoustics, or optical path length to a transport container. In another embodiment a suite of sensors are used to detect the attachment location of a commissionable transponder.

[0060] For example, changes in capacitance are detectable using certain QProx charge transfer capacitance sensors available from Quantum Research Group Ltd. of Hamble, England. Ultrasonic range sensors are available from supplier such as muRata Manufacturing Co., Ltd. of Kyoto Japan under the trade name Piezotite. Optical path length sensors are available from Keyence Corporation of Osaka, Japan. Sharp manufactures a compact distance-measuring sensor GP2DO2 that is responsive in the range from 5 to 100 cm. Thus, when a predetermined set of conditions is realized, the sensor triggers, enables, or selects a desired action. In one embodiment, proximity or contact of sensor suite with the targeted transport container causes a second type of Trigger Event, resulting in the commissioning and dispensing of a transponder by an encoder.

[0061] In other embodiments, the sensor is designed to determine the distance an encoder resides from an object that is to be tagged. Range information is acquired and processed in real time to determine if the encoder is in Close Proximity, Near, or Far from a transport container. In certain embodiments a controller is programmed to alter threshold distances between each range category and to associate a function with each range. In certain embodiments, range category Close Proximity is associated with transponder programming and application functions. For example, the range category Near is reserved for transponder verification and/or reading functions; and Far is reserved for bar code scanning functions to verify that bar code information aligns properly with RFID transponder data.

[0062] In other embodiments a sensor suite is responsive to certain colors or patterns and use that information to instruct the placement or detect the correct locations for applying good transponders and separate locations for discharging bad transponders.

[0063] C. Mobile Encoder

[0064] FIG. **1** shows a system **10** according to one embodiment of the present invention including a mobile encoder **30**. And, FIG. **5** details one possible mobile encoder **30**. In this embodiment, the encoder can attach to the belt of an operator, accordingly, mounted on the housing **32** is a belt mounting means such as belt-clip **34**, which easily adjusts for left-handed or right-handed operation and corresponding mounting on the belt (not shown) of the operator. An external antenna **36** enhances wireless connectivity to a host or network computer (not shown in this view) or, to a remote-mounted computer device such as a PDA or bar code reader. Several operator indicator lights including a system-ready LED **37**, data-ready LED **38**, tag-ready LED **39**, and battery-ready LED **40** mount on the housing enabling the operator an easy view of the device status.

[0065] Also included on the exterior of the housing are an external, power-cord receptacle **41** so that the on-board lithium-ion battery may be charged as required. A combination on/off-next switch **33** enables the operator to selectively power up the encoder. A reset port, such as a recessed reset button (not shown in this view), enables an operator to reset the software settings of the device as required.

[0066] A cartridge **42** containing a plurality of RFID transponders releasably mounts to a face of the housing **32**. The cartridge further includes a take-up reel **44** for non-dispensed RFID transponders, a port **46** (above **44** but not shown in FIG. **5**) for dispensing commissioned transponders, and a supply reel **43** for holding blank RFID transponders prior to commissioning.

[0067] In one alternative embodiment, the mobile encoder **64** includes a handle (as FIG. **9** shows, for example) for hand operation of the encoder. In another contemplated embodiment, the mobile encoder is fixed to an assembly line in a stationary manner. Accordingly, the stationary-mounted encoder further includes machine-controlled devices for extracting a commissioned RFID transponder from the encoder and places the transponder on the container of interest by means well understood in the art.

[0068] In the aforementioned embodiments of the mobile encoder **30** (or hand-held encoder **64** of FIG. **8**, for example) key features commonly shared include means for enable Gen2 EPC compliance and multiple printer-emulation modes. An on-board power source, such as a rechargeable lithium-ion battery enables freedom of movement as does means for wireless connectivity to a data network, such as the 802.11 wireless LAN (Wi-Fi) standards-based communications protocol. However, a conventional power source that requires connectivity to a power-grid and a cable-based data network connectivity link would work under certain circumstances.

[0069] Further, in contemplated embodiments, the fixed or mobile encoder enables selective mounting to a magazine or cartridge filled with un-commissioned RFID transponders, which facilitates rapid and easy loading of the encoder with ready-to-use RFID transponders and further enables re-use, re-commissioning, and recycling of un-dispensed transponders and the associated cartridge. The mobile encoder can be monitored and controlled by virtually any handheld or mobile device, a host computer in a central location, or over the Internet.

[0070] The mobile encoder **30** is activated (turned on) when an operator selectively depresses the combination on/off-next switch **33**. However, depressing the on/off-next switch for about three seconds or longer results in a sleep-mode cycle that can be interrupted by re-pressing the on/off-next switch. In sleep mode the operator indicators (LEDS **37**, **38**, and **39**) will turn off. If active, the mobile encoder system-ready LED **37** illuminates and connects to the assigned network. Network connectivity results in the illumination of both the system-ready LED **37** and the data-ready LED **38**. The encoder receives commands and data via the wireless link from the remote computer **20** or host network computer **11** (of FIG. **1**). The data represents information to be encoded on an RFID transponder. The information is stored in the encoder's on-board memory and the tag-ready LED **39** rapidly blinks green (cycles on/off to pulsate). An RFID transponder is moved from within the cartridge **42** to a position on the top edge of the cartridge for encoding in the encoder and the transponder is encoded with the appropriate information. The transponder is tested and if it is good—contains the data and encoding was successful—all three indicator LEDs indicate a solid-green color. The operator removes the encoded RFID transponder from the encoder and places it on the container of interest.

[0071] In the event that the encoding process failed, the bad transponder is detected and retained by the encoder, where it remains on the take up reel **44** inside the cartridge **42**. The take up reel also collects the release liner as the encoder **30** dispenses good transponders (properly encoded RFID transponders). The take up roll returns to a re-cycling center where components are re-used or recycled as necessitated. Further, the re-cycling center can perform failure analysis on returned transponders.

[0072] FIG. **7** is a schematic diagram of additional electromechanical and logic components of a possible encoder **30**. An RFID Module **63**, such as a MP9311 UHF reader module available from Sirit Technologies, 1321 Valwood Parkway, Suite 620, Carrollton, Tex., 75006, USA, communicates with a vertical polarized YAGI antenna **62** with a downward side lobe to low-power program (commission) RFID transponders to create an RFID transponder, and the same downward side lobe and verify transponders at low power also can read far-field transponders at a higher, second power. Additional components include a mechanical paddle trigger **86** for operator-selected override of the reel of RFID transponder stored in the supply or source reel **43** in the cartridge **42**. A drive motor **76** coupled to a dual output shaft gearbox drives the source transponder reel **43** via an intermediate take-up reel gear interface **78** at the cartridge mouth. Another gear assembly along with a spring couple **85** advances and positions the tag feeder paddle **85**. A tag sensor **74** detects the location of the RFID transponder to-be commissioned by the YAGI antenna **62**. As the reel of RFID transponder advances inside the encoder, the lead edge passes the ratchet post **82**. If the now-commissioned transponder is read by the antenna **62** as "good", a ratcheting-back torque spring **83** enables a peel device, such as the shield and tag peel edge **73**, to engage, forcing the commissioned tag to peel away from the carrier layer, which continues on to the take up reel **44**. In the event of a "bad" tag—that is, the antenna **62** reads the RFID transponder and determines an error has occurred—the shield **73** does not engage, allowing the defective transponder to remain on the carrier layer and proceed to the take-up reel. Once the good transponder is removed from the encoder, the tag sensor **74** detects the condition and enables the encoder to stand-by for the next event. Transponders are read, written, and verified when an operator initiates an action such pulling a trigger **86**, pushing a button, or some other command sequence.

[0073] Certain protective enclosures, such as cartridges **42** or magazines, are part of a family of interchangeable magazines of similar size, shape, and functionality, which are capable of housing and dispensing certain types, styles, shapes, and sizes of new or used RFID transponders. In at least one embodiment, the magazine or cartridge **42** includes a unique and embedded, RFID transponder which enables automatic interrogation and tracking of cartridge **42**. In certain embodiments, to minimize interference, the cartridge-specific and unique RFID transponder or RFID transponder operates in a frequency band that is different than the supply RFID transponder contained within the protective enclosure. Alternatively, other embodiments selectively interrogate cartridge identification transponders that operate in the same band as transponders within the cartridge that are to be applied.

[0074] Certain encoders require replenishment of the battery or other internal, on-board power source, such as a fuel cell, or other energy storage technology. Accordingly, in some embodiments, an encoder **30** (or encoder **64** or encoder **210** of FIGS. **8** and **10**, respectively) further includes a remote, selectively coupling base unit. The base unit enables a replenishment of magazines or cartridges, provides replaceable power sources, recharges the on-board power source, serves as a communications gateway, and provides a user interface for programming and maintenance of the encoder. For example, spare transponder magazines/cartridges are retained in cartridge pockets where they are protected from damage. Cartridges indicate their empty/full status with a visible indicator such as: an LED, an LCD, a mechanical flag, a window with a view into the source reel, or other such indicators that help an operator choose which cartridge from which to next consume transponders. The encoder, also, is retained by a protective pocket to prevent damage and to make any required electrical or mechanical connections to the base unit. In some embodiments a base unit mounts to diverse operating locations including various models of fork lift trucks. In such applications, the base unit includes a variety of wired and wireless communications options to enable omni directional communication with the encoder, cartridges, a host computer, vehicle mount terminal, a fork truck computer, or other relevant computing devices. The base unit includes a power system that is suitable for the application, including power filtering and energy storage capabilities such as batteries or fuel cells.

[0075] As with all ESD-sensitive equipment, care must be taken to avoid a build-up of damaging electrostatic charges. Accordingly, in certain embodiments charge is removed using a variety of conduction methods including wiping, air, and humidity controls.

[0076] In some embodiments, the encoder adapts to use a particular type of RFID transponder. One type of suitable RFID transponder is model number AD-220 from Avery Dennison of Brea, Calif. or, alternatively, Raflatac model 300846 from Tampere, Finland. Such a transponder is die cut and adhered to release liner. Additionally, wireless sensors are manufactured to specifications that are compat-

ible with the specific encoder, including such specifications as core diameter, outer diameter, and web width. Alternatively, certain steps are required to prepare a standard roll of ALL-9338-02 tags for use in an automated encoder, including unrolling from a large roll (up to about 6-inches in core diameter) onto several smaller rolls having a smaller core diameter (of about 1-inch to about 2-inches in core diameter).

[0077] Encoder **30** communicates with a remote computer and includes options to physically, electrically, and communicatively integrate with a portable data terminal (PDT) or a mobile computing platform. Certain PDT's have a variety of wireless connections including PAN and WLAN. Certain PDT's include a barcode scanner comprising a laser, an imager, or other means. In other suitable PDT's an RFID interrogator and antenna are built-in, while certain others have a card slot manufactured to a standard such as PCMCIA, CompactFlash, or Secure Digital, into which interrogator/antenna is plugged. An example of such a card is the MPR 5000 that plugs into a PCMCIA Type **11** slot and is available from WJ Communications of San Jose, Calif. The MPR 5000 is compatible with handheld computers such as the Hewlett Packard iPAQ5550 or other models that accommodate smaller card-form factors, enabling them to read and write EPCglobal or ISO 18000 compatible UHF RFID transponders.

[0078] Other events, information, and status—such as changes in transponder readiness, transponders remaining on the source roll, remaining charge in the battery, changes in range-status between certain predefined states such as Close, Near, and Far—are communicated to the associated PDT. Other possible information, including certain power management functions, commands, status, and data-to-be-encoded into each readied transponder, is provided to the PDT over a wireless connection. Such a configuration puts the encoder in the role of a peripheral device to the PDT **219**, with PDT **219** managing the primary user interface and most computation functions.

[0079] In some embodiments the encoder adapts to exchange information with a host device, including a PDT, in either a batch-mode or through a real time connection. Batch mode uses a periodically connected data transfer channel such as a wired connection. Certain wired connections include serial data, infrared, optical, Universal Serial Bus, a parallel port, or other physical data connection. Certain real-time connections include wireless data links including Personal Area Network (PAN), Wireless Local Area Network (WLAN), and Wide Area Network (WAN). Certain PAN connections include Bluetooth and Zigbee. Certain suitable WLAN connections include IEEE 802.11a, IEEE 802.11b, and IEEE 802.11g.

[0080] For certain encoder embodiments passwords are encoded into transponders or wireless sensors when they are commissioned. Passwords are safeguarded using cloaking, obfuscation, cryptographic techniques, secure and trusted channels, locked memory, and other methods that are commonly used to protect confidential information. Passwords are generated or retrieved from data encoded in an RFID transponder to generate an index into one or more databases that contain a one dimensional array of passwords, a two dimensional array of passwords, a multidimensional array of passwords, or an array of actual or pointers to algorithms used to generate passwords from transponder data, for example. Alternatively, cryptographic algorithms are used generate passwords from transponder data.

[0081] Although this disclosure makes specific reference to a mobile encoder, it is understood that the encoder can easily adapt and be readily configured to a fixed operating environment. For example, it can be mounted to a forklift truck or a high-speed conveyer line and maintain advantages of wireless communication, rapid change-over and other qualities as discussed and developed more fully in this disclosure.

[0082] D. Interrogator Apparatus

[0083] Working as a stand-alone device, or combined with an encoder, certain embodiments of the present invention include an RFID transponder reader, also called an interrogator. The interrogator, in one embodiment, is a physically separate device that is solely in wireless communication with the encoder. In another embodiment the interrogator includes a wired connection to the encoder. In yet another embodiment, the interrogator connects to the encoder via an intermediate processor, such as a remote computer, or some other intermediate device. In yet another embodiment, the intermediate device is a shared processor in a physically integrated encoder/interrogator apparatus.

[0084] Regardless of the physical configuration of the interrogator, its function is to encode and/or verify a RFID transponder's (including wireless sensors) functionality. Certain embodiments use a mobile handheld reader to verify transponder functionality after carton attachment. Certain handheld readers also read bar codes that either partially or completely specify the data that is to be programmed into a transponder. Accordingly, an optical path from the interrogator to a location for reading bar code labels is used to identify certain information about the objects or containers that are to be tagged. Additional transponder encoding instructions and data is acquired through an integral network interface or a batch mode memory in the interrogator.

[0085] In certain embodiments, a shield structure incorporated in a combined interrogator/encoder prevents RF fields from interrogating or reprogramming RFID transponders yet-to-be-commissioned that are resident in the combined interrogator/encoder device.

[0086] In one embodiment, shown as a cross-sectional schematic in FIG. **8**, a contact image sensor (CIS) **90** or a linear optical array is used to scan along the length of an RFID transponder before it is applied to a container. CIS **90** produces a video stream that is decoded and then interpreted and stored by an on-board Computer **63**. CIS or a similar linear array sensor is capable of reading both linear and two-dimensional bar codes. In certain embodiments, CIS reads two-dimensional bar codes before attachment to inlay or transponder. The on-board computer creates a logical association between bar codes and the commissioned RFID transponder. Encoder **30** reads and associates all bar code symbols on a single segment with the RFID transponder or inlay adhered to it.

[0087] When an operator pulls the trigger **86**, which is either a mechanical trigger or an electro-mechanical device, the on-demand commissioning of the RFID transponder occurs and nearly simultaneously is pressed against a container within a fraction of a second. In certain embodiments,

mechanisms internal to encoder transfer mechanical force to the RFID transponder tag through the use of air, springs, motors, plungers, elastomers, or other energy storing or delivering methods. Reloading of the next tag (next transponder) and readying of the system are performed within a time interval that is acceptable to the operator and enables a high degree of productivity for tagging cartons, pallets, or other transport containers.

[0088] In certain embodiments of a combined interrogator/application, a trigger **86** couples to an electrical switch having one or more stable positions that are detectable by a controller. In certain modes of operation trigger-switch state is coupled with range information from a sensor suite to execute functions at predetermined ranges at predetermined times. The result is a trigger that functions based upon detected range from a container or other object of interest. This advantageously improves operator efficiency and productivity as one trigger executes several different functions that are typically involved with RFID tagging including the tagging of bar-coded cartons that have been selected to receive wireless sensors.

[0089] Verification of bar code occurs either before or after an RFID transponder is commissioned and the tag applied to the container by merely stepping back to at a point where the sweep angle of a laser beam or field of view of an imager can read a bar code label. In certain embodiments ranges shorter than that, but not in Close Proximity, are used for sweeping a radio frequency interrogation signal across the faces of multiple cartons to assure that the correct tags, the correct number of transponders, and the correct data within that transponders were all properly programmed.

[0090] In certain embodiments Close Proximity range is reserved exclusively for programming, applying, and verifying one transponder, all in a single pull of trigger. In other embodiments, the interrogator includes programmable conditions that enable Trigger Events to interact with external devices or nearby equipment. For example, at a predetermined range from the interrogator, activation of the trigger causes the encoder to transmit a coded signal to an external device as an indication of an operator action: at a Far-range the signal to requests an external device to read a bar code and the bar code information is decoded and transmitted back to encoder. In another embodiment, decoded barcode information is processed by a portable data terminal (PDT), a vehicle mount terminal, or other computing device.

[0091] The on-board computer **61** controls the operation of the RFID Interrogator Module **63** to read, write, and verify RFID tags, inlays, transponders, and wireless sensors that are applied or are within range of the interrogation fields produced by antenna **62**. The encoder **30**, capable of reading multiple RFID transponders near it, can, in certain embodiments, produce a linearly polarized radio field via the internal antenna **62**. In another embodiment, the internal antenna produces a horizontally polarized RF field. A commissioned transponder can be read both before and after it is applied to a transport container. When multiple transponders are within the interrogation field of the encoder **30** with an interrogator module **63** the on-board computer **63** determines which transponders are commissioned and dispensed versus those transponder that have not. In certain embodiments, the on-board computer maintains records of transponders recently applied in order to properly determine how to interact with each transponder in the field of the internal antenna or other antennae under the control of RFID Interrogator.

[0092] In one possible embodiment, the interrogator/encoder utilizes preprinted information on a set of RFID transponders. The pre-printed information includes one or more logos, an EPC-global Seal, and other informative alpha-numeric or bar-code data. Certain embodiments have a motorized tape drive and dispensing system. Certain embodiments contain some or all of the following: a rechargeable battery, an operator display, a wireless interface, a network stack, an IP address, a PCMCIA port, a Compact Flash port, a USB cable, a serial cable, a dock port, a window to allow the operator to view the transponder attachment process, or a bar code scanner.

[0093] One suitable interrogator includes model MP9311 available from Sirit Technologies of 1321 Valwood Parkway, Suite 620 Carrollton, Tex. 75006, USA. Other RFID transponder or wireless sensor interrogator modules with other feature sets are also possible for use in the interrogator/encoder.

[0094] FIGS. **8** and **9** show one possible interrogator/encoder **64** according to the present invention. The interrogator **64** comprises a housing having a user input device **67**, such as a key pad or key board, and a user output device, such as an LCD screen, for displaying optically scanned label data, RF interrogated data from a transponder, and other information including on-board diagnostic functions, bios status, and external information provided from a remote computer as sent over a wireless network, for example. A handle structure **66** enables point-of-use deployment while cartridge **42** enables on-demand commissioning of RFID transponders, which are dispensed from the transponder port **46**. In this embodiment, an integrated YAGI antenna **62** creates a large forward-looking main lobe of radio frequency energy for interrogation of commissioned RFID transponders. The internal antenna also produces side lobes of RF energy that although attenuated from the main lobe by several dB, couple enough power into nearby readied transponder to interrogate and write to it.

[0095] As further depicted in FIG. **10**, a reflector **219***b* passively reflects RF signals from an upper side lobe downward toward readied tag **216***f*. Backscatter from tag **216***f* propagates to both antenna **219***a* and reflector **219***b* for processing by the interrogator. Having such an antenna embedded in PDT **219** and mounted to the structure of the encoder housing enables the PDT **219** to encode and verify readied transponder **216***f* while commanding the encoder to commission and dispense a tag when a particular Trigger Event or a predetermined range status change occurs.

[0096] An antenna, or alternatively, a leaky coax or a near-field coupler located outside of the protective enclosure in a location very close to the tag attachment zone in front of tamp head **175** or tag application roller and holding rollers or hammer **216***a*.

[0097] In some embodiments the antenna is a patch antenna with a radiation pattern toward the tag attachment zone. In other embodiments the antenna is a near field coupler. Alternatively, leaky coax, a type of coaxial cable having slits, slots, or perforations that allow radio frequencies to leak in or out, is used in encoders according to the

present invention. A coupled-mode cable, which does not radiate as well as radiating-mode cable, is constructed with closely spaced slots in a corrugated outer conductor. Radiating-mode cable typically has a foil outer conductor with non-uniformly spaced slots arranged in a periodic pattern. Coupled-mode cable is a slow-wave structure. In free space its external fields are closely bound to the cable and do not radiate, except for minor end effects according to "Prediction of Indoor Wireless Coverage by Leaky Coaxial Cable Using Ray Tracing" by Samuel P. Morgan of Bell Laboratories, Lucent Technologies.

[0098] In certain embodiments an interrogator drives a signal into a leaky coax that is terminated in a purely resistive load of about 50 ohms. An RF-switch selects between radiating and non-radiating loads including an antenna or leaky coax and, therefore, avoids mismatched load impedance.

[0099] In other embodiments the internal antenna is a patch antenna with its strongest lobes oriented toward the tag holding and placement area in the region of holding rollers **216***d*. Antenna **212***c* or leaky coax **212***a* work with an interrogator to produce electromagnetic fields to interrogate, program, and verify wireless sensors. Shield **217***e* prevents interrogation or programming of RFID transponders until they arrive at separation roller or tag peel edge **217***d*. A reflector is used in certain embodiments to reflect RF radiation toward a readied transponder. In the event that verification fails, the operator is informed that the bad tag (or inoperable transponder) is to be discharged onto a surface of a third object other than the encoder or the transport container, for post-mortem analysis.

[0100] E. Method of Inlay Conversion

[0101] FIG. **11** shows one method according to the present invention and includes preparing a carrier substrate (Block **111**) for use in an RFID transponder or in a wireless sensor that includes both an RFID transponder and sensor device. This process contemplates utilizing adhesive-backed packing tape or some similar material suitable for adhering a commissioned RFID transponder to a container or other object of interest. Certain embodiments for this step include machines to cut large rolls of mesh or net into numerous small rolls with the desired width, length, and core diameter. For example, a supply-roll of stock mesh or net measures about 14-feet wide and about 5000-feet long, rolled onto a core. In one embodiment the supply-roll must be trimmed to fit the width suitable for use in a mobile encoder **30** or similar encoder/interrogator as described in this disclosure.

[0102] For certain embodiments, the carrier substrate width about the length of a simple UHF dipole inlay, as show, for example, in FIG. **1**. In one embodiment the carrier substrate width measures about 4-inches. The length of the carrier substrate depends on many factors including the target cost per transponder of the cartridge and all of its components. Other factors that determine the length of the carrier substrate include the target size and weight of the cartridge and/or the mobile encoder. A possible machine that converts large supply-rolls into smaller ones, in one embodiment, consists of a stand-alone industrial machine. However, in other embodiments, the trimming function is part of an integrated machine.

[0103] Block **12** represents the testing process of an RFID inlay comprising, at least, an RFID chip and antenna device. The testing, or interrogation, of the inlay, in one embodiment, includes an interrogator and an antenna or a near field coupler, which read the inlay. This process further includes monitoring various parameters such as activation energy, backscatter signal strength, sensor performance, and other indicators of the quality of the RFID transponder or wireless sensor. Any transponder or tag that does not meet certain minimum performance criteria is discarded. Good transponder or tags are subsequently programmed, encoded, or commissioned with new information relating to the associated object of interest. Such information resides or stores in non-volatile memory within the RFID inlay. Inlays that fail to perform to adequate levels of performance are immediately separated from the process.

[0104] Block **113** represents a third process step consisting of applying and encapsulating good inlays in an encapsulation layer or encapsulation zone of the RFID transponder. One possible encapsulation layer comprises a packing tape constructed from pressure sensitive acrylic adhesive and backed by a substrate layer of bi-axially oriented polypropylene film. In certain configurations such packing tapes provide up to about 25,000 volts of ESD resistance when properly applied in about 0.002-inch thick layers of encapsulation. Other packing tapes, available in thicknesses of about 0.001-inches, when combined in layers provide higher ESD voltage resistance ratings. The inlay substrate contributes additional ESD resistance in certain contemplated configurations.

[0105] Block **114** represents another process step consisting of applying the converted RFID transponder to an interposing transport media. Such media preserves the tackiness of the exposed adhesive. One possible adhesive includes a pressure-sensitive adhesives, which adheres to most surfaces with very slight pressure and retains tackiness above their melting point of about negative-65 (−65) to about negative-90 (−90) degrees centigrade. In another embodiment, silicone-based release liner is used to transport and preserve pressure sensitive adhesive tags and labels. In other embodiments, the transport media includes utilizing air pockets bounded by regions having tensile strength such as fibers: For example, plastic or metal fibers. Certain plastic resins have a low surface energy and prevent strong adhesive bonds from forming and are bound together to form a mesh or net. Mesh (or net) constructions offer a means of handling converted tags without allowing a substantial percentage of the available adhesive to make contact with any other solids until the tag is commissioned.

[0106] Block **115** represents another process step consisting of winding converted transponders onto a spool with the interposing transport media. The core diameter, number, of transponders, layer thickness, the thickness of any dielectric foam spacer layer, and outer diameter are all optimized for efficient, economical, and convenient deployment in transponder commissioning processes disclosed herein. Finished spools are packaged in a manner to prevent ESD damage. Certain enclosures include anti-static bags, foil-lined cartons, metal plated cartridges, and carbon-impregnated plastic enclosures. Certain enclosures are reusable. Certain enclosures of application-ready rolls or Z-folded transponders having low energy interposing transport media mate directly with encoders as described in this disclosure.

[0107] F. Method of Tagging Containers

[0108] FIG. **12** is a block diagram representing a second method according to the present invention including applying RFID transponders to objects of interest. One suitable object of interest comprises transport containers such as corrugated cartons or shrink-wrapped cases on a shipping pallet, which is inadequately addressed by the prior-art, particularly for solutions for manually operated automatic encoding and attachment to a container.

[0109] Block **121** represents a process step including the identification and selection of a container to be tagged with an RFID transponder or wireless sensor. In one embodiment this step includes a manual selection and verification processes that consists of manual handling, visual sighting, and scanning bar codes with a hand-held optical reader device. This method contemplates that a transponder encoding scheme is ready in advance and synchronized with a pick list, customer purchase order, advanced shipping notice, and other such records to assure that goods are properly moved and accounted for.

[0110] Block **122** represents another process step of identifying the information to be encoded, and may be included in the step represented by Block **121**. In this step (Block **122**), an operator uses a bar code reader or an encoder/interrogator of this disclosure. Alternatively, the operator may receive instructions delivered to a hand-held PDT or other mobile data terminal connected to a wireless network. This information is delivered to an encoder, such as encoder **30**.

[0111] Block **123** represents another process step whereby, using a mobile encoder, the operator then commissions an RFID transponder with the information of the previous step (Block **122**). Optionally, successful commissioning of the RFID transponder is verified by the encoder. In one embodiment, the encoder tests the next transponder and determines if it is operating within certain predefined specifications including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. If the encoder determines that the transponder is not likely to result in a successful transponder deployment due to either physical or electronic deficiencies or abnormalities, then the operator is informed and the failed or bad transponder is discarded automatically or when an operator pulls a trigger under an operator-acknowledged transponder failure condition.

[0112] This step (Block **123**) also includes processes to read or determine by dead reckoning the information encoded into certain preprinted optically encoded symbols on the outward facing non-adhesive surface of the adhesive tape. In certain embodiments the adhesive tape is printed with information. In other embodiments the printed information is a machine-readable symbol such as a bar-code symbol. For example, one or more machine-readable symbols are read when the tape is prepared for use in an automated encoder or, alternatively, during the inlay conversion process and conveyed to an encoder through other data storage means, such as an RFID transponder. In one embodiment, an information encoding method uses either one-dimensional or two-dimensional bar codes. In some embodiments a linear imager is used to read either linear or two-dimensional bar codes as the tape is being unrolled from a spool. Some encoding schemes preprint machine-readable symbols at regular intervals along the length of a roll of adhesive tape. In certain embodiments the spacing of the preprinted symbols is at an interval of one half of the nominal length of each section of adhesive tape. In certain embodiments, the encoded information is used as a reference to one or more data storage locations. In other embodiments the data storage locations are accessible through a computer network. In some embodiments, the encoded information is a series of sequential numbers. Information relating to data stored in the RFID transponder is stored in data storage locations that are referenced by one or more of the preprinted symbols. In an alternative embodiment more than one type of machine-readable symbols can be read from the surface of a segment of tape. In certain embodiments, more than one machine-readable symbol is used as a reference to the same or closely related data records of information stored in the RFID transponder or inlay, and either can be successfully used to access stored data.

[0113] In some encoders used in this step (Block **123**) a Trigger Event occurs, which results in the verification that a particular commissioned RFID transponder has been tagged and associated with a specific container. This Trigger Event occurs, in certain embodiments, when an operator pulls a trigger on the encoder. In other embodiments the Trigger Event occurs when certain sensors detect preprogrammed conditions relating to the proximity of the encoder face to an object that is to be tagged.

[0114] Finally, (Block **124**) the operator applies the RFID transponder on the container and, thus, commissions the transponder. In certain embodiments, the location of the targeted placement of the RFID transponder or wireless sensor on the container is stored in a database, which is referenced or pointed to by information that is stored in the memory of the encoder. In one embodiment, the operator holds the encoder against the face of the container based on the tagging requirements for that particular container. The tagging requirements including the location and orientation of the RFID transponder to be placed is conveyed visually or aurally. For example, the operator receives visual information via a screen or display on the encoder. In certain embodiments, physical indicators are attached to the encoder and extend from its body in a direction and manner so as to assist the operator in the positioning of the transponder onto the carton. In other embodiments, transponders are applied to the interior of a carton, before it is sealed.

[0115] G. Method of Commissioning RFID Transponders Using a Mobile Applictor.

[0116] FIG. **13** is a block diagram showing a method according to the present invention for commissioning RFID transponders using an encoder, such as the encoder **30**, couples to a cartridge containing a plurality of RFID transporters releaseably mounted on a transport sheet or roll. The encoder enables the roll of RFID transponders to advance one position (Block **131**), placing the Next Tag in a test **1** position. The Next Tag is tested (Block **133**) to ensure that it performs within predetermined parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. One possible method includes encoding a transponder using only a minimal amount of radio-frequency energy. Since transponder encoding requires more energy than read-

ing a transponder, this low power test constitutes a basic test of both minimal activation energy and backscatter signal strength.

[0117] An RFID transponder that fails this test (Block **133**) results in a "Bad Tag" status and proceeds to the take-up reel of the encoder (Block **135**). Thus, any failed transponder remains captive in the cartridge and cannot be released from the encoder by an operator. Optionally, the operator is notified of the failed transponder so the operator can request a newly encoded transponder (Block **137**). However, in one embodiment, the notification step occurs automatically, and a newly encoded next transponder is generated without input from the operator.

[0118] Block **132** shows that a "good" transponder is positioned in the encoder for the encoding process. The RFID transponder that passes the test **1** position is commissioned with predetermined data based on the container to be tagged. Methods of obtaining, storing, encoding, and commissioning this information on the RFID transponder are discussed elsewhere in this disclosure.

[0119] The commissioned transponder undergoes a verification process (Block **134**) to determine if the intended information was successfully encoded on the RFID transponder. Certain embodiments combine the verification step with the encoding step to gain operational efficiencies. If this verification test results in a fail condition, the transponder remains in the encoder and ultimately winds on the take-up reel in the cartridge for subsequent post-mortem failure analysis.

[0120] Block **136** represents a pass condition. The encoder removes the commissioned RFID transponder from the transport web or release liner, enabling the operator to retrieve the transponder from the encoder and apply the transponder to the container. In an alternative embodiment, the operator holds the encoder against a surface of the container and the encoder places the commissioned RFID transponder directly on the container without operator intervention.

[0121] H. Method of Providing RFID Transponders to an Encoder.

[0122] FIG. **14** is a block diagram showing another method according to the present invention. One step, represented by Block **141**, includes providing suitable RFID transponders such as the transponder **50** of FIG. **2**, which are presented on a sheet or roll, such as sheet **59** of FIG. **4**.

[0123] Block **142** shows the process step of inserting the roll of RFID transponders into a cartridge of an encoder such as cartridge **42** of FIG. **5**. Steps **141** and **142** are ideally suited for off-site repairs and replacements of cartridges. Accordingly, a customer may send a used cartridge to a repair facility, enabling the cartridge to be recycled.

[0124] At a point-of-use location, such as a customer's warehouse or packaging facility, a fresh cartridge full of blank, or non-commissioned, RFID transponders attaches to an encoder adapted for such use (Block **143**). And is used normally (Block **144**), as previously described herein, to identify containers and data to encode on an RFID transponder. Prior to encoding, (Block **145**) the encoder verifies that a non-commissioned transponder remains in the cartridge. If such a transponder is available (Block **148**) the RFID transponder is commissioned and applied to the container (Block **149**) by means previously disclosed herein. If the cartridge is empty (Block **146**), the operator is alerted by various known means described herein or otherwise known by those skilled in the art. And, the cartridge is removed (Block **147**). The removed cartridge is sent to a recycling, re-use, repair, or re-building center that is either on or off-site, or is discarded.

[0125] I. Method for Recycling Used Cartridges of RFID Transponders.

[0126] FIG. **15**, a block diagram, shows a method for recycling cartridges from, for example, a process similar to the one shown in FIG. **14**. A repair center receives the used cartridge (Block **151**). In one embodiment, the repair center is off-site from the customer, and allows specialized repair, reconditioning, re-use, recycling, and replenishment to provide cost-effective and environmentally sensible replacement cartridges.

[0127] In certain embodiments, a protective enclosure and RFID transponder recycling center reduces the amount of waste associated with enabling the convenience of tagging and safely handling RFID transponders and devices such as encoders or interrogators. For example, plastics and silicone are non-biodegradable materials that are suitable for recovery, re-use, and recycling. Certain plastic parts are disassembled, hub-cores are recycled for paper waste, and silicon-coated release liner is accumulated and separated from the recyclable (re-pulpable) paper for proper handling, recovery, and disposal—if needed. In such an embodiment, a customer sends the spent protective enclosure, such as the cartridge **42**, to an off-site recycling facility. The spent cartridge is replaced by either a new (virgin) cartridge or a refurbished cartridge, as appropriate and such replacement cartridge is replenished with blank RFID transponders.

[0128] Recycling continues with the RFID transponders as well. In certain embodiments, the RFID transponder **50** is configured and adapted for re-use. Accordingly, the data is wiped and re-coded as appropriate. In other embodiments portions of the RFID transponder are recycled. For example, the aluminum antenna separates from the encapsulation layer and is recycled. The paper stock is recovered and re-pulped.

[0129] In certain embodiments, replenishment of empty cartridges or magazines is performed as a service at a customer's site such as a warehouse, distribution center, packing plant, 3PL logistics center, or a manufacturing plant.

[0130] FIG. **16**, a block diagram, shows another method according to the present invention and consists of an algorithm for determining when an RFID transponder is commissioned based on predetermined criteria. For example, a shipping container typically includes a mixed lot of products. Accordingly, several different product-identifying barcodes are serially scanned (Block **161**) until an end of condition event occurs (Block **162**). This end of condition event may be queried after each scan or provided to an interrogator/encoder based on a supplied heuristic (i.e. volume, weight, etc.), pack list, or other customer-driven data.

[0131] Once all data is compiled and stored on the encoder, an RFID transponder is commissioned and encoded with the data or a logical pointer to a storage location of the

data (Block **163**). Then, it is applied to the container (Block **164**) by means discussed previously herein.

[**0132**] While the invention has been particularly shown and described with reference to certain embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

I claim:

1. An encoder for commissioning RFID transponders, the encoder comprising:

an RFID interrogator module adapted to enable encoding predetermined data according to a commissioning algorithm and communicating with an internal antenna, the antenna being adapted to encode the predetermined data on the RFID transponder;

a memory storage device for storing at least a portion of the predetermined data;

a processing means for controlling and communicating with the memory storage device, the RFID interrogator and the internal antenna;

a means for providing a supply of RFID transponders, the transponders configured for tensile extraction from the encoder; and

a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable encoding of the predetermined data.

2. The encoder of claim 1 further comprising a wireless communication means for wirelessly receiving at least a portion of the predetermined data or the commissioning algorithm, or both.

3. The encoder of claim 1 further comprising an external housing adapted to enclose the internal antenna and further being adapted to receive a protective enclosure, the protective enclosure being adapted to enable tensile extraction of the RFID transponders.

4. The encoder of claim 1 wherein the means for presenting the RFID transponder comprises a motor assembly adapted to pull the RFID transponder from a supply reel.

5. The encoder of claim 4 wherein the supply reel rotatably mounts inside a protective enclosure, the protective enclosure adapted to releasably couple to the encoder, the protective enclosure further comprising a take-up reel wherein both the supply reel and the take-up reel include a drive mechanism that selectively engages the motor assembly.

6. The encoder of claim 4 further comprising a power supply module controlled by the processor and coupled to the motor.

7. The encoder of claim 6 wherein the power supply module comprises a rechargeable battery.

8. The encoder of claim 3 wherein the wireless communication means further comprises an external antenna mounted to the housing.

9. The encoder of claim 1 further comprising a housing assembly for enclosing the internal antenna and a handle-device mounted on a bottom surface of the housing.

10. The encoder of claim 1 further comprising a housing assembly for enclosing the internal antenna and a belt-clip attachment mechanism mounted on a side surface of the housing.

11. The encoder of claim 1 further comprising a housing assembly for enclosing the internal antenna and a mounting mechanism for selectively coupling the encoder to a provided structure.

12. The encoder of claim 1 further comprising means for reading a commissioned RFID transponder.

13. The encoder of claim 12 wherein the means for reading a commissioned RFID transponder comprises the internal antenna.

14. The encoder of claim 1 wherein the commissioning algorithm further comprises an encryption subroutine.

15. The encoder of claim 1 further comprising a user-output device comprising at least one LED light, the LED light adapted to indicate at least one color in response to a predetermined condition and the LED light being controlled by the processor.

16. The encoder of claim 1 further comprising a user-input device comprising at least one switch coupled to the processor whereby activation of the switch enables a predetermined first function to execute.

17. The encoder of claim 1 further comprising a user-output device comprising a LCD panel coupled to the processor and adapted to display a user first-information set.

18. The encoder of claim 1 further comprising an optical reader adapted to read barcodes and transmit data to the processor.

19. The encoder of claim 1 further comprising dispensing means for verifying that the RFID transponder was encoded and for dispensing an encoded RFID transponder and for not dispensing an un-encoded RFID transponder.

20. The encoder of claim 19 wherein the dispensing means further comprises a transponder peel-device for removing the encoded RFID transponder from a transport liner and a transport liner collection mechanism for spooling the transport liner on a take-up reel.

21. A system for enabling on-demand, point-of-use commissioning of RFID transponders to uniquely identify an object, the system comprising:

an RFID transponder comprising a self-adhesive layer adapted to adhere the transponder to the object, a release liner releasably coupled to the self-adhesive layer on a first side, an oppositely spaced self-adhesive layer second side couples to a carrier substrate, the carrier substrate adapted to receive an RFID chip and an antenna device, the antenna device coupling to the RFID chip and the antenna device further adapted to wirelessly send and receive data packets corresponding to an information set;

an RFID transponder encoder device having processing means and memory means, the encoder device being adapted to receive at least one RFID transponder from a first dispensing means, the encoder device further including commissioning means for commissioning the at least one RFID, means for verifying the status of a commissioned transponder, means for selectively removing the release liner and for dispensing the commissioned transponder, and means for selectively capturing an un-dispensed transponder;

an RFID transponder encoding algorithm;

a means for coupling a protective enclosure adapted to contain a supply of the RFID transponders, the tran-

sponders being further adapted for tensile extraction from the protective enclosure; and

a remote computer system adapted to wirelessly communicate with the transponder encoder and adapted to selectively enable the encoder to commission the transponder with data encoded according to the encoding algorithm.

22. The system of claim 21 further comprising an interrogator device adapted to wirelessly read the data set encoded on the RFID transponder.

23. The system of claim 21 further comprising an interrogator device adapted to wirelessly encode a new data set on the RFID transponder.

24. An RFID transponder adapted for use in an RFID encoder, the RFID transponder comprising:

a transport liner substrate layer adapted to selectively peel away from a pressure-sensitive adhesive layer when sufficient tension is provided around a peel-device to enable extraction of the RFID transponder from a protective enclosure; and

an RFID inlay comprising an antenna structure coupled to an RFID chip, the RFID inlay coupled to the adhesive layer.

25. The RFID transponder of claim 24 further comprising an ESD-resistant encapsulation.

26. The RFID transponder of claim 24 further comprising a visual-marking layer for enabling machine or human visual recognition of a bar code or other visual marking scheme.

27. A method for tagging a container comprising:

providing an encoder having at least one RFID transponder;

identifying information to be encoded on the RFID transponder;

commissioning the RFID transponder by encoding the information;

associating the RFID transponder with the container; and

presenting the RFID transponder for attachment to the container by pulling a conveyance web or a release liner with transponder attached thereto around a peel-device to extract transponders from a protective enclosure.

28. A method for commissioning RFID transponders comprising:

providing an RFID transponder encoder having a peel-device;

providing information to the encoder;

providing a protective enclosure containing at least one of the RFID transponders;

mounting the RFID transponder to a conveyance web or release liner;

coupling the protective enclosure to the encoder;

advancing the RFID transponder in the encoder; and

encoding the information on the transponder.

29. The method of claim 28 further comprising:

verifying that the information was encoded to the transponder.

30. The method of claim 29 further comprising:

Dispensing the RFID transponder if the information was properly encoded.

31. The method of claim 28 further comprising:

Storing the RFID transponder if the information was not properly encoded.

32. The method of claim 28 further comprising:

providing the encoder with a motor adapted to provide tension in the conveyance web or release liner in a direction along its major axis.

33. A method for commissioning RFID transponders comprising:

providing a roll or sheet of RFID transponders;

providing a cartridge;

providing an encoder;

inserting the roll or sheet in the cartridge;

coupling the cartridge to the encoder;

identifying information to encode; and

encoding the information on at least one RFID transponder.

34. The method of claim 33 further comprising:

verifying that the roll or sheet of RFID transponders has at least one blank transponder;

alerting an operator of an empty condition; and

de-coupling the cartridge.

35. A method for recycling RFID transponders comprising:

providing a cartridge coupled to an encoder;

de-coupling the cartridge from the encoder;

removing any unused or un-commissioned RFID transponders from the cartridge; and

inserting a new set of blank RFID transponders into the cartridge.

36. A method for recycling protective enclosures adapted to enclose RFID transponders, the method comprising:

providing a protective enclosure coupled to an encoder;

de-coupling the protective enclosure from the encoder; and

removing any conveyance web and unused or un-commissioned RFID transponders from the protective enclosure.

* * * * *

EXHIBIT

3

US007827200B2

(12) **United States Patent**
Rowe et al.

(10) **Patent No.: US 7,827,200 B2**
(45) **Date of Patent: Nov. 2, 2010**

(54) **SOLUTION FOR MANAGING SERIALIZATION OF EPC IDENTIFIERS FOR USE WITH RFID TAGS**

(75) Inventors: **Frederick W. Rowe**, Raleigh, NC (US); **John K. Senegal**, Durham, NC (US)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

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See application file for complete search history.

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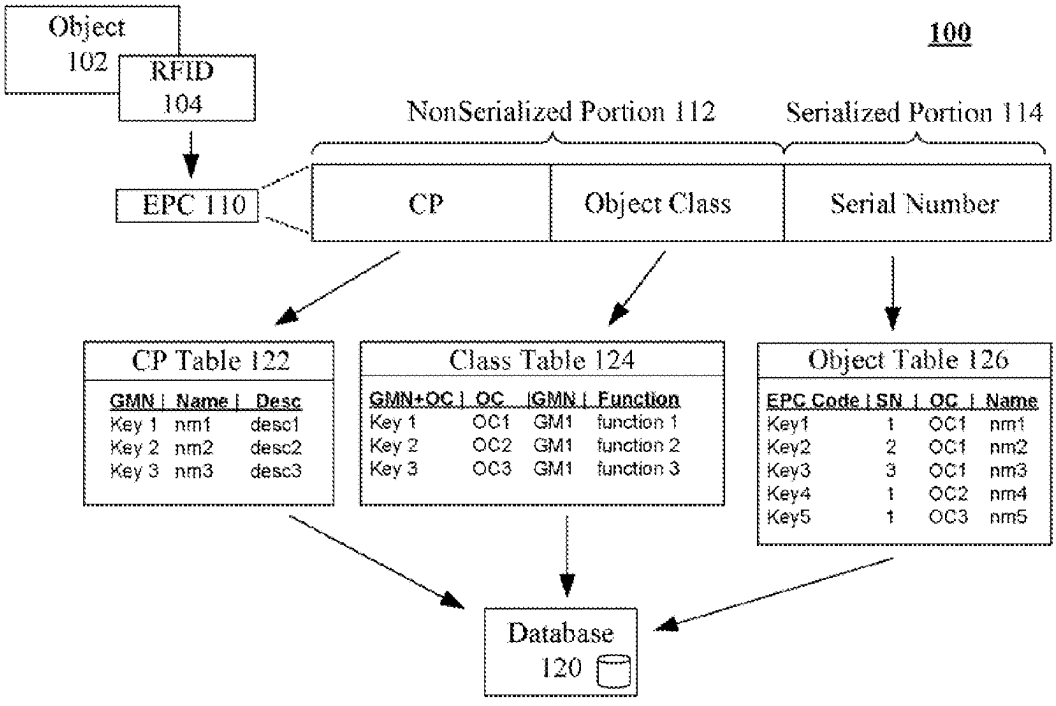
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Primary Examiner—Cheryl Lewis
(74) *Attorney, Agent, or Firm*—Patents On Demand, PA; Brian K. Buchheit

(57) **ABSTRACT**

The present invention includes a method for managing serialization of ELECTRONIC PRODUCT CODES (EPCs). The method can include a step of identifying a software system for managing Tag Data Specification (TDS) compliant EPCs. The software system can include a database containing two or more related tables. A tuple can be included for each unique nonserialized portion of an EPC ID URN. The database can utilize the nonserialized portion to manage a serialized portion of the EPC. In one embodiment, the database can use the nonserialized portion of an EPC to automatically generate the serialized portion of the EPC. Different sets of sequentially increasing (or sequentially decreasing) serial numbers (that are assigned to the associated unique nonserialized portions of the EPCs) can be associated with different nonserialized values.

17 Claims, 2 Drawing Sheets



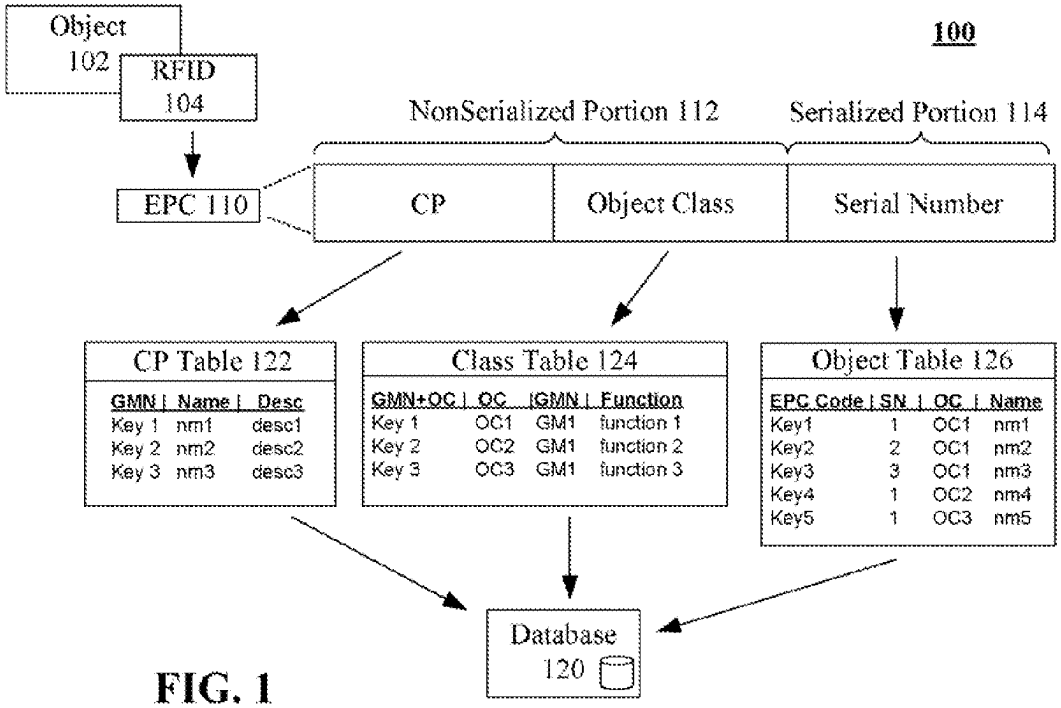

Object
102
RFID
104
100
NonSerialized Portion 112
Serialized Portion 114
EPC 110
CP
Object Class
Serial Number
CP Table 122
GMN | Name | Desc
Key 1 nm1 desc1
Key 2 nm2 desc2
Key 3 nm3 desc3
Class Table 124
GMN+OC | OC | GMN | Function
Key 1 OC1 GM1 function 1
Key 2 OC2 GM1 function 2
Key 3 OC3 GM1 function 3
Object Table 126
EPC Code | SN | OC | Name
Key1 1 OC1 nm1
Key2 2 OC1 nm2
Key3 3 OC1 nm3
Key4 1 OC2 nm4
Key5 1 OC3 nm5
Database
120

FIG. 1

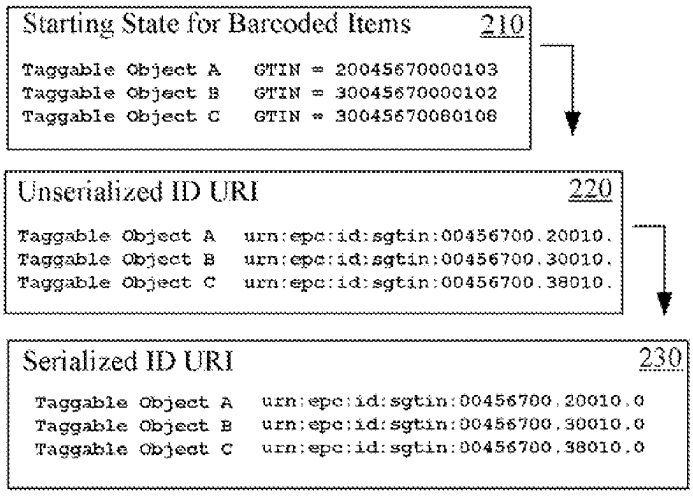

Starting State for Barcoded Items 210
Taggable Object A GTIN = 20045670000103
Taggable Object B GTIN = 30045670000102
Taggable Object C GTIN = 30045670080108
Unserialized ID URI 220
Taggable Object A urn:epc:id:sgtin:00456700.20010.
Taggable Object B urn:epc:id:sgtin:00456700.30010.
Taggable Object C urn:epc:id:sgtin:00456700.38010.
Serialized ID URI 230
Taggable Object A urn:epc:id:sgtin:00456700.20010.0
Taggable Object B urn:epc:id:sgtin:00456700.30010.0
Taggable Object C urn:epc:id:sgtin:00456700.38010.0

FIG. 2

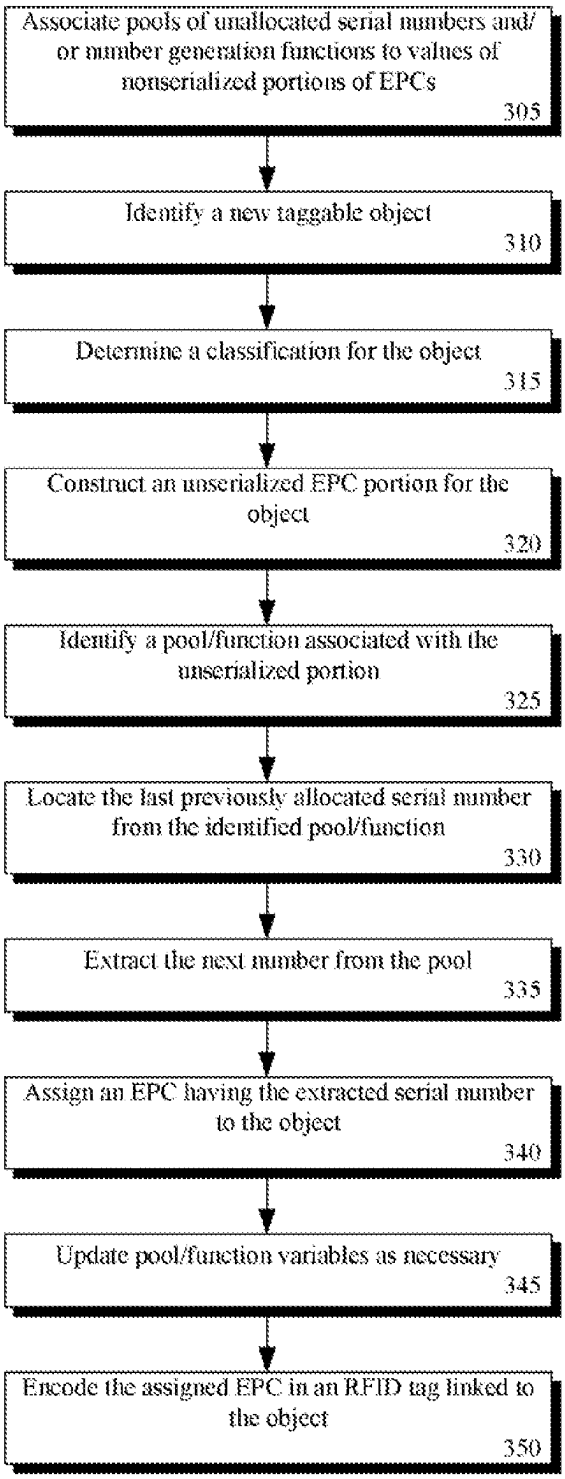

300
Associate pools of unallocated serial numbers and/or number generation functions to values of nonserialized portions of EPCs
305
Identify a new taggable object
310
Determine a classification for the object
315
Construct an unserialized EPC portion for the object
320
Identify a pool/function associated with the unserialized portion
325
Locate the last previously allocated serial number from the identified pool/function
330
Extract the next number from the pool
335
Assign an EPC having the extracted serial number to the object
340
Update pool/function variables as necessary
345
Encode the assigned EPC in an RFID tag linked to the object
350

FIG. 3

SOLUTION FOR MANAGING SERIALIZATION OF EPC IDENTIFIERS FOR USE WITH RFID TAGS

BACKGROUND

1. Field of the Invention

The present invention relates to the field of object identification using RFID tags and, more particularly, to a solution for efficiently managing serialization of EPC identifiers.

2. Description of the Related Art

An ELECTRONIC PRODUCT CODE (EPC) is an identification scheme for universally identifying physical objects via Radio Frequency Identification (RFID) tags and other means. EPC was the creation of the MIT Auto-ID Center that is currently managed by EPCglocal Inc. The EPC scheme is designed to meet the needs of various industries, while guaranteeing uniqueness for all EPC-compliant tags. The format and contents of an EPC-compliant tag are governed by the EPCglobal Tag Data Specification (TDS).

Various retailers including WAL-MART, TARGET, and the US Department of Defense (DoD) are requiring suppliers to tag material with an EPC identifier encoded on an RFID tag in order to increase visibility of goods moving within a supply chain. This requires the generation of an EPC identifier for each case/pallet of goods shipped and potentially (if tagging is required at an item level) the generation of an EPC identifier for each item. Additionally, RFID chips are currently being implanted in pets and in some instances in humans for identification purposes. All of these applications for RFID tags having EPC identifiers can result in a huge number of identifiers that must be generated and/or managed.

To complicate matters, the TDS, a specification managed by EPCglobal, Inc., requires that each EPC identifier includes a serial number that is unique for each tagged object/location/entity or collection thereof. In order to maintain uniqueness, current versions of the TDS require that each assigned serial number can either never be reused or may only be reused after a specified time period so as to prevent potential ambiguities in ascertaining the identity of a tagged item. Further, each unique serial number is only a portion of the entire EPC identifier. It can be difficult to manage the unique serialization of EPC identifiers in addition to other EPC identifier fields. No conventional solution/technology exists to efficiently generate and manage unique serial number portions of EPC identifiers.

SUMMARY OF THE INVENTION

The present invention can be implemented in accordance with numerous aspects consistent with material presented herein. For example, one aspect of the present invention can include a method for managing serialization of ELECTRONIC PRODUCT CODES (EPCs). The method can include a step of identifying a software system for managing Tag Data Specification (TDS) compliant EPCs. The software system can include a database containing two or more related tables. A tuple can be included for each unique nonserialized portion of an EPC Identity Uniform Resource Name (ID URN). The database can utilize the nonserialized portion to manage a serialized portion of the EPC. In one embodiment, the database can use the nonserialized portion of an EPC to automatically generate the serialized portion of the EPC. Different sets of sequentially increasing (or sequentially decreasing) serial numbers (that are assigned to the associated unique nonserialized portions of the EPCs) can be associated with different nonserialized values.

Another aspect of the present invention can include a method for assigning serial numbers for EPCs. The method can include a step of mapping classification values to different serial number generation functions using at least one table of a database. A nonserial value for a nonserialized portion of an EPC ID URN can be determined. The method can also determine that a serialized portion of the EPC is needed. The database can be queried to match the determined nonserial value to one of the classification values. One of the serial number generation functions can be selected based on the query results. The selected function can generate a serial number, which is uniquely generated relative to the selected function. The generated serial number can be used in conjunction with the associated serialized portion of the EPC.

Still another aspect of the present invention can include a database structure including related tables normalized in third normal form. The tables can include an object table and a collection table, where a one-to-many relationship exists between the collection table and the object table. The object table can include an EPC field, which is a candidate key of the object table. A pure identity of a value associated with the EPC field can include a serialized portion and a nonserialized portion. The collection table can include a candidate key having a value equivalent to the nonserialized portion.

It should be noted that various aspects of the invention can be implemented as a program for controlling computing equipment to implement the functions described herein, or a program for enabling computing equipment to perform processes corresponding to the steps disclosed herein. This program may be provided by storing the program in a magnetic disk; an optical disk, a semiconductor memory, or any other recording medium. The program can also be provided as a digitally encoded signal conveyed via a carrier wave. The described program can be a single program or can be implemented as multiple subprograms, each of which interact within a single computing device or interact in a distributed fashion across a network space.

It should also be rioted that the methods detailed herein can also be methods performed at least in part by a service agent and/or a machine manipulated by a service agent in response to a service request.

BRIEF DESCRIPTION OF THE DRAWINGS

There are shown in the drawings, embodiments which are presently preferred, it being understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown.

FIG. **1** is a schematic diagram of a system for managing serialization of Radio Frequency Identification (RFID) ELECTRONIC PRODUCT CODES (EPCs) in accordance with an embodiment of the inventive arrangements disclosed herein.

FIG. **2** shows an example where EPCs are serialized in accordance with an embodiment of the inventive arrangements disclosed herein.

FIG. **3** is a flow chart of a method for serializing EPCs in accordance with an embodiment of the inventive arrangements disclosed herein.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** is a schematic diagram of a system **100** for managing serialization of Radio Frequency Identification (RFID) ELECTRONIC PRODUCT CODES (EPCs) in accordance with an embodiment of the inventive arrangements disclosed herein System **100** shows an object **102** associated with RFID

tag **104**. The RFID tag **104** includes a digitally encoded EPC **110**, which is uniquely assigned to the object **102**.

Object **102** can refer to any "taggable thing," such as a person, animal, place, item, container, or collection. For example, an object **102** can include an item inventoried and/or sold by a retailer, where the RFID tag **104** and encoded EPC **110** can be used on tagged goods instead of a barcode. An object **102** can also include an animate being, such as a pet or livestock. The pet can have an embedded RFID tag **104** or chip inserted to be used to determine ownership in the event of the pet becoming lost. Additionally, the object **102** can be associated with a geographic location, where the RFID tag **104** can be used to permit interoperating electronic devices to function a specific way when proximate to the geographic location. Additionally, the object **102** can be a collection of things, such as a tagged shipping container that can be used to automatically track a status of shipped objects included in the container.

RFID tag **104** is typically a small object that can be attached or incorporated into object **102** that includes a transponder, silicon chips, and/or an antenna. An RFID tag **104** is able to respond to radio frequency queries from an RFID transceiver. RFID tags **104** can store data that is selectively transmitted to authorized RFID transceivers. RFID tags **104** can be passive devices having no internal power supply, can be semi-passive devices having a small internal battery that allows the device to be constantly powered, and/or can be active devices having internal power sources used to power integrated circuits (ICs) that generate outgoing signals.

EPC **110** is an object encoded scheme for object identification created by the MIT Auto-ID Center and currently managed by EPC global, Inc. The EPC **110** is a simple, compact "license plate" or identifier that uniquely identifies an associated object **102**. The EPC is built around a basic hierarchical idea that can be used to express a wide variety of different, existing numbering systems, such as European Article Numbering-Uniform Code Council (EAN-UCC) system keys, Unique Identification (UID) codes, Vehicle Identification Number (VIN), and other numbering systems. The EPC is divided into numbers that identify manufacturer, object type, and serial number. The format and contents of an EEC-compliant tag is governed by the EPCglobal Tag Data Specification (TDS).

Many different types of EPCs **110** exist. These types include a General identifier type, five EAN-UCC types, and a DOD type. The five EAN-UCC types include a Serialized Global Trade Item Number (SGTIN) type, a Serial Shipping Container Code (SSCC) type, a Serialized Global Location Number (SGLN) type, a Global Reusable Asset Identifier (GRAI) type, and a Global Individual Asset Identifier (GIAI) type. Each type has type specific format considerations. The present invention can be utilized with any of type of EPC **110**, but is not limited to the existing types of EPCs. Rather, the present invention can be used to manage serialization of any EPC that is able to be represented in an EPC ID URN format.

Regardless of the EPC type, each EPC **110** has a pure identity that includes a nonserialized portion **112** and a serialized portion **114**. The pure identity is an identity associated with a specific physical or local object **102** independent of any particular encoding vehicle, such as RFID tag **104**, barcode or database field. That is, the pure identity is an abstract name or number used to identity object **102** that consists of the information required to uniquely identify a specific object **102** and nothing more.

The nonserialized portion **112** of the EPC can specify a manufacturer and an object classification of object **102**. Each company or manufacturer can be assigned a unique Company Prefix (CP) or General Manager Number (GMN) by the EPCglobal. The company can then use the assigned CP to define new EPC numbers. Each CP can be recorded in a database table **122**. Another component of the nonserialized portion **112** can include an object classification that must be unique for a given company or CP. Object classification values can be stored in database table **124**.

The serialized portion **114** of EPC **110** can be specifically associated with object **102**. Combining the serialized portion **114** with the nonserialized portion **112** can result in a unique identifier for object **102**. Serialized values can be stored in database table **126**.

Each of the tables **122**, **124**, and **126** can be related tables of database **120**, which can be a relational database. The tables **122-126** can be normalized in third normal form (3NF). A one-to-many relationship can exist between table **122** and table **124** and a one-to-many relationship can exist between table **124** and table **126**. A CP or equivalent identifier can be a candidate key of table **122** and/or can be a foreign key of table **124**.

An object classification or equivalent identifier can be combined with the CP to form a combined key for table **124**. The nonserialized portion **112** can be a candidate key for table **124**. In embodiments where database **120** includes records for a single company (not shown), table **122** can be excluded from database **120** and the object classification can be a candidate key for table **124**.

An object serial number or equivalent identifier, which includes serialized portion **114**, can be combined with a candidate key of table **124** to form a combined key for table **126**. Accordingly, the EPC can be a candidate key of table **126**.

A candidate key can be a key that uniquely identifies rows, also called tuples, in a table. Any candidate key can be used as a table's primary key. Any candidate key that is not used as a primary key is called an alternate key. Hence, a candidate key of a relation (a 3NF relation) is a set of attributes of that relation such that (A) in all instances of the relation no two distinct tuples exist with the same values for these attributes and (B) no proper subset of the candidate key exists for which (A) holds. A combined key, also called a super key, is a set of two or more attributes that combined are a candidate key of a table. A foreign key is a database field of one table that points to a candidate key in a different table.

In database **120** when a new entry is needed for table **126**, the serialized portion **114** of the entry can be automatically generated based upon the nonserialized portion **112**. For example, serialized portions **114** can be sequentially generated from a base number (such as one) by increasing the base number by a fixed increment (such as by one value). The automatic assignment and generation of serial numbers is not limited to a simple increasing one-up generated number, but can utilize any mathematical function or serial number generation function that results in unique numbers. Each mathematical function can in a sense assign unique numbers from a pool of unallocated numbers specific to the nonserialized portion **112**.

That is, serial number generation function can be uniquely generated number for each object classification. In one embodiment, table **124** can have a field for determining which function is associated with which classification. In another embodiment, the function in table **124** can be replaced with one or more generation parameters, such as a parameter indicating a last used serial number for a given classification that are used to automatically generate unique serial numbers on a classification-by-classification basis. While serial numbers generated by different functions can be equivalent, no one function is permitted to assign the same serial number twice

unless that serial number has been expressly decommissioned or the required period for the recycling of the serial number has passed. Therefore, a first serial number generation function can generate a series of serial numbers including 1, 2, 3, 4 . . . 200. A second serial number generation function can generate a series of serial numbers including 0, 2, 4, 6 . . . 200.

In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated. For example, a serial number generation function used by a first division can sequentially assign odd serial numbers, while a different serial number generation function used by a second division can sequentially assign even serial numbers. In another example, a first division can assign serial numbers in the range of one to a million and the second division can assign serial numbers in a range of three to four million. It should be appreciated that the different divisions can be communicatively linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification.

FIG. **2** shows an example where EPCs are serialized in accordance with an embodiment of the inventive arrangements disclosed herein. Specifically, FIG. **2** shows how EPCs are generated for three taggable objects. Objects A, B, and C.

Initially, these objects can be barcoded using a Universal Product Code (UPC). UPC codes use Global Trade Item Numbers (GTINs). State **210** shows a starting state for barcoded items, where Object A has an associated GTIN of 20045670000103; Object B has a GTIN of 30045670000102, and Object C has a GTIN of 30045670080108.

State **220** shows values for unserialized identity Uniform Resource Identifiers (URIs) for an EPC. An identity URI is one expression, format, or representation for a pure identity. The TDS specification details a manner to convert GTINs into identity URIs. Specifically the TDS specifies:

Object A	urn:epc:id:sgtin:00456700.20010.nnnnn
Object B	urn:epc:id:sgtin:00456700.30010.nnnnn
Object C	urn:epc:id:sgtin:00456700.38010.nnnnn

where nnnnn represents a serial number to be generated by any entity possessing an EPCglobal, Inc. approved unique identifier and producing taggable objects. The unserialized ID URIs for each of the objects is the URI excluding the serialized portion; which for Object A is "urn:epc:id:sgtin: 00456700.20010.", for Object B is "urn:epc:id:sgtin: 00456700.300.10." and for Object C is "urn:epc:id:sgtin: 00456700.3 8010."

It should be noted that it would be obvious and trivial to assign a serial number from a single pool to all taggables for a given company. If assignments were performed in this fashion, identity URIs for Objects A, B, and C, would be as follows (serializing from zero in increments of one).

Object A	urn:epc:id:sgtin:00456700.20010.0
Object B	urn:epc:id:sgtin:00456700.30010.1
Object C	urn:epc:id:sgtin:00456700.38010.2

If size of a serial number was not an issue, this simple serial assignment system could function for a company. Unfortunately, size of a serial number is limited because of physical memory constraints of an RFID tag. Therefore it is important to manage serial numbers on products in a manner that avoids exhausting all available numbers. For example, a 64-bit RFID tag that uses the above simple assignment methodology would provide two to the twenty fifth power or 33,554,432 potential serial numbers based on the number of bits (25) allocated to the serial number portion of a SGTIN identity URI. If the company annually ships twenty million units of taggable items a year, the available pool of serial numbers for URIs would be exhausted in under a year and a half.

For this reason, the present invention teaches that a serialized portion of EPCs are to be managed and allocated on a classification-by-classification basis, where each classification is based upon the unserialized portion of the EPC.

As shown in stage **230**, a serialized identity URI automatically assigned to Object A is "urn:epc:id:sgtin: 00456700.20010.0", the identity URI for Object B is "urn: epc:id:sgtin:00456700.30010.0", and the identity URI for Object C is "urn:epc:id:sgtin:00456700.38010.0." Consequently, each classification of goods can have 33,554,432 potential serial numbers assuming 64-bit RFID tags are used as described above.

Accordingly, serialized portions of EPCs can be automatically assigned based upon a taggable classification defined by a particular EPC type. The nonserialized portion of the EPC remains constant for a given taggable class. The uniqueness of the unserialized ID URI allows for lifecycle management techniques to be applied to EPCs. For example, previously assigned serial numbers can be deleted, deallocated, or unassigned once they are no longer needed. Deallocated serial numbers can be re-assigned to new objects as needed. Another lifecycle management technique can allow for blocks of serial numbers to be generated and handed out at once, which can be a significant advantage for many supply chain processes.

FIG. **3** is a flow chart of a method **300** for serializing EPCs in accordance with an embodiment of the inventive arrangements disclosed herein. Method **300** can begin in step **305**, where multiple pools of numbers and/or number assignment functions can be associated with values for nonserialized portions of EPCs. In step **310**, a new taggable object can be identified that needs an EPC. In step **315**, a classification for the new object can be determined. In step **320**, an unserialized portion of the EPC can be constructed from the classification information, in step **325**, a pool of numbers and/or a number assignment function associated with the unserialized portion can be identified. In step **330**, a last previously allocated serial number in the identified pool can be located. In step **335**, the next unallocated serial number can be extracted from the pool and used as the serialized portion of the EPC. In step **340**, the new EPC can be assigned to the new taggable object. In step **345**, variables associated with the pool or function used to generate the assigned number can be updated to ensure that the assigned serial number is not reassigned to a different object having the same unserialized portion of an EPC. In step **350**, the assigned EPC can be encoded into an RFID tag that can be physically linked to the object.

The present invention may be realized in hardware, software, or a combination of hardware and software. The present invention may be realized in a centralized fashion in one computer system or in a distributed fashion where different elements are spread across several interconnected computer systems. Any kind of computer system or other apparatus adapted for carrying out the methods described herein is suited. A typical combination of hardware and software may be a general purpose computer system with a computer pro-

gram that, when being loaded and executed, controls the computer system such that it carries out the methods described herein.

The present invention also may be embedded in a computer program product, which comprises all the features enabling the implementation of the methods described herein, and which when loaded in a computer system is able to carry out these methods. Computer program in the present context means any expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following: a) conversion to another language, code or notation; b) reproduction in a different material form.

This invention may be embodied in other forms without departing from the spirit or essential attributes thereof. Accordingly, reference should be made to the following claims, rather than to the foregoing specification, as indicating the scope of the invention.

What is claimed is:

1. A method for managing serialization of ELECTRONIC PRODUCT CODES (EPCs) comprising:

identifying a software system for managing Tag Data Specification (TDS) compliant EPCs, said software system having a database containing a plurality of related tables;

including a tuple for each of the EPCs within one of the tables;

for each tuple, determining a nonserialized portion of an EPC associated with the tuple; and

the database utilizing the nonserialized portion to manage a serialized portion of the EPC, wherein each of the EPCs is formatted as a Uniform Resource Name (URN), and wherein the nonserialized portion is a portion of the URN exempting the serial number portion of the URN.

2. The method of claim **1**, further comprising:

digitally encoding the EPC into a Radio Frequency Identification (RFID) tag; and

using the RFID tag to uniquely identify an object to which the RFID tag is physically linked.

3. The method of claim **1**, further comprising the step of:

the database utilizing the nonserialized portion to automatically generate the serialized portion of the EPC.

4. The method of claim **3**, wherein different generation functions are used by the database, which are selected based upon a value of the nonserialized portion.

5. The method of claim **1**, wherein the nonserialized portion is a candidate key for another one of the tables.

6. The method of claim **1**, wherein the plurality of related tables are in third normal form.

7. The method of claim **1**, wherein each of the tuples includes a field for the nonserialized portion, which is used as a foreign key.

8. The method of claim **1**, wherein each of the tuples includes a field for the nonserialized portion and a field for a serialized portion that together are a compound key.

9. The method of claim **1**, further comprising:

establishing a plurality of pools of unassigned serial numbers;

selecting one of the pools based upon the nonserialized portion; and

automatically assigning a value from the selected pool for the serial portion.

10. The method of claim **1**, further comprising:

establishing a plurality of mathematical functions, each function including an ordered set of unique numbers;

mapping different values for nonserialized portions of the EPC to different ones of the mathematical functions;

based upon the nonserialized portion, selecting a mapped one of the mathematical functions;

utilizing the selected mathematical function to automatically generate the serial portion; and

increasing a parameter associated with the selected mathematical function to ensure the function will not regenerate the generated serialized portion in the future.

11. The method of claim **1**, wherein said steps of claim **1** are steps performed by at least one machine in accordance with at least one computer program having a plurality of code sections that are executable by the at least one machine.

12. A method for assigning serial numbers for ELECTRONIC PRODUCT CODES (EPCs) comprising:

mapping a plurality of classification values to different serial number generation functions using at least one table of a database;

determining a nonserial value for a nonserialized portion of an EPC, wherein a serialized portion of the EPC is needed;

querying the database to match the determined nonserial value to one of the classification values;

using results from the querying step to automatically select an associated one of the serial number generation functions;

using the selected serial number generation function to generate a serial number, wherein the generated serial number is uniquely generated relative to the selected serial number generation function;

using the generated serial number as a serialized portion of the EPC, and

utilizing the database to manage the EPC and a plurality of other EPCs, wherein EPCs are stored in a database table having a field for the nonserial value, wherein the field is a foreign key linking the database table to a different database table, and wherein the tables of the database are in third normal form.

13. The method of claim **12**, further comprising:

digitally encoding the EPC into a Radio Frequency Identification (RFID) tag; and

using the RFID tag to uniquely identify an object to which the RFID tag is physically linked.

14. A database structure comprising:

a plurality of related tables normalized in third normal form, said tables including an object table and a collection table;

the object table comprising an ELECTRONIC PRODUCT CODE (EPC) field, which is a candidate key of the object table, wherein a pure identity of a value associated with the EPC field comprises a serialized portion and a nonserialized portion; and

the collection table comprising a candidate key having a value equivalent to the nonserialized portion, said object table comprising a collection field having a value equivalent to the nonserialized portion, wherein the collection field is a foreign key relating the object table to the collection table.

15. The database of claim **14**, wherein the value in the EPC field is automatically generated for the object table by concatenating the candidate key and an automatically generated serial number.

16. The database of claim **15**, further comprising:

a plurality of different serial number generation functions, each function mapped to a particular value of the nonserialized portion, wherein the database uses a value of the nonserialized portion to determine which of the

serial number generation functions is used to generate the automatically generated serial number.

17. The database of claim **15**, wherein the automatically generated EPC value is digitally encoded into a Radio Frequency Identification (RFID) tag and is used to uniquely identify an object to which the RFID tag is physically linked.

* * * * *

EXHIBIT

4

US008373545B2

(12) **United States Patent**
Traub et al.

(10) **Patent No.: US 8,373,545 B2**
(45) **Date of Patent: Feb. 12, 2013**

(54) **EPC PROVISIONING SYSTEM USING BUSINESS RULES**

(75) Inventors: **Kenneth R. Traub**, Lexington, MA (US); **Manju James**, Lexington, MA (US); **Marina Yurievna Popova**, Arlington, MA (US)

(73) Assignee: **Oracle International Corporation**, Redwood Shores, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 924 days.

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(51) **Int. Cl.**
H04Q 5/22 (2006.01)

(52) **U.S. Cl.** **340/10.5**; 340/572.1; 235/375

(58) **Field of Classification Search** 340/10.5, 340/825, 10.1, 1.1

See application file for complete search history.

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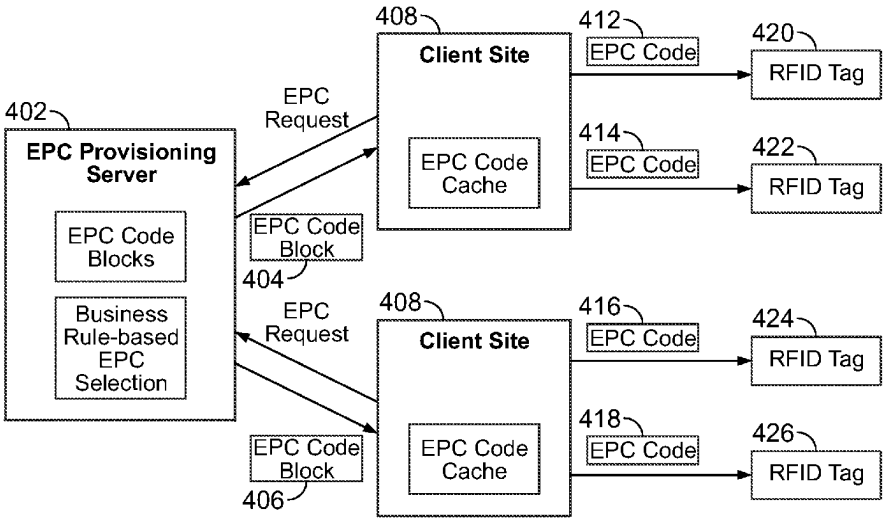
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Primary Examiner — Brian Zimmerman
Assistant Examiner — Sara Samson
(74) *Attorney, Agent, or Firm* — Fliesler Meyer LLP

(57) **ABSTRACT**

An EPC provisioning system comprising a EPC server can dynamically provide EPC code blocks for one product to multiple client sites. The EPC server can use business rules to determine the EPC codes for the multiple client sites.

20 Claims, 60 Drawing Sheets



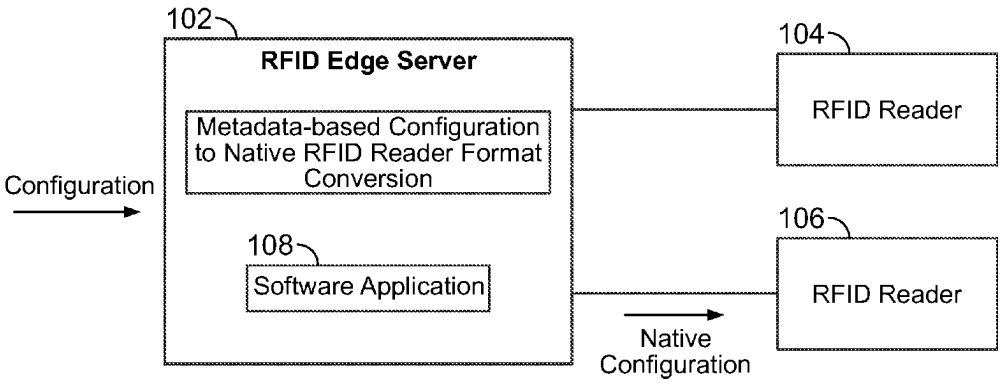


FIG. 1

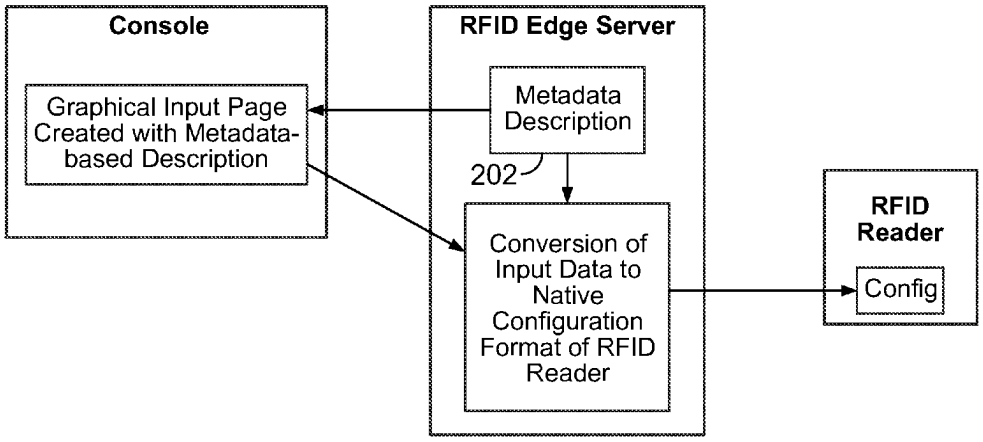


FIG. 2

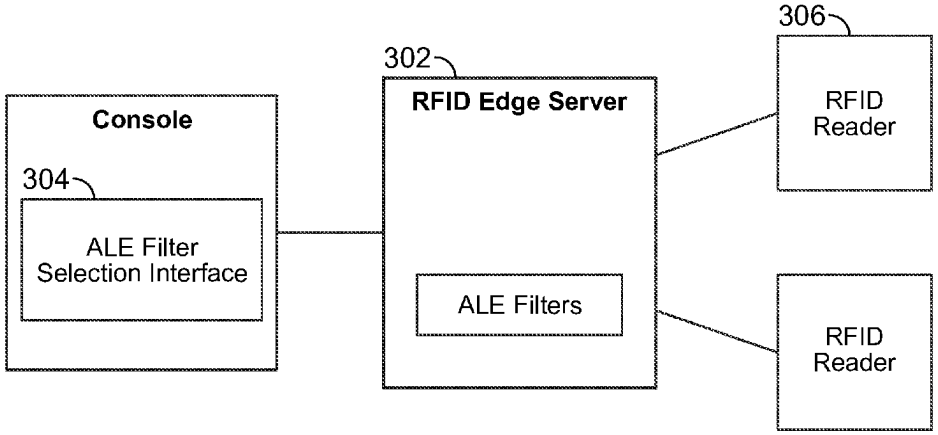


FIG. 3

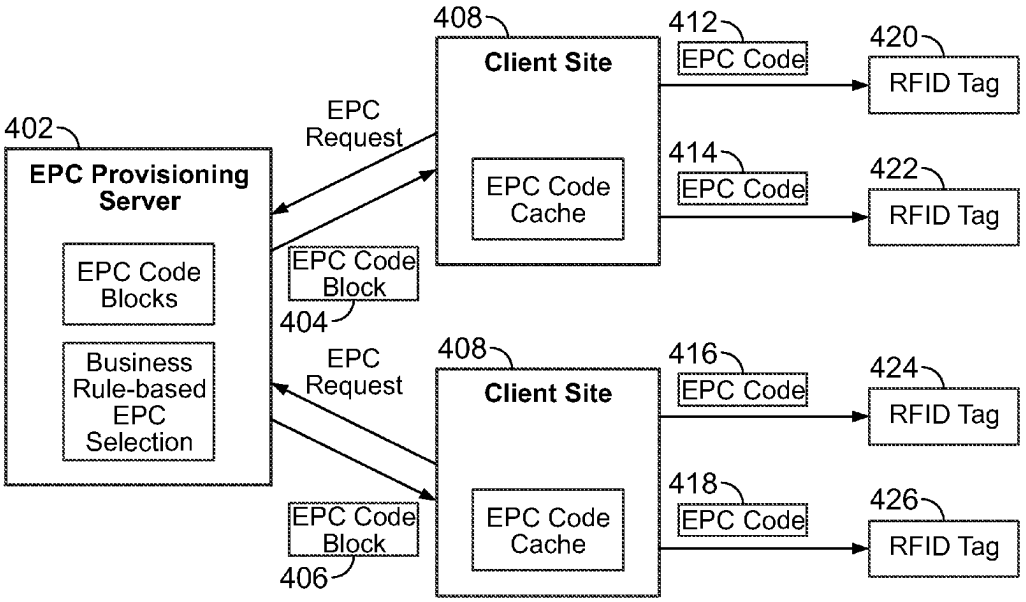


FIG. 4A

header	company	product id	serial number		
header	company	product id	loc	lot #	serial #
header	company	product id	loc	serial #	
header	company	product id	lot #	serial #	

FIG. 4B

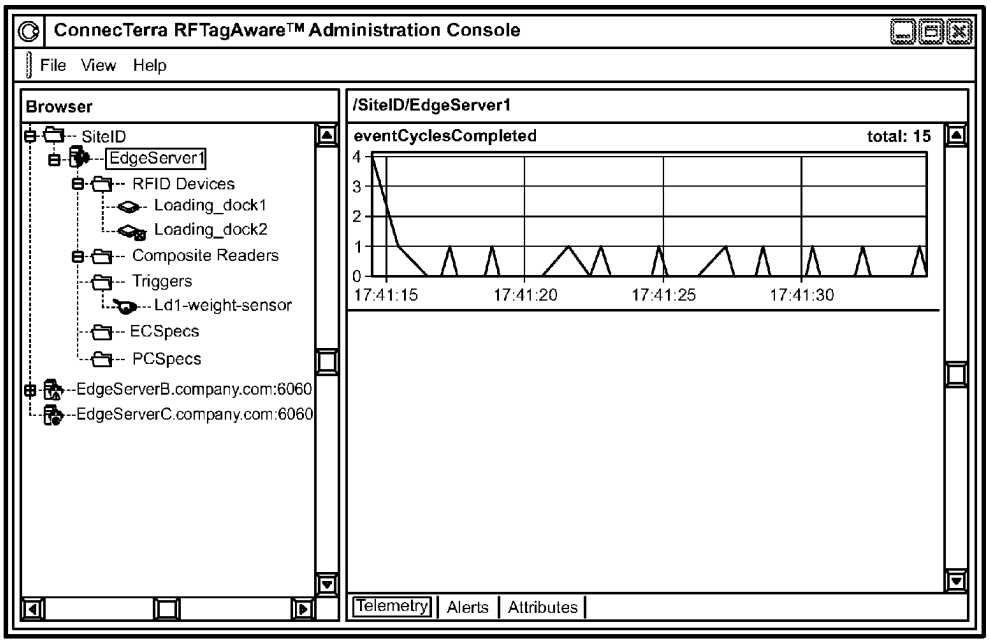

ConnecTerra RFTagAware™ Administration Console
File View Help
Browser
SiteID
EdgeServer1
RFID Devices
Loading_dock1
Loading_dock2
Composite Readers
Triggers
Ld1-weight-sensor
ECSpecs
PCSpecs
EdgeServerB.company.com:6060
EdgeServerC.company.com:6060
/SiteID/EdgeServer1
eventCyclesCompleted
total: 15
4
3
2
1
0
17:41:15
17:41:20
17:41:25
17:41:30
Telemetry
Alerts
Attributes

FIG. 5A

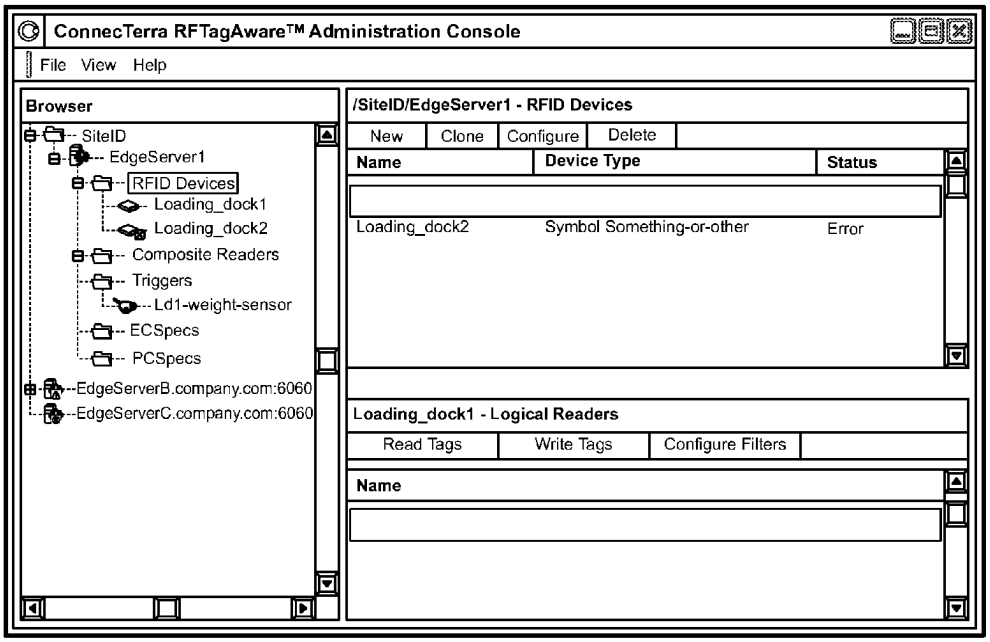

ConnecTerra RFTagAware™ Administration Console
File View Help
Browser
SiteID
EdgeServer1
RFID Devices
Loading_dock1
Loading_dock2
Composite Readers
Triggers
Ld1-weight-sensor
ECSpecs
PCSpecs
EdgeServerB.company.com:6060
EdgeServerC.company.com:6060
/SiteID/EdgeServer1 - RFID Devices
New
Clone
Configure
Delete
Name
Device Type
Status
Loading_dock2
Symbol Something-or-other
Error
Loading_dock1 - Logical Readers
Read Tags
Write Tags
Configure Filters
Name

FIG. 5B

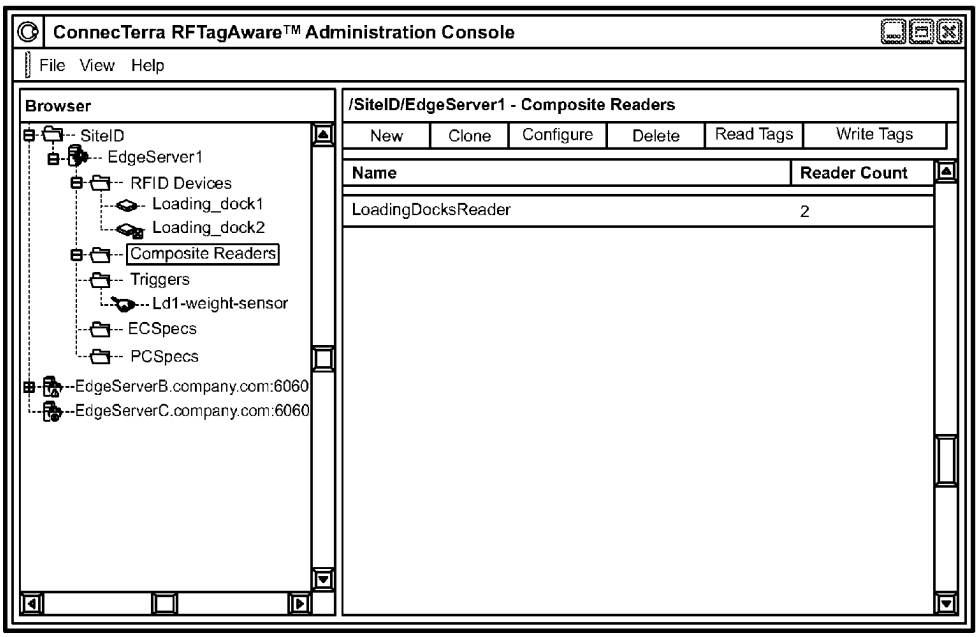

ConnecTerra RFTagAware™ Administration Console
File View Help
Browser
SiteID
EdgeServer1
RFID Devices
Loading_dock1
Loading_dock2
Composite Readers
Triggers
Ld1-weight-sensor
ECSpecs
PCSpecs
EdgeServerB.company.com:6060
EdgeServerC.company.com:6060
/SiteID/EdgeServer1 - Composite Readers
New
Clone
Configure
Delete
Read Tags
Write Tags
Name
Reader Count
LoadingDocksReader
2

FIG. 5C

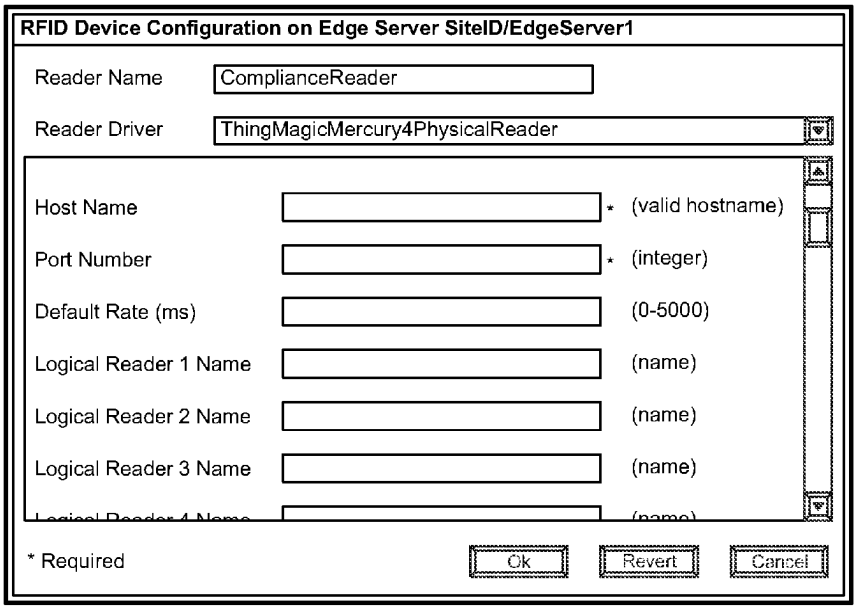

RFID Device Configuration on Edge Server SiteID/EdgeServer1
Reader Name
ComplianceReader
Reader Driver
ThingMagicMercury4PhysicalReader
Host Name
(valid hostname)
Port Number
(integer)
Default Rate (ms)
(0-5000)
Logical Reader 1 Name
(name)
Logical Reader 2 Name
(name)
Logical Reader 3 Name
(name)
* Required
Ok
Revert
Cancel

FIG. 5D

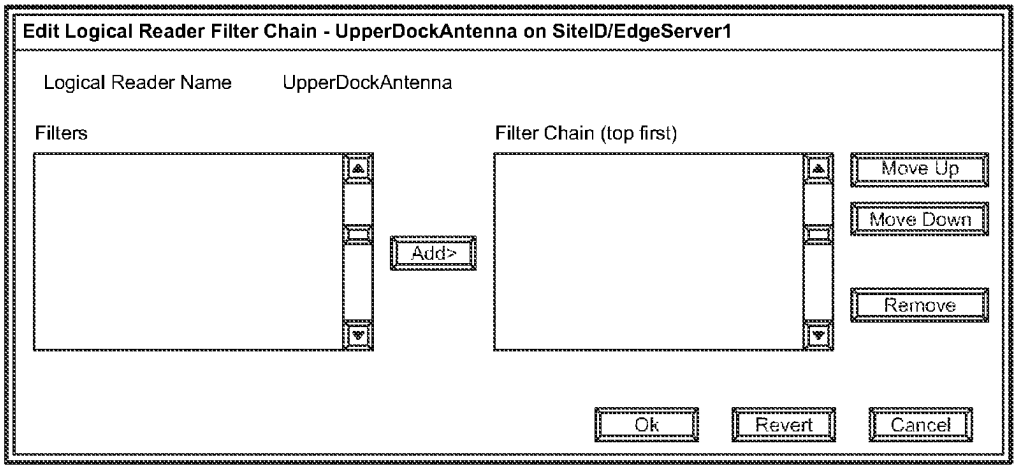

Edit Logical Reader Filter Chain - UpperDockAntenna on SiteID/EdgeServer1
Logical Reader Name
UpperDockAntenna
Filters
Filter Chain (top first)
Add>
Move Up
Move Down
Remove
Ok
Revert
Cancel

FIG. 5E

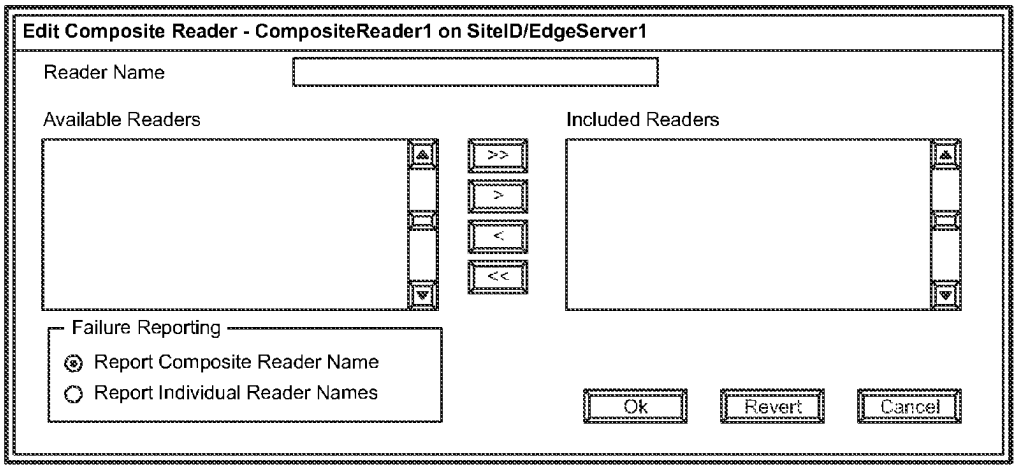

Edit Composite Reader - CompositeReader1 on SiteID/EdgeServer1
Reader Name
Available Readers
Included Readers
>>
>
<
<<
Failure Reporting
Report Composite Reader Name
Report Individual Reader Names
Ok
Revert
Cancel

FIG. 5F

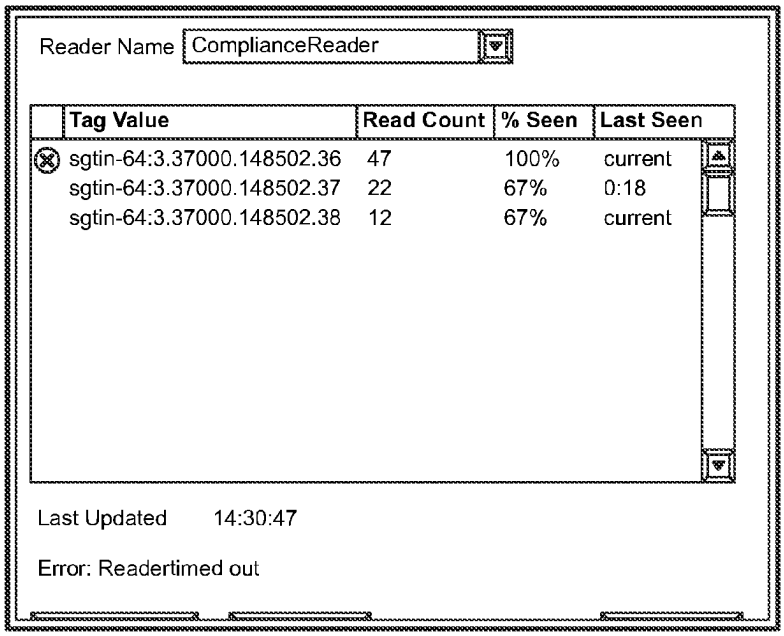

Reader Name ComplianceReader
Tag Value
Read Count
% Seen
Last Seen
sgtin-64:3.37000.148502.36 47 100% current
sgtin-64:3.37000.148502.37 22 67% 0:18
sgtin-64:3.37000.148502.38 12 67% current
Last Updated 14:30:47
Error: Readertimed out

FIG. 5G

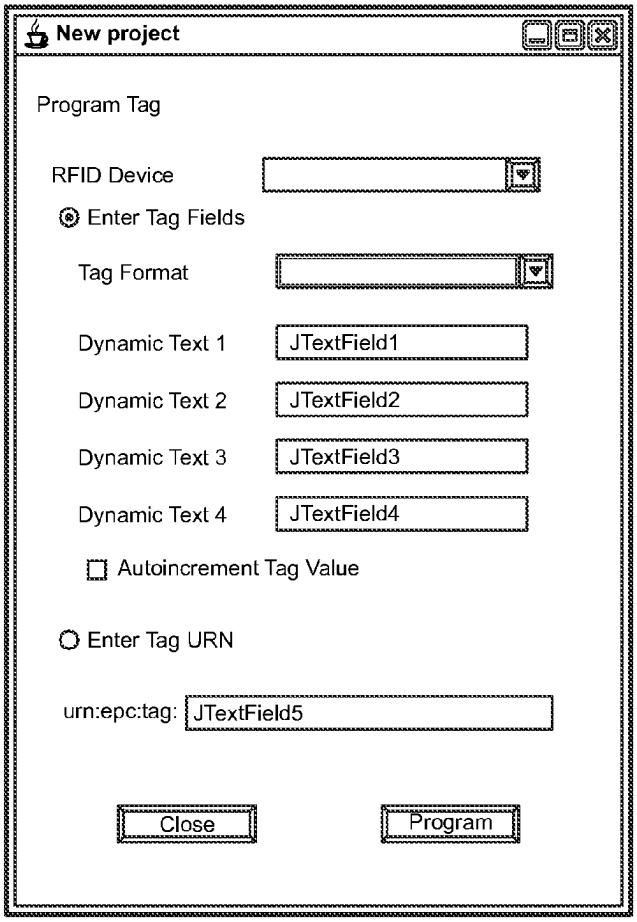

New project
Program Tag
RFID Device
Enter Tag Fields
Tag Format
Dynamic Text 1
JTextField1
Dynamic Text 2
JTextField2
Dynamic Text 3
JTextField3
Dynamic Text 4
JTextField4
Autoincrement Tag Value
Enter Tag URN
urn:epc:tag:
JTextField5
Close
Program

FIG. 5H

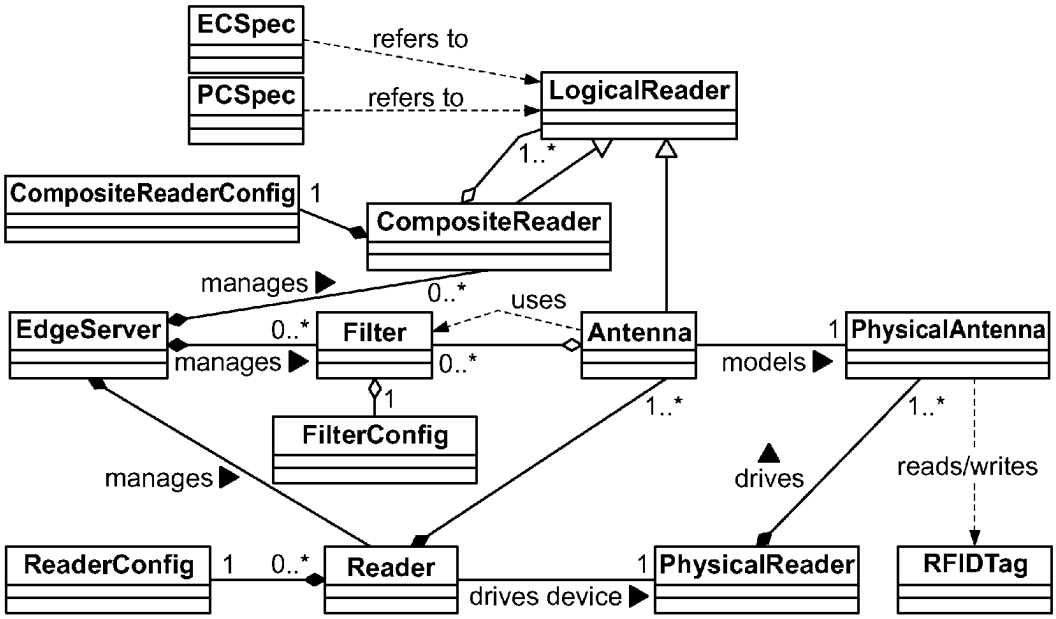

ECSpec
refers to
PCSpec
refers to
LogicalReader
1..*
CompositeReaderConfig
1
CompositeReader
manages
0..*
uses
EdgeServer
0..*
Filter
Antenna
1
PhysicalAntenna
manages
0..*
models
1
1..*
1..*
FilterConfig
manages
drives
reads/writes
ReaderConfig
1
0..*
Reader
1
PhysicalReader
RFIDTag
drives device

FIG. 6A

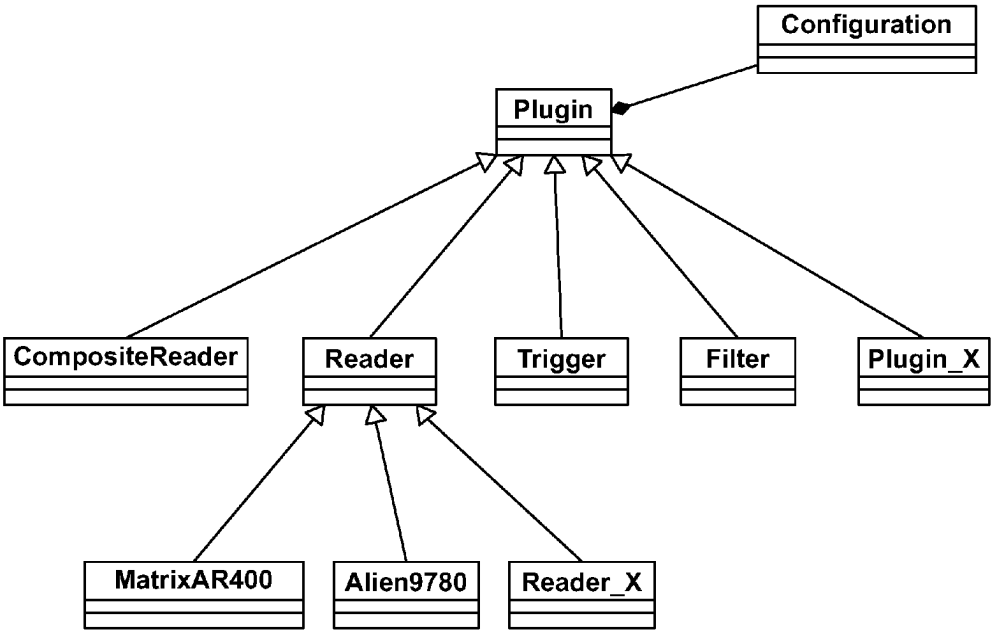

Configuration
Plugin
CompositeReader
Reader
Trigger
Filter
Plugin_X
MatrixAR400
Alien9780
Reader_X

FIG. 6B

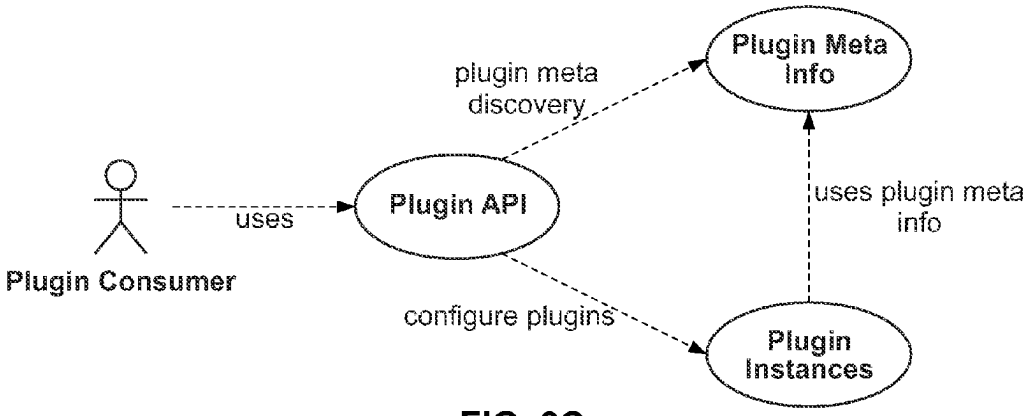

Plugin Meta Info
plugin meta discovery
Plugin API
uses
Plugin Consumer
uses plugin meta info
configure plugins
Plugin Instances

FIG. 6C

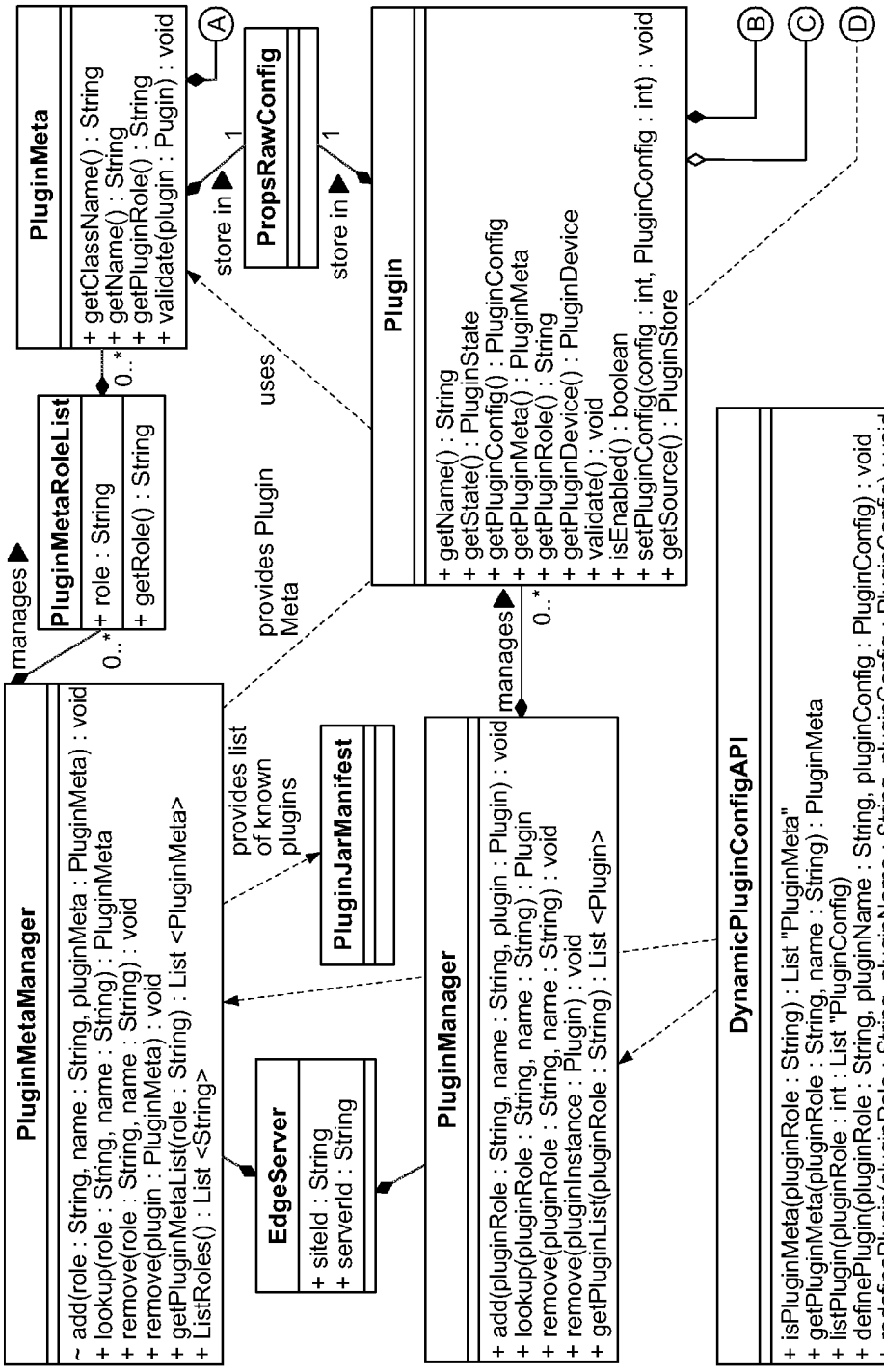

PluginMeta
+ getClassName() : String
+ getName() : String
+ getPluginRole() : String
+ validate(plugin : Plugin) : void
A
store in
1
PropsRawConfig
store in
1
PluginMetaRoleList
+ role : String
+ getRole() : String
0..*
0..*
manages
uses
provides Plugin Meta
Plugin
+ getName() : String
+ getState() : PluginState
+ getPluginConfig() : PluginConfig
+ getPluginMeta() : PluginMeta
+ getPluginRole() : String
+ getPluginDevice() : PluginDevice
+ validate() : void
+ isEnabled() : boolean
+ setPluginConfig(config : int, PluginConfig : int) : void
+ getSource() : PluginStore
B
C
D
PluginMetaManager
~ add(role : String, name : String, pluginMeta : PluginMeta) : void
+ lookup(role : String, name : String) : PluginMeta
+ remove(role : String, name : String) : void
+ remove(plugin : PluginMeta) : void
+ getPluginMetaList(role : String) : List <PluginMeta>
+ ListRoles() : List <String>
provides list of known plugins
PluginJarManifest
manages
0..*
EdgeServer
+ siteId : String
+ serverId : String
PluginManager
+ add(pluginRole : String, name : String, plugin : Plugin) : void
+ lookup(pluginRole : String, name : String) : Plugin
+ remove(pluginRole : String, name : String) : void
+ remove(pluginInstance : Plugin) : void
+ getPluginList(pluginRole : String) : List <Plugin>
DynamicPluginConfigAPI
+ isPluginMeta(pluginRole : String) : List "PluginMeta"
+ getPluginMeta(pluginRole : String, name : String) : PluginMeta
+ listPlugin(pluginRole : int : List "PluginConfig)
+ definePlugin(pluginRole : String, pluginName : String, pluginConfig : PluginConfig) : void
+ redefinePlugin(pluginRole : String, pluginName : String, pluginConfig : PluginConfig) : void
+ undefinePlugin(pluginRole : String, pluginName : String) : void
+ getPlugin(pluginRole : String, pluginName : String) : PluginConfig
+ listRoles(): List "String"

FIG. 6D-1

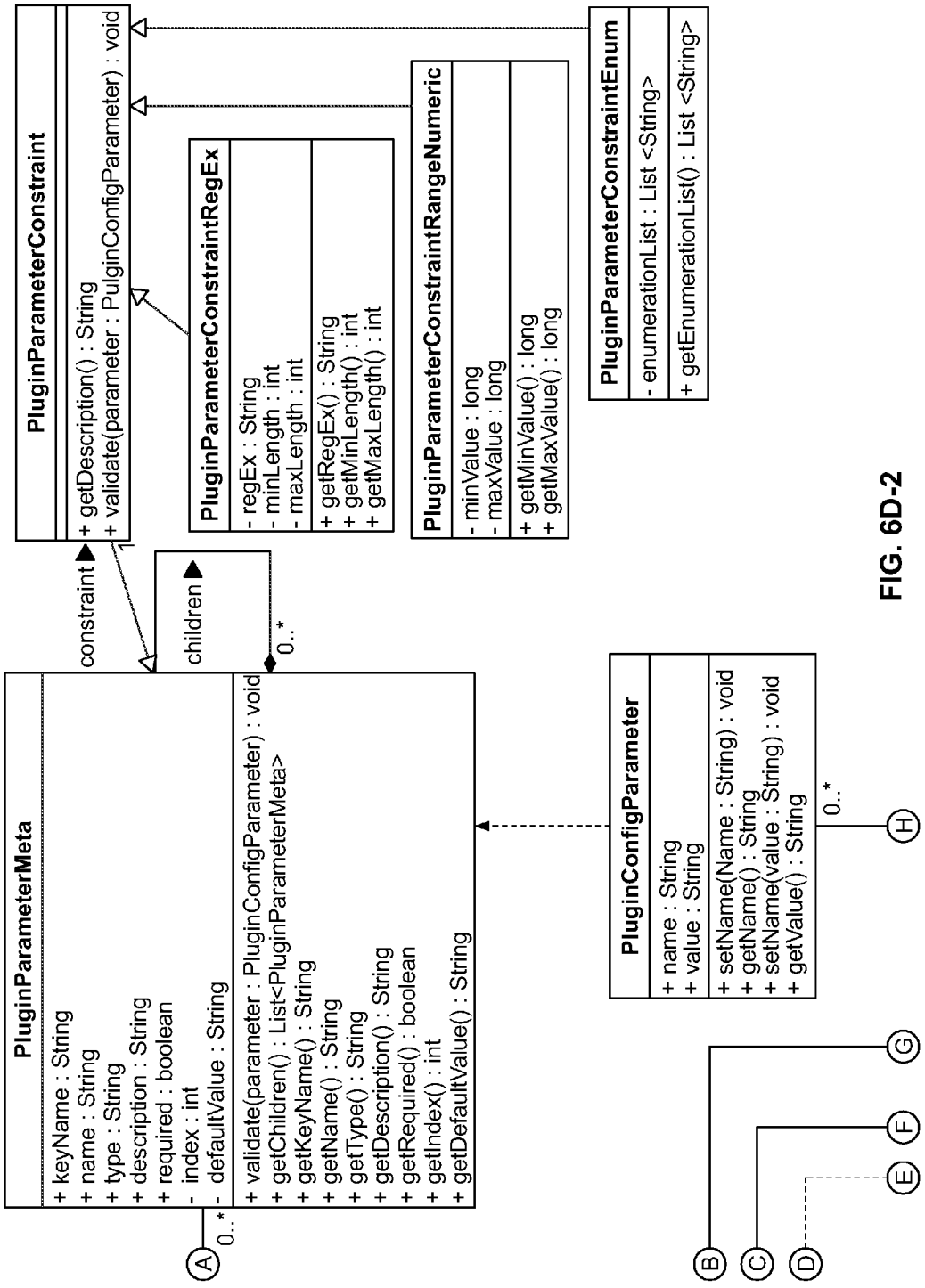

PluginParameterConstraint
+ getDescription() : String
+ validate(parameter : PulginConfigParameter) : void
PluginParameterConstraintRegEx
- regEx : String
- minLength : int
- maxLength : int
+ getRegEx() : String
+ getMinLength() : int
+ getMaxLength() : int
PluginParameterConstraintRangeNumeric
- minValue : long
- maxValue : long
+ getMinValue() : long
+ getMaxValue() : long
PluginParameterConstraintEnum
- enumerationList : List <String>
+ getEnumerationList() : List <String>
constraint
1
children
0..*
PluginParameterMeta
+ keyName : String
+ name : String
+ type : String
+ description : String
+ required : boolean
- index : int
- defaultValue : String
+ validate(parameter : PluginConfigParameter) : void
+ getChildren() : List<PluginParameterMeta>
+ getKeyName() : String
+ getName() : String
+ getType() : String
+ getDescription() : String
+ getRequired() : boolean
+ getIndex() : int
+ getDefaultValue() : String
PluginConfigParameter
+ name : String
+ value : String
+ setName(Name : String) : void
+ getName() : String
+ setName(value : String) : void
+ getValue() : String
0..*
A
B
C
D
E
F
G
H

FIG. 6D-2

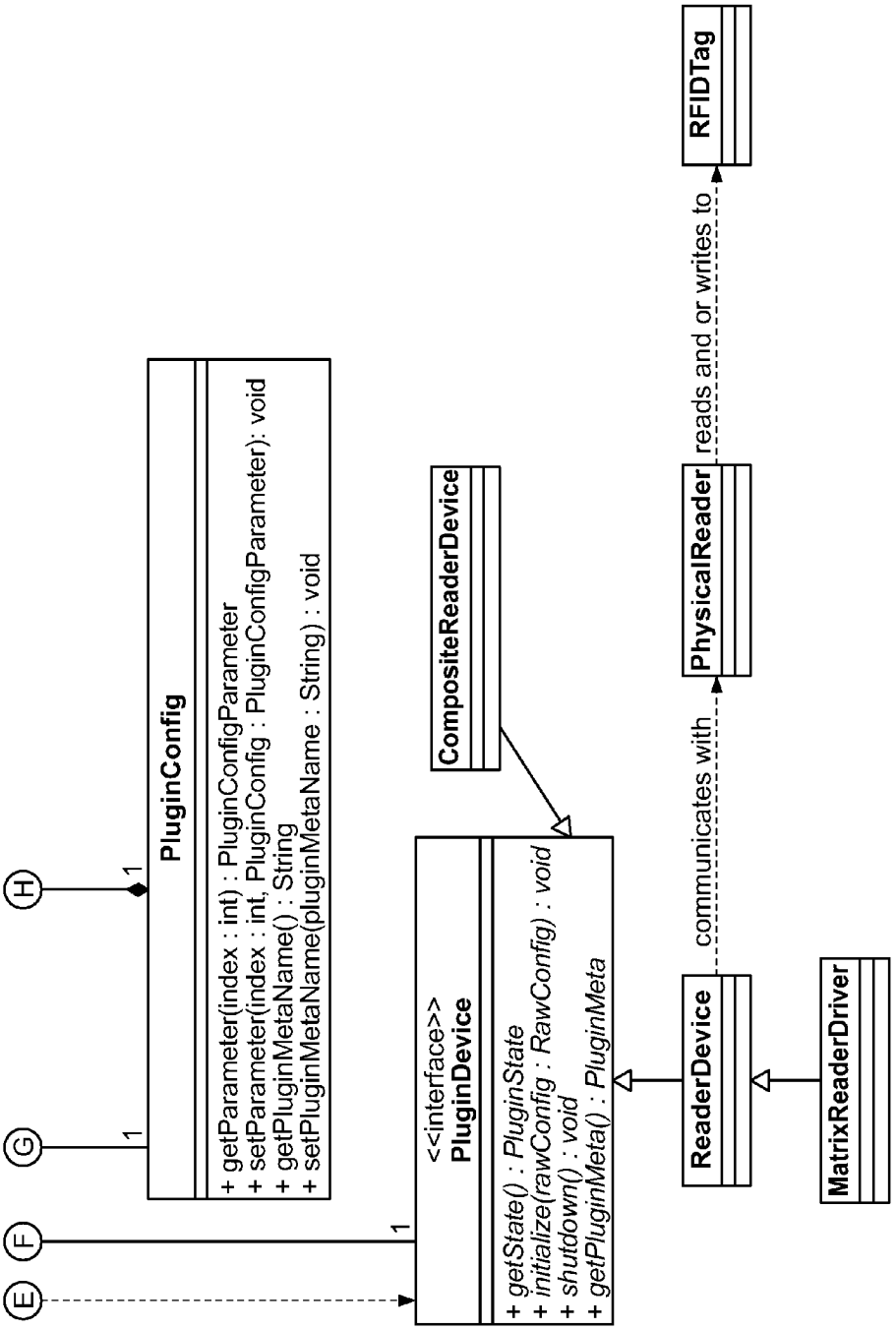

RFIDTag
reads and or writes to
PhysicalReader
CompositeReaderDevice
communicates with
<<interface>>
PluginDevice
+ getState() : PluginState
+ initialize(rawConfig : RawConfig) : void
+ shutdown() : void
+ getPluginMeta() : PluginMeta
PluginConfig
+ getParameter(index : int) : PluginConfigParameter
+ setParameter(index : int, PluginConfig : PluginConfigParameter): void
+ getPluginMetaName() : String
+ setPluginMetaName(pluginMetaName : String) : void
ReaderDevice
MatrixReaderDriver
E
F
G
H
1
1
1

FIG. 6D-3

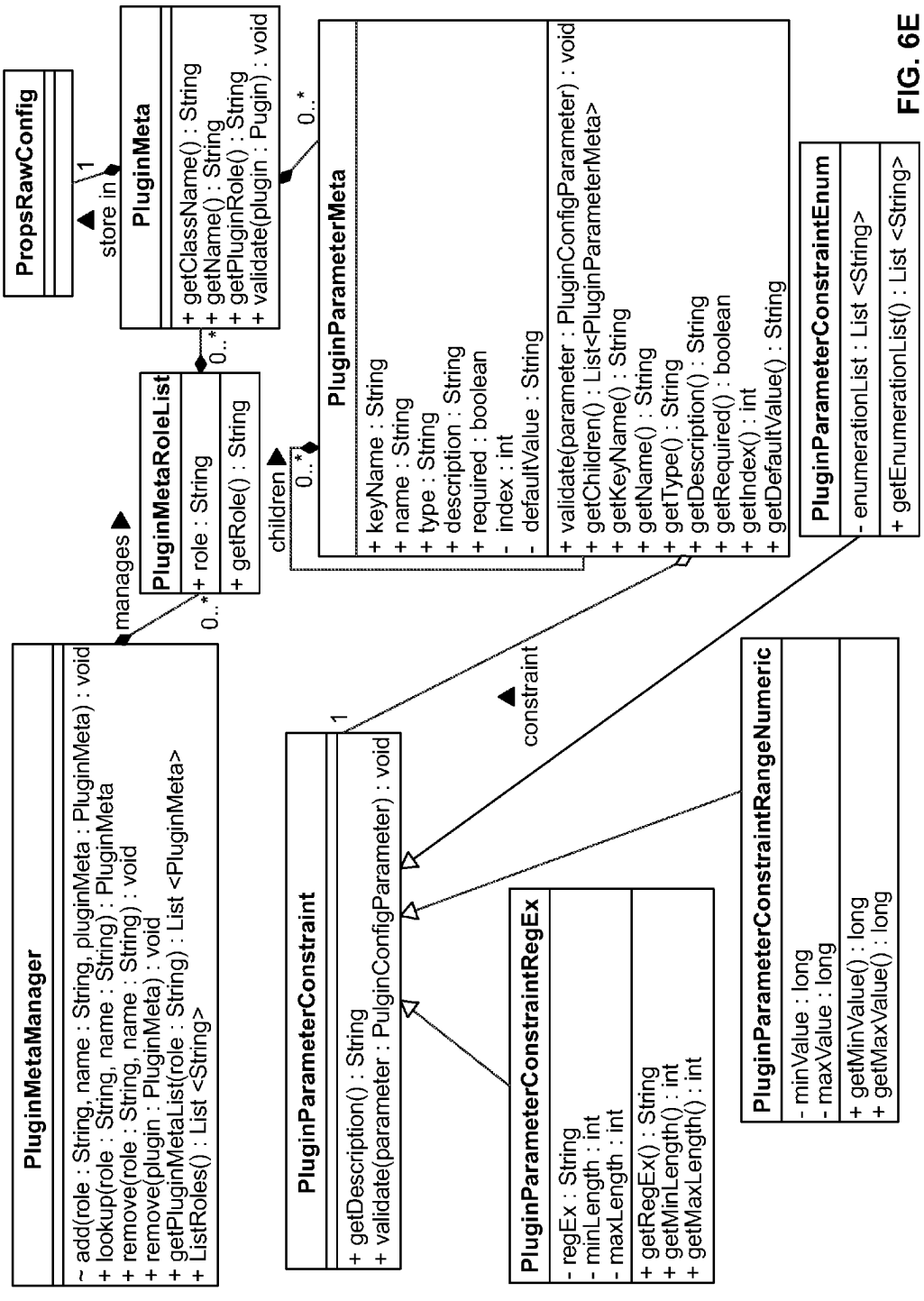

PropsRawConfig
store in
1
PluginMeta
+ getClassName() : String
+ getName() : String
+ getPluginRole() : String
+ validate(plugin : Pugin) : void
0..*
PluginMetaRoleList
+ role : String
+ getRole() : String
0..*
manages
children
PluginParameterMeta
+ keyName : String
+ name : String
+ type : String
+ description : String
+ required : boolean
- index : int
- defaultValue : String
+ validate(parameter : PluginConfigParameter) : void
+ getChildren() : List<PluginParameterMeta>
+ getKeyName() : String
+ getName() : String
+ getType() : String
+ getDescription() : String
+ getRequired() : boolean
+ getIndex() : int
+ getDefaultValue() : String
PluginMetaManager
~ add(role : String, name : String, pluginMeta : PluginMeta) : void
+ lookup(role : String, name : String) : PluginMeta
+ remove(role : String, name : String) : void
+ remove(plugin : PluginMeta) : void
+ getPluginMetaList(role : String) : List <PluginMeta>
+ ListRoles() : List <String>
PluginParameterConstraint
+ getDescription() : String
+ validate(parameter : PulginConfigParameter) : void
1
constraint
PluginParameterConstraintEnum
- enumerationList : List <String>
+ getEnumerationList() : List <String>
PluginParameterConstraintRegEx
- regEx : String
- minLength : int
- maxLength : int
+ getRegEx() : String
+ getMinLength() : int
+ getMaxLength() : int
PluginParameterConstraintRangeNumeric
- minValue : long
- maxValue : long
+ getMinValue() : long
+ getMaxValue() : long

FIG. 6E

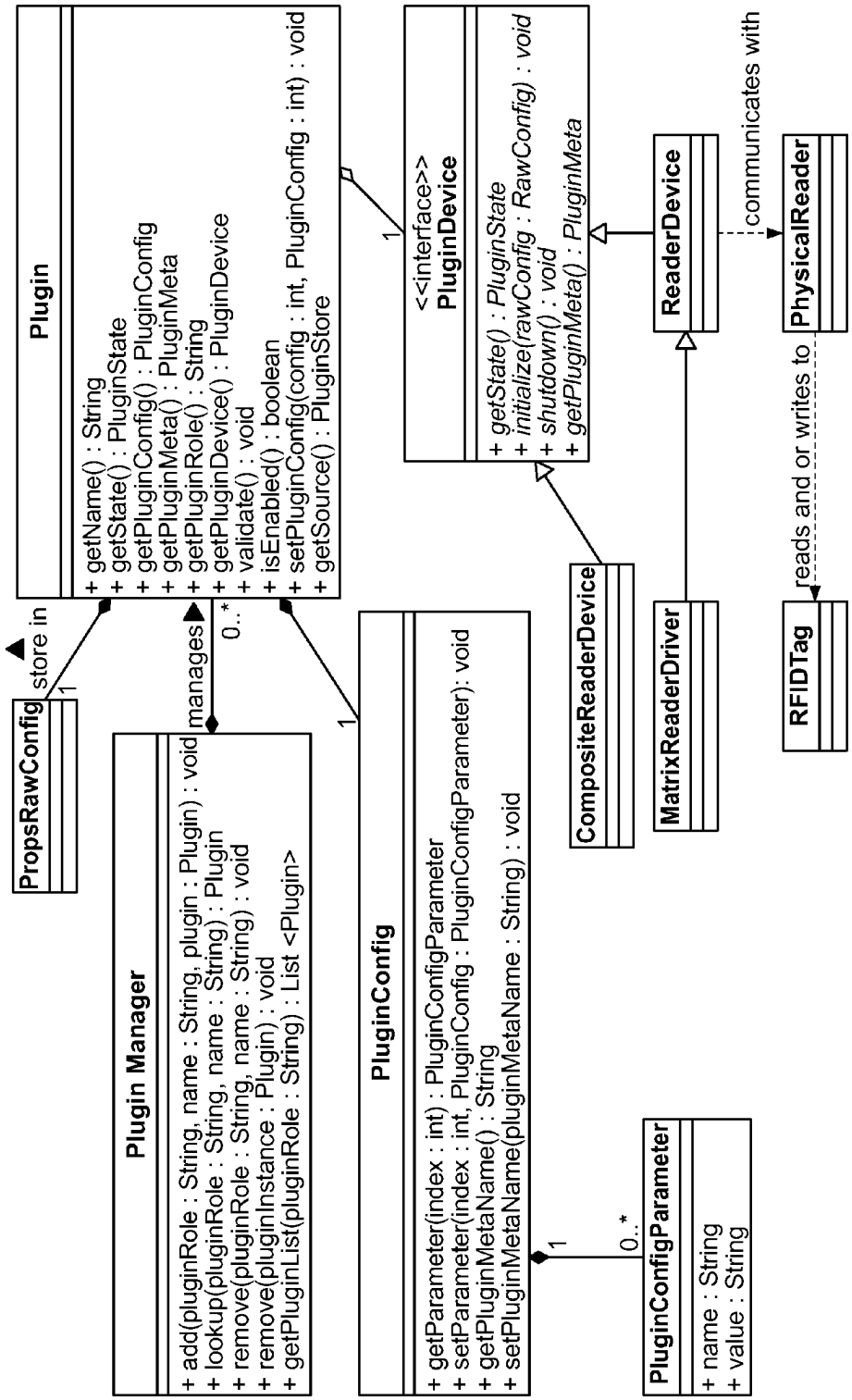

Plugin
+ getName() : String
+ getState() : PluginState
+ getPluginConfig() : PluginConfig
+ getPluginMeta() : PluginMeta
+ getPluginRole() : String
+ getPluginDevice() : PluginDevice
+ validate() : void
+ isEnabled() : boolean
+ setPluginConfig(config : int, PluginConfig : int) : void
+ getSource() : PluginStore
<<interface>>
PluginDevice
+ getState() : PluginState
+ initialize(rawConfig : RawConfig) : void
+ shutdown() : void
+ getPluginMeta() : PluginMeta
ReaderDevice
communicates with
PhysicalReader
PropsRawConfig
store in
1
Plugin Manager
+ add(pluginRole : String, name : String, plugin : Plugin) : void
+ lookup(pluginRole : String, name : String) : Plugin
+ remove(pluginRole : String, name : String) : void
+ remove(pluginInstance : Plugin) : void
+ getPluginList(pluginRole : String) : List <Plugin>
manages
0..*
1
PluginConfig
+ getParameter(index : int) : PluginConfigParameter
+ setParameter(index : int, PluginConfig : PluginConfigParameter): void
+ getPluginMetaName() : String
+ setPluginMetaName(pluginMetaName : String) : void
CompositeReaderDevice
MatrixReaderDriver
reads and or writes to
RFIDTag
1
0..*
PluginConfigParameter
+ name : String
+ value : String

FIG. 6F

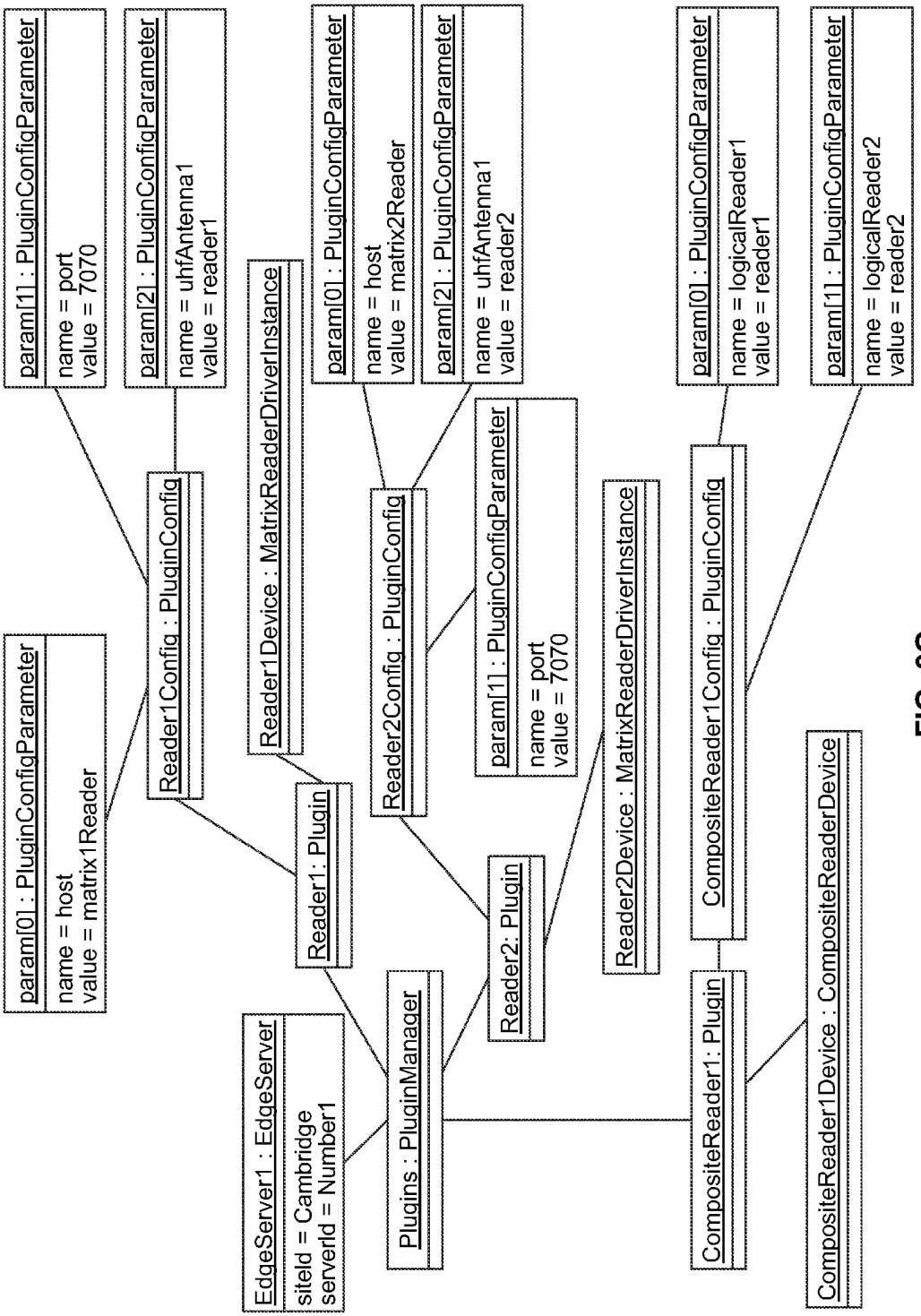

param[1] : PluginConfigParameter
name = port
value = 7070
param[2] : PluginConfigParameter
name = uhfAntenna1
value = reader1
param[0] : PluginConfigParameter
name = host
value = matrix1Reader
Reader1Config : PluginConfig
Reader1Device : MatrixReaderDriverInstance
param[0] : PluginConfigParameter
name = host
value = matrix2Reader
param[2] : PluginConfigParameter
name = uhfAntenna1
value = reader2
Reader2Config : PluginConfig
param[1] : PluginConfigParameter
name = port
value = 7070
Reader1: Plugin
Reader2: Plugin
Reader2Device : MatrixReaderDriverInstance
param[0] : PluginConfigParameter
name = logicalReader1
value = reader1
param[1] : PluginConfigParameter
name = logicalReader2
value = reader2
CompositeReader1Config : PluginConfig
EdgeServer1 : EdgeServer
siteId = Cambridge
serverId = Number1
Plugins : PluginManager
CompositeReader1: Plugin
CompositeReader1Device : CompositeReaderDevice

FIG. 6G

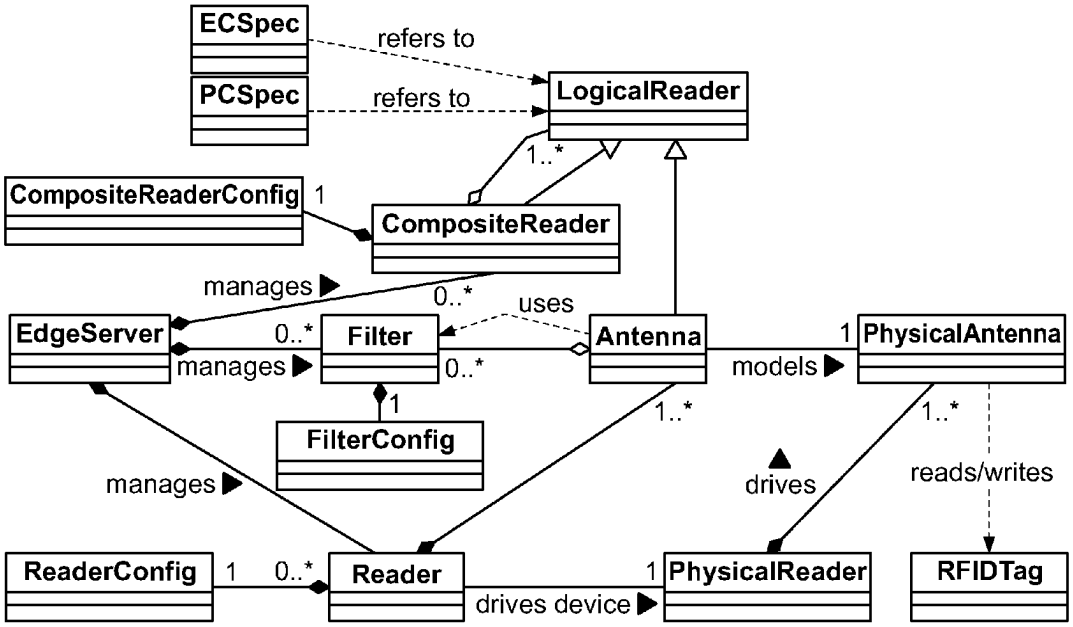

ECSpec
refers to
PCSpec
refers to
LogicalReader
1..*
CompositeReaderConfig
1
CompositeReader
manages
0..*
uses
EdgeServer
0..*
Filter
Antenna
1
PhysicalAntenna
manages
0..*
models
1
1..*
1..*
FilterConfig
manages
drives
reads/writes
ReaderConfig
1
0..*
Reader
1
PhysicalReader
RFIDTag
drives device

FIG. 6H

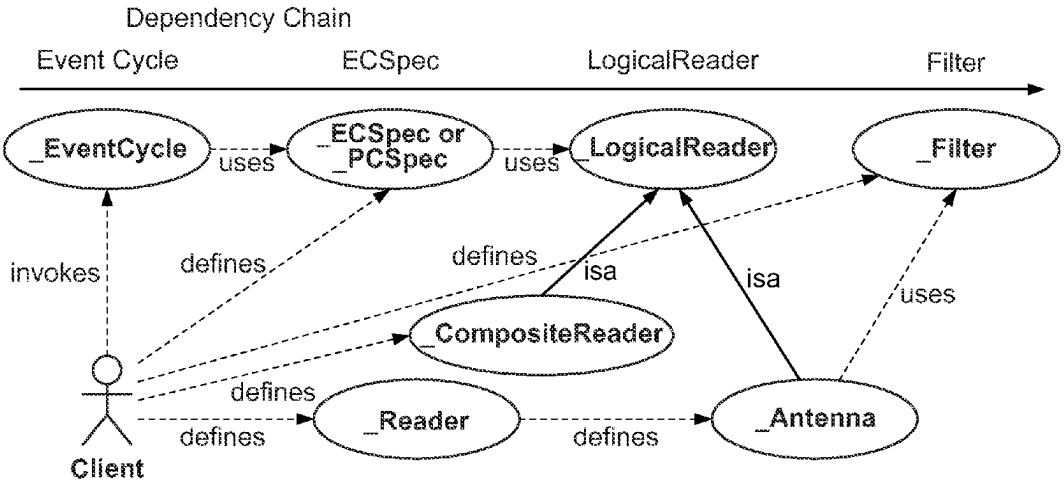

Dependency Chain
Event Cycle
ECSpec
LogicalReader
Filter
_EventCycle
uses
_ECSpec or _PCSpec
uses
_LogicalReader
_Filter
invokes
defines
defines
isa
isa
uses
_CompositeReader
defines
defines
_Reader
defines
_Antenna
Client

FIG. 6I

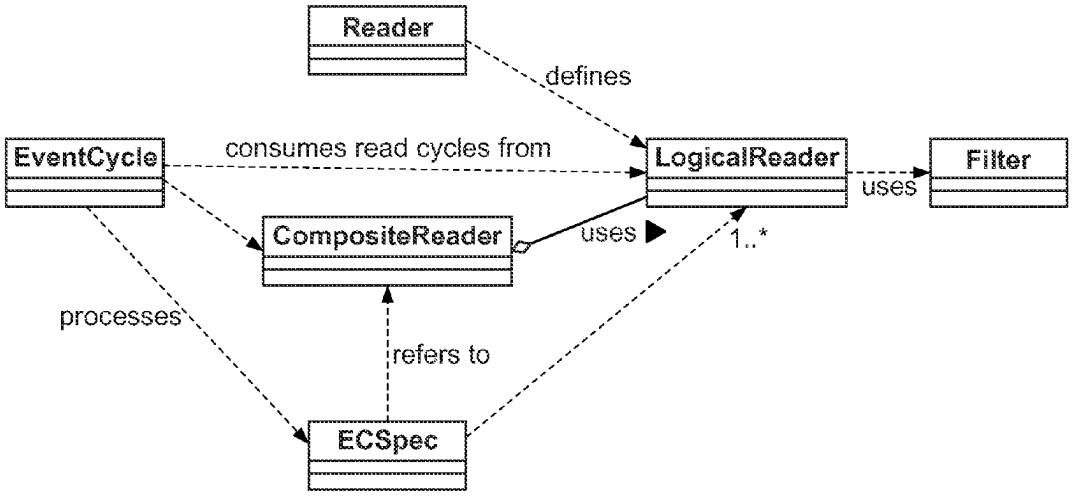

Reader
defines
EventCycle
consumes read cycles from
LogicalReader
Filter
uses
CompositeReader
uses
1..*
processes
refers to
ECSpec

FIG. 6J

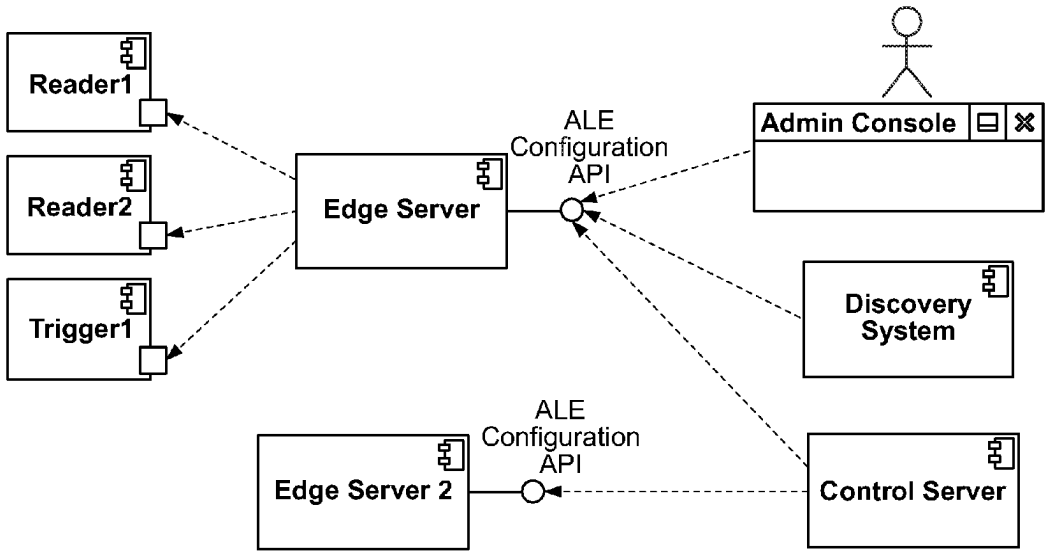

Reader1
Reader2
Trigger1
Edge Server
ALE
Configuration
API
Admin Console
Discovery
System
ALE
Configuration
API
Edge Server 2
Control Server

FIG. 7A

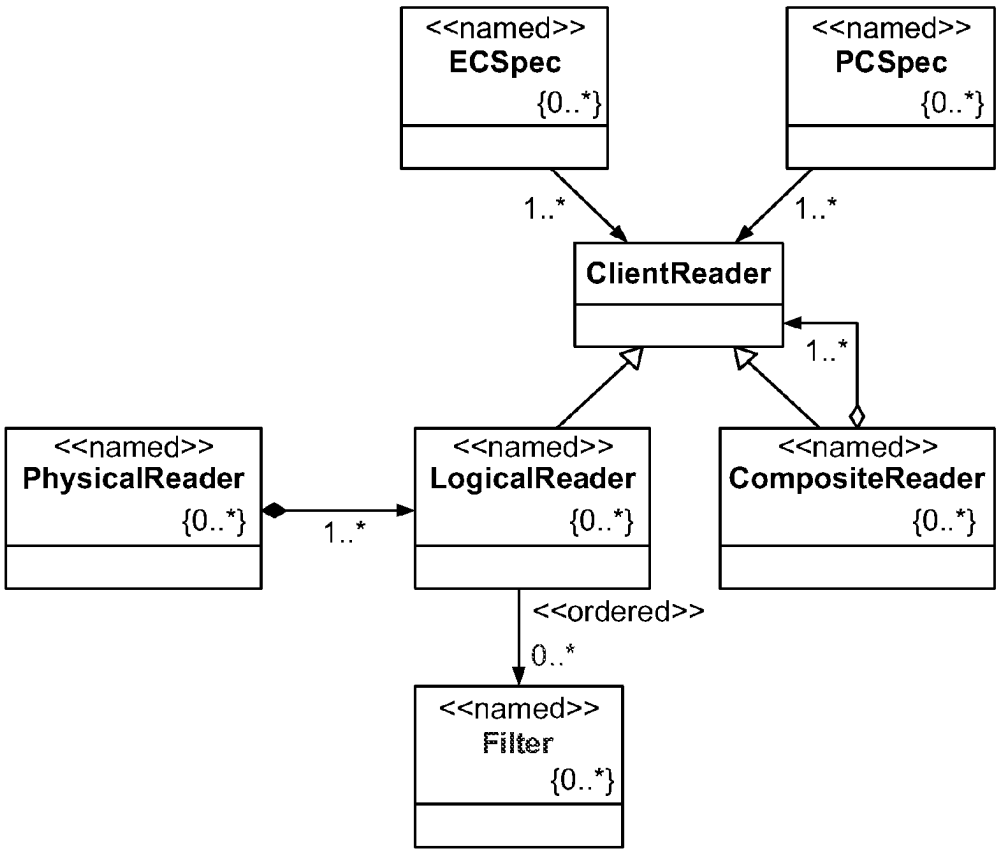

<<named>>
ECSpec
{0..*}
<<named>>
PCSpec
{0..*}
1..*
1..*
ClientReader
1..*
<<named>>
PhysicalReader
{0..*}
1..*
<<named>>
LogicalReader
{0..*}
<<named>>
CompositeReader
{0..*}
<<ordered>>
0..*
<<named>>
Filter
{0..*}

FIG. 7B

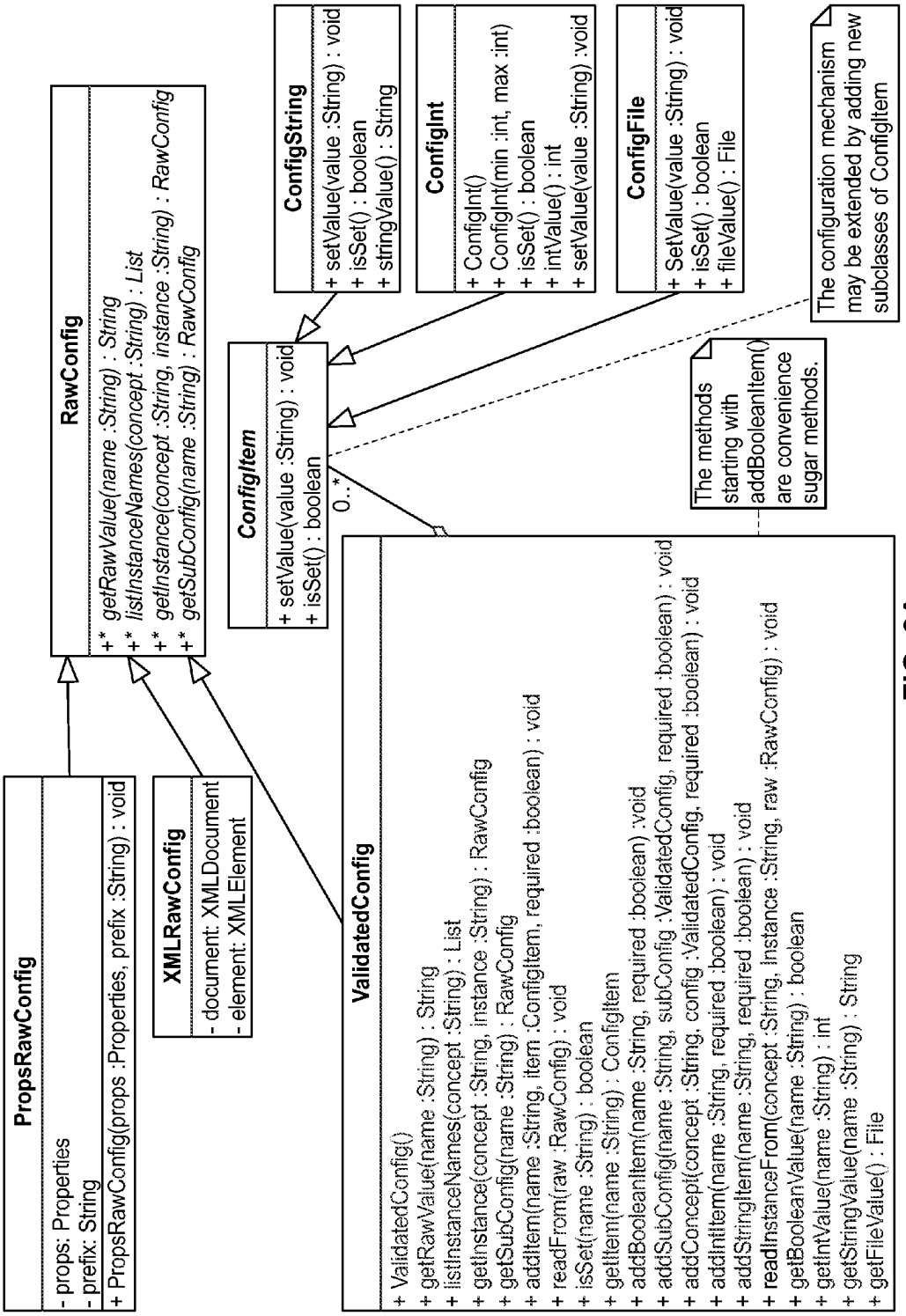

PropsRawConfig
- props: Properties
- prefix: String
+ PropsRawConfig(props :Properties, prefix :String) : void
XMLRawConfig
- document: XMLDocument
- element: XMLElement
RawConfig
+* getRawValue(name :String) : String
+* listInstanceNames(concept :String) : List
+* getInstance(concept :String, instance :String) : RawConfig
+* getSubConfig(name :String) : RawConfig
ConfigItem
+ setValue(value :String) : void
+ isSet() : boolean
0..*
ConfigString
+ setValue(value :String) : void
+ isSet() : boolean
+ stringValue() : String
ConfigInt
+ ConfigInt()
+ ConfigInt(min :int, max :int)
+ isSet() : boolean
+ intValue() : int
+ setValue(value :String) :void
ConfigFile
+ SetValue(value :String) : void
+ isSet() : boolean
+ fileValue() : File
The configuration mechanism may be extended by adding new subclasses of ConfigItem
The methods starting with addBooleanItem() are convenience sugar methods.
ValidatedConfig
+ ValidatedConfig()
+ getRawValue(name :String) : String
+ listInstanceNames(concept :String) : List
+ getInstance(concept :String, instance :String) : RawConfig
+ getSubConfig(name :String) : RawConfig
+ addItem(name :String, item :ConfigItem, required :boolean) : void
+ readFrom(raw :RawConfig) : void
+ isSet(name :String) : boolean
+ getItem(name :String) : ConfigItem
+ addBooleanItem(name :String, required :boolean) :void
+ addSubConfig(name :String, subConfig :ValidatedConfig, required :boolean) : void
+ addConcept(concept :String, config :ValidatedConfig, required :boolean) : void
+ addIntItem(name :String, required :boolean) : void
+ addStringItem(name :String, required :boolean) : void
+ readInstanceFrom(concept :String, instance :String, raw :RawConfig) : void
+ getBooleanValue(name :String) : boolean
+ getIntValue(name :String) : int
+ getStringValue(name :String) : String
+ getFileValue() : File

FIG. 8A

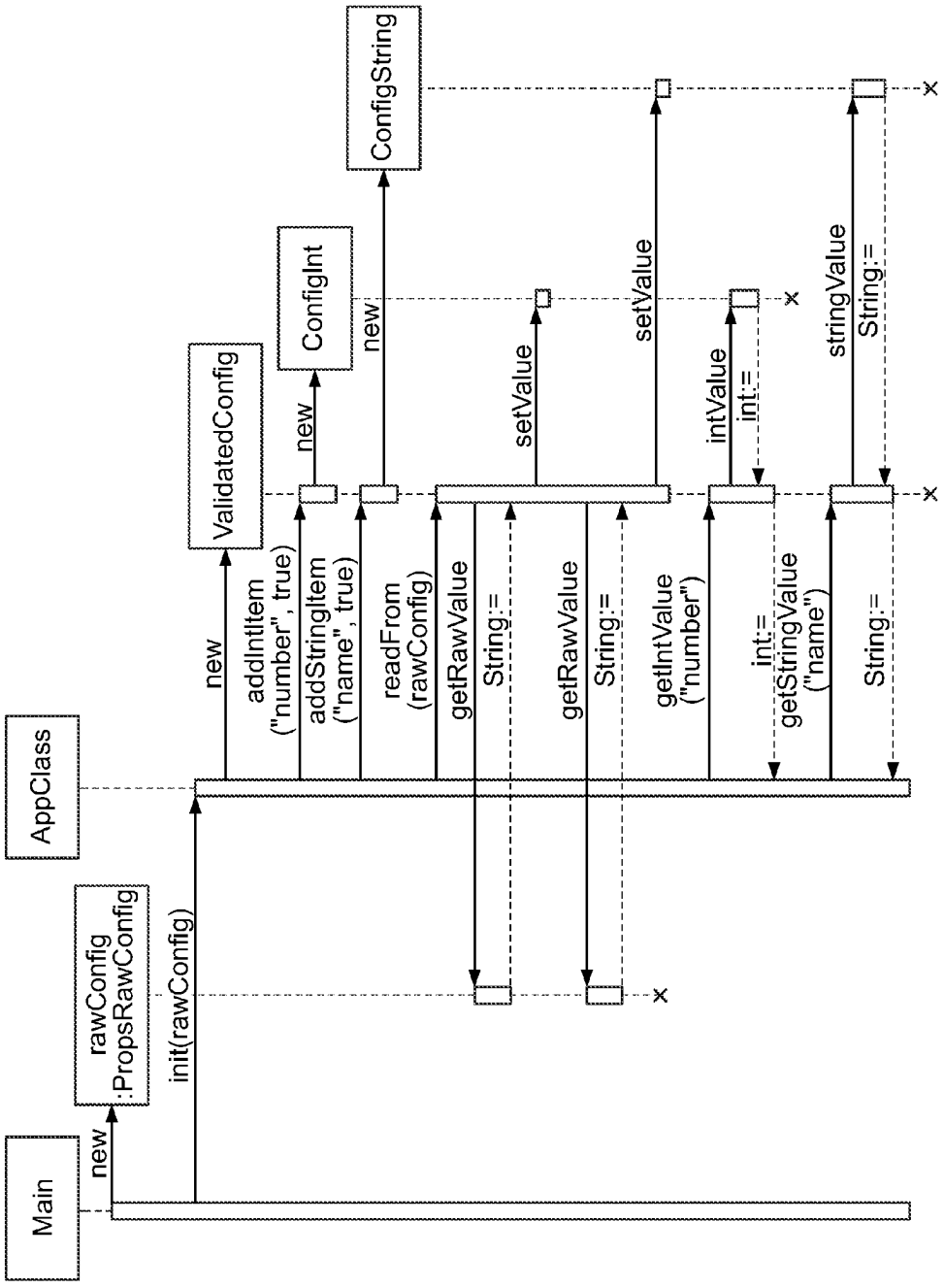

Main
rawConfig :PropsRawConfig
AppClass
ValidatedConfig
ConfigInt
ConfigString
new
init(rawConfig)
new
addIntItem ("number", true)
addStringItem ("name", true)
readFrom (rawConfig)
getRawValue
String:=
setValue
getRawValue
String:=
setValue
getIntValue ("number")
intValue
int:=
getStringValue ("name")
stringValue
String:=

FIG. 8B

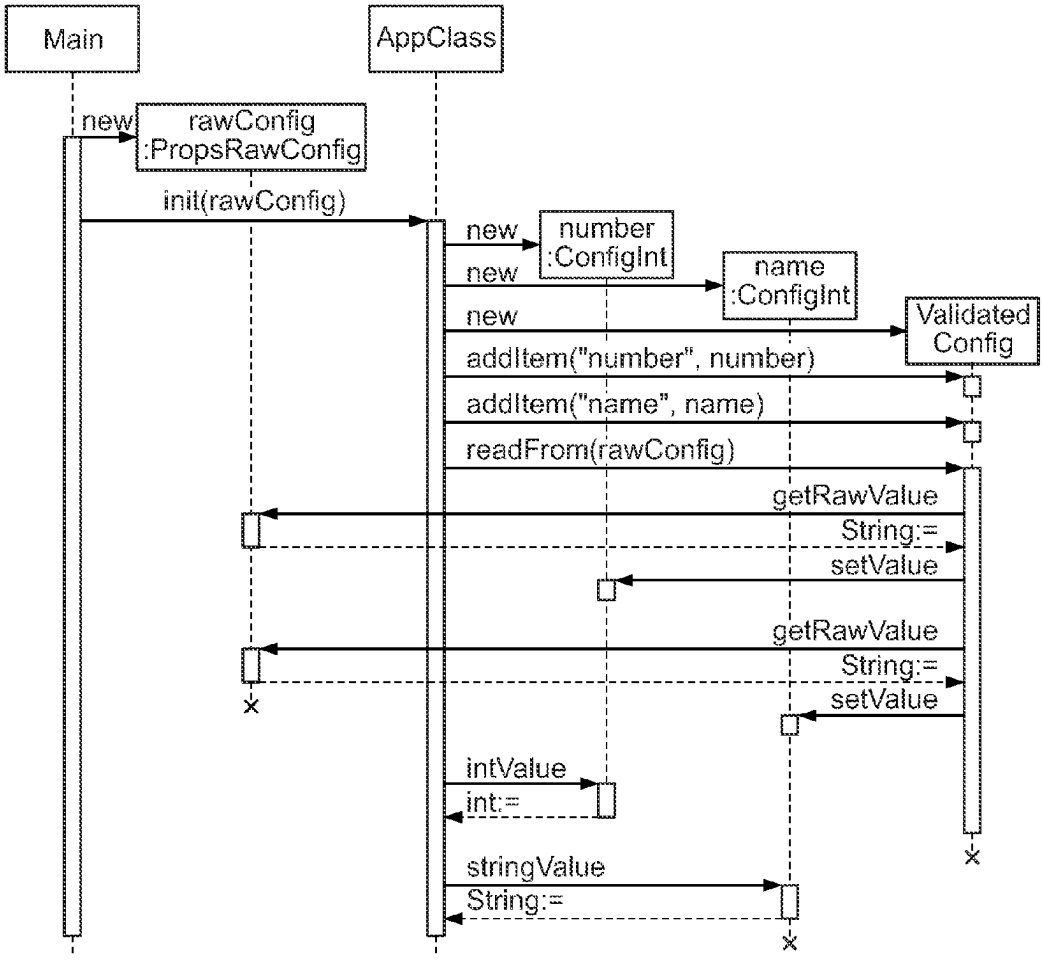

Main
AppClass
new
rawConfig
:PropsRawConfig
init(rawConfig)
new
number
:ConfigInt
new
name
:ConfigInt
new
Validated
Config
addItem("number", number)
addItem("name", name)
readFrom(rawConfig)
getRawValue
String:=
setValue
getRawValue
String:=
setValue
intValue
int:=
stringValue
String:=

FIG. 8C

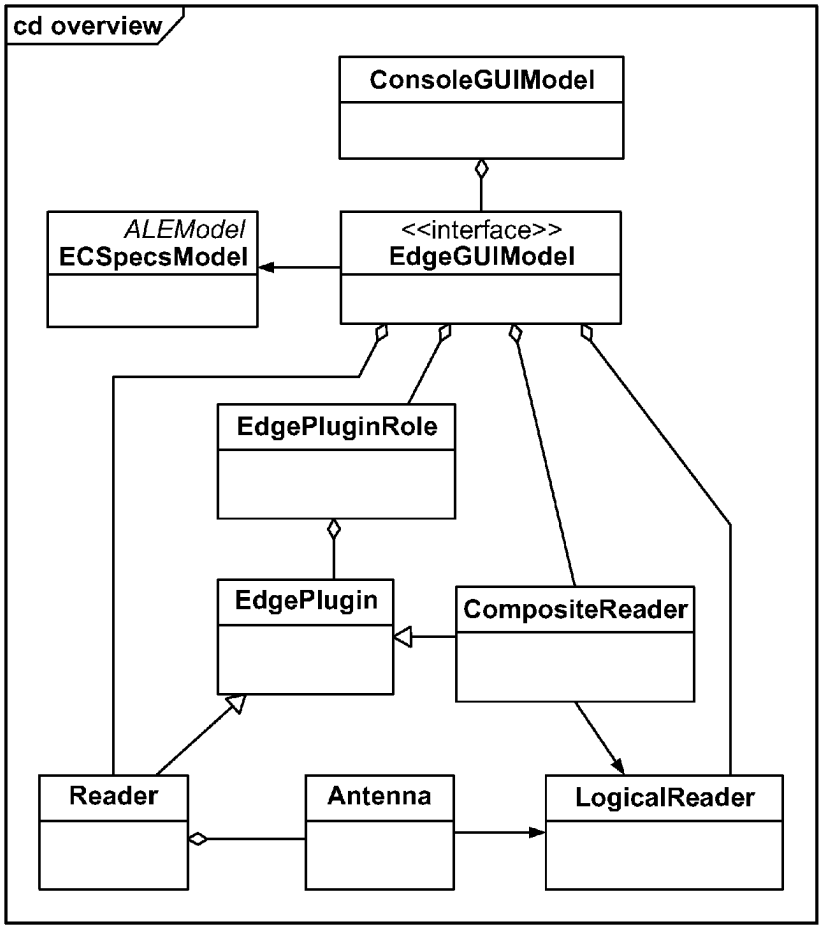

cd overview
ConsoleGUIModel
ALEModel
ECSpecsModel
<<interface>>
EdgeGUIModel
EdgePluginRole
EdgePlugin
CompositeReader
Reader
Antenna
LogicalReader

FIG. 9A

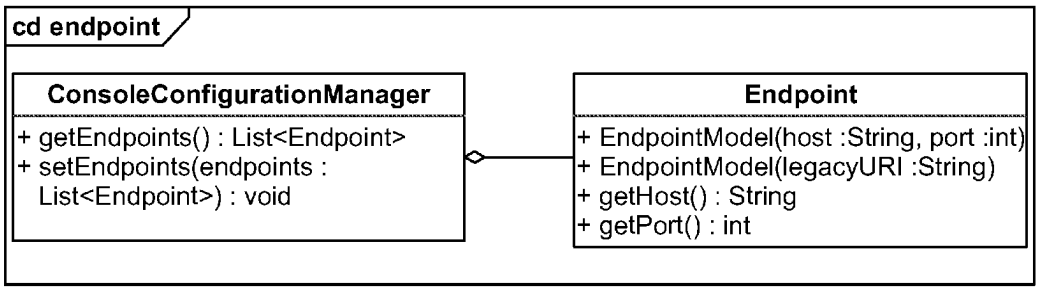

cd endpoint
ConsoleConfigurationManager
+ getEndpoints() : List<Endpoint>
+ setEndpoints(endpoints :
List<Endpoint>) : void
Endpoint
+ EndpointModel(host :String, port :int)
+ EndpointModel(legacyURI :String)
+ getHost() : String
+ getPort() : int

FIG. 9B

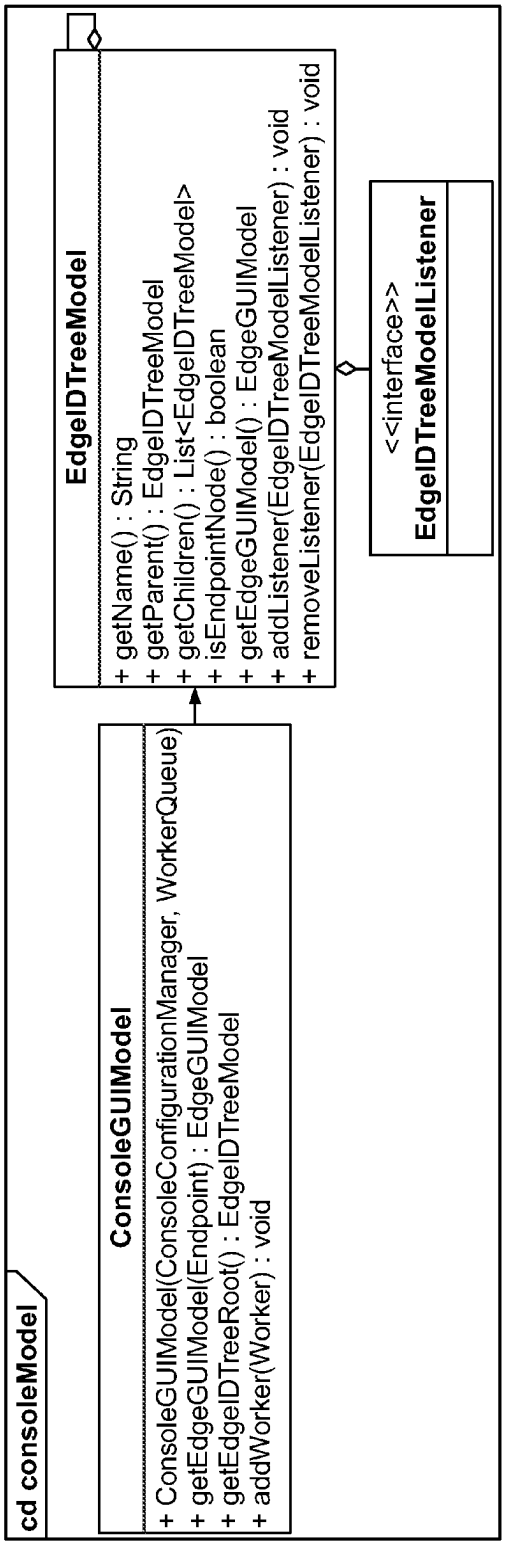

cd consoleModel
ConsoleGUIModel
+ ConsoleGUIModel(ConsoleConfigurationManager, WorkerQueue)
+ getEdgeGUIModel(Endpoint) : EdgeGUIModel
+ getEdgeIDTreeRoot() : EdgeIDTreeModel
+ addWorker(Worker) : void
EdgeIDTreeModel
+ getName() : String
+ getParent() : EdgeIDTreeModel
+ getChildren() : List<EdgeIDTreeModel>
+ isEndpointNode() : boolean
+ getEdgeGUIModel() : EdgeGUIModel
+ addListener(EdgeIDTreeModelListener) : void
+ removeListener(EdgeIDTreeModelListener) : void
<<interface>>
EdgeIDTreeModelListener

FIG. 9C

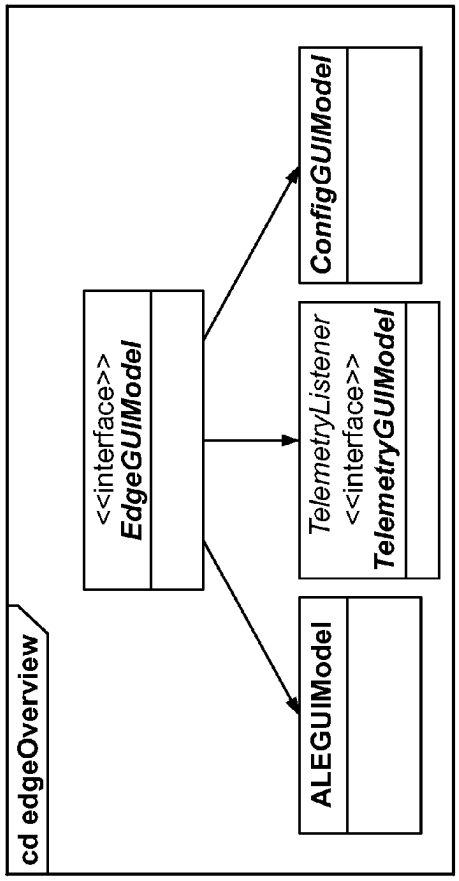

cd edgeOverview
<<interface>>
EdgeGUIModel
ConfigGUIModel
TelemetryListener
<<interface>>
TelemetryGUIModel
ALEGUIModel

FIG. 9D

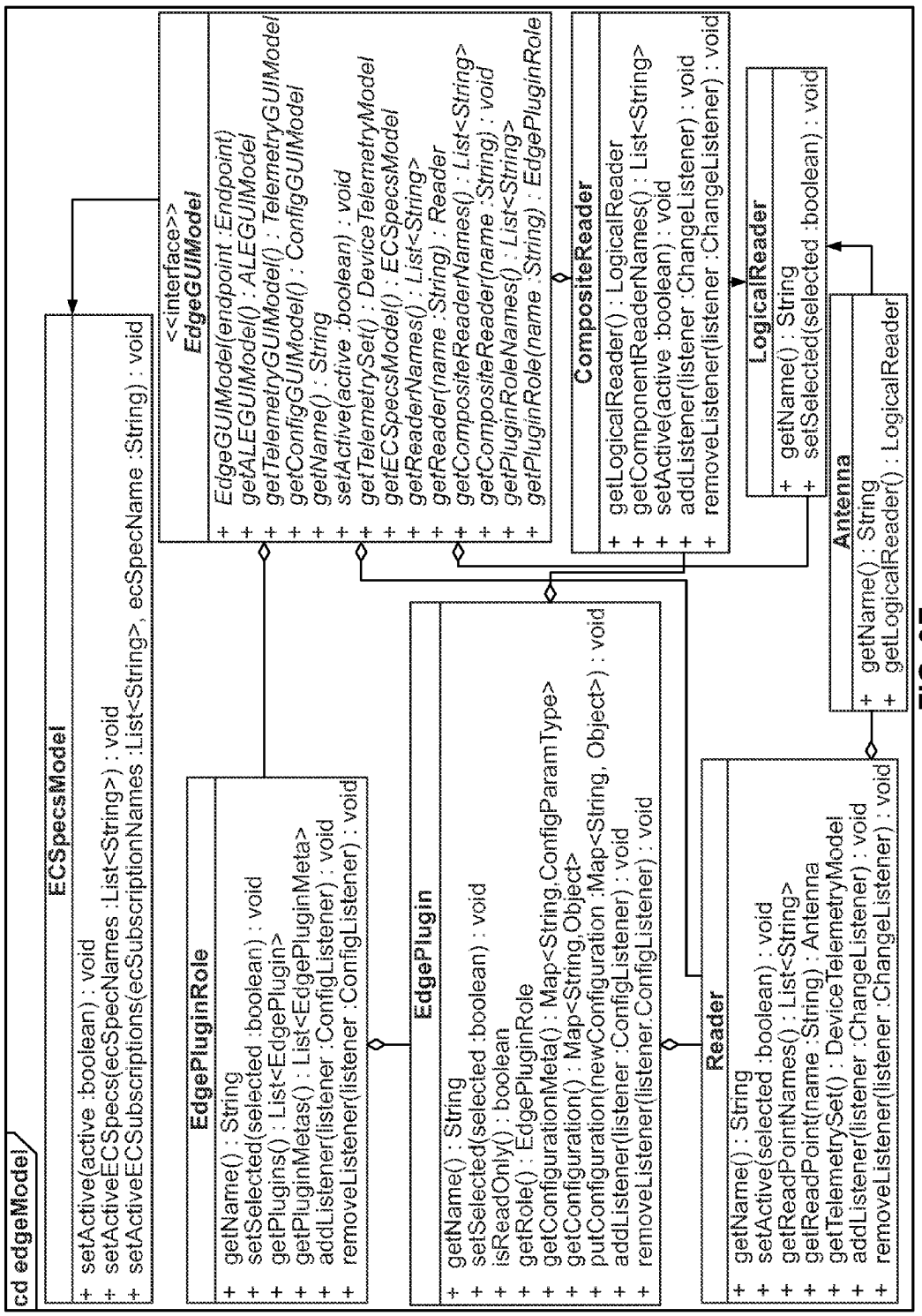

cd edgeModel
ECSpecsModel
+ setActive(active :boolean) : void
+ setActiveECSpecs(ecSpecNames :List<String>) : void
+ setActiveECSubscriptions(ecSubscriptionNames :List<String>, ecSpecName :String) : void
<<interface>>
EdgeGUIModel
+ EdgeGUIModel(endpoint :Endpoint)
+ getALEGUIModel() : ALEGUIModel
+ getTelemetryGUIModel() : TelemetryGUIModel
+ getConfigGUIModel() : ConfigGUIModel
+ getName() : String
+ setActive(active :boolean) : void
+ getTelemetrySet() : DeviceTelemetryModel
+ getECSpecsModel() : ECSpecsModel
+ getReaderNames() : List<String>
+ getReader(name :String) : Reader
+ getCompositeReaderNames() : List<String>
+ getCompositeReader(name :String) : void
+ getPluginRoleNames() : List<String>
+ getPluginRole(name :String) : EdgePluginRole
EdgePluginRole
+ getName() : String
+ setSelected(selected :boolean) : void
+ getPlugins() : List<EdgePlugin>
+ getPluginMetas() : List<EdgePluginMeta>
+ addListener(listener :ConfigListener) : void
+ removeListener(listener :ConfigListener) : void
EdgePlugin
+ getName() : String
+ setSelected(selected :boolean) : void
+ isReadOnly() : boolean
+ getRole() : EdgePluginRole
+ getConfigurationMeta() : Map<String,ConfigParamType>
+ getConfiguration() : Map<String,Object>
+ putConfiguration(newConfiguration :Map<String, Object>) : void
+ addListener(listener :ConfigListener) : void
+ removeListener(listener.ConfigListener) : void
Reader
+ getName() : String
+ setActive(selected :boolean) : void
+ getReadPointNames() : List<String>
+ getReadPoint(name :String) : Antenna
+ getTelemetrySet() : DeviceTelemetryModel
+ addListener(listener :ChangeListener) : void
+ removeListener(listener :ChangeListener) : void
CompositeReader
+ getLogicalReader() : LogicalReader
+ getComponentReaderNames() : List<String>
+ setActive(active :boolean) : void
+ addListener(listener :ChangeListener) : void
+ removeListener(listener :ChangeListener) : void
LogicalReader
+ getName() : String
+ setSelected(selected :boolean) : void
Antenna
+ getName() : String
+ getLogicalReader() : LogicalReader

FIG. 9E

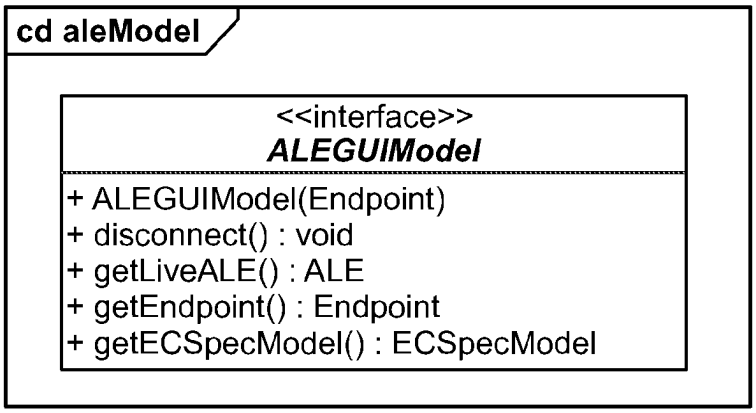

cd aleModel
<<interface>>
ALEGUIModel
+ ALEGUIModel(Endpoint)
+ disconnect() : void
+ getLiveALE() : ALE
+ getEndpoint() : Endpoint
+ getECSpecModel() : ECSpecModel

FIG. 9F

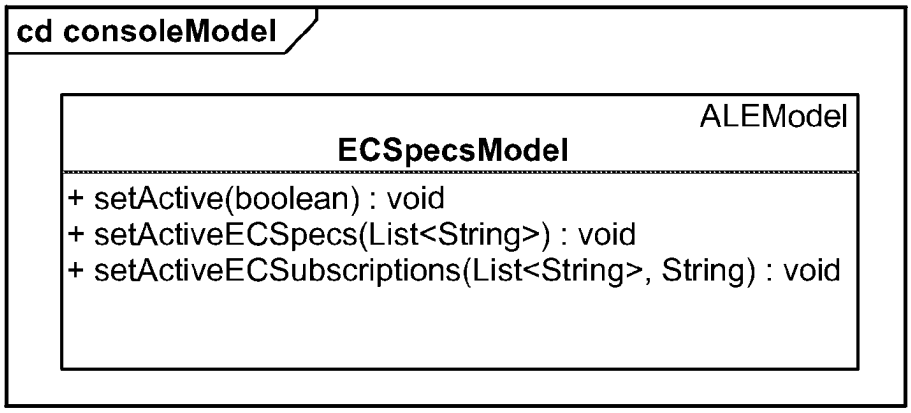

cd consoleModel
ALEModel
ECSpecsModel
+ setActive(boolean) : void
+ setActiveECSpecs(List<String>) : void
+ setActiveECSubscriptions(List<String>, String) : void

FIG. 9G

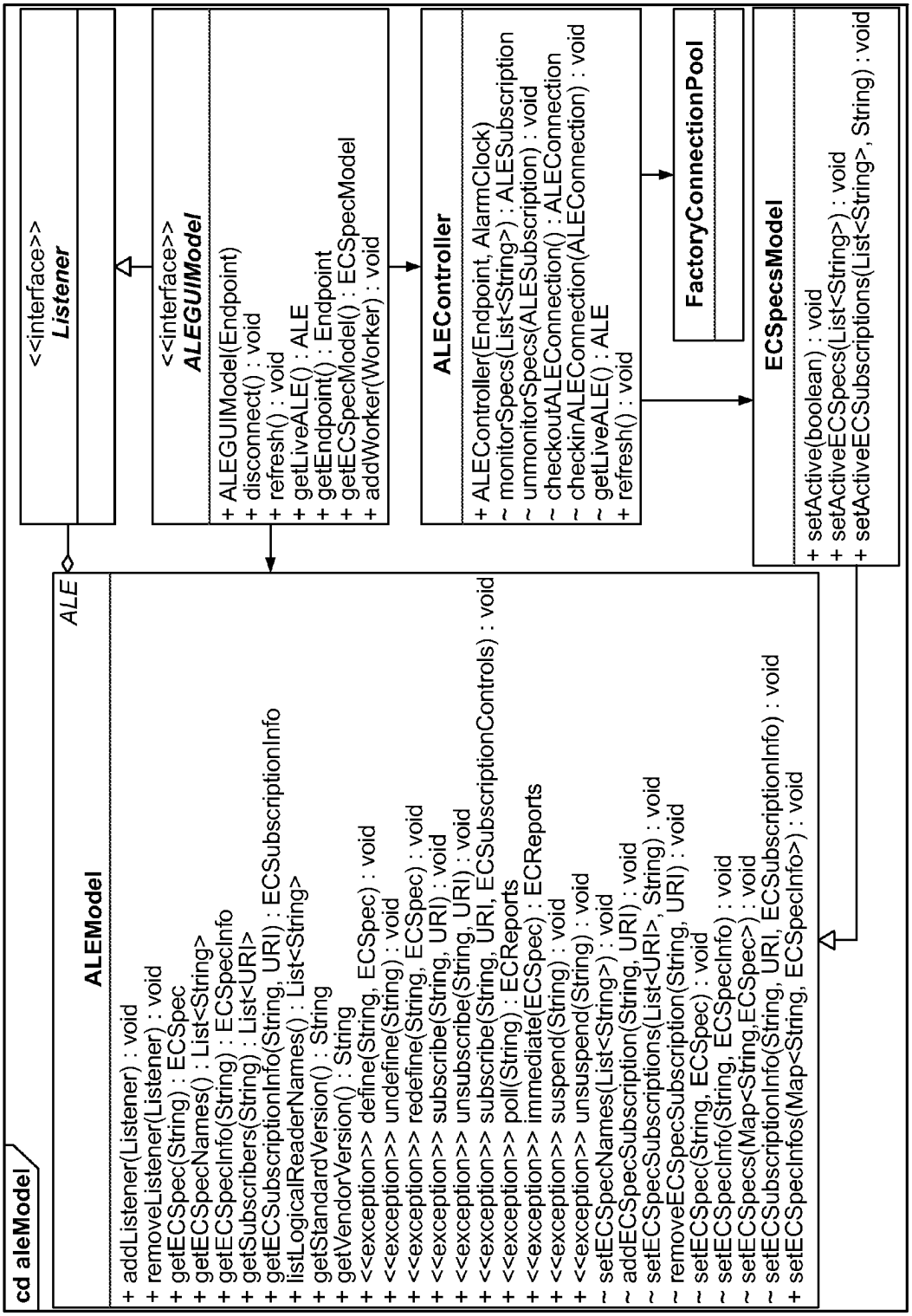

cd aleModel
<<interface>>
Listener
<<interface>>
ALEGUIModel
+ ALEGUIModel(Endpoint)
+ disconnect() : void
+ refresh() : void
+ getLiveALE() : ALE
+ getEndpoint() : Endpoint
+ getECSpecModel() : ECSpecModel
+ addWorker(Worker) : void
ALEController
+ ALEController(Endpoint, AlarmClock)
~ monitorSpecs(List<String>) : ALESubscription
~ unmonitorSpecs(ALESubscription) : void
~ checkoutALEConnection() : ALEConnection
~ checkinALEConnection(ALEConnection) : void
~ getLiveALE() : ALE
+ refresh() : void
FactoryConnectionPool
ECSpecsModel
+ setActive(boolean) : void
+ setActiveECSpecs(List<String>) : void
+ setActiveECSubscriptions(List<String>, String) : void
ALE
ALEModel
+ addListener(Listener) : void
+ removeListener(Listener) : void
+ getECSpec(String) : ECSpec
+ getECSpecNames() : List<String>
+ getECSpecInfo(String) : ECSpecInfo
+ getSubscribers(String) : List<URI>
+ getECSubscriptionInfo(String, URI) : ECSubscriptionInfo
+ listLogicalReaderNames() : List<String>
+ getStandardVersion() : String
+ getVendorVersion() : String
+ <<exception>> define(String, ECSpec) : void
+ <<exception>> undefine(String) : void
+ <<exception>> redefine(String, ECSpec) : void
+ <<exception>> subscribe(String, URI) : void
+ <<exception>> unsubscribe(String, URI) : void
+ <<exception>> subscribe(String, URI, ECSubscriptionControls) : void
+ <<exception>> poll(String) : ECReports
+ <<exception>> immediate(ECSpec) : ECReports
+ <<exception>> suspend(String) : void
+ <<exception>> unsuspend(String) : void
~ setECSpecNames(List<String>) : void
~ addECSpecSubscription(String, URI) : void
~ setECSpecSubscriptions(List<URI>, String) : void
~ removeECSpecSubscription(String, URI) : void
~ setECSpec(String, ECSpec) : void
~ setECSpecInfo(String, ECSpecInfo) : void
~ setECSpecs(Map<String,ECSpec>) : void
~ setECSubscriptionInfo(String, URI, ECSubscriptionInfo) : void
+ setECSpecInfos(Map<String, ECSpecInfo>) : void

FIG. 9H

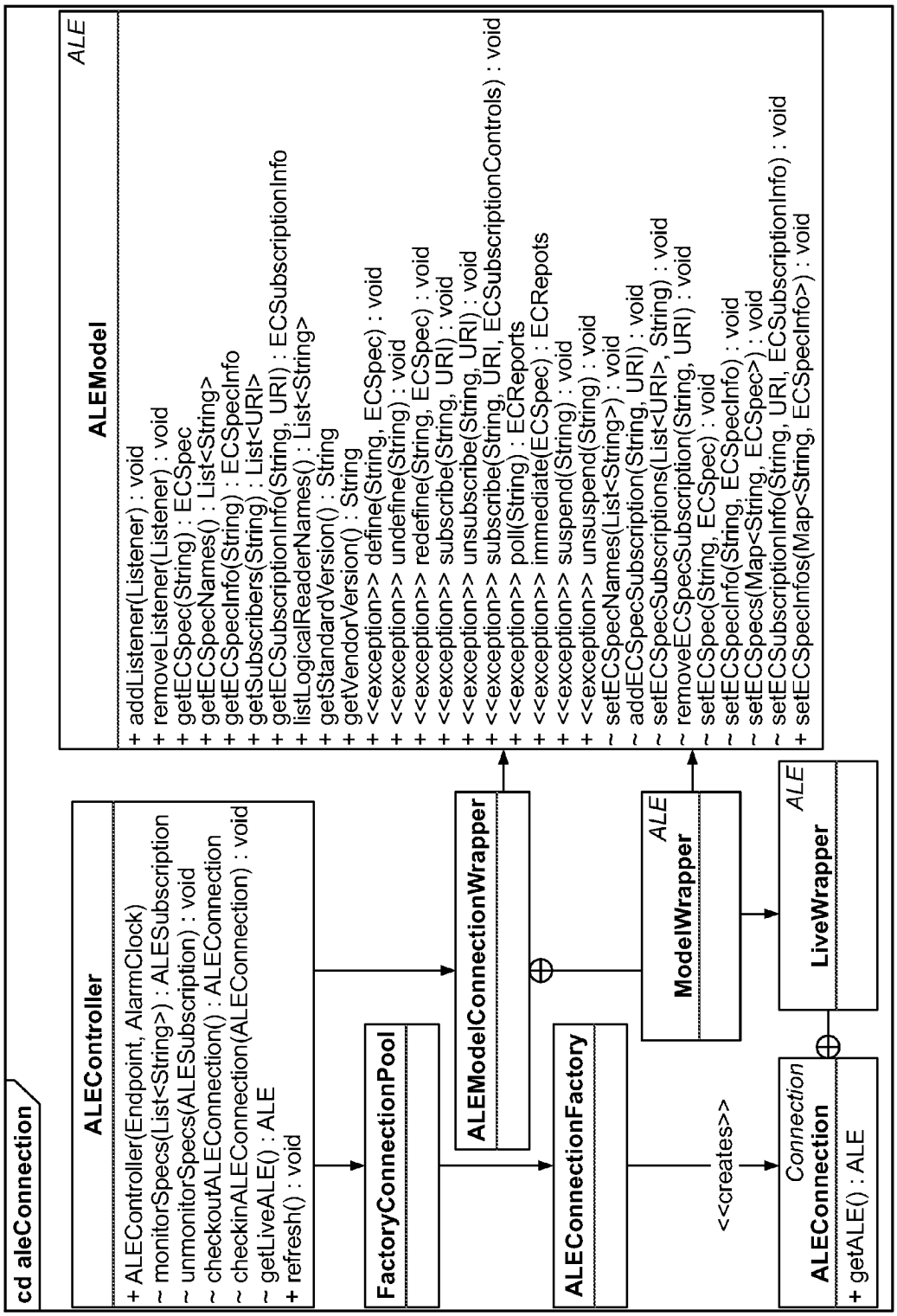

cd aleConnection
ALEController
+ ALEController(Endpoint, AlarmClock)
~ monitorSpecs(List<String>) : ALESubscription
~ unmonitorSpecs(ALESubscription) : void
~ checkoutALEConnection() : ALEConnection
~ checkinALEConnection(ALEConnection) : void
~ getLiveALE() : ALE
+ refresh() : void
FactoryConnectionPool
ALEModelConnectionWrapper
ALEConnectionFactory
<<creates>>
Connection
ALEConnection
+ getALE() : ALE
ALE
ModelWrapper
ALE
LiveWrapper
ALEModel
ALE
+ addListener(Listener) : void
+ removeListener(Listener) : void
+ getECSpec(String) : ECSpec
+ getECSpecNames() : List<String>
+ getECSpecInfo(String) : ECSpecInfo
+ getSubscribers(String) : List<URI>
+ getECSubscriptionInfo(String, URI) : ECSubscriptionInfo
+ listLogicalReaderNames() : List<String>
+ getStandardVersion() : String
+ getVendorVersion() : String
+ <<exception>> define(String, ECSpec) : void
+ <<exception>> undefine(String) : void
+ <<exception>> redefine(String, ECSpec) : void
+ <<exception>> subscribe(String, URI) : void
+ <<exception>> unsubscribe(String, URI) : void
+ <<exception>> subscribe(String, URI, ECSubscriptionControls) : void
+ <<exception>> poll(String) : ECReports
+ <<exception>> immediate(ECSpec) : ECRepots
+ <<exception>> suspend(String) : void
+ <<exception>> unsuspend(String) : void
~ setECSpecNames(List<String>) : void
~ addECSpecSubscription(String, URI) : void
~ setECSpecSubscriptions(List<URI>, String) : void
~ removeECSpecSubscription(String, URI) : void
~ setECSpec(String, ECSpec) : void
~ setECSpecInfo(String, ECSpecInfo) : void
~ setECSpecs(Map<String, ECSpec>) : void
~ setECSubscriptionInfo(String, URI, ECSubscriptionInfo) : void
+ setECSpecInfos(Map<String, ECSpecInfo>) : void

FIG. 9I

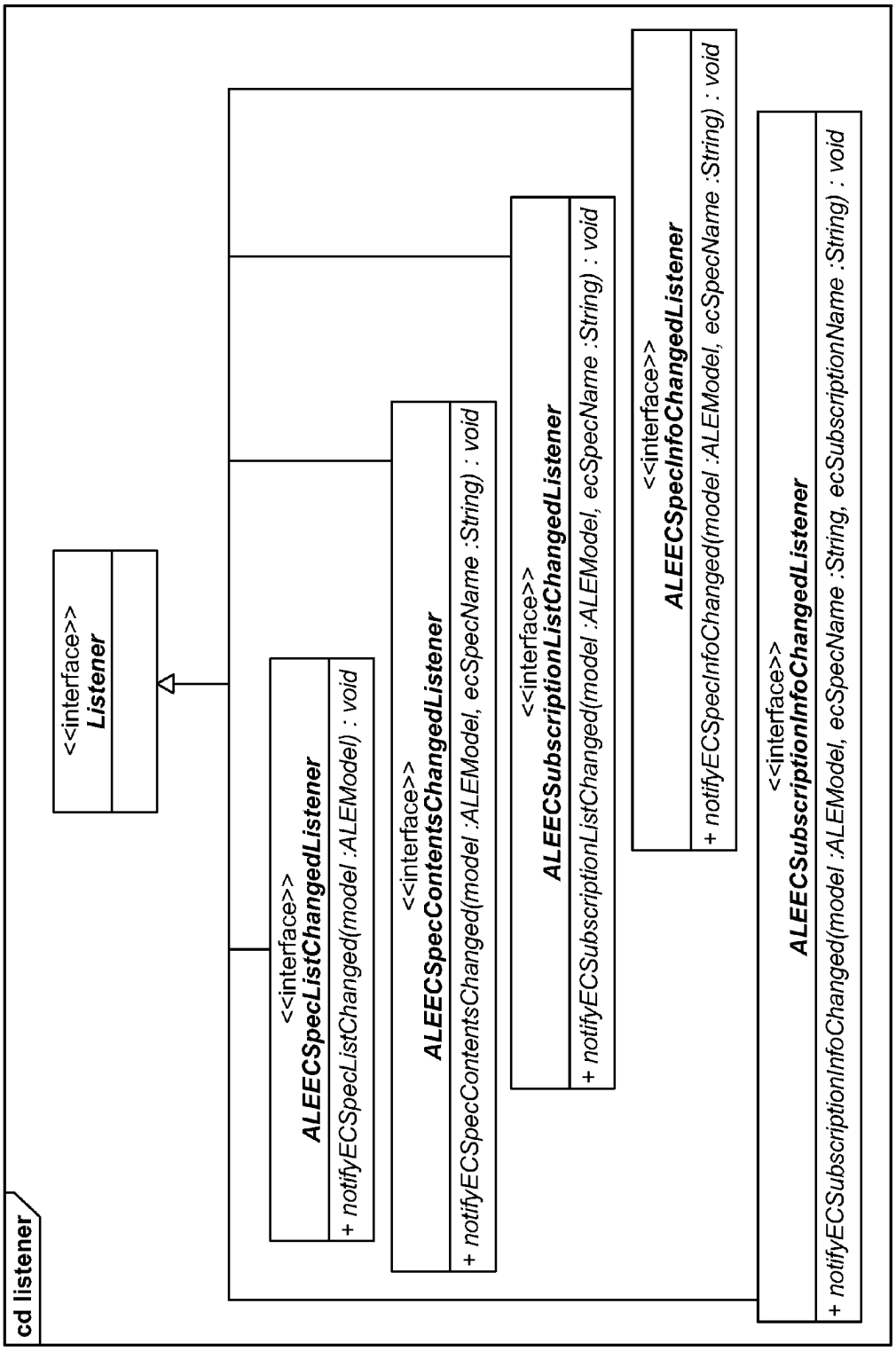

cd listener
<<interface>>
Listener
<<interface>>
ALEECSpecListChangedListener
+ notifyECSpecListChanged(model :ALEModel) : void
<<interface>>
ALEECSpecContentsChangedListener
+ notifyECSpecContentsChanged(model :ALEModel, ecSpecName :String) : void
<<interface>>
ALEECSubscriptionListChangedListener
+ notifyECSubscriptionListChanged(model :ALEModel, ecSpecName :String) : void
<<interface>>
ALEECSpecInfoChangedListener
+ notifyECSpecInfoChanged(model :ALEModel, ecSpecName :String) : void
<<interface>>
ALEECSubscriptionInfoChangedListener
+ notifyECSubscriptionInfoChanged(model :ALEModel, ecSpecName :String, ecSubscriptionName :String) : void

FIG. 9J

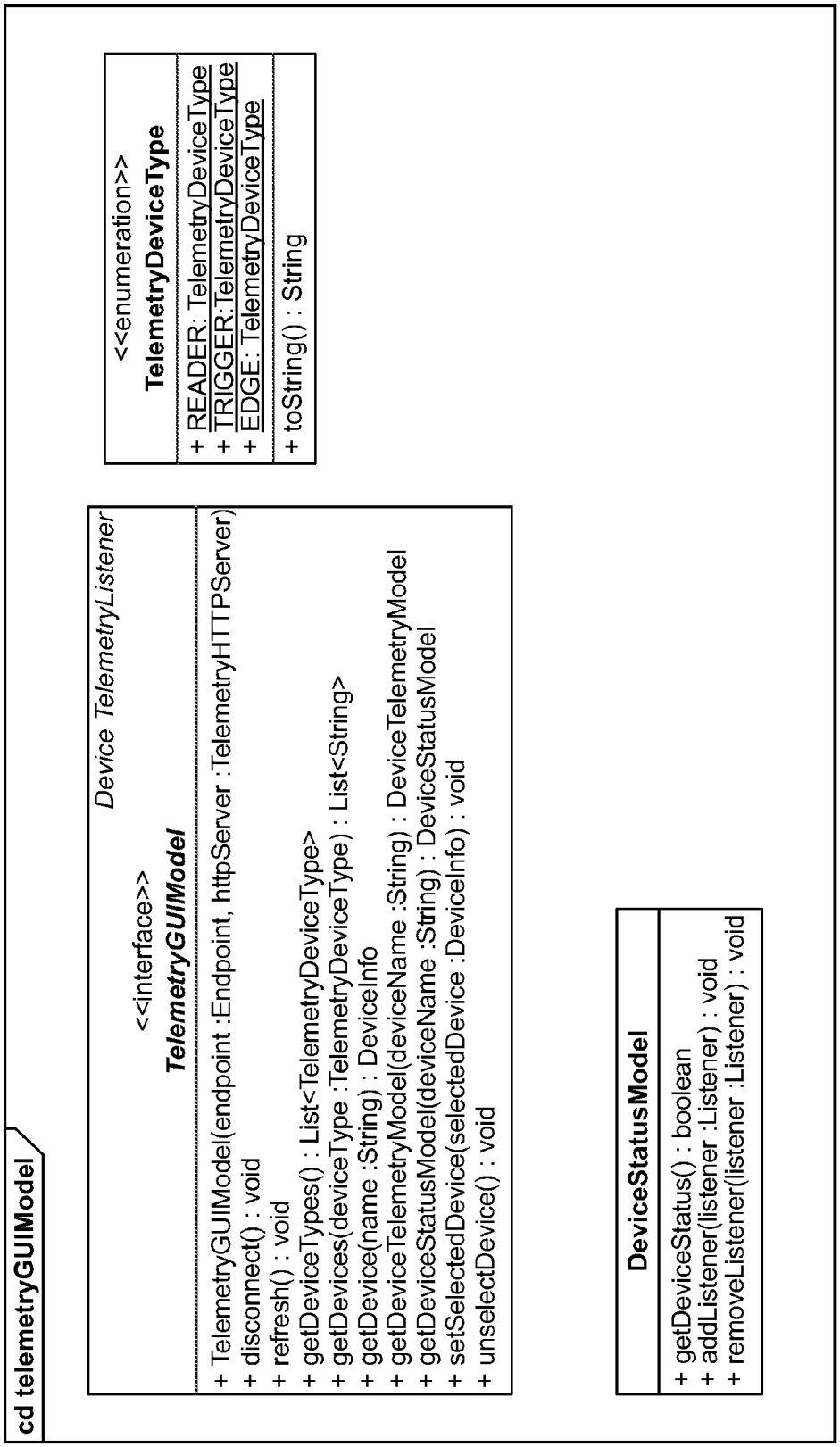

cd telemetryGUIModel
<<enumeration>>
TelemetryDeviceType
+ READER: TelemetryDeviceType
+ TRIGGER:TelemetryDeviceType
+ EDGE: TelemetryDeviceType
+ toString() : String
Device TelemetryListener
<<interface>>
TelemetryGUIModel
+ TelemetryGUIModel(endpoint :Endpoint, httpServer :TelemetryHTTPServer)
+ disconnect() : void
+ refresh() : void
+ getDeviceTypes() : List<TelemetryDeviceType>
+ getDevices(deviceType :TelemetryDeviceType) : List<String>
+ getDevice(name :String) : DeviceInfo
+ getDeviceTelemetryModel(deviceName :String) : DeviceTelemetryModel
+ getDeviceStatusModel(deviceName :String) : DeviceStatusModel
+ setSelectedDevice(selectedDevice :DeviceInfo) : void
+ unselectDevice() : void
DeviceStatusModel
+ getDeviceStatus() : boolean
+ addListener(listener :Listener) : void
+ removeListener(listener :Listener) : void

FIG. 9K

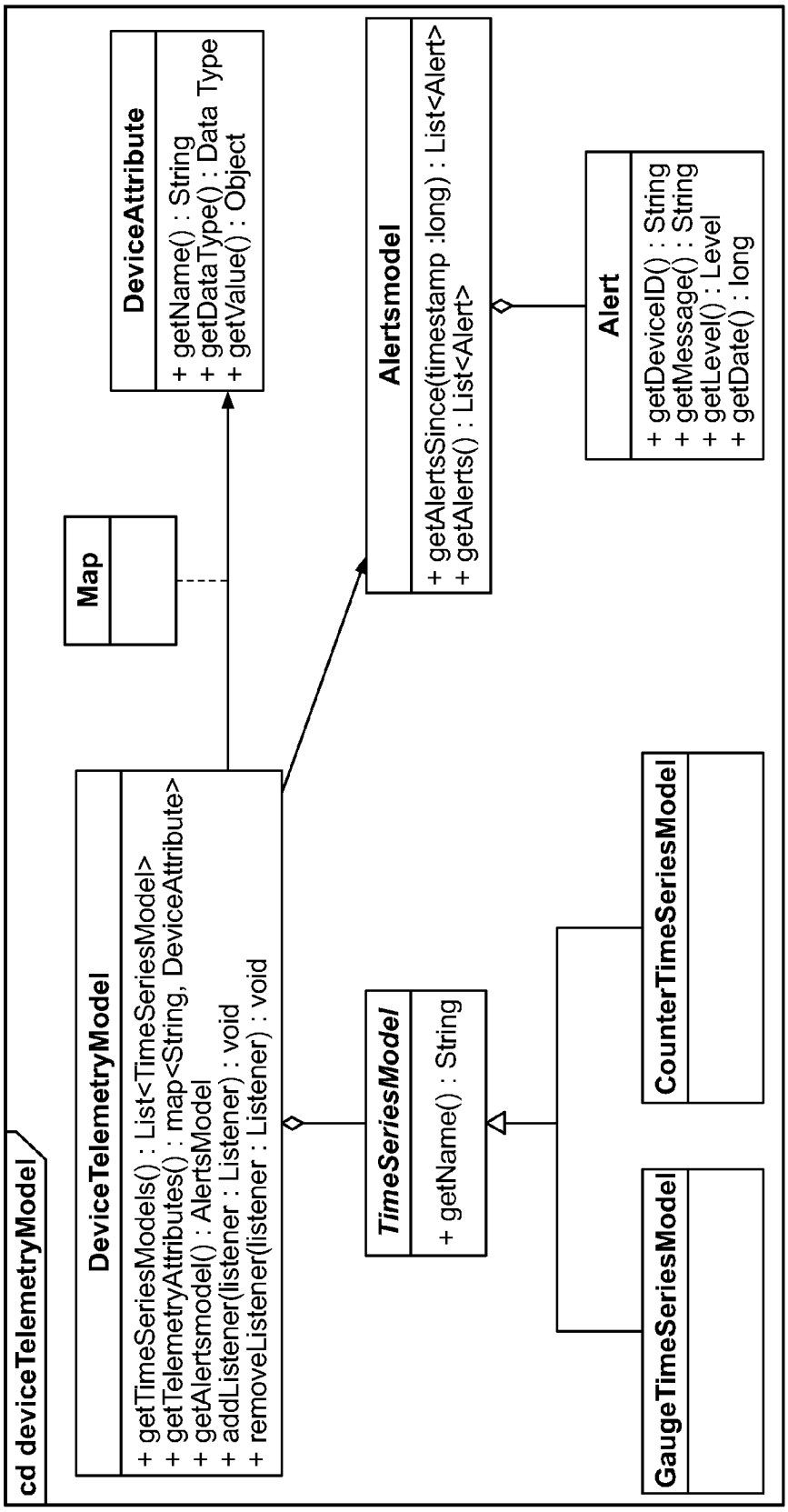

cd deviceTelemetryModel
DeviceTelemetryModel
+ getTimeSeriesModels() : List<TimeSeriesModel>
+ getTelemetryAttributes() : map<String, DeviceAttribute>
+ getAlertsmodel() : AlertsModel
+ addListener(listener : Listener) : void
+ removeListener(listener : Listener) : void
DeviceAttribute
+ getName() : String
+ getDataType() : Data Type
+ getValue() : Object
Map
Alertsmodel
+ getAlertsSince(timestamp :long) : List<Alert>
+ getAlerts() : List<Alert>
Alert
+ getDeviceID() : String
+ getMessage() : String
+ getLevel() : Level
+ getDate() : long
TimeSeriesModel
+ getName() : String
CounterTimeSeriesModel
GaugeTimeSeriesModel

FIG. 9L

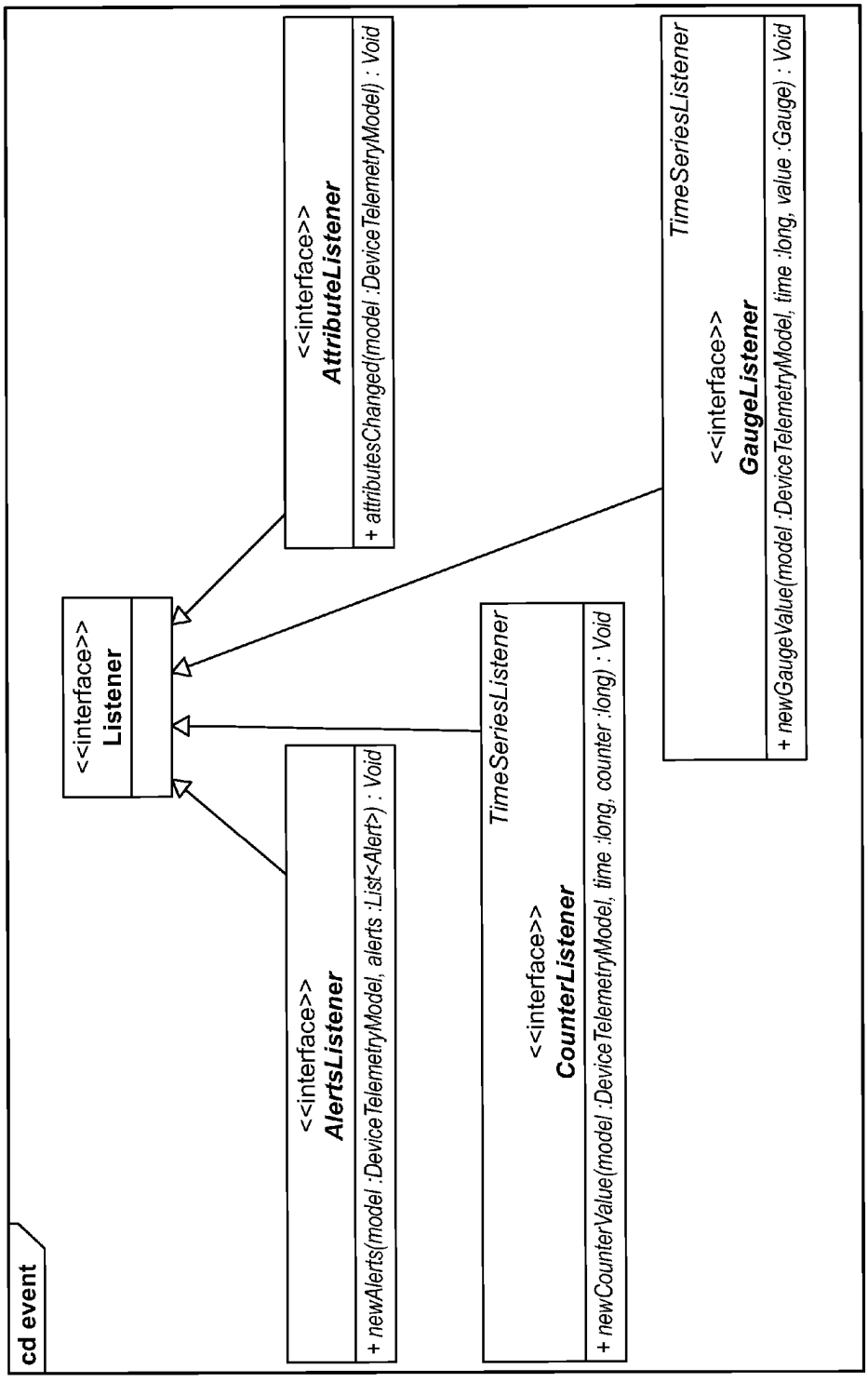

cd event
<<interface>>
Listener
<<interface>>
AttributeListener
+ attributesChanged(model :DeviceTelemetryModel) : Void
<<interface>>
AlertsListener
+ newAlerts(model :DeviceTelemetryModel, alerts :List<Alert>) : Void
TimeSeriesListener
<<interface>>
CounterListener
+ newCounterValue(model :DeviceTelemetryModel, time :long, counter :long) : Void
TimeSeriesListener
<<interface>>
GaugeListener
+ newGaugeValue(model :DeviceTelemetryModel, time :long, value :Gauge) : Void

FIG. 9M

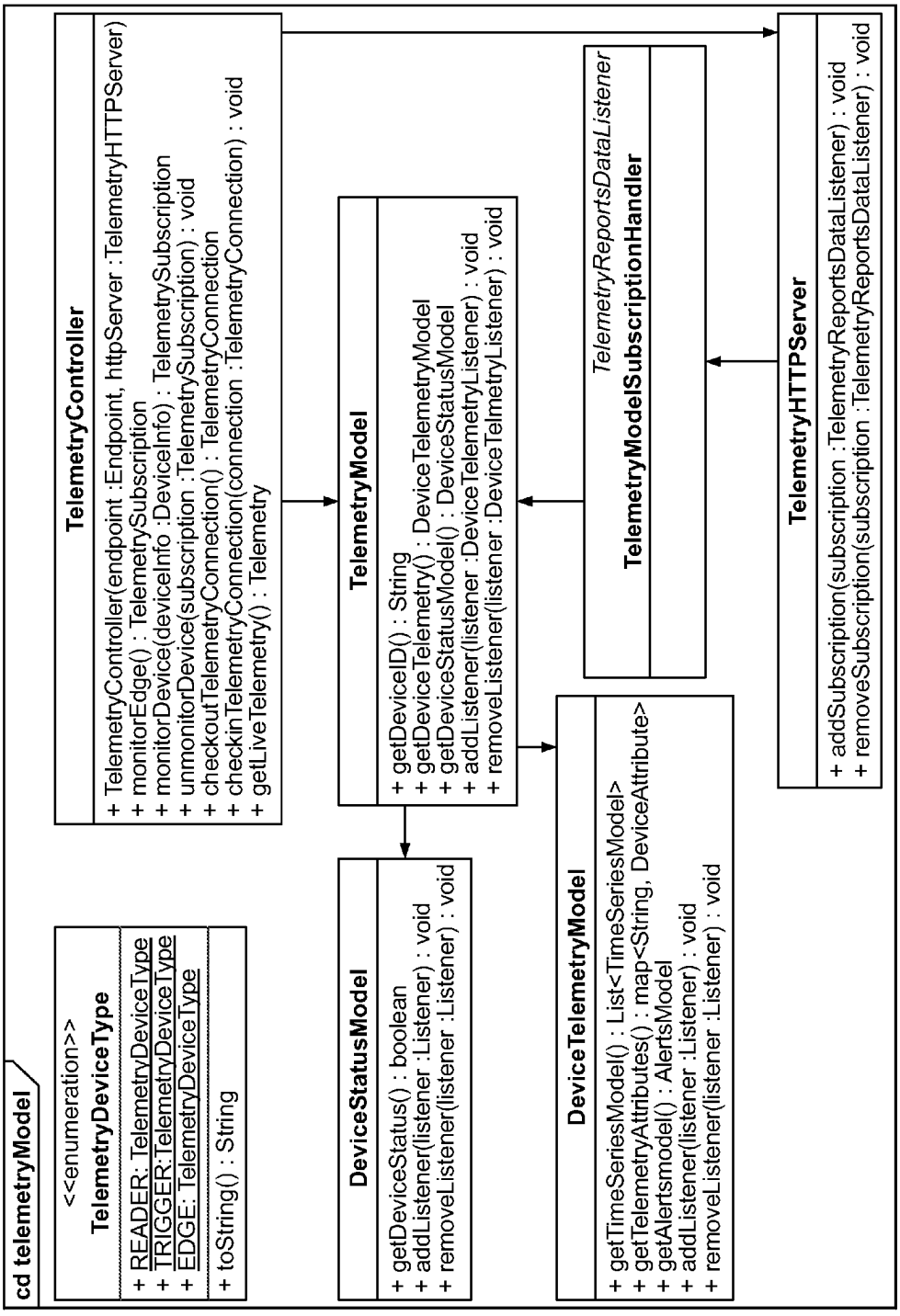

cd telemetryModel
<<enumeration>>
TelemetryDeviceType
+ READER: TelemetryDeviceType
+ TRIGGER:TelemetryDeviceType
+ EDGE: TelemetryDeviceType
+ toString() : String
TelemetryController
+ TelemetryController(endpoint :Endpoint, httpServer :TelemetryHTTPServer)
+ monitorEdge() : TelemetrySubscription
+ monitorDevice(deviceInfo :DeviceInfo) : TelemetrySubscription
+ unmonitorDevice(subscription :TelemetrySubscription) : void
+ checkoutTelemetryConnection() : TelemetryConnection
+ checkinTelemetryConnection(connection :TelemetryConnection) : void
+ getLiveTelemetry() : Telemetry
TelemetryModel
+ getDeviceID() : String
+ getDeviceTelemetry() : DeviceTelemetryModel
+ getDeviceStatusModel() : DeviceStatusModel
+ addListener(listener :DeviceTelemetryListener) : void
+ removeListener(listener :DeviceTelmetryListener) : void
DeviceStatusModel
+ getDeviceStatus() : boolean
+ addListener(listener :Listener) : void
+ removeListener(listener :Listener) : void
DeviceTelemetryModel
+ getTimeSeriesModel() : List<TimeSeriesModel>
+ getTelemetryAttributes() : map<String, DeviceAttribute>
+ getAlertsmodel() : AlertsModel
+ addListener(listener :Listener) : void
+ removeListener(listener :Listener) : void
TelemetryReportsDataListener
TelemetryModelSubscriptionHandler
TelemetryHTTPServer
+ addSubscription(subscription :TelemetryReportsDataListener) : void
+ removeSubscription(subscription :TelemetryReportsDataListener) : void

FIG. 9N

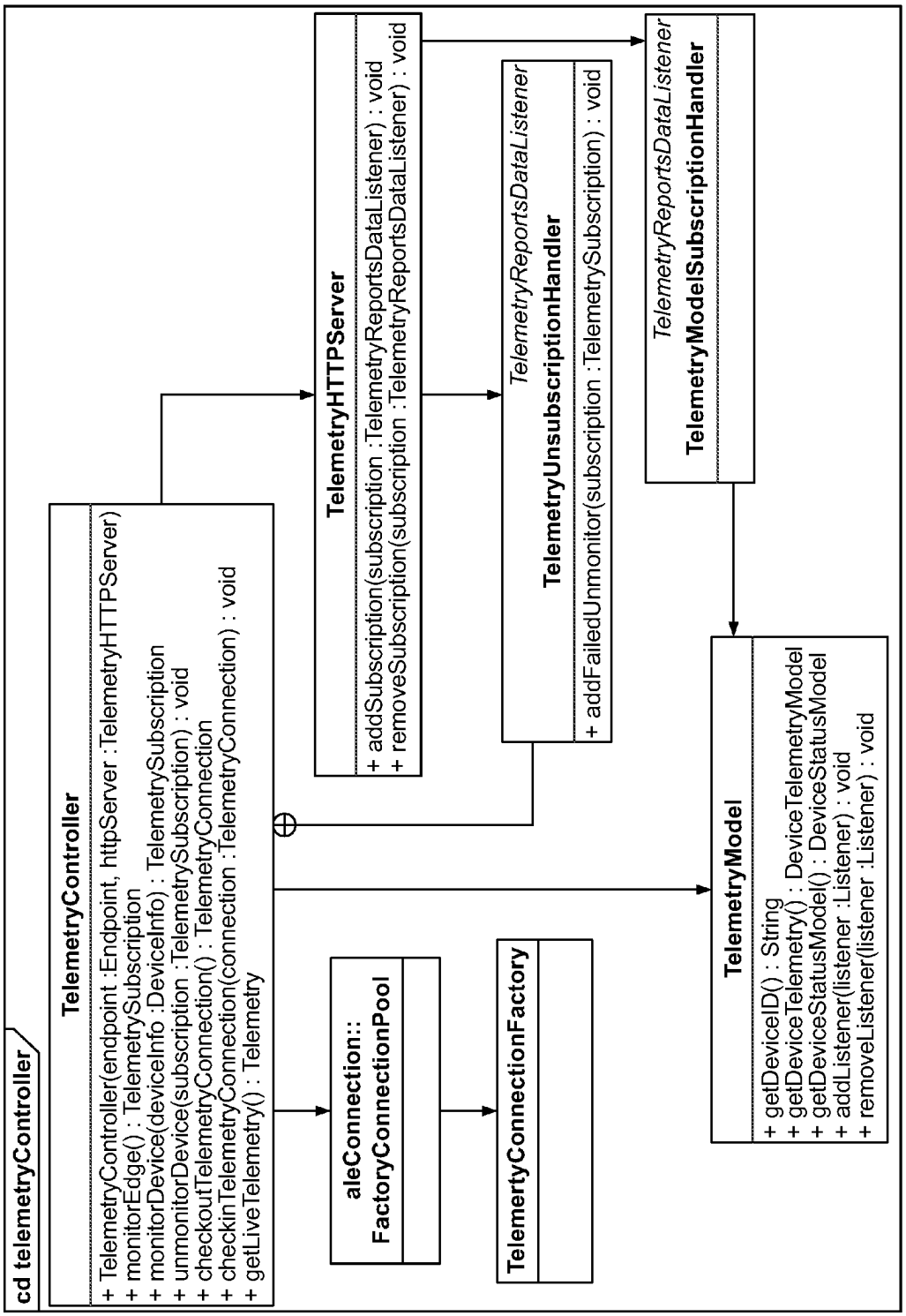

cd telemetryController
TelemetryController
+ TelemetryController(endpoint :Endpoint, httpServer :TelemetryHTTPServer)
+ monitorEdge() : TelemetrySubscription
+ monitorDevice(deviceInfo :DeviceInfo) : TelemetrySubscription
+ unmonitorDevice(subscription :TelemetrySubscription) : void
+ checkoutTelemetryConnection() : TelemetryConnection
+ checkinTelemetryConnection(connection :TelemetryConnection) : void
+ getLiveTelemetry() : Telemetry
TelemetryHTTPServer
+ addSubscription(subscription :TelemetryReportsDataListener) : void
+ removeSubscription(subscription :TelemetryReportsDataListener) : void
TelemetryReportsDataListener
TelemetryUnsubscriptionHandler
+ addFailedUnmonitor(subscription :TelemetrySubscription) : void
TelemetryReportsDataListener
TelemetryModelSubscriptionHandler
aleConnection::
FactoryConnectionPool
TelemertyConnectionFactory
TelemetryModel
+ getDeviceID() : String
+ getDeviceTelemetry() : DeviceTelemetryModel
+ getDeviceStatusModel() : DeviceStatusModel
+ addListener(listener :Listener) : void
+ removeListener(listener :Listener) : void

FIG. 9O

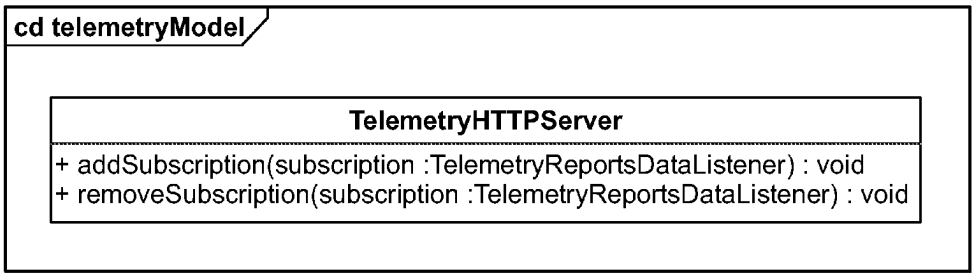

cd telemetryModel
TelemetryHTTPServer
+ addSubscription(subscription :TelemetryReportsDataListener) : void
+ removeSubscription(subscription :TelemetryReportsDataListener) : void

FIG. 9P

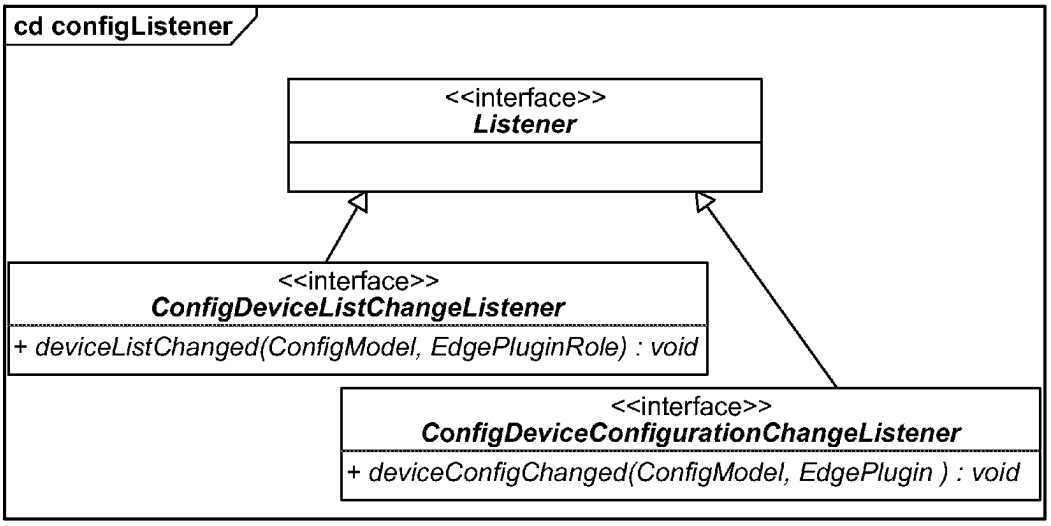

cd configListener
<<interface>>
Listener
<<interface>>
ConfigDeviceListChangeListener
+ deviceListChanged(ConfigModel, EdgePluginRole) : void
<<interface>>
ConfigDeviceConfigurationChangeListener
+ deviceConfigChanged(ConfigModel, EdgePlugin) : void

FIG. 9R

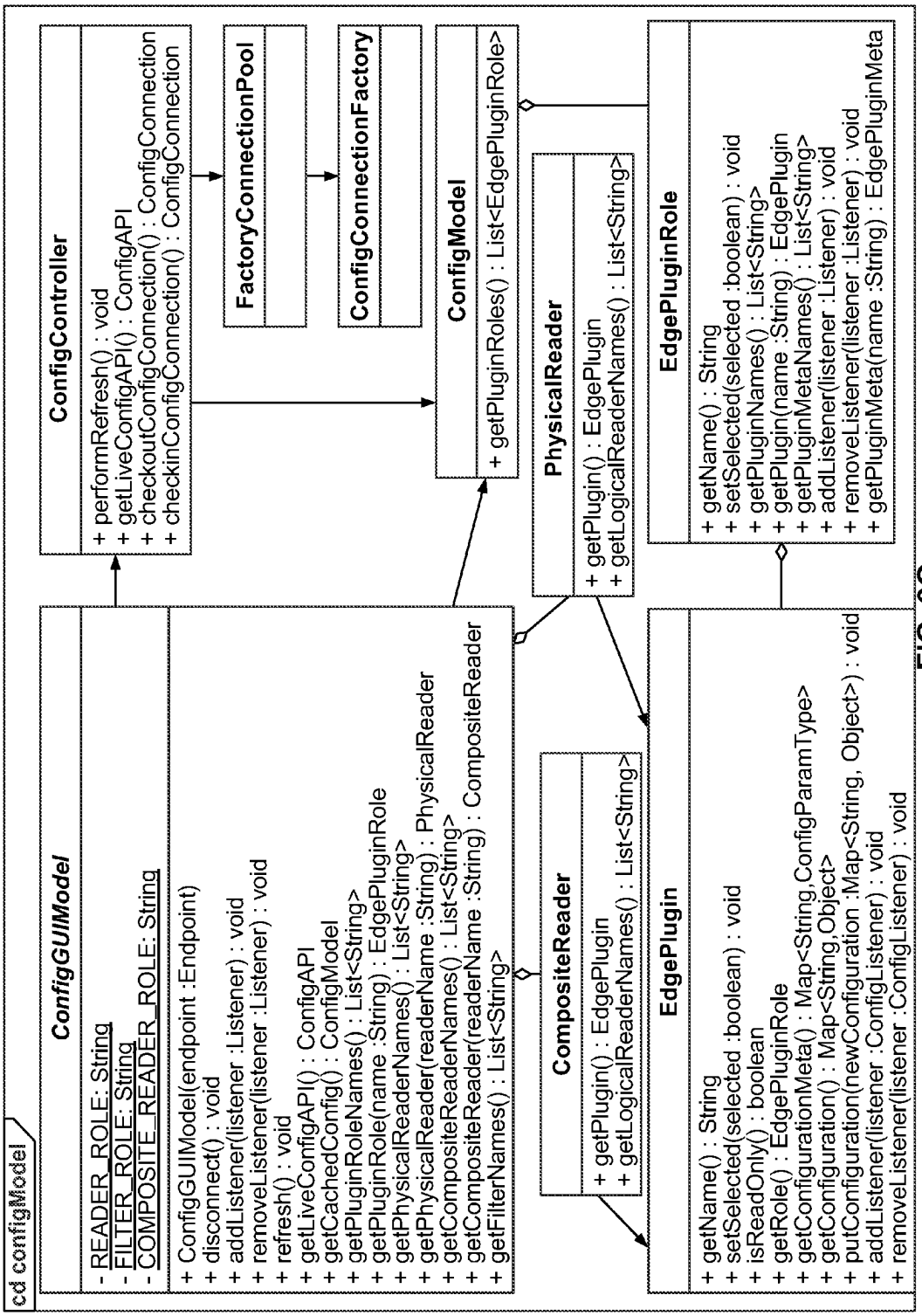

cd configModel
ConfigGUIModel
- READER_ROLE: String
- FILTER_ROLE: String
- COMPOSITE_READER_ROLE: String
+ ConfigGUIModel(endpoint :Endpoint)
+ disconnect() : void
+ addListener(listener :Listener) : void
+ removeListener(listener :Listener) : void
+ refresh() : void
+ getLiveConfigAPI() : ConfigAPI
+ getCachedConfig() : ConfigModel
+ getPluginRoleNames() : List<String>
+ getPluginRole(name :String) : EdgePluginRole
+ getPhysicalReaderNames() : List<String>
+ getPhysicalReader(readerName :String) : PhysicalReader
+ getCompositeReaderNames() : List<String>
+ getCompositeReader(readerName :String) : CompositeReader
+ getFilterNames() : List<String>
ConfigController
+ performRefresh() : void
+ getLiveConfigAPI() : ConfigAPI
+ checkoutConfigConnection() : ConfigConnection
+ checkinConfigConnection() : ConfigConnection
FactoryConnectionPool
ConfigConnectionFactory
ConfigModel
+ getPluginRoles() : List<EdgePluginRole>
PhysicalReader
+ getPlugin() : EdgePlugin
+ getLogicalReaderNames() : List<String>
CompositeReader
+ getPlugin() : EdgePlugin
+ getLogicalReaderNames() : List<String>
EdgePluginRole
+ getName() : String
+ setSelected(selected :boolean) : void
+ getPluginNames() : List<String>
+ getPlugin(name :String) : EdgePlugin
+ getPluginMetaNames() : List<String>
+ addListener(listener :Listener) : void
+ removeListener(listener :Listener) : void
+ getPluginMeta(name :String) : EdgePluginMeta
EdgePlugin
+ getName() : String
+ setSelected(selected :boolean) : void
+ isReadOnly() : boolean
+ getRole() : EdgePluginRole
+ getConfigurationMeta() : Map<String,ConfigParamType>
+ getConfiguration() : Map<String,Object>
+ putConfiguration(newConfiguration :Map<String, Object>) : void
+ addListener(listener :ConfigListener) : void
+ removeListener(listener :ConfigListener) : void

FIG. 9Q

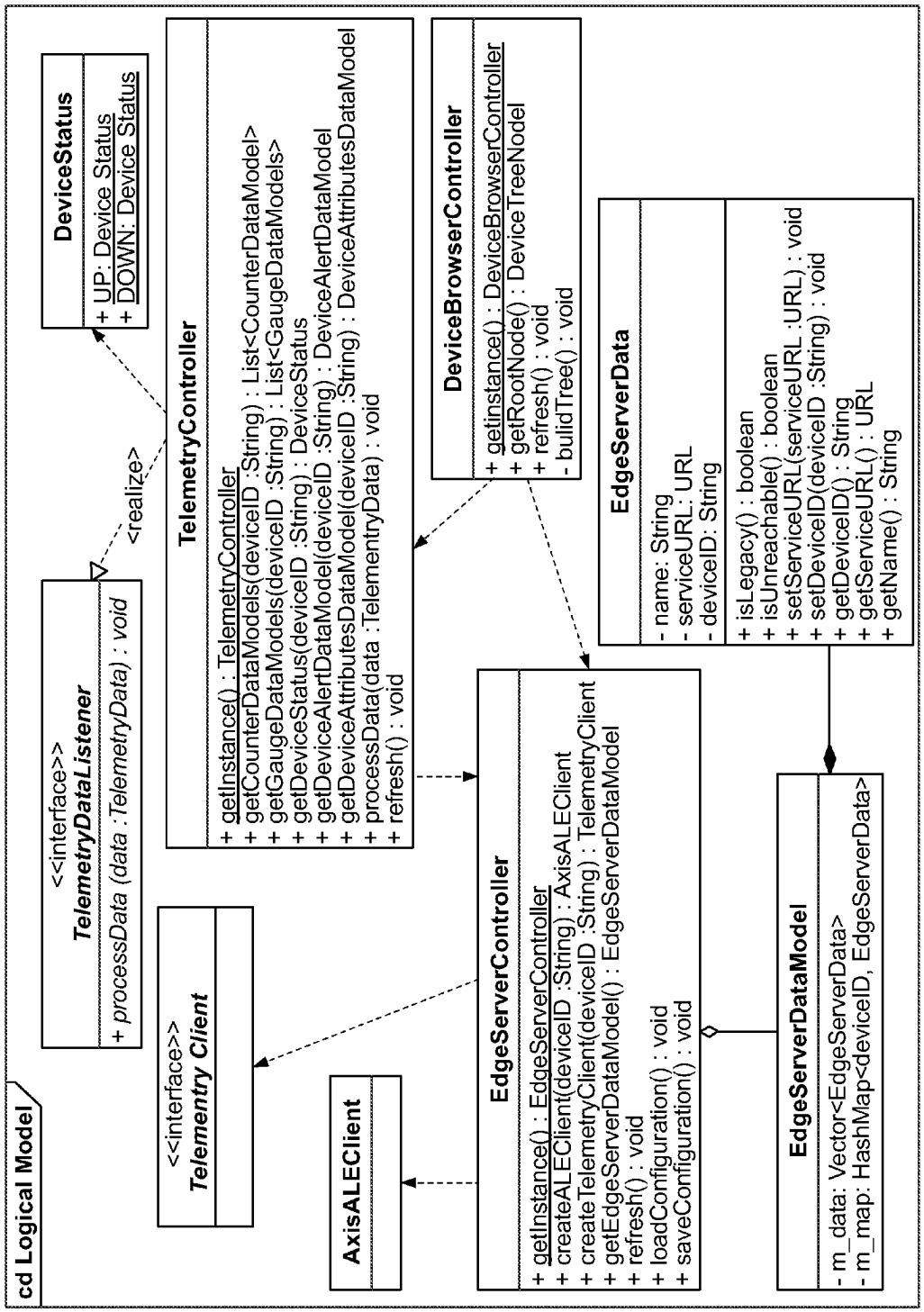
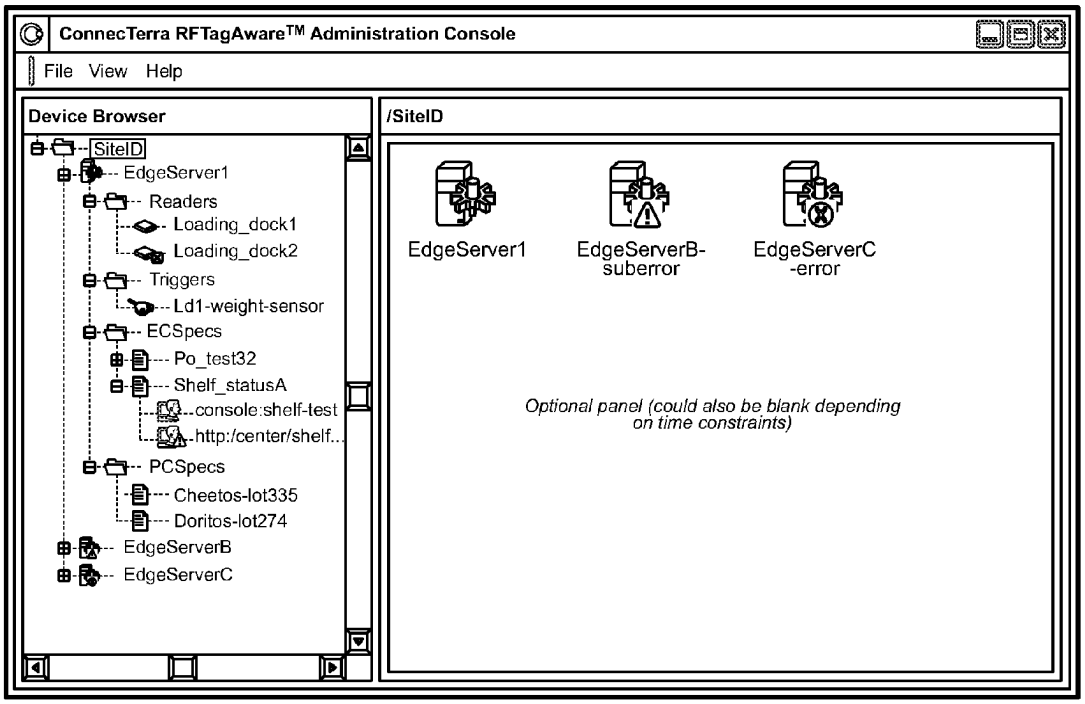

cd Logical Model
<<interface>>
TelemetryDataListener
+ processData (data :TelemetryData) : void
<realize>
DeviceStatus
+ UP: Device Status
+ DOWN: Device Status
TelemetryController
+ getInstance() : TelemetryController
+ getCounterDataModels(deviceID :String) : List<CounterDataModel>
+ getGaugeDataModels(deviceID :String) : List<GaugeDataModels>
+ getDeviceStatus(deviceID :String) : DeviceStatus
+ getDeviceAlertDataModel(deviceID :String) : DeviceAlertDataModel
+ getDeviceAttributesDataModel(deviceID :String) : DeviceAttributesDataModel
+ processData(data :TelemetryData) : void
+ refresh() : void
DeviceBrowserController
+ getinstance() : DeviceBrowserController
+ getRootNode() : DeviceTreeNodel
+ refresh() : void
- bulidTree() : void
EdgeServerData
- name: String
- serviceURL: URL
- deviceID: String
+ isLegacy() : boolean
+ isUnreachable() : boolean
+ setServiceURL(serviceURL :URL) : void
+ setDeviceID(deviceID :String) : void
+ getDeviceID() : String
+ getServiceURL() : URL
+ getName() : String
<<interface>>
Telementry Client
AxisALEClient
EdgeServerController
+ getInstance() : EdgeServerController
+ createALEClient(deviceID :String) : AxisALEClient
+ createTelemetryClient(deviceID :String) : TelemetryClient
+ getEdgeServerDataModel() : EdgeServerDataModel
+ refresh() : void
+ loadConfiguration() : void
+ saveConfiguration() : void
EdgeServerDataModel
- m_data: Vector<EdgeServerData>
- m_map: HashMap<deviceID, EdgeServerData>

FIG. 10


ConnecTerra RFTagAware™ Administration Console
File View Help
Device Browser
/SiteID
SiteID
EdgeServer1
Readers
Loading_dock1
Loading_dock2
Triggers
Ld1-weight-sensor
ECSpecs
Po_test32
Shelf_statusA
console:shelf-test
http:/center/shelf...
PCSpecs
Cheetos-lot335
Doritos-lot274
EdgeServerB
EdgeServerC
EdgeServer1
EdgeServerB-suberror
EdgeServerC-error
Optional panel (could also be blank depending on time constraints)

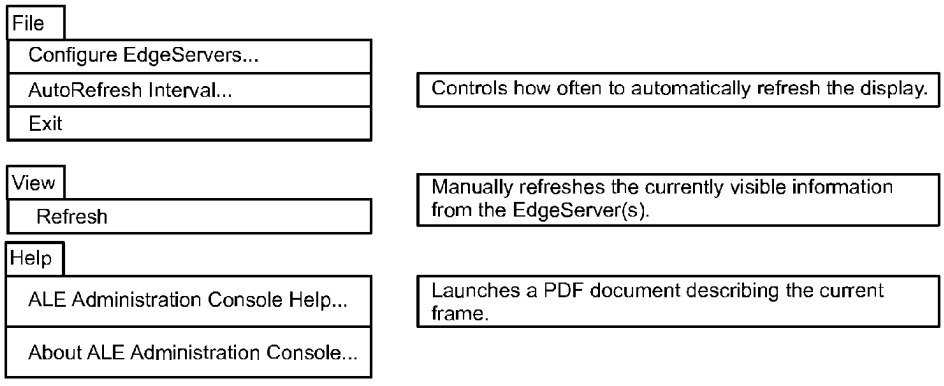
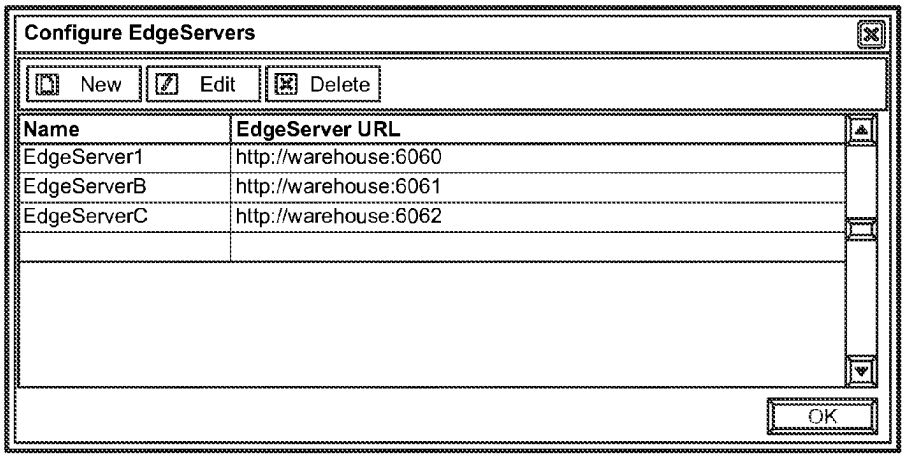
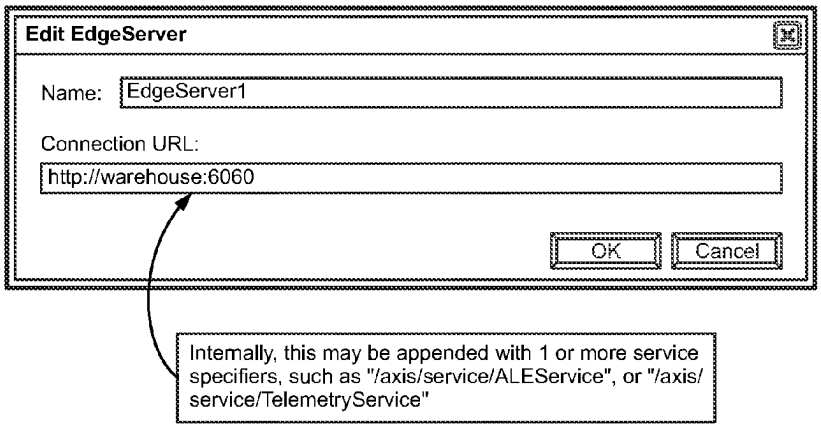

File
Configure EdgeServers...
AutoRefresh Interval...
Exit
Controls how often to automatically refresh the display.
View
Refresh
Manually refreshes the currently visible information from the EdgeServer(s).
Help
ALE Administration Console Help...
About ALE Administration Console...
Launches a PDF document describing the current frame.

FIG. 11A


Configure EdgeServers
New
Edit
Delete
Name
EdgeServer URL
EdgeServer1
http://warehouse:6060
EdgeServerB
http://warehouse:6061
EdgeServerC
http://warehouse:6062
OK


Edit EdgeServer
Name:
EdgeServer1
Connection URL:
http://warehouse:6060
OK
Cancel
Internally, this may be appended with 1 or more service specifiers, such as "/axis/service/ALEService", or "/axis/service/TelemetryService"

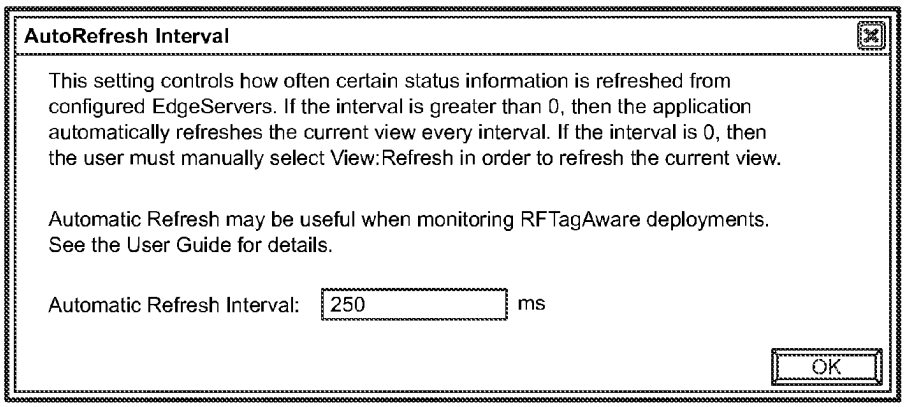

AutoRefresh Interval
This setting controls how often certain status information is refreshed from configured EdgeServers. If the interval is greater than 0, then the application automatically refreshes the current view every interval. If the interval is 0, then the user must manually select View:Refresh in order to refresh the current view.
Automatic Refresh may be useful when monitoring RFTagAware deployments. See the User Guide for details.
Automatic Refresh Interval:
250
ms
OK

FIG. 11B

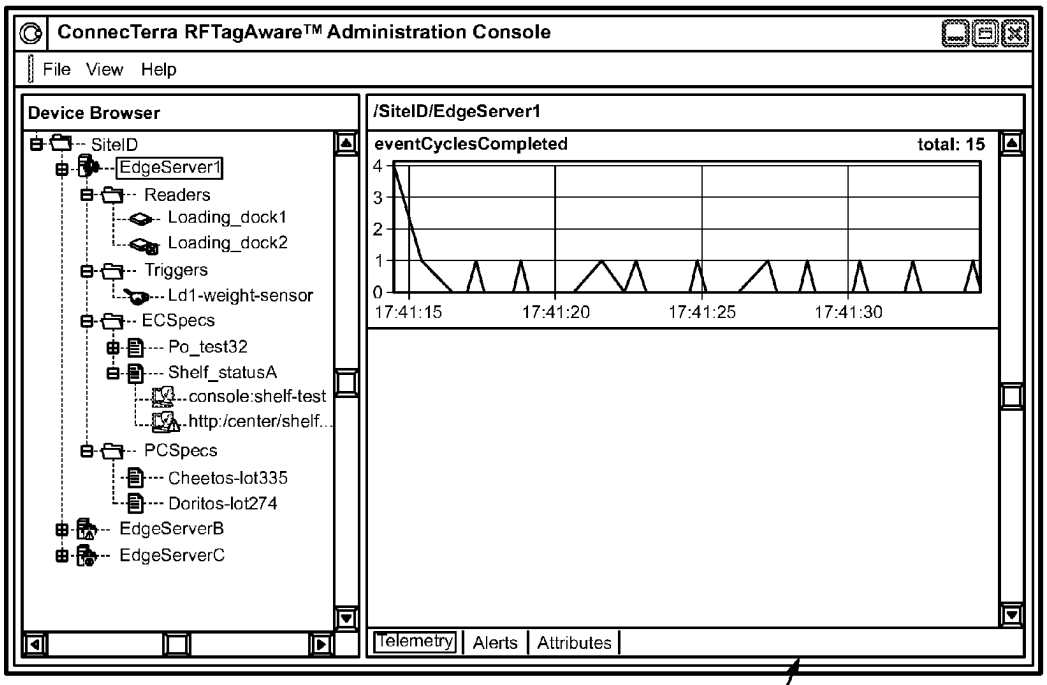


FIG. 11C

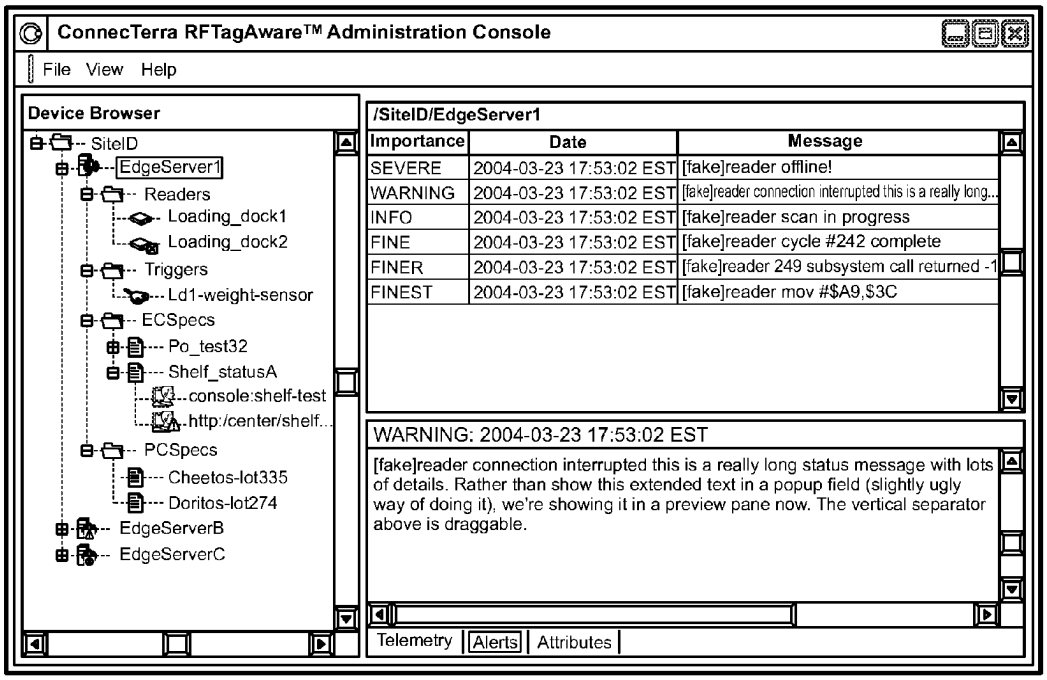


FIG. 11D

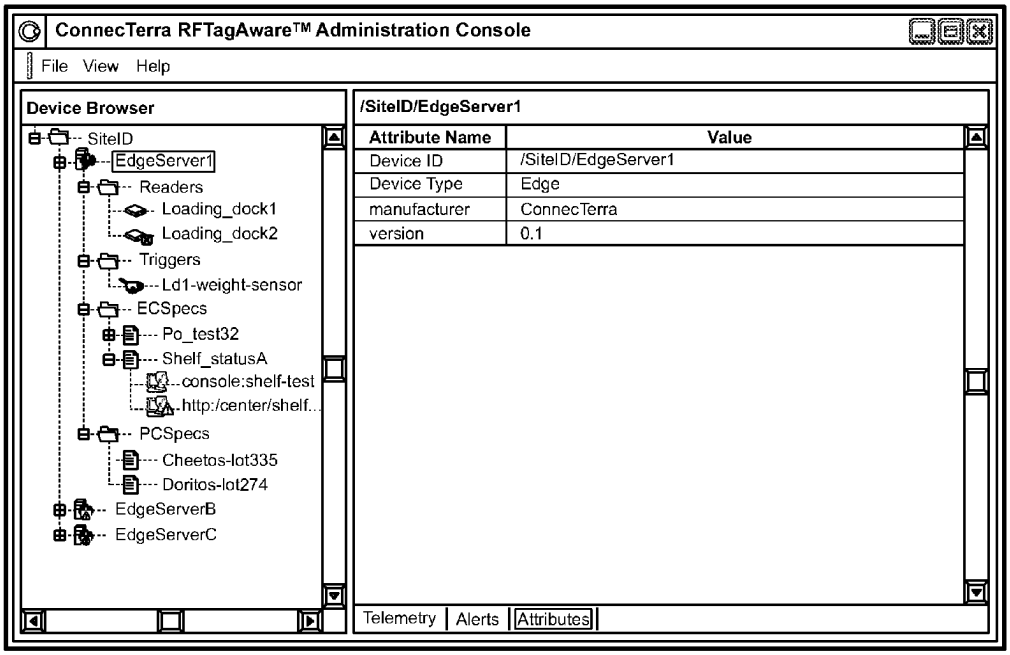


FIG. 11E

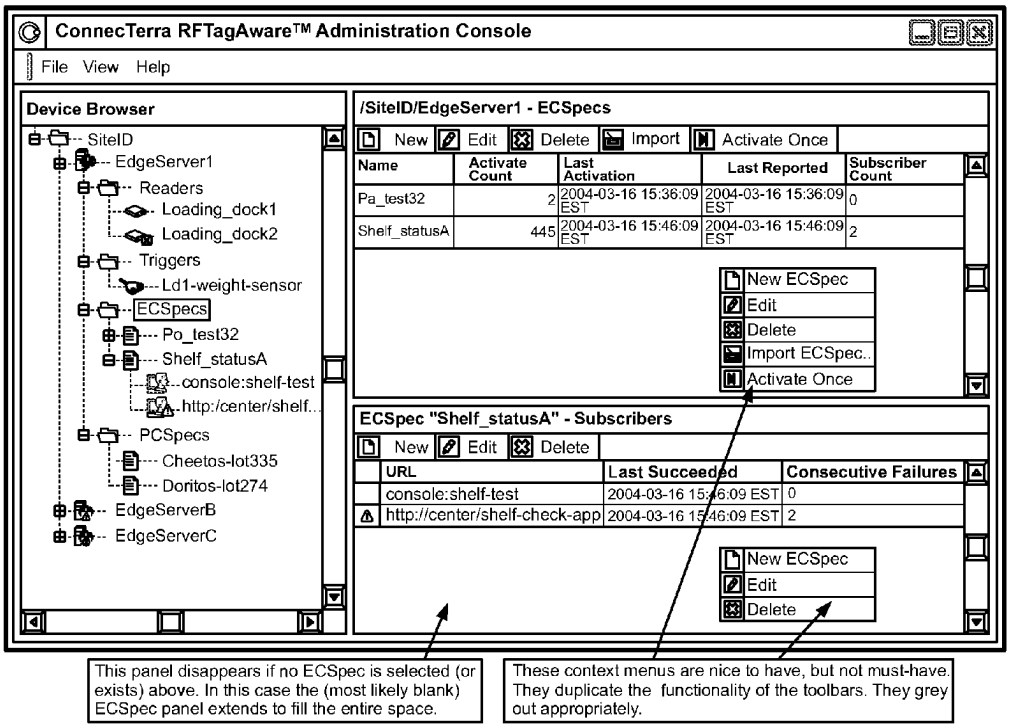


FIG. 11F

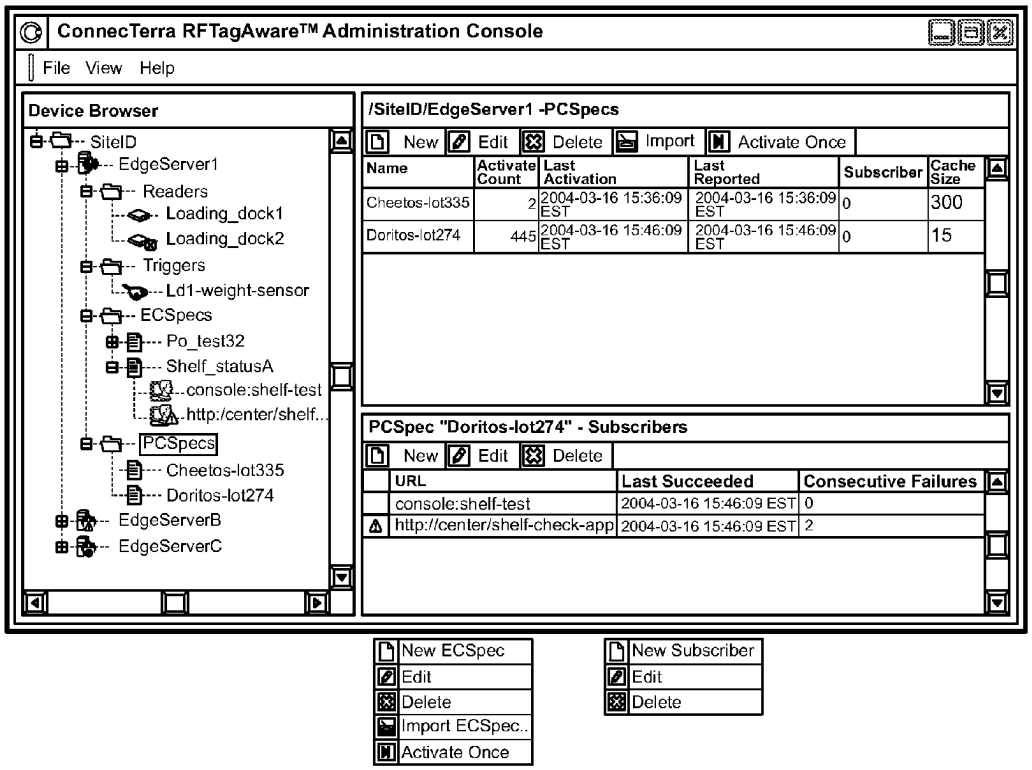


FIG. 11G

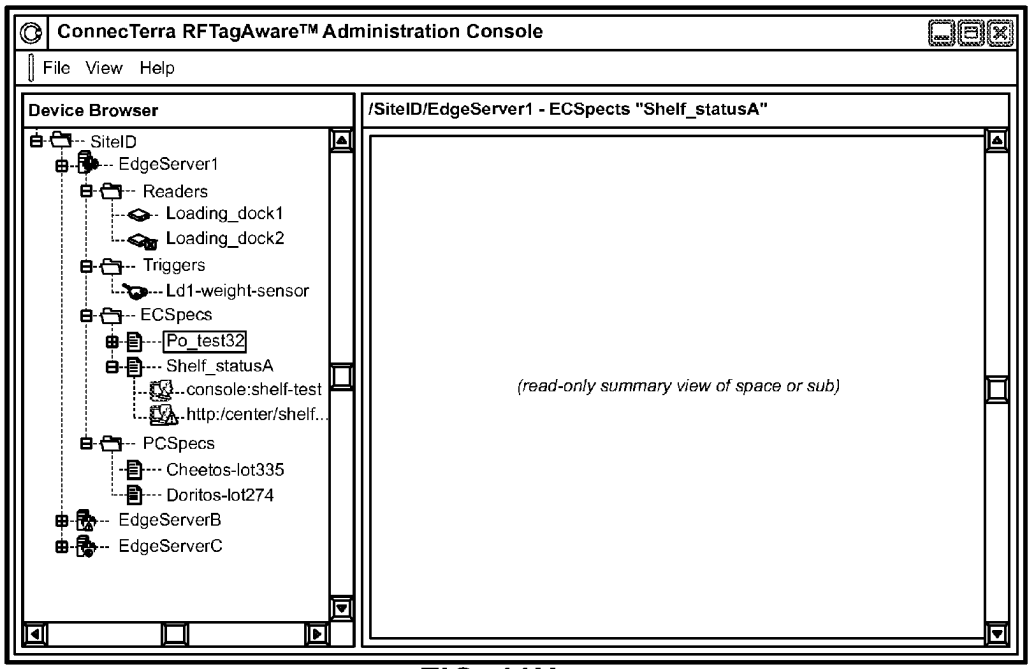


FIG. 11H

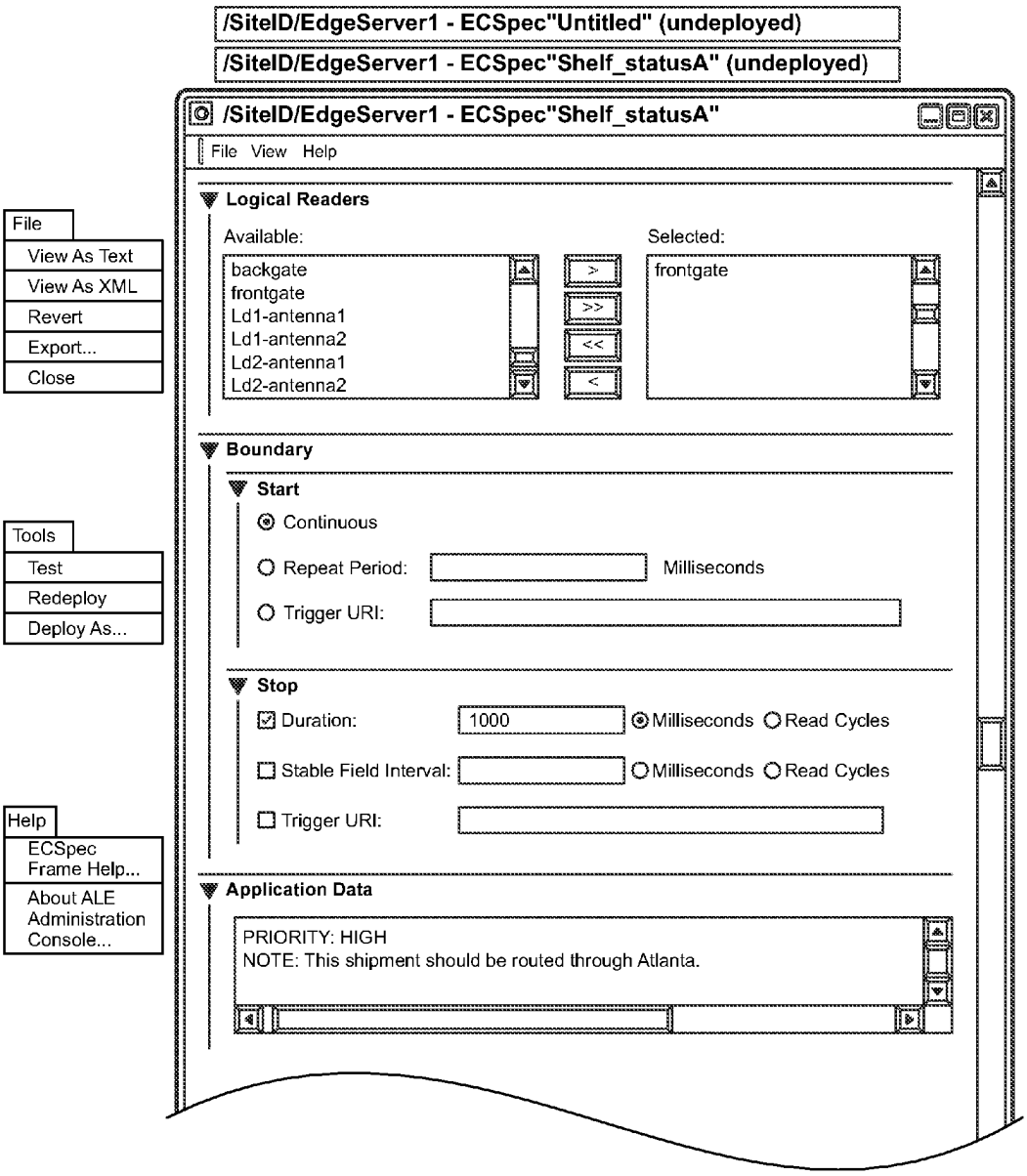

/SiteID/EdgeServer1 - ECSpec"Untitled" (undeployed)
/SiteID/EdgeServer1 - ECSpec"Shelf_statusA" (undeployed)
/SiteID/EdgeServer1 - ECSpec"Shelf_statusA"
File View Help
File
View As Text
View As XML
Revert
Export...
Close
Tools
Test
Redeploy
Deploy As...
Help
ECSpec Frame Help...
About ALE Administration Console...
Logical Readers
Available:
backgate
frontgate
Ld1-antenna1
Ld1-antenna2
Ld2-antenna1
Ld2-antenna2
>
>>
<<
<
Selected:
frontgate
Boundary
Start
Continuous
Repeat Period:
Milliseconds
Trigger URI:
Stop
Duration:
1000
Milliseconds
Read Cycles
Stable Field Interval:
Milliseconds
Read Cycles
Trigger URI:
Application Data
PRIORITY: HIGH
NOTE: This shipment should be routed through Atlanta.

FIG. 11I

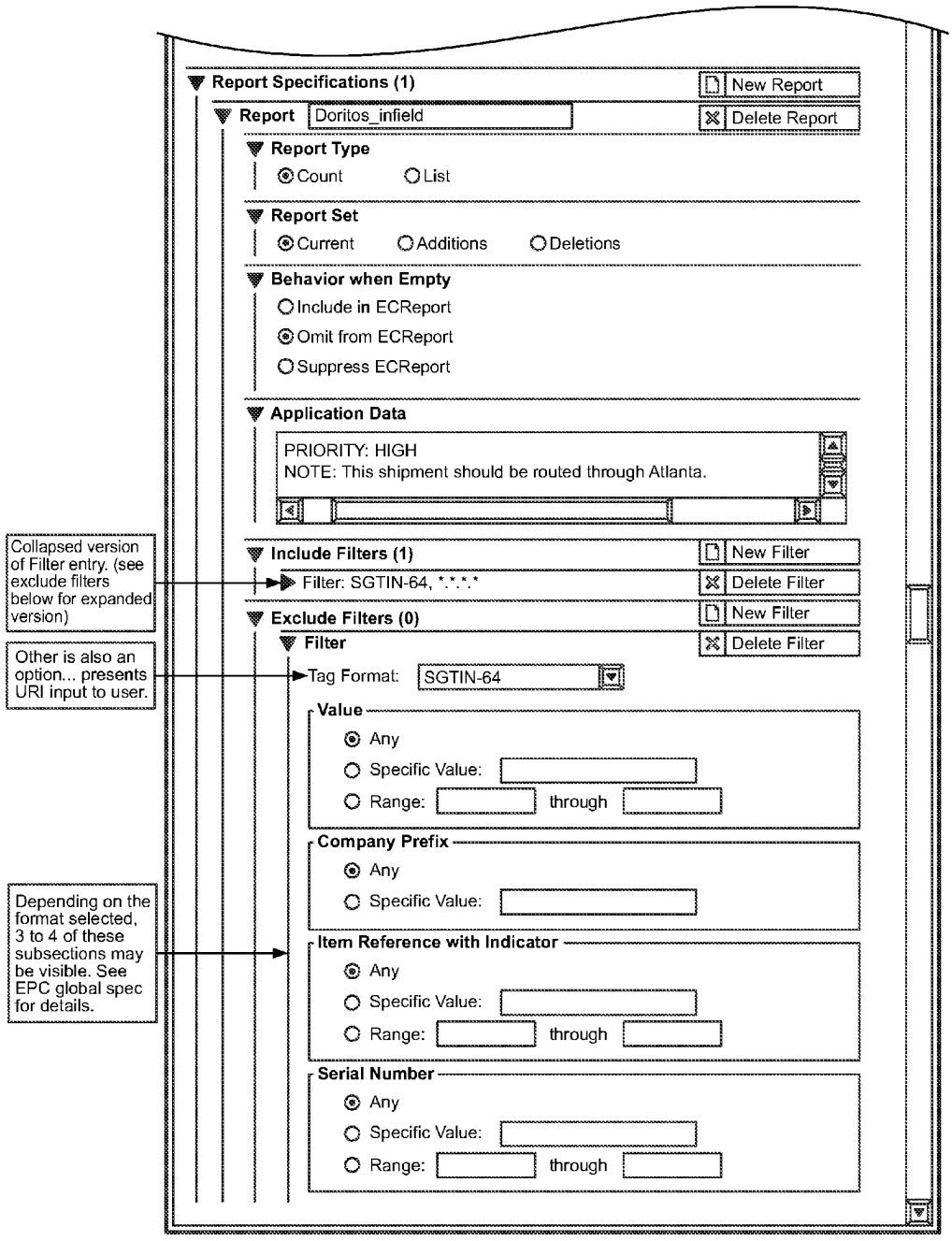

Report Specifications (1)
New Report
Report
Doritos_infield
Delete Report
Report Type
Count
List
Report Set
Current
Additions
Deletions
Behavior when Empty
Include in ECReport
Omit from ECReport
Suppress ECReport
Application Data
PRIORITY: HIGH
NOTE: This shipment should be routed through Atlanta.
Include Filters (1)
New Filter
Filter: SGTIN-64, *.*.*
Delete Filter
Exclude Filters (0)
New Filter
Filter
Delete Filter
Tag Format:
SGTIN-64
Value
Any
Specific Value:
Range:
through
Company Prefix
Any
Specific Value:
Item Reference with Indicator
Any
Specific Value:
Range:
through
Serial Number
Any
Specific Value:
Range:
through
Collapsed version of Filter entry. (see exclude filters below for expanded version)
Other is also an option... presents URI input to user.
Depending on the format selected, 3 to 4 of these subsections may be visible. See EPC global spec for details.

FIG. 11J

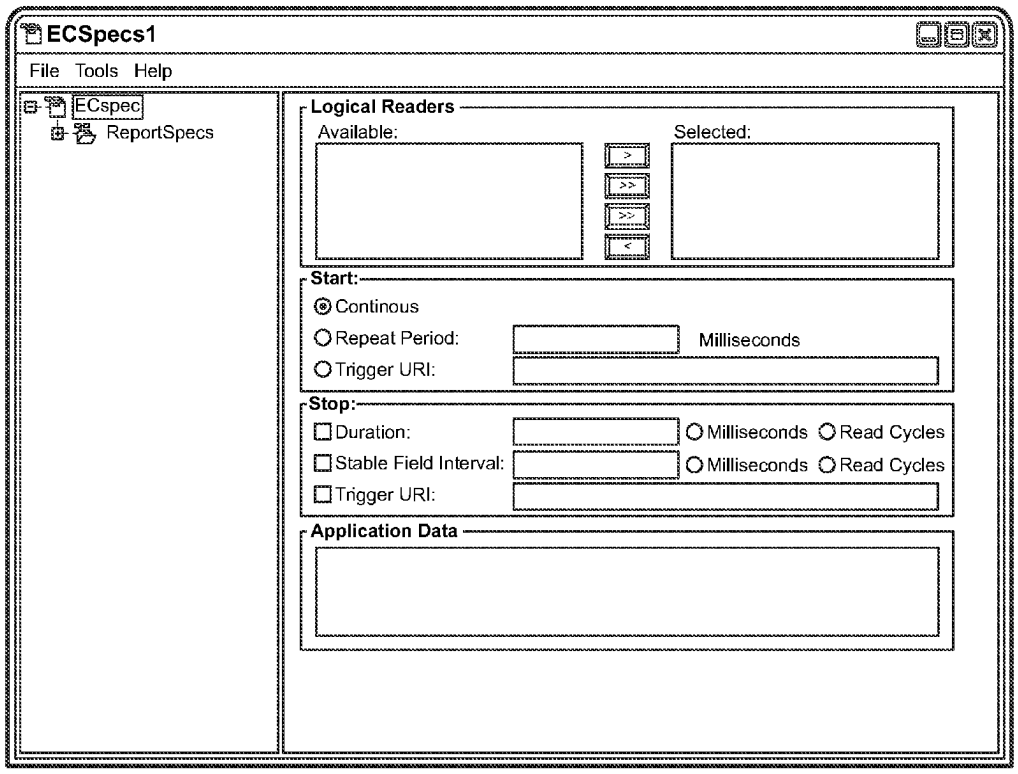


FIG. 11K

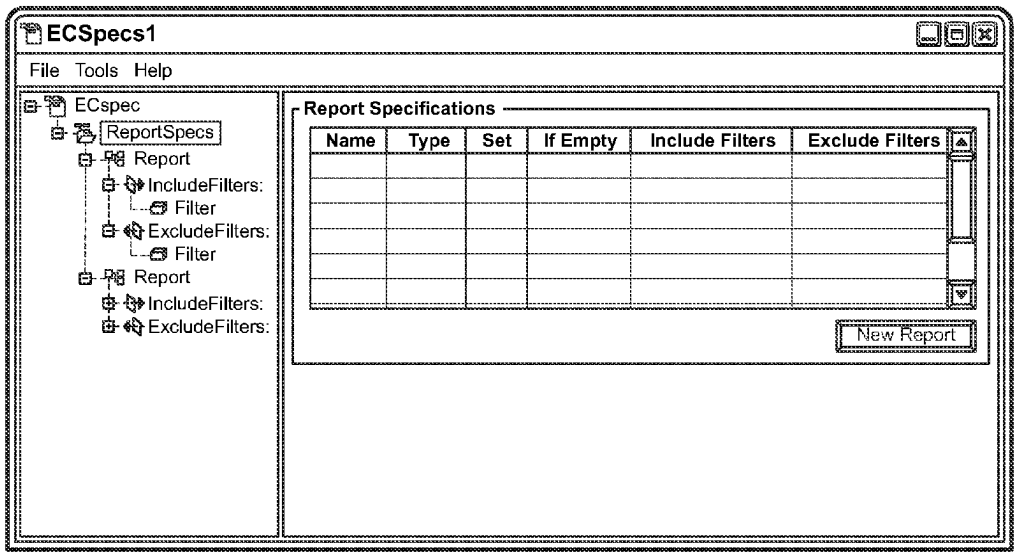


FIG. 11L

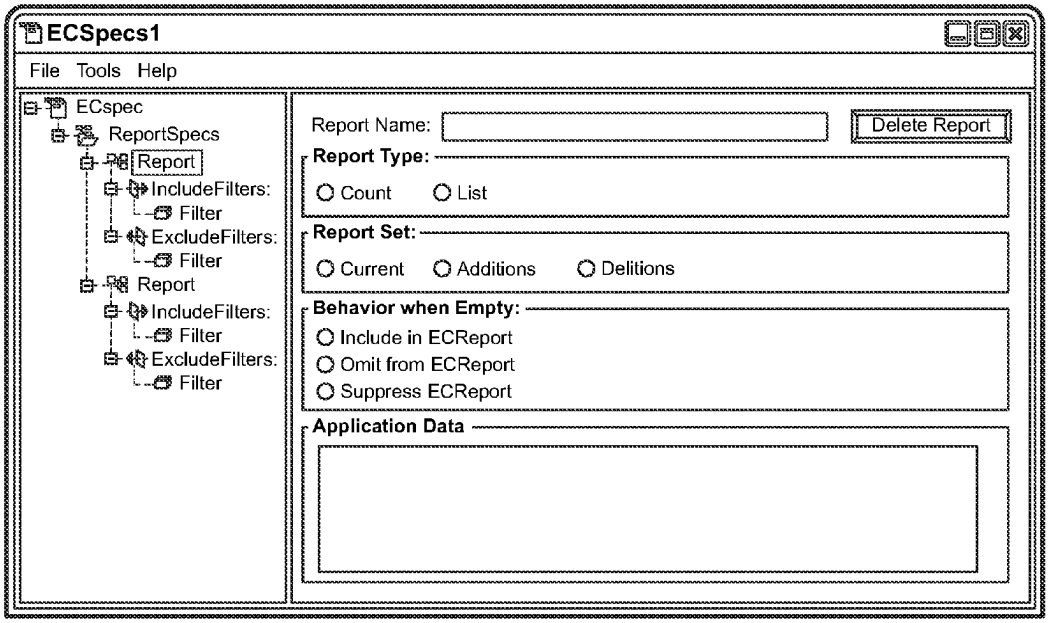


FIG. 11M

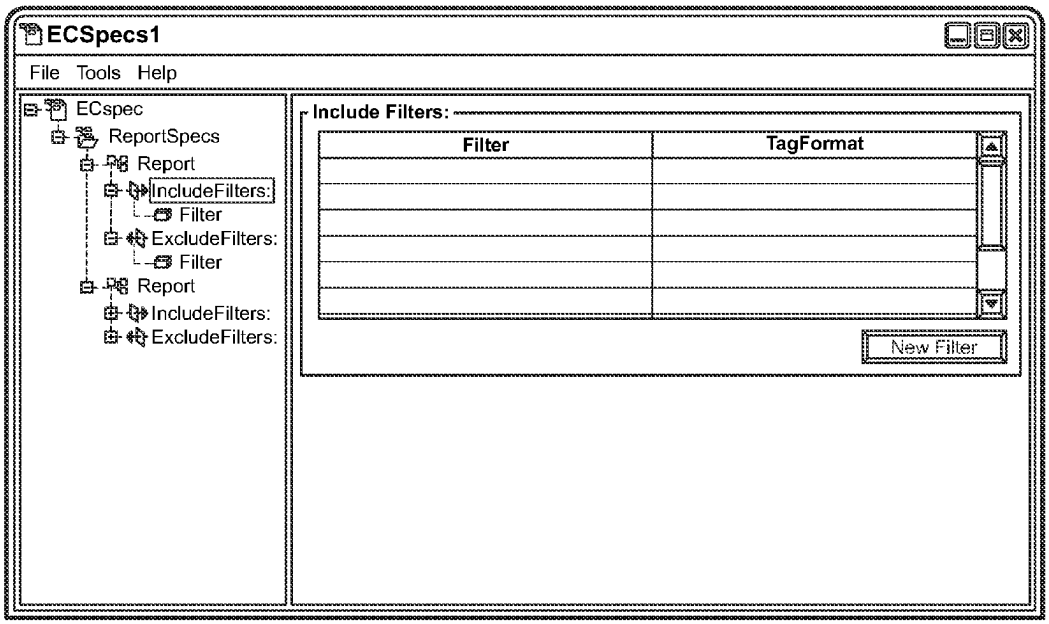


FIG. 11N

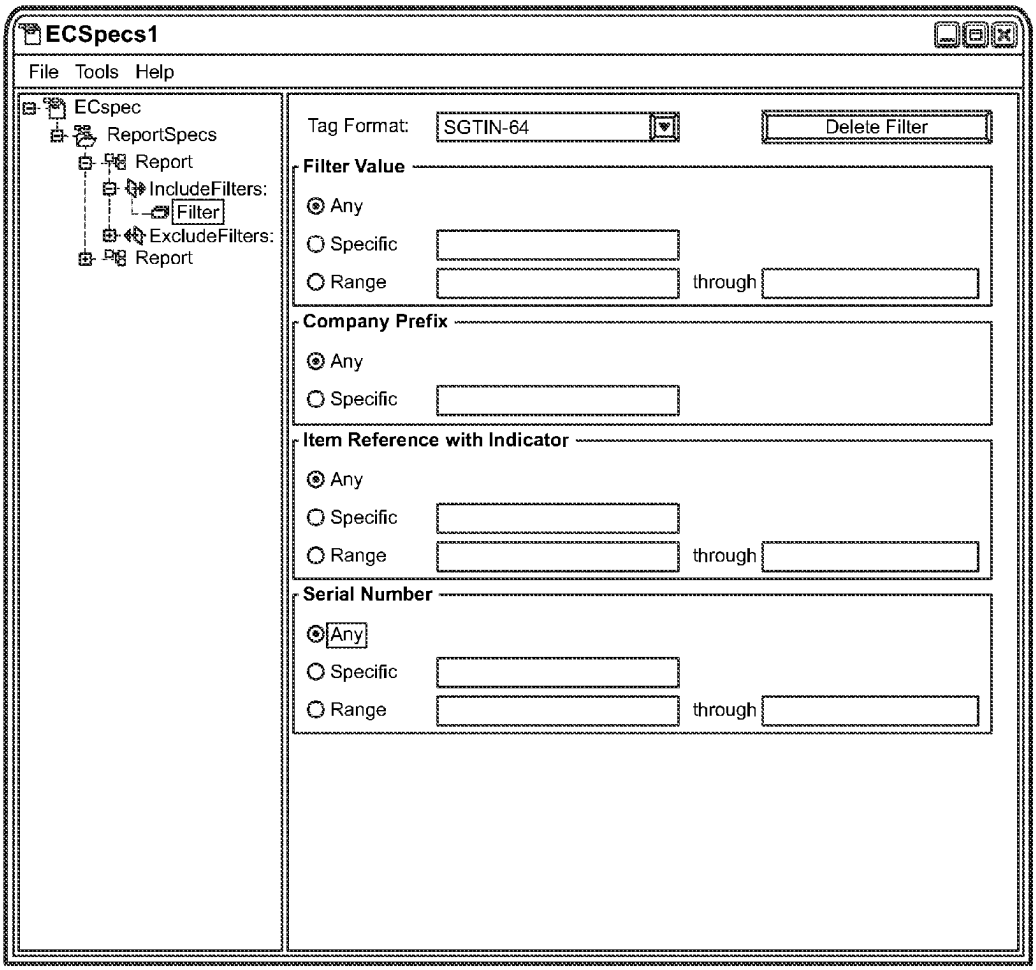

ECSpecs1
File Tools Help
ECspec
ReportSpecs
Report
IncludeFilters:
Filter
ExcludeFilters:
Report
Tag Format:
SGTIN-64
Delete Filter
Filter Value
Any
Specific
Range
through
Company Prefix
Any
Specific
Item Reference with Indicator
Any
Specific
Range
through
Serial Number
Any
Specific
Range
through

FIG. 11O

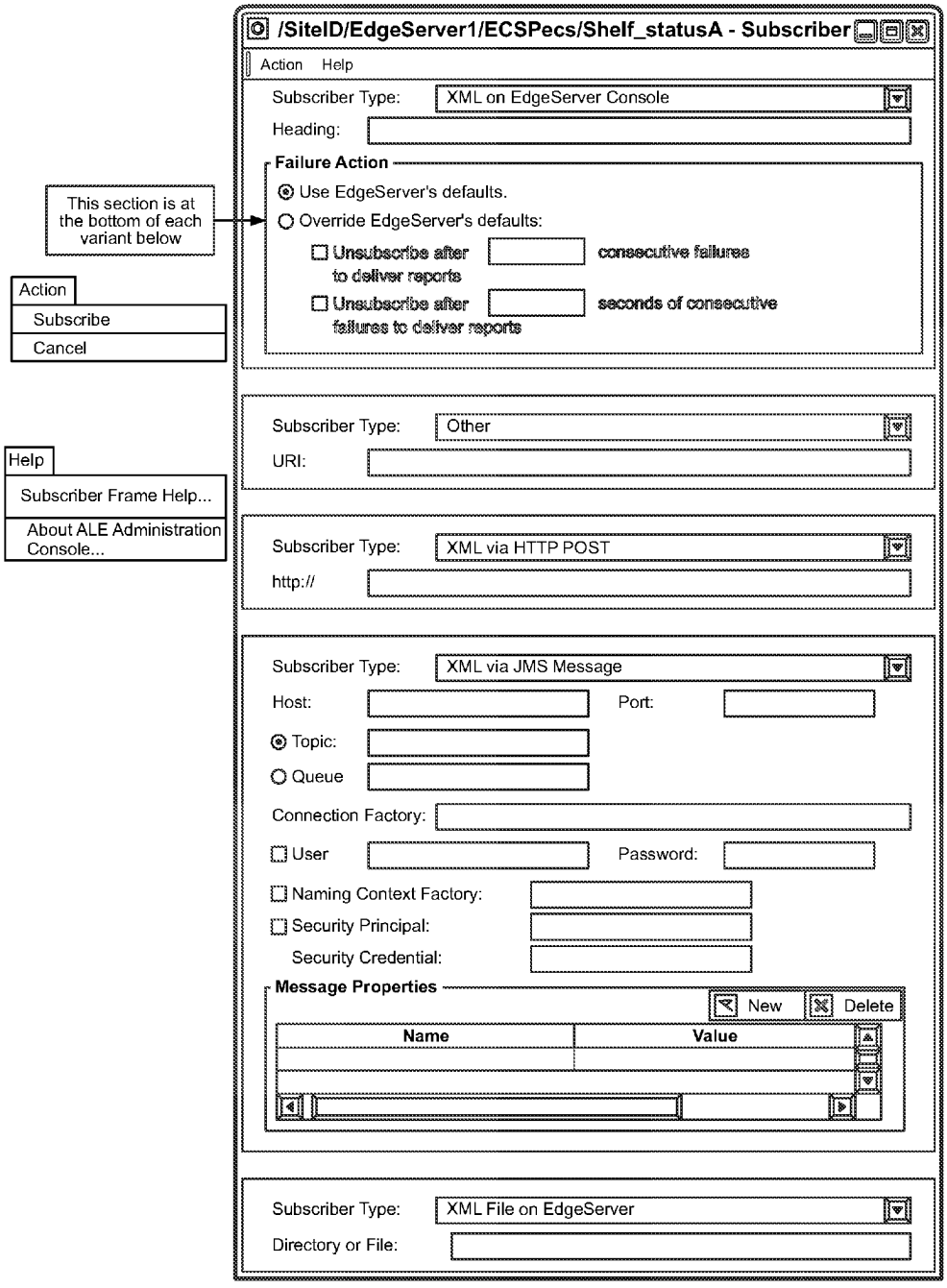

/SiteID/EdgeServer1/ECSPecs/Shelf_statusA - Subscriber
Action Help
Subscriber Type: XML on EdgeServer Console
Heading:
Failure Action
Use EdgeServer's defaults.
Override EdgeServer's defaults:
Unsubscribe after to deliver reports
consecutive failures
Unsubscribe after failures to deliver reports
seconds of consecutive
This section is at the bottom of each variant below
Action
Subscribe
Cancel
Help
Subscriber Frame Help...
About ALE Administration Console...
Subscriber Type: Other
URI:
Subscriber Type: XML via HTTP POST
http://
Subscriber Type: XML via JMS Message
Host:
Port:
Topic:
Queue
Connection Factory:
User
Password:
Naming Context Factory:
Security Principal:
Security Credential:
Message Properties
New
Delete
Name
Value
Subscriber Type: XML File on EdgeServer
Directory or File:

FIG. 11P

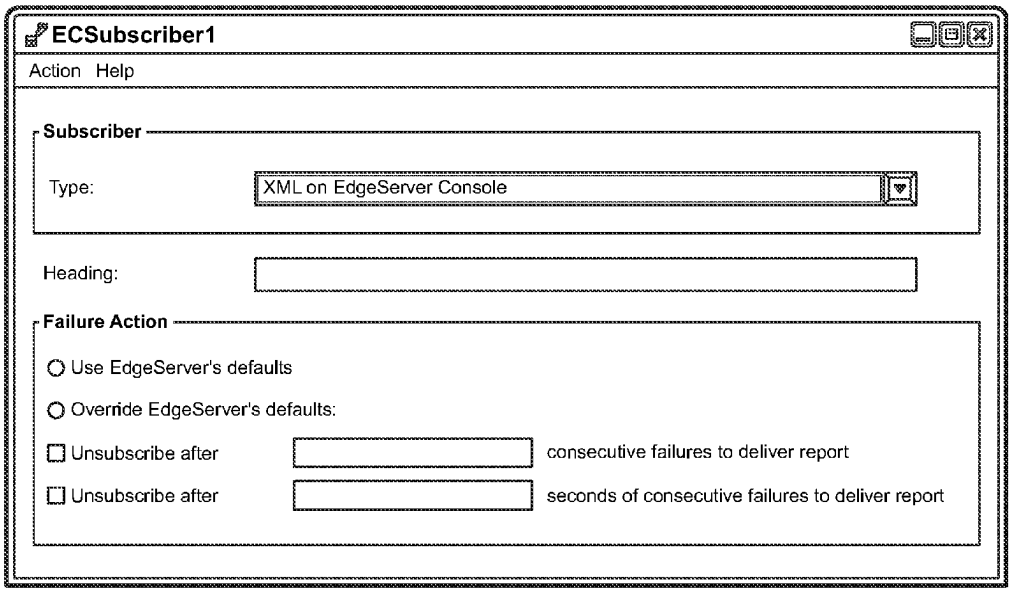

ECSubscriber1
Action Help
Subscriber
Type:
XML on EdgeServer Console
Heading:
Failure Action
Use EdgeServer's defaults
Override EdgeServer's defaults:
Unsubscribe after
consecutive failures to deliver report
Unsubscribe after
seconds of consecutive failures to deliver report

FIG. 11Q

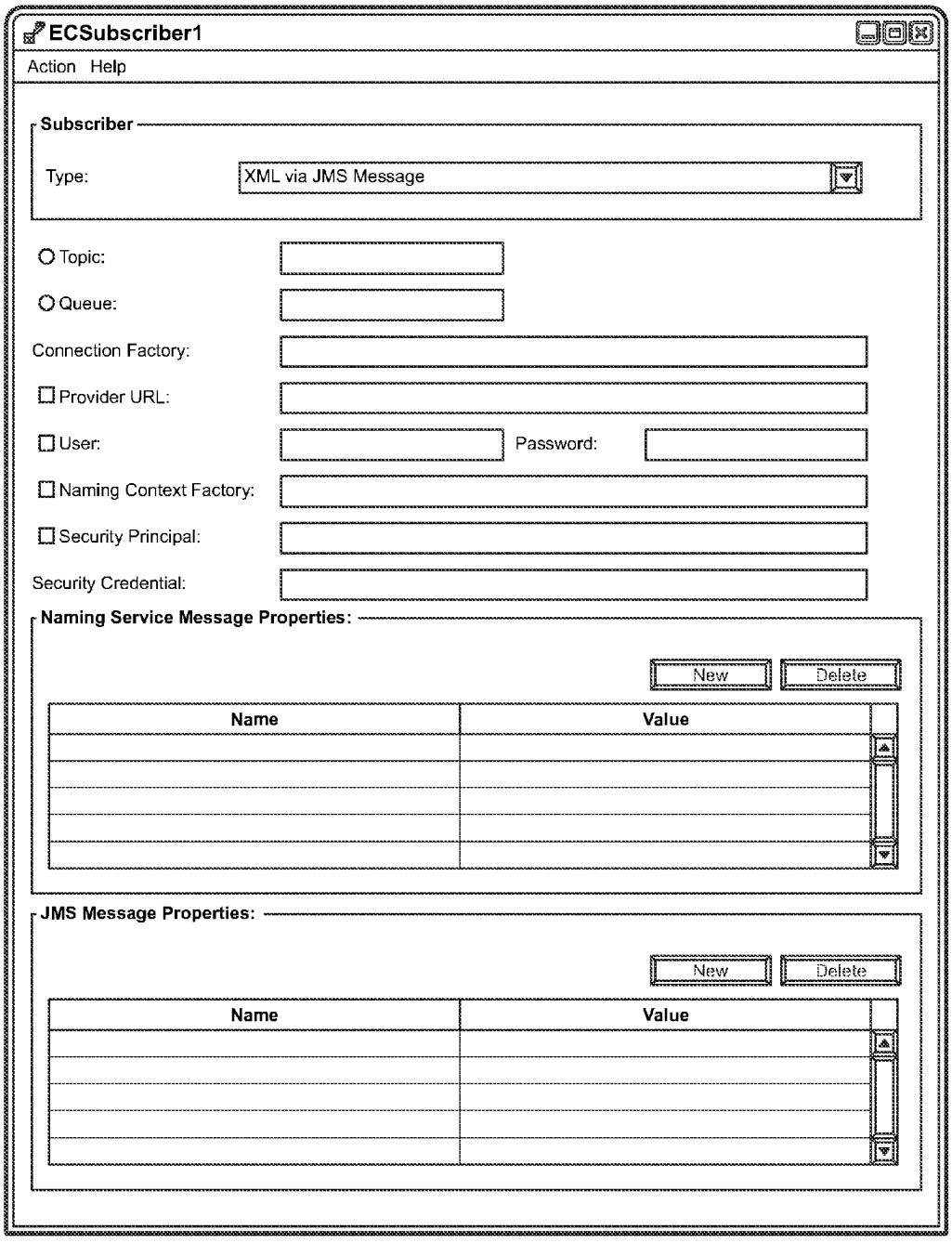

ECSubscriber1
Action Help
Subscriber
Type:
XML via JMS Message
Topic:
Queue:
Connection Factory:
Provider URL:
User:
Password:
Naming Context Factory:
Security Principal:
Security Credential:
Naming Service Message Properties:
New
Delete
Name
Value
JMS Message Properties:
New
Delete
Name
Value

FIG. 11R

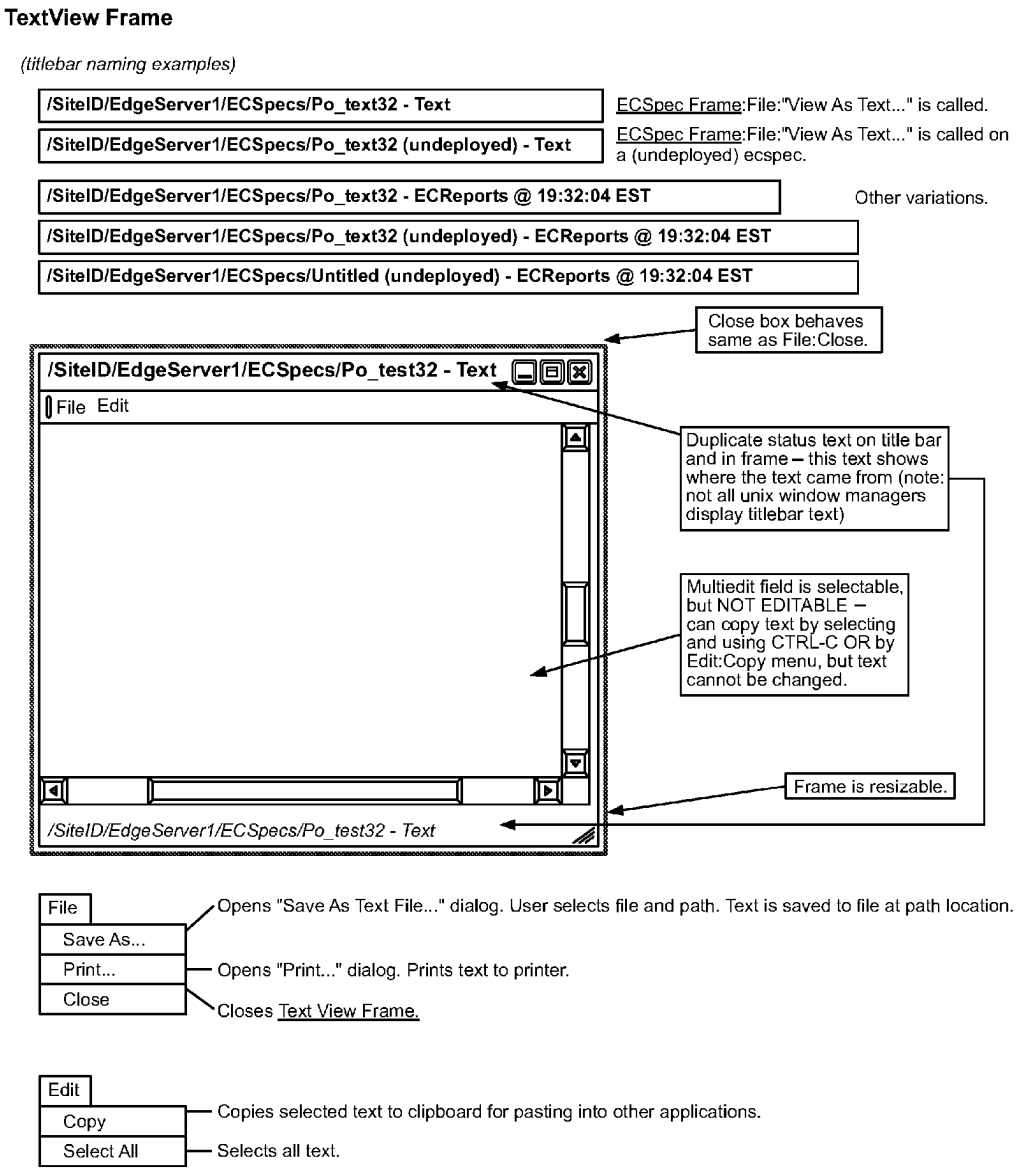

TextView Frame
(titlebar naming examples)
/SiteID/EdgeServer1/ECSpecs/Po_text32 - Text
ECSpec Frame:File:"View As Text..." is called.
/SiteID/EdgeServer1/ECSpecs/Po_text32 (undeployed) - Text
ECSpec Frame:File:"View As Text..." is called on a (undeployed) ecspec.
/SiteID/EdgeServer1/ECSpecs/Po_text32 - ECReports @ 19:32:04 EST
Other variations.
/SiteID/EdgeServer1/ECSpecs/Po_text32 (undeployed) - ECReports @ 19:32:04 EST
/SiteID/EdgeServer1/ECSpecs/Untitled (undeployed) - ECReports @ 19:32:04 EST
Close box behaves same as File:Close.
/SiteID/EdgeServer1/ECSpecs/Po_test32 - Text
File Edit
Duplicate status text on title bar and in frame – this text shows where the text came from (note: not all unix window managers display titlebar text)
Multiedit field is selectable, but NOT EDITABLE – can copy text by selecting and using CTRL-C OR by Edit:Copy menu, but text cannot be changed.
Frame is resizable.
/SiteID/EdgeServer1/ECSpecs/Po_test32 - Text
File
Save As...
Print...
Close
Opens "Save As Text File..." dialog. User selects file and path. Text is saved to file at path location.
Opens "Print..." dialog. Prints text to printer.
Closes Text View Frame.
Edit
Copy
Select All
Copies selected text to clipboard for pasting into other applications.
Selects all text.

FIG. 11S

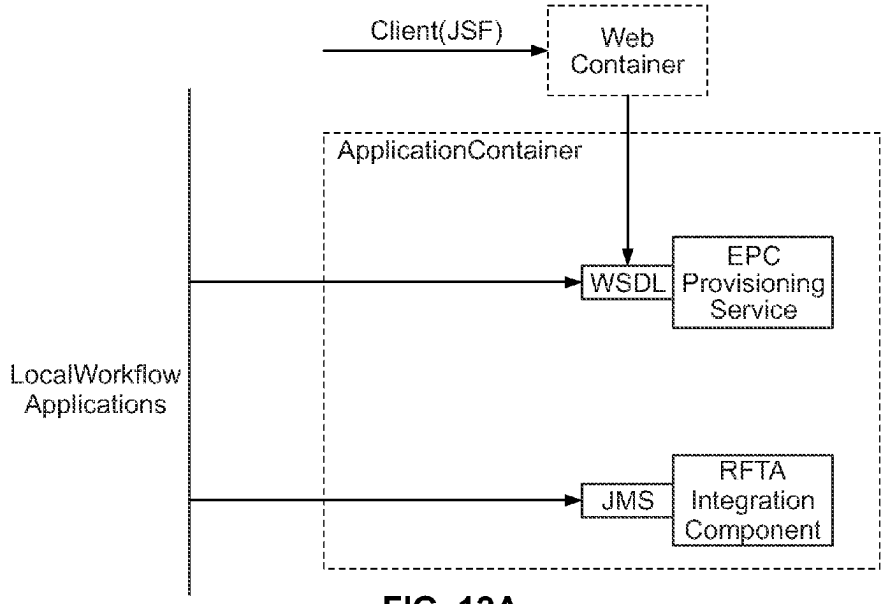


FIG. 12A

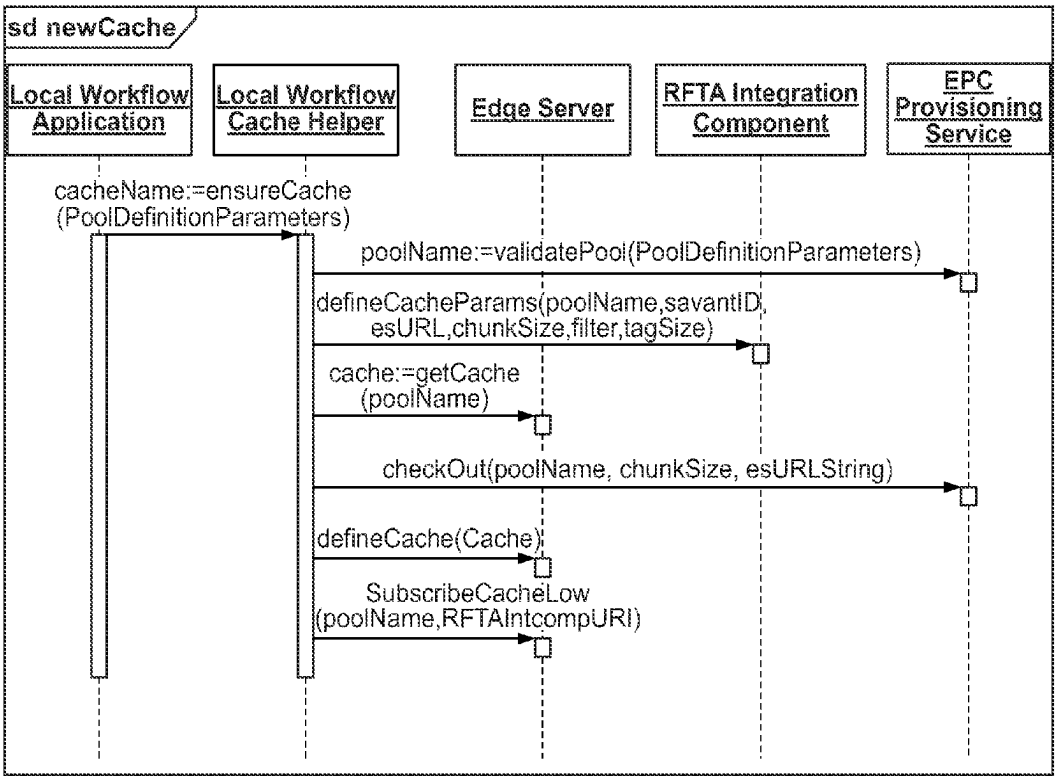


FIG. 12B

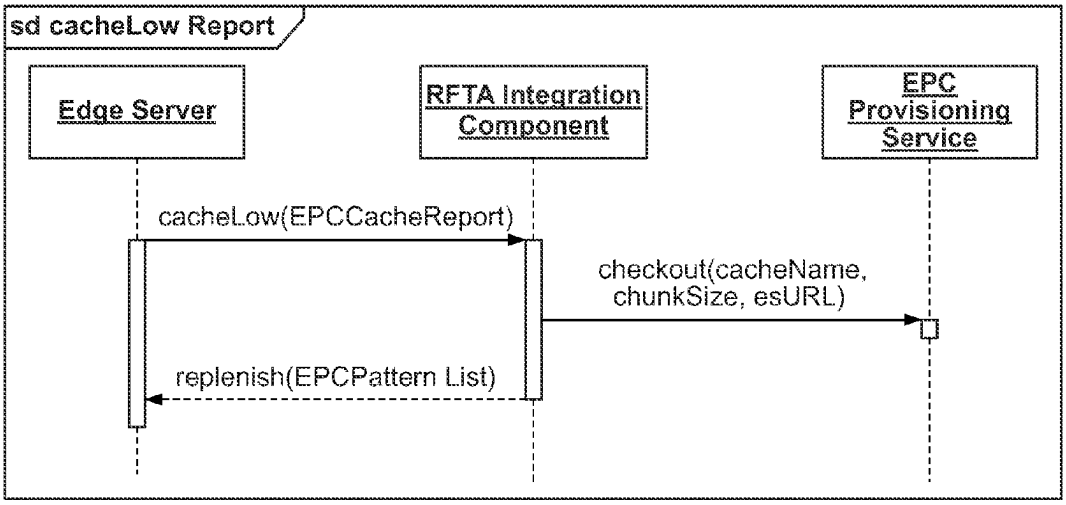


FIG. 12C

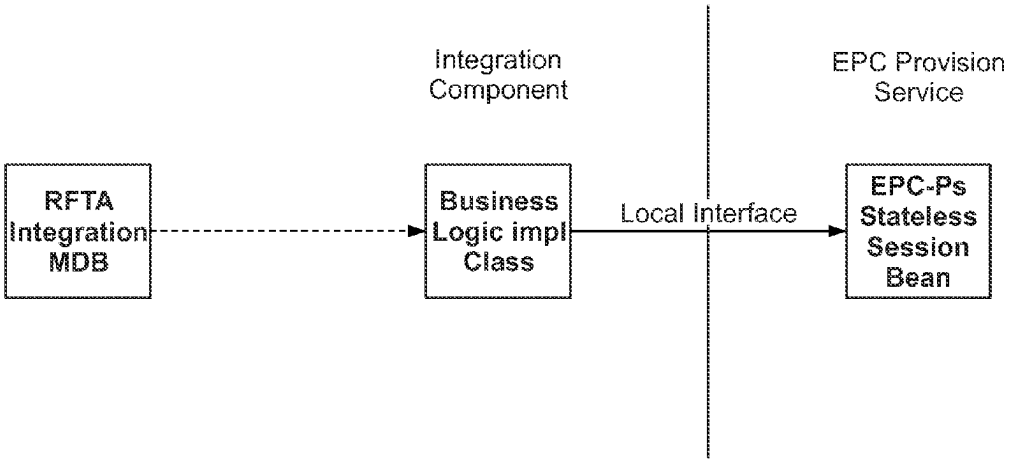


FIG. 12D

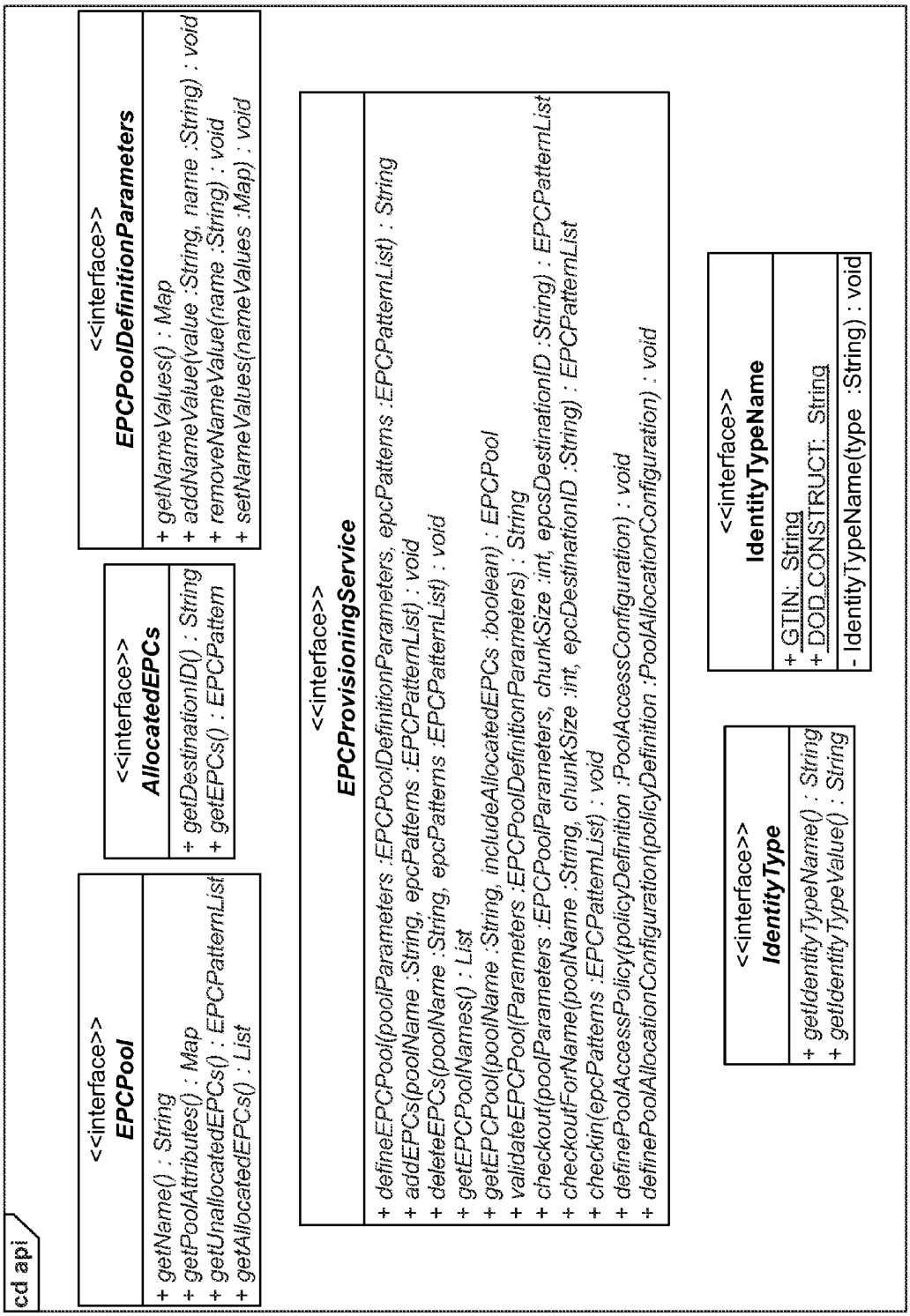

cd api
<<interface>>
EPCPool
+ getName() : String
+ getPoolAttributes() : Map
+ getUnallocatedEPCs() : EPCPatternList
+ getAllocatedEPCs() : List
<<interface>>
AllocatedEPCs
+ getDestinationID() : String
+ getEPCs() : EPCPattern
<<interface>>
EPCPoolDefinitionParameters
+ getNameValues() : Map
+ addNameValue(value :String, name :String) : void
+ removeNameValue(name :String) : void
+ setNameValues(nameValues :Map) : void
<<interface>>
EPCProvisioningService
+ defineEPCPool(poolParameters :EPCPoolDefinitionParameters, epcPatterns :EPCPatternList) : String
+ addEPCs(poolName :String, epcPatterns :EPCPatternList) : void
+ deleteEPCs(poolName :String, epcPatterns :EPCPatternList) : void
+ getEPCPoolNames() : List
+ getEPCPool(poolName :String, includeAllocatedEPCs :boolean) : EPCPool
+ validateEPCPool(Parameters :EPCPoolDefinitionParameters) : String
+ checkout(poolParameters :EPCPoolParameters, chunkSize :int, epcsDestinationID :String) : EPCPatternList
+ checkoutForName(poolName :String, chunkSize :int, epcDestinationID :String) : EPCPatternList
+ checkin(epcPatterns :EPCPatternList) : void
+ definePoolAccessPolicy(policyDefinition :PoolAccessConfiguration) : void
+ definePoolAllocationConfiguration(policyDefinition :PoolAllocationConfiguration) : void
<<interface>>
IdentityType
+ getIdentityTypeName() : String
+ getIdentityTypeValue() : String
<<interface>>
IdentityTypeName
+ GTIN: String
+ DOD.CONSTRUCT: String
- IdentityTypeName(type :String) : void

FIG. 12E

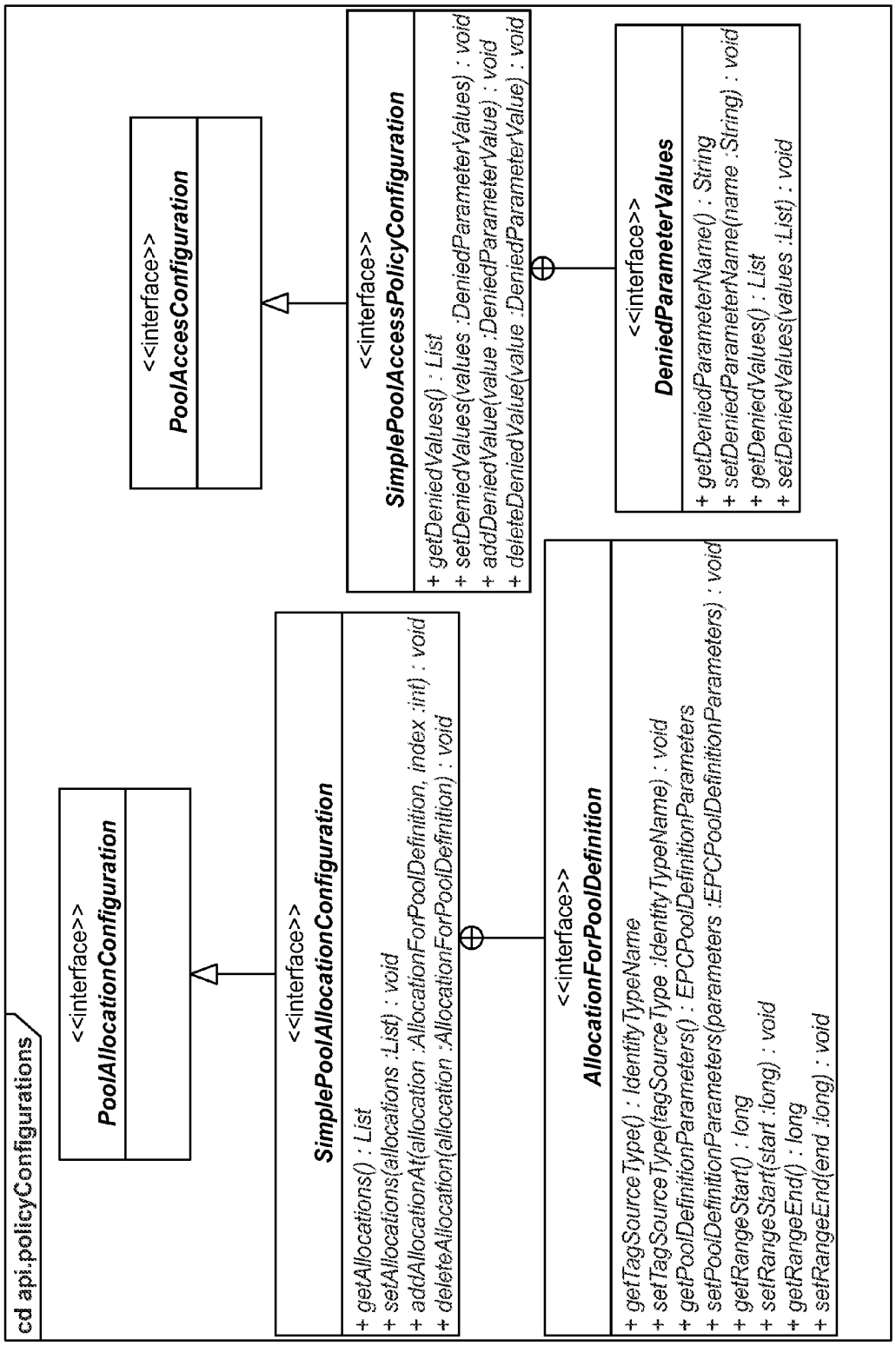

cd api.policyConfigurations
<<interface>>
PoolAllocationConfiguration
<<interface>>
PoolAccesConfiguration
<<interface>>
SimplePoolAllocationConfiguration
+ getAllocations() : List
+ setAllocations(allocations :List) : void
+ addAllocationAt(allocation :AllocationForPoolDefinition, index :int) : void
+ deleteAllocation(allocation :AllocationForPoolDefinition) : void
<<interface>>
SimplePoolAccessPolicyConfiguration
+ getDeniedValues() : List
+ setDeniedValues(values :DeniedParameterValues) : void
+ addDeniedValue(value :DeniedParameterValue) : void
+ deleteDeniedValue(value :DeniedParameterValue) : void
<<interface>>
AllocationForPoolDefinition
+ getTagSourceType() : IdentityTypeName
+ setTagSourceType(tagSourceType :IdentityTypeName) : void
+ getPoolDefinitionParameters() : EPCPoolDefinitionParameters
+ setPoolDefinitionParameters(parameters :EPCPoolDefinitionParameters) : void
+ getRangeStart() : long
+ setRangeStart(start :long) : void
+ getRangeEnd() : long
+ setRangeEnd(end :long) : void
<<interface>>
DeniedParameterValues
+ getDeniedParameterName() : String
+ setDeniedParameterName(name :String) : void
+ getDeniedValues() : List
+ setDeniedValues(values :List) : void

FIG. 12F

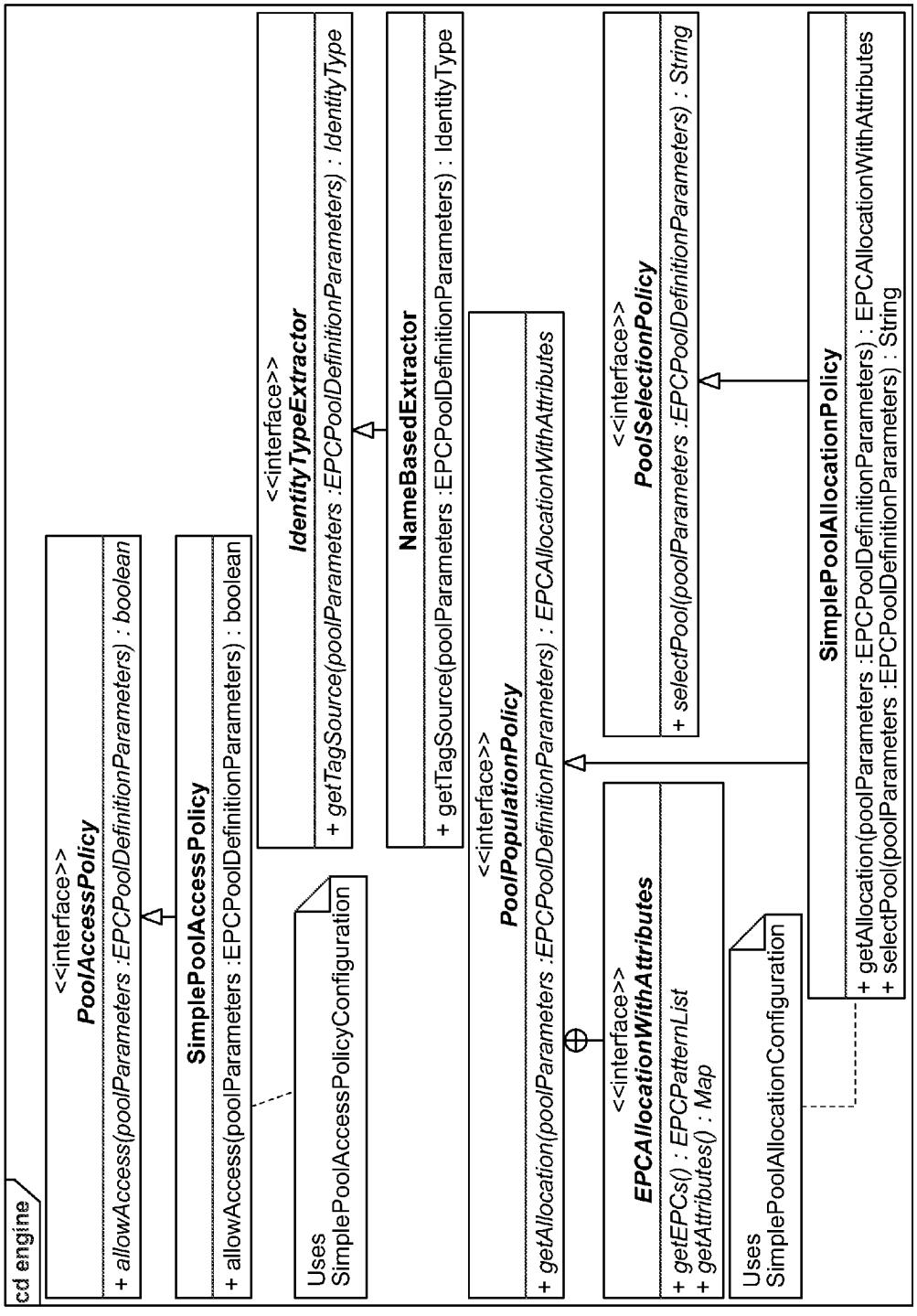

cd engine
<<interface>>
PoolAccessPolicy
+ allowAccess(poolParameters :EPCPoolDefinitionParameters) : boolean
SimplePoolAccessPolicy
+ allowAccess(poolParameters :EPCPoolDefinitionParameters) : boolean
Uses
SimplePoolAccessPolicyConfiguration
<<interface>>
IdentityTypeExtractor
+ getTagSource(poolParameters :EPCPoolDefinitionParameters) : IdentityType
NameBasedExtractor
+ getTagSource(poolParameters :EPCPoolDefinitionParameters) : IdentityType
<<interface>>
PoolPopulationPolicy
+ getAllocation(poolParameters :EPCPoolDefinitionParameters) : EPCAllocationWithAttributes
<<interface>>
EPCAllocationWithAttributes
+ getEPCs() : EPCPatternList
+ getAttributes() : Map
Uses
SimplePoolAllocationConfiguration
<<interface>>
PoolSelectionPolicy
+ selectPool(poolParameters :EPCPoolDefinitionParameters) : String
SimplePoolAllocationPolicy
+ getAllocation(poolParameters :EPCPoolDefinitionParameters) : EPCAllocationWithAttributes
+ selectPool(poolParameters :EPCPoolDefinitionParameters) : String

FIG. 12G

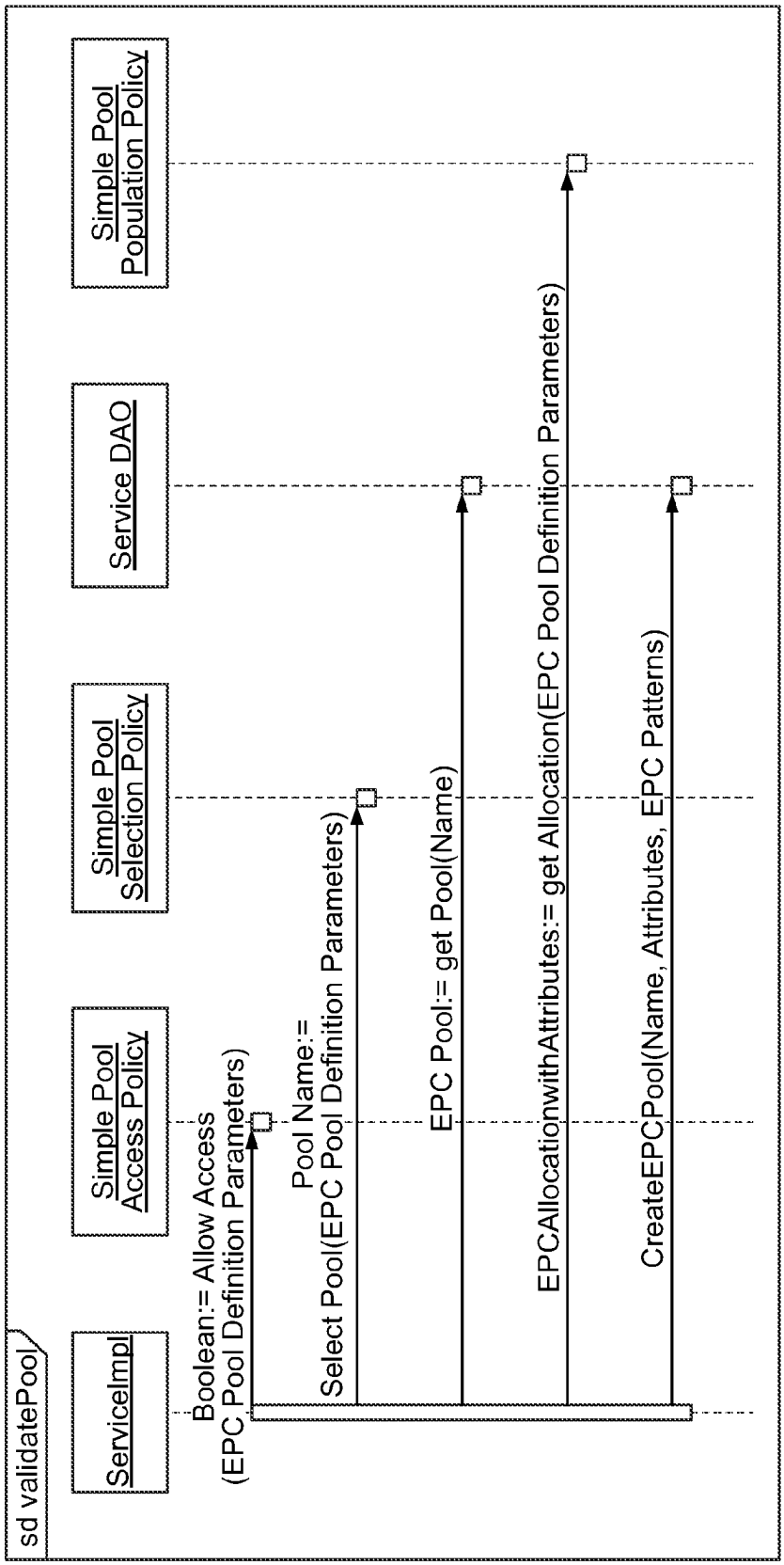

sd validatePool
ServiceImpl
Simple Pool Access Policy
Simple Pool Selection Policy
Service DAO
Simple Pool Population Policy
Boolean:= Allow Access (EPC Pool Definition Parameters)
Pool Name:= Select Pool(EPC Pool Definition Parameters)
EPC Pool:= get Pool(Name)
EPCAllocationwithAttributes:= get Allocation(EPC Pool Definition Parameters)
CreateEPCPool(Name, Attributes, EPC Patterns)

FIG. 12H

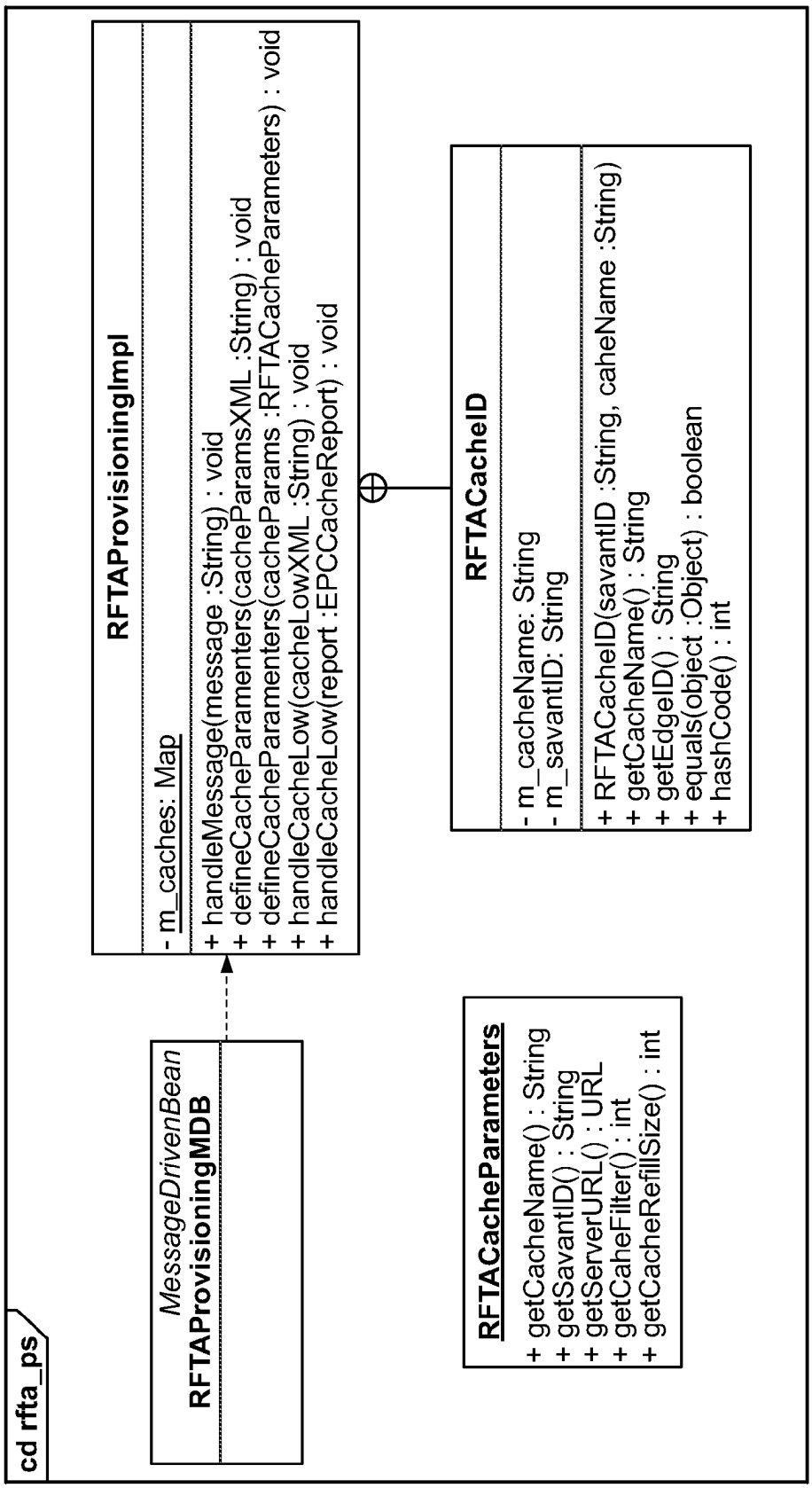

cd rfta_ps
RFTAProvisioningImpl
- m_caches: Map
+ handleMessage(message :String) : void
+ defineCacheParamenters(cacheParamsXML :String) : void
+ defineCacheParamenters(cacheParams :RFTACacheParameters) : void
+ handleCacheLow(cacheLowXML :String) : void
+ handleCacheLow(report :EPCCacheReport) : void
RFTACacheID
- m_cacheName: String
- m_savantID: String
+ RFTACacheID(savantID :String, caheName :String)
+ getCacheName() : String
+ getEdgeID() : String
+ equals(object :Object) : boolean
+ hashCode() : int
MessageDrivenBean
RFTAProvisioningMDB
RFTACacheParameters
+ getCacheName() : String
+ getSavantID() : String
+ getServerURL() : URL
+ getCaheFilter() : int
+ getCacheRefillSize() : int

FIG. 12I

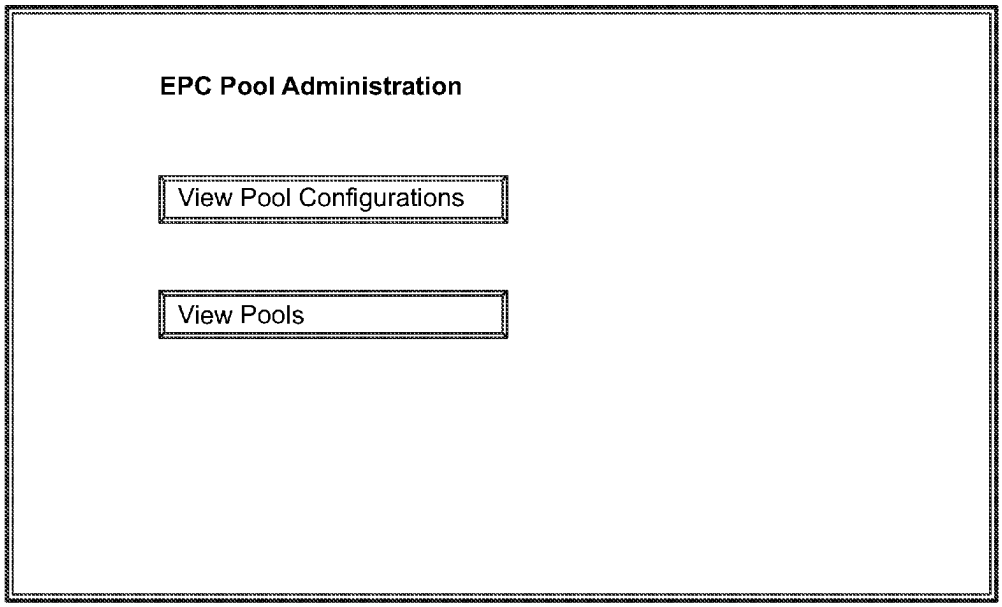


FIG. 13A

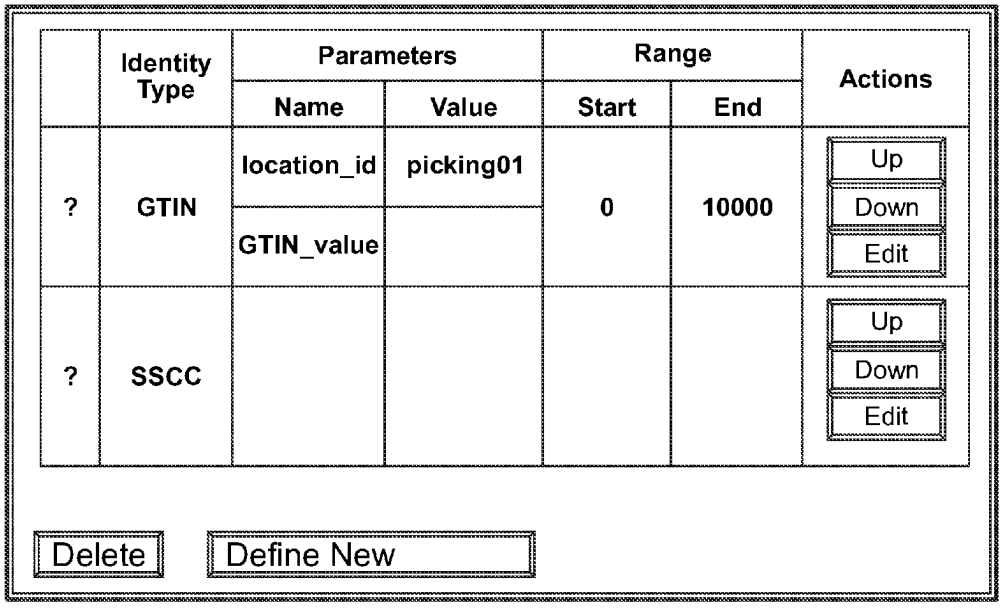


FIG. 13B

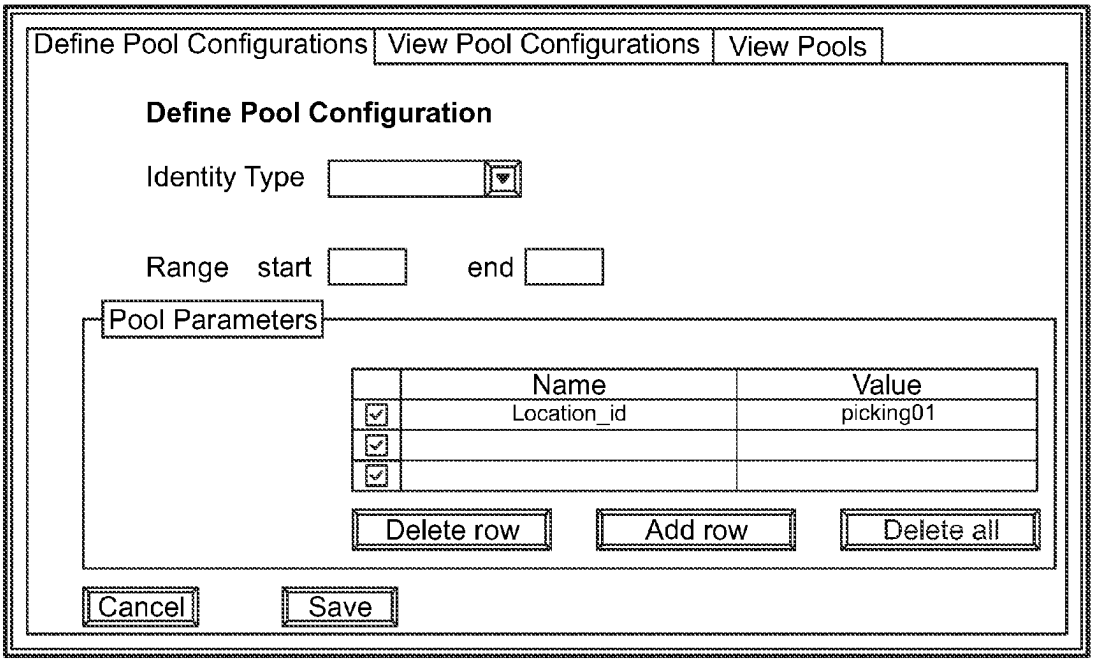


FIG. 13C

Pool Name	Creation Date	Pool Attributes		Checked out EPCs count	Available EPCs count	Actions
		Name	Value			
Name_1	06-01-05 12:00 PM	location_id GTIN _value	picking01	24000000	45000000	View
Name_2						View

FIG. 13D

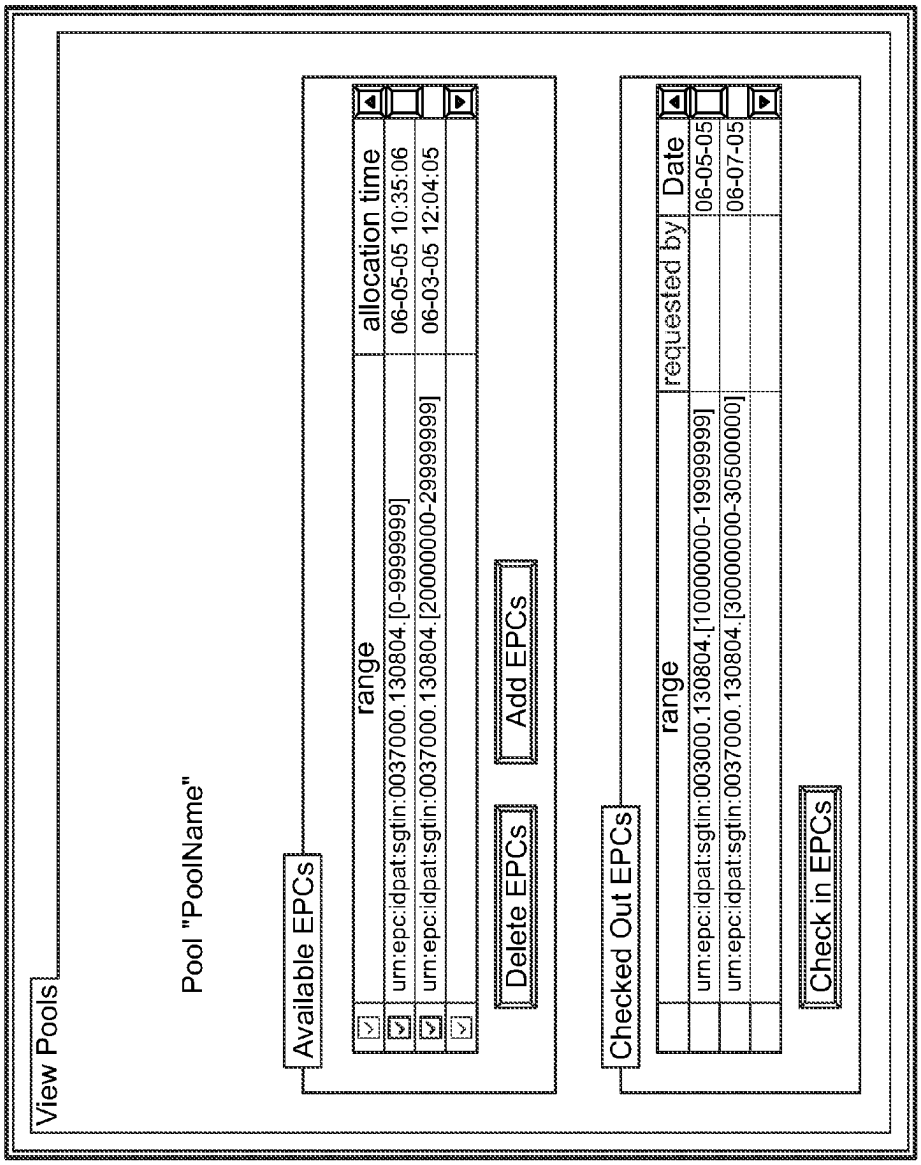

View Pools
Pool "PoolName"
Available EPCs
range
allocation time
urn:epc:idpat:sgtin:0037000.130804.[0-9999999]
06-05-05 10:35:06
urn:epc:idpat:sgtin:0037000.130804.[20000000-29999999]
06-03-05 12:04:05
Delete EPCs
Add EPCs
Checked Out EPCs
range
requested by
Date
urn:epc:idpat:sgtin:003000.130804.[10000000-19999999]
06-05-05
urn:epc:idpat:sgtin:0037000.130804.[30000000-30500000]
06-07-05
Check in EPCs

FIG. 13E

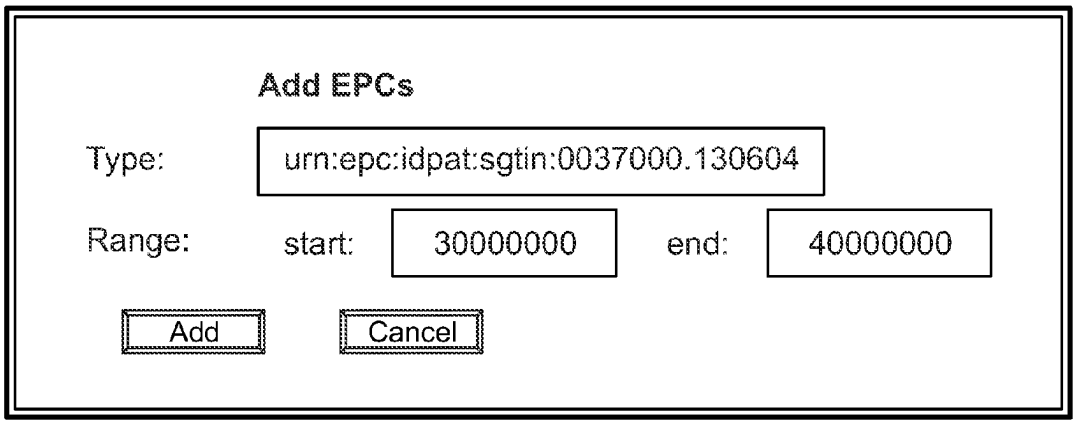


FIG. 13F

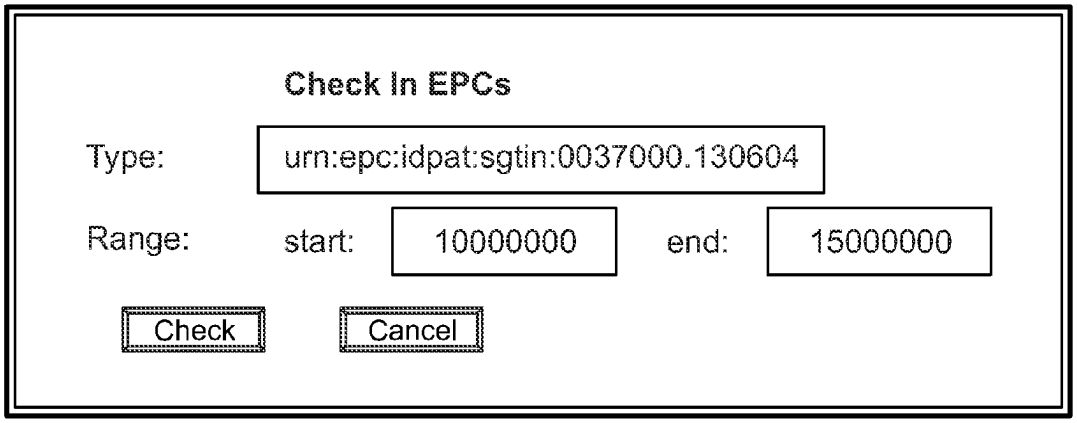


FIG. 13G

EPC PROVISIONING SYSTEM USING BUSINESS RULES

CLAIMS OF PRIORITY

This application claims priority to U.S. Provisional Application No. 60/763,781 entitled "RFID Edge Server Improvements" filed Jan. 31, 2006; U.S. Provisional Application No. 60/821,643 entitled "RFID Edge Server Improvement" filed Aug. 7, 2006 and U.S. Provisional Application No. 60/864,759 entitled "RFID Edge Server Improvement" filed Nov. 7, 2006 which are herein incorporated by reference.

BACKGROUND OF INVENTION

A Radio Frequency Identification (RFID) system may consist of several components: RFID tags, tag readers, edge servers, middleware, and application software.

RFID tags typically contain Integrated Circuits (ICs) and antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver. Passive tags require no internal power source, whereas active tags use a power source.

The RFID tag can include a unique electronic product code (EPC). The RFID transceiver can emit a signal activating the RFID tag which then can reply with the EPC code.

The EPCs currently can have either a 64- or 96-bit code numbering scheme, but additional versions can be supported in the future. The EPC includes sections that indicate the product and manufacturer of a given item as well as a section to uniquely identify an object. Currently, an EPC number can contain:

- A Header, identifying the length, type, structure, version and generation of EPC
- The Manager Number, which identifies the company or company entity
- Object Class, similar to a Stock Keeping Unit or (SKU)

RFID readers can typically produce very large amounts of data. The RFID data can be filtered at an RFID edge server by applications using an Application-Level Events(ALE) interface. ALE allows applications to indicate what information it wants from the raw stream of RFID reads. Through ALE, an application can specify:

- Which locations it wants to read from (where a location maps to one or more RFID readers or antennas)
- What interval of time to accumulate data (absolute time, triggered by external events such as motion detectors, etc.)
- How to filter the data (e.g., include only Acme products, exclude all item-level tags)
- How to group the results (e.g., by company, by product or each tag separately)
- Whether to report currently visible tags or just additions or deletions
- And whether to report actual EPCs or just a count of the tags that are read.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates the use of a RFID edge server to configure RFID readers.

FIG. **2** illustrates the use of a metadata based description to configure RFID readers.

FIG. **3** illustrates the use of a graphical interface to select ALE filters.

FIGS. **4**A-**4**B illustrate a dynamic EPC providing system.

FIGS. **5**A-**5**H illustrate console screens of an exemplary console for a RFID edge filter.

FIGS. **6**A-**6**J illustrate an exemplary dynamic RFID reader configuration system.

FIGS. **7**A-**7**B illustrate an exemplary ALE configuration API.

FIGS. **8**A-**8**C illustrate an exemplary configuration API.

FIGS. **9**A-**9**R illustrate an exemplary ALE GUI.

FIG. **10** illustrates an exemplary ALE GUI logic model.

FIGS. **11**A-**11**S illustrate an exemplary ALE GUI.

FIGS. **12**A-**12**I illustrate an exemplary EPC provisioning system design.

FIGS. **13**A-**13**G illustrate an exemplary EPC provisioning system interface.

DETAILED DESCRIPTION

One embodiment of the present invention is an RFID edge server **102** to configure multiple associated RFID readers **106**. The RFID edge server **102** receives configuration info for at least one of the associated RFID readers. The RFID edge server can update the configuration of the at least one of the associated RFID readers **106** without restarting at least one other RFID reader **104** of the associated RFID readers.

Such a dynamic configuration system allows the system to continuously run rather than being shut down temporarily for a change of configuration.

The configuration info also can be maintained as a metadata-based description at the RFID edge server. The configuration can be sent to the RFID reader **106** in a format specific to the RFID reader. The at least one of the RFID readers **106** can produce RFID data for a software application **100**. The RFID edge server **102** can restart the at least one RFID reader **106** without restarting the software application **108**. The at least one RFID reader **106** can be restarted in between the timed transfers of the RFID data to the RFID edge server **102**. The RFID readers can be from different vendors with their own native configuration arrangements.

One embodiment of the present invention is an RFID edge server **102** to configure multiple associated RFID readers **104** and **106**. The RFID edge server **102** can receive configuration info for at least one of the RFID readers **106**. The at least one of the RFID readers **106** providing data for a software application **108**. The RFID edge server **102** can restart the at least one RFID reader **106** without interrupting the operations of the software application **108**.

One embodiment of the present invention is a computer implemented method comprising receiving configuration info for at least one associated RFID reader **106** at a RFID edge server **102** and updating the configuration of the at least one associated RFID reader **106** without restarting at least one other RFID reader associated with the RFID edge server.

One embodiment of the present invention is a computer implemented method comprising receiving at a RFID edge server **102** configuration info for at least one associated RFID reader **106**. The associated RFID reader **106** providing RFID data for a software application **108** and initiating restart of the associated RFID reader **106** without interrupting the operation of the software application **108**. The configuration can be sent to the RFID reader in a format specific to the RFID reader.

One embodiment of the present invention is a computer readable medium with a metadata-based description **202** of the configuration of an RFID reader, wherein an RFID edge server is adapted to interact with the metadata-based description **202** to configure the RFID reader.

The metadata-based description can include configuration parameters. The configuration parameters can include parameter name, description, type and default value. The metadata can be used to produce an interface, such as a console, to get configuration information from a user. The RFID edge server can use the interface to set configuration data. Different metadata-based descriptions can be used for different types of RFID readers. In one embodiment, the Metadata description can be used for filters, such as ALE filters, as well as for the RFID reader configuration.

One embodiment of the present invention is a computer-based method comprising receiving a metadata-based description of RFID reader and using the metadata-based description to produce an interface, such as a console page, to input a configuration for the RFID reader.

One embodiment of the present invention is a console for an RFID edge server **302**, including a graphical interface **304** to receive ALE filter information such that the graphical interface **304** can be used to select the ALE filtering on the RFID edge server **302**. The filters can be associated with an RFID reader **306**. A list of available ALE filters can be displayed. The graphical interface **304** can allow the selection of one of the available ALE filters. The graphical interface **304** can show filters in a filter chain. The graphical interface **304** can allow the repositioning of filters in a filter chain.

One embodiment of the present invention is a computer implemented method comprising using a graphical interface **304** to select an ALE filter and using the selected ALE filter to filter RFID tag data at an RFID edge server.

One embodiment of the present invention is a computer readable medium including code to receive a selected ALE filter from a graphical interface **304** and use the selected ALE filter to filter RFID tag data at an RFID edge server **302**.

A system of one embodiment comprises using an EPC server **402** to dynamically provide EPC code blocks **404** and **406** for one product to multiple client sites **408** and **410**. The client sites **408** and **410** can use the EPC codes **412**, **414**, **416** and **418** of the EPC code block for RFID tags **402**, **422**, **424** and **426**.

In one embodiment, the EPC server can create pools of EPC codes. The EPC codes can be created based on business policies that can be used to indicate business information in the EPC code. The RFID edge servers can obtain EPC codes from the pool, store these EPC codes into a local cache and then use these EPC codes in the construction of RFID tags, such as with an RFID tag printer. Unused RFID tags can be returned from the cache to the pool.

The client sites **408** and **410** can be, or can include, RFID edge servers. The EPC server can use business rules to assign the EPC code blocks. The EPC code blocks can be assigned so as to indicate business information such as lot number and/or location. The client sites **408** and **410** can cache EPC codes for later use. The client sites can request EPC code blocks **404** and **406**.

One embodiment of the present invention is a computer implemented method comprising dynamically providing EPC code blocks **404** and **406** for one product to multiple client sites and using EPC codes of the EPC code blocks **404** and **406** for RFID tags at the client sites **408** and **410**.

One embodiment of the present invention is a computer readable medium including code to dynamically provide EPC code blocks **404** and **406** for one product to multiple client sites **408** and **410**; and using the EPC codes **412**, **414**, **416** and **418** of the EPC code blocks **404** and **406** for RFID tags **420**, **422**, **424** and **426** at the client sites **408** and **410**.

One embodiment of the present invention is an EPC provisioning system **400** comprising an EPC server **402** adapted to dynamically provide EPC code blocks **404** and **406** for one product to multiple client sites. The EPC server **402** can use business rules to determine the EPC codes for the multiple client sites **408** and **410**.

The client sites **408** and **410** can be RFID edge servers. The client sites can use the EPC codes **412**, **414**, **416** and **418** for RFID tags **420**, **422**, **424** and **426**. The EPC code blocks can be assigned to as to indicate lot number. The EPC code blocks can be assigned so as to indicate location. The client sites **408** and **410** can cache EPC codes for later use. The client sites **408** and **410** can request the EPC code blocks **404** and **406**.

One embodiment of the present invention is a computer implemented method using business rules to determine EPC code blocks for multiple client sites and providing the EPC code blocks to the multiple client sites.

One embodiment of the present invention is a computer readable medium including code to use business rules to determine EPC code blocks for multiple client sites and providing the EPC code blocks to multiple client sites.

DETAILS OF EXEMPLARY EMBODIMENTS

The following embodiments are merely exemplary and are not meant to limit the scope of the present invention.

A Dynamic Reader Configuration interface can be used by an Admin Console. The interface can be public facing, or for internal use by other applications, including the Admin Console and workflow applications. A centralized control server may use the interface to provision RFID Edge Servers.

In one embodiment, the dynamic reader configuration can:

1. Provide an interface to obtain plug-in Meta information.
2. Provide an interface to configure plug-in instances

Clients can determine the available plug-in drivers supported by the Edge Server. For a given plug-in driver, clients can retrieve Meta information describing the plug-in and each of the associated configuration parameters. Plug-in Meta information can include the name of the plug-in, the plug-in type (e.g. Reader or Filter), the associated physical device name, and a description of the plug-in. Meta information for configuration parameters can include the parameter name, description, type, constraints, required flag, default value, and an index indicating importance relative to other parameters.

A plug-in instance can provide the connection between the Edge Server and the physical device (e.g. Matrix Reader). Clients can be able to list, get configuration details of, define, redefine and un-define plug-in instances. Creation of a plug-in instance can require the combination of a plug-in driver and configuration. The driver can provide access to the physical device, where the configuration provides the driver parameters. The presence of the physical device need not be required when defining, redefining or un-defining plug-in instances.

Dynamic Plugin configuration changes can be coordinated so that the operation of the edge server is not interrupted.

In one embodiment, the reader configuration can support updates of the reader drivers on the edge server. If a new reader driver is added to the edge server, the reader driver configuration can allow the configuration of new reader driver instances using the new driver.

Plug-in configuration changes can be persistent. The changes do not need to be reflected in the Reader configuration files.

In one embodiment, a dual mode operation can be supported with a configuration flag, such as EnableDynamicConfiguration. If set, all configuration can be read from the persisted dynamic configuration and configuration modifications can be supported through the dynamic configuration

API. If the configuration parameter is not set, then the configuration information can be read from the reader configuration file, not from the persisted dynamic configuration. Also, the Dynamic Configuration will operate in a read only mode, allowing dynamic inspection of Plugin Meta and Configuration the configuration, but not supporting modification to the Plugin Configuration.

The implementation of the dynamic reader configuration can be extensible so that other types of plug-ins can be added in the future without extensive changes to the dynamic reader configuration framework (e.g. Trigger Driver, Notification Driver, and Filter Driver).

In one embodiment the following APIs can be exposed:

listPluginMetaInfo(pluginRole : String) : List <PluginMetaInfo>
Returns list of PluginMetaInfo instances identifying each of the plugins supported by the edge server. If pluginRole is not null, return only the drivers of the given role. For release 1.3, the type will be limited to Reader and CompositeReader.
getPluginMeta(pluginRole: String, pluginMetaName : String) : PluginMeta
Returns the PluginMeta instance for the pluginMeta with the specified name.
definePlugin(pluginRole : String, pluginName : String, pluginConfig : PluginConfig) : void
Defines a new Plugin instance with the given name and configuration.
redefinePlugin(pluginRole : String, pluginName : String, pluginConfig : PluginConfig) : void
Updates an existing Plugin instance.
undefinePlugin (pluginRole : String, pluginName : String) : void
Undefines an existing Plugin with the specified name
getPlugin(pluginRole : String, pluginName : String) : Plugin
Return the plugin for the given plugin name and type.
listPlugins(pluginRole : String) : List <PluginConfig>
List all plug-in instances of the specified type. If type is null, include all plug-in types. For Release 1.3, only CompositeReader, Reader, Filter are supported.
listRoles( ) : List <String>
List all known Plugin roles.

The Plug-in driver Meta information and plug-in instance configuration interfaces can be exposed through a web service hosted by the edge server. An XML schema can define the parameters passed in the SOAP interface.

A JAVA API can support access to the Reader Configuration API. The JAVA API can provide a wrapper around the SOAP interface and provide JAVA classes for handling the plug-in driver Meta information and configuration. The JAVA API can also be used internally within the edge server to interact with the plug-in configuration information.

The Admin Console can be a client of the Dynamic Reader Configuration interface provided by the Edge Server. The Admin Console can contain new panels to provide read write access to the reader configuration.

In one embodiment:

1. The Admin Console can query the interface to determine the extent of reader drivers, and display the results.
2. The Admin Console can query the interface to determine the configured reader drivers and display the results.
3. The Admin Console can request meta information on the configuration parameters for a particular reader. The meta information can be used to dynamically create configuration forms.
4. The Admin Console can support the specification of parameters for a driver configuration.
5. The Admin Console can define a new reader driver instance passing the plug-in driver name and the configuration.
6. The Admin Console can redefine existing reader driver instance passing the plug-in driver name and the configuration.
7. The Admin Console can un-define existing reader driver instances passing the plug-in driver name.

The Dynamic Reader Configuration design can provide an open framework for supporting dynamic configuration of plug-ins. The initial implementation can be limited to supporting two types of plug-ins: Readers and Composite Readers.

The class diagram of FIG. **6**A provides an overview of the Edge Server, Reader, CompositeReader, Trigger, Filter and related classes of one embodiment.

As shown in FIG. **6**A a Reader can model a physical RFID reader, for example a Matrix reader. Readers can aggregate one or more antennas. An Antenna can model an individual physical antenna. The relation between Readers and Antenna can be defined as part of the Reader Configuration. The Reader Configuration can also include parameters required by the reader driver. Example configuration can include the IP address and port number used to communicate with the physical device.

The LogicalReader can be referenced by ECSpecs and PCSpecs as a source for tag read/writes. The logical reader can be an abstract base class for Antennas and Composite Readers.

The Antenna can model a physical Antenna.

A CompositeReader can aggregate a collection of Logical Readers independent of physical reader and antenna configuration.

The edge server can provide an aggregation point for the collection of CompositeReaders and Readers.

The PhysicalReader can represent an actual physical reader connected to one or more antennas.

The Physical Antenna can represent an actual physical antenna connected to a physical reader. The Antenna acts as a RFID transducer.

The Filter can used to filter tags read by the Antenna. One or more filters may be associated with an Antenna.

The concept of a Plugin can be used to support an extensible configuration mechanism. The Plugin can provide a base class for configurable entities within the Edge Server. The analysis model of FIG. **6**B describes the resulting Plugin class hierarchy of one embodiment.

The Plugin can provide the root type for all configurable entities. The Plugin can contain a Configuration that defines the parameters (i.e. name value pairs) required for operation of the Plugin. The class Plugin_X can be a placeholder for other Plugin types to be added in the future. The class Reader_X can be a place holder for other types of readers currently supported and to be added in the future.

The design can be composed of three main components:

1. Plugin Meta
2. Plugin
3. Plugin Config API

The Plugin Meta component can manage a list of Plugin Meta instances. Each Plugin Meta instance can contain meta information that describes the class that implements the Plugin and associated configuration parameters.

The Plugin component can manage Plugin instances. Plugin instances can aggregate a PluginConfig with a PluginDevice. A Plugin instance can be defined by an associated Plugin Meta instance.

The Plug-in API component can provide a SOAP interface for accessing Plug-i Meta information and configuring Plug-i instances. The Plug-in API can also provide a JAVA API that includes a java client stub for the API, and a set of JAVA classes used to model the data objects marshaled through the API.

FIG. **6**C shows Plugin Components such as, Plugin Instances, Plugin Meta Info, and Plugin API of one embodiment.

FIG. **6**D shows an implementation class diagram for the Plug-in Framework of one embodiment.

FIG. **6**E shows an UML class diagram describes the Plugin Meta Component classes of one embodiment.

The PluginMetaManager can provide a container for management of PluginMeta instances. The PluginMetaManager can also manage PluginMeta Persistence.

add(role: String, name: String, pluginMeta : PluginMeta) : void, throws DuplicatePluginMetaException
: Adds a new PluginMeta instance with given role and name. Throws DuplicatePluginMetaException if a PluginMeta instance already exist with the same name and type.
lookup(role: String, name: String): PluginMeta, throws PluginMetaException
: Looks up and returns the PluginMeta instance with matching role and name. Throws PluginMetaException if a matching PluginMeta instance is not found.
remove(role: String, name: String): void, throws PluginMetaException
: Removes the PluginMeta instance with matching role and name. Marks the PluginMeta instance as void. Throws a PluginMetaException if a matching PluginMeta instance is not found.
remove(plugin: PluginMeta) : void, throws PluginMetaException
: Removes the PluginMeta instance and marks the PluginMeta instance as void.
getPluginMetaList(role: String) : List <PluginMeta>
: Returns the extent of PluginMeta instances for the given Plugin Role. If the specified Plugin Role is null, the extent for all PluginRoles is returned.
listRoles( ) : List <String>
: Returns the list of known Plugin Roles (e.g. Composite Reader, Reader)

The PluginMeta class can describe a Plugin. The meta information can include the Plugin name, role, description, and parameters used to configure the Plugin.
Methods can include:

getClassName( ): String
: Returns the fully qualified class name for the class used to implement the plugin.
getName( ): String
: Returns the descriptive name for the Plugin (e.g. Mercury4Reader). This name is referenced when creating a Plugin instance.

-continued

getPluginRole( ): String
: Returns the string representation of the Plugin Role for this plugin. (e.g. "READER" or "COMPOSITE_READER")
validate(plugin: Plugin): void, throws PluginValidationException
: Validates the specified Plugin by validating each of the contained parameters. If invalid, throws PluginValidationException.

The PluginParameterMeta class can describe a PluginParameter. The meta information can include the PluginParameter name, type, description, required flag, and index.
Attributes can include:

keyName: String (non i18n)
: Provides a uniuqe name for the parameter
name: String (i18n)
: Provides a descriptive name for the parameter
type: PluginParameterType

Defines the type for the parameter; numeric or string. The supported types include:
NUMERIC
STRING
LIST <String>
ANTENNA
description: String (i18n)
Provides a descriptive text for associated PluginParameter.
required: Boolean
Boolean indicating whether or not the parameter is required.
index: int
Parameter index indicating ordering with respect to other parameters.
defaultValue: String (non i18n)
Default value of this plugin parameter. It may be null if there is no default.
Methods can include:
getChildren( ): List <PluginParamameterMeta>
Returns a list of child (i.e. contained) PluginParameterMeta instances.
validate(pluginParameter: PluginParameter): void, throws PluginValidationException
Validates the specified PluginParameter with the associated
PluginParameterConstraint. If invalid, throws PluginValidationException.

The PluginParameterConstraint class can define constraints for the associated PluginParameterMeta instance. The constraint information can include a description and parameter value contstraints. This class can be abstract, concrete derived classes include PluginParameterConstraintRangeNumeric and PluginParameterConstraintRegEx.
Methods can include:

getDescription( ): String
: Return a descriptive text string defining the Plugin Constraint, for example: "[1-1000]".
validate(parameter: PluginConfigParameter): void, throws PluginValidationException
: Validates the specified PluginConfigParameter. If invalid, throws PluginValidationException. This method is defined as abstract and must be overridden by derived classes.

The PluginParameterConstraintRangeNumeric class can be derived from PluginParameterConstraint and defines a value constraint for a PluginParameter of type numeric. Attributes can include:

minValue : long
The minimum allowable value for the constraint
maxValue : long
The maximum allowable value for the constraint.

The PluginParameterConstraintRegEx class can be derived from PluginParameterConstraint and defines a value constraint for a PluginParameter of type String.

Attributes can include:

regEx : String
Defines a regular exception for validation of a String Constraint.
minLength: int
Return the minimum allowable length for the string.
maxLength: int
Return the maximum allowable length for the string, or 0 if no limit.

The PluginParameterConstraintEnum class can be derived from PluginParameterConstraint and defines a value constraint for a PluginParameter of type List <String>.
Attributes can include:
EnumerationList : List <String>
Defines a list of allowable String values.

The PropsRawConfig class can be used to persist PluginMeta instances to files.

FIG. **6**F shows UML class diagram that describes the Plugin Component classes of one embodiment.

FIG. **6**G shows a sample instance diagram showing Plugins and the relation to PluginConfig, PluginConfigParameter, and PluginDevice instances of one embodiment. The PluginManager singleton can manage all Plugin instances.

The PluginManager can be a singleton and provide a container for management of Plugin instances. The PluginManager can support Plugin configuration requests through the Plugin API. The PluginManager can also manage Plugin Persistence. Persistence can be supported in one of two ways; through the edge.properties file or through the dynamic configuration persistence. The mode of persistence operation can be controlled through the EnableDynamicConfiguration Boolean property. If this value is set to true, then the dynamic configuration persistence mechanism can be enabled. When the edge server starts, all Plugin instances can be read from the dynamic configuration store. The dynamic configuration store can be in the form of a set of PropsRawConfig files within the var/edgestate/plugin directory.

In one embodiment, if the EnableDynamicConfiguration Boolean property is set to false, then the plugin configuration can be read from the edge.props file. This allows for backward compatibility with existing RFID edge server installations. In this mode, the Plugin Configuration API can be restricted to read only access, so that no modification may be made through the Plugin Configuration API. In this mode, current configuration may be discovered through the Plugic Configuration API.
Methods can include:

add(role : String, name : String, plugin : Plugin) : void, throws PluginValidationException
Adds a new Plugin instance with given role, name and Plugin instance. Throws DuplicateNameException if a Plugin instance with the same name and role already exist. Throws PluginValidationException if there is a problem validating the configuration parameters. The add command persist the newly defined Plugin to the persistent store.
lookup(role : String, name : String): Plugin, throws PluginException
Looks up and returns the Plugin instance with matching role and name. Throws NoSuchPluginException if a matching Plugin instance is not found.
remove(role : String, name : String): void, throws NoSuchPluginException
Removes the Plugin instance with matching role and name. Marks the Plugin instance as void. Throws a NoSuchPluginException if a matching Plugin instance is not found. The associated Plugin is removed from the persistent store.
remove(plugin : Plugin) : void, throws PluginException
Removes the Plugin instance and marks the Plugin instance as void. The associated Plugin is removed from the persistent store.
getPluginList(role : String) : List <Plugin>
Returns the extent of Plugin instances for the given Plugin Role. If Plugin Role is null, the extent for all Plugin Roles is returned.

The Plugin class can model a configured Plugin instance. It can be responsible for management of the PluginConfiguration instance and the PluginDevice instance. The Plugin class can support the redefine operation by shutting down, reconfiguring and restarting the PluginDevice.

Methods can include:

getName( ): String
Returns the assigned name of the Plugin. Together, the Name and Role uniquely dentify the plugin instance.
getState( ): PluginState
Returns an instance of the PluginState enumeration class that defines the state of he Plugin. (e.g. Active, Disabled).
getPluginConfig( ): PluginConfig
Returns the associated PluginConfig instance, containing the configuration for the Plugin instance.
setPluginConfig(pluginConfig: PluginConfig) : void, throws PluginException

Replaces the existing configuration with the specified configuration. Executes following steps:

1. Validates the Specified Configuration
2. Shutdown the associated PluginDevice instance.
3. Either reinitialize the existing PluginDevice with the new configuration and restart or create a new PluginDevice with the new configuration.

If any of the above steps fail, a PluginException is thrown.

getPluginMeta( ) : PluginMeta
Returns the associated PluginMeta instance.
getPluginRole( ) : String
Returns the instance of the PluginType enumeration. (e.g. READER, COMPOSITE_READER, FILTER, TRIGGER)
getPluginDevice( ) : PluginDevice, throws PluginDeviceException
Returns the associated PluginDevice. PluginDevice is an Interface for instances of ReaderDrivers, etc. Throws PluginDeviceException if the PluginDevice is not available.
validate( ): void , throws PluginValidationException
Validates the Plugin configuration. If not valid, a PluginValidationException is thrown.
isEnabled( ): boolean
Returns true if the plugin is enabled. The plugin may be disabled in the course of a redefine operation that fails due to invalid configuration.
getSource( ): PluginSource
Returns the source of the Plugin Configuration information, either the Edge Server properties file or the Dynamic Plugin Configuration store.

The PluginConfig class can provide a holder for plugin configuration parameters. There can be a single PluginConfig instance for each Plugin. Optional parameters can be omitted if values are not provided.
Methods can include:

getParameter(index : int) : PluginConfigParameter
Returns the plugin configuration parameter for the associated index.
getParameterCount( ) : int
Returns the count of Plugin parameters.

The PluginConfigParameter class can provide a container for a plugin configuration parameter. An instance of the PluginConfigParameter class can be created for each specified parameter.
Attributes can include:
name: String
The name of the parameter, this name maps to the UniqueKey specified by the associated PluginParameterMeta instance.
value : String
The PluginDevice interface can be implemented by devices managed by the Plugin class. Example implementations of the PluginDevice can include Reader Drivers, Triggers and Filters. The PluginDevice instances can be created from the actual driver classes that are instantiated when a new driver is created.
The driver classes can implement the PluginDevice interface and implement the getStatus( ), initialize( ), shutdown( ), and getPluginMeta( ) methods.
Methods can include:

getStatus( ) : PluginStatus
Returns the PluginStatus enumeration value that defines the current state of the PluginDevice. This method is used by the parent Plugin to provide status information.
initialize(rawConfig : RawConfig): void , throws PluginDeviceException
Initializes the PluginDevice with the specified rawConfig. Throws PluginDeviceException on error.
shutdown( ): void, throws PluginDeviceException
Requests that the PluginDevice shutdown. Throws PluginDeviceException on error.

-continued

This method is to support the redefine operation where an existing reader is updated with a new configuration.
getPluginMeta( ): PluginMeta, throws PluginDeviceException
Returns that the PluginMeta information associated with the Pluging. Throws PluginDeviceException on error. Existing Plugins and new plugins must implement this method to provide accurate Plugin Meta Information.

The PluginStatus class can provide an enumeration of Plugin states defined as Strings:
ACTIVE (in use)
INACTIVE
The PluginType class can provide an enumeration of Plugin types defined as Strings:
READER
COMPOSITE_READER
TRIGGER
FILTER
The Plug-in API can be composed of two parts: the Plug-in Meta API and the Plug-in Configuration API. The Plug-in API can be implemented as a SOAP interface defined with a WSDL file. The objects referenced within the interface can be defined in an XML Schema definition and serialized through the SOAP interface. The Plug-in API can also be exposed to clients with a JAVA API.
The PluginMeta API can provide methods for read only access to the Plugin Meta Information.
Methods can include:

listPluginMeta(pluginRole: String) : List <PluginMeta>
Returns a list of PluginMeta objects for the given Plugin Role.
getPluginMeta(pluginRole: String, name : String) : PluginMeta, throws NoSuchPluginMetaException
Returns the PluginMeta instance with matching role and name. Throws NoSuchPluginMetaException if a matching PluginMeta instance is not found.
listRoles( ) : List <String>
Returns a list of the available Plugin Roles.

The Plugin configuration API can provide methods for creating, modifying, removing and listing Plugins. Plugins can live within the scope of the EdgeServer.
Methods can include:

listPlugin(pluginRole: String) : List <PluginConfig>, throws PluginException
Returns a list of Plugins defined on the Edge Server that match the specified pluginType.
definePlugin(pluginRole: String, pluginName: String, pluginConfig: PluginConfig): void, throws PluginException
Defines the plugin with role, name, and plugin configuration on the edge server. Throws PluginException if the plugin already exist or the configuration is incorrect.
redefinePlugin(pluginRole: String, pluginName: String, pluginConfig: PluginConfig) : void, throws PluginException
Redefines the plugin with matching role and name, applying the new pluginConfig. Throws PluginException if the plugin is not already defined or the plugin configuration is not valid.
undefinePlugin(pluginRole: String, pluginName: String) : void, throws PluginException
Un-defines the plugin with matching role and name. Throws PluginException if the plugin is not already defined.
getPlugin(pluginRole: String, pluginName: String,): PluginConfig, throws NoSuchPluginException
Returns the Plugin instance with matching role and name. Throws a NoSuchPluginException if the Plugin is not found.

The ability to dynamically update a Plugin Configuration can result in a synchronization problem with the Event Cycle engine. The synchronization issue results due to the interdependences between ECSpecs, PCSpecs, Readers, Logical Readers (i.e. Composite Readers and Antennas (a.k.a. Reader Point)) and Filters. FIG. **6**H is an analysis model that provides an overview of the dependencies of one embodiment.

FIG. **6**I shows an exemplary dependency graph.

FIG. **6**J shows an exemplary event cycle dependency graph of one embodiment.

EventCycles can be at the root of the dependency graph. Event Cycles can manage the processing of an active ECSpec or PCSpec. Event Cycles can be invoked by the client through the following interface calls:

1. Poll
2. Immediate
3. Subscribe

An Event Cycle can directly depend on:

ECSpec

PCSpec

ECSpecs can define the characteristics of an event cycle. ECSpecs can be modified by the client through calls to the following methods:

1. Define
2. Redefine
3. Undefine

ECSpec and PCSpec can directly depend on:

Logical Reader

Composite Reader

Antenna

Concrete implementations of Logical Reader can include Composite Reader and Antenna. A Composite Reader can be a composite for Logical Reader. Composite Readers can be defined by the client through the plugin interface. An Antenna is defined as part of the configuration for a Reader. Where the Reader can model a physical Reader (e.g. MatrixAR4000) and the Antenna can model a physical antenna (e.g. uhfl Antenna) attached to the Reader.

An Antenna can directly depend on a filter:

A filter can support filtering of EPCs at the Antenna source. A Filter can be defined by the client through the Plugin API. In one embodiment, a filter has no dependencies.

A Configuration Event can result from a configuration change to one of the EventCycle entities (i.e. CompositeReader, Reader, or Filter). A configuration event can generate a change event notification. The Change Notification can be sent to each of the observers of the entity. Depending on the entity and configuration, there may be 0, 1 or more observers. Observers of the entity can normally include consumers of the entity. For example, observers of a filter can include any Antennas that reference the filter.

When an observer receives a Change Notification, the observer can take an appropriate action. In some cases, no action will be required.

If the receiver of a Change notification has registered observers, the change event can be forwarded to those observers.

In one embodiment, changes to Filters may only occur through configuration events. Consumers of filters can be limited to the Antenna subtype of Logical Readers.

Addition:

Add the new Filter to the filter manager.

No notification required.

Modification can include:

1. Create a new Filter object with new configuration.
2. Notify Logical Readers to replace the old Filter with the new Filter.
3. Disable and remove the old Filter.

Removal can include:

1. Create a placeholder Filter object.
2. Notify Logical Readers to replace the old filter with placeholder Filter.
3. Disable and remove old Filter

In one embodiment, changes to Readers may occur through configuration events.

Addition can include:

Add the new Reader and Logical Readers defined by the configuration.

Process addition of each Logical Readers defined by the Reader

Modification can include:

Process removal of each Logical Reader associated with the old Reader instance

Disable old Reader Object

Create new Reader Object

Process addition of each Logical Reader associated with the new Reader instance

Removal can include:

Process removal of each Logical Reader

Disable old Reader instance

Changes to Logical Readers:

Addition can include:

1. If there is a matching placeholder Logical Reader, then:
2. Create new Logical Reader
3. Notify Event Cycles to update references to use new Logical Reader
4. Remove old Placeholder Logical Reader
5. Validate, execute and persist changes.
6. Otherwise, no action since the Logical Reader is not currently required by any active EventCycles

Modification can include:

Error condition. Conflicts with another active logical reader.

Removal:

1. Create a placeholder Logical Reader (if it is currently referenced by an active Event Cycle).
2. Notify Event Cycles to update reference to use new placeholder object
3. Remove old Logical Reader

Updates to ECSpecs can continue to use current mechanism to handle define, redefine and undefine events.

In one embodiment, if EnableDynamicConfig Boolean property is set to true:

1. Get plugin data from Dynamic Plugin Configuration persistent store
2. If a logical reader is missing, create a placeholder for use by referencing ECSpecs and Composite Readers.

In one embodiment, if EnableDynamicConfig Boolean property is set to false:

1. Use edge.props for plugin configuration information.

The JAVA API can include the following set of classes.

PluginMeta

PluginParameterMeta

PluginParameterConstraint

PluginParameterConstraintRangeNumeric

PluginParameterConstratintRegEx

PluginConfig

PluginConfigParameter

PluginType

PluginStatus

The JAVA API can also support a client stub to expose the methods defined by the Plug-in API.

Schema definition can be added to support the serialization into XML of the following classes:

PluginMeta
PluginParameterMeta
PluginParameterConstraint
PluginParameterConstraintRangeNumeric
PluginParameterConstratintRegEx
PluginConfig
PluginConfigParameter
PluginType
PluginStatus

A new boolean configuration parameter "EnableDynamicPluginConfiguration" can be added to the edge.props file. This configuration parameter can determine the mode of operation for handling Plugin Instance creation and persistence. The default setting can be true.

The edge.properties file can support static declaration of readers, composite readers, triggers, and filters.

PluginMeta information can be provided by the getPluginMeta( ) method of all Plugin drivers.

The Plugin information can be stored in the form of PropsRawConfig files. These files can be constructed and updated dynamically in response to definePlugin, redefinePlugin and undefinePlugin API method invocations.

The Admin Console can be updated to support read only access to Plug-in Meta information and read/write access to Plug-in information using the Plug-in a JAVA API.

An edge server can be configured by means of an configuration file, such as an edge.props file, which can be a JAVA-properties formatted file that configures:

1. The name of the edge server and the port on which its Soap server listens for connections.
2. Internal matters such as thread concurrency and queue depths.
3. Location(s) of EPC company prefix index translation tables.
4. Other settings for: persistence, telemetry, notification drivers and default notification delivery failure handling.
5. Physical readers: driver class, and per-driver configuration items.
6. Composite readers.
7. Filters for logical readers.
8. Triggers: driver class, and per-driver configuration items.

The "Admin Console" can be currently the primary user-visible manifestation of a RFID edge server deployment. This can be where all edge servers are listed and monitored, where ECSpecs and PCSpecs are authored and deployed, and where telemetry and alerts are marshalled. The Admin Console can be extended to allow the configuration of an edge server to be viewed and manipulated via the ALE Configuration API, for example allowing new readers to be defined and configured, triggers to be created, etc.

FIG. **7**A shows the relationship between the readers/triggers, edge servers, the admin console, discovery system, and control server of one embodiment.

Using the ALE Configuration API, an edge server can be configured to work with one or more readers and zero or more triggers. The ALE Configuration API can be accessible to the admin console, so that an administrator may view and manipulate the reader/trigger definitions in an edge server.

The ALE Configuration API can also be available to a discovery system that is responsible for noting the comings and goings of readers on the site network. The discovery system can use the ALE Configuration API to configure an edge server to use a discovered reader.

A control server can use the ALE Configuration API to manipulate the configuration of multiple edge servers.

The ALE Configuration API can provide methods that expose and manipulate various aspects of an edge server's configuration. This API may be considered to be a public interface to an underlying object model.

FIG. **7**B shows an exemplary entity-relationship diagram of one embodiment. In the interest of simplicity, triggers are not shown.

The <<named>> stereotype indicates that the entity is a collection of instances, each of which has a distinct name (akin to the primary key in a relational model). For example, an edge server can have any number of ECSpec instances, each of which has a unique name. In one embodiment, the ALE Configuration API, such entities are always reference by their name. When one entity references another, it does so via the name of the referenced entity (like a foreign key). ECSpecs and PCSpecs are created via the ALE and ALEPC APIs, respectively. Each ECSpec (or PCSpec) refers to one or more "client" readers, each of which is either a logical reader or a composite reader. A composite reader can be created by use of the ALE Configuration API, and can simply be a collection of logical readers and/or composite readers. A physical reader entity can be created by use of the ALE Configuration API, by specifying a driver implementation class and a set of properties, interpreted by the driver, that configure the physical reader instance. Each physical reader can define one or more logical readers. In one embodiment, Logical readers are not created directly by the ALE Configuration API, but instead are owned by a physical reader. Filters can be created by use of the ALE Configuration API. Each logical reader may have an ordered sequence of filters configured for use during read cycle processing.

Like the other ALE APIs, the ALE Configuration API can be organized as a set of top-level methods, helper objects, and exceptions. In this section we present the ALE Configuration API, with the top-level methods organized and grouped according to function. The API can be presented using pseudo-JAVA syntax. Fundamentally, the API can be exposed as a SOAP-based remote invocation wire protocol, with a JAVA client binding provided to encapsulate the SOAP layer. In addition to the exceptions listed below, all methods can also throw EngineException and RemoteException.

Physical Reader Methods can include:

```
List getAllPhysicalReaderNames( )
void definePhysicalReader(String physicalReaderName, EntitySpec spec)
  throws DuplicatePhysicalReaderNameException,
    DuplicateLogicalReaderNameException,
    EntitySpecValidationException,
    NoSuchDriverException
void undefinePhysicalReader(String physicalReaderName)
  throws NoSuchPhysicalReaderException
void undefinePhysicalReader(String physicalReaderName,
ReferentialIntegrity riControl)
  throws NoSuchPhysicalReaderException,
    InUseException
void redefinePhysicalReader(String physicalReaderName,
EntitySpec spec)
  throws NoSuchPhysicalReaderException,
    DuplicateLogicalReaderNameException,
    EntitySpecValidationException,
    NoSuchDriverException
void redefinePhysicalReader(String physicalReaderName,
        EntitySpec spec, ReferentialIntegrity riControl)
  throws NoSuchPhysicalReaderException,
    DuplicateLogicalReaderNameException,
    EntitySpecValidationException,
    NoSuchDriverException,
    InUseException
EntitySpec getPhysicalReaderSpec(String physicalReaderName)
```

-continued

```
List getLogicalReaderNames(String physicalReaderName)
   throws NoSuchPhysicalReaderException
List getPhysicalReaderDriverNames( )
// TBD: methods to list ECSpecs/PCSpecs that depend on a given
physical reader?
//   Not here-such methods should be part of the ALE and ALEPC
//   APIs.
```

The following helper object can be used by all of the methods that define entity instances and return information about them:

```
class EntitySpec
{
   String driverName;
   Map config;
}
```

The driverName can identify the driver class responsible for this entity. The config can be a set of name/value pairs, and is interpreted by the driver class. Each driver class should specify what names it looks for in the map and how it treats their values.

The following enum can be used by methods that could possibly break inter-entity references:

```
enum ReferentialIntegrity
{
   ENFORCE,// throw InUseException rather than break reference
   RELAX      // allow reference to dangle
   // UPDATE // remove the reference
}
```

If ENFORCE is specified, a method such as undefinePhysicalReader( ) can throw InUseException if the operation would cause a reference to be broken (such as an ECSpec that references a logical reader defined by the to-be-undefined physical reader).

In one embodiment, if RELAX is specified, then enforcement of referential integrity constraints is not performed. This introduces the possibility of dangling references. For example, if a physical reader is undefined, and an ECSpec lists a logical reader which no longer exists as a result of undefining the physical reader, then we say that the ECSpec has a dangling reference to a non-existent logical reader. In all such cases, can carefully specify the resulting behavior. In the present example, the ECSpec can operate as if the missing logical reader exists but always produces read errors (say).

UPDATE can maintain referential integrity by modifying a referencing entity so that it no longer references the deleted entity. For example, ECSpecs and PCSpecs can be altered to remove an undefined reader from their list of logical readers.

Logical Reader Methods can include:

```
List getAllLogicalReaderNames( )
boolean supportsReading(String logicalReaderName)
   throws NoSuchLogicalReaderException
boolean supportsWriting(String logicalReaderName)
   throws NoSuchLogicalReaderException
List getFilterChain(String logicalReaderName)
   throws NoSuchLogicalReaderException
void setFilterChain(String logicalReaderName, List filterNames)
   throws NoSuchLogicalReaderException,
      NoSuchFilterException
void prependFilterToChain(String logicalReaderName, String filterName)
   throws NoSuchLogicalReaderException,
      NoSuchFilterException
void appendFilterToChain(String logicalReaderName, String filterName)
   throws NoSuchLogicalReaderException,
      NoSuchFilterException
void removeFilterFromChain(String logicalReaderName,
String filterName)
   throws NoSuchLogicalReaderException,
      NoSuchFilterException
String getPhysicalReaderName(String logicalReaderName)
   throws NoSuchLogicalReaderException
// This method should be part of ALE: getECSpecsForReader
//List getECSpecNamesUsingReader(String clientReaderName)
//   throws NoSuchClientReaderException
// This method should be part of ALEPC: getPCSpecsForReader
//List getPCSpecNamesUsingReader(String clientReaderName)
//   throws NoSuchClientReaderException
List getCompositeReaderNamesUsingReader(String clientReaderName)
   throws NoSuchClientReaderException
```

Filter Methods can include:

```
List getAllFilterNames( )
void defineFilter(String filterName, EntitySpec spec)
   throws DuplicateFilterNameException,
      EntitySpecValidationException,
      NoSuchDriverException
void undefineFilter(String filterName)
   throws NoSuchFilterException
void undefineFilter(String filterName, ReferentialIntegrity riControl)
   throws NoSuchFilterException,
      InUseException
void redefineFilter(String filterName, EntitySpec spec)
   throws NoSuchFilterException,
      EntitySpecValidationException,
      NoSuchDriverException
void redefineFilter(String filterName, EntitySpec spec,
ReferentialIntegrity riControl)
   throws NoSuchFilterException,
      EntitySpecValidationException,
      NoSuchDriverException,
      InUseException
EntitySpec getFilterSpec(String filterName)
List getLogicalReaderNamesUsingFilter(String filterName)
   throws NoSuchFilterException
List getFilterDriverNames( )
```

Composite Reader Methods can include:

```
List getAllCompositeReaderNames( )
void defineCompositeReader(String compositeReaderName,
         List clientReaderNames, boolean reportFailedMembers)
   throws DuplicateCompositeReaderNameException,
      NoSuchClientReaderException,
      CyclicDefinitionException
void undefineCompositeReader(String compositeReaderName)
   throws NoSuchCompositeReaderException
void undefineCompositeReader(String compositeReaderName,
ReferentialIntegrity riControl)
   throws NoSuchCompositeReaderException,
      InUseException
void redefineCompositeReader(String compositeReaderName,
         List clientReaderNames, boolean reportFailedMembers)
   throws NoSuchCompositeReaderException,
      NoSuchClientReaderException,
      CyclicDefinitionException
void redefineCompositeReader(String compositeReaderName,
         List clientReaderNames, boolean reportFailedMembers,
         ReferentialIntegrity riControl)
   throws NoSuchCompositeReaderException,
```

-continued

```
    NoSuchClientReaderException,
    CyclicDefinitionException,
    InUseException
void addReaderToComposite(String compositeReaderName, String
clientReaderName)
  throws NoSuchCompositeReaderException,
    CyclicDefinitionException
void addReadersToComposite(String compositeReaderName, List
clientReaderNames)
  throws NoSuchCompositeReaderException,
    CyclicDefinitionException
void removeReaderFromComposite(String compositeReaderName, String
clientReaderName)
  throws NoSuchCompositeReaderException
boolean getReportFailedMembers(String compositeReaderName)
  throws NoSuchCompositeReaderException
List getClientReaderNames(String compositeReaderName)
  throws NoSuchCompositeReaderException
```

Trigger Methods can include:

```
List getAllTriggerNames( )
void defineTrigger(String triggerName, EntitySpec spec)
  throws DuplicateTriggerNameException,
    EntitySpecValidationException,
    NoSuchDriverException
void undefineTrigger(String triggerName)
  throws NoSuchTriggerException
void undefineTrigger(String triggerName, ReferentialIntegrity riControl)
  throws NoSuchTriggerException,
    InUseException
void redefineTrigger(String triggerName, EntitySpec spec)
  throws NoSuchTriggerException,
    EntitySpecValidationException,
    NoSuchDriverException
void redefineTrigger(String triggerName, EntitySpec spec,
  ReferentialIntegrity riControl) throws NoSuchTriggerException,
    EntitySpecValidationException,
    NoSuchDriverException,
    InUseException
EntitySpec getTriggerSpec(String triggerName)
// This method should be part of ALE: getECSpecsForTrigger
//List getECSpecNamesUsingTrigger(String triggerName)
//    throws NoSuchTriggerException
// This method should be part of ALEPC: getPCSpecsForTrigger
//List getPCSpecNamesUsingTrigger(String triggerName)
//    throws NoSuchTriggerException
```

The definitions for readers, filters, triggers, etc. can be all persisted in a persistent store, such as the var/edgestate repository along with ECSpecs, subscriptions, EPC caches, etc.

The ClearEdgeServerState utility can have options to control which persistent state is cleared.

In one embodiment, dynamic changes to an edge server's configuration can have an effect on that edge server's ongoing processing activities.

In one embodiment, the general strategy can be twofold. First, we notify affected entities of a change to something they refer to. So for example, if a filter is changed, then affected logical readers can be notified. If a reader is changed, then affected event cycles and/or programming cycles can be notified.

Second, if an entity is undefined in RELAX mode, then other entities that refer to it can replace their reference with a reference to a "placeholder" object of the same name, where the placeholder object provides an appropriate neutral behavior (for example, a placeholder filter's behavior can be pass-through). Later, if an entity is defined again to the same name, then such placeholder references can be replaced (such as, in the change-notification logic) with a reference to the newly defined entity of the same name as the previously undefined entity.

Normally, defining a new physical reader (and so one or more logical readers), filter, composite reader, or trigger would not affect any existing ECSpecs or PCSpecs, because the ECSpecs and PCSpecs are already bound to existing entities and don't care about any additional readers etc.

However, a RELAX-mode change to configuration could have left an ECSpec or PCSpec with a "dangling" reference to a reader or trigger (or a logical reader could have a dangling reference to a filter, etc.), in which case defining a "new" entity could really be re-establishing a previous referential relationship.

Thus, even new entity definitions should be treated as potentially affecting ongoing processing activity.

All event cycles (and programming cycles) can be told (by queuing a change notification event) whenever:

- a new client reader (logical or composite) is defined. The change notification is decorated with the reader's name and a reference to the reader instance.
- a new trigger is defined. The change notification is decorated with the trigger's name and a reference to the trigger instance.
- a composite reader is updated due to a new logical reader being defined, with the effect of replacing a placeholder reference in the composite reader.

When the event cycle processes the queued change notification, it can check its client reader list (or trigger specs) to see if any placeholder references thereon are to be replaced with a reference to a newly defined reader (or trigger). If so, the event cycle can re-performs any of its validations or computations related to its reader list (or trigger specs).

Whenever a new filter is defined, the reader manager can notify all logical readers (via a new method to be defined in the LogicalReader interface), identifying the name of the new filter and providing the filter definition (factory, in the parlance of our implementation). Each logical reader can determine whether it has any placeholder references that should be re-bound to an instance of the newly defined filter, and if so, create an instance of the new filter and replaces the placholder with it, and commence using the new filter in the logical reader's filter chain.

If a new logical reader is defined (indirectly, by (re)defining a physical reader), then the CompositeReaderManager can be notified so that it can update its tables, replacing placeholder references as appropriate. In addition, all event/programming cycles can be notified of the change, as mentioned above.

Whenever an entity is undefined in RELAX mode, all entities that reference it can be notified, so that the references to the undefined entity can be replaced with "placeholder" references. Placeholder references can be used so that if the just-undefined entity is later re-defined, the redefined entity will take the place of the previously undefined original in all referencing entities.

When an entity is undefined, the telemetry subsystem can be notified. Any TelemetrySpecs that reference the just-undefined entity can replace the entity with a placeholder, and optionally also generate a report to subscribers notifying them that the device has been undefined.

When a physical reader is undefined in RELAX mode, resulting in one or more logical readers being undefined, then any referencing ECSpecs or PCSpecs (and composite readers) can replace their reference to the just-undefined logical reader with a reference to a placeholder logical reader.

In one embodiment, a placeholder logical reader is not visible through the ALE Configuration API methods, and so

for example placeholder logical readers are not part of the getAllLogicalReaderNames( ) collection. But an ECSpec (or PCSpec, or composite) that references a placeholder logical reader can include the logical reader name among its list of client readers.

When an active event cycle (or programming cycle) attempts to use a placeholder logical reader, the placeholder logical reader can complete its operation with an "undefined logical reader" failure status, and the event cycle (or programming cycle) can behave as it normally does when a logical reader fails.

When a composite reader is undefined in RELAX mode, then any referencing ECSpecs or PCSpecs (or other composite readers) can replace their reference to the just-undefined composite reader with a reference to a placeholder composite reader. In one embodiment, a placeholder composite reader is not visible through the ALE Configuration API methods, and so for example placeholder composite readers are not part of the getAllCompositeReaderNames( ) collection. An ECSpec (or PCSpec, or another composite) that references a placeholder composite reader can include the composite reader name among its list of client readers. A placeholder composite reader can simply behave as a composite reader with no entries.

When a filter is undefined in RELAX mode, then any referencing logical readers can replace their reference to the just-undefined filter with a reference to a placeholder filter. In one embodiment, a placeholder filter is not visible through the ALE Configuration API methods, and so for example placeholder filters are not part of the getAllFilterNames( ) collection. In one embodiment, a logical reader that references a placeholder filter can include the filter name in its chain of filters. A placeholder filter can behave as a pass-through (identity) function, leaving the EPCBuffer contents unchanged.

When a trigger is undefined in RELAX mode, then any referencing ECSpecs or PCSpecs can replace their reference to the just-undefined trigger with a reference to a placeholder trigger. A placeholder trigger is not visible through the ALE Configuration API methods, and so for example placeholder triggers are not part of the getAllTriggerNames( ) collection. A ECSpec (or PCSpec) that references a placeholder trigger can continue to include the trigger name in its specification. A placeholder trigger can behave as a "dead" trigger, one that can be subscribed/unsubscribed, but never actually fires.

When a physical reader is redefined, this can cause new logical readers to be defined or existing logical readers to be undefined (because the replacement physical reader's spec can define a different set of logical readers as the original physical reader spec). Handling of newly defined (or undefined) logical readers can be handled as described above. In addition, the read/write capability of an existing logical reader may be changed as a result of redefining the physical reader that defines the logical reader. Affected ECSpecs and PCSpecs can re-evaluate the usability of their logical readers whenever such a change occurs.

When a composite reader is redefined, affected ECSpecs and PCSpecs can be notified so that they can re-expand the composite and continue working with the resulting list of logical readers.

When a filter is redefined, affected logical readers can be notified so that they can replace their corresponding filter chain entries with a reference to a replacement filter instance.

When a trigger is redefined, affected ECSpecs and PCSpecs can be notified so that they can replace their reference to the previous trigger with a reference to the new trigger.

The dynamic configuration API can expand the configuration API discussion below.

The Configuration API can provide a mechanism for applications to decouple the form of a configuration file (properties, XML, database, etc) from the usage of that configuration. It can thus easy to add a new configuration file format without changing the application code which uses the configuration data. It can also be easy to delegate description and validation of configuration to the module which makes use of that configuration. In one embodiment, configuration items may be Boolean values, integers, strings, files, and may also be extended to include new types. Configuration items may be organized into subconfigurations, or into concepts, which allow an arbitrary number of similar configurations to be created.

The design can consists of three separate parts. First is the RawConfig class. This class can represent configuration which is read directly from a configuration source, before any parsing and validation. It is also possible to create a RawConfig class by taking a piece of an existing RawConfig.

The next part of the system can be the ConfigItem and its derived classes. A ConfigItem represents one bit of configuration data. Each derived class can determine the semantics of a particular type, including validation criteria such as format and ranges. The derived class can also acts as a holder for the typed configuration item.

Finally, the ValidatedConfig class can tie together RawConfig and ConfigItems. This class can represent a description of configuration for a specific component of the system. A ValidatedConfig object can be composed of a set of ConfigItem objects. After the ValidatedConfig is created and all its ConfigItem objects are set, the ValidatedConfig can be tied to a RawConfig object. The ValidatedConfig object can read items from the RawConfig for each ConfigItem, and uses the ConfigItem to verify and store the value. After this step, the application can read the values from the ValidatedConfig object, from holder ConfigItem objects, or create a new RawConfig which represents a slice of the RawConfig which is associated with the ValidatedConfig.

The properties can be imported into the configuration system by crearing a PropsRawConfig object using these properties. The prefix can indicate that only properties with this prefix should be considered.

The first two properties are simple ConfigItems. The first can be an integer, and the second can be string. They could be described using addIntItem( ) and addstringItem( ), or they could be described using addItem( ) and explicitly created ConfigInt and ConfigString objects. Once ValidatedConfig.readFrom( ) is called to parse the RawConfig, their values can be retrieved using getIntValue( ) and getStringValue( ) on the ValidatedConfig object, or by calling ConfigInt.int Value( ) and ConfigString.stringValue( ). com.connecterra.ale.servicePort=6060
com.connecterra.ale.siteID=DistributionCenter

The next two values can introduce the idea of subconfiguration. The persistence subsystem of ALE can take a set of config values. Rather than having the persistence subsystem aware of the structure of the entire application, the application can create a slice of the configuration space by calling getSubConfig("persistence") on either the RawConfig or ValidatedConfig objects. Then, the persistence subsystem can treat the directory and interval items as simple items. If the configuration of the subsystem is known in advance, ValidatedConfig.addSubConfig( ) can be used to partially or fully describe it. ValidatedConfig.readFrom( ) will then validate and read into the subconfig as well. com.connecterra.ale.per-

sistence.directory=/opt/rfta/var/edgestate com.connecterra.ale.persistence.interval=3600

The final aspect of configuration can be concepts and instances. It is sometimes useful to use configuration to describe an open-ended set. In the example below, we describe two instances of a concept "reader", named "dock**1**" and "dock**2**". A common pattern will be to create a simple inferior ValidatedConfig containing only the items common across all instances (in this case, "class"), add that to the main validated config with the addConcept( ) method. When readFrom( ) is called, the configuration implementation can verify that each instance of the concept which is given contains the necessary properties. The inferior ValidatedConfig can be filled in with arbitrary data at this point. Next, the caller can use listInstanceNames( ) to get a list of all of the instances, and then use getInstance( ) to construct a slice of the configuration which can be passed to the specific initialization code for further validation. The specific initialization code can treat its configuration as simple items. The readFromInstance( ) sugar method can combine a call to getInstance( ) with a call to readFrom( ). com.connecterra.ale.reader.dock**1**.class=com.connecterra.ThingMagic com.connecterra.ale.reader.dock**1**.hostname=thingmagic.example.com com.connecterra.ale.reader.dock**2**.class= com.connecterra.Matrics com.connecterra.ale.reader.dock**2**.defaultRate=500

FIG. **8**A shows a configuration UML interaction diagram of one embodiment.

The API can be used in two ways. The higher level interface can use sugar methods to add configuration items to the ValidatedConfig and to retrieve their values. This can result in less code for the common case (no subConfigs or concepts, and only native or String types). It can be used in other situations, but will generally require downcasts which can only be correctly verified at runtime.

The low level interface can use ConfigItem objects as holders. It can involve more code, but allows complex configurations to be built while still permitting compile-time checking for all types, including new ConfigItem types for which no sugar methods exist.

FIG. **8**B shows a diagram of a high level configuration API of one embodiment.

FIG. **8**C shows a diagram of a low level configuration API of one embodiment.

In one embodiment, there are three places where exceptions need to be considered

- When a configuration item is invalid according to ConfigItem.setValue( ) In this case, a ConfigItemException checked exception is thrown. The reason string for this exception will give a human-readable description of the configuration error.
- When ConfigFoo.fooValue( ) or ValidatedConfig.getFooValue( ) has no value to return, because the underlying value was optional and not specified. In this case, an UnsetItemException unchecked exception, which derives from IllegalStateException, is thrown.
- When the validation performed by readFrom( ) fails.

When the ValidatedConfig.readFrom( ) method runs, it can attempt to collect as much information about the configuration problems it sees as it can, so that the user can respond to them all at once, instead of repeating a run-error-fix-retry cycle. To accomplish this, ConfigValidationException, which derives from com.connecterra.util.MultiException, can be used. When setValue( ) throws a ConfigItemException, this exception can be added to a ConfigValidationException, which can be thrown at the end of the validation process. The ConfigItemException can also be decorated with additional information to determine the context, such as the property name, XML path, file line number, etc.

FIG. **5**A shows an exemplary administration console window for use with a system of the present invention. Active edge servers can be organized into a site/server hierarchy, based on the SiteID and ServerID configured at the edge. Each edge server node in the tree can have children that represent different parts of the edge server. Readers, Triggers, ECSpecs, PCSpecs, and Composite Readers can be nodes in the tree.

FIG. **5**B shows an exemplary administration console RFID Devices Panel window. When the "RFID Devices" node is selected in the tree, the right-hand panel can show the RFID Devices Panels. In the RFID Devices subpane, the "New" button can always be enabled, allowing the user to configure a new device.

When a device is selected from the list, the Logical Readers list panel can update, displaying a list of Logical Readers associated with that device. Also, the panel can enables the Clone, Configure, and Delete buttons. The Clone button can act like the New button, beginning the creation of a new RFID Device entry on the server, but it can also fill in the configuration dialog fields with values from the currently-selected device. The Configure button can display the configuration dialog for the device, allowing the user to change configuration values as desired. The Delete button can ask the user to confirm their intention to remove the device's configuration from the Edge Server.

In the Logical Readers subpane, when a logical reader is selected, the Configure Filters button can be enabled. Also, if the selected reader supports reading tags, the Read Tags button can be enabled; likewise with the Write Tags button. The Read Tags and Write Tags buttons can activate their respective User Interfaces. The Configure Filters button can allow the user to configure the edge server filters associated with the reader at the device level.

As shown in FIG. **5**C, when a composite reader is selected from the list, the panel can enable the Clone, Configure, and Delete buttons. The Clone button can create a new composite reader and populate the new configuration dialog with the selected reader's configuration. The Configure button can display the configuration dialog for the selected reader, allowing the user to modify its reader list as desired. The Delete button can ask the user to confirm their intention to remove the selected reader from the Edge Server.

Read Tags and Write Tags can work on a Composite Reader as they do on a Logical Reader. When the user selects "New Reader . . . ", the Reader Configuration dialog can be displayed with empty fields. The Reader Driver combo box selection can read "Select a Driver . . . " and the parameter area of the screen can be left empty until an initial driver selection.

The first time the user tries to create or edit a Reader on a given Edge Server, the list of available drivers can be requested from the remote server. Once we have the list of drivers for a server, we can assume that it won't change while we believe the Edge Server is running. If the Edge Server ever appears to be unavailable, we can clear this memorized list of drivers, since this could be the result of a restart operation. Also, if the user chooses to manually refresh an Edge's device tree, that server's list of drivers can be cleared.

The list of drivers can be used to populate the Reader Driver pull down combo box of one embodiment is shown in FIG. **5**D. The Reader Configuration dialog can be dynamically generated from server-provided information about the configuration options supported by the currently-selected driver. When the driver changes, the dialog can remember all

values associated with their internal key name, and attempts to configure the new driver with the remembered values. If there is sufficient room to display the parameters and the driver need to be configured, the dialog can simply consist of a set of parameter edit fields, allowing the user to enter values for each parameter. If there are too many parameters to fit gracefully, these parameters can be embedded in a scrolling pane.

Each parameter edit field can display the human-readable parameter name (if this is provided by the Config API—if not, it can display the internal parameter name), a text entry field, a "required field" indicator, and a description of the field constraint, if such a description is available through the Config API. When the user completes the form, entries can be validated and the specified reader saved to the server.

FIG. **5**E shows a screen for managing the ALE filters of one embodiment. The list of available filters on an Edge Server can be obtained in a just-in-time basis, and cached for the lifetime of an Edge Server connection. Like the list of available reader drivers, the cached version of this list can be invalidated if we lose connection to the Edge. This screen of FIG. **5**E can be used to edits the filter chain associated with a logical reader. The "Add" button can add the currently selected filter from the Filters list to the bottom of the chain. Adding a filter to the chain need not remove it from the Filters list, since a filter can be include multiple times in a given reader's chain. The "Move Up" and "Move Down" button can move the selected filter earlier or later in the filter chain. "Remove" can remove the selected filter from the chain.

In one embodiment, the Add button is only enabled if there is a filter selected in the Filters list and the Move Up, Move Down, and Remove buttons need only enabled if there is a filter selected in the Filter Chain. When the user presses the "Revert" button, the filter chain is reverted to the list of filters it contained when the dialog was initialized. "Cancel" can exit the dialog box without saving changes. The "Ok" button can commit the changes to the filter chain to the edge server.

In one embodiment, when the user configures or creates a composite reader, the admin console can present the Composite Reader Configuration Dialog as shown in FIG. **5**F. The Available Readers list box can list Logical Readers that are configured, but not included in the Composite Reader. The Included Readers list box can list all Logical Readers that are included in this Composite Reader. Two arrow buttons can allow "moving" a logical reader from one side to the other. Double-clicking a reader in either list can move it to the other side.

The "Failure Reporting" radio buttons can let the user choose the form a failure report takes in the ECReports object for an ECSpec that lists the CompositeReader. In one embodiment, the user can only add currently configured Logical Readers to a Composite Reader. The user is given a warning if he attempts to remove an unconfigured Logical Reader from the Composite Reader: "The Logical Reader you are removing is not configured. You will not be able to add it back to this Composite Reader without reconfiguring it first."

An EC Spec Editor can be used to indicate when a EC Spec is suspended, rather than adding another column to the pane, the suspended state will be indicated by added "(suspended)" to the Subscriber Count and by changing the row to have a yellow background, similar to the warnings on the Alerts page. The EC Spec table to be sorted by the various columns (using TableSorter), and enable the user to open an EC Spec, Filter or Report by double clicking on the appropriate line in the corresponding table.

"Deploy" and "Deploy As" can be added to the ECSpec file menu to join "Export" and "Close". Add "Import" and "Revert" can be also added to the Leave "Test" as the only item in Tools menu.

View menu can include "EC Spec Editor", "As XML" and "As Text" with one of them grayed out at any given time. The icons for these three functions can always be visible, with one grayed out.

The Attributes section can be added to allow the user to specify whether to include the EC Spec in each EC Report. It can be below the Stop section and above the Application Data section. In the Stop section, the user can be able to specify Duration (Milliseconds), Duration (Read Cycles), Stable Field Interval (Milliseconds) and Stable Field Interval (Read Cycles) independently.

In the Start section, the label Milliseconds can be positioned to the left of the repeat period text box to be consistent with Duration and Stable Set Interval in the Stop section.

There need not be three tabs at the bottom of the screen to switch to View by Text or View by XML, or back to the editor. Instead these functions can be accessed through the menu or toolbar.

Include can be renamed Include Filters, Exclude can be renamed to Exclude Filters, and there can be a new entry named Grouping in that tree. Selecting Grouping can call up a list of the grouping patterns, just like the filters table. The input grouping pattern screen can look just like the input filter screen except that there is a fourth option for each field "Group By" inserted between "Any" and "Specific". When the user enters a grouping pattern, an abbreviated URI representation can appear in the tree on the left, similar to the filters.

In one embodiment, validation of the EC Spec will not be done as the user enters data. Validation can be left to the edge server whenever possible. The messages section need not be a tabbed pane. It can be a simple pane with a blue grouping box similar to the sections in the EC Spec Edit pane above it.

The Report Type section can be renamed "Report Contents:". It can have 5 check boxes in a column, "EPC List", "Tag List", "Raw Hexadecimal List", "Raw Decimal List" and "Count". EPC List is checked by default. This list need not be validated. Validation can be left to the Edge Server. The "Behavior when Empty" section can be replaced by "Omit Report:" section. In this section is "Omit if empty", "Omit if unchanged from last cycle" and "If omitted, suppress all EC Reports this cycle". The last of these can be grayed out if the first two are both unchecked as it would not have an effect.

When the EC Report comes back, it can be viewed in a new frame The title can include the EC Spec Name and a Timestamp. It can have a menu bar (not Save and OK buttons). The File menu can contain "Export" and "Close". The Help menu can contain "EC Reports Help". The frame can be non-modal.

There can be a progress dialog that says "Please wait while we communicate with the Edge Server", it can have an animated gif like an hourglass or an endlessly repeating progress bar. It can have a single button Cancel. This dialog can be modal and appears roughly half a second after the message is sent to the Edge Server if the response hasn't come back. This may be accomplished by creating the dialog immediately and setting a timer that will display it. The cursor can change to a watch cursor (with an hourglass) as soon as the user clicks, and the user will be prevented from clicking around.

This dialog need not be used for Activate Once or Test (on an edited EC Spec). Instead the EC Report View dialog can be called up instead, and initially says something like "waiting for results from the edge server." That dialog can be non-modal.

FIG. 5G shows a Read Tags dialog that can come up when a user presses the "Read Tags" toolbar button from the Logical Readers table or the Composite Readers table. The Admin Console can repeatedly perform immediate tag reads on the selected reader, displaying the results in the tag values list box. The first column can be an indicator of tag status; a red X shows a tag that has left the reader's field. Once 5 minutes have passed without seeing a tag, that tag can be deleted from the list. The Read count can show how many times a tag has been read. The % Seen column can be calculated as a percentage of read cycles in which the tag has been detected since the tag was first seen. Thus, a tag can start out at 100%, and if the tag is removed from the field its percentage can decrease until the tag entry expires from the list in five minutes. This column can be most valuable for measuring intermittent tags. When the reader is running, the user can press the "Stop" button to suspend reads. If a read returns an error, reads can be suspended. When reads are suspended, the "Start" and "Clear" buttons can be enabled. "Restart" can continue reading. In one embodiment, the values in the table do not update while reads are suspended, and tags do not expire from the list.

FIG. 5H shows a Write Tags dialog that can come up when a user presses the "Write Tags" toolbar button from the Logical Readers table or the Composite Readers table. If a reader was selected in that table, the Logical Reader field can be populated with the selected reader's name.

When the user presses the "Program" button, the Admin Console can validate the tag value, put together a PC Spec with the specified tag value (using certain hard-coded defaults for PC Spec parameters) and attempt to write the tag. If there is an error, a Tag Programming Error dialog can come up with descriptive text. Otherwise, the console can either dismiss the dialog or update it, depending on the value of the "Autoincrement Tag Value" checkbox.

This document describes a part of the design for the ALE GUI. Specifically, it provides a controller and model design on which the ALE GUI views are to be built. These components may also be reused by other user interfaces which make use of the RFID Edge Server, ALE and telemetry APIs.

This section lists key terms and definitions as utilized in the design of one embodiment:

- Model—A data container that holds a view-independent version of system information. Often, models notify registered listeners when changes have occurred in the underlying data.
- Controller—An object that provides a mechanism for getting data into the Model in an application-specific way. The Controller is the link between the Model/View and the real world.
- Telemetry—The RFID Edge Server can have a Telemetry API that provides device status and time-series information on a subscription basis. The client subscribes to a telemetry stream, and the Edge Server begins pushing data to the client, until either the client unsubscribes, or there are enough consecutive delivery failures.
- Time-series information—Various devices on the Edge Server export time-series data streams via the Telemetry API. These data streams are either time/value pairs, or time/gauge pairs, and the names of these streams are device-specific.
- Gauge—a stock-ticker style data point with a high-water mark, low-water mark, and average value for any given time.

The design encompasses separate controllers and models for the ALE API and the Telemetry API. They can share a few classes which describe edge servers, since this is the common point of reference for both APIs. Each controller can provide methods which can be used to monitor changes to some edge server data. The interface can hide details such as whether a publish/subscribe model or a polling model is used, so as protocols are enhanced, the GUI can work more efficiently without making changes to the view code. Each controller can also provide access to their underlying connection pools, to provide managed access to server connections for other tasks.

The use case for these classes can be GUI clients which use network calls which may take a long time to complete or fail, and which the user may wish to cancel. These operations can take place on separate threads so that the interface does not appear to hang to the user.

The Admin Console GUI can have panels that monitor the state of the edge server and its constituent devices. The device browser can maintain a graphical display of device status in its tree view; the display can update asynchronously, when the edge server can push new telemetry information to the console application.

When certain device nodes are selected, the device information panel can display the device's associated time-series telemetry charts. When the user can select such a node, the application can send the edge server a telemetry subscription request, and when the user deselects the node, the application can unsubscribe.

The ECSpec information panel can display an edge server's ECSpecs in a table, and update that information periodically. The ALEController can provide a subscription-like interface to this information so that the pattern of subscribing when the "ECSpecs" node is selected and unsubscribing when leaving the node parallels the device telemetry stream pattern.

In one embodiment, the design of the ALE GUI can take into account a complex set of requirements.

- The GUI can manage multiple edge servers. This management can use several different APIs (ALE and Telemetry, and possibly others in the future)
- For good user interaction, the GUI can never appear to block. Instead, any long-lived operation can be performed on a separate thread.
- For efficient use of resources, multiple calls to the same API on the same edge server can share a single connection.
- The user can be allowed to cancel operations, even though the underlying network protocol implementation does not always provide a mechanism to interrupt an operation in progress.
- Some of the information needed can be subscribed to, but other information can be polled.

This design can provide an interface for a local caching model for the ALE API, one for the Telemetry API, and another for the Config API. The model can also include a listener/event mechanism so that the view can automatically updated when the model is changed. A controller can provide methods which cause periodic updates to the local model to be made which can then be acted on by listeners.

FIG. 9A shows a model exposed by this architecture is a confluence of information and operational methods into one interface that hides the underlying mechanism used to implement the requests. Information from the various edge server interfaces can be merged into this one model; the GUI does not need to know that device status information comes from the telemetry. In one embodiment, the model can hide the fact that, while the association of logical reader name to physical reader comes from the Configuration API, the capability of that logical reader—whether it can read tags, write tags, or both—can be gleaned from the ALE API.

In one embodiment, while the ConfigAPIModel exposes Readers and CompositeReaders as plugins, the EdgeGUIModel can treat these specially, hiding the reader and composite reader "roles" in favor of specific interfaces for accessing the models. Other plugin-type objects (filters and triggers) can be handled through the plugin role interface, since the admin console should be able to handle new types of objects as they are introduced underneath.

FIG. **9**B shows an Endpoint model that encapsulates the information necessary to connect to an edge server. This can simply be a host and port, since the ALE, Config, and Telemetry API URI paths can all be generated from this information. The Endpoint can be constructed from a host/port combination or a string representation. The string representation can be a legacy URI, for backwards compatibility with older Admin Console configurations, or simply a host/port pair of the form "host:port". When the admin console writes the configuration back out, though, legacy URLs can be converted to the new form, "host:port". The URI-based constructor can throw an InvalidURIException, if the String is a malformed URI, or if it is not one of the expected legacy forms.

In one embodiment, the Endpoint is immutable; to change an edge server endpoint, the endpoint must be removed from the EndpointList under the old value, and re-added with the new value. This object is the key identifier for any edge server connection.

The Admin Console initialization can generate this configuration manager and passes it into ConsoleGUIModel. As shown in FIG. **9**C, in one embodiment, the ConsoleGUIModel gets its list of endpoints from this object. The config manager can simply handles transfer of the list of endpoints to and from persistence.

The ConsoleGUIModel can be the top-level Model object for the Admin Console application. It can represent the tree structure of the device browser. It can also hold the ConfigurationManager passed in from the application. It can get the list of connections to edge servers from that object, and uses it to persist changes to that list.

When an Endpoint is removed from the edge server list, the ConsoleGUIModel can be responsible for making sure that the associated EdgeGUIModel disconnects from the server and that it's associated node is removed from the device tree.

The Admin Console can read the edge list configuration into a ConsoleConfigurationManager and passes that object to the ConsoleGUIModel constructor. The constructor can create a preliminary EdgeIDTreeModel tree structure with each edge server in the "Unknown" path, and create EdgeModels for each edge server. As the telemetry service returns device path information for each edge server, it can update the EdgeIDTreeModel tree structure to sort those servers into the reported device path.

The EdgeTreeModel can be a tree structure maintained by the ConsoleGUIModel. The tree structure can mirror the structure present in the device ID paths returned each Edge Server's telemetry. The following invariant can apply to this tree—any node with children is not an endpoint node, and has no associated EdgeGUIModel; all leaves are endpoint nodes that contain a reference to an EdgeGUIModel object.

As shown in FIGS. **9**D and **9**E, the EdgeGUIModel can provide a subtree for the ConsoleGUIModel's device tree to include. It can also consolidate the information from the ALEGUIModel, TelemetryGUIModel, and ConfigGUIModel into one full representation.

An EdgeGUIModel can be constructed to provide access to a single edge server specified by an Endpoint object. It can create an ALEGUIModel, a TelemetryGUIModel, and a ConfigGUIModel with that endpoint and holds those objects. When the EdgeGUIModel is in "active" mode, it can start the TelemetryGUIModel monitoring the telemetry for the associated Edge Server. The EdgeGUIModel can also expose the TelemetrySetModel that holds the edge server's "edge device" telemetry. The EdgeGUIModel can provide access to the edge server's associated devices; readers and composite readers bypass the generic "role" mechanism provided to parallel the ConfigAPI, but other devices can be referenced first by their role on the edge server. Readers can be instead accessed through the getReaderNames/getReader interface, since these devices have meaning even to an edge server that does not support the Config API. Composite Readers can be the same.

EdgePluginRole can represent a type of configurable device the Edge Server exposes via the Configuration API. This can simply provide read-only access to filters, per the limitations of the Configuration API. Readers and composite readers can bypass this mechanism, accessed through specific APIs on the EdgeGUIModel; the "reader" and "composite reader" roles can be kept hidden at this layer.

The EdgePlugin can represent a configurable device exposed by the server's Configuration API. The getConfigurationMeta( ) method can return the Config API's native PluginMeta object for the associated PluginDevice's Plugin. This dependency on the Config API can be useful because the parameter information structure is complex; it may be useful for these classes to be moved into a more shared component in the future.

A Reader can represent a Physical Reader device on the edge server. The device can have configuration information (with accessors inherited from the EdgePlugin object) and a TelemetrySet associated with it. It can also have ReadPoints associated with it, each of which has a Logical Reader.

As shown in FIG. **9**F, in one embodiment, the ALEGUIModel can expose a more UI-centric interface to the information in the ALEController and ALEModel. It can provide direct access to the underlying caching ALEModel and the ECSpecModel. The class can also provide direct access to the ALEController's "Live ALE" object—this object is a wrapper around the ALE interface that automatically checks out a connection, makes the requested call, and then checks the connection back in.

As shown in FIG. **9**G, in one embodiment, the ECSpecsModel can be a thin extension over the ALEModel (which itself implements the ALE interface to provide cached information). The Admin Console can inform the ECSpecsModel which ECSpecs are "active"—active ECSpecs can have their ECSpecInfo periodically polled and updated in the ECSpecsModel. Similarly, the ALEGUIModel can maintain information on which ECSubscriptions are active.

As shown in FIG. **9**H, the model/controller abstraction over the ALE API is multi-layered, adding a distinct set of new function at each level. The lowest level, the Connection Pool can enable server connection sharing. The FactoryConnectionPool can use an AxisALEConnectionFactory to create a simple Axis-based connection to the Edge Server's ALE service and wraps that ALE object in a layer that detects exceptions that are related to the connection to the server. If the connection goes down, that wrapper can mark the associated connection object "suspect." Then when the connection is checked back into the connection pool, the pool knows to remove it. The next level can consist of two classes, the ALEController and the ALEModel. The ALEController can wrap the Connection's ALE object—the ALEController's wrapper maintains the link between data seen over the ALE connection and the cached information in the ALEModel. The ALEController can also have a polling thread that

watches for changes in edge server's ECSpecs. Operations on ALEModel can always refer to the cache and never block on network traffic. The ALEModel can implement certain package-private setter methods for use by the ALEController's ALE wrapper. ALEModel can call to define, undefine, redefine, poll, or immediate result in an IllegalOperationException. The ECSpecModel can be a thin layer over ALEModel that provides a connection back to the ALEConnection's polling mechanism.

As shown in FIG. **9**I, in one embodiment, the next level is the ALEGUIModel, which combines the ALEController and ALEModel into one interface. It can expose the ALEController's live ALE connection, the Worker Queue, and the ECSpecModel.

This class can implement methods for requesting updates to ECSpecs or ECSubscriptions on an edge server. This can be implemented with a polling thread. If the ALE API can be enhanced or a ConnecTerra-private API is developed in the future to support a subscription mechanism for changes in this data, the implementation can be updated to take advantage of that. The ALEController can use the AlarmClock mechanism from the ConnecTerra Util component to perform this periodic polling.

The ALEController can also provide a "Live ALE" object which implements the ALE API by wrapping calls with checkout and checkin operations to the ALE Connection pool. This can be useful for callers to perform specific ALE operations, such as creating or deleting ECSpecs, within the ALEController's connection management framework.

The ALEConnectionFactory instance can return AxisALEClient instances directly or the AxisALEClient object can be wrapped in another class which implements the ALE interface. For each method in the ALE interface which can alter the model, this wrapper class can update the model, perhaps issuing additional ALE method calls if the arguments and return value are insufficient to understand the model changes. In this way, changes made as a result of user calls can be automatically updated in the model, and if appropriate listeners are in place, the view as well. Additionally, exceptions that indicate an error with the connection can label the associated ALEConnection object as suspect, causing the ConnectionPool to discard the connection and attempt to generate a new one. The ALEController can use the FactoryConnectionPool to adapt this factory class into a connection pool.

Operations on ALEModel can refer to the cache and never block on network traffic. The ALEModel can implement certain package-private setter methods for use by the ALEController's ALE wrapper. ALEModel calls to define, undefine, redefine, poll, or immediate can result in an IllegalOperationException. The ALEModel object can store the local cached data for all the edge servers which the system is monitoring. There can be methods for adding and removing listeners which receive events whenever the model changes. There can be getter methods for the view to query the model in order to build UI objects. And, there can be setter methods which are used by the controller to update the model, either as a result of a subscription or poll operation, or by the ALE instance wrapper. The ECSpecModel can be a thin layer over ALEModel that provides a connection back to the ALEConnection's polling mechanism.

As shown in FIG. **9**J, in one embodiment, these listener interfaces can monitor the ALEModel and ECSpecsModel for changes. Each leaf of the tree can listen for a specific type of change. When the listener is added to a model object, the model can maintain list of differentiated listener interfaces, and adds the listener to each list that matches that type. That way, an object can implement as many or as few of these interfaces as it wishes, but it only has to get passed into the model addListener call once to be added to all the relevant internal lists.

As shown in FIG. **9**K, the TelemetryGUIModel can expose a GUI-specific representation of the telemetry for a given Edge Server. It can list the device types, and the devices in each type. It can also provide a DeviceTelemetryModel for each device, combining all the telemetry data (alerts, time-series, and attributes) into one object. In one embodiment, only the selected device can have a subscription to telemetry data. The TelemetryGUIModel can subscribe to device status information for all devices, however, and the returned DeviceStatusModel for each device maintains its state based on that. In one embodiment, when the TelemetryGUIModel is disconnected, associated DeviceStatusModels can stop updating.

As shown in FIG. **9**L, the Device TelemetryModel can represent the information the Edge telemetry provides for any given device. Alert and DeviceAttribute Alert and DeviceAttribute can be objects that implement the interfaces from the Telemetry API.

As shown in FIG. **9**M, the TelemetrySetListener can be a listener for the DeviceTelemetryModel. The DeviceTelemetryListener can follow the ALEListener pattern with the specific list of interfaces the listener implements being used to dispatch the appropriate

As shown in FIGS. **9**N and **9**O, in one embodiment, the Telemetry API can abstracted in a similar way as the ALE API, with succeeding layers adding new functionality to the underlying layer.

It can implement methods for monitoring device telemetry, which are implemented by subscribing and unsubscribing to TelemetrySpecs. This permits the admin console to subscribe just to the telemetry needed to update whatever UT objects are visible to the user. It also can include methods for checking a Telemetry connection object out of the connection pool, and checking it back in when done. Additionally, the TelemetryController can keep track of failed unsubscription attempts; if telemetry associated with a terminated subscription arrives, it can assume the connection has been reestablished, and it attempts to resend the unsubscribe request.

In one embodiment, when the TelemetryController attempts to unsubscribe to a telemetry stream and fails for some transient reason, it does not expose that failure to its callers. Instead, it can pass information about the failed subscription to its contained TelemetryModelUnsubscriptionHandler object. This object can subscribe to telemetry information from the HTTP server, and when it recognizes data associated with a failed unsubscription, it can attempt again to unsubscribe from that telemetry stream. A race condition could arise if the UI attempts to subscribe to a stream that has, during a previous interaction, had a failed unsubscription attempt. In this situation the TelemetryUnsubscriptionListener could potentially unsubscribe shortly after the new subscription is established. To avoid this, the TelemetryController can inform the TelemetryUnsubscriptionListener of new subscription requests before making the subscription request. The TelemetryUnsubscriptionListener can detect a match in its list of failed unsubscriptions and remove matching entries from its list. The Worker Queue mechanism can be used to serialize these requests, making sure the removal from the Handler's list completes before the new subscription is attempted.

As shown in FIG. **9**P, in one embodiment, the TelemetryHTTPServer can be an HTTP server thread that receives Telemetry streams from Edge Servers, converts the received XML data into TelemetryReports objects (from the Telem-

etryAPI component) and passes them on to listeners. In one embodiment, the TelemetryModel and the TelemetryUnsubscriptionListener are the only two objects that will listen to the streams at this level of abstraction.

As shown in FIG. **9**Q, in one embodiment, the ConfigGUIModel can hide the Reader and Composite Reader roles from the Config Model and exposes the reader devices through a specific interface. This can parallel the fact that the GUI will treat these devices specially, and the plugin interface exposed out of this layer can be used in a generic fashion to display the rest of the configurable objects. PhysicalReader can wrap a reader-type EdgePlugin. It can implement the getLogicalReaderNames call by going through the configuration for the reader and assuming all parameters of type "logical reader name" represent a logical reader defined by this physical reader.

PhysicalReader can wrap a composite reader-type EdgePlugin. It can understand the configuration specifics of the composite reader and exports a specific interface for that configuration task. The ConfigModel can be a cache for all of the configuration on an Edge Server. The ConfigController can be responsible for keeping the ConfigModel up to date. A refresh can be triggered manually at the GUI level, though this may easily be extended to involve the AlarmClock with a polling interval, as in the ALEController. It can depend on the use case; the configuration is not expected to change often.

As shown in FIG. **9**R, ConfigListener can follow the pattern established by ALEListener and TelemetryListener. Additional specific change listeners can be added as they are needed.

FIG. **10** shows an exemplary logical model. The TelemetryController can coordinate all monitoring data (counters, gauges, subscription status, last activated counts, etc.) coming from the edgeserver. (Note that some of the data comes from traditional telemetry methods, and other parts of it come from ALE APIs). Whether the actual data is pulled or pushed doesn't matter, it can be stored and retrieved by this controller by mapping telemetry data items to deviceID. In one embodiment, get operations may be implemented differently—pull operations would be executed when gets are called, whereas push operations would retrieve stored data as it comes in from the edgeserver. The end result however, is that the rest of the GUI application does not need to distinguish between push/pull modes, which will make it easy to change these modes for various data as desired in the future. Models can be thread safe since they will be accessed/modified from various threads, including the main dispatch thread.

The EdgeServerController can maintain the configuration data for edgeservers, as well as maintaining a mapping of deviceID to various EdgeServer client interfaces. Since the rest of the GUI application speaks of selectable devices in terms of their "deviceID", they may ask the EdgeServerController for AxisALEClient interfaces or TelemetryClient interfaces by "deviceID" instead of having to ask for the service URL. AxisALEClient can be used rather than the more general ALEClient or ALE because access to the underlying factory methods is necessary for much of the construction work required of things like the ECSpec frame, etc.

The DeviceBrowserController can take care of building and maintaining the main tree control for the application. It can use the EdgeServerController to iterate all the configured Edgeservers and list devices/specs/subscribers. It also can use the TelemetryController to detect changes in device status.

Tasks that may take a long time are typically tasks using the EdgeServer in some way. In one embodiment, these tasks may be initiated in the following contexts:

the task needs to execute synchronously—i.e. other user action is not allowed to occur, however wait_cursor is updated during this task over the affected frames.

the task may execute asynchronously—i.e. the user can browse other items while this task is completing. Visual feedback that an action is being processed can be given in the form of a progress dialog.

Examples of Tasks

1. populating the device browser tree—(asynchronous trickle—user should be able to select while other parts of tree are loading rather than have to wait for the entire tree to load at once and on every update.) By and large this can be handled in the implementation of TelemetryController, which will spawn a worker thread for interrogating pull data, and have separate listener threads for receiving push data.
2. populating monitor data (ecspec monitor, subscribers monitor, etc)—again can be handled by telemetryController.
3. edit, deploy, activate once, test—any of these operations can open a progress dialog. They all can have well known end states: the progress dialog closes and
   a. edit—the ECSpec or ECSubscriber edit frame opens. (on success only)
   b. commit the ECSubscriber—ECSubscriber edit frame closes. (on success only)
   c. deploy—the ECSpec edit frame closes. (on success only)
   d. activate once—the TextView frame opens with the ECReport (success only)
   e. test—the TextView frame opens with the ECReport (success only)

FIG. **11**A shown an example of site ID selection of one embodiment.

FIG. **11**B illustrates the configuration edge server and preferences of one embodiment.

FIG. **11**C illustrates telemetry selection of one embodiment.

FIG. **11**D illustrates alert selection of one embodiment.

FIG. **11**E illustrates attribute selection of one embodiment.

FIG. **11**F illustrates monitor selection of one embodiment.

FIG. **11**G illustrates PC specs folder selection of one embodiment.

FIG. **11**H illustrates EPCSpce selection of one embodiment.

The read-only view of a ecspec can display the collapsed view for every leaf node, and can expand every non-leaf node. Collapsed leaf nodes can display the full content of information summarized. No nodes can be collapsed or expanded in read-only mode—they are a fixed presentation. Any editable fields can be locked during read-only mode. A fall-back alternative to this kind of display is to use a text-view representation of the ECSPec and just make this a text control.

FIGS. **11**I and **11**J illustrate an ECSpec frame of one embodiment.

The components in this section can be expandable and collapsible views. Each leaf node can have a collapsible view; all non-leaf nodes can be collapsible in edit view, but not in read-only view as described in the preceding section. Selecting "Deploy" or "Redeploy" closes the ECSpec being edited after successfully deploying.

FIGS. **11**K, **11**L, **11**M, **11**N and **11**O illustrate the configuring of an ECSpec of one embodiment.

FIGS. **11**P, **11**Q and **11**R illustrate a subscriber frame windows of one embodiment.

FIG. **11**S illustrates a text view frame of one embodiment.

This document outlines an exemplary EPC Provisioning Service.

This section lists key terms and definitions as utilized in the design of one embodiment. EPC Pool: A named list of EPCs maintained in the provisioning system. EPCs may be checked out or checked in to the pool by outside applications. Identity Type: As used in EPC Tag Data Standards document. Examples of some identity types used in this design doc are GTIN, SSCC, DoD Construct. Pool Name, Cache Name: This design assumes that the name of a cache in the Edge Server is the same as the pool name in the provisioning service. Therefore the terms pool name and cache name can be used interchangeably in this document.

Tag writing systems can use a central authority from which they can receive unique EPCs. The EPC Provisioning Service is designed to satisfy this need. In addition to providing a service to give out unique EPCs, a design goal is also to make it easy for administrators to define and maintain pools. Administrators can be able to specify parameters based on which naming of pools and EPC allocations to pool can be done automatically. The service can be generic enough to work with different server products as well as third party products.

- Local workflow can check out EPCs from the provisioning service by specifying the parameters for the checkout. An example of the parameters specified is (GTIN=10037000308048, TAG_LENGTH=64, LOCATION_ID=tag@ship-station-1). The provisioning service can check to see if the set of parameters has access to a pool and then returns EPCs to the local workflow. In this process, as required, the provisioning service may create a new pool and allocate EPCs to it. The EPCs given out will be marked as 'allocated' by the provisioning service.
- Provisioning system can receive a tag-cache-low report from the RFID Edge Server. The provisioning service will checkout EPCs from the correct pool and replenish the cache in the Edge Server.
- Administrator finds out that a product or station must no longer be allowed to get EPCs from the provisioning service. Administrator can make changes to the provisioning service and requests with those parameters will be denied access.
- An edge server tag cache can be reset and the EPCs left in the cache is released back to the provisioning service. The provisioning service removes these from allocated list and puts them back in the available list.
- Administrator finds out that a tagging station needs to switch from using 64 bit tags to 96 bit tags. Administrator can set up pool naming policy and pool population policy to enable that.

The provisioning service system can be composed of 2 main components:

1. EPC Provisioning Service: This can be a web service that will provide generic provisioning related operations like administering EPC pools, checkout or check-in from EPC pools etc.
2. Integration Component: This component is used to integrate between the RFID Edge Server and the provisioning service. This component can accept cache-low notifications from the edge server and replenish the cache.

There can be a web based GUI for administering the provisioning system. This GUI will be developed using JAVA Server Faces (JSF) technology and communication with the provisioning service can be through the web service interface. Local workflows can communicate with the EPC Provisioning Service or RFTA Integration Component as needed.

FIG. **12**A illustrates an exemplary providing architecture of one embodiment.

FIG. **12**B shows interaction between local workflow components, edge server and EPC provisioning system when the local workflow encounters a new item for which it may need to define a cache at the edge server of one embodiment.

FIG. **12**C shows the interactions between the edge server, RFTA Integration Component and EPC Provisioning Service when the edge server detects that a cache's size has reached the low threshold value of one embodiment.

The design overview diagram for a EPC provisioning web service can be similar to other web services in Enterprise Server.

VCC components for this can be:

1. EPCPS_API: This will contain the public facing interfaces (JAVA, WSDL and XSD)
2. EPCPS_Axis: Axis generated classes common to client and server sides of an axis service. Also contains adapter classes for axis generated classes.
3. EPCPS_Client: Implementation of public facing JAVA interface.
4. EPCPS_Engine: Server side implementation of public facing JAVA interfaces which will be used by all the different web service implementations.
5. EPCIS_Service: Different web-service implementations (for example: Axis, BEA) of the provisioning service.

The component can accept EPC Cache Low report from the edge server and replenish the corresponding cache. This can be accomplished using a message driven bean that will accept 2 kinds of messages:

1. Define cache parameters: This message can associate a cache with its edge server URL, filter value, tag size and chunk size. A cache can identified using the cache name and savant ID.
2. EPC Cache low report: This report will be sent by the edge server when the cache falls below a certain prespecified value. The message driven bean can get EPCs for replenishment from the provisioning service and replenish the cache (the URL for the edge server can be specified by message 1).

The message driven bean can delegate all the business logic work to a simple JAVA class, so that supporting other communication mechanisms in the future will be easy. RFID integration component can communicate with the EPC Provisioning Service through local EJB interfaces to avoid communication overheads.

FIG. **12**D illustrates an exemplary embodiment of one embodiment.

FIG. **12**E illustrates an exemplary key classes UML of one embodiment.

Pool attributes can represent attributes like which GTIN this pool was created for ([GTIN, <gtin-value] will be the name-value pair in this case) or what tag-length the pool is for etc. Allocated EPCs can give EPCs that were allocated and opaque id of the destination of the EPCs. In one embodiment, an EPC Pool cannot contain EPCs of more than one tag-type. The EPCs can be stored as pure identities.

FIG. **12**F illustrates exemplary EPC provisioning policy changes of one embodiment.

Com.connecterra.epcps.api.policy-Configuration.PoolAllocationConfiguration Class can serve as the super-type for different pool allocation configurations that may be supported by the provisioning service. Using the pool allocation configuration administrator can define which pool gets allocated for a given set of pool definition parameters and also define how the pool may get populated.

com.connecterra.epcps.api.policy-Configurations.SimplePoolAllocationConfiguration Class can allows you to make associations between an EPCPoolDefinitionParameters, identity type, and a serial number range. This association can define how to select a pool and how the pool gets populated initially. The order of the associations can be maintained and is used when matching an input request with the definitions. On receiving a request for an EPC pool based on an input EPCPoolDefinitionParameters, the first AllocationForPoolDefinition that matches the input EPCPoolDefinitionParameters can be selected. Using this, you can get the pool name and if needed, the initial range for the pool.

com.connecterra.epcps.api.policy-Configurations.PoolAccessConfiguration Class can be a Super-type for different pool access configurations that may be supported by the provisioning service.

com.connecterra.epcps.api.policy-Configurations.SimplePoolAccessConfiguration Class can be an interface lets you disallow access to EPC pools for certain pool definition parameters. This can be a simple configuration where you only configure negative entries. If any of the parameters in an input request matches any of the denied parameters, the request need not be granted access to an EPC pool.

FIG. **12**G shows key class UML for an EPC provisioning service engine of one embodiment.

com.connecterra.epcps.engine.PoolAccessPolicy Class can be the contract for pool access policies. com.connecterra.epcps.engine.SimplePoolAccessPolicy Class can be the Class that implements pool access policy using the SimplePoolAccessConfiguration. com.connecterra.epcps.engine.IdentityTypeExtractor can be the Class Interface that lets you get to a IdentityType from a given EPCPoolDefinitionParameters object.com.connecterra.epcps.engine.NameBasedExtractor Class can be the Class that gets a IdentityType by looking for identity type names (defined in IdentityTypeName) in the parameter list. com.connecterra.epcps.engine.PoolSelectionPolicy Class can be the contract for policies that let you select a pool name from a given EPCPoolDefinitionParameter. com.connecterra.epcps.engine.PoolPopulationPolicy Class can be the contract for policies that gives you the range for populating a pool based on an EPCPoolDefinitionParamter. com.connecterra.epcps.engine.SimplePoolAllocationPolicy Class can implement PoolSelectionPolicy and PoolPopulationPolicy. It can use the SimplePoolAllocationConfiguration that may be specified by the administrator.

FIG. **12**H is a sequence diagram showing how the different classes interact with each other on a validatePool call of one embodiment:

Exemplary EPC provisioning data structure.

EPC Pool

Column Name	Column Type	Constraints
pool_id	integer	Primary Key
pool_name	varchar2(255)	Unique Index
creation_date	date	
last_modified_date	date	

Pool_Attributes

Column Name	Column Type	Constraints
attr_row_id	Integer	Primary Key
pool_id	integer	Indexed
attr_name	varchar2(255)	Indexed
attr_value	varchar2(255)	Indexed

Separate tables can be used for allocated and unallocated EPCs in a pool. This can be done so that searches on the unallocated EPC pattern list will not be slowed down because of all the allocated EPCs. The allocated EPC pattern list can be assumed to grow very long.

Similarly, different tables can be used to store different types of tag, instead of one table storing the EPC pattern string. This way searching on individual fields in the pattern in the database can be efficient. We can search on the individual fields when assigning EPCs to a pool, allocating EPCs to a client, checking in EPCs etc.

Exemplary Tables for allocated and unallocated EPCs for SGTIN patterns are shown below:

SGTIN_Unallocated_Epcs

Column Name	Column Type	Constraints
Unallocated_epcs_id	integer	Primary Key
pool_id	integer	Indexed
company_prefix	varchar2(12)	Indexed
item_ref_and_ind	varchar2(7)	Indexed
serial_range_start	long	Indexed
serial_range_end	long	Indexed
creation_date	date	

SGTIN_Allocations

Column Name	Column Type	Constraints
allocation_id	integer	Primary Key
pool_id	integer	Indexed
company_prefix	varchar2(12)	Indexed
item_ref_and_ind	varchar2(7)	Indexed
serial_range_start	long	Indexed
serial_range_end	long	Indexed

SGTIN Allocation Details

Column Name	Column Type	Constraints
allocation_details_id	integer	Primary Key
allocation_id	integer	Indexed
Destination_id	varchar2(255)	Indexed
serial_range_start	long	Indexed
serial_range_end	long	Indexed
allocation_date	date	

Exemplary Pool Access Policy Configuration Access_Parameters

Column Name	Column Type	Constraints
parameter_name	varchar2(255)	Primary Key

Access_Parameter_Values

Column Name	Column Type	Constraints
row_id	integer	Primary Key
parameter_name	varchar2(255)	Indexed
parameter_value	varchar2(255)	

Exemplary Pool Allocation Policy Configuration

Pool_Allocation_Configuration

Column Name	Column Type	Constraints
config_row_id	integer	Primary Key
identity_type_name	varchar2(255)	Indexed
range_start	long	
range_end	long	
Ordinal	int	

Pool_Allocation_Parameters

Column Name	Column Type	Constraints
row_id	integer	Primary Key
config_row_id	integer	Indexed
parameter_name	varchar2(255)	Indexed
parameter_value	varchar2(255)	Indexed

FIG. **12**I shows an exemplary integration component of one embodiment.

Admin application can provide the following functionality:

- Defining EPC pool configurations—"Define Pool Configuration" screen
- Viewing and editing existing pool configurations—"View Pool Configurations" screen
- Viewing details of existing EPC pools—"View Pools" screen

Admin application can be implemented as a Web Application deployable into any Application Server (JBoss, WebLogic, etc.) as a WAR file. Main implementation technologies can be JSP and JSF (JAVA Server Faces).

FIG. **13**A shows an exemplary EPC pool page of one embodiment.

FIG. **13**B provides detailed information about existing pool configurations. Pool configurations can be represented in a table format in the correct order of one embodiment. The rows of the table (individual pool configurations) can be:

- deleted by checking the check-box in the leftmost column and clicking the "Delete" button located underneath the table
- re-ordered by using "Up" and "Down" buttons associated with the rows
- edited by clicking "Edit" buttons associated with the rows. This action will bring up a pop-up window with the "Define Pool Configuration" screen defined in the next section populated with the data of the selected pool configuration

A new pool configuration can be created by clicking on the "Create New Configuration" button. This can open a new screen, "Define Pool Configuration".

This screen can be used by an administrator to define parameters of a new pool configuration. The same screen is used for editing parameters of an existing pool configuration. The following pool configuration options can be set here:

- Identity Type—a pull-down menu with pre-defined supported identity types (GTIN or SSCC, for example)
- Pool Parameters—Name/Value pairs of pool parameters (for example, location id). Represented in a table format. Table rows can be added or deleted.
- EPC Pool range start and end values—range of EPCs allowed in this pool

FIG. **13**C shows a draft representation of a screen of one embodiment.

FIG. **13**D shows a screen containing information about existing EPC pools of one embodiment. The screen can be divided into two parts. The upper half can contain a table with the list of existing pools and some brief information about the pools.

Each row (pool) can have an associated "View" button. Clicking on the view button can brings up detailed information about selected pool into the table in the lower half of the screen.

FIG. **13**E shows checked out EPCS of one embodiment.

Available EPCs can be deleted from the pool by checking the check boxes of the corresponding table rows and clicking on the "Delete EPCs" button. More EPCs can be added to the pool by clicking on the "Add EPCs" button. As a result, a pop-up window can appear where a range of EPCs to be added can be specified.

FIG. **13**F illustrates a screen for adding EPCs.

FIG. **13**G illustrates a screen for checking in EPCs.

Checked out EPCs can be checked back into the pool by clicking the "Check In" button.

One embodiment may be implemented using a conventional general purpose of a specialized digital computer or microprocessor(s) programmed according to the teachings of the present disclosure, as will be apparent to those skilled in the computer art. Appropriate software coding can readily be prepared by skilled programmers based on the teachings of the present discloser, as will be apparent to those skilled in the software art. The invention may also be implemented by the preparation of integrated circuits or by interconnecting an appropriate network of conventional component circuits, as will be readily apparent to those skilled in the art.

One embodiment includes a computer program product which is a storage medium (media) having instructions stored thereon/in which can be used to program a computer to perform any of the features present herein. The storage medium can include, but is not limited to, any type of disk including floppy disks, optical discs, DVD, CD-ROMs, micro drive, and magneto-optical disks, ROMs, Rams, EPROMs, EEPROMs, Drams, Rams, flash memory of media or device suitable for storing instructions and/or data.

Stored on any one of the computer readable medium (media), the present invention includes software for controlling both the hardware of the general purpose/specialized computer or microprocessor, and for enabling the computer or microprocessor to interact with a human user or other mechanism utilizing the results of the present invention. Such software may include, but is not limited to, device drivers, operating systems, execution environments/containers, and user applications.

The forgoing description of preferred embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations will be apparent to one of ordinary skill in the relevant arts. For example, steps preformed in the embodiments of the invention disclosed can be performed

in alternate orders, certain steps can be omitted, and additional steps can be added. The embodiments where chosen and described in order to best explain the principles of the invention and its practical application, thereby enabling others skilled in the art to understand the invention for various embodiments and with various modifications that are suited to the particular used contemplated. It is intended that the scope of the invention be defined by the claims and their equivalents.

What is claimed is:

1. An electronic product code (EPC) provisioning system comprising:

a central electronic product code (EPC) server that executes on one or more microprocessor and creates and maintains a pool of electronic product codes, wherein the pool of electronic product codes is divided into a plurality of EPC code blocks, each EPC code block adapted to be associated with a different product, and wherein the central EPC server assigns said plurality of EPC code blocks to multiple client sites according to a set of rules, and distributes the plurality of EPC code blocks to said multiple client sites;

a plurality of radio frequency identification (RFID) edge servers being located at said multiple client sites, wherein each said RFID edge server includes a cache to store the plurality of EPC code blocks and is in communication with one or more RFID readers;

wherein each RFID edge server reads a metadata-based description of a configuration of at least one of the one or more RFID readers, and wherein each of the one or more RFID readers has a configuration arrangement associated therewith that is defined in the metadata-based description, and wherein each of the one or more RFID readers uses a different metadata-based description;

a console that includes a graphical user interface to manage the pool of electronic product codes and the one or more RFID readers;

a local workflow at each client site, wherein when the local workflow detects a new product at a particular client site, the local workflow

associates the new product with the cache of one of the one or more of said RFID edge servers,

submits a checkout request to the central EPC server requesting one or more of the plurality of EPC code blocks for the new product, and

wherein upon receiving the checkout request at the central EPC server, the central EPC server communicates the one or more of the plurality of EPC code blocks requested from the EPC server to the local workflow according to the set of rules; and

wherein, based on the metadata-based description read by at least one RFID edge server, the graphical user interface is employed to update the configuration of at least one of the one or more RFID readers to receive data from the at least one RFID reader to the at least one RFID edge server without interruption to the at least one RFID edge server.

2. The system of claim **1**, wherein the client sites use the EPC codes for RFID tags to maintain information regarding said product.

3. The system of claim **2**, wherein the EPC code blocks are assigned by the central EPC server to indicate a lot number associated with the product.

4. The system of claim **3**, wherein the EPC code blocks are assigned so as to indicate location.

5. The system of claim **1**, wherein the RFID edge servers at the client sites request the electronic product codes from the central EPC server.

6. The system of claim **1**, wherein the local workflow, at each client site, returns unused EPC code blocks to the central EPC server.

7. The system of claim **1**, further including a console to manage the pool of electronic product codes, said console including a graphical interface used to divide the pool of electronic product code blocks, add EPC code blocks, delete EPC code blocks and check-in unused EPC code blocks.

8. The system of claim **7**, wherein the graphical interface is used to view configuration information about the pool of electronic product codes.

9. The system of claim **7**, wherein the console is implemented as a web application.

10. A computer implemented method comprising:

creating a pool of electronic product codes for a product by a central electronic product code (EPC) server that executes on one or more microprocessor, wherein the pool of electronic product codes is divided into a plurality of EPC code blocks, each EPC code block adapted to be associated with a different product;

assigning the plurality of EPC code blocks to multiple client sites according to a set of rules;

distributing the plurality of EPC code blocks from the central EPC server to a plurality of radio frequency identification (RFID) edge servers located at the multiple client sites, wherein each said RFID edge server includes a cache to store the plurality of EPC code blocks and is in communication with one or more RFID readers;

reading a metadata-based description of a configuration of at least one of the one or more RFID readers by each RFID edge server, wherein each of the one or more RFID readers has a configuration arrangement associated therewith that is defined in the metadata-based description, and wherein each of the one or more RFID readers uses a different metadata-based description;

providing a console that includes a graphical user interface to manage the pool of electronic product codes and the one or more RFID readers;

detecting, at each client site by a local workflow at that client site, that a new product has been encountered, wherein when the local workflow detects the new product, the local workflow

associates the new product with the cache of one of the one or more of said RFID edge servers,

submits a checkout request to the central EPC server requesting one or more of the plurality of EPC code blocks for the new product, and

wherein upon receiving the checkout request at the central EPC server, the central EPC server communicates the one or more of the plurality of EPC code blocks requested from the EPC server to the local workflow according to the set of rules; and

wherein, based on the metadata-based description read by at least one RFID edge server, employing the graphical user interface to update the configuration of at least one of the one or more RFID readers to receive data from the at least one RFID reader to the at least one RFID edge server without interruption to the at least one RFID edge server.

11. The computer implemented method of claim **10**, wherein the client sites use the EPC codes for RFID tags to maintain information regarding said product.

12. The computer implemented method of claim 11, wherein the EPC code blocks are assigned by the central EPC server to indicate a lot number associated with the product.

13. The computer implemented method of claim 11, wherein the EPC codes are assigned so as to indicate location.

14. The computer implemented method of claim 10, wherein RFID edge servers at the client sites request the EPC code blocks from the central EPC server.

15. The method of claim 10, further comprising:

returning, by the local workflow at each client site, unused EPC code blocks to the central EPC server.

16. A non-transitory computer readable storage medium storing one or more sequences of instructions, said instructions, when executed by one or more microprocessors, causing the one or more microprocessors to perform the steps of:

creating a pool of electronic product codes for a product by a central electronic product code (EPC) server, wherein the pool of electronic product codes is divided into a plurality of EPC code blocks, each EPC code block adapted to be associated with a different product;

assigning the plurality of EPC code blocks to multiple client sites according to a set of rules;

distributing the plurality of EPC code blocks from the central EPC server to a plurality of radio frequency identification (RFID) edge servers located at the multiple client sites, wherein each said RFID edge server includes a cache to store the plurality of EPC code blocks and is in communication with one or more RFID readers;

reading a metadata-based description of a configuration of at least one of the one or more RFID readers by each RFID edge server, wherein each of the one or more RFID readers has a configuration arrangement associated therewith that is defined in the metadata-based description, and wherein each of the one or more RFID readers uses a different metadata-based description;

providing a console that includes a graphical user interface to manage the pool of electronic product codes and the one or more RFID readers;

detecting, at each client site by a local workflow at that client site, that a new product has been encountered, wherein when the local workflow detects the new product, the local workflow

associates the new product with the cache of one of the one or more of said RFID edge servers,

submits a checkout request to the central EPC server requesting one or more of the plurality of EPC code blocks for the new product, and

wherein upon receiving the checkout request at the central EPC server, the central EPC server communicates the one or more of the plurality of EPC code blocks requested from the EPC server to the local workflow according to the set of rules; and

wherein, based on the metadata-based description read by at least one RFID edge server, employing the graphical user interface to update the configuration of at least one of the one or more RFID readers to receive data from the at least one RFID reader to the at least one RFID edge server without interruption to the at least one RFID edge server.

17. The computer readable medium of claim 16, wherein the client sites use the EPC codes for RFID tags to maintain information regarding said product.

18. The computer readable medium of claim 17, wherein the EPC code blocks are assigned by the central EPC server to indicate a lot number associated with the product.

19. The computer readable medium of claim 17, wherein the EPC electronic product codes are assigned so as to indicate location.

20. The non-transitory computer readable storage medium of claim 16, further comprising:

returning, by the local workflow at each client site, unused EPC code blocks to the central EPC server.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,373,545 B2
APPLICATION NO. : 11/668389
DATED : February 12, 2013
INVENTOR(S) : Traub et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Drawings:

On sheet 44 of 60, in FIG. 11M, line 9, delete "Delitions" and insert -- Deletions --, therefor.

In the Specifications:

In column 7, line 14, delete "Plug-i Meta" and insert -- Plug-in Meta --, therefor.

In column 7, line 14, delete "Plug-i" and insert -- Plug-in --, therefor.

In column 8, line 17, delete "uniuqe" and insert -- unique --, therefor.

In column 8, line 41, delete "<PluginParamameterMeta>" and insert -- <PluginParameterMeta> --, therefor.

In column 8, line 53, delete "contstraints." and insert -- constraints. --, therefor.

In column 10, line 15, delete "Plugic" and insert -- Plugin --, therefor.

In column 10, line 49, delete "dentify" and insert -- identify --, therefor.

In column 10, line 52, delete "he" and insert -- the --, therefor.

In column 10, line 62, delete "Configuration" and insert -- Configuration. --, therefor.

In column 11, line 13, delete "void ," and insert -- void, --, therefor.

In column 11, line 63, delete "void ," and insert -- void, --, therefor.

In column 13, line 37, delete "uhfl" and inserl -- uhf1 --, therefor.

In column 14, line 59, delete "PluginParameterConstratintRegEx" and insert -- PluginParameterConstraintRegEx --, therefor.

In column 15, line 5, delete "PluginParameterConstratintRegEx" and insert -- PluginParameterConstraintRegEx --, therefor.

In column 15, line 26, before "JAVA" delete "a".

In column 20, line 41, delete "placholder" and insert -- placeholder --, therefor.

Signed and Sealed this
Fourth Day of June, 2013

Teresa Stanek Rea

Teresa Stanek Rea
Acting Director of the United States Patent and Trademark Office

In column 26, line 49, delete "frame The" and insert -- frame. The --, therefor.

In column 28, line 37, delete "future)" and insert -- future). --, therefor.

In column 32, line 26, delete "appropriate" and insert -- appropriate. --, therefor.

In column 32, line 34, delete "UT" and insert -- UI --, therefor.

In column 33, line 7, delete "Config Model" and insert -- ConfigModel --, therefor.

In column 34, line 33, delete "only)" and insert -- only). --, therefor.

In column 37, line 47, delete "EPCPoolDefinitionParamter." and insert
-- EPCPoolDefinitionParameter. --, therefor.

In the Claims:

In column 41, line 66, in Claim 4, delete "claim 3," and insert -- claim 2, --, therefor.

EXHIBIT

7

22764 U.S.PTO 081905

PTO/SB/16 (07-05)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. ED 324783075 US

112975 U.S.PTO 60/709713 081905

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
CLARKE	McALLISTER	EUGENE, OREGON, USA

Additional inventors are being named on the _____ *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max):

SYSTEMS, METHODS, AND APPARATUS FOR CONVERTING AND COMMISSIONING WIRELESS SENSORS

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☑ The address corresponding to Customer Number: 000045649

OR

☐ Firm or Individual Name

Address

City	State	Zip
Country	Telephone	Email

ENCLOSED APPLICATION PARTS *(check all that apply)*

☐ Application Data Sheet. See 37 CFR 1.76

☑ Specification *Number of Pages* 35

☑ Drawing(s) *Number of Sheets* 11

☐ CD(s), Number of CDs _____

☐ Other (specify) _____

Fees Due: Filing Fee of $200 ($100 for small entity). If the specification and drawings exceed 100 sheets of paper, an application size fee is also due, which is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

METHOD OF PAYMENT OF FILING FEES AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT

☑ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fee and application size fee (if applicable).

☑ Payment by credit card. Form PTO-2038 is attached

100.00
TOTAL FEE AMOUNT ($)

☐ The Director is hereby authorized to charge the filing fee and application size fee (if applicable) or credit any overpayment to Deposit Account Number: _____. A duplicative copy of this form is enclosed for fee processing.

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

SIGNATURE _____ Date 19 AUGUST 2005

TYPED or PRINTED NAME PETER A. HAAS REGISTRATION NO. 52,481 *(if appropriate)*

TELEPHONE 503-319-3024 Docket Number: _____

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

SYSTEMS, METHODS, AND APPARATUS FOR CONVERTING AND COMMISIONING WIRELESS SENSORS

Inventor: Clarke McAllister

BACKGROUND

The field of the present invention relates to manufacturing and deployment of RFID (radio frequency identification) and wireless sensors. Large-scale adoption and deployment of RFID depends on low cost transponders (also referred to as tags, inlets, or inlays) and efficient means to commission them for use. Such deployments mark a starting point for widespread adoption of a broader class of devices called wireless tags that include RFID transponders, RFID tags, RFID inlays, and wireless sensors. RFID tags are simple wireless tags that report object identity. Wireless sensors can report identity, or some combination of additional information such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental details. Wireless sensors and RFID tags are distributed nodes of computing networks that are interconnected by wired and wireless interfaces. Wireless sensors may be made using silicon circuits, polymer circuits, crystals, or Surface Acoustic Wave (SAW) materials to affect radio frequency or other signaling methods.

SUMMARY OF THE INVENTION

The present invention is directed to improved systems and methods for converting and commissioning wireless tags, RFID tags, and wireless sensors. The present inventor has recognized that significant benefits can be realized from using wireless sensors that are not directly part of a demand printed label. Among them include elimination of facestock and silicone-based release liner, improved deployment yield and efficiency, and greater mobility for the tag commissioning process.

DRAWING

Fig. 1 is a top view of a UHF RFID inlay with a single dipole antenna structure according to one embodiment of the present invention.

Fig. 2 is a cross-sectional view of a possible arrangement of layers of materials used to create a taped inlay according to one embodiment of the present invention.

Fig. 3 is a cross-sectional view of a possible ESD resistant inlay constructed from adhesive tape according to one embodiment of the present invention.

Fig. 4 is a cross-sectional view of an ESD resistant inlay constructed from adhesive tape according to another embodiment of the present invention.

Fig. 5 is a cross-sectional view of an ESD resistant inlay constructed from adhesive tape according to a possible embodiment of the present invention.

Fig. 6 is a cross-sectional view of an ESD resistant inlay adhered to a conveyance layer according to one embodiment of the present invention.

Fig. 7 is a top view of converted inlays adhered to a conveyance mesh according to one embodiment of the present invention.

Fig. 8 is a flowchart of a method of inlay conversion according to one embodiment of the present invention.

Fig. 9 is flow chart illustrating a method of tagging cartons using a mobile applicator according to one embodiment of the present invention.

Fig. 10 is a top view of a possible adhesive tape and illustrates possible regions of adhesive on the tape according to one embodiment of the present invention.

Fig. 11 is a diagrammatic representation of an inlay attached to encoded adhesive tape according to one embodiment of the present invention.

Fig. 12 is a diagrammatic representation of an automated tag encoding system according to one embodiment of the present invention.

Fig. 13 is a cross-sectional side view of a handheld RFID tag applicator according to one embodiment of the present invention.

Fig. 14 is a diagrammatic representation of a base unit for a mobile applicator and cartridges according to one possible embodiment of the present invention.

Fig. 15 is a diagrammatic representation of a machine to selectively attach RFID transponders to adhesive tape according to one embodiment of the present invention.

Fig. 16 is a diagrammatic representation of RFID transponders attached to adhesive tape according to one embodiment of the present invention.

Fig. 17 is a diagrammatic representation of a mechanism to attach RFID tags from a roll of RFID Tape according to one embodiment of the present invention.

Fig. 18 is a diagrammatic representation of a mechanism to attach tags from an RFID magazine according to one embodiment of the present invention.

Fig. 19 is a diagrammatic representation of a mechanism to attach RFID tags from a mesh roll according to one embodiment of the present invention.

Fig. 20 is a diagrammatic representation of a mechanism to attach RFID tags from a mesh roll according to another embodiment of the present invention.

Fig. 21 is a diagrammatic representation of a mechanism to attach RFID tags from release liner according to an alternate embodiment of the present invention.

DESCRIPTION OF THE INVENTION

Possible embodiments will now be described with reference to the drawings and those skilled in the art will understand that alternative configurations and combinations of components may be substituted without subtracting from the invention. Also, in some figures certain components are omitted to more clearly illustrate the invention.

Certain preferred embodiments are directed to methods for tagging transportation containers. In most instances, the tagging methods will be described with

reference to containers such as loaded pallets, paperboard boxes, corrugated cartons, pharmaceutical containers, and conveyable cases, but other containers may be used by these methods. Certain preferred embodiments relate to commercial corrugated shipping cartons, RFID or wireless sensors, tagged pallet-loads of shrink-wrapped cases, consumer goods packaging, consumer goods, or to other various methods of tagging objects. Corrugated cases are typically constructed with an inner and an outer linerboard, between which a corrugated medium is glued.

This document refers to transponders interchangeably with the term tags. A transponder is generally fabricated from an inlay and additional materials that may include a substrate material. An inlay is a thin segment of plastic such as PET that carries an antenna structure bonded to at least one RFID chip or other type of wireless sensor device. Though many of the embodiments herein are described with reference to various inlays, transponders and RFID tags, the methods and devices described herein may be applicable to other types of wireless tags, transponders, or wireless sensors. Wireless tags are a broad class of wireless devices that transmit and receive information wirelessly, have a unique identity, and optionally sense one or more attributes within its environment. Wireless tags include RFID transponders, RFID tags, RFID inlays, and wireless sensors. Wireless sensors are devices that report identity, and or some combination of additional information such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless tags are distributed nodes of computing networks that are interconnected by wired and wireless interfaces. Wireless tags may be made using silicon circuits, polymer circuits, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave (SAW) materials to affect radio frequency or other signaling methods. Wireless tags preferably communicate wirelessly to an interrogator, and certain preferred embodiments of wireless tags communicate on a peer-to-peer basis. Communication methods may include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods.

There are certain preferred transponder embodiments that include RFID tags or wireless sensors as a component. Other preferred tag embodiments include RFID inlays as a component.

This disclosure refers to objects that are associated with RFID tags and are referred to by the data within RFID tag memories. Such objects may include, but are not limited to: manufactured sub-assemblies, pharmaceuticals, medical supplies, electronic products or components, consumer goods, manufactured goods, waste containers, shipping containers, and industrial equipment.

Preferred categories of tag attachment include:

1) Conveyor line or other high-speed machinery with automated tag printing, encoding, and attachment.

2) Hand attachment of tags (a method that is referred to as "slap and ship").

3) And now, a new category of mobile tag applicators.

UHF is an acronym for Ultra High Frequency. UHF refers to the band of the electromagnetic spectrum that, for RFID applications, spans from about 860MHz to 960MHz. RFID tags responsive to this frequency band generally have some form of one or more dipoles in their antenna structure.

Ultra Wide Band (UWB) is a method of transmitting radio pulses across a very wide spectrum of frequencies that span several gigahertz of bandwidth. Modulation techniques include the use of Orthogonal Frequency Division Multiplexing (OFDM) to derive superior data encoding and data recovery from low power radio signals. OFDM and UWB provide a robust radio link in RF noisy or multi-path environments and improved performance through and around RF absorbing or reflecting materials compared to narrowband, spread spectrum, or frequency-hopping radio systems. UWB wireless sensors are preferably reused according to certain preferred methods disclosed herein. UWB wireless sensors may be combined with narrowband, spread spectrum, or frequency-hopping inlays or wireless sensors as disclosed herein.

Passive RFID refers to tags without batteries. Active tags have batteries and have been historically been considerably more expensive than passive RFID tags. Passive RFID tags backscatter incident RF energy. Active RFID tags often have their own transmitter and generally do not use backscatter for the return link. A battery assist tag is a sort of hybrid that uses a battery to power the RFID chip and a backscatter return link to the interrogator.

The RFID inlays are fundamentally an RFID chip bonded to an antenna, formed on a substrate that is often plastic such as Mylar®, polyester, or PET. Antennae may be formed by etching copper from the substrate, but an alternate method is to print multiple layers of conductive ink onto a substrate.

Particularly highlighted in Figures 1 and 2, inlay 10 and other designs may also be optionally combined with a shield and/or a dielectric spacer behind the antenna to create a tag that performs well over a broad range of packaging conditions. A robust design would preferably also include features to protect the tag from damage.

Inlay 10 may alternatively be replaced by a used or recycled wireless tag. In certain preferred embodiments, RFID tags are recovered from waste streams for reconditioning, reprogramming, and reuse.

Additional transponder layers have been developed by Power Paper Ltd. Power Paper has developed technology that enables the mass production of low-cost, thin and flexible energy cells capable of powering a host of applications. Power Paper's core technology is an innovative process that enables the printing of caseless, thin, flexible and environment-friendly energy cells on a polymer film substrate, by means of a simple mass-printing technology and proprietary inks. Power Paper cells are composed of two non-toxic, widely-available commodities: zinc and manganese dioxide. The cathode and anode layers are fabricated from proprietary ink-like materials that can be printed onto virtually any substrate, including specialty papers. The cathode and anode are produced as different mixes of ink, so that the combination of the two creates a 1.5-volt battery that is thin and flexible. Unlike conventional batteries, the Company's power source does

not require casing. UHF-based battery-assisted backscatter tags can operate at about twice the range of a passive RFID tag. UHF battery-assist RFID tags and battery-powered UWB wireless sensors represent a class of devices that warrant reuse according to preferred methods disclosed herein.

Paper facestock may be the lowest cost RFID tag structure, but it is the least environmentally resistant. UV-resistant plastic and plastic foam facestocks generally provide the best survivability in outdoor and rough service environments, and also tend to provide the best protection for the tag.

Materials such as adhesive-backed tape used on or around a wireless tag preferably will not absorb radio frequencies within the range of frequencies used by the transponder, tag, sensor, or inlay. The tape materials must also never cause corrosion of the inlay or in any way hamper its functionality.

A layer of clear, translucent, or opaque adhesive-backed film or tape is required to attach the panel and the transponder, wireless sensor, or inlay to the box, bottle, jug, transport container, or shrink wrap. The tape may be any thin, low cost, flexible material with a self adhesive backing. A conventional packing tape is representative of the material that may be used for this method of attachment. The tape may be formed into various shapes to achieve the requirements of this method. Certain preferred embodiments may use tape that is preprinted with certain logos, marks, symbols, bar codes, colors, and designs.

Certain preferred embodiments use the same constituent materials as packing tape and is manufactured specifically for applicators 130, 170, 180, 190, or 200. Packing tape can be single-coated pressure sensitive adhesive tape or alternatively media constructed with multiple layers including a backing layer. Certain preferred backing layers are constructed on a plastic film having one or more layers. Certain preferred backing layers are made from plastic resins such as polypropylene (PP), polyethylene (PE), or copolymers of PP, PE, PVC, polyesters, or vinyl acetates. Certin preferred embodiments of PP are monoaxially-oriented polypropylene (MOPP), biaxially-oriented

polypropylene (BOPP), or sequentially biaxially-oriented polypropylene (SBOPP). Certain preferred backing layers are biodegradable. Certain preferred backing layers are coated with a pressure sensitive adhesive on one side and a low adhesion release coating on the other side to reduce the amount of power required for the applicator to unroll the tape for application.

Referring to Fig. 8, a preferred method is disclosed for converting RFID inlays or wireless sensor components into application-ready wireless tags. This process uses adhesive-backed packing tape or some similar material to adhere inlays to transport containers such as corrugated cartons. Certain preferred embodiments of tape include pre-printed text, symbols, graphics, and background. Certain preferred embodiments contain a series of preprinted bar codes.

Certain preferred embodiments of this process use mesh or netting as a transport media for converted tags. In certain preferred embodiments, mesh or netting is made of plastic such as nylon, polypropylene, polyethylene, HDPE, Teflon, or other resins. In certain other preferred embodiments, mesh or netting is fabricated from metal or carbon impregnated plastic to provide a conductive path to bleed electric charge away from points of accumulation. Certain preferred embodiments within all parts of the conversion and tag application process do not allow significant amounts of electric charge to accumulate to voltages in excess of the ESD rating of the tags. In certain preferred embodiments, there are several conductive paths to bleed charge away to a safe location away from ESD-sensitive tags. The first step 81 is to prepare the adhesive tape and mesh for the conversion process.

Certain preferred embodiments for step 81 include machines to cut large rolls of mesh or net into numerous small rolls with the desired width, length, and core diameter. Certain preferred rolls of stock mesh or net are 14 feet wide and 5000 feet long, rolled onto a core. For certain preferred embodiments, including the mobile applicator illustrated in Figs. 18-20, the mesh or net width is about the length of a simple UHF dipole inlay 10 as shown in Fig. 1. For certain preferred embodiments, this is a width of

about 4 inches. The preferred length of mesh or net is dependent on many factors including the target cost per tag of the cartridge and all of its components. This is an important consideration, even if the cartridge is intended to be reconditioned and reused. Other important factors that determine the length of mesh or net is the target size and weight of the cartridge and/or the mobile applicator. As the length of mesh or net increase, so do the diameters of both the empty and the full rolls of converted tags and the housing required to contain them.

The machine that converts large mesh rolls into smaller ones in step 81 is in certain preferred embodiments, a separate stand alone industrial machine. In certain other preferred embodiments, that function is part of an integrated machine.

Preparation of adhesive-backed tape in step 81 for certain preferred embodiments includes cuts along two major axes: length and width. Cuts along the length of tape are performed in certain preferred embodiments for two reasons: ESD hardening and tag size reduction. Referring to Fig. 10, there are preferably four zones across the width of an adhesive-backed tape such as packing tape. In certain preferred embodiments, all four zones are of approximately the same width. In certain preferred embodiments, zone 101 is reserved for an RFID inlay to be adhered preferably according to a construction method illustrated in Fig. 2-5. Zone 100 and zone 102 are preferably reserved for attachment to a transport container such as any wall or flap of a corrugate carton. Zone 103 is preferably removed from the other three zones to create an encapsulation layer 35, 45, or 55 with corresponding adhesive layer 34, 44, or 54. In certain preferred tape conversion machines, zone 103 is cut from adhesive-backed tape as it spools off of a source reel or roll. In certain preferred embodiments, source rolls are 2 inches wide or about 48mm wide, and one quarter of that width is removed to provide material for cap layer 35, 45, or 55 with their corresponding adhesive layers 34, 44, and 54, and inverted 180 degrees in preparation for attachment to create an ESD resistant tag according to certain preferred constructions including those illustrated in Figs. 3-5.

In step 82 each inlay is preferably interrogated. In certain preferred embodiments, an interrogator and an antenna or a near field coupler are used to read the transponder, wireless sensor, tag or inlay, preferably monitoring parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the tag. Any tag or sensor that does not meet certain minimum performance criteria is preferably discarded. Good tags or sensors are then preferably programmed with new information relating to the object that it is being associated with. That information is stored in non-volatile memory within the RFID inlay. Tag programming may also occur during, after, or between the second step 82 and third step 83. In certain preferred embodiments inlays that fail to perform to adequate levels of performance are immediately separated from the tag conversion process.

The third step 83 is preferably to apply and encapsulate good inlays preferably in the adhesive tape layer zone 101 shown in Fig 10. Certain preferred packing tapes are constructed from pressure sensitive acrylic adhesive and backed by a substrate layer of bi-axially oriented polypropylene film. Certain preferred packing tapes can provide up to about 25,000 volts of ESD resistance when properly applied in about 0.002-inch thick layers of encapsulation. Certain packing tapes are available in thicknesses less than that, and in certain preferred embodiments are about 0.001-inches thick. In certain preferred embodiments, two layers of tape are layered on top of each other to provide higher ESD voltage resistance ratings. In certain other preferred embodiments, the inlay substrate also contributes additional ESD resistance in certain preferred configurations.

Certain preferred embodiments do not include an encapsulation layer of additional tape; such a construction is illustrated in Fig 2. In such a construction, adhesive layer 21 preferably bonds with antenna layer 22 and integrated circuit 26. Inlay substrate layer 23 and tape substrate layer 20 preferably provide resistance against electrostatic discharge into antenna layer 22 or chip 26.

Certain preferred constructions for converted tags have one or more additional layers of high dielectric material such as packing tape that encapsulate or substantially

cover the inlay. Certain preferred embodiments use material from zone 103 as self-adhesive dielectric material for layers 35, 45, or 55. Certain preferred embodiments for such a construction are illustrated in Figs 3-5. In the preferred embodiment shown in Fig 3, chip 36 and antenna 32 are preferably bonded to adhesive layer 31 and protected from a discharge path through tape substrate 30 by its particular thickness of dielectric material. In general, the thicker the dielectric layer, the higher the voltage must be to initiate a flow of electrons through a dielectric layer, which preferably results in higher ESD voltage ratings for the resulting tag. Second dielectric layer 35 is preferably bonded to inlay substrate 33 by adhesive layer 34, preferably such that a low voltage discharge path is non existent around the layers of tape substrates 30 and 35.

Certain preferred inlay conversion constructions use inlay substrate 43 as a second layer of ESD resistance against a discharge path through outward facing tape layer 40 and adhesive layer 41. Such a preferred construction is illustrated in Fig 4, and preferably protects antenna 42 and chip 46 from electrostatic discharge originating from any direction. Encapsulation tape layer 45 is bonded to antenna 42 and chip 46 by adhesive layer 44. Like substrate 35, tape substrate 45 provides no adhesive bond to the transport container when the tag is commissioned, and therefore depends on zones 100 and 102 for attachment to the desired object to be transported and tracked by the wireless sensor.

Figure 5 illustrates another preferred embodiment for multiple layers of ESD resistance where an outer layer substrate 50 is bonded to an inner substrate 55 by an adhesive layer 51. Adhesive layer 54 then bonds with chip 56 and antenna 52. Inlay substrate 53 is inward facing, preferably pressed against a transport container when the tag is commissioned.

Preferably the adhesives create strong and permanent bonds between tapes and inlay layers over a certain practical range of operating temperatures.

The fourth step 84 is preferably to apply the converted tag to an interposing transport media. Such media preferably have properties that preserve the tackiness of

exposed adhesive in zones 100 and 102. Pressure sensitive adhesives adhere to most surfaces with very slight pressure and they retain their tackiness above their melting point of about -65 to -90 degrees centigrade. Certain prior art uses silicone-based release liner to transport and preserve pressure sensitive adhesive tags and labels. Certain preferred embodiments use air pockets bounded by regions having tensile strength such as fibers. Certain preferred fibers are made of plastic or metal. Certain plastic resins have a low surface energy, and preferably prevent strong adhesive bonds from forming with them. In certain preferred embodiments, fibers are bound together to form a mesh or net. Certain preferred mesh or net constructions offer a means of handling converted tags without allowing a substantial percentage of the available adhesive to make contact with any other solids until the tag is commissioned.

There are two principal advantages of net or mesh over prior art silicone release liners: less weight and increased recyclability. A comparison of the weight of a net with a higher percentage of open area to a typical sheet of release liner reveals that the netting is lighter for any given section of comparable size. Environmental problems of disposal of release liner are well known, especially in Europe. Mesh or netting that is comprised of recyclable resins is preferably recovered after each use so that the mesh or net can be either reused or recycled for its constituent materials.

Figs. 6 and 7 illustrate preferred embodiments for attachment of converted tags 60, 71 and 73 onto a transport layer of mesh or net 67 or 70. Preferred inlay conversion construction of Fig. 4 is shown in Fig. 6 adhered to mesh or net 67. Adhesive zones 100 and 102 of tape 60 make contact with the fibers of mesh or net 67, leaving a substantial percentage of the adhesive not in contact with anything. Within the shelf life of the adhesive, the tackiness preferably remains at or near full potential, ready for commissioning. In certain preferred embodiments, and in step 85, some small percentage of adhesive layers 61 makes contact through the centers of holes in mesh 67 with the backs of layers 60 on the layers below that are rolled onto a spool immediately before the present layer. In certain preferred embodiments, the thickness and hole sizes of mesh

67 are optimized to provide a desired percentage of adhesive 61 in contact with both the fibers of mesh 67 and tape backing 60 for certain bend radii of certain spools. In certain preferred embodiments, only a small amount of energy is required to unroll the spool during tag commissioning, yet there exists a certain amount of adhesion to prevent a converted spool from unraveling.

In step 85, converted tags are preferably wound onto a spool with the interposing media described in step 84. The core diameter, number, of tags, layer thickness, and outer diameter are all preferably optimized for efficient, economical, and convenient deployment in tag commissioning processes disclosed herein. Finished spools are preferably packaged in a manner to prevent ESD damage. Certain preferred enclosures include anti-static bags, foil-lined cartons, metal plated cartridges, and carbon-impregnated plastic enclosures. Certain preferred enclosures are reusable. Certain preferred enclosures of application-ready rolls or Z-folded tags having low energy interposing transport media mate directly with certain tag applicators such as applicator 180, 190, or 200.

Referring to Fig. 9, a novel preferred method is disclosed for applying RFID tags to transport containers such as corrugated cartons or shrink-wrapped cases on a shipping pallet. Prior art does not provide solutions for manually operated automatic encoding and attachment to a carton.

The first step 91 is to select a carton to attach a wireless tag onto. Certain preferred methods include manual selection and verification processes involving manual handling, visual sighting, and scanning bar codes. A tag encoding scheme is preferably ready in advance and preferably synchronized with a pick list, customer purchase order, advanced shipping notice, and other such records to assure that goods are properly moved and accounted for.

In preparation for step 92, an operator is to be holding a preferred embodiment of a mobile tag applicator, such as one illustrated in Figs. 13, 17, 18, 19, 20, or 21. In this step, an operator preferably holds an applicator against the face of a transport container

such as a corrugated carton. The location and orientation of the applicator is preferably matched to the tagging requirements for that particular carton, if any. In certain preferred embodiments, the operator is informed of the proper location and orientation of the tag that is to be applied. In certain preferred embodiments, the preferred location and orientation information is conveyed visually or aurally. In certain preferred embodiments, visual information is received by the operator through a screen or display. In certain preferred embodiments, a display is integrated into the applicator. In certain other preferred embodiments, visual information is conveyed through the use of guides and other physical indicators. In certain preferred embodiments, physical indicators are attached to the applicator and extend from its body in a direction and manner so as to assist the operator in the positioning of the tag onto the carton. In certain preferred embodiments, tags are applied to the interior of a carton, preferably before it is sealed.

Step 92 also preferably performs certain preparations for successful execution of step 93, including the verification of available tags and commissioning data. In certain preferred embodiments, applicator 130, 170, 180, 190, 200, or 210 tests the next tag and determines if it is operating within certain predefined specifications. Certain preferred embodiments read the transponder, wireless sensor, or tag, preferably monitoring parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the tag. If the applicator determines that the next tag is not likely to result in a successful tag deployment due to either physical or electronic deficiencies or abnormalities, then the operator is preferably informed. In certain preferred embodiments, a bad tag is discarded when an operator pulls a trigger under an operator-acknowledged tag failure condition and the bad tag is preferably not released into a supply chain or other intended use. Instead, all bad tags are preferably collected in such a manner to allow for subsequent problem diagnosis.

The second step 92 also preferably includes processes to read or determine by dead reckoning the information encoded into certain preprinted optically encoded symbols on the outward facing non-adhesive surface of the adhesive tape. In certain

preferred embodiments the adhesive tape is printed with information. In certain preferred embodiments the printed information is a machine readable symbol such as a bar code symbol. In certain preferred embodiments, one or more machine readable symbols are read when the tape is prepared for use in an automated applicator or alternatively during the inlay conversion process and conveyed to an applicator through other data storage means, such as an RFID tag. Certain preferred information encoding methods use either one-dimensional or two-dimensional bar codes. In certain preferred embodiments a linear imager 368 is used to read either linear 113 or two-dimensional 114 bar codes as the tape 110 or 367 is being unrolled from a spool. Certain preferred encoding schemes preprint machine-readable symbols at regular intervals along the length of a roll of adhesive tape. In certain preferred embodiments the spacing of the preprinted symbols is at an interval of one half of the nominal length of each section of adhesive tape. In certain preferred embodiments, the encoded information is used as a reference to one or more data storage locations. In certain preferred embodiments, the data storage locations are accessible through a computer network. In certain preferred embodiments, the encoded information is a series of sequential numbers. Information relating to data stored in the RFID tag or inlay is preferably stored in certain data storage locations that are referenced by one or more of the preprinted symbols. In certain preferred embodiments, more than one machine readable symbols can be read from the surface of a segment of tape. In certain preferred embodiments, more than one machine readable symbol is used as a reference to the same or closely related data records of information stored in the RFID tag or inlay, and either can be successfully used to access stored data.

In step 93, a Trigger Event occurs preferably resulting in the attachment and verification of an encoded tag to a transport container. In certain preferred embodiments, an operator preferably pulls a trigger to commission a tag. Tag commissioning preferably involves attachment, encoding, and verification. In certain preferred modes of preconfigured operation of certain preferred applicator embodiments, a Trigger Event occurs when certain sensors detect certain preprogrammed conditions

resulting in the commissioning of a tag. Details of certain preferred Trigger Events and sensor functions are described herein, including one or more modes wherein the operator-induced action of step 92 whereby an applicator with sensor suite 178, 188, 198, 208, or 218 is placed against a carton face, causing step 93 to occur immediately after step 92 is completed.

Good tags or sensors are preferably programmed with new information relating to the object that it is being associated with. That information is stored in non-volatile memory within the RFID inlay. Tag programming may also occur during, after, or between the second step 92 and third step 93. Wireless sensors, transponders, or wireless tags that are capable of collecting other information such as location, temperature, barometric pressure, humidity, nuclear radiation, biological information, interrogator interactions, or other measurable conditions or events are preferably activated at this time if they require such an action.

Figure 10 is a diagrammatic view of an RFID tag, inlay, transponder, or wireless sensor 111 that is attached to a segment of adhesive tape 110. Inlay 111 is secured under adhesive tape 110 preferably using any of the preferred constructions shown in Figs. 3-5. In certain preferred embodiments, machine readable symbol 113 and/or symbol 114 are printed on the tape. In certain preferred embodiments the machine readable symbols are unique preprinted symbols such as a bar code. In certain preferred embodiments, the bar codes are two-dimensional barcodes. In certain preferred embodiments, more than one unique bar code is applied to the same segment of tape to assure that at least one machine readable symbol can be read regardless of the position of the symbols relative to the ends of the segments. In certain preferred embodiments more than one type of bar code symbol is used. In Fig. 10 symbol 113 is a PDF417 bar code and symbol 114 is a Data Matrix bar code. In certain preferred embodiments, other types of bar code symbols are used in other useful combinations.

Certain preferred embodiments use rolls or z-folded transponders mounted to a continuous web or release liner. Other certain embodiments use transponders that are

stacked and loaded into magazines for transport, handling, and automated dispensing. In certain preferred embodiments, the magazines contain metallic shielding to protect tags and inlays from electrostatic discharges (ESD).

Certain preferred magazines are part of a family of interchangeable magazines of similar size, shape, and functionality, preferably capable of housing and dispensing certain types, styles, shapes, and sizes of new or used RFID tags, transponders, or inlays. Certain preferred embodiments of magazines and cartridges have RFID tags permanently attached to them such that they can be automatically interrogated and tracked. In order to minimize interference, certain preferred embodiments use permanently attached RFID tags that operate in a frequency band that is different than the tags or inlays contained within the magazine. Other preferred embodiments selectively interrogate cartridge identification tags that operate in the same band as tags within the cartridge that are to be applied.

Referring now to Fig. 12, certain preferred methods of commissioning transponders 125 having no exposed adhesive use a magazine 122 of new or reprocessed transponders that are transported from another location.

Certain preferred embodiments use a mobile handheld reader 128 to verify transponder functionality after carton attachment. Certain preferred methods use a fixture to align and coordinate a mobile reader 128 and automate the programming of a magazine of transponders 122. Certain preferred handheld readers also read bar codes that either partially or completely specify the data that is to be programmed into a transponder. An optical path 129 from reader 128 to a location for reading bar code labels 120 is preferably used to identify at least certain non-serialized information about the objects or containers that are to be tagged. Additional transponder encoding instructions and data is preferably acquired through an integral network interface or a batch mode memory in reader 128.

Transponders 123 are preferably dispensed one at a time from magazine 122 under the control of a miniature tag singulation system 121. Shield 126 prevents RF

fields from interrogating or reprogramming tag 125. Tag 123 is preferably retained in the interrogation field by material handling roller 124 preferably until a programming transaction is completed.

Compared to methods that use stationary readers and conveyors, the handheld reader 128 is a preferred solution for small scale or decentralized RFID deployments. A handheld is preferably able to both program and verify transponders, saving the expense of a Smart Label printer, a stationary reader, and a conveyor.

A preferred embodiment of a handheld RFID tag applicator 130 is shown in Fig. 13. A handheld tag applicator is preferably capable of helping an operator apply and commission RFID transponders or wireless sensors. Certain preferred embodiments use a transponder magazine 134 to handle and dispense tags, transponders, inlays, or wireless sensors that are stacked, ready to be adhered onto a transport container such as a carton or pallet. Certain preferred adhesives are adhesive tape, spray on, or dispensed as a gel or paste. Transponders are preferably read, written, and verified when an operator initiates an action such pulling a trigger 135, pushing a button, or some other command sequence.

In the preferred embodiment shown in Fig 13, a contact image sensor (CIS) 138 or a linear optical array is used to scan along the length of a roll of packing tape 137 or 110 before each segment is applied to a carton. CIS 138 preferably produces a video stream that is decoded and then interpreted and stored by an On-board Computer 131. CIS 138 or a similar linear array sensor is preferably capable of reading both linear and two-dimensional bar codes. In certain preferred embodiments, CIS 138 reads two-dimensional bar code 114 and 116 from adhesive tape 110, preferably before attachment to inlay or tag 111. Preferably symbols 115 and messages 112 and 113 do not adversely affect bar code scanning and decoding functions. In certain preferred embodiments On-board Computer 131 creates a logical association between bar codes 114/ 116 and RFID tag 133. In certain preferred embodiments, the location and number of readable bar codes on tape 110 is not controlled, there may be more than one

readable bar code on some segments of tape 110. Applicator 130 preferably reads and associates all bar code symbols on a single segment of tape 110 with the RFID tag or inlay 133 adhered to it.

When an operator pulls trigger 135, RFID tag 133 is preferably pressed against a transport container, a corrugated carton, or a pallet within a fraction of a second. In certain preferred embodiments, mechanisms internal to applicator 130 transfer mechanical force to tag 133 through the use of air, springs, motors, plungers, elastomers, or other energy storing or delivering methods. Reloading of the next tag and readying of the system are preferably performed within a time interval that is acceptable to the operator and preferably enables a high degree of productivity for tagging cartons, pallets, or other transport containers.

Onboard computer 131 preferably controls operation of RFID Interrogator Module 132 to read, write, and verify RFID tags, inlays, transponders, and wireless sensors that are applied or are within range of the interrogation fields produced by antenna 139. Handheld applicator 130 is preferably capable of reading multiple RFID tags near it. In certain preferred embodiments antenna 139 produces a linearly polarized radio field. In Fig. 13, and in certain preferred embodiments antenna 139 produces a horizontally polarized RF field that is preferably aligned with RFID tags 133 that it is capable of applying. Tag 133 can preferably be read both before and after it is applied to a transport container. When multiple tags are within the interrogation field of applicator 130, On-board computer 131 is preferably able to determine which tags have already been applied and which tags have not. In certain preferred embodiments, On-board Computer 131 maintains records of tags recently applied in order to properly determine how to interact with each tag in the field of antenna 139 or other antennae under the control of RFID Interrogator 132.

Certain preferred embodiments of a handheld applicator have a handle grip and trigger to activate the application of a programmed transponder. Certain preferred embodiments have an RFID interrogator to read, write, and verify RFID tags,

transponders, or wireless sensors. Certain preferred embodiments have a magazine or stack of transponders that are ready for programming and application. Certain preferred embodiments have a roll of adhesive-backed tape ready to be dispensed and applied to the transponders in sequence. Certain preferred embodiments have adhesive tape that is pre-printed with certain information. Certain preprinted information preferably includes one or more logos, an EPCglobal Seal, and informative information. Certain preferred embodiments have a motorized tape drive and dispensing system. Certain preferred embodiments contain some or all of the following: a rechargeable battery, an operator display, a wireless interface, a network stack, an IP address, a PCMCIA port, a Compact Flash port, a USB cable, a serial cable, a dock port, a window to allow the operator to view the tag attachment process, or a bar code scanner. A bar code scanner is preferably used to help verify that RFID tag 133 receives encoding that correctly matches the bar coded information that may be attached to the same transport container.

Certain features and methods described and explained with relation to handheld applicators are also relevant to non-mobile RFID tag applicators that use a magazine, cartridge, reel, or roll to handle, transport, and dispense RFID tags, inlays, transponders, or wireless sensors. Magazines, cartridges, reels, and rolls are preferably capable of carrying either new or used tags and are preferably capable of being used in either mobile or non-mobile applicators. Magazines, cartridges, and reels are preferably refilled and reused. Magazines and cartridges preferably protect RFID tags from ESD. Such devices are preferably capable of communicating with other devices or networks using either wired or wireless means, over either long or short distances.

Mobile applicators such as applicator 130, 170, 180, 190, 200, and 210 all require replenishment of a stored energy source such as batteries, fuel cell, or other energy storage technology. Referring now to Fig. 14 certain preferred methods of using mobile applicators involve the use of a base unit 140 that preferably remains in close proximity to one or more applicators 130, 170, 180, 190, 200, and 210. The principal purpose of base unit 140 is to replenish tag magazines and/or cartridges 146a-c,

recharge applicator energy levels, and provide a communications gateway and an optional user interface 142. Spare tag magazines/cartridges 146a-c are preferably retained in cartridge pockets 145a-c where they are preferably protected from damage. Cartridges preferably indicate their empty/full status with a visible indicator such as: an LED, an LCD, a mechanical flag, a window with a view into the source reel, or other such indicators that help an operator choose which cartridge from which to next consume tags. Applicator 144 is preferably retained by pocket 143 to prevent damage and to make any electrical or mechanical connections to base unit 140. Frame 141 provides an overall structure and preferably mounting options for various operating locations including various models of fork lift trucks. Base unit 140 preferably includes a variety of wired and wireless communications options with applicator 144, cartridges 146a-c, a host computer, a vehicle mount terminal, a fork truck computer, or other relevant computing devices. Base unit 140 preferably has a power system that is suitable for the application, including power filtering and energy storage capabilities such as batteries or fuel cells.

Certain preferred applicator embodiments such as applicator 160 use a spool of converted self-adhesive RFID tape 160 to transport to a desired location and replenish mobile applicators. A preferred embodiment for RFID tape is illustrated in Fig. 16. In certain preferred embodiments, the tape is translucent, clear, or opaque. In certain preferred embodiments, RFID tape 160 has certain preferred preprinted symbols as shown in Fig. 11. A spool is preferably constructed on a hollow core 161. Inlays 162, 163a, and 163b are preferably attached to adhesive backed tape 164. Preferred construction methods are shown in Figs. 2-5, and are an improvement over prior art such as "Packaging Tape with Radio Frequency Identification Technology" disclosed in U.S. Patent number 6,478.229 by Harvey Epstein of Newton, MA. Epstein teaches a packing tape construction consisting of two layers of tape bonded to each other along their lengths and encapsulating scrim and a plurality of RFID tags. Epstein furthermore teaches that pressure sensitive adhesive on the bottom layer should be covered by an additional

layer of release liner to maintain its active life and to prevent it from bonding to adjacent portions of the laminated tape. The present invention teaches the opposite as a preferred and improved design for RFID tape by having the pressure sensitive adhesive be intentionally become bonded to selected adjacent portions of the laminated tape, provided that the surface energy of the tape backing is relatively low, allowing for release and reuse of the van der Waals bonds. The present invention has the advantage over Epstein's prior art of having no release liner to dispose of nor any water-activated adhesive to dampen. Both of these advantages are important for preferred embodiments of mobile applicators disclosed herein.

Figure 15 illustrates a preferred embodiment of a machine to convert RFID inlays into RFID tape 150b as is also shown in Fig 16 as RFID tape 160. Care must be exercised to prevent damage do to electrostatic discharge when operating the machine illustrated in Fig. 15. In certain preferred embodiments charge is removed using a variety of conduction methods including wiping, air, and humidity controls. A roll of inlays 159a is preferably mounted onto tag source fixture 159b in preparation for use. Inlay 156 is preferably interrogated, tested, and selectively programmed by antenna 157 and interrogator 158. Punch 155b preferably cuts inlay 155a from inlay roll 159a. If the inlay does not perform within required operational parameters it is preferably discarded into reject port 152 and removed from the conversion process. Good inlay 151 is preferably attached to exposed adhesive on tape 153 as it unrolls from tape source fixture 154a.

Certain preferred applicator embodiments such as applicator 210 use wireless tags or RFID tags such as ALL-9338-02 from Alien Technology of Morgan Hill, California that are die cut and adhered to release liner. Preferably wireless tags are manufactured to specifications that are compatible with applicator 210, including such specifications as core diameter, outer diameter, and web width. Alternatively, certain preferred steps are required to prepare a standard roll of ALL-9338-02 tags for use in an automated applicator, including unrolling from a large roll onto several smaller rolls having a smaller core diameter.

Referring now to Figs. 17-21 and within them applicators 170, 180, 190, 200, and 210 there are certain preferred characteristics that are shared among them. Preferred characteristics are described only once while making references to instances within those five Figs 17-21.

Applicators 170, 180, 190, 200, and 210 preferably include options to physically, electrically, and communicatively integrate with a portable data terminal (PDT) or a mobile computing platform. Figs 20-21 illustrate a preferred configuration for mechanically integrating PDT 209 or 219 which is representative of a wide range of commercially available PDT's or PDA's of various shapes, sizes, types, and capabilities. Certain preferred PDT's have a variety of wireless connections including PAN and WLAN. Certain preferred PDT's include a bar code scanner comprised of a laser, an imager, or other means.

Certain preferred Applicators 170, 180, 190, 200, and 210 preferably exchange information with a host device, including PDT 219, in either a batch more or through a real time connection. Batch mode preferably uses a periodically connected data transfer channel such as a wired connection. Certain preferred wired connections include serial data, infrared, optical, Universal Serial Bus, a parallel port, or other physical data connection. Certain preferred real time connections include wireless data links including Personal Area Network (PAN), Wireless Local Area Network (WLAN), and Wide Area Network (WAN). Certain preferred PAN connections include Bluetooth and Zigbee. Certain preferred WLAN connections include IEEE802.11a, IEEE802.11b, and IEEE802.11g.

Sensor suite 178, 188, 198, 208, and 218 - in certain preferred embodiments - includes a single sensor that is responsive to changes in light, capacitance, pressure, acoustics, or optical path length to a transport container. In certain other preferred embodiments, sensor suite 178, 188, 198, 208, and 218 operates as a collection of sensors. Changes in capacitance are detectable using certain preferred QProx charge transfer capacitance sensors available from Quantum Research Group Ltd. of Hamble, England. Ultrasonic range sensors are available from supplier such as muRata

Manufacturing Co., Ltd. of Kyoto Japan under the trade name Piezotite. Optical path length sensors are available from Keyence Corporation of Osaka, Japan. Sharp manufactures a compact distance measuring sensor GP2D02 that is responsive in the range from 5 to 100 cm. When a predetermined set of conditions is realized, sensor suite 178, 188, 198, 208, and 218 preferably triggers, enables, or selects a desired action. In certain preferred embodiments, proximity or contact of sensor suite 178, 188, 198, 208, and 218 with the targeted transport container causes a second type of Trigger Event, resulting in the programming and application of a tag.

Certain preferred embodiments of sensor suite 178, 188, 198, 208, and 218 measure range of applicator 170, 180, 190, 200, and 210 from other objects. Preferably range information is acquired and processed in real time to determine if the applicator is: in Close Proximity, Near, or Far from a transport container. In certain preferred embodiments controller 203b or 213b are programmable to alter threshold distances between each range category. In certain preferred embodiments, controller 203b or 213b are programmed to associate a preferred function with each range. In certain preferred embodiments, range category Close Proximity is associated with tag programming and application functions. In certain preferred embodiments range category Near is reserved for tag verification and/or reading functions; and Far is preferred for bar code scanning functions to verify that bar code information aligns properly with RFID tag data.

Certain preferred embodiments include trigger 135, 205b or 215b that is preferably coupled with an electrical switch having one or more stable positions that are detectable by controller 203b or 213b. In certain preferred modes of operation trigger switch state is coupled with range information from sensor suite 178, 188, 198, 208, and 218 to execute preferred functions at preferred ranges at preferred times. The result is a trigger 135, 205b or 215b whose function is preferably dependent upon detected range from a transport container. The advantage of doing this is operator productivity. One trigger is used to execute several different functions that are typically

involved with RFID tagging including the tagging of bar-coded cartons that have been selected to receive wireless tags.

Certain preferred embodiments of applicator 170, 180, 190, 200, and 210 do not have any means to interrogate RFID tags or read bar codes. Such embodiments are intended to apply tags and inform PDT 219 of certain events, including but not limited to certain Trigger Events. Other events, information, and status such as changes in tag readiness, tags remaining on source roll 217b, remaining charge in battery 213a, changes in range status between certain predefined states such as Close, Near, and Far are preferably communicated to PDT 219. Certain preferred information is communicated from PDT 219 to applicator 170, 180, 190, 200, or 210, including certain power management functions, commands, status, and data that is to be encoded into each readied tag 216f at the appropriate time. Certain preferred embodiments exchange information over a wireless connection to PDT 219, including PAN or WLAN. Such a configuration puts applicator 170, 180, 190, 200, or 210 in the role of a peripheral device to PDT 219, with PDT 219 managing the primary user interface and most computation functions. Certain preferred means of pairing wireless communications nodes includes PDT 219 reading a bar code attached to applicator 170, 180, 190, 200, or 210.

Bar code verification is preferably performed either before or after an RFID tag is applied by merely stepping back away from the marker cartons to at least the point where the sweep angle of a laser beam or field of view of an imager can read a bar code label. In certain preferred embodiments, ranges shorter than that, but not in close proximity are used for sweeping a radio frequency interrogation signal across the faces of multiple cartons to assure that the correct tags, the correct number of tags, and the correct data within that tags were all properly programmed.

In certain preferred embodiments Close Proximity range is reserved exclusively for programming, applying, and verifying one tag, preferably all in a single pull of trigger 135, 205b or 215b.

In certain preferred embodiments, certain programmable conditions are set such that Trigger Events enable interaction with external devices or nearby equipment. In a preferred embodiment trigger 135, 205b or 215b at a certain range as determined by sensor suite 208 or 218 and controller 203b or 213b causes applicator 200 or 210 to transmit a coded signal to an external device as an indication of an operator action. In certain preferred embodiments pulling trigger 135, 205b or 215b at Far range causes a signal to be transmitted from applicator 200 or 210 requesting an external device to read a bar code. In certain preferred embodiments, bar code information is decoded and transmitted back to applicator 200 or 210. In other preferred embodiments, decoded bar code information is processed remotely from applicator 200 or 210. In certain preferred embodiments, decoded bar code information is processed by a portable data terminal (PDT), a vehicle mount terminal, or other computing device. In certain preferred embodiments a PDT is collocated with applicator 200 or 210. In certain preferred embodiments, PDT 209 or 219 is mounted to applicator 200 or 210 as shown in Figs 20 and 21. In certain preferred embodiments, there are no ohmic or electrical connections between applicator 200 or 210 and PDT 209 or 219. In certain preferred embodiments the coded signal is transmitted using a Bluetooth, or a Zigbee, or an IEEE air interface standard.

Certain preferred embodiments of sensor suite 178, 188, 198, 208, and 218 are responsive to certain colors or patterns. Sensor suite 178, 188, 198, 208, and 218 is preferably capable of recognizing certain predefined colors and patterns to initiate certain preprogrammed responses including the detection of the correct locations for applying good tags and separate locations for discharging bad tags.

Certain preferred embodiments of applicators 170, 180, 190, 200, and 210 are capable of using sensor suite 178, 188, 198, 208, and 218 to learn one or more colors and/or patterns and storing information relating to it, and optionally exchanging that information with other applicators 170, 180, 190, 200, and 210.

Certain preferred embodiments of applicators 170, 180, 190, 200, and 210 manage preset conditions that allow an operator to only apply a tag to objects having a predetermined set of surface characteristics. Certain preferred embodiments of applicators 170, 180, 190, 200, and 210 use sensor suite 178, 188, 198, 208, and 218 to detect colors and/or patterns to identify preferred target locations for wireless tags. Certain preferred embodiments of corrugated cartons are preprinted with certain preferred colors and patterns that are detectable by sensor suite 178, 188, 198, 208, and 218.

Certain preferred embodiments of applicators 170, 180, 190, 200, and 210 manage preset conditions that allow an operator to discharge a defective tag from the applicator. Prior art teaches that defective tags are to be rolled up with spent release liner. There are two problems with that, one relating to the lack of proper waste disposal, and the other relating to the lack of failure analysis. Certain preferred embodiments of applicators 170, 180, 190, 200, and 210 enable a mode of operation whereby an operator is informed that the next tag is defective and should be discharged onto a particular object or surface for subsequent failure analysis and disposal. Certain preferred embodiments also prevent an operator from discharging a defective tag onto a surface that does not match a predetermined set of conditions. Such a lock-out condition is preferred as a solution to prevent bad tags from being shipped to a customer or from being improperly discarded before a failure analysis can be performed.

Fig. 17 illustrates a preferred embodiment of mobile applicator 170 using RFID tape roll 171 loaded into cartridge 179. Capstan 173 assures that the minimum bend radius of the tag specifications is not violated. In certain preferred embodiments, capstan 173 is motor-driven and has sufficient surface texture to provide enough friction to help tape 172 move forward. The gateway to the tag attachment zone is marked by cut-and-hold device 174. Sensors preferably monitor the location of each tag on tape 172 to properly register their position and to spatially synchronize all applicator functions with

them. The forward motion of tape 172 is led by strokes from right to left of cut-and-hold device 174.

Trigger 135, 205b or 215b, preferably embedded within trigger handle 136, 176, 186, 196, 205a, or 215a is actuated by an operator, preferably causing a Trigger Event. In certain preferred embodiments, there is more than one kind of Trigger Event. In certain preferred embodiments of applicators 200 and 210 certain types of either mechanical or electromechanical actuators are preferably used to cause hammer mechanism 206a or 216a to trip, being driven toward readied tag 206f or 216f, through opening 206e or 216e for placement on a transport container at the face of bulkhead 201a or 211a.

Figure 20 illustrates certain preferred embodiments of a mechanical actuator that can be embodied within applicator 200 or 210, or other similar applicator designs. Proximity probe 205c when pressed against the face of a transport container such as a corrugated carton will preferably slide deeper into applicator 200 along its primary axis, applying pressure to trigger arm 205d preferably causing it to move at least to the point that latch 206b becomes disengaged. Having no means to hold off the torque applied by the energy stored in spring 206c, hammer 206a accelerates toward impact with tag 206f and the face of a carton that tripped probe 205c. In certain preferred embodiments, push rod 206h preferably makes contact with a transport container, exerting force inward through housing wall 201a to load spring 206c preferably locking it into firing position. This closed loop mechanical system preferably achieves a high degree of properly placed wireless tags by ensuring that an applicator such as applicator 200 or 210 is in close contact with a target transport container.

An alternative mechanical actuation system that is embodied within certain preferred embodiments of applicator 200 or 210 is a manually initiated Trigger Event using trigger 205b. When an operator pulls trigger 205b, trigger arm 205d preferably moves away from its point of engagement with latch 206b preferably by sliding along its primary axis. Once disengaged from latch 206b, hammer 206a is free to strike tag 206f and also preferably the target zone of the container.

A means of electromechanical actuation is initiated by solenoid 205e that is preferably embedded within handle 205a and is capable of initiating another type of Trigger Event. In certain preferred embodiments of applicator 130, 200, or 210, trigger 135, 205b or 215b is coupled with an electrical switch mechanism to make or break electrical circuits that are indicative of an operator's intent to perform an action such as applying a tag to a carton. In certain preferred embodiments of applicator 200 or 210, solenoid 205e pulls on trigger arm 205d to disengage latch 206b and the corresponding chain of events.

Another means of electromechanical actuation is initiated by a Trigger Event detected by sensor suite 178, 188, 198, 208, and 218. Such a Trigger Event is preferably processed and controlled by a set of preprogrammed rules and conditions in a controller such as controller 203b or 213b. A positive result of that process preferably causes solenoid 205e to actuate whereby retracting trigger arm 205d and causing latch 206b to disengage.

Another means of electromechanical actuation from a Trigger Event initiated by sensor suite 178, 188, 198, 208, and 218 is illustrated in Fig. 21 whereby DC motor 215c runs in a reverse direction causing ratchet 216b to become disengaged, allowing hammer 216a to accelerate toward tag 216f due to the torque exerted by spring 216c. Hammer 216a passes between holding rollers 216d to press tag 216f against the face of a transport container.

At the moment a Trigger Event occurs a properly programmed tag is preferably applied. A Trigger Event preferably sets into motion a sequence of events to commission a tag by applying a properly programmed tag to a carton, a shrink-wrapped pallet of cases, or other shipping container.

Referring to Fig. 17, immediately following a Trigger Event and the commissioning of a tag, another tag is preferably pulled into position squarely in front of tamp head 175 and cut-and-hold-device 174 preferably severs tape 172.

Referring to Figs. 20 and 21 drive motor 204 or 214 are preferably located inside the center of the source reel 207b or 217b within the circular walls of applicator housing 210b or 211b, around which cartridge 207a or 217a is nested when mated to applicator 200 or 210. Motor 204 or 214 is mounted to the structural frame of applicator 200 or 210 and preferably transfers mechanical power to certain drive points preferably using gears, belts, or drive shafts within applicator housing 201a or 211a. In certain preferred embodiments of applicators 170, 180, 190, 200, and 210 certain preferred drive points include take-up reel 184, 194, 207c or 217c, source reel 207b or 217b, separation roller 183, 193, 207d, hammer arm 206a, roller 181, 191, or spring 206c.

Separation roller 183, 193, 207d preferably has nubs that extend in uniformly spaced radial directions from a cylindrical core that preferably extend through mesh or net from source reel 195, 207b or Z-fold stack 185 to break the weak adhesive bonds that have formed between the packing tape primarily in zones 100 and 102, and form a temporary bond with it so that it can be temporarily bonded to holding rollers 182, 192, 206d. In certain preferred embodiments separation roller 183, 193, 207d is powered by motor 204, and preferably maintains desired tension and registration of tags, mesh or net transport layer. Take-up reel 207c is diagrammatically shown in both the empty and the full conditions to illustrate the range of possible mechanical relationships among the various parts of the transport system.

Edge 217d illustrates a preferred method of removing pressure sensitive adhesive backed tags from release liner from source reel 217b. Unlike removal from mesh or net, there is no need for a separation roller, Instead the smooth surface of the release liner glides easily round the distal end of edge 217d causing the stiffer tag substrate to continue on toward holding roller 216d or other suitable mechanism to temporarily hold a tag until it is struck by hammer 216a as it swings through the tag holding area defined by holding rollers 216d in Fig 21.

Certain preferred embodiments of applicators 170, 180, 190, 200, or 210 do not contain an RFID interrogator or antenna but are collocated in proximity of a device that

does. Certain preferred PDT 219 embodiments contain an RFID interrogator and antenna 219a. Preferred embodiments of PDT 219 have RFID interrogator/antenna 219a built in, while certain others have a card slot manufactured to a standard such as PCMCIA, CompactFlash, or Secure Digital, into which interrogator/antenna 219a is plugged. An example of such a card is the MPR5000 that plugs into a PCMCIA Type II slot and is available from WJ Communications of San Jose, California. The MPR 5000 is compatible with handheld computers such as the Hewlett Packard iPAQ5550, enabling it to read and write EPCglobal compatible UHF RFID tags. Certain preferred embodiments, such as the MPR 5000 use an integrated YAGI antenna to create a large forward-looking main lobe of radio frequency energy for interrogation of RFID tags. Antennae, including a YAGI also produce side lobes of RF energy that although attenuated from the main lobe by several dB, couple enough power into nearby readied tag 216f to interrogate and preferably write to it. Certain preferred embodiments also use reflector 219b to passively reflect RF signals from an upper side lobe downward toward readied tag 216f. Backscatter from tag 216f then preferably propagates back to both antenna 219a and reflector 219b for processing by the interrogator. Having an antenna 219a be such an antenna, embedded in PDT 219, mounted to the structure of applicator housing 211a preferably enables PDT 219 to encode and verify readied tag 216f while commanding applicator 200 to apply tag 216f preferably when a Trigger Event or a predetermined range status change occurs.

Antenna 177a, 187, 197, 202b, 212b, 202c, 212c or leaky coax 177b, 202a, 212a are preferably located outside of cartridge 179, 189, 199, 207a, 217a in a location very close to the tag attachment zone in front of tamp head 175 or tag application roller 181 or 191 and holding rollers 182 or 192, or hammer 206a or 216a. In certain preferred embodiments antenna 177a, 187, 197, 202c, 212c is a patch antenna with a radiation pattern toward the tag attachment zone. In certain other preferred embodiments antenna 177a, 187, 197, 202c, 212c is a near field coupler having multiple points of radiation along its length.

Leaky coax 177b, 202a, or 212a is a type of coaxial cable having slits, slots, or perforations that allow radio frequencies to leak in or out. Certain preferred embodiments of leaky coax cables for use in applicators 170, 180, 190, 200, or 210 are coupled-mode cables that do not radiate as well as radiating-mode cable. Coupled-mode cable is preferably constructed with closely spaced slots in a corrugated outer conductor. Radiating-mode cable typically has a foil outer conductor with non-uniformly spaced slots arranged in a periodic pattern. Coupled-mode cable is a slow-wave structure. In free space its external fields are closely bound to the cable and do not radiate, except for minor end effects according to "Prediction of Indoor Wireless Coverage by Leaky Coaxial Cable Using Ray Tracing" by Samuel P. Morgan of Bell Laboratories, Lucent Technologies.

In certain preferred embodiments an interrogator 202d or 212d drives a signal into a leaky coax 202a or 212a that is terminated in a purely resistive load. In certain preferred embodiments the resistive load is about 50 ohms. In certain preferred embodiments there is an RF switch selectable between radiating and non-radiating loads such as antenna 177a or leaky coax 177b. Interrogator 202d or 212d preferably never feeds into a mismatched load impedance.

In certain preferred embodiments antenna 187, 197, 202c or 212c is a patch antenna with its strongest lobes oriented toward the tag holding and placement area in the region of holding rollers 182, 192, 206d or 216d. Antenna 177a, 187, 197, 202b, 212b, 202c, 212c or leaky coax 177b, 202a, or 212a preferably work with an interrogator to produce electromagnetic fields to interrogate, program, and verify wireless tags. Shield 207e and 217 e preferably prevent interrogation or programming of tags until they arrive at separation roller 207d or tag peel edge 217d. Reflector 206g is used in certain preferred embodiments to reflect RF radiation back toward readied tag 206f. In the event that verification failed, and a preferred number of programming and verification retries also fail, then the operator is preferably informed that the bad tag is to be preferably discharged onto a surface of a third object other than the applicator or the transport container, preferably for post-mortem analysis.

All properly programmed tags are preferably adhered to a wall or flap of a transport container by a single forward stroke of tamp head 175, a single lateral stroke of roller 181 or 191 between holding rollers 182 or 192, or a single forward stroke of hammer 206a or 216a.

Certain preferred embodiments of applicators 130, 170, 180, 190, and 200 correlate RFID tag data with data encoded in certain preferred bar codes 113 and/or 114 marked on packing tape 110. In certain preferred embodiments, applicators such as applicator 130 read the bar code preferably using a sensor such as CIS 138 as the tape is unrolled from a spool. In certain other preferred embodiments, an RFID tag is located on cartridge 179, 189, 199, or 207a and contains a numerical value that is directly or indirectly representative of the numerical values optically encoded into bar codes 113 and/or 114, preferably at least indicating the starting numerical values of a number sequence. Other additional information is also encoded in the RFID tag in certain preferred embodiments, including the number of tag positions, the number of good tags, the ending sequence number, the date, time and place of tag conversion or other preferred commercial, logistic, or manufacturing information. In certain preferred embodiments of applicators 130, 170, 180, 190, 200, or 210 certain wireless tags attached to cartridges 179, 189, 199, 207a, or 217a are capable of being read. In certain preferred embodiments the interrogator such as interrogator 202d or 212d is capable of reading an RFID tag mounted to the loaded cartridge, and is also preferably capable of filtering out its response to interrogation or programming of RFID tags.

Interrogator 202d or 212d is a device that is commercially available from several manufacturers, including SAMSys Technologies, Inc. of Durham, NC. Interrogator 202d or 212d is preferably similar to a SAMSys model MP9311. Other RFID or wireless tag interrogator modules with other feature sets are also suitable for use in mobile applicators 130, 170, 180, 190, 200, or 210.

Interrogator 202d or 212d is preferably capable of working with controller 203b or 213b to recognize which tags have been recently programmed or applied so as to

filter out their response to interrogations other tags, especially those tags that are being prepared for attachment. Interrogators such as interrogator 202d or 212d are preferably capable of modulating their transmitted radio power to affect the range and signal to noise ratio of their coupling to wireless tags.

In certain preferred embodiments batteries 203a or 213a are used to store electrical energy to operate applicator 130, 170, 180, 190, 200, or 210. In certain other preferred embodiments other devices are used to store electrical energy, including devices such as fuel cells, or devices that convert hydrogen or hydrogen-rich molecules into an electromotive force and a stream of electrons.

For certain preferred applicator embodiments 130, 170, 180, 190, 200, or 210 passwords are encoded into tags or wireless sensors when they are programmed. Password generation methods are disclosed below. For certain preferred embodiments, passwords are safeguarded using cryptographic techniques, secure and trusted channels, locked memory, and other methods that are commonly used to protect confidential information. Passwords are generated or retrieved:

1) Data from a tag or transponder is used to generate an index into one or more databases that contain any of the following:

a. A one dimensional array of passwords; or

b. A two dimensional array of passwords; or

c. A multidimensional array of passwords; or

d. An array of actual or pointers to algorithms used to generate passwords from tag data.

2) Cryptographic algorithms are used generate passwords from tag data.

In certain preferred embodiments, the location of wireless sensor such as tag 10, 110, 163b on transport containers is stored in a database. In certain preferred embodiments, templates or certain other descriptive or characteristic information is

stored one or more databases that are preferably referenced or pointed to by information that is stored in the memory a wireless sensor such as tag 10, 110 or 163b.

In certain preferred embodiments, replenishment of empty cartridges or magazines is performed as a service at a customer's site such as a warehouse, distribution center, packing plant, 3PL logistics center, or a manufacturing plant. In certain preferred embodiments, all machines that are required to replenish and service applicators 130, 170, 180, 190, 200, and 210 and their cartridges or magazines are preferably contained within a single vehicle.

While the invention has been particularly shown and described with reference to certain embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

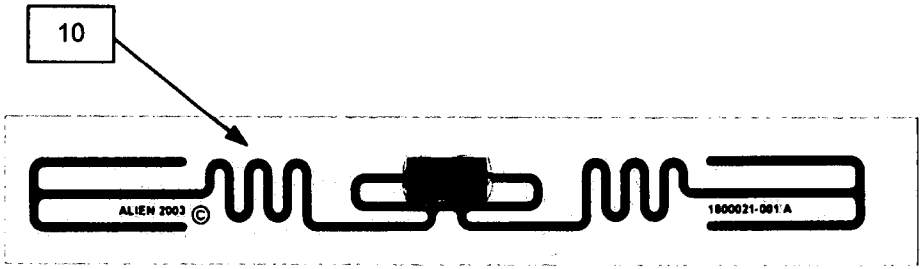


Fig. 1 - A UHF RFID inlay using a linear dipole antenna structure

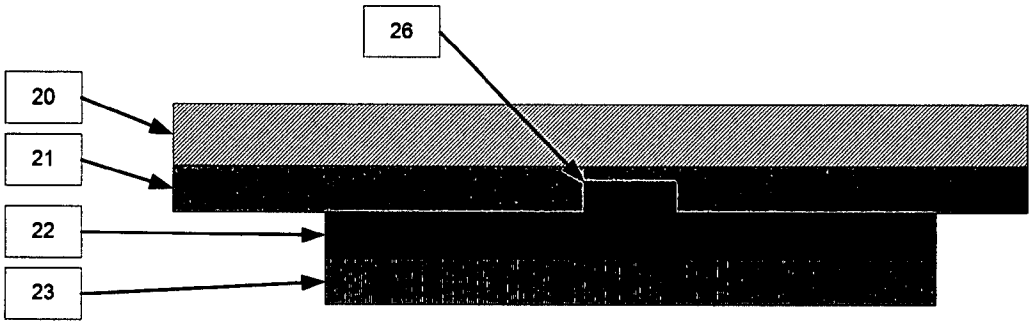


Fig. 2 – Diagrammatic view of layers of materials used to create a taped inlay

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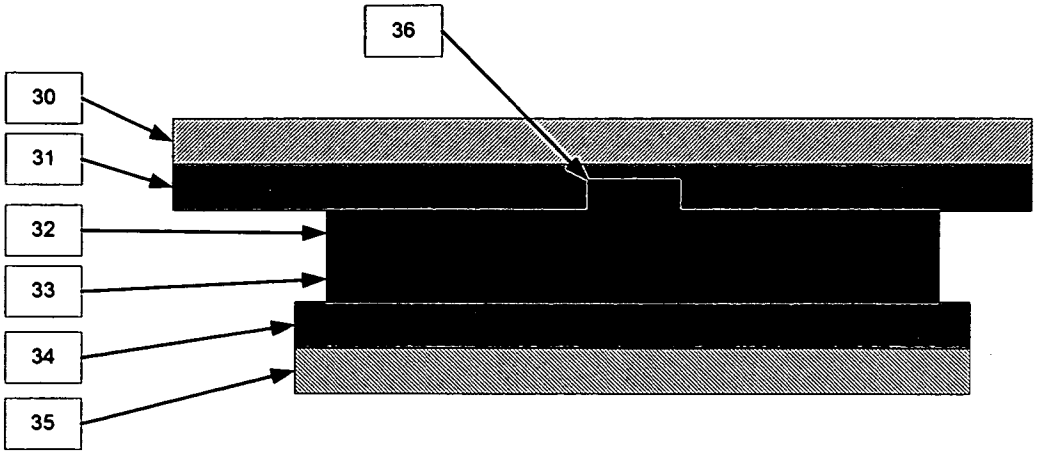


Fig. 3 – Diagrammatic view of an ESD resistant inlay constructed from adhesive tape

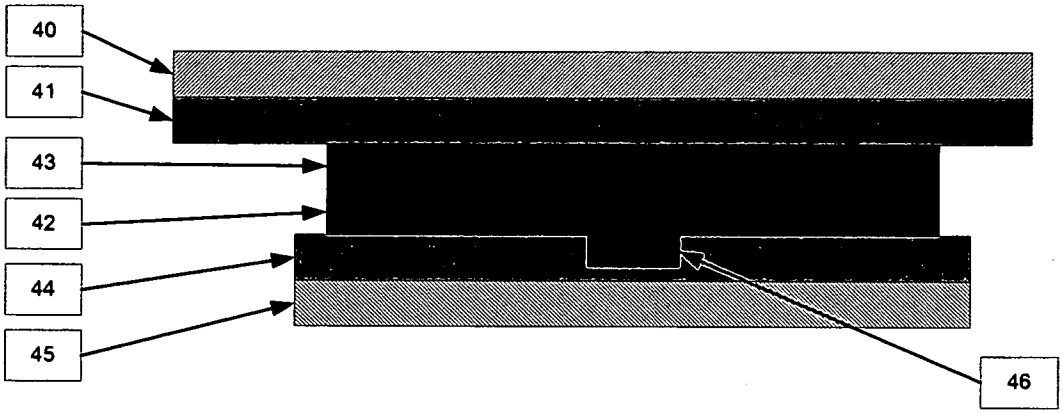


Fig. 4 – Diagrammatic view of an ESD resistant inlay constructed from adhesive tape

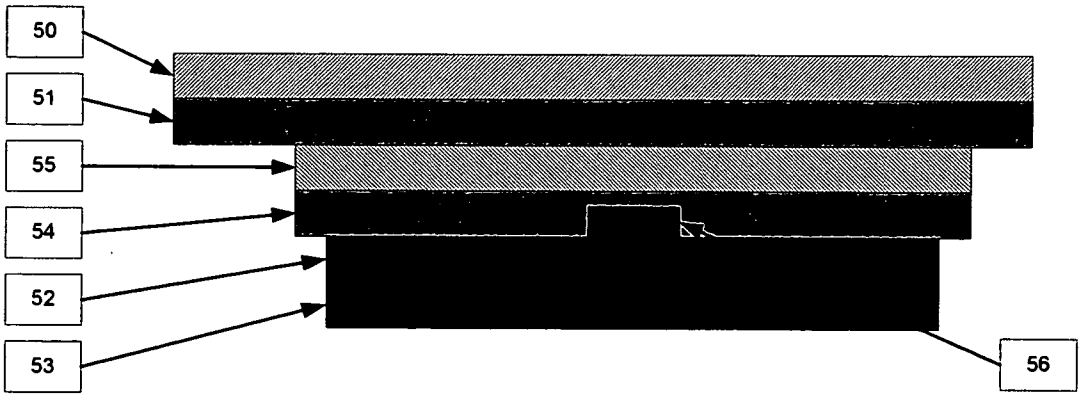


Fig. 5 – Diagrammatic view of an ESD resistant inlay constructed from adhesive tape

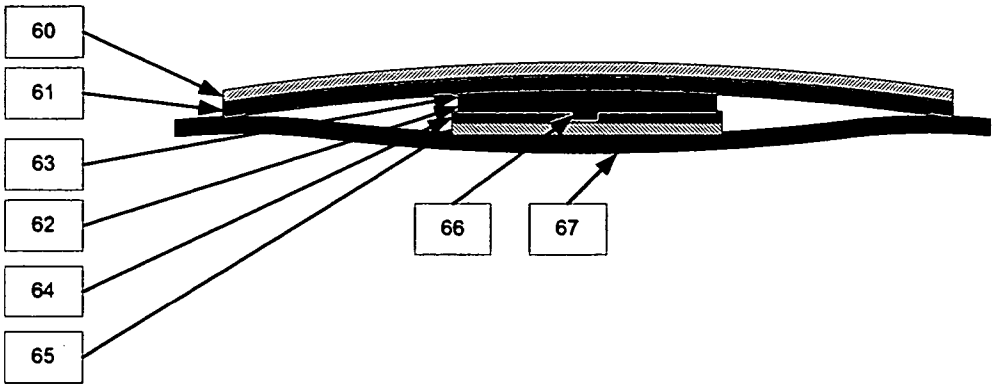


Fig. 6 – Diagrammatic view of an ESD resistant inlay adhered to a conveyance layer

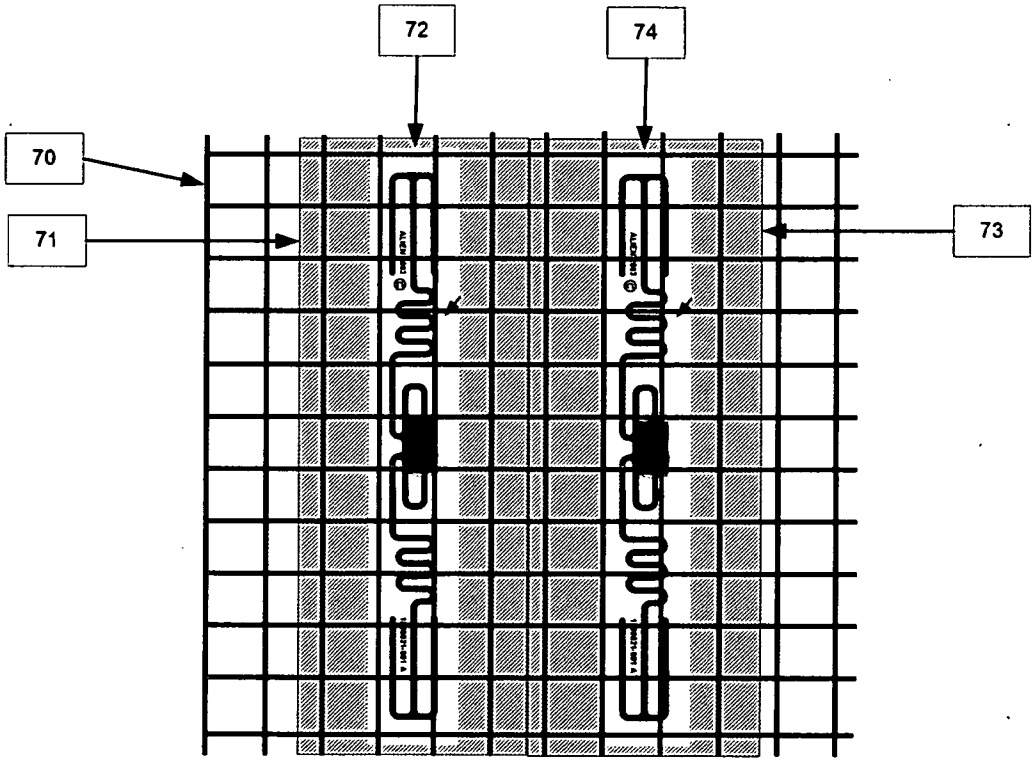


Fig. 7 – Diagrammatic view of converted inlays adhered to a conveyance mesh

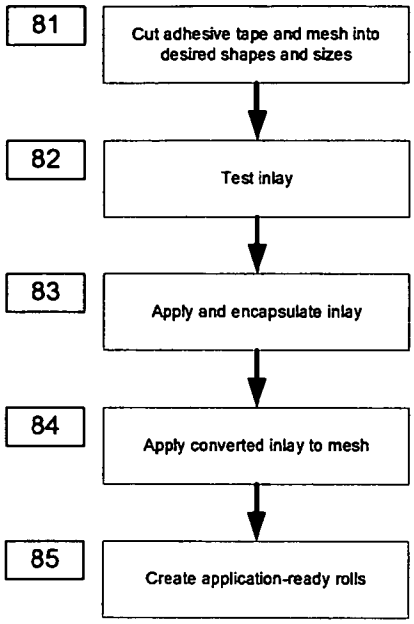


Fig. 8 - Flowchart of a method of inlay conversion

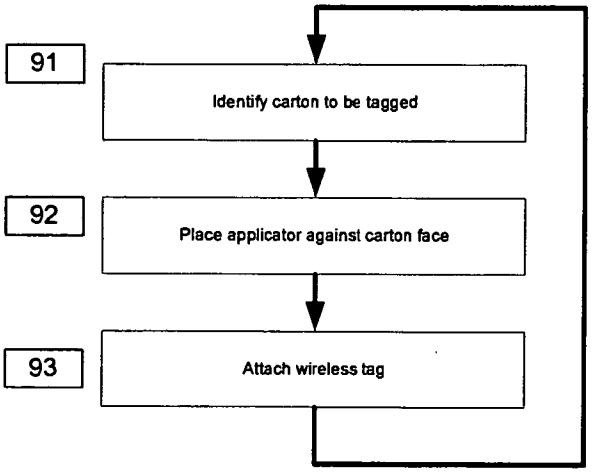


Fig. 9 - Method of tagging cartons using a mobile applicator

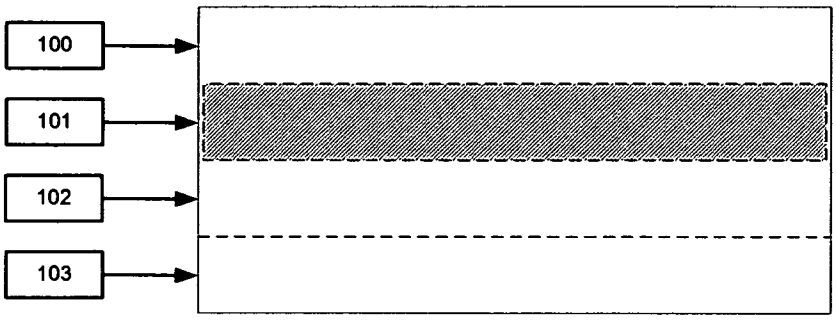


Fig. 10 – is a diagrammatic view of regions of adhesive tape

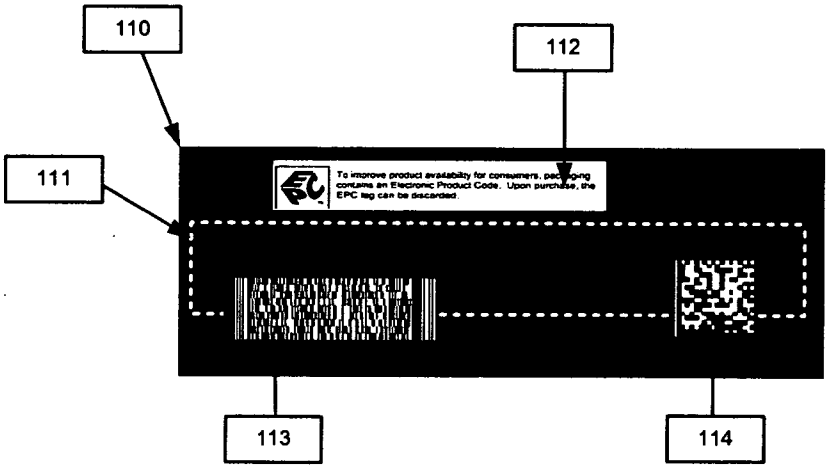


Fig. 11 – is a diagrammatic view of an inlay attached to encoded adhesive tape

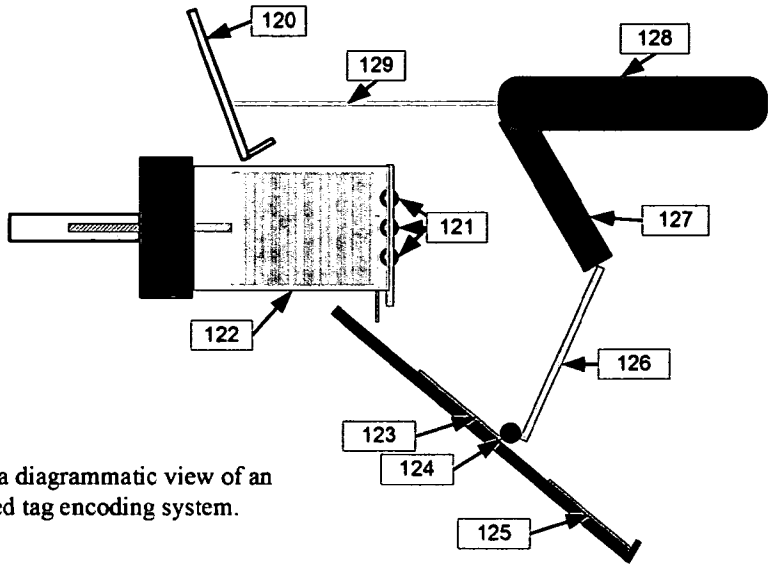


Fig. 12 – is a diagrammatic view of an automated tag encoding system.

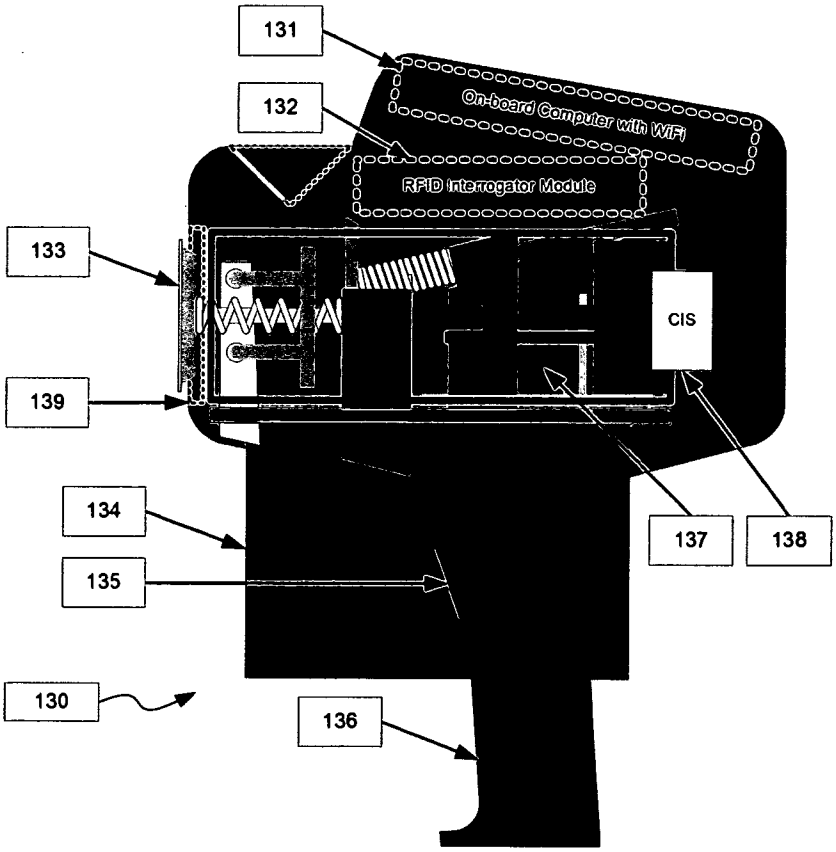


Fig. 13 – is a diagrammatic view of a handheld RFID tag applicator.

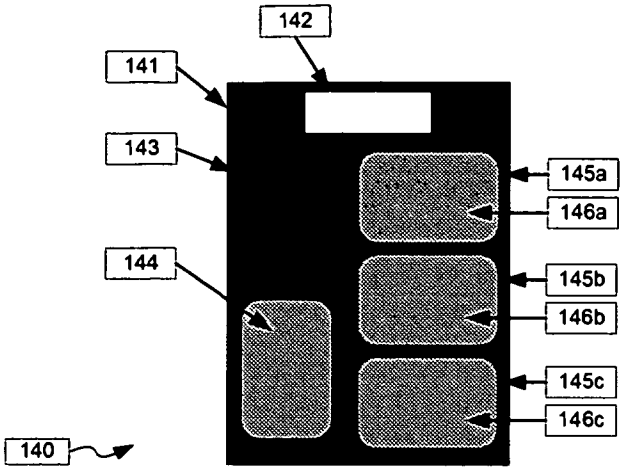


Fig. 14 – is a diagrammatic view of a base unit for a mobile applicator and spare cartridges.

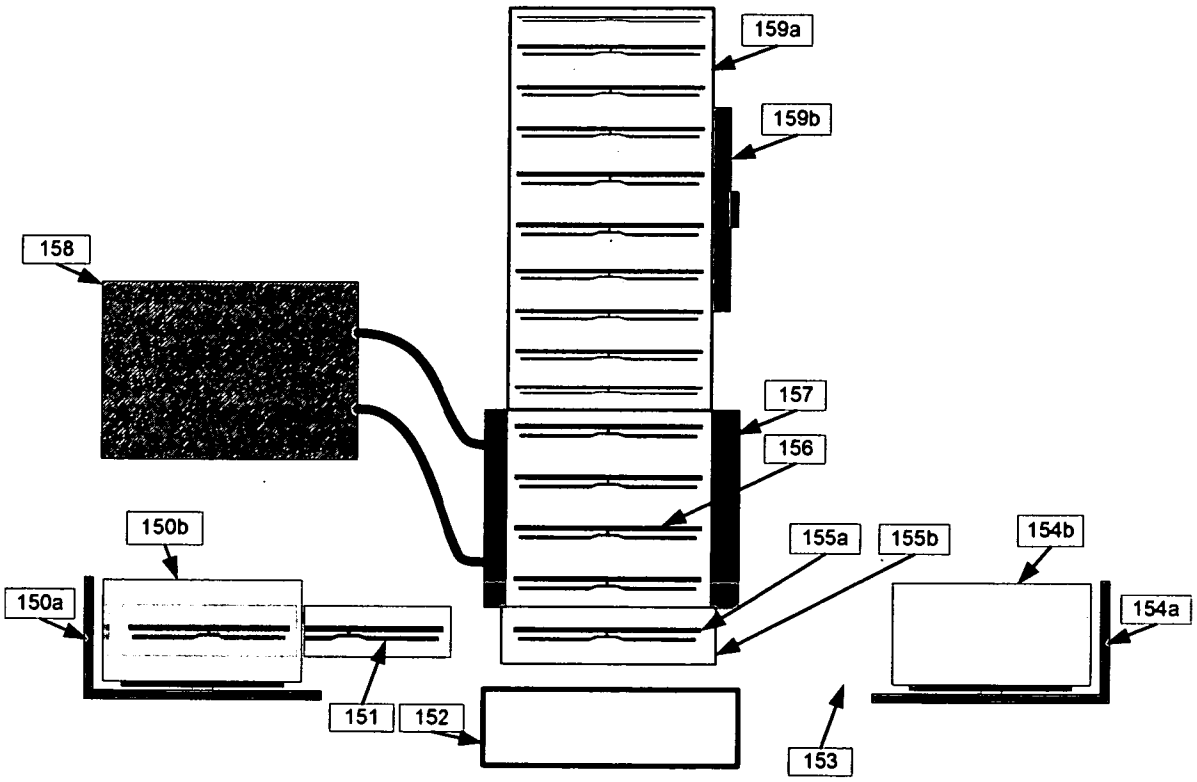


Fig. 15 – is a diagrammatic view of a machine to selectively attach RFID transponders to adhesive tape.

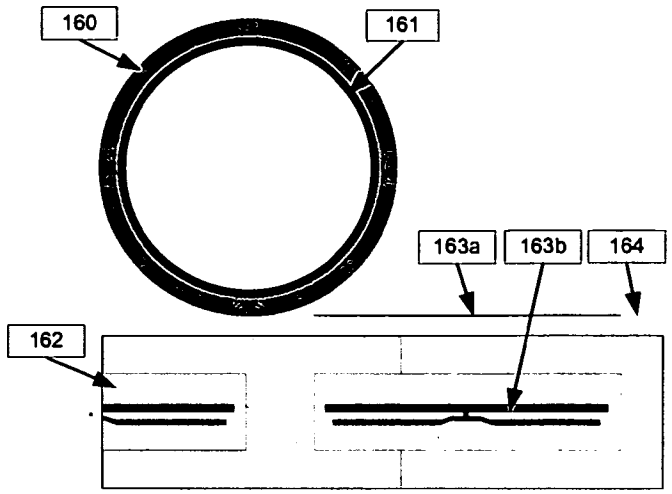


Fig. 16 – is a diagrammatic view of RFID transponders attached to adhesive tape.

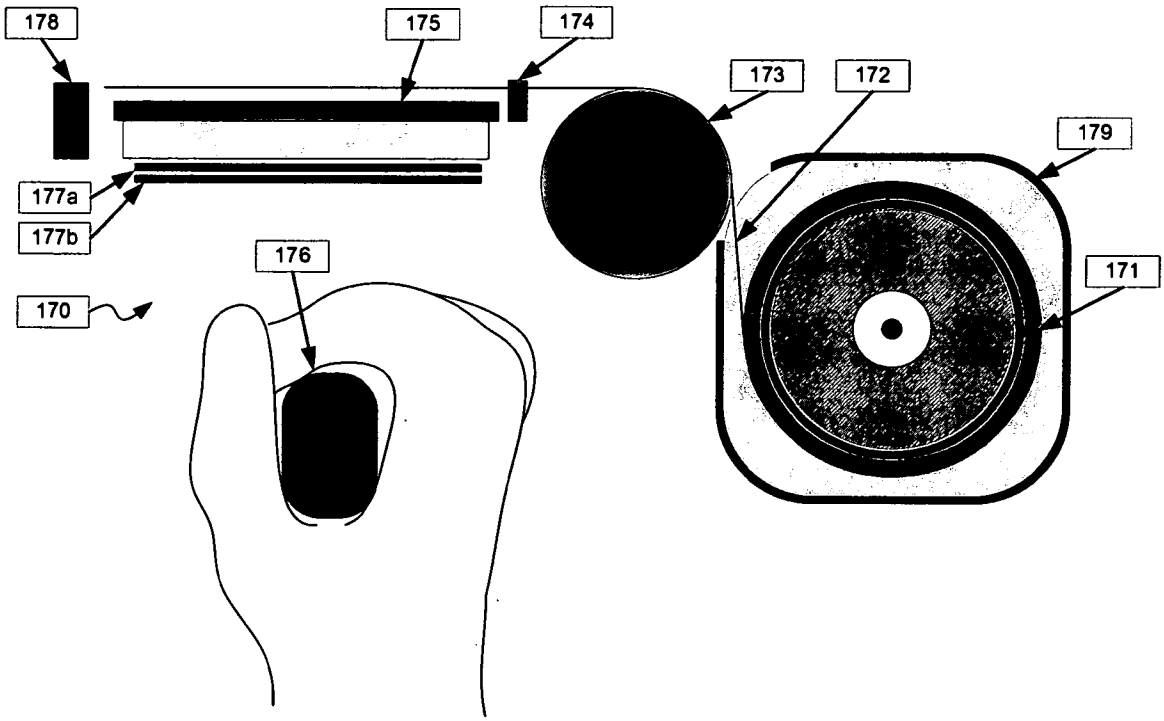


Fig. 17 – is a diagrammatic view of a mechanism to attach RFID tags from a roll of RFID Tape.

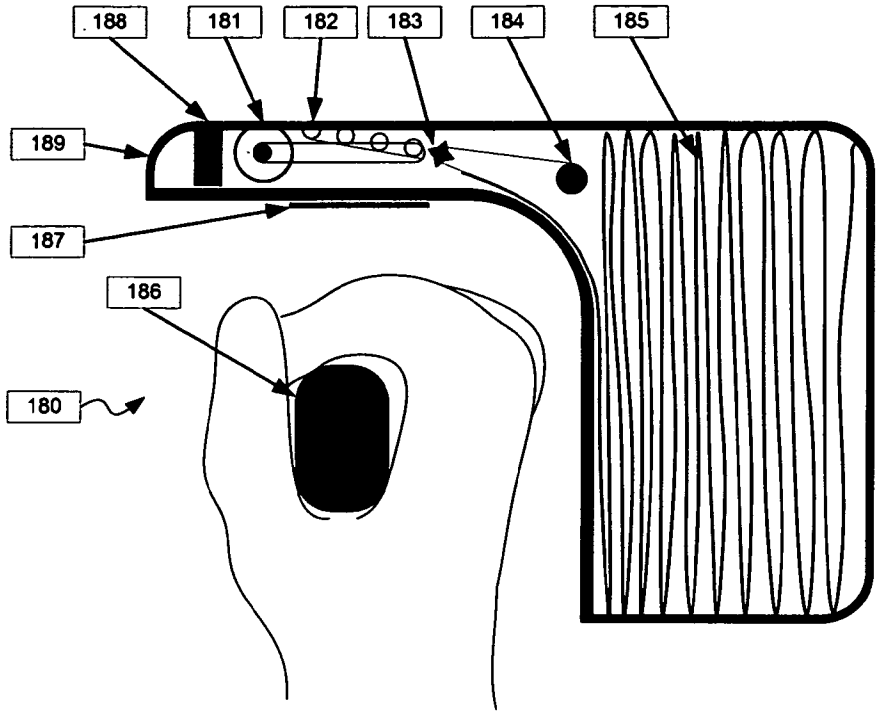


Fig. 18 – is a diagrammatic view of a mechanism to attach tags from an RFID magazine.

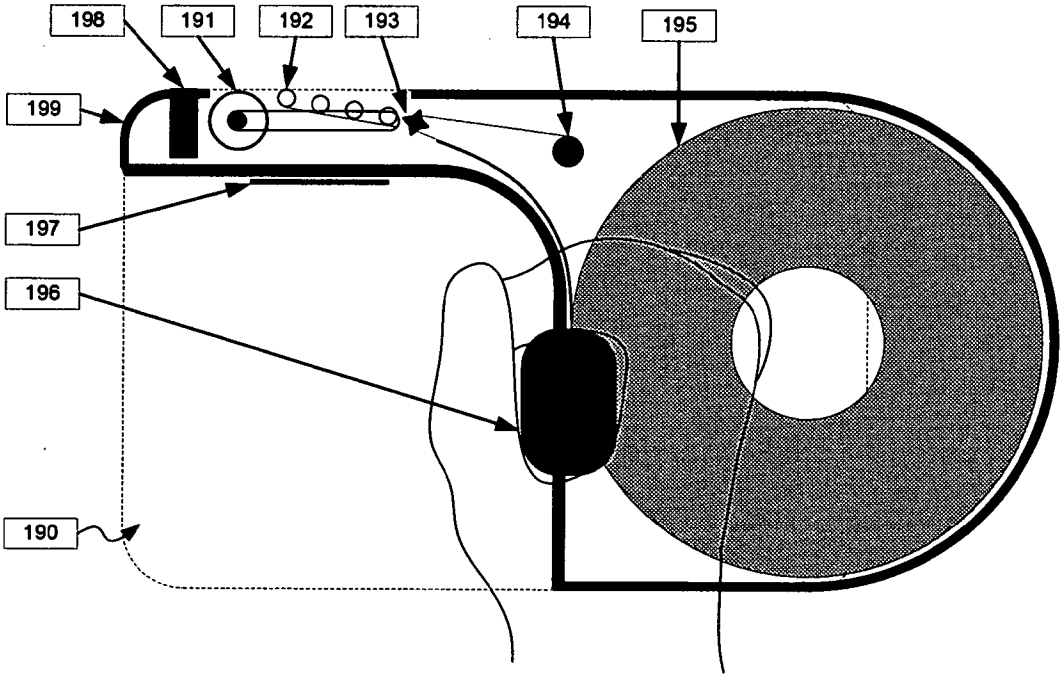


Fig. 19 – is a diagrammatic view of a mechanism to attach RFID tags from a mesh roll

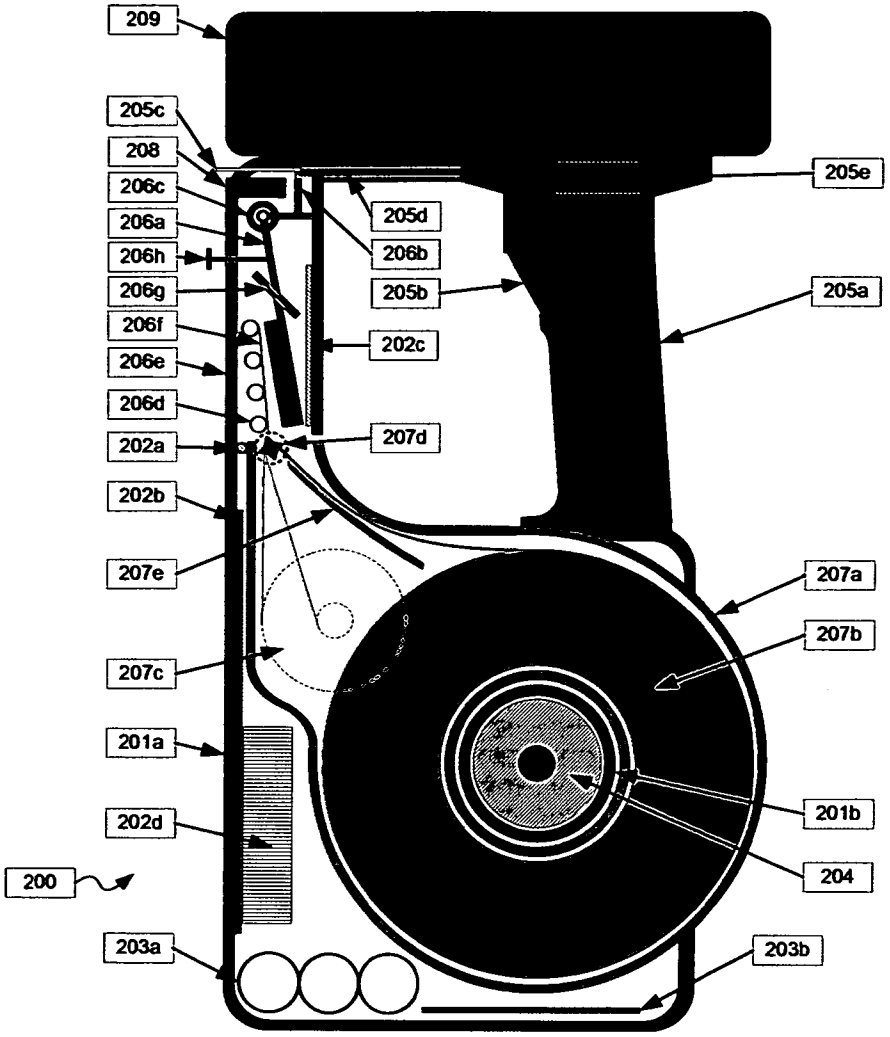


Fig. 20 – is a diagrammatic view of a mechanism to attach RFID tags from a mesh roll

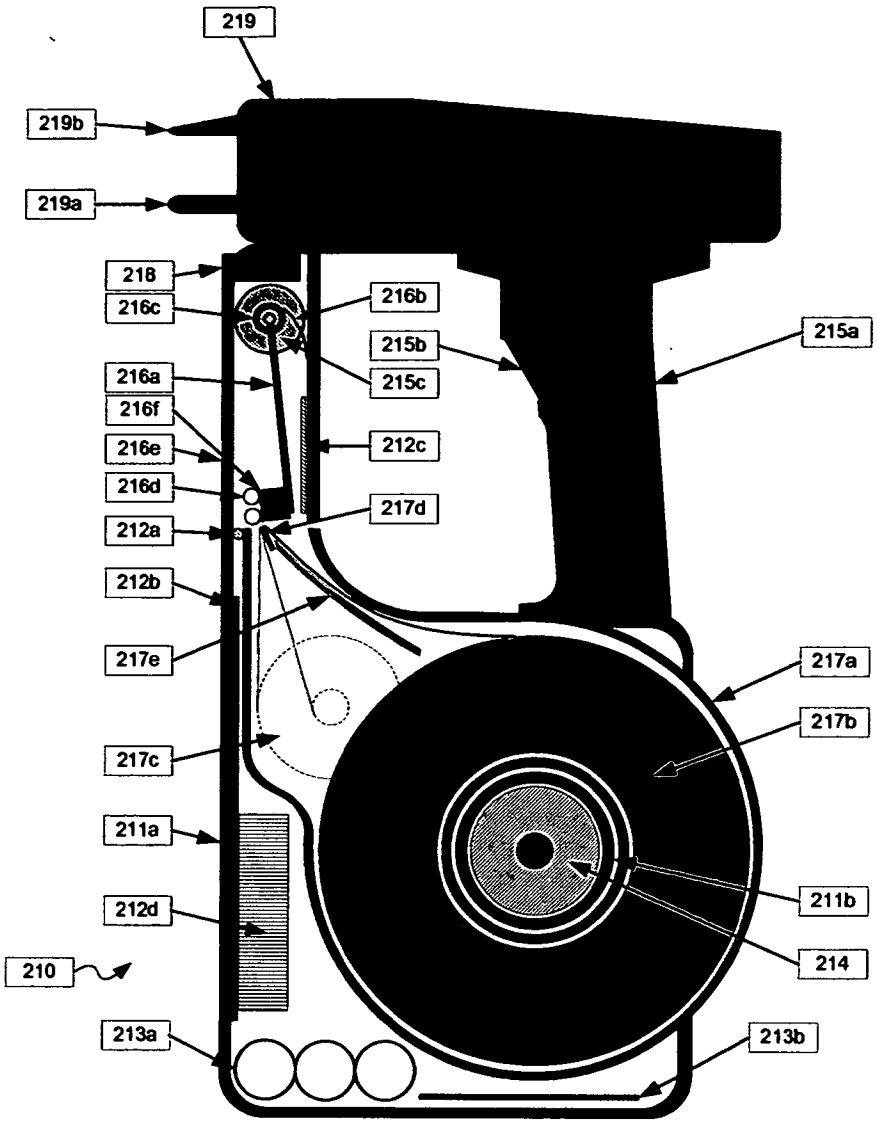


Fig. 21 – is a diagrammatic view of a mechanism to attach RFID tags from release liner

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EXHIBIT

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 1 of 2

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. _____

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Clarke William	McAllister	Eugene, Oregon

Additional inventors are being named on the _____ *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max):

SYSTEMS, METHODS, AND DEVICES FOR REPLICATATION OF DATA ONTO WIRELESS SENSORS

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☐ The address corresponding to Customer Number:

OR

☒ Firm or individual Name: Clarke William McAllister

Address: 4060 Sunridge Drive

City	Eugene	State	OR	Zip	97405
Country	USA	Telephone	541-968-2988	Email	clarke@clarkemcallister.com

ENCLOSED APPLICATION PARTS *(check all that apply)*

☐ Application Data Sheet. See 37 CFR 1.76

☒ Drawing(s) *Number of Sheets* 6

☒ Specification (e.g. description of the invention) *Number of Pages* 32

☐ CD(s), Number of CDs _____

☐ Other (specify) _____

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METHOD OF PAYMENT OF THE FILING FEE AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT

☒ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fee and application size fee (if applicable).

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☐ The Director is hereby authorized to charge the filing fee and application size fee (if applicable) or credit any overpayment to Deposit Account Number: _____. A duplicative copy of this form is enclosed for fee processing.

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SIGNATURE _____ Date 22 May 2007

TYPED or PRINTED NAME Clarke W. McAllister REGISTRATION NO. _____ (if appropriate)

TELEPHONE 541-968-2988 Docket Number: _____

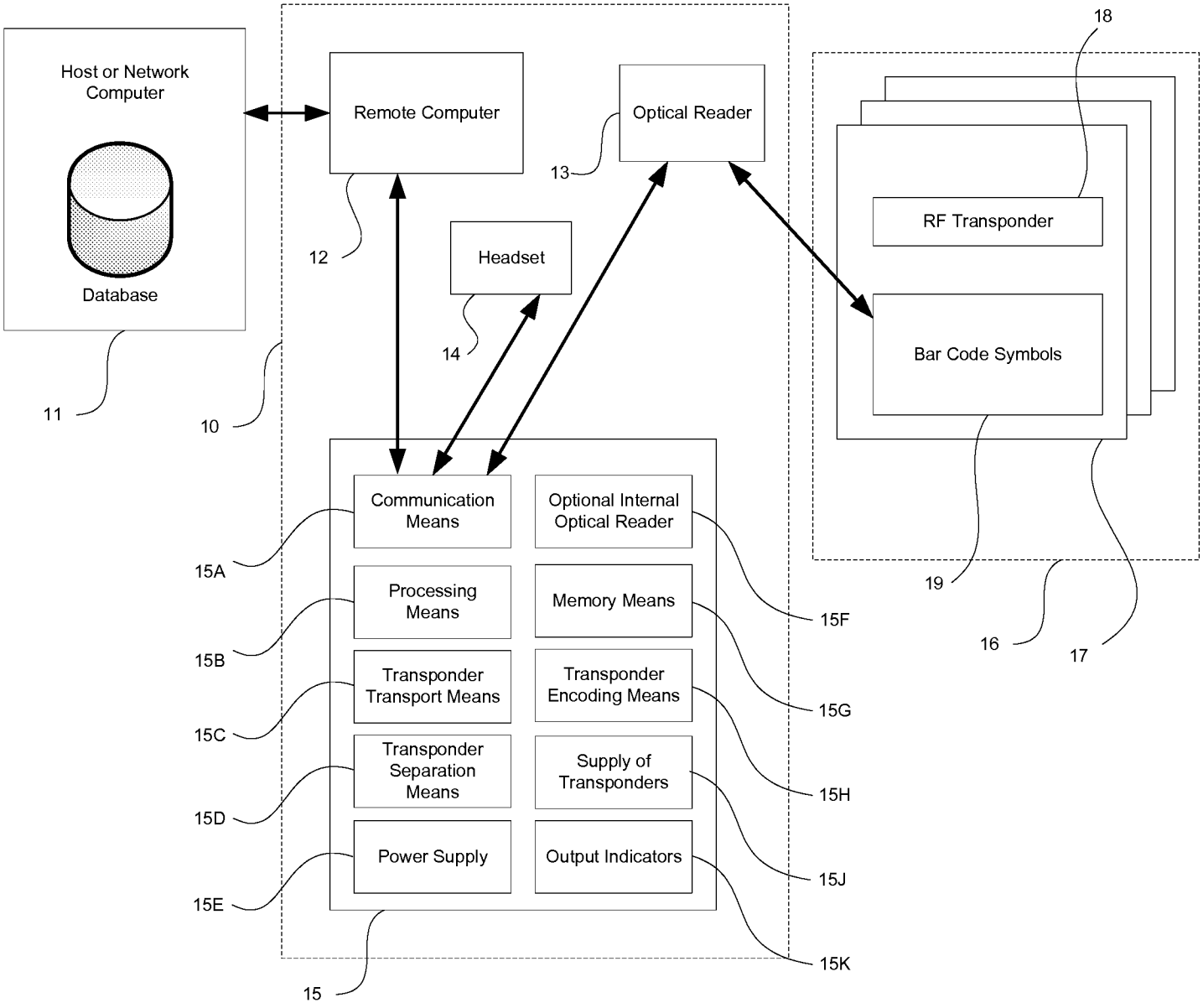

Host or Network Computer
Database
11
Remote Computer
12
Optical Reader
13
Headset
14
10
18
RF Transponder
Bar Code Symbols
19
16
17
Communication Means
Optional Internal Optical Reader
Processing Means
Memory Means
Transponder Transport Means
Transponder Encoding Means
Transponder Separation Means
Supply of Transponders
Power Supply
Output Indicators
15A
15B
15C
15D
15E
15F
15G
15H
15J
15K
15

FIG 1

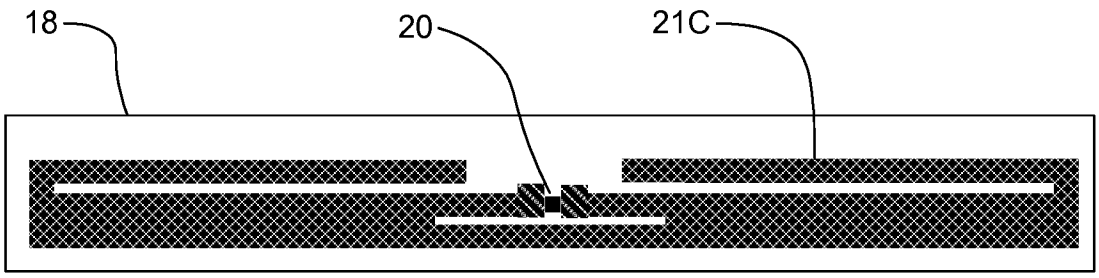


FIG 2

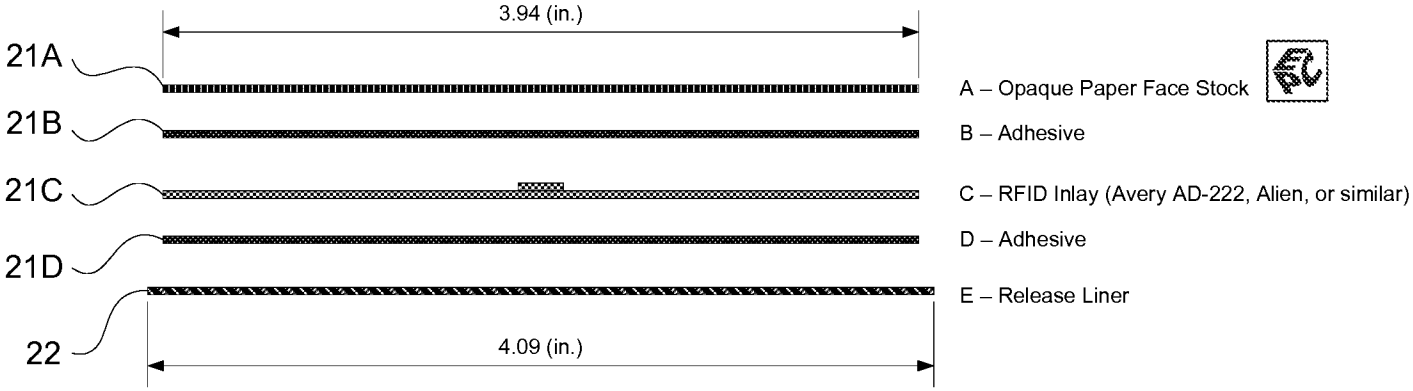


FIG 3

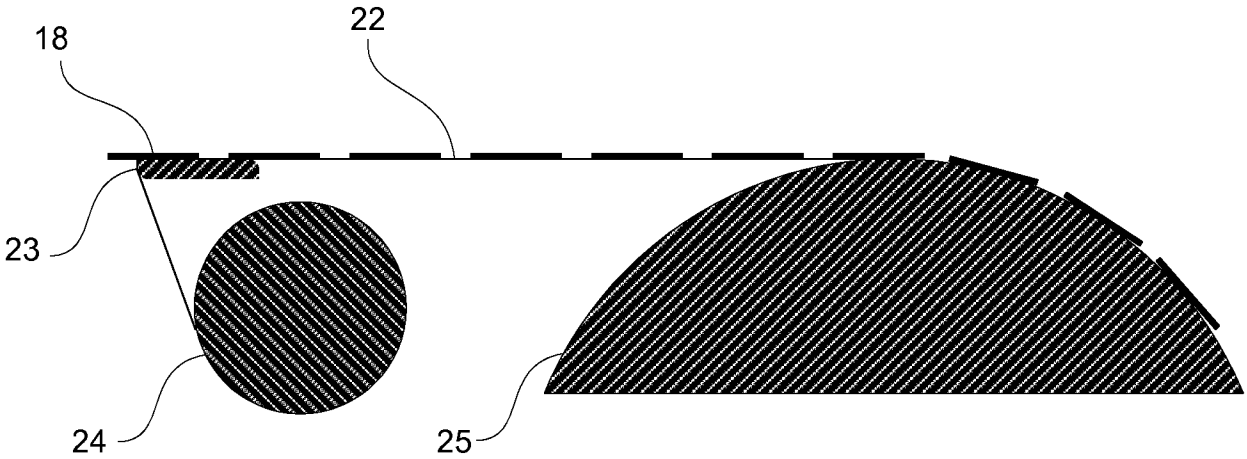


FIG 4

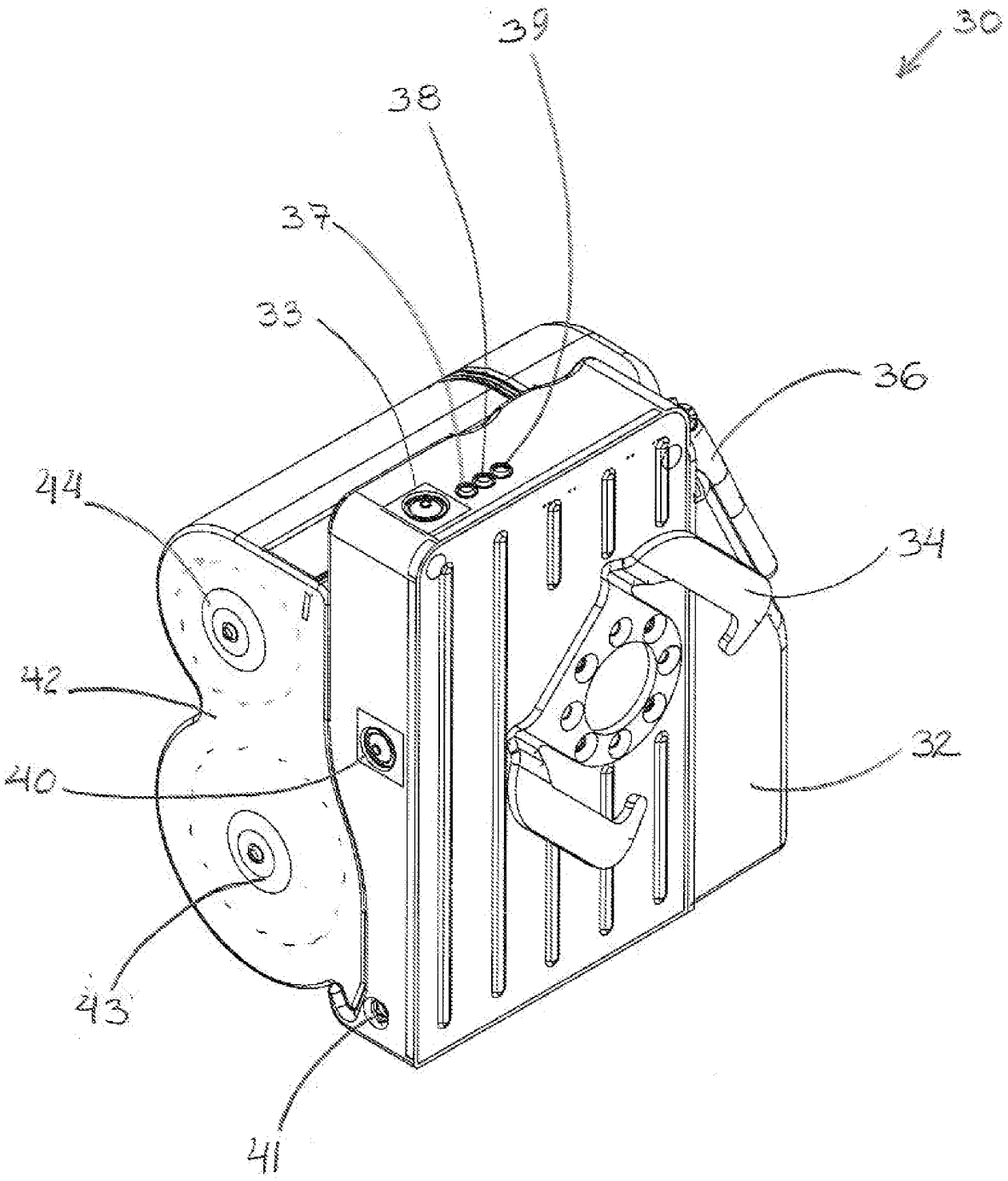


FIG 5

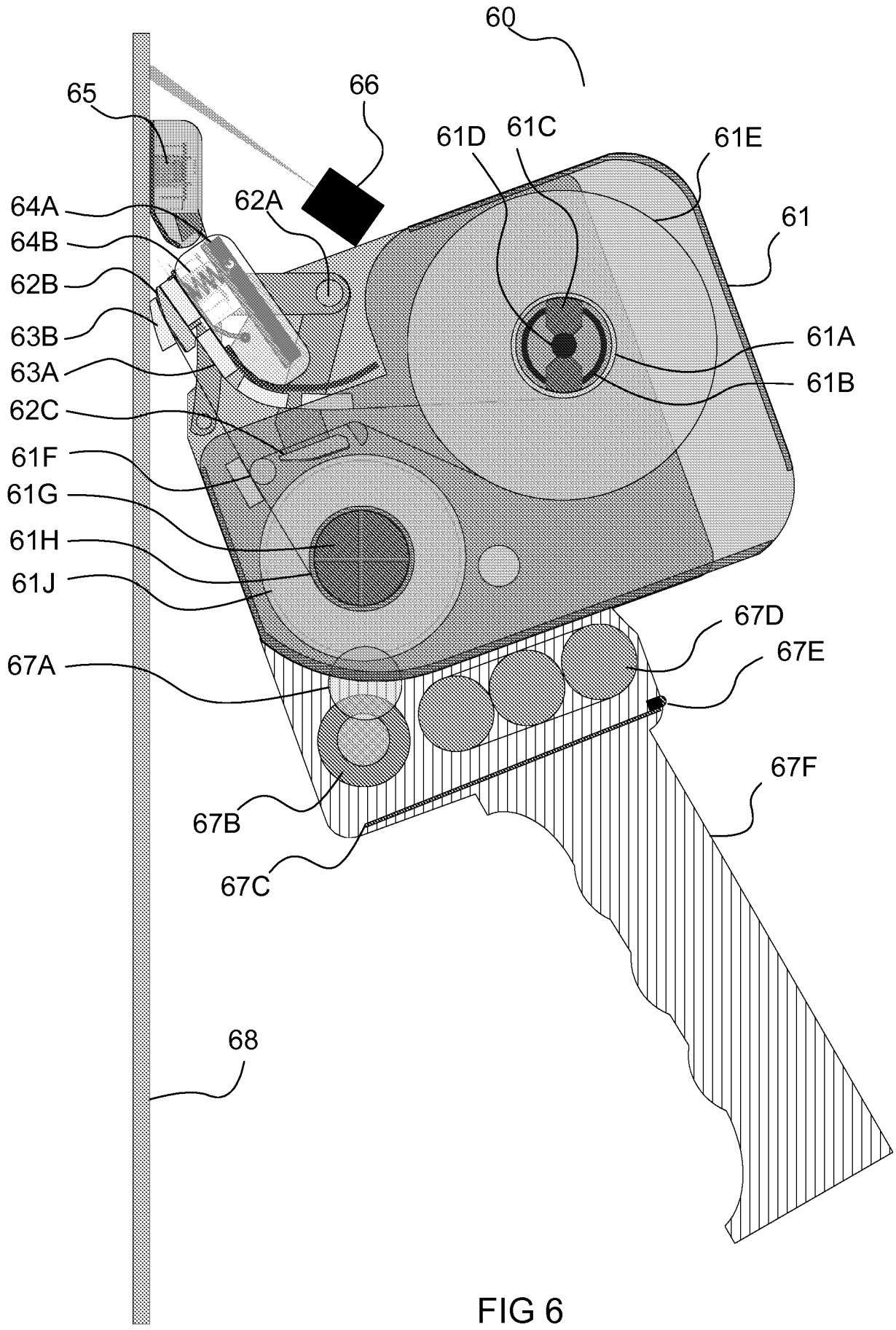

60
65
66
61D
61C
61E
64A
62A
61
64B
62B
63B
61A
63A
61B
62C
61F
61G
61H
61J
67D
67A
67E
67F
67B
67C
68

FIG 6

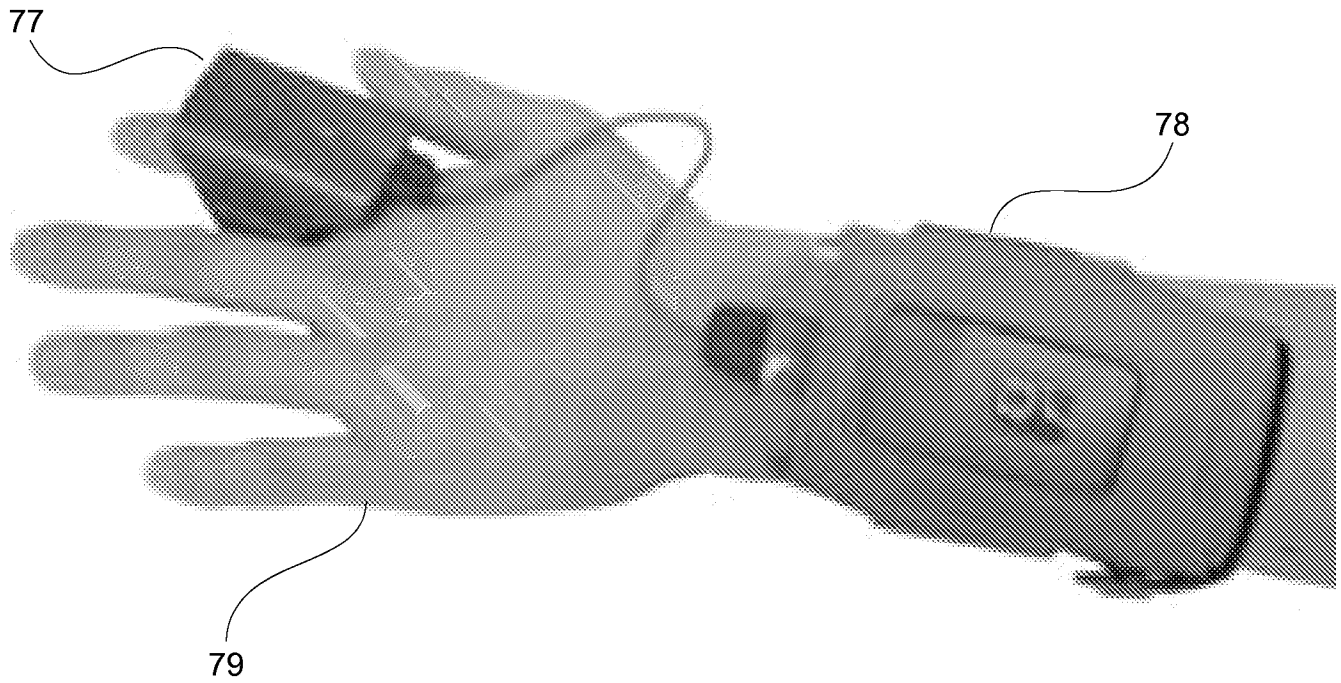


FIG 7

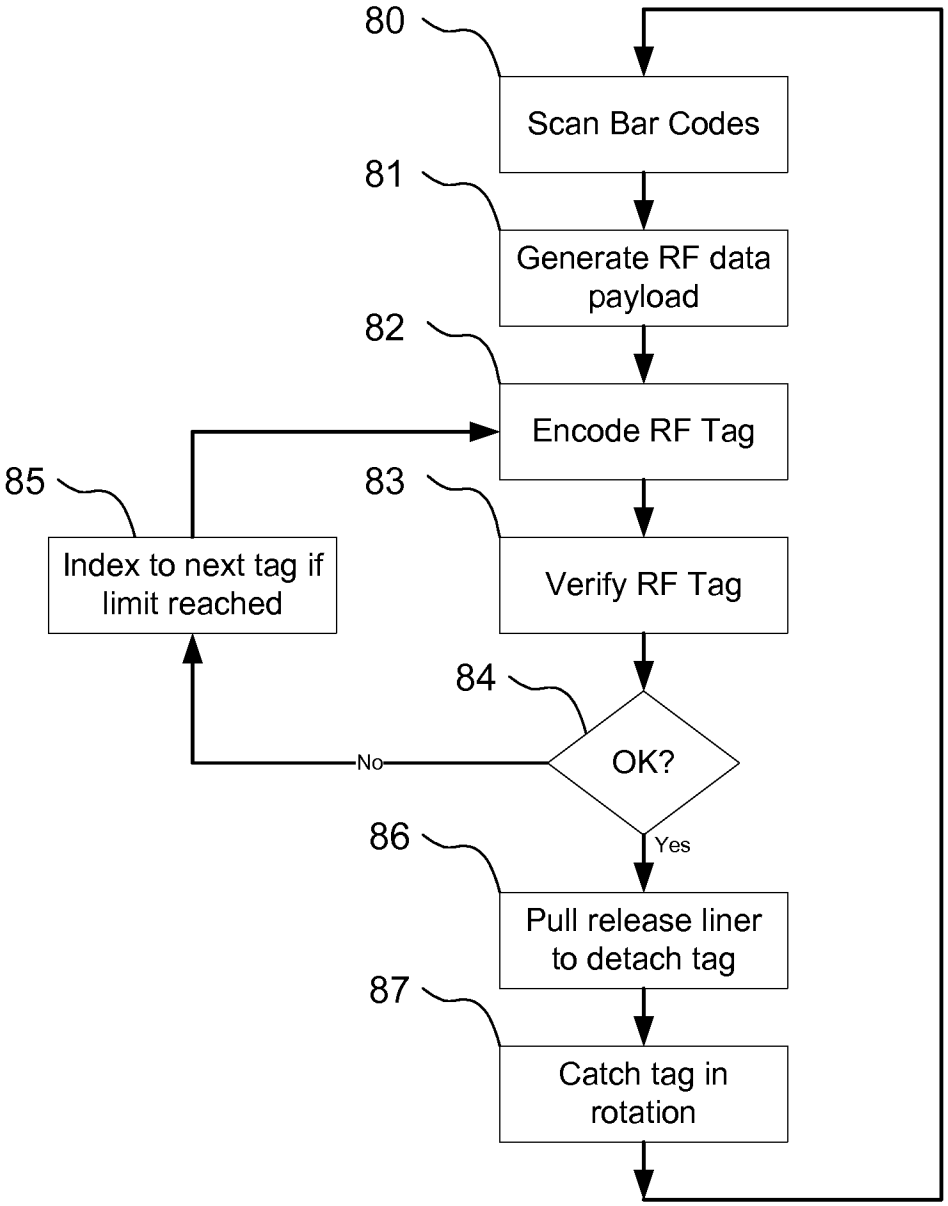

80
Scan Bar Codes
81
Generate RF data payload
82
Encode RF Tag
83
Verify RF Tag
84
OK?
No
Yes
85
Index to next tag if limit reached
86
Pull release liner to detach tag
87
Catch tag in rotation

FIG 8

SYSTEMS, METHODS, AND DEVICES FOR REPLICATATION OF DATA ONTO WIRELESS SENSORS

Inventor: Clarke McAllister

BACKGROUND

The present invention relates to a system, including methods and devices, utilizing wireless sensor devices and RFID (radio-frequency identification) transponders. Specifically, the present invention relates to a system incorporating novel devices and methods that enable point-of-use and on-demand commissioning of RFID transponder-equipped wireless sensors.

Radio-frequency identification (RFID) transponders enable improved identification and tracking of objects by encoding data electronically in a compact tag or label. And, advantageously, the compact tag or label can optionally carry the same data that is encoded into one or more printed indicia such as bar codes. In fact, using the Gen2 EPC specification, or the equivalent ISO Standard 18000-6C an RFID transponder can carry as a subset of its entire data payload, data that is also represented by bar codes.

Radio-frequency identification (RFID) transponders are typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, serial number, a date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, an item or a shipping container), associates a specific object with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder.

Current classes of RFID transponders rank into two primary categories: active RFID transponders and passive RFID transponders. Active RFID transponders include an integrated power source capable of self-generating signals, which may be used by other, remote reading devices to interpret the data associated with the transponder. Active transponders include batteries and, historically, are considered considerably more

expensive than passive RFID transponders. Passive RFID transponders backscatter incident RF energy to specially designed remote devices such as interrogators.

Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces.

Wireless sensors, made using silicon circuits, polymer circuits, an encoded quartz crystal diode, or Surface Acoustic Wave (SAW) materials to affect radio frequency or other signaling methods, communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods.

Additional examples of RFID transponders, wireless tags, and wireless sensors are more fully discussed this inventor's co-pending U.S. Patent Application Publication No. 2006/0080819, entitled "Systems and Methods for Deployment and Recycling of RFID Tags, Wireless Sensors, and the Containers Attached thereto," published on 20 April 2006, which is incorporated by reference for all purposes in this document.

One problem of prior-art systems is the total cost for encoding and applying wireless sensors. In the case of manual encoding and application of RFID tags or wireless sensors, the cost is dominated by labor costs. Therefore business process integration plays a significant role in reducing the total cost of ownership of tagging objects. For example, in many supply chain applications, case picking is performed during the fulfillment of a customer order, this is an operation where individual cases or groups of cases are manually handled. Similarly in receiving of goods at retail, manufacturing, or distribution receiving docks are other business process where individual cases are manually handled. In either of these types of business processes

where individual cartons are handled, there is an opportunity to encode and apply an RFID tag or wireless sensor to each carton on a selective basis.

Generating a unique serial number is imperative, and is required for EPCglobal RFID tagging implementations. Serialization requires a central issuing authority of numbers for manufacturers, products, and items to guarantee uniqueness and to avoid duplication of numbers. Blocks of numbers are distributed to remote locations globally. Unless a product (or SKU) is serialized at one location, the numbering space is usually partitioned according to some method, or each remote location receives each number one-by-one. Either way, there is eventually a reconciliation of serial number usage with a granularity of either one or several numbers at a time.

A preferred method of generating unique serial numbers is to assign unique numbers in a central location, such as in a label converter facility where unique bar coded labels are printed. Each unique label is then packed and shipped to remote locations, usually either in sheets or rolls. Upon arrival at a manufacturing facility, rolls are loaded onto high speed label applicators that apply one serialized label onto each carton. As those serialized cartons move through the supply chain, they may eventually arrive at a case pick location, a receiving dock, or similar location where a serialized carton is selected for having an RFID tag applied to it. Using a bar code scanner to read one or more bar codes sufficient information can be collected to uniquely encode that data into an RFID tag and apply it to that carton.

The uniqueness of an identifier is critical to the success of almost any tracking system. Assuring uniqueness is not necessarily simple. A generically descriptive bar code can be expanded by locally providing additional data fields including a unique serial number using algorithms that often assure uniqueness through numerical representations of time and space.

Other data fields that may be required for an RFID tag data standard can also be filled using pre-loaded values for such data fields as manufacturer code lengths, filter values (that designate packaging levels such as item, case, pallet, etc.), and other pre-determined parameters. Such parameters are preferably loaded into memory means 15G of mobile encoder 15 in advance of tag commissioning operations. These are all forms of data replication where data is read from one or more bar codes that are substantially

complete enough to outright copy or at least to locally generate some data fields for encoding into a second type of data carrier such as an RFID tag.

This type of data replication process is very fast and efficient. There is no absolute need to query a database in real time; hence there is no need for wireless network connectivity. This simplification eliminates the possibilities for non-deterministic network delays. Non-deterministic delays are delays that cannot be guaranteed, usually due to the probabilistic nature of packet collisions that are common in Ethernet and WiFi. By eliminating the need to access a network database, the variable non-deterministic delays caused by changing database sizes, changing record counts, and database user load fluctuations are completely circumvented. Reduction or outright elimination of non-deterministic delays helps manual labor operate at maximum efficiency, allowing them to achieve a regular and dependable cadence in their tag application processes.

Certain prior art systems use printer encoders to merge the printing and RFID tag encoding operations into a single atomic transaction. This method is more expensive in every respect. It requires mobile distributed printing with nearly perfect networking implementations in order to achieve a smooth, easy, and regular manual tag application process. This all comes at a higher price, size, and weight. Prior art implementations tend not to be mobile, as represented by U.S. Patent No. 7,066,667 issued to Chapman et al. on 27 June 2006 and include U.S. Patent No. 5,899,476 issued to Barrus et al. on 31 May 2005, or by U.S. Patent No. 6,246,326 issued to Wiklof et al. on 12 June 2001, describe a device that commissions an RFID transponder with a printed label. This approach, however, introduces unnecessary waste, cost, and propensities for error. There is a growing category of applications that do not require anything other than a custom-encoded RFID transponder. This prior art calls for the inclusion of label printer hardware and related consumable materials that are not necessary for many RFID applications. Unneeded printer mechanisms create unnecessary complexities, size, and weight. In some instances this additional bulk hinders practical mobile applications. The result is that tagging solutions that include printing result in a higher total cost of ownership than a pure RF tag encoding system.

United States Patent Application No. 2003/0227528 by Hohberger et al. published on 11 December 2003 describes another attempt at improving demand-print labels by providing a device that combines two standard, die-cut rolls of media, one of which may

be a roll of RFID transponders, and the second, print-label stock, in an attempt to provide on-demand smart labels. As with the aforementioned references, this approach adds unnecessary cost and complexity by combining RFID transponders with demand-printed labels.

SO, DESPITE RECENT ADVANCES IN RFID TECHNOLOGY, THE STATE-OF-THE-ART DOES NOT FULLY ADDRESS THE NEEDS OF SIMPLE, EFFICIENT, ECONOMICAL, SMOOTH, RELIABLE COMMISSIONING OF RFID TRANSPONDERS AND WIRELESS SENSORS. LARGE-SCALE ADOPTION AND DEPLOYMENT OF RFID TRANSPONDERS DEPENDS ON THOUSANDS OF DISTRIBUTED LOCATIONS THAT IMPLEMENT SIMPLE AND EFFICIENT MANUAL TAG COMMISSIONING PROCESSES. SUCH SYSTEMS SHOULD FURTHER INCLUDE MEANS AND PROCESSES FOR EFFICIENT REPLICATION OF BAR CODED DATA INTO GEN2 EPC OR ISO STANDARD TAGS, WITHOUT THE NEED FOR REALTIME WIRELESS CONNECTIVITY TO AN INFRASTRUCTURE DATABASE ON A TAG-BY-TAG BASIS.

SUMMARY OF THE INVENTION

The present invention overcomes the shortcomings of the prior-art attempts and, accordingly, provides systems, methods, and devices that commission RFID transponders on-demand and at a point-of-use in a compact wearable solution that is well-suited to mobile use in multiple applications. The present invention is used for replication of data from bar code data carriers onto wireless transponder data carriers with no external authorizations or queries required on a tag-by-tag basis. Further advantages of the present invention will be well-appreciated by those skilled in the art upon reading this disclosure including the appended figures of the drawing.

DRAWINGS

Fig. 1 is a block diagram of the system and environment according to one embodiment of the present invention.

Fig. 2 is a top view of a possible RFID transponder according to one embodiment of the present invention.

Fig. 3 is a material stack specification of an RFID transponder according to one embodiment of the present invention.

Fig. 4 is a side view of a web of release liner containing RFID transponders, provided on a source roll, stretched tight around a peel device, and advanced forward onto a take-up reel according to one embodiment of the present invention.

Fig. 5 is an orthogonal view of a mobile RFID encoder according to one embodiment of the present invention.

Fig. 6 is a side view of a handheld mobile encoder with an integrated bar code scanner according to one embodiment of the present invention.

Fig. 7 is a photograph of a wearable wireless bar code scanner according to one embodiment of the present invention.

Fig. 8 is a flow chart of a first method according to the present invention.

DESCRIPTION OF THE INVENTION

Making reference to various figures of the drawing, possible embodiments of the present invention are described and those skilled in the art will understand that alternative configurations and combinations of components may be substituted without subtracting from the invention. Also, in some figures certain components are omitted to more clearly illustrate the invention. In some figures similar features share common reference numbers.

To clarify certain aspects of the present invention, certain embodiments are described in a possible environment – as identification means for containers. In these instances, certain methods make reference to containers such as loaded pallets, paperboard boxes, corrugated cartons, pharmaceutical containers, and conveyable cases, but other containers may be used by these methods. Certain embodiments of the present invention are directed for use with commercial corrugated shipping cartons, tagged pallet-loads of shrink-wrapped cases, consumer-goods packaging, consumer goods, or other methods of identifying objects using RFID transponders or wireless sensors, or both.

Some terms are used interchangeably as a convenience and, accordingly, are not intended as a limitation. For example, transponders are used interchangeably with the term tags and the term inlay is used interchangeably with inlet. This document generally uses the term tag or RF Tag to refer to passive transponders, which do not include a battery, but include an antenna structure coupled to an RFID chip to form an inlay which is thin and flat and may be constructed on top of a layer of foam standoff material or a folded substrate structure. Passive transponders typically include a pressure-sensitive adhesive backing. However, certain aspects of the present invention work equally well with active transponders. A third type: a battery-assist tag is a hybrid RFID transponder that uses a battery to power the RFID chip and a backscatter return link to the interrogator. Programmable transponders enable data to be read, written or stored more than once.

Suitable environments or applications for certain aspects of the present invention include case picking operations that include selective tagging process steps, receiving untagged cartons into an RFID-enabled retail store or a manufacturing plant.

The systems, methods, and devices of the present invention utilize an RFID transponder or wireless sensors as a component. Certain RFID transponders and wireless sensors operate at High Frequencies (HF) and Ultra High Frequencies (UHF). HF is the band of the electromagnetic spectrum that is centered around 13.56MHz. UHF for RFID applications spans from about 860MHz to 960MHz. Transponders and tags responsive to these frequency bands generally have some form of antenna. For HF there is typically an inductive loop. For UHF there is often an inductive element and one or more dipoles in their antenna structure. Such RFID transponders and wireless sensors utilize any range of possible modulation schemes including amplitude modulation, amplitude shift keying (ASK), double-sideband ASK, phase-shift keying, phase-reversal ASK, frequency-shift keying (FSK), phase jitter modulation, time-division multiplexing (TDM), or Ultra Wide Band (UWB) method of transmitting radio pulses across a very wide spectrum of frequencies spanning several gigahertz of bandwidth. Modulation techniques may also include the use of Orthogonal Frequency Division Multiplexing (OFDM) to derive superior data encoding and data recovery from low power radio signals. OFDM and UWB provide a robust radio link in RF noisy or multi-path environments and improved performance through and around RF absorbing or reflecting materials compared to narrowband, spread spectrum, or frequency-hopping radio systems. Wireless sensors are reused according to certain methods disclosed herein. UWB wireless sensors may be combined with narrowband, spread spectrum, or frequency-hopping inlays or wireless sensors.

A. SYSTEM OVERVIEW

Figure 1 shows one system 10 according to the present invention in a typical environment, such as a packaging or distribution facility wherein a collection 16 of entities 17 with visual external labels 19 exist and a sub-set (or all entities) need to be associated with a wireless RFID transponder, tag, or label 18. The object 17 needing an RFID transponder 18 could be a packing container. As entities 17 are pulled from the collection 16, an optical reader 13 or 15F reads and decodes the machine readable symbols printed on visual external label 19.

The present invention includes a system for commissioning wireless sensors at a point of use and on-demand. For example, in one embodiment, the present invention incorporates a mobile encoder device 15, 30, or 60 which may be held in the hand of an

operator, worn on a belt or vest, or mounted on a pallet jack or forklift truck. Mobile encoder device 15, 30, or 60 is preferably powered by rechargeable batteries or a fuel cell.

System 10 includes at least three possible intermittently connected entities if they are present and connected: mobile encoder 15, remote computer 12, optical reader 13, and headset 14. A preferred short range wireless connection such as a PAN (Personal Area Network) may be established from time to time between mobile encoder 15 and remote computer 12, optical reader 13, and headset 14. There is a preference for low power wireless connection apparatus within mobile encoder 15 so as to realize the greatest possible battery life in light weight mobile encoder 15. Mobile encoder 15, 30, or 60 is in intermittent wireless communication with a computer 12 typically at close range through wireless communication means 15A. Database and associated host computer 11 may be housed at a remotely located facility that may optionally be accessed over a large distance through remote computer 12. Continuous wireless connection to a host database is not required for ongoing tag commissioning process steps disclosed herein.

Wireless communication means 15A is preferably a slave node of a Bluetooth personal area network according one embodiment of the present invention. Model 100-SER manufactured by EmbeddedBlue of Poway, California is an example of a preferred OEM Serial Bluetooth module. Other wireless interfaces may alternatively be used to achieve connectivity between encoder 15 and optical reader 13.

Other preferred embodiments of mobile encoder 15 and system 10 replace wireless communication means 15A with a cable, resulting in an embodiment of mobile encoder 15 with a tethered bar code scanner. A key advantage of an alternative embodiment of system 10 that utilizes a wired connection to optical reader 13 instead of wireless communication means 15A is a very simple solution having virtual immunity to any surrounding RF interference that might raise the noise floor hindering wireless communications.

The operator can cause mobile encoder 15, 30, or 60 to commission a transponder by scanning certain printed bar code symbols received through optical reader 13 which is connected to encoder 15 through wireless communication means 15A. Or alternatively internal optical reader 15F is used to scan printed bar code symbols. In either case data from optical reader 13 or 15F is delivered to processing means 15B.

Certain preferred embodiments of system 10 use optical scanners with self-contained symbol decoding capabilities to deliver decoded symbol information to processing means 15B. Certain other embodiments of system 10 relies on processing means 15B to conduct some or all decoding operations to derive information from scanned symbols.

The information derived from the optical reader 13 or 15F is used by mobile encoder 15 to either directly or indirectly encode data into RF transponder 18 while it is still physically within mobile encoder 15. Mobile encoder 30 uses external optical reader 13, and alternatively mobile encoder 60 uses internal optical reader 15F, as embodied in reader 66 of Fig. 6. Preferred embodiments of optical reader 66 are mechanically aligned relative to transponder encoding means 15H or more specifically with the antenna or near field coupler of RFID interrogator 64A. Spatial alignment assures that an operator will be able to comfortably scan bar codes and then encode and apply RFID transponders along a line of movement such that the operator can easily assure proper placement of encoded transponders.

Symbol decoding functions may be physically, electrically, or logically separated from symbol scanning operations. One preferred embodiment of optical reader 13 is a model CRS-9M or CRS-9P Bluetooth ring scanner 77 shown in Fig-7 manufactured by Socket Communications of Newark, California. Ring scanner 77 if not completely self-contained with battery and wireless connection is, in a preferred embodiment tethered to a battery pack and wireless interface 78 strapped to the arm 79 of an operator. Certain preferred embodiments designate ring scanner 77 as the master node of a Bluetooth network. As a master, ring scanner 77 will preferably pair with a specific mobile encoder designated by a unique identifier that is also encoded onto a bar code affixed to the external housing of mobile encoder 15. Ring scanner 77 is used to scan that bar code and decode it to acquire the unique identifier to perform a Bluetooth pairing operation that results in that instance of mobile encoder 15 becoming a slave on that network. Then whenever a bar code 19 is scanned, the Bluetooth-paired instance of mobile encoder 15 is notified of the new bar code data to support RFID tag encoding operations or command inputs.

Processing scanned commands involves a processing step to determine that a bar code should be interpreted as a command or configuration instructions rather than as

bar code 19 that identifies an object that is to be tagged. Commands are used to alter the flow and operation of mobile encoder 15.

Fig. 6 is a preferred embodiment of a mobile encoder wherein optical reader 66 is an OEM bar code scanner manufactured by such companies as Intermec or Motorola and is a preferred embodiment of optional internal optical reader 15F shown in Fig. 1.

In a preferred embodiment one or more bar codes are pre-printed and applied as symbol 19 on entity 17 in a manufacturing facility or other suitable location. Such bar codes are described in ISO/IEC draft document PDTR 24729-1 and are more generally referred to as one or more bar codes having Application Identifiers (AI) 01 and 21 encoded into them, and preferably include header information and other control bits that are required for certain protocols. AI 01 is used to represent the Stock Keeping Unit (SKU) as a GS1 Global Trade Identification Number (GTIN). AI 21 is used to serialize the SKU. Together the two AI's are used to specify a GS1 serialized GTIN (SGTIN). Bar codes can also be used to specify data payloads that use numbering systems other than the EPC numbering system. The Application Family Identifier (AFI) also plays an important role in designating alternative numbering authorities.

This preferred method that is described by the flow chart in Fig. 8 will allow batch mode operation where there are at best intermittent connections with remote computer 12. This preferred method allows existing label application and/or printing hardware located on existing manufacturing lines to provide in printed symbolic form all data that would be encoded into an RF transponder. By providing printed symbols, manufacturers do not have to incur either the cost of that transponder or the special equipment that is required to encode and apply RF transponders.

Optical reader 13 or 66 is described above and is used as the primary source of real time data input for the mobile encoding system that uses an embodiment such as mobile encoder 30 or 60. Optical reader 13 or 66 is also preferably used to scan special bar codes that instruct mobile encoder 15, 30, or 60 to perform certain prescribed functions which will be described below.

Certain preferred embodiments of system 10 include headset 14 which may be a headset worn by the operator or a Bluetooth-linked loud speaker that is mounted to a pallet jack or fork lift truck. Headset 14 is optionally used by system 10 to give

instructions, confirmation signals, or warnings to the operator. Synthesized speech or audible tones are used to interact with the operator through headset 14.

In these aforementioned embodiments, the mobile encoder 15 is a portable device that can be easily carried such as mobile encoder 60, or worn by a human operator such as mobile encoder 30, or hung from a suspended tool cable. As such, the mobile encoder 15 includes an internal power source 15E or 67D such as a rechargeable lithium-ion battery. Further details of possible configurations of the mobile encoder will be further detailed in subsequent sections of this disclosure.

In the system 10 of Figure 1, the mobile encoder 15 carries a supply of un-commissioned, blank, or securely encodable RFID transponders 15J, 25, 43, or 61E. Once the desired data is accumulated by mobile encoder 15 it advances the tag commissioning process by encoding an RFID transponder using transponder transport means 15C and transponder encoding means 15H and any one of several preferred encoding algorithms to program an RFID tag or label 18 for the object 17. Tag separation means 15D is used to separate a properly encoded transponder 18 from release liner conveyance web 22 by breaking the bond at adhesive layer 21D on the leading edge of transponder 18. Tag separation means 15D is preferably a peel device 23 as shown in Fig. 4 or peel device 62B in mobile encoder 60. Peel devices 23 or 62B are preferably made from anti-static plastic, metal, or other material that will conduct electrostatic charge away from transponder 18 and release liner 22. The commissioned tag or label 18 is associated and applied to the target object by known means including a human operator or a machine transfer as will be further described in this disclosure.

B. RFID TRANSPONDERS

Figure 2 shows a possible RFID transponder 18. RFID transponders, essentially, comprise an RFID integrated circuit (IC) device (or “chip”) 20 bonded to an inlay antenna apparatus 21C, formed on a substrate that is often plastic such as Mylar®, polyester, or PET. One way to form an antenna structure is to etch copper from a substrate. An alternate way includes printing multiple layers of conductive ink onto a substrate. One additional method includes stamping UHF antennae from thin sheets of aluminum or by selective aluminum deposition onto a substrate. In certain embodiments, RFID transponders and wireless sensors are recovered from waste streams for reconditioning, reprogramming, and reuse.

Other suitable RFID transponders include designs that combine a dielectric spacer behind inlay antenna 21C to create a transponder that performs well over a broad range of packaging conditions or objects by separating the metallic antenna inlay 21C from surrounding metals that may detune it, or liquids that may absorb RF energy from it. The dielectric material is a foam standoff material or an expanding mechanical structure that provides lift from the target object and also a more robust structural integrity to additionally protect the transponder from mechanical damage.

In one embodiment, additional transponder layers include a thin and flexible energy cell comprising two non-toxic, widely-available commodities: zinc and manganese dioxide. One suitable energy cell is developed by Power Paper Ltd. of 21 Yegia Kapayim Street, Kiryat Arye, Petah Tikva, P.O.B. 3353, ISRAEL 49130, and incorporates an innovative process that enables the printing of caseless, thin, flexible and environment-friendly energy cells on a polymer film substrate, by means of a simple mass-printing technology and proprietary inks. The cathode and anode layers are fabricated from proprietary ink-like materials that can be printed onto virtually any substrate, including specialty papers. The cathode and anode are produced as different mixes of ink, so that the combination of the two creates a 1.5-volt battery that is thin and flexible. Unlike conventional batteries, this type of power source does not require casing.

Fig. 3 illustrates how a top layer of an RFID transponder assembly comprises a paper face-stock 21A, which is a very low-cost material but also is the least environmentally resilient. UV-resistant plastic face-stock generally provide the best survivability in outdoor and rough-service environments, and also provide the best protection for the RFID transponder assembly.

A bottom layer of pressure-sensitive adhesive (PSA) 21D often is used for attachment of transponders to objects and often is referred to as a wet inlay or a wet tag or a wet transponder because of adhesion layer 21B. A web of release liner 22 is used to convey transponders 18 through the transponder encoding process.

Fig.4 also shows how transponders 18 are rolled onto reels in preparation for encoding. Source roll 25 contains a supply of transponders ready for encoding. Release liner 22 conveys transponders 18 around peel device 23. Unless transponders 18 are mechanically prevented from rotating around peel device 23, they are conveyed onto take-up roll 24. Take-up reel 24 advances forward while source roll 25 lags behind due to

drag created by a clutch, brake, motor or other back-torque generating device. Opposing torques of take-up reel 24 and source reel 25 result in tension in release liner web 22. Shape memory in face stock 21A preferably prevents transponder 18 from remaining adhered to release liner 22 as it passes over peel device 23, resulting in the leading edge lifting off and separating from webbing 22. If take-up reel 24 continues to advance, and transponder 18 does not collide with another object, its attachment to release liner 22 on its trailing edge will result in that transponder being passed completely around peel device 23 onto take-up reel 24. Full path rotation is preferably reserved for transponders that fail to properly encode desired information; and is therefore intended to be a reject process for failed transponders. Preferred embodiments result in tension created in web 22 in a process of tensile extraction of transponders from a source reel and selective transfer of good transponders onto an object or a person's finger. Mobile encoder 30 depends on a person's finger to prevent transponders 18 from rotating around peel device 23. Mobile encoder 60 depends on a target object such as carton face 68 to prevent transponder 63B from rotating around peel plate 62B on a path toward take-up reel 61J.

C. MOBILE ENCODER

Figure 1 shows a system 10 according to one embodiment of the present invention including a mobile encoder 15. Fig 5 shows a preferred embodiment for a mobile encoder. Mobile encoder 30 is comprised of housing 32, belt clip 34, antenna 36, on/off switch 33, system ready LED 37, data ready LED 38, and tag ready LED 39. It is further comprised of auxiliary switch 40, and charger plug 41. A cartridge or other pre-packaged self-contained supply of transponders 42 is preferably latched, snapped, clicked, popped, inserted, slid, or releasably mounted to the body of housing 32. The cartridge preferably includes a take-up reel 44 for non-dispensed RFID transponders, and a port through which blank or securely encodable transponders emerge from source reel 43. The source reel is preferably comprised of a core which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge 42 to form an axle around which release liner and tags are wound and subsequently unwound.

In certain preferred embodiments source reel or roll 43 is constructed using materials such as non-petroleum-based plastics, laminated paper layers, and materials primarily comprised of natural fibers. In another preferred embodiment the entire pre-packaged self-contained supply of unused tags is transported to mobile encoder 15, loaded into it, consumed, and disposed of preferably without generating landfill waste.

A key aspect of this invention is a complete pre-packaged, pre-assembled, pre-threaded, self-contained supply of encodable transponders, preferably unlocked with cryptographic access methods. The supply is preferably configured for efficient transportation and shipping, conveyance to a work site, and easy loading into mobile encoder 15, preferably in a single fluid motion.

Fig. 6 is a preferred embodiment of system 10 wherein printed symbols are optically scanned by internal optical reader 66. The embodiment shown in Fig. 6 uses a preferred method of sensing the linear motion of mobile encoder 60 across a target surface by using an optical mouse sensor 65. Such devices are commonly used to track the hand movements of the operator of a computer. Motion in either the X or Y direction is translated into numerical displacement representations which when timed are converted into linear velocities. Tracking and processing the primary axis of motion parallel to the major axis of the release liner, the web speed is preferably controlled by processing means 15B and transponder transport means 15C such that transponder 63A advances at a rate of speed that matches the velocity of the entire mobile encoder across the target surface. Optical mouse 65 tracks displacement across the target surface and also acts as a tamp head to strengthen the adhesive bond of each freshly applied tag. The process of attachment of the encoded transponder to the target surface is along a vector that is nearly parallel to the target surface at a speed that is based on real time feedback from the surrounding environment as sensed by the optical mouse or other sensor. Optical mouse sensor 65 preferably illuminates its target surface with either a LED (Light Emitting Diode) or a laser. Avago Technologies of San Jose, California manufactures a variety of mouse sensors, both LED-based and laser-based. Laser illumination provides smooth and accurate motion sensing across a variety of surfaces. The model ADNS-6150 small form factor lens working in conjunction with the ADNS-6530 integrated chip-onboard laser sensor and single-mode vertical-cavity surface emitting laser can be used to not only detect motion in the X and Y directions, but also to some

degree in the Z direction. Displacement along the Z (depth) vector is reported by the decrease in the number of resolvable features within the field of view as the target surface fades away from the optical focal point. That measurement is reported in the surface quality (SQUAL) register.

Optical mouse sensor 64B is used to measure the linear velocity of tags as they move along the path of the release liner toward peel device 62B, as well as sense the gaps and edges between tags 63A and those adjacent to them. The angular velocity of motor 67B and gear train 67A are controlled to achieve a linear tag velocity that matches the velocity of the mobile encoder itself as it moves across the target surface. Therefore an operator with a fast hand motion is just as successful as a person with a slower hand motion, both will result in a tag that lays flat, co-planar with the target surface, void of kinks or wrinkles that are characteristic of a poorly controlled tag application process. In either case, tag dispensing by transponder transport means 15C will not initiate until optical mouse sensor 65 preferably illuminates the target surface and detects a minimum number of valid features as reported by the SQUAL register internal to the ADNS-6530.

RFID Interrogator 64A encodes RF transponders using either LF (Low Frequency), HF (High Frequency), UHF (Ultra High Frequency), or microwave radio energy. Transponders may be powered by radio energy, light, or stored energy from a source such as a battery. RF coupling is preferably through a near field coupler, an inductive loop or other suitable transducer to focus RF energy on a small area within mobile encoder 15, 30, or 60.

Certain preferred mobile encoder embodiments will not encode RF transponders that fail authenticity tests. In a like manner, RF transponders will preferably not allow themselves to be programmed unless the interrogator can successfully unlock its secured memory banks. This is a preferred method of protecting tag cartridge and mobile encoder supply chains from counterfeits and knock-offs. Mobile encoder 15 and the transponders loaded into it will only be successful in exchanging certain data if certain data encryption and challenge response protocols are adhered to. In a preferred embodiment each authorized RFID tag converter company uses one or more encryption keys to generate passwords that lock the RF tags, whereby preventing them from being programmed unless they are unlocked using the same password. Passwords of this type are specified in the EPC Gen 2 specification and in ISO standards. The passwords are preferably

generated by processing means 15B using a public key from publicly readable data such as an asset number or a tag serial number. A shared private key is then used by an encryption algorithm such as AES in order to create a password or a collection of passwords that can be used to lock or unlock one or several RF tags. Other methods may be used that provide a high degree of certainty that the both the tags and the mobile encoders are from legitimate sources. Individual failures or patterns of authentication failures are preferably reported to a central database through wireless communications means 15A for subsequent fraud investigation.

Peel device 62B is part of the mobile encoder and preferably rotates or pivots about pivot point 62A into position 62C and a corresponding position (not shown) in Fig 6. When cartridge 61 is inserted into applicator body 67F the web is held in a non-interfering position by guide post 61F and its accompanying cartridge guide post such that peel device 62C can self-thread around the transport web without human effort. This is an improvement over prior art where a peel device is an integral part of the pre-packaged self-contained supply of transponders and requires threading during the cartridge manufacturing process.

Peel device 62B preferably contains a shield on the outer face of the blade, through which radio energy will not pass to encode or interact with a rejected tag 63B. The dielectric material of the peel device 62B provides sufficient separation from a tag within the encoding zone and the shield on the back side of the peel device. This is another advantage over a peel device that is part of the cartridge, where the cost sensitivity is much more acute. The shielding on the back side of peel device 62B may be any suitable metal attached or adhered in any reliable or economical manner against the non-conductive dielectric structure of the peel device.

Rejecting tag 63B requires that mobile encoder tag peel device 62B have sufficient clearance from target surface 68 as determined by optical mouse sensor 65 using either the SQUAL reading or the shutter readings. Such readings are used to determine if there is sufficient space to advance and rotate a bad tag 63B around the distal end of peel device 62B.

Several operator indicator lights 67E preferably include a system-ready LED, data-ready LED, tag-ready LED, and battery-ready LED on the housing with appropriately

positioned light pipes to enable the operator an easy view of the mobile encoder device status.

Also included on the exterior of the housing are an external, power-cord receptacle so that the on-board lithium-ion, nickel metal hydride, or other appropriate battery 67D may be charged as required. An on/off switch enables the operator to selectively power up the encoder. A reset port, such as a recessed reset button enables an operator to reset the device circuitry on control board 67C as may be required.

A cartridge 61 containing a plurality of RFID transponders releasably mounts to the body of housing 67F. The cartridge further includes a take-up reel 61J for non-dispensed RFID transponders, and a port through which blank or securely encodable transponders emerge from source reel 61E. The source reel is comprised of core 61A which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge 61 to form axle 61B around which core 61A rotates. Brake shoes 61C create drag, resulting in back torque on the source core, the magnitude of which is controlled by screw 61D which with a knob (not shown) is used to adjust the force applied by brake shoes 61C. The back torque for cartridge 61 is alternatively developed through a motor or an expandable friction coupling into a brake mechanism attached to encoder body 67F.

Take-up core 61H is driven by a tight coupling with drive hub 61G. This tight coupling is achieved through a combination or selection of tight fit, expandable coupling, and sharp teeth. The result is a hub that will easily slide in or out of core 61H with little effort, but still be capable of delivering a substantial amount of drive torque through that connection without slippage.

Drive torque is delivered from gear motor 67B to hub 61G through drive gear 67A the teeth of which engage with each other as cartridge 61 is set into position and locked into place.

In a preferred embodiment, mobile encoder 30 cryptographically unlocks, encodes, and verifies each tag one by one. Transponders may be designed for operation in any or all of the UHF, HF, LF, or microwave frequency bands.

A plurality of cartridges 42 are preferably disassembled for easy recycling. For example, end users may choose to reduce their shipping costs for the recycling of

cartridges and release liner by separating them into different recycle waste streams at the point of use. Conversely cartridges 42 are manufactured and assembled by snapping together the mating components with latches, guide pins, slots, and other such features to mechanically secure themselves into a rugged structure, capable of tolerating the abuse that is common for shipping and handling. After each use, cartridges 42 are preferably disassembled such that similar parts of like cartridges all nest within each other to form a dense stack. Each stack can then be accumulated and shipped either together or separately back to a tag recycling facility. The spent release liner and any rejected tags may also be accumulated separately and may optionally be sent to a different preferred waste processing facility, possibly in order to reduce shipping costs. One such facility preferably has the ability to reprocess release liner, both silicone and non-silicone-based materials. Certain silicone alternatives include emulsion release coatings that are water-based coatings that offer similar performance to hydrocarbon solvent-based release liner products. Emulsion coatings are compatible with paper repulping processes and are highly preferred. The benefits of the silicone alternative coatings are not normally available to the RFID tagging work flows because proper attention has not been given to solving this environmental problem. Therefore, by controlling both the composition of the outbound materials as well as the inbound recycling processes, this cartridge-based method of tag encoding offers real promise for reducing stress on the environment.

In the aforementioned embodiments of the mobile encoder 15, 30, or 60, key features commonly shared include means to enable Gen2 EPC or ISO standards compliance. An on-board power source 57D, such as a rechargeable lithium-ion, Nickel Metal Hydride, or other battery enables freedom of movement. Mobility is further afforded by means for wireless connectivity to a data network, such as the 802.11 wireless LAN (Wi-Fi), Bluetooth, or other standards-based communications protocol. However, a conventional power source that requires connectivity to a power-grid and a cable-based data network connectivity link would work under certain circumstances.

Further, in contemplated embodiments, the fixed or mobile encoder enables selective mounting of a magazine or cartridge filled with un-commissioned RFID transponders, which facilitates rapid and easy loading of the encoder with ready-to-use RFID transponders and further enables re-use, re-commissioning, and recycling of un-

dispensed transponders and the associated cartridge. The mobile encoder can be monitored and controlled by virtually any handheld or mobile device, a host computer in a central location, or over the Internet.

The mobile encoder 15 is activated (turned on) when an operator selectively depresses the combination on/off switch. Pushing the on/off switch, possibly in conjunction with a second switch for about three seconds or longer results in a sleep-mode cycle that can be interrupted by re-pressing the on/off-next switch. In sleep mode the operator indicators will turn off. If active, the mobile encoder system-ready LED illuminates and connects to the assigned network. Network connectivity may result in the illumination of both the system-ready LED and the data-ready LED.

Mobile encoders 15 and 30 optionally receive commands and data via the wireless link from the remote computer 12 or optical reader 13. Special bar code commands are scanned by optical reader 13, passed through wireless communication means 15A, and interpreted by processing means 15B mobile encoder 15 to perform certain pre-programmed functions. Commands originating from either computer 12, optical reader 13, or internal bar code scanner 66 (also designated in Fig.1 as internal optical reader 15F) perform functions in categories that include power management, data management, wireless configuration, security, configuration options, and utilization of internal resources.

Data originating from computer 12, optical reader 13, or internal optical reader 15F typically represents information that is to be encoded on an RFID transponder. The information is processed by the encoder's on-board processor 15B and stored in memory 15G and the tag-ready LED of output indicator means 15K rapidly blinks green (cycles on/off to pulsate). An RFID transponder is moved from within cartridge 42 to a position near the distal edge of a peel device for encoding in the encoder and the transponder is encoded with the appropriate information. The transponder is tested, and if it contains the correct data and the encoding was successful then all three indicator LEDs indicate a solid-green color. The encoded RFID transponder is then ready to be attached onto the container of interest when the operator removes it and applies it to the target surface.

In the event that the encoding process failed, the bad transponder is detected and retained by the encoder, where it remains on the take up reel 44 inside cartridge 42. The take up reel also collects the release liner as the encoder 15 dispenses good

transponders (properly encoded RFID transponders). The take up roll returns to a recycling center where components are reused or recycled as necessitated. Further, the recycling center can perform failure analysis on returned transponders.

Certain protective enclosures, such as cartridges or magazines 42, are part of a family of interchangeable magazines of similar size, shape, and functionality, which are capable of housing and dispensing certain types, styles, shapes, and sizes of new or used RFID transponders. Transponder sizes typically range from 4mm-thick foam-backed tags measuring 12mm wide down to thin tags that are 15mm wide on 19mm pitch.

In at least one embodiment, the magazine or cartridge includes a unique and embedded, RFID transponder which enables automatic interrogation and tracking of cartridge 42. In certain embodiments, to minimize interference, the cartridge-specific and unique RFID transponder or RFID transponder operates in a frequency band that is different than the supply RFID transponder contained within the protective enclosure. Alternatively, other embodiments selectively interrogate cartridge identification transponders that operate in the same band as transponders within the cartridge that are to be applied.

Certain encoders require replenishment of the battery or other internal, on-board power source, such as a fuel cell, or other energy storage technology. Accordingly, in some embodiments, an encoder 15 further includes a remote, selectively coupling base unit. The base unit enables a replenishment of magazines or cartridges, provides replaceable power sources, recharges the on-board power source, serves as a communications gateway, and provides a user interface for programming and maintenance of the encoder.

As with all ESD-sensitive equipment, care must be taken to avoid a build-up of damaging electrostatic charges. Accordingly, in certain embodiments charge is removed using a variety of conduction methods including wiping or use of special materials that contain short conductive elements optionally arranged within a flexible elastic cord.

In some embodiments, the encoder adapts to use a particular type of RFID transponder. One type of suitable RFID transponder is model number AD-220 or AD-222 from Avery Dennison of Brea, CA, or Raflatac model 300846 from Tampere, Finland, or a Spider tag or FT-33 FAT tag from RSI ID Technologies of Chula Vista, California. Such a

transponder is die cut and adhered to release liner. Additionally, wireless sensors are manufactured to specifications that are compatible with the specific encoder, including such specifications as core diameter, outer diameter, and web width. Alternatively, certain steps are required to prepare a standard roll of tags for use in an automated encoder, including unrolling from a large roll (up to about 6-inches in core diameter) onto several smaller rolls having a smaller core diameter (of about 1-inch to about 2-inches in core diameter).

For certain encoder embodiments passwords are encoded into transponders or wireless sensors when they are commissioned. Passwords are used to lock certain memory blocks. Passwords are safeguarded using cloaking, obfuscation, cryptographic techniques, secure and trusted channels, locked memory, and other methods that are commonly used to protect confidential information. Passwords are generated or retrieved from data encoded in an RFID transponder to generate an index into one or more databases that contain a one dimensional array of passwords, a two dimensional array of passwords, a multidimensional array of passwords, or an array of actual or pointers to algorithms used to generate passwords from transponder data, for example. Alternatively, cryptographic algorithms are used to generate passwords from transponder data.

Although this disclosure makes specific reference to a mobile encoder, it is understood that the encoder can easily adapt and be readily configured to a fixed operating environment. For example, it can be mounted to a forklift truck or a high-speed conveyer line and maintain advantages of autonomous encoding, rapid cartridge change-over and other qualities as discussed and developed more fully in this disclosure.

D. METHOD OF TAGGING CONTAINERS

Figure 8 is a flow chart representing a method according to the present invention including applying RFID transponders to objects of interest. One suitable object of interest comprises transport containers such as corrugated cartons or shrink-wrapped cases on a shipping pallet, which is inadequately addressed by the prior-art, particularly for solutions for manually operated automatic encoding and attachment to a container.

Block 80 represents a process step including the identification and selection of a container to be tagged with an RFID transponder or wireless sensor. In one embodiment

this step includes a manual selection and verification processes that consists of manual handling, visual sighting, and scanning bar codes with a manually operated optical reader device. This method contemplates that an operator is working from a pick list or customer purchase order or other such records to assure that goods are properly moved and accounted for. Preferred bar code scanners include those that allow an operator to freely handle cartons with two hands. Such scanners include laser bar code scanners or imagers that are worn on either that back of the operator's hand or near the top knuckle of a finger. Such scanners are described above, and preferably have a Bluetooth or similar wireless interface to connect to mobile encoder 15 or 30. Bar code scanner 66 of Fig. 6 is a preferred embodiment of an alternative device that combines manual bar code scanning and RFID transponder encoding into a single handheld device. The operator may choose to scan bar codes that contain data, application identifiers, commands, or other elements commonly found in automatic data capture applications.

Block 81 represents the process step of processing bar code information to derive the underlying data. Depending on the type of bar code, how it is encoded, and its purpose, different processing steps will be used. In preferred embodiments the bar code may contain SKU information, a GTIN, an SGTIN, EPC data structures, a military UID, an SSSC, an asset number, a file identifier, or other such identifying information. In certain preferred embodiments, the bar code (either one or two dimensional) contains a partial or complete description of the data that is to be encoded into the RF transponder. Such bar codes are described in ISO/IEC draft document PDTR 24729-1. Application identifiers 01 and 21 are combined with additional encoded printed information to fully specify a serialized GTIN (or SGTIN). Using such bar codes does not require the use of additional data in order to generate RF transponder payload data. Mobile encoder 15 may therefore independently receive and process the RF transponder payload information. One type of bar code is used to signal mobile encoder 15, 30, or 60 that it should enter a mode whereby it performs a serialization algorithm without using an AI 21 bar code.

Block 82 represents the process step whereby mobile encoder 15, 30, or 60 encodes an RFID transponder with the information of the previous step (Block 81).

Successful commissioning of the RFID transponder is preferably verified by the encoder as shown in Block 83. In one embodiment, the encoder tests the immediate transponder and determines if it is operating within certain predefined specifications

including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder.

If in Block 84 the encoder determines that the transponder is not likely to result in a successful transponder deployment as may be determined by failure on multiple encoding and verification attempts or due to other evidence of physical or electronic deficiencies or abnormalities, then the operator is optionally informed and the failed or bad transponder is discarded automatically as shown in Block 85.

Block 86 is the process of using motor 67B and/or transponder transport means 15C to pull release liner 22 tighter and tighter such that webbing 22 advances forward to the point that the leading edge of transponder 18 extends past the distal end of peel device 23 or 62B.

In Block 87 web 22 is pulled forward to the point that transponder 18 or 63A begins to rotate around peel device 23 or 62B. It is in this step that either a human finger or some target object needs to be presented in the rotational path of the tipping transponder 18 or 63A must be located. In the case of mobile encoder 30 where the operator is required to handle the encoded tag, it is important that their finger be present as transponder 18 begins to tip, allowing adhesive layer 21D of transponder 18 to make contact and be removed for placement on a target object such as a shipping container, trackable asset, automobile windshield, or other object of interest. In cases where the operator scans a bar code and applies encoded transponder 18 in a single motion, mobile encoder 60 is preferred, wherein as transponder 18 tips as it rotates around peel device 62B adhesive layer 21D sticks directly onto target surface 68. In either case, encoded transponder 18 is caught mid-rotation and adhesive layer 21D provides adhesive forces sufficient to completely detach transponder 18 from release liner 22, thus completing the function of Block 87 where work flow returns to Block 80 for another transponder encoding cycle to begin.

While the invention has been particularly shown and described with reference to certain embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

CLAIMS:

I claim:

1. A mobile encoding system for commissioning RFID transponders, the system comprising:

an RFID interrogator adapted to enable encoding data using an internal antenna, the antenna being adapted to encode the data into an RFID transponder;

a memory storage device for storing at least a portion of the data;

a bar code scanning means to gather commands and data;

a processing means for controlling and communicating with the memory storage device, the bar code scanning means, the RFID interrogator and the internal antenna;

a means for constructing transponder data payloads by processing data gathered from bar code scanning means;

a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable encoding of the data payload;

a transponder peel device means; and

a means for providing a cartridge or a pre-packaged self-contained supply of RFID transponders conveyed on a web from which properly encoded transponders are removed as they pivot around the peel device.

2. The encoder of claim 1 comprising bar code scanning means that uses an imager or a laser mechanically aligned with internal antenna to read printed symbols which contain some or all of the data payload.

3. The encoder of claim 1 comprising a bar code scanning means that is tethered with a cable attached to an enclosure that is adapted to contain processing means, the RFID interrogator, and internal antenna.

4. The encoder of claim 1 comprising a bar code scanning means that communicates through a wireless communication means to processing means.

5. The encoder of claim 1 further comprising an external housing adapted to receive a pre-packaged self-contained supply of RFID transponders.

6. The encoder of claim 1 wherein the means for presenting the RFID transponder comprises a motor assembly adapted to pull the RFID transponder from a supply reel.

7. The encoder of claim 6 wherein the supply reel and a take-up reel together comprise a pre-packaged self-contained supply of RFID transponders.

8. The pre-packaged self-contained supply of RFID transponders of Claim 7 further comprising a tag peel device whereby the leading edge of tags are separated from a conveyance web.

9. The pre-packaged self-contained supply of RFID transponders of Claim 8 wherein the peel device comprises radio frequency shielding and at least one sharp edge around which release liner wraps as it separates from an adhesive-backed RFID transponder.

10. The encoder of Claim 1 further comprising a housing assembly for enclosing the internal antenna and a handle-device mounted on a bottom surface of the housing.

11. The encoder of Claim 1 further comprising a housing assembly for enclosing the internal antenna and a mounting mechanism for selectively coupling the encoder to a provided structure.

12. The encoder of Claim 1 further comprising means for controlling linear tag peel rate to the measured velocity of the housing across the face of a target object.

13. The encoder of Claim 1 wherein the RFID interrogator further comprises security protocols and codes to enable programming of RFID transponders that have been secured against unauthorized access.

14. The encoder of Claim 1 further comprising dispensing means for verifying that the RFID transponder was encoded and for dispensing an encoded RFID transponder and for not dispensing an improperly encoded RFID transponder.

15. The encoder of Claim 14 wherein the dispensing means further comprises a transponder peel-device for removing the encoded RFID transponder from a transport liner and a transport liner collection mechanism for spooling the transport liner on a take-up reel.

16. A system for enabling on-demand, point-of-use commissioning of RFID transponders to uniquely identify an object, the system comprising:

an RFID transponder comprising a self-adhesive layer adapted to adhere the transponder to the object, a release liner releasably coupled to the self-adhesive layer on a first side, an oppositely spaced self-adhesive layer second side couples to a carrier substrate, the carrier substrate adapted to receive an RFID chip and an antenna device, the antenna device coupling to the RFID chip and the antenna device further adapted to wirelessly send and receive data packets corresponding to an information set;

an RFID transponder encoder device having processing means and memory means, the encoder device being adapted to receive at least one RFID transponder from a first dispensing means, the encoder device further including commissioning means for commissioning the at least one RFID transponder, means for verifying the status of a commissioned transponder, means for selectively removing the release liner and for dispensing the commissioned transponder, and means for selectively capturing an un-dispensed transponder;

an RFID transponder encoding algorithm;

a means for coupling a cartridge or other pre-packaged self-contained supply of the RFID transponders, the transponders being further adapted for tensile extraction from said supply; and

an associated bar code scanner adapted to collect commands and data to direct the functioning of the transponder encoding actions.

17. The system of claim 16 further comprising a processing means to systematically expand data beyond the explicit data carried by the bar code.

18. The system of claim 16 comprising a laser bar code scanner.

19. The system of claim 16 comprising a bar code scanner that uses an imager to read printed indicia.

20. A method for tagging a container comprising:

providing an encoder having at least one RFID transponder;

identifying information to be encoded on the RFID transponder;

commissioning the RFID transponder by encoding the information;

presenting the RFID transponder for attachment to the container by pulling a conveyance web or a release liner with transponder attached thereto around a peel-device to extract transponders from a cartridge or other pre-packaged self-contained supply of RFID transponders.

21. A method for commissioning RFID transponders comprising:

providing an RFID transponder encoder having a peel-device;

providing information to the encoder;

providing a cartridge or other pre-packaged self-contained supply of RFID transponders;

advancing the RFID transponder in the encoder; and

checking the RFID transponder for authenticity; and

encoding the information into the transponder.

22. The method of claim 21 further comprising:

halting transponder encoding if transponders lack proper authentication.

23. The method of claim 21 further comprising:

applying the RFID transponder to a target surface only if the information was properly encoded.

24. The method of claim 21 further comprising:

storing the RFID transponder if the information was not properly encoded.

25. The method of claim 21 further comprising:

providing the encoder with a motor adapted to provide tension in the conveyance web or release liner in a direction along its major axis.

26. A method for commissioning RFID transponders comprising:

providing a roll or sheet of RFID transponders;

providing a cartridge or other pre-packaged self-contained supply of RFID transponders;

providing an encoder;

inserting the roll or sheet in the cartridge or other pre-packaged self-contained supply of RFID transponders;

coupling the cartridge to the encoder;

acquiring information to encode from printed indicia;

encoding the information on at least one RFID transponder; and

adapting the process of attachment of the encoded transponder to the target surface along a vector that is nearly parallel to the target surface based upon real time feedback from the surrounding environment.

27. The method of claim 26 further comprising:

controlling the linear velocity that each transponder is dispensed based upon sensory input regarding movement relative to the target surface.

28. A method for recycling or reusing RFID transponder cartridges comprising:

providing a cartridge coupled to an encoder;

de-coupling the cartridge from the encoder;

removing any unused or un-commissioned RFID transponders and transport web from the cartridge.

ABSTRACT

In one embodiment the present invention is a bar code scanner and an encoder for commissioning RFID transponders and includes a housing encasing a motor assembly, an RFID interrogator, wireless communication means for transferring instructions and data from and to a remote host, on-board memory, a processor, and an antenna with corresponding mechanism to encode and verify a programmable RFID transponder on a conveyance web. The present invention further includes novel methods for commissioning RFID transponders, as well as methods for recycling and reusing the protective enclosure.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SYSTEMS, METHODS, AND DEVICES FOR REPLICATATION OF DATA ONTO WIRELESS SENSORS
First Named Inventor/Applicant Name:	Clarke William McAllister
Filer:	Clarke William McAllister
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Provisional Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Provisional Application filing fee	2005	1	100	100
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
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Document Number	Document Description	File Name	File Size(Bytes)	Multi Part /.zip	Pages (if appl.)

1	Application Data Sheet	CM-coverP7.pdf	121752	no	2
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
2	Drawings	CM-dwgP7.pdf	419557	no	6
Warnings:					
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3		CM-specP7-5.pdf	95362	yes	32

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Specification	1	25
	Claims	26	31
	Abstract	32	32

Warnings:					
Information:					
4	Fee Worksheet (PTO-06)	fee-info.pdf	8138	no	2
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Clarke William McAllister
4060 Sunridge Drive
Eugene, OR97405

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Receipt is acknowledged of this provisional Patent Application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please mail to the Commissioner for Patents P.O. Box 1450 Alexandria Va 22313-1450. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).**

Applicant(s)

Clarke William McAllister, Eugene, OR;

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** SMALL ENTITY **

Title

SYSTEMS, METHODS, AND DEVICES FOR REPLICATATION OF DATA ONTO WIRELESS SENSORS

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file

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Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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EXHIBIT

9

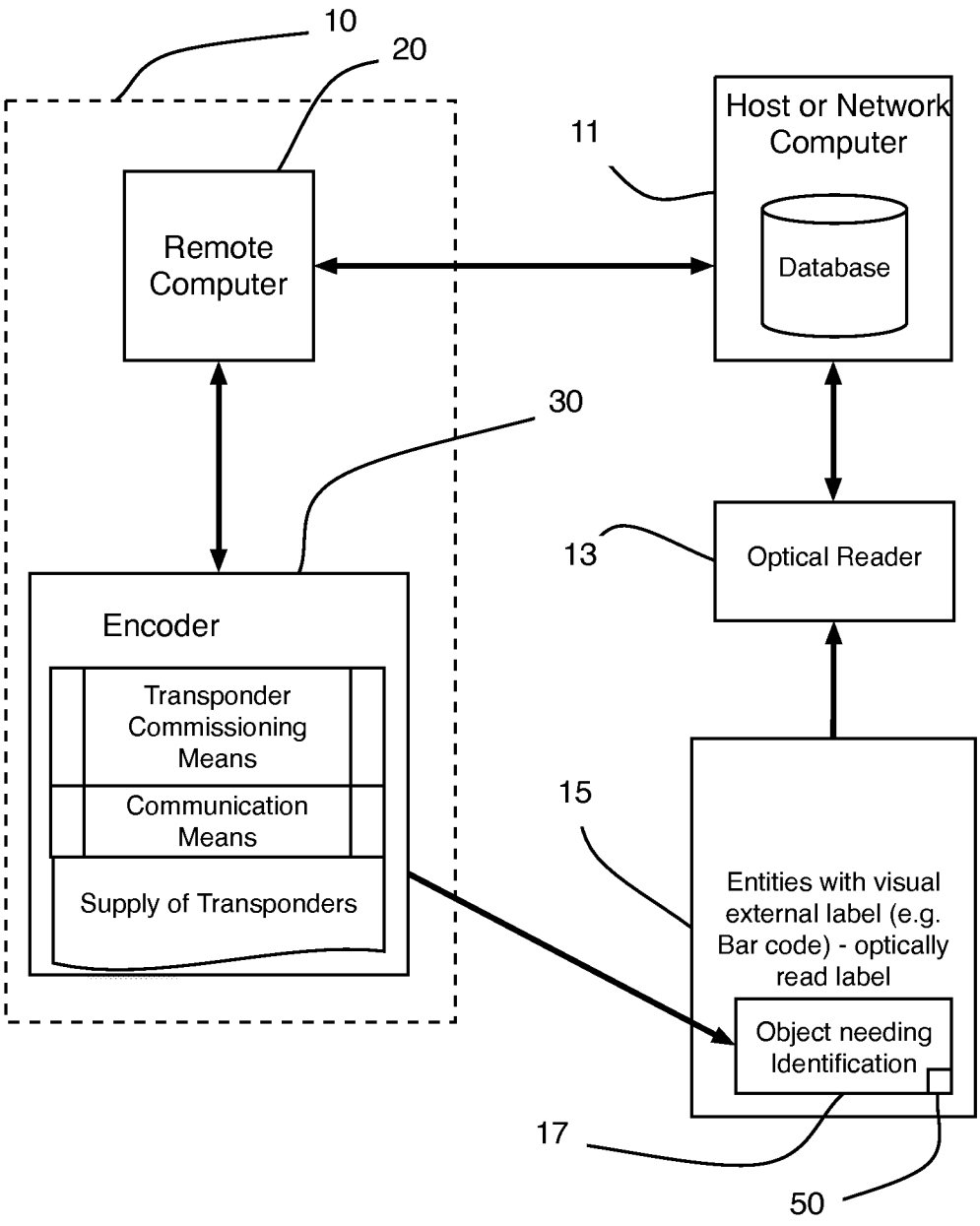
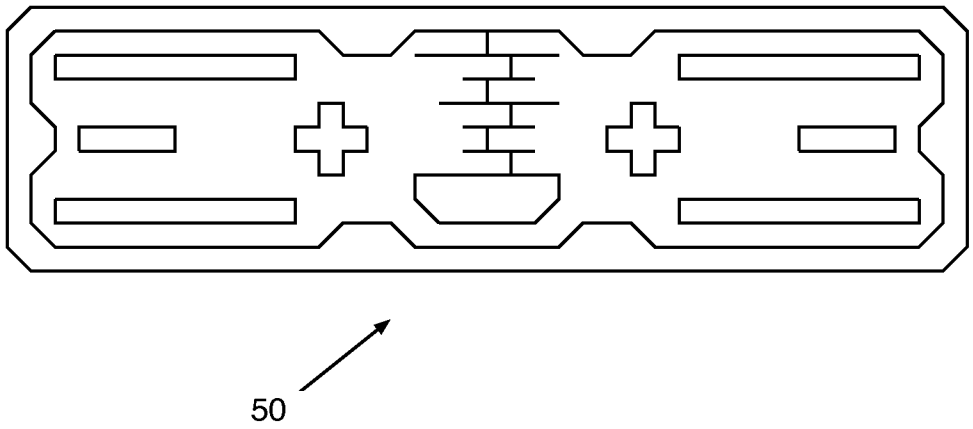

10
20
Host or Network Computer
11
Remote Computer
Database
30
13
Optical Reader
Encoder
Transponder Commissioning Means
Communication Means
Supply of Transponders
15
Entities with visual external label (e.g. Bar code) - optically read label
Object needing Identification
17
50

FIG. 1

FIG. 2



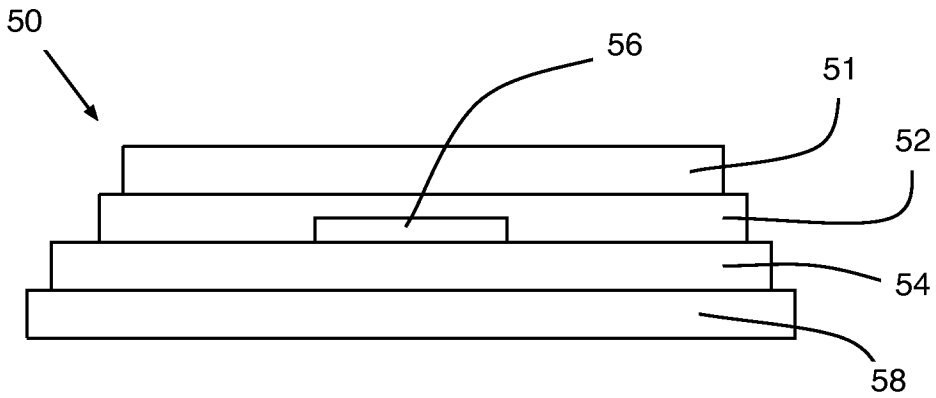


FIG. 3

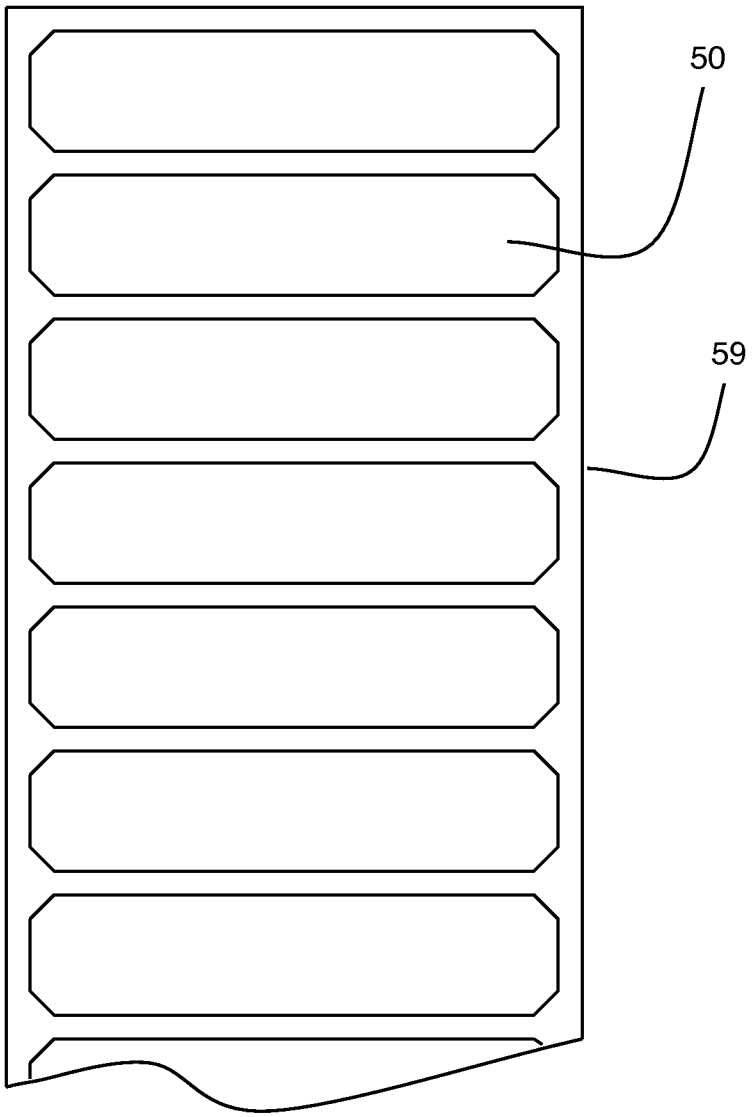
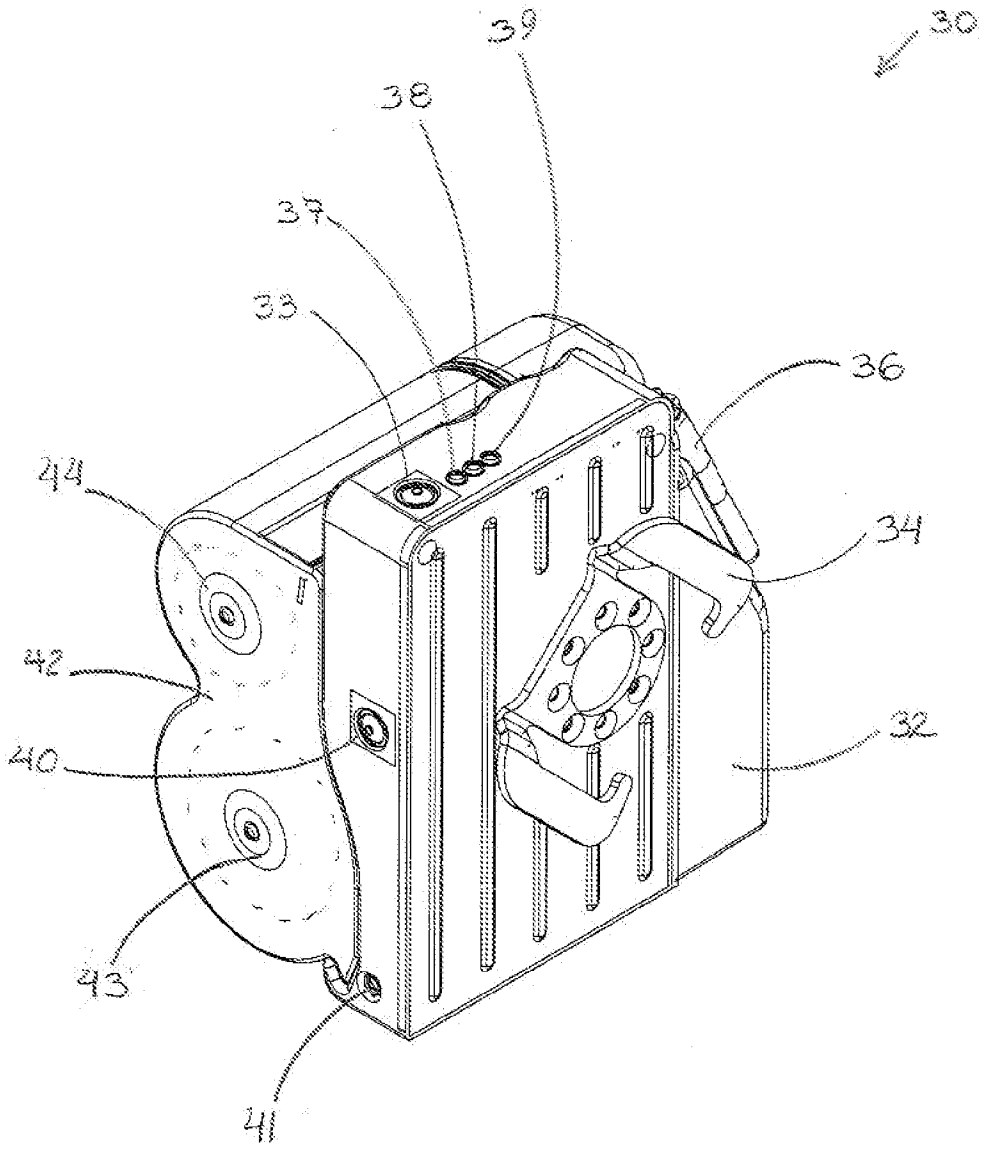


FIG. 4

FIG. 5



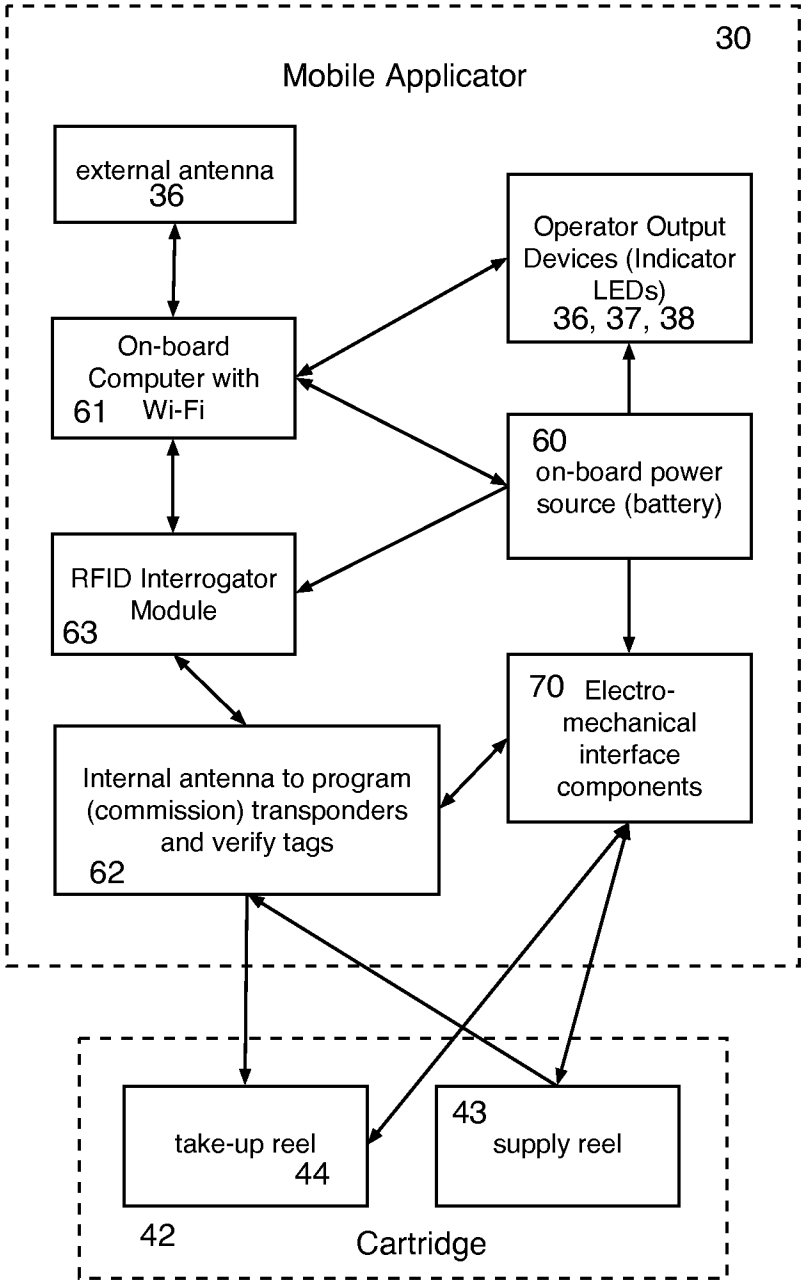

30
Mobile Applicator
external antenna
36
Operator Output Devices (Indicator LEDs)
36, 37, 38
On-board Computer with
61 Wi-Fi
60
on-board power source (battery)
RFID Interrogator Module
63
70 Electro-mechanical interface components
Internal antenna to program (commission) transponders and verify tags
62
take-up reel
44
43
supply reel
42
Cartridge

FIG. 6

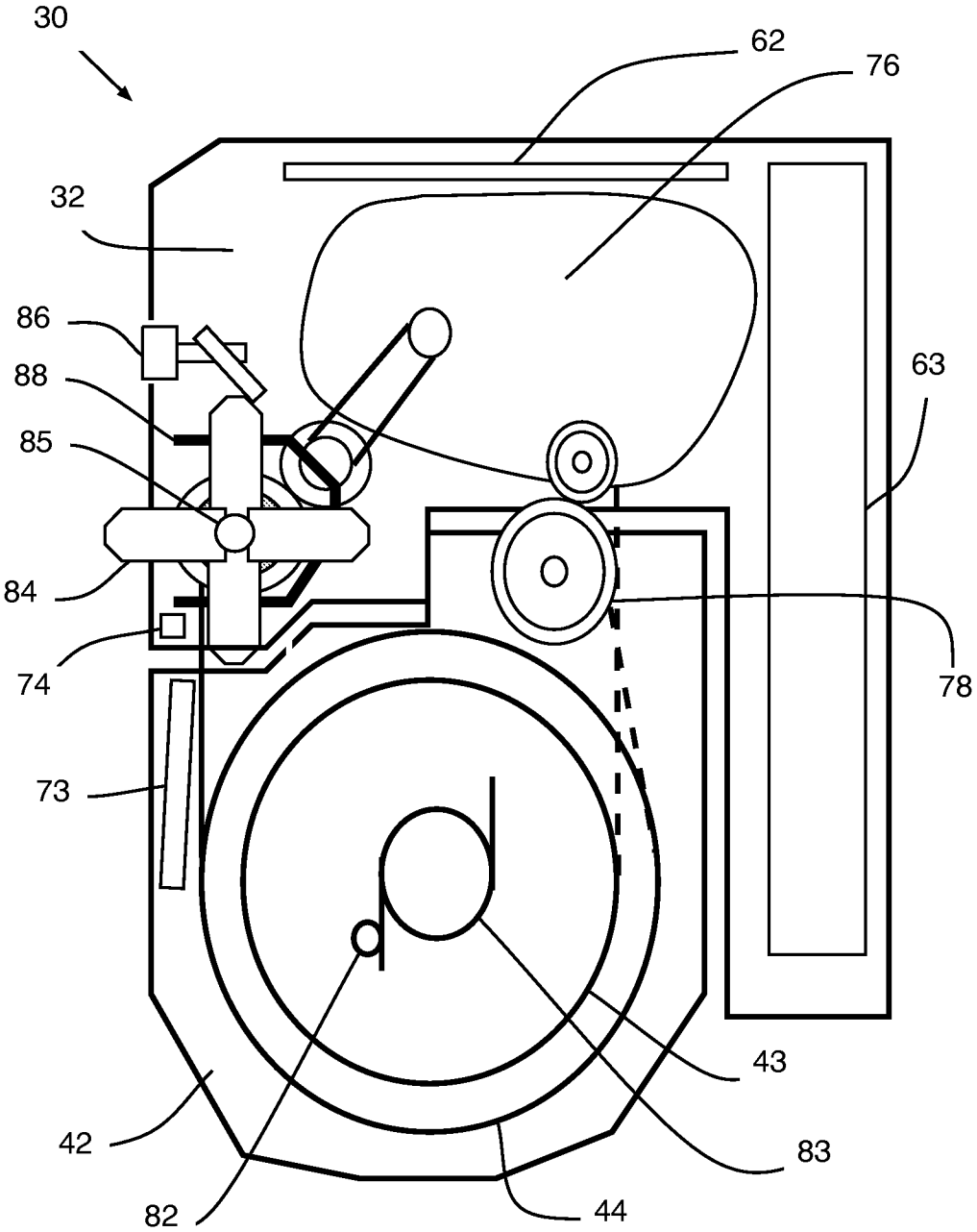


FIG. 7

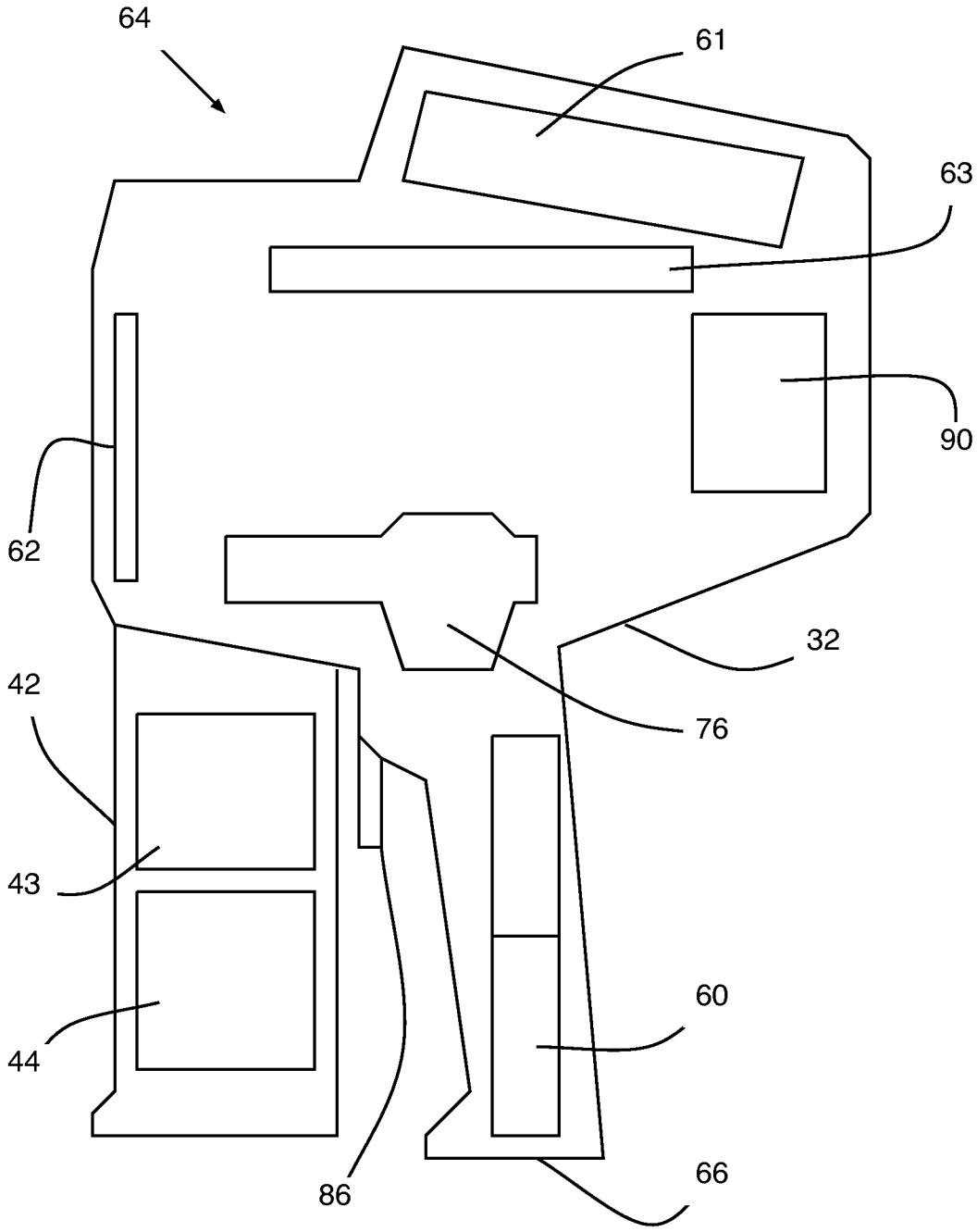


FIG. 8

FIG. 9

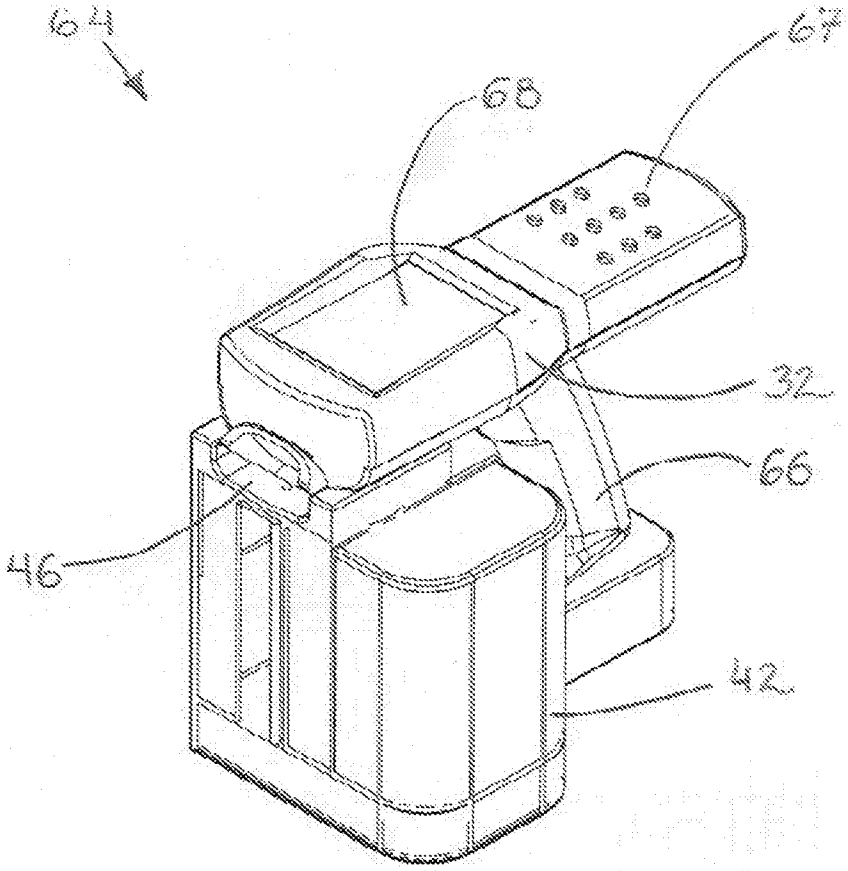
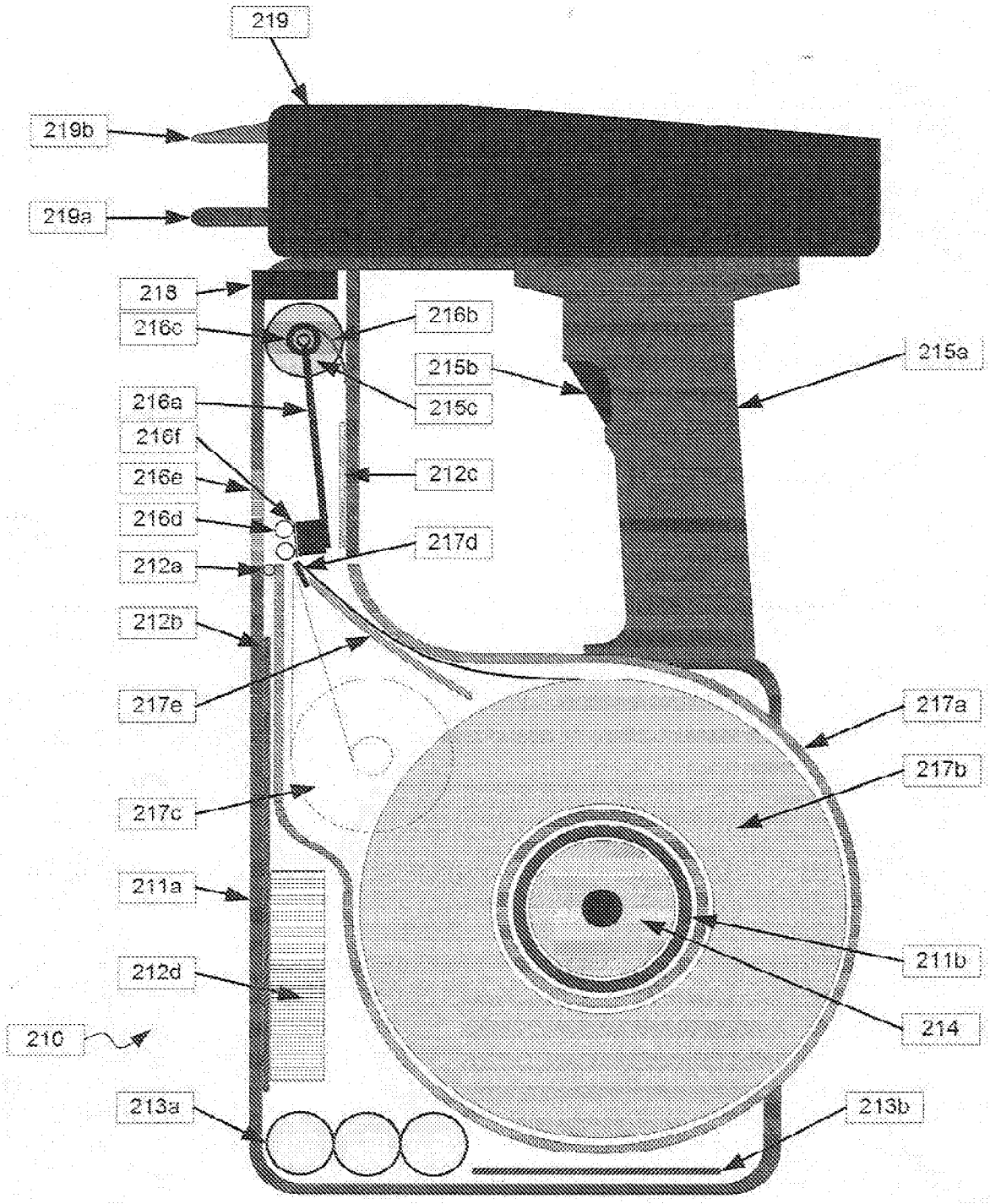


FIG. 10


219
219b
219a
218
216c
216b
215a
215b
215c
216a
216f
216e
212c
216d
217d
212a
212b
217e
217a
217b
217c
211a
211b
212d
214
210
213a
213b

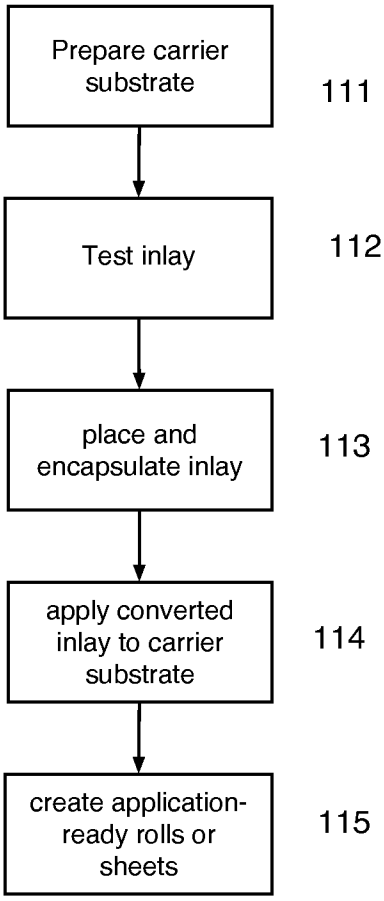
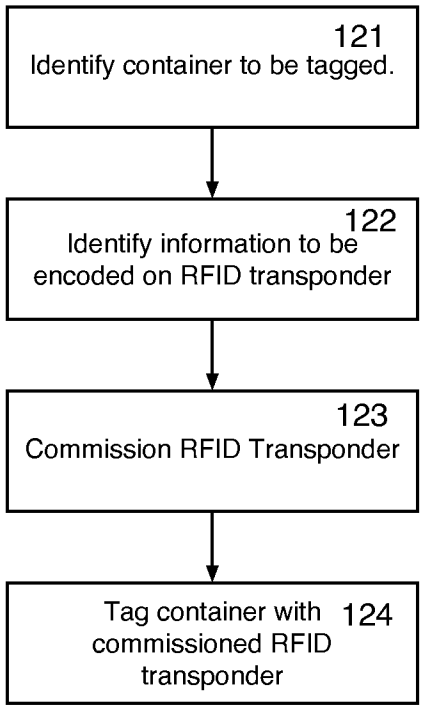

Prepare carrier substrate
111
Test inlay
112
place and encapsulate inlay
113
apply converted inlay to carrier substrate
114
create application-ready rolls or sheets
115

FIG. 11

FIG. 12


121
Identify container to be tagged.
122
Identify information to be encoded on RFID transponder
123
Commission RFID Transponder
Tag container with commissioned RFID transponder
124

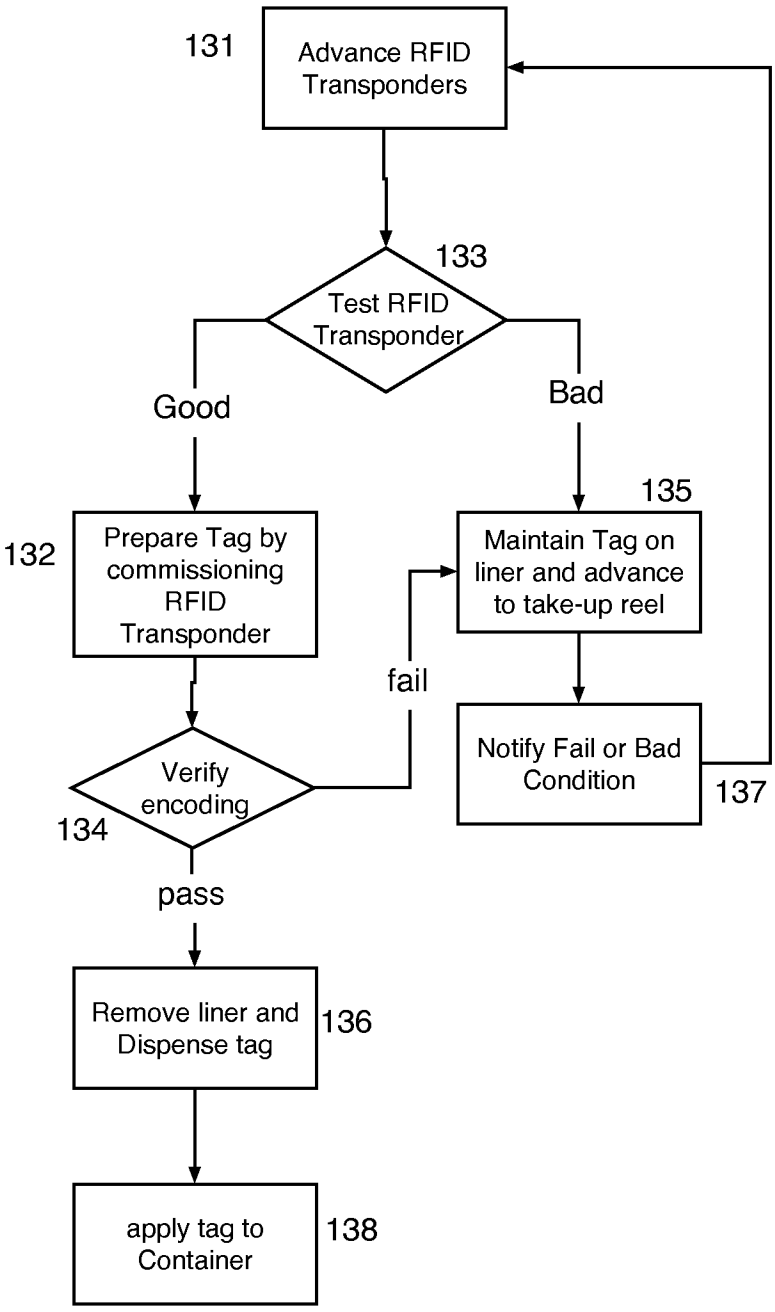

131
Advance RFID Transponders
133
Test RFID Transponder
Good
Bad
132
Prepare Tag by commissioning RFID Transponder
135
Maintain Tag on liner and advance to take-up reel
fail
Verify encoding
134
Notify Fail or Bad Condition
137
pass
Remove liner and Dispense tag
136
apply tag to Container
138

FIG. 13

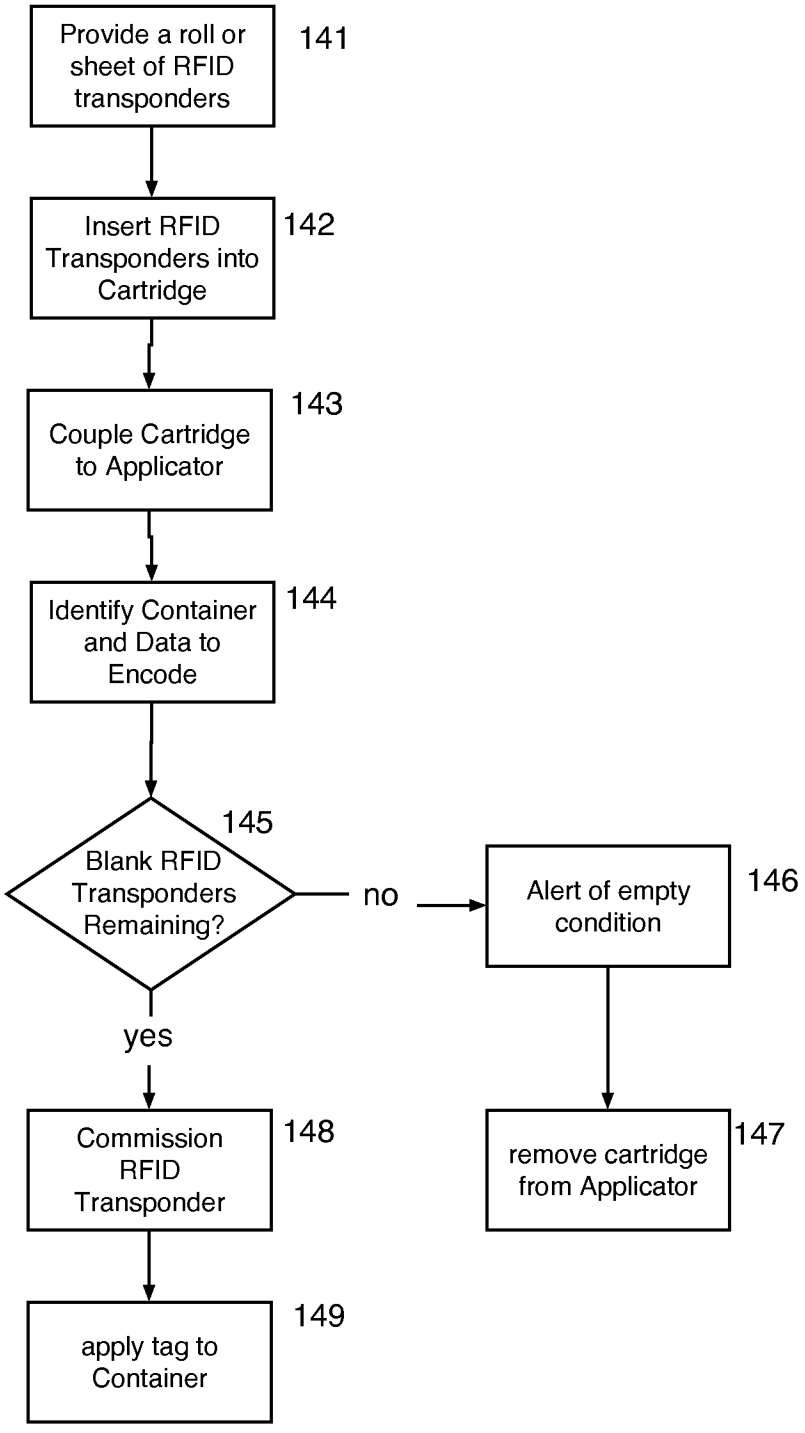

Provide a roll or sheet of RFID transponders
141
Insert RFID Transponders into Cartridge
142
Couple Cartridge to Applicator
143
Identify Container and Data to Encode
144
145
Blank RFID Transponders Remaining?
no
Alert of empty condition
146
yes
Commission RFID Transponder
148
remove cartridge from Applicator
147
apply tag to Container
149

FIG. 14

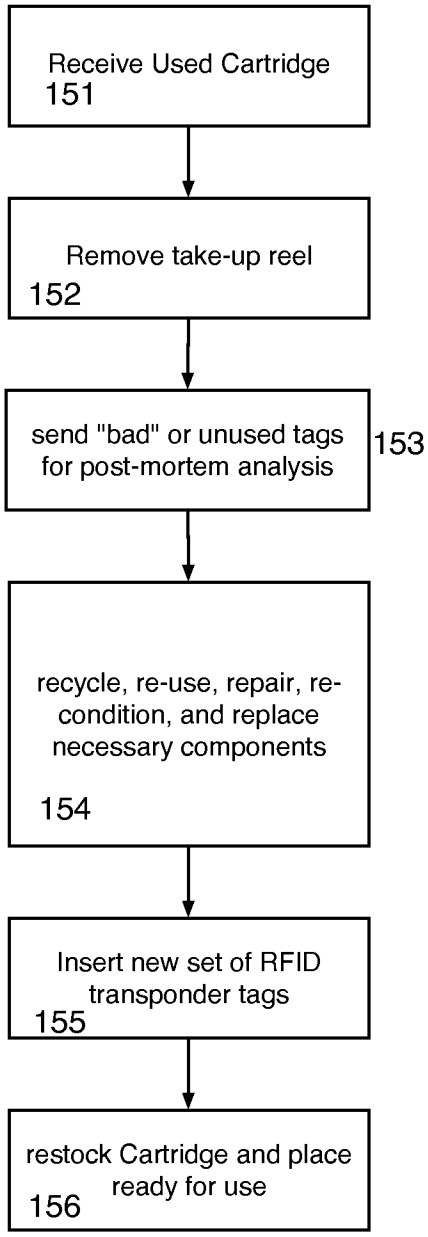

Receive Used Cartridge
151
Remove take-up reel
152
send "bad" or unused tags for post-mortem analysis
153
recycle, re-use, repair, re-condition, and replace necessary components
154
Insert new set of RFID transponder tags
155
restock Cartridge and place ready for use
156

FIG. 15

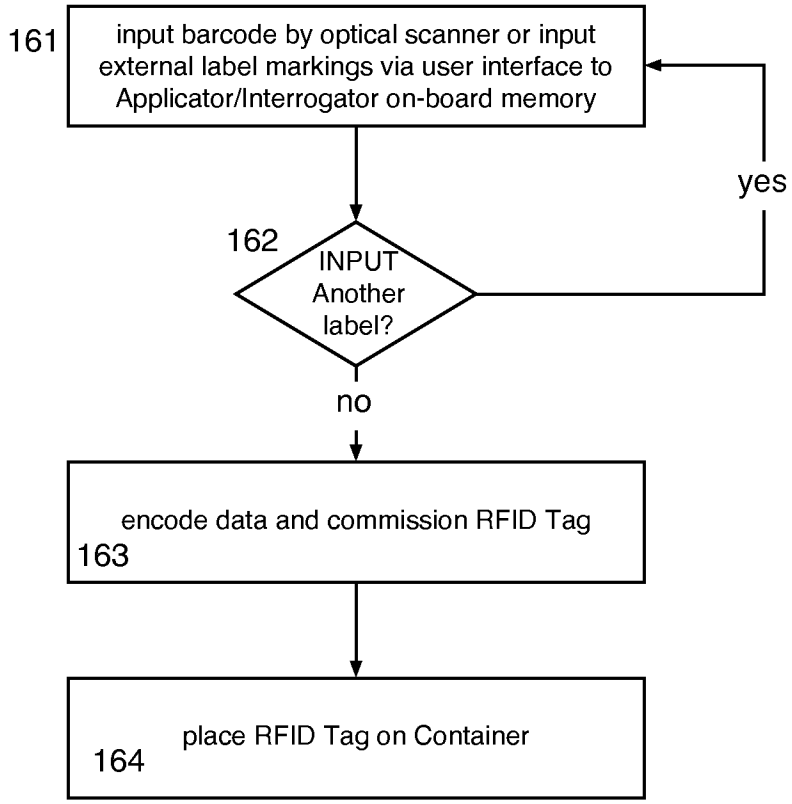

161
input barcode by optical scanner or input external label markings via user interface to Applicator/Interrogator on-board memory
yes
162
INPUT Another label?
no
encode data and commission RFID Tag
163
place RFID Tag on Container
164

FIG. 16

PTO/SB/01 (07-06)
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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☑ Declaration Submitted With Initial Filing **OR** ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	ADA-06-REG-01
First Named Inventor	McALLISTER, CLARK W.
COMPLETE IF KNOWN	
Application Number	
Filing Date	18 August 2006
Art Unit	
Examiner Name	

I hereby declare that:

Each inventor's residence, mailing address, and citizenship are as stated below next to their name.

I believe the inventor(s) named below to be the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYSTEMS, METHODS, AND DEVICES FOR CONVERTING AND COMMISSIONING WIRELESS TAGS

(Title of the Invention)

the specification of which

☑ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) ☐ as United States Application Number or PCT International Application Number ☐ and was amended on (MM/DD/YYYY) ☐ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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DECLARATION — Utility or Design Patent Application

Direct all correspondence to: ☐ The address associated with Customer Number: _____ OR ☑ Correspondence address below

Name: PETER A HAAS ESQUIRE LLC		
Address: 1929 SW 19TH AVE		
City: PORTLAND	State: OR	ZIP: 97201
Country: USA	Telephone: 503-319-3024	Email: peterahaas@flatfee-ip.com

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]): Clarke W.		Family Name or Surname: McALLISTER	
Inventor's Signature: Clarke W. McAllister			Date: 18 August 2006
Residence: City: Eugene	State: Oregon	Country: USA	Citizenship: USA
Mailing Address: 4060 Sunridge Drive			
City: Eugene	State: OREGON	Zip: 97405	Country: USA

☐ Additional inventors or a legal representative are being named on the _____ supplemental sheet(s) PTO/SB/02A or 02LR attached hereto.

PTO/SB/08B (07-06)
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(Use as many sheets as necessary)

Sheet 3 of 3

Complete if Known	
Application Number	
Filing Date	18 August 2006
First Named Inventor	McAllister, Clarke W.
Art Unit	
Examiner Name	
Attorney Docket Number	ADA-06-reg-01

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
		MORGAN, SAMUEL P., "Prediction of Indoor Wireless Coverage by Leaky Coaxial Cable Using Ray Tracing", Bell Laboratories, Lucent Technologies, http://www.bell-labs.com/org/wire	

Examiner Signature		Date Considered	

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Sheet 1 of

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	McALLISTER, CLARKE
Art Unit	
Examiner Name	
Attorney Docket Number	ADA-06-REG-01

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-6963351	11-08-2005	SQUIRES ET AL	
		US-6478229	11-12-2002	EPSTEIN	
		US-7066667	06-27-2006	CHAPMAN ET AL	
		US-6899476	05-31-2005	BARRUS ET AL	
		US-2003/0227528	12-11-2003	HOHBERGER ET AL	
		US-6857714	02-22-2005	HOHBERGER ET AL	
		US-6280544	08-28-2001	FOX ET AL	
		US-6246326	06-12-2001	WIKLOF ET AL	
		US-6532346	03-11-2003	GALLIVAN	
		US-6481907	11-19-2002	BANACH ET AL	
		US-6379058	04-30-2002	PETTERUTI ET AL	
		US-6409401	06-25-2002	PETTERUTI ET AL	
		US-5227617	07-13-1993	CHRISTOPHER ET AL	
		US-6279638	08-28-2001	GOODWIN ET AL	
		US-6805183	10-19-2004	GOODWIN ET AL	
		US-6884312	04-26-2005	MITCHELL ET AL	
		US-2005/0045724	03-03-2005	TSIRLINE ET AL	
		US-6848616	02-01-2005	TSIRLINE ET AL	
		US-7069251	06-27-2006	BARTZ ET AL	

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Examiner Signature		Date Considered	

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Art Unit	
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Attorney Docket Number	ADA-06-REG-01

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Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-7073712	07-11-2006	JUSAS ET AL	
		US-7075435	07-11-2006	JESSER	
		US-			
		US-			
		US-			
		US-			
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First Named Inventor	McALLISTER, CLARKE W.
Title	Systems, Methods, and Device for Co
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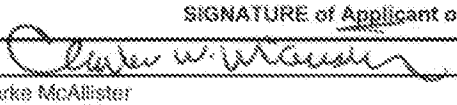
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SIGNATURE of Applicant or Assignee of Record

Signature		Date	18 August 2006
Name	Clarke McAllister	Telephone	541-359-1677
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SYSTEMS, METHODS, AND DEVICES FOR CONVERTING AND COMMISSIONING WIRELESS SENSORS

Inventor: Clarke W. McAllister

RELATED APPLICATIONS

This document claims priority and benefit for all purposes of U.S. provisional patent application number 60/709,713 filed on 19 August 2005, entitled "Systems, Methods, and Apparatus for Converting and Commissioning Wireless Sensors" by the same inventor.

BACKGROUND

The present invention relates to a system, including methods and devices, utilizing wireless sensor devices and RFID (radio-frequency identification) transponders. Specifically, the present invention relates to a system incorporating novel devices and methods that enable point-of-use and on-demand commissioning of RFID transponder-equipped wireless sensors.

Radio-frequency identification (RFID) transponders enable improved identification and tracking of objects by encoding data electronically in a compact tag or label. And, advantageously, the compact tag or label does not need external, optically recognizable or human-readable markings. In fact, using the Gen2 EPC specification, a three-meter read-distance for RFID transponders is common – even on high-speed material handling lines.

Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding

Peter A. Haas, Esquire LLC
1929 SW 13th Ave.
Portland, OR 97201
503-319-3024

specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder.

Current classes of RFID transponders rank into two primary categories: active RFID transponders and passive RFID transponders. Active RFID transponders include an integrated power source capable of self-generating signals, which may be used by other, remote reading devices to interpret the data associated with the transponder. Active transponders include batteries and, historically, are considered considerably more expensive than passive RFID transponders. Passive RFID transponders backscatter incident RF energy to specially designed remote devices such as interrogators.

Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces.

Wireless sensors, made using silicon circuits, polymer circuits, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave (SAW) materials to affect radio frequency or other signaling methods,

communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods.

Additional examples of RFID transponders, wireless tags, and wireless sensors are more fully discussed this inventor's co-pending U.S. Patent Application Publication No. 2006/0080819, entitled "Systems and Methods for Deployment and Recycling of RFID Tags, Wireless Sensors, and the Containers Attached thereto," published on 20 April 2006, which is incorporated by reference for all purposes in this document.

One problem of prior-art systems, such as conventional print labels or barcode systems, includes a requirement for line of sight and an overdependence on the optical quality of the label. Many factors can render such a label unreadable including printing errors, excess ink, insufficient ink, physical destruction of the markings, obstruction of the markings due to foreign matter, and, in extreme cases, outright deception by placing an altered label over the top of such a print label.

RFID transponder labeling eliminates the need for an optically readable print label and overcomes all of the shortcomings related to print quality and the need for line of sight to scan the label. Moreover, RFID transponder labels enable secure data encryption, making outright deception considerably less likely to occur. However, current RFID label systems have their own limitations as well.

For example, certain prior art systems, as represented by U.S. Patent No. 7,066,667 issued to Chapman et al. on 27 June 2006 and include U.S. Patent No. 5,899,476 issued to Barrus et al. on 31 May 2005, or by U.S. Patent No. 6,246,326 issued to Wiklof et al. on 12 June 2001, describe a device that

commissions an RFID transponder with a printed label. This approach, however, introduces unnecessary waste, cost, and propensities for error. There is a growing category of applications that do not require anything other than a custom-encoded RFID transponder. This prior art calls for the inclusion of label printer hardware and related consumable materials that are not necessary for many RFID applications. Unneeded printer mechanisms create unnecessary complexities, size, and weight. In some instances this additional bulk hinders practical mobile applications.

United States Patent Application No. 2003/0227528 by Hohberger et al. published on 11 December 2003 describes another attempt at improving demand-print labels by providing a device that combines two standard, die-cut rolls of media, one of which may be a roll of RFID transponders, and the second, print-label stock, in an attempt to provide on-demand smart labels. As with the aforementioned references, this approach adds unnecessary cost and complexity by combining RFID transponders with demand-printed labels.

So, despite recent advances in RFID technology, the state-of-the-art does not fully address the needs of efficient, economical, high-volume, cost-effective, reliable deployment and commissioning of RFID transponders and wireless sensors. And, large-scale adoption and deployment of RFID transponders depends on systems utilizing reliable, low-cost transponders and efficient commissioning means. Such systems should further include compliance with Gen2 EPC specifications or ISO standards, enable a plurality of printer-emulation modes, enable wireless connectivity – for example, in accordance with the IEEE 802.11b wireless LAN standards-based communications – provide various levels of WLAN security, efficient replenishment of programmable transponder supplies, and enable secure software re-programming to adapt to future demands and improvements.

SUMMARY OF THE INVENTION

The present invention overcomes the shortcomings of the prior-art attempts and, accordingly, provides systems, methods, and devices that commission RFID transponders on-demand and at a point-of-use utilizing wireless data transfer in a compact package that is well-suited to portable, mobile, or fixed use in multiple applications. Further advantages of the present invention will be well-appreciated by those skilled in the art upon reading this disclosure including the appended figures of the drawing.

For example, in one embodiment the present invention consists of an encoder for commissioning RFID transponders. The encoder consists of an RFID interrogator module adapted to enable encoding predetermined data according to a commissioning algorithm and communicating with an internal antenna, the antenna being adapted to encode the predetermined data on the RFID transponder; a memory storage device for storing at least a portion of the predetermined data; a processing means for controlling and communicating with the memory storage device, the RFID interrogator and the internal antenna; a means for providing a supply of RFID transponders, the transponders configured for tensile extraction from the encoder or, preferably from means for providing a supply of RFID transponder comprising a cartridge; and a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable encoding of the predetermined data.

DRAWING

Fig. 1 is a block diagram of the system and environment according to one embodiment of the present invention.

Fig. 2 is a top view of a possible RFID transponder according to one embodiment of the present invention.

Fig. 3 is a schematic end-view of the RFID transponder of Fig. 2.

Fig. 4 is a top view schematic drawing of a sheet or roll of a plurality of RFID transponders of Fig. 3.

Fig. 5 is an offset orthogonal view of a mobile encoder according to one embodiment of the present invention.

Fig. 6 is a schematic block diagram showing some components of the mobile encoder of Fig. 5.

Fig. 7 is a schematic cross section view showing electro-mechanical components of one embodiment of a mobile encoder.

Fig. 8 is a schematic cross section of an encoder according to the present invention.

Fig. 9 is a frontal-offset view of a hand-held, mobile encoder according to the present invention.

Fig. 10 is a schematic cross section of another encoder according to the present invention.

Fig. 11 is a flow chart of a first method according to the present invention.

Fig. 12 is a flow chart of a second method according to the present invention.

Fig. 13 is a flow chart of a third method according to the present invention.

Fig. 14 is a flow chart of a fourth method according to the present invention.

Fig. 15 is a flow chart of a fifth method according to the present invention.

Fig. 16 is a flow chart of a sixth method according to the present invention.

DESCRIPTION OF THE INVENTION

Making reference to various figures of the drawing, possible embodiments of the present invention are described and those skilled in the art will understand that alternative configurations and combinations of components may be substituted without subtracting from the invention. Also, in some figures certain components are omitted to more clearly illustrate the invention. In some figures similar features share common reference numbers.

To clarify certain aspects of the present invention, certain embodiments are described in a possible environment – as identification means for containers. In these instances, certain methods make reference to containers such as loaded pallets, paperboard boxes, corrugated cartons, pharmaceutical containers, and conveyable cases, but other containers may be used by these methods. Certain embodiments of the present invention are directed for use with commercial corrugated shipping cartons, tagged pallet-loads of shrink-wrapped cases, consumer-goods packaging, consumer goods, or other methods of identifying objects using RFID transponders or wireless sensors, or both.

Some terms are used interchangeably as a convenience and, accordingly, are not intended as a limitation. For example, transponders are used interchangeably with the term tags and the term inlay is used interchangeably with inlet. This document generally uses the term tag to refer to passive inlay transponders, which do not include a battery, but include an antenna structure coupled to an RFID chip which are generally a thin and flat and substantially co-planar and located on a substrate. One common type of passive inlay transponder further includes a pressure-sensitive adhesive backing positioned opposite an inlay carrier layer. However, certain aspects of the present invention work equally well with active inlay transponders. A third type: a battery-assist tag is a hybrid RFID transponder that uses a battery to power the RFID chip and a

backscatter return link to the interrogator. Further, this document uses programmable RFID transponders interchangeably with RFID transponders. Programmable transponders enable data to be written or stored more than once.

Suitable environments or applications for certain aspects of the present invention include: Traditional conveyor line or other high-speed machinery with automated transponder printing, encoding, and attachment; Hand attachment of transponders (a method that often is referred to as "slap and ship"; and a novel category of mobile transponder encoders as will be more fully described herein.

The systems, methods, and devices of the present invention utilize an RFID transponder or wireless sensors as a component. Certain RFID transponders and wireless sensors operate at Ultra High Frequencies (UHF), the band of the electromagnetic spectrum that, for RFID applications, spans from about 860MHz to 960MHz. Transponders and tags responsive to this frequency band generally have some form of one or more dipoles in their antenna structure. Such RFID transponders and wireless sensors utilize any range of possible modulation schemes including amplitude modulation, amplitude shift keying (ASK), double-sideband ASK, phase-shift keying, phase-reversal ASK, frequency-shift keying (FSK), time-division multiplexing (TDM), or Ultra Wide Band (UWB) method of transmitting radio pulses across a very wide spectrum of frequencies spanning several gigahertz of bandwidth. Modulation techniques may also include the use of Orthogonal Frequency Division Multiplexing (OFDM) to derive superior data encoding and data recovery from low power radio signals. OFDM and UWB provide a robust radio link in RF noisy or multi-path environments and improved performance through and around RF absorbing or reflecting materials compared to narrowband, spread spectrum, or frequency-hopping radio systems. Wireless sensors are reused according to certain methods disclosed herein. UWB wireless

sensors may be combined with narrowband, spread spectrum, or frequency-hopping inlays or wireless sensors.

A. SYSTEM OVERVIEW

The present invention includes a system for commissioning wireless sensors at a point of use and on-demand. For example, in one embodiment, the present invention incorporates a mobile encoder device, which may be attached to a belt of an operator and powered by rechargeable batteries. The mobile encoder is in wireless communication with a remotely located host computer. The operator can selectively (on-demand) enable the mobile encoder to commission a transponder based on various criteria, including input received from a mobile bar-code scanner, for example.

Figure 1 shows one system 10 according to the present invention in a typical environment, such as a packaging facility wherein a collection of entities with visual external labels 15 exist and a sub-set (or all entities) need to be associated with a wireless RFID transponder, tag, or label. The object 17 needing an RFID transponder could be a packing container having an assorted collection of entities 15. As entities 15 are pulled from the collection, a traditional optical reader 13 (human or machine) interprets the visual external label. Information from the external, visual label is correlated to information stored in a centralized location, represented by a network computer 11 having a database. The information taken by the optical reader 13 is transmitted to the network computer 11. System 10 includes a wireless connection between the remote computer 20 and the mobile encoder 30 either directly or through a common wireless access point. Additionally, a wireless connection could occur between the remote computer 20 and the host computer 11, and in this embodiment, the remote computer 20 is in physical connection with the mobile encoder. In yet

another embodiment, the remote computer 20 wirelessly connects to both the mobile encoder 30 and the host computer 11. Optionally, the optical reader 13 can be incorporated in the encoder 30. In these aforementioned embodiments, the mobile encoder 30 is a portable device that can be easily carried by a human operator. As such, the mobile encoder 30 includes an internal power source such as a rechargeable lithium-ion battery and would further include a handle or a belt-clip for ease of use. In another embodiment, the mobile encoder can be attached to a high-speed conveyor line. In such an application, the on-board battery could be replaced or augmented by a physical connection to a remote power source. Further, the computer 20 could have wired connects to the host network 11. Further details of possible configurations of the mobile encoder will be further detailed in subsequent sections of this disclosure.

In the system 10 of Figure 1, the mobile encoder 30 carries a supply of un-commissioned (or blank) RFID transponders. Once the desired data is accumulated and presented to the encoder 30 from the computer 20, the encoder commissions an RFID transponder, creating an RFID tag or label 50 for the object 17. The commissioned tag or label 50 can then be applied, linked, or otherwise associated with the object by known means including a human operator or a machine transfer.

B. RFID TRANSPONDERS

Figure 2 shows a possible RFID transponder 50. RFID transponders, essentially, comprise an RFID integrated circuit (IC) device (or "chip") bonded to an antenna apparatus, formed on a substrate that is often plastic such as Mylar®, polyester, or PET. One way to form an antenna structure is to etch copper from a substrate. An alternate way includes printing multiple layers of conductive ink onto a substrate. One additional method includes stamping UHF

antennae from thin sheets of aluminum. In certain embodiments, RFID transponders and wireless sensors are recovered from waste streams for reconditioning, reprogramming, and reuse.

Other suitable RFID transponders include designs that combine a dielectric spacer behind the antenna to create a transponder that performs well over a broad range of packaging conditions. A robust design also includes features to protect the transponder from damage.

In certain embodiments, the RFID transponder is both programmable and mechanically configured for tensile extraction from a protective enclosure.

In one embodiment, additional transponder layers include a thin and flexible energy cell comprising two non-toxic, widely-available commodities: zinc and manganese dioxide. One suitable energy cell is developed by Power Paper Ltd. of 21 Yegia Kapayim Street, Kiryat Arye, Petah Tikva, P.O.B. 3353, ISRAEL 49130, and incorporates an innovative process that enables the printing of caseless, thin, flexible and environment-friendly energy cells on a polymer film substrate, by means of a simple mass-printing technology and proprietary inks. The cathode and anode layers are fabricated from proprietary ink-like materials that can be printed onto virtually any substrate, including specialty papers. The cathode and anode are produced as different mixes of ink, so that the combination of the two creates a 1.5-volt battery that is thin and flexible. Unlike conventional batteries, this type of power source does not require casing.

A top layer of an RFID transponder assembly comprises a paper face-stock, which is a very low-cost material but also is the least environmentally resilient. UV-resistant plastic face-stock generally provide the best survivability in outdoor and rough-service environments, and also provide the best protection for the RFID transponder assembly.

A bottom layer of pressure-sensitive adhesive (PSA) often is used for attachment of transponders to objects and often is referred to as a wet inlay or a wet tag or a wet transponder. Alternatively, a layer of clear, translucent, or opaque adhesive-backed film or tape is used to attach the transponder or wireless sensor to object or container. The tape, any thin, low cost, flexible material with a self-adhesive backing, such as a conventional packing tape, is well-suited for this method of attachment. The tape may be formed into various shapes to achieve the requirements of this method. Certain embodiments may use tape that is preprinted with certain logos, marks, symbols, bar codes, colors, and designs. Suitable adhesive-backed tape must not – or at least minimally - absorb radio frequencies within the range of frequencies used by the transponder or tag. The tape material, also, must not corrode the device or otherwise hamper its functionality.

Certain embodiments use a type of packing manufactured specifically for a given encoder. Packing tape can be single-coated pressure-sensitive adhesive tape or, alternatively, media constructed with multiple layers including a backing layer. Certain backing layers are constructed on a plastic film having one or more layers. Certain backing layers are made from plastic resins such as polypropylene (PP), polyethylene (PE), or copolymers of PP, PE, PVC, polyesters, or vinyl acetates. Certain embodiments of PP are mono-axially oriented polypropylene (MOPP), bi-axially oriented polypropylene (BOPP), or sequentially and bi-axially oriented polypropylene (SBOPP). Certain backing layers are biodegradable. Certain backing layers are coated with a pressure sensitive adhesive on one side and a low adhesion release coating on the other side to reduce the amount of power required for the encoder to unroll the tape for application.

Figure 3 shows a possible embodiment of an RFID transponder 50 that does not include an encapsulation layer comprising a separate tape. In this

example, an adhesive layer 52 bonds with antenna layer 54 that is bonded to inlay substrate layer 58 and integrated circuit 56. Inlay substrate layer 58 and face-stock layer 51 provide resistance against electrostatic discharge (ESD) into antenna layer 54 or chip 56.

Other constructions for RFID transponders include one or more additional layers of high-dielectric material that encapsulate or substantially cover the inlay. In general, the thicker the dielectric layer the higher the voltage must be to initiate a flow of electrons through a dielectric layer. This results in higher ESD voltage ratings. Also, it is well known to those skilled in the art that thicker dielectric layers between antenna layer 54 and any other metal or liquid also tends to reduce parasitic loading of the antenna whereby maintaining antenna tuning for proper coupling to interrogators within a specified UHF band. In such embodiments, the integrated circuit chip and antenna bond to an adhesive layer and are protected from a discharge path through the tape layer by its particular thickness of dielectric material. A second dielectric layer bonds to the inlay substrate by a second adhesive layer, so that a low voltage discharge path is non existent around the two layers of tape substrate.

In another possible embodiment of an RFID transponder, the inlay substrate provides a second layer of ESD resistance against a discharge path through an outward-facing tape layer and associated adhesive layer. This construction protects the antenna and chip from electrostatic discharge originating from any direction. The encapsulation tape layer bonds to the antenna and chip via an adhesive layer and provides no adhesive bond to the transport container when the transponder is commissioned, and therefore depends on separate adhesive zones to attach to the container of interest.

In another possible embodiment, an RFID transponder includes multiple layers of ESD resistant material. For example, an outer layer substrate bonds to an inner substrate by an intermediate adhesive layer. A second adhesive layer bonds with the chip and antenna. The inlay substrate faces inward and presses against a transport container when the transponder is commissioned.

The contemplated adhesives in the various RFID transponder embodiments create strong and permanent bonds between tapes and inlay layers over a certain practical range of operating temperatures.

Because RFID transponders are designed to adhere to a container, one face of an external layer includes a pressure-sensitive adhesive. This external adhesive, however, must not cause mechanisms associated with the commissioning devices to jam. To prevent unwanted sticking of the RFID transponder, a transport layer protects the sticky, external adhesive. The transport layer is either a release liner such as a silicone-treated paper liner or a net (or mesh) web. A net or mesh web offers two principal advantages: less weight and are recyclable or reusable. A comparison of the weight of a net with a higher percentage of open area to a typical sheet of release liner reveals that the netting is lighter for any given section of comparable size. Environmental problems of disposal of release liner are well known. Mesh or netting, comprised of recyclable resins, is recovered after each use so that the mesh or net can be either reused or recycled for its constituent materials.

In one possible embodiment the mesh or netting is made of plastic such as nylon, polypropylene, polyethylene, HDPE, Teflon, or other resins. In other embodiments the mesh or netting is fabricated from metal or carbon-impregnated plastic to provide a conductive path to bleed electric charge away from points of accumulation.

Other advantages of a net or mesh transport layer include a substantial percentage of the adhesive not in contact with anything during storage and commissioning. When stored in a roll, a small percentage of the adhesive layer makes contact with the backside of the roll through the openings in the mesh. Thus, a small amount of energy is required to unroll the spool during transponder commissioning, yet there exists a certain amount of adhesion to prevent a converted spool from unraveling.

In other possible embodiments, the RFID transponders can include a surface suitable for human or machine readable, visible, external markings including bar-code symbols or alpha-numeric sequences.

Figure 4 shows another embodiment of RFID transponders 50 grouped on sheet stock 59 such as rolls or z-folded sheets that enables a plurality of transponders to be carried on a continuous web or traditional release liner. Other certain embodiments use transponders that are stacked and loaded into magazines for transport, handling, and automated dispensing. In certain embodiments, the magazines contain metallic shielding to protect transponders and inlays from electrostatic discharges (ESD).

In certain embodiments an RFID encoder is combined with a sensor suite to enable semi-automated tag application to desired objects. In one embodiment, a semi-automatic encoder/applicator is created by integrating a single sensor device. The sensor responds to changes in light, capacitance, pressure, acoustics, or optical path length to a transport container. In another embodiment a suite of sensors are used to detect the attachment location of a commissionable transponder.

For example, changes in capacitance are detectable using certain QProx charge transfer capacitance sensors available from Quantum Research Group Ltd.

of Hamble, England. Ultrasonic range sensors are available from supplier such as muRata Manufacturing Co., Ltd. of Kyoto Japan under the trade name Piezotite. Optical path length sensors are available from Keyence Corporation of Osaka, Japan. Sharp manufactures a compact distance-measuring sensor GP2D02 that is responsive in the range from 5 to 100 cm. Thus, when a predetermined set of conditions is realized, the sensor triggers, enables, or selects a desired action. In one embodiment, proximity or contact of sensor suite with the targeted transport container causes a second type of Trigger Event, resulting in the commissioning and dispensing of a transponder by an encoder.

In other embodiments, the sensor is designed to determine the distance an encoder resides from an object that is to be tagged. Range information is acquired and processed in real time to determine if the encoder is in Close Proximity, Near, or Far from a transport container. In certain embodiments a controller is programmed to alter threshold distances between each range category and to associate a function with each range. In certain embodiments, range category Close Proximity is associated with transponder programming and application functions. For example, the range category Near is reserved for transponder verification and/or reading functions; and Far is reserved for bar code scanning functions to verify that bar code information aligns properly with RFID transponder data.

In other embodiments a sensor suite is responsive to certain colors or patterns and use that information to instruct the placement or detect the correct locations for applying good transponders and separate locations for discharging bad transponders.

C. MOBILE ENCODER

Figure 1 shows a system 10 according to one embodiment of the present invention including a mobile encoder 30. And, Figure 5 details one possible mobile encoder 30. In this embodiment, the encoder can attach to the belt of an operator, accordingly, mounted on the housing 32 is a belt mounting means such as belt-clip 34, which easily adjusts for left-handed or right-handed operation and corresponding mounting on the belt (not shown) of the operator. An external antenna 36 enhances wireless connectivity to a host or network computer (not shown in this view) or, to a remote-mounted computer device such as a PDA or bar code reader. Several operator indicator lights including a system-ready LED 37, data-ready LED 38, tag-ready LED 39, and battery-ready LED 40 mount on the housing enabling the operator an easy view of the device status.

Also included on the exterior of the housing are an external, power-cord receptacle 41 so that the on-board lithium-ion battery may be charged as required. A combination on/off-next switch 33 enables the operator to selectively power up the encoder. A reset port, such as a recessed reset button (not shown in this view), enables an operator to reset the software settings of the device as required.

A cartridge 42 containing a plurality of RFID transponders releasably mounts to a face of the housing 32. The cartridge further includes a take-up reel 44 for non-dispensed RFID transponders, a port 46 (above 44 but not shown in Fig. 5) for dispensing commissioned transponders, and a supply reel 43 for holding blank RFID transponders prior to commissioning.

In one alternative embodiment, the mobile encoder 64 includes a handle (as Figure 9 shows, for example) for hand operation of the encoder. In another contemplated embodiment, the mobile encoder is fixed to an assembly line in a

stationary manner. Accordingly, the stationary-mounted encoder further includes machine-controlled devices for extracting a commissioned RFID transponder from the encoder and places the transponder on the container of interest by means well understood in the art.

In the aforementioned embodiments of the mobile encoder 30 (or hand-held encoder 64 of Figure 8, for example) key features commonly shared include means for enable Gen2 EPC compliance and multiple printer-emulation modes. An on-board power source, such as a rechargeable lithium-ion battery enables freedom of movement as does means for wireless connectivity to a data network, such as the 802.11 wireless LAN (Wi-Fi) standards-based communications protocol. However, a conventional power source that requires connectivity to a power-grid and a cable-based data network connectivity link would work under certain circumstances.

Further, in contemplated embodiments, the fixed or mobile encoder enables selective mounting to a magazine or cartridge filled with un-commissioned RFID transponders, which facilitates rapid and easy loading of the encoder with ready-to-use RFID transponders and further enables re-use, re-commissioning, and recycling of un-dispensed transponders and the associated cartridge. The mobile encoder can be monitored and controlled by virtually any handheld or mobile device, a host computer in a central location, or over the Internet.

The mobile encoder 30 is activated (turned on) when an operator selectively depresses the combination on/off-next switch 33. However, depressing the on/off-next switch for about three seconds or longer results in a sleep-mode cycle that can be interrupted by re-pressing the on/off-next switch. In sleep mode the operator indicators (LEDS 37, 38, and 39) will turn off. If

active, the mobile encoder system-ready LED 37 illuminates and connects to the assigned network. Network connectivity results in the illumination of both the system-ready LED 37 and the data-ready LED 38. The encoder receives commands and data via the wireless link from the remote computer 20 or host network computer 11 (of Figure 1). The data represents information to be encoded on an RFID transponder. The information is stored in the encoder's on-board memory and the tag-ready LED 39 rapidly blinks green (cycles on/off to pulsate). An RFID transponder is moved from within the cartridge 42 to a position on the top edge of the cartridge for encoding in the encoder and the transponder is encoded with the appropriate information. The transponder is tested and if it is good – contains the data and encoding was successful – all three indicator LEDs indicate a solid-green color. The operator removes the encoded RFID transponder from the encoder and places it on the container of interest.

In the event that the encoding process failed, the bad transponder is detected and retained by the encoder, where it remains on the take up reel 44 inside the cartridge 42. The take up reel also collects the release liner as the encoder 30 dispenses good transponders (properly encoded RFID transponders). The take up roll returns to a re-cycling center where components are re-used or recycled as necessitated. Further, the re-cycling center can perform failure analysis on returned transponders.

Figure 7 is a schematic diagram of additional electro-mechanical and logic components of a possible encoder 30. An RFID Module 63, such as a MP9311 UHF reader module available from Sirit Technologies, 1321 Valwood Parkway, Suite 620, Carrollton, Texas, 75006, USA, communicates with a vertical polarized YAGI antenna 62 with a downward side lobe to low-power program (commission) RFID transponders to create an RFID transponder, and the same downward side

lobe and verify transponders at low power also can read far-field transponders at a higher, second power. Additional components include a mechanical paddle trigger 86 for operator-selected override of the reel of RFID transponder stored in the supply or source reel 43 in the cartridge 42. A drive motor 76 coupled to a dual output shaft gearbox drives the source transponder reel 43 via an intermediate take-up reel gear interface 78 at the cartridge mouth. Another gear assembly along with a spring couple 85 advances and positions the tag feeder paddle 85. A tag sensor 74 detects the location of the RFID transponder to-be commissioned by the YAGI antenna 62. As the reel of RFID transponder advances inside the encoder, the lead edge passes the ratchet post 82. If the now-commissioned transponder is read by the antenna 62 as "good", a ratcheting-back torque spring 83 enables a peel device, such as the shield and tag peel edge 73, to engage, forcing the commissioned tag to peel away from the carrier layer, which continues on to the take up reel 44. In the event of a "bad" tag – that is, the antenna 62 reads the RFID transponder and determines an error has occurred – the shield 73 does not engage, allowing the defective transponder to remain on the carrier layer and proceed to the take-up reel. Once the good transponder is removed from the encoder, the tag sensor 74 detects the condition and enables the encoder to stand-by for the next event. Transponders are read, written, and verified when an operator initiates an action such pulling a trigger 86, pushing a button, or some other command sequence.

Certain protective enclosures, such as cartridges 42 or magazines, are part of a family of interchangeable magazines of similar size, shape, and functionality, which are capable of housing and dispensing certain types, styles, shapes, and sizes of new or used RFID transponders. In at least one embodiment, the magazine or cartridge 42 includes a unique and embedded, RFID transponder which enables automatic interrogation and tracking of cartridge 42. In certain

embodiments, to minimize interference, the cartridge-specific and unique RFID transponder or RFID transponder operates in a frequency band that is different than the supply RFID transponder contained within the protective enclosure. Alternatively, other embodiments selectively interrogate cartridge identification transponders that operate in the same band as transponders within the cartridge that are to be applied.

Certain encoders require replenishment of the battery or other internal, on-board power source, such as a fuel cell, or other energy storage technology. Accordingly, in some embodiments, an encoder 30 (or encoder 64 or encoder 210 of Figures 8 and 10, respectively) further includes a remote, selectively coupling base unit. The base unit enables a replenishment of magazines or cartridges, provides replaceable power sources, recharges the on-board power source, serves as a communications gateway, and provides a user interface for programming and maintenance of the encoder. For example, spare transponder magazines/cartridges are retained in cartridge pockets where they are protected from damage. Cartridges indicate their empty/full status with a visible indicator such as: an LED, an LCD, a mechanical flag, a window with a view into the source reel, or other such indicators that help an operator choose which cartridge from which to next consume transponders. The encoder, also, is retained by a protective pocket to prevent damage and to make any required electrical or mechanical connections to the base unit. In some embodiments a base unit mounts to diverse operating locations including various models of fork lift trucks. In such applications, the base unit includes a variety of wired and wireless communications options to enable omni directional communication with the encoder, cartridges, a host computer, vehicle mount terminal, a fork truck computer, or other relevant computing devices. The base unit includes a power

system that is suitable for the application, including power filtering and energy storage capabilities such as batteries or fuel cells.

As with all ESD-sensitive equipment, care must be taken to avoid a build-up of damaging electrostatic charges. Accordingly, in certain embodiments charge is removed using a variety of conduction methods including wiping, air, and humidity controls.

In some embodiments, the encoder adapts to use a particular type of RFID transponder. One type of suitable RFID transponder is model number AD-220 from Avery Dennison of Brea, CA or, alternatively, Raflatac model 300846 from Tampere, Finland. Such a transponder is die cut and adhered to release liner. Additionally, wireless sensors are manufactured to specifications that are compatible with the specific encoder, including such specifications as core diameter, outer diameter, and web width. Alternatively, certain steps are required to prepare a standard roll of ALL-9338-02 tags for use in an automated encoder, including unrolling from a large roll (up to about 6-inches in core diameter) onto several smaller rolls having a smaller core diameter (of about 1-inch to about 2-inches in core diameter).

Encoder 30 communicates with a remote computer and includes options to physically, electrically, and communicatively integrate with a portable data terminal (PDT) or a mobile computing platform. Certain PDT's have a variety of wireless connections including PAN and WLAN. Certain PDT's include a barcode scanner comprising a laser, an imager, or other means. In other suitable PDT's an RFID interrogator and antenna are built-in, while certain others have a card slot manufactured to a standard such as PCMCIA, CompactFlash, or Secure Digital, into which interrogator/antenna is plugged. An example of such a card is the MPR 5000 that plugs into a PCMCIA Type II slot and is available from WJ

Communications of San Jose, California. The MPR 5000 is compatible with handheld computers such as the Hewlett Packard iPAQ5550 or other models that accommodate smaller card-form factors, enabling them to read and write EPCglobal or ISO 18000 compatible UHF RFID transponders.

Other events, information, and status – such as changes in transponder readiness, transponders remaining on the source roll, remaining charge in the battery, changes in range-status between certain predefined states such as Close, Near, and Far – are communicated to the associated PDT. Other possible information, including certain power management functions, commands, status, and data-to-be-encoded into each readied transponder, is provided to the PDT over a wireless connection. Such a configuration puts the encoder in the role of a peripheral device to the PDT 219, with PDT 219 managing the primary user interface and most computation functions.

In some embodiments the encoder adapts to exchange information with a host device, including a PDT, in either a batch-mode or through a real time connection. Batch mode uses a periodically connected data transfer channel such as a wired connection. Certain wired connections include serial data, infrared, optical, Universal Serial Bus, a parallel port, or other physical data connection. Certain real-time connections include wireless data links including Personal Area Network (PAN), Wireless Local Area Network (WLAN), and Wide Area Network (WAN). Certain PAN connections include Bluetooth and Zigbee. Certain suitable WLAN connections include IEEE 802.11a, IEEE 802.11b, and IEEE 802.11g.

For certain encoder embodiments passwords are encoded into transponders or wireless sensors when they are commissioned. Passwords are safeguarded using cloaking, obfuscation, cryptographic techniques, secure and trusted channels, locked memory, and other methods that are commonly used to

protect confidential information. Passwords are generated or retrieved from data encoded in an RFID transponder to generate an index into one or more databases that contain a one dimensional array of passwords, a two dimensional array of passwords, a multidimensional array of passwords, or an array of actual or pointers to algorithms used to generate passwords from transponder data, for example. Alternatively, cryptographic algorithms are used generate passwords from transponder data.

Although this disclosure makes specific reference to a mobile encoder, it is understood that the encoder can easily adapt and be readily configured to a fixed operating environment. For example, it can be mounted to a forklift truck or a high-speed conveyer line and maintain advantages of wireless communication, rapid change-over and other qualities as discussed and developed more fully in this disclosure.

D. INTERROGATOR APPARATUS

Working as a stand-alone device, or combined with an encoder, certain embodiments of the present invention include an RFID transponder reader, also called an interrogator. The interrogator, in one embodiment, is a physically separate device that is solely in wireless communication with the encoder. In another embodiment the interrogator includes a wired connection to the encoder. In yet another embodiment, the interrogator connects to the encoder via an intermediate processor, such as a remote computer, or some other intermediate device. In yet another embodiment, the intermediate device is a shared processor in a physically integrated encoder/interrogator apparatus.

Regardless of the physical configuration of the interrogator, its function is to encode and/or verify a RFID transponder's (including wireless sensors) functionality. Certain embodiments use a mobile handheld reader to verify

transponder functionality after carton attachment. Certain handheld readers also read bar codes that either partially or completely specify the data that is to be programmed into a transponder. Accordingly, an optical path from the interrogator to a location for reading bar code labels is used to identify certain information about the objects or containers that are to be tagged. Additional transponder encoding instructions and data is acquired through an integral network interface or a batch mode memory in the interrogator.

In certain embodiments, a shield structure incorporated in a combined interrogator/encoder prevents RF fields from interrogating or reprogramming RFID transponders yet-to-be-commissioned that are resident in the combined interrogator/encoder device.

In one embodiment, shown as a cross-sectional schematic in Fig 8, a contact image sensor (CIS) 90 or a linear optical array is used to scan along the length of an RFID transponder before it is applied to a container. CIS 90 produces a video stream that is decoded and then interpreted and stored by an on-board Computer 63. CIS or a similar linear array sensor is capable of reading both linear and two-dimensional bar codes. In certain embodiments, CIS reads two-dimensional bar codes before attachment to inlay or transponder. The on-board computer creates a logical association between bar codes and the commissioned RFID transponder. Encoder 30 reads and associates all bar code symbols on a single segment with the RFID transponder or inlay adhered to it.

When an operator pulls the trigger 86, which is either a mechanical trigger or an electro-mechanical device, the on-demand commissioning of the RFID transponder occurs and nearly simultaneously is pressed against a container within a fraction of a second. In certain embodiments, mechanisms internal to encoder transfer mechanical force to the RFID transponder tag through the use

of air, springs, motors, plungers, elastomers, or other energy storing or delivering methods. Reloading of the next tag (next transponder) and readying of the system are performed within a time interval that is acceptable to the operator and enables a high degree of productivity for tagging cartons, pallets, or other transport containers.

In certain embodiments of a combined interrogator/application, a trigger 86 couples to an electrical switch having one or more stable positions that are detectable by a controller. In certain modes of operation trigger-switch state is coupled with range information from a sensor suite to execute functions at predetermined ranges at predetermined times. The result is a trigger that functions based upon detected range from a container or other object of interest. This advantageously improves operator efficiency and productivity as one trigger executes several different functions that are typically involved with RFID tagging including the tagging of bar-coded cartons that have been selected to receive wireless sensors.

Verification of bar code occurs either before or after an RFID transponder is commissioned and the tag applied to the container by merely stepping back to at a point where the sweep angle of a laser beam or field of view of an imager can read a bar code label. In certain embodiments ranges shorter than that, but not in Close Proximity, are used for sweeping a radio frequency interrogation signal across the faces of multiple cartons to assure that the correct tags, the correct number of transponders, and the correct data within that transponders were all properly programmed.

In certain embodiments Close Proximity range is reserved exclusively for programming, applying, and verifying one transponder, all in a single pull of trigger. In other embodiments, the interrogator includes programmable

conditions that enable Trigger Events to interact with external devices or nearby equipment. For example, at a predetermined range from the interrogator, activation of the trigger causes the encoder to transmit a coded signal to an external device as an indication of an operator action: at a Far-range the signal to requests an external device to read a bar code and the bar code information is decoded and transmitted back to encoder. In another embodiment, decoded barcode information is processed by a portable data terminal (PDT), a vehicle mount terminal, or other computing device.

The on-board computer 61 controls the operation of the RFID Interrogator Module 63 to read, write, and verify RFID tags, inlays, transponders, and wireless sensors that are applied or are within range of the interrogation fields produced by antenna 62. The encoder 30, capable of reading multiple RFID transponders near it, can, in certain embodiments, produce a linearly polarized radio field via the internal antenna 62. In another embodiment, the internal antenna produces a horizontally polarized RF field. A commissioned transponder can be read both before and after it is applied to a transport container. When multiple transponders are within the interrogation field of the encoder 30 with an interrogator module 63 the on-board computer 63 determines which transponders are commissioned and dispensed versus those transponder that have not. In certain embodiments, the on-board computer maintains records of transponders recently applied in order to properly determine how to interact with each transponder in the field of the internal antenna or other antennae under the control of RFID Interrogator.

In one possible embodiment, the interrogator/encoder utilizes preprinted information on a set of RFID transponders. The pre-printed information includes one or more logos, an EPC-global Seal, and other informative alpha-numeric or bar-code data. Certain embodiments have a motorized tape drive and dispensing

system. Certain embodiments contain some or all of the following: a rechargeable battery, an operator display, a wireless interface, a network stack, an IP address, a PCMCIA port, a Compact Flash port, a USB cable, a serial cable, a dock port, a window to allow the operator to view the transponder attachment process, or a bar code scanner.

One suitable interrogator includes model MP9311 available from Sirit Technologies of 1321 Valwood Parkway, Suite 620 Carrollton, Texas 75006, USA. Other RFID transponder or wireless sensor interrogator modules with other feature sets are also possible for use in the interrogator/encoder.

Figures 8 and 9 show one possible interrogator/encoder 64 according to the present invention. The interrogator 64 comprises a housing having a user input device 67, such as a key pad or key board, and a user output device, such as an LCD screen, for displaying optically scanned label data, RF interrogated data from a transponder, and other information including on-board diagnostic functions, bios status, and external information provided from a remote computer as sent over a wireless network, for example. A handle structure 66 enables point-of-use deployment while cartridge 42 enables on-demand commissioning of RFID transponders, which are dispensed from the transponder port 46. In this embodiment, an integrated YAGI antenna 62 creates a large forward-looking main lobe of radio frequency energy for interrogation of commissioned RFID transponders. The internal antenna also produces side lobes of RF energy that although attenuated from the main lobe by several dB, couple enough power into nearby readied transponder to interrogate and write to it.

As further depicted in Figure 10, a reflector 219b passively reflects RF signals from an upper side lobe downward toward readied tag 216f. Backscatter from tag 216f propagates to both antenna 219a and reflector 219b for

processing by the interrogator. Having such an antenna embedded in PDT 219 and mounted to the structure of the encoder housing enables the PDT 219 to encode and verify readied transponder 216f while commanding the encoder to commission and dispense a tag when a particular Trigger Event or a predetermined range status change occurs.

An antenna, or alternatively, a leaky coax or a near-field coupler located outside of the protective enclosure in a location very close to the tag attachment zone in front of tamp head 175 or tag application roller and holding rollers or hammer 216a.

In some embodiments the antenna is a patch antenna with a radiation pattern toward the tag attachment zone. In other embodiments the antenna is a near field coupler. Alternatively, leaky coax, a type of coaxial cable having slits, slots, or perforations that allow radio frequencies to leak in or out, is used in encoders according to the present invention. A coupled-mode cable, which does not radiate as well as radiating-mode cable, is constructed with closely spaced slots in a corrugated outer conductor. Radiating-mode cable typically has a foil outer conductor with non-uniformly spaced slots arranged in a periodic pattern. Coupled-mode cable is a slow-wave structure. In free space its external fields are closely bound to the cable and do not radiate, except for minor end effects according to "Prediction of Indoor Wireless Coverage by Leaky Coaxial Cable Using Ray Tracing" by Samuel P. Morgan of Bell Laboratories, Lucent Technologies.

In certain embodiments an interrogator drives a signal into a leaky coax that is terminated in a purely resistive load of about 50 ohms. An RF-switch selects between radiating and non-radiating loads including an antenna or leaky coax and, therefore, avoids mismatched load impedance.

In other embodiments the internal antenna is a patch antenna with its strongest lobes oriented toward the tag holding and placement area in the region of holding rollers 216d. Antenna 212c or leaky coax 212a work with an interrogator to produce electromagnetic fields to interrogate, program, and verify wireless sensors. Shield 217e prevents interrogation or programming of RFID transponders until they arrive at separation roller or tag peel edge 217d. A reflector is used in certain embodiments to reflect RF radiation toward a readied transponder. In the event that verification fails, the operator is informed that the bad tag (or inoperable transponder) is to be discharged onto a surface of a third object other than the encoder or the transport container, for post-mortem analysis.

E. METHOD OF INLAY CONVERSION

Figure 11 shows one method according to the present invention and includes preparing a carrier substrate (Block 111) for use in an RFID transponder or in a wireless sensor that includes both an RFID transponder and sensor device. This process contemplates utilizing adhesive-backed packing tape or some similar material suitable for adhering a commissioned RFID transponder to a container or other object of interest. Certain embodiments for this step include machines to cut large rolls of mesh or net into numerous small rolls with the desired width, length, and core diameter. For example, a supply-roll of stock mesh or net measures about 14-feet wide and about 5000-feet long, rolled onto a core. In one embodiment the supply-roll must be trimmed to fit the width suitable for use in a mobile encoder 30 or similar encoder/interrogator as described in this disclosure.

For certain embodiments, the carrier substrate width about the length of a simple UHF dipole inlay, as show, for example, in Fig. 1. In one embodiment the

carrier substrate width measures about 4-inches. The length of the carrier substrate depends on many factors including the target cost per transponder of the cartridge and all of its components. Other factors that determine the length of the carrier substrate include the target size and weight of the cartridge and/or the mobile encoder. A possible machine that converts large supply-rolls into smaller ones, in one embodiment, consists of a stand-alone industrial machine. However, in other embodiments, the trimming function is part of an integrated machine.

Block 112 represents the testing process of an RFID inlay comprising, at least, an RFID chip and antenna device. The testing, or interrogation, of the inlay, in one embodiment, includes an interrogator and an antenna or a near field coupler, which read the inlay. This process further includes monitoring various parameters such as activation energy, backscatter signal strength, sensor performance, and other indicators of the quality of the RFID transponder or wireless sensor. Any transponder or tag that does not meet certain minimum performance criteria is discarded. Good transponder or tags are subsequently programmed, encoded, or commissioned with new information relating to the associated object of interest. Such information resides or stores in non-volatile memory within the RFID inlay. Inlays that fail to perform to adequate levels of performance are immediately separated from the process.

Block 113 represents a third process step consisting of applying and encapsulating good inlays in an encapsulation layer or encapsulation zone of the RFID transponder. One possible encapsulation layer comprises a packing tape constructed from pressure sensitive acrylic adhesive and backed by a substrate layer of bi-axially oriented polypropylene film. In certain configurations such packing tapes provide up to about 25,000 volts of ESD resistance when properly applied in about 0.002-inch thick layers of encapsulation. Other packing tapes,

available in thicknesses of about 0.001-inches, when combined in layers provide higher ESD voltage resistance ratings. The inlay substrate contributes additional ESD resistance in certain contemplated configurations.

Block 114 represents another process step consisting of applying the converted RFID transponder to an interposing transport media. Such media preserves the tackiness of the exposed adhesive. One possible adhesive includes a pressure-sensitive adhesives, which adheres to most surfaces with very slight pressure and retains tackiness above their melting point of about negative-65 (-65) to about negative-90 (- 90) degrees centigrade. In another embodiment, silicone-based release liner is used to transport and preserve pressure sensitive adhesive tags and labels. In other embodiments, the transport media includes utilizing air pockets bounded by regions having tensile strength such as fibers: For example, plastic or metal fibers. Certain plastic resins have a low surface energy and prevent strong adhesive bonds from forming and are bound together to form a mesh or net. Mesh (or net) constructions offer a means of handling converted tags without allowing a substantial percentage of the available adhesive to make contact with any other solids until the tag is commissioned.

Block 115 represents another process step consisting of winding converted transponders onto a spool with the interposing transport media. The core diameter, number, of transponders, layer thickness, the thickness of any dielectric foam spacer layer, and outer diameter are all optimized for efficient, economical, and convenient deployment in transponder commissioning processes disclosed herein. Finished spools are packaged in a manner to prevent ESD damage. Certain enclosures include anti-static bags, foil-lined cartons, metal plated cartridges, and carbon-impregnated plastic enclosures. Certain enclosures are reusable. Certain enclosures of application-ready rolls or Z-folded

transponders having low energy interposing transport media mate directly with encoders as described in this disclosure.

F. METHOD OF TAGGING CONTAINERS

Figure 12 is a block diagram representing a second method according to the present invention including applying RFID transponders to objects of interest. One suitable object of interest comprises transport containers such as corrugated cartons or shrink-wrapped cases on a shipping pallet, which is inadequately addressed by the prior-art, particularly for solutions for manually operated automatic encoding and attachment to a container.

Block 121 represents a process step including the identification and selection of a container to be tagged with an RFID transponder or wireless sensor. In one embodiment this step includes a manual selection and verification processes that consists of manual handling, visual sighting, and scanning bar codes with a hand-held optical reader device. This method contemplates that a transponder encoding scheme is ready in advance and synchronized with a pick list, customer purchase order, advanced shipping notice, and other such records to assure that goods are properly moved and accounted for.

Block 122 represents another process step of identifying the information to be encoded, and may be included in the step represented by Block 121. In this step (Block 122), an operator uses a bar code reader or an encoder/interrogator of this disclosure. Alternatively, the operator may receive instructions delivered to a hand-held PDT or other mobile data terminal connected to a wireless network. This information is delivered to an encoder, such as encoder 30.

Block 123 represents another process step whereby, using a mobile encoder, the operator then commissions an RFID transponder with the information of the previous step (Block 122). Optionally, successful

commissioning of the RFID transponder is verified by the encoder. In one embodiment, the encoder tests the next transponder and determines if it is operating within certain predefined specifications including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. If the encoder determines that the transponder is not likely to result in a successful transponder deployment due to either physical or electronic deficiencies or abnormalities, then the operator is informed and the failed or bad transponder is discarded automatically or when an operator pulls a trigger under an operator-acknowledged transponder failure condition.

This step (Block 123) also includes processes to read or determine by dead reckoning the information encoded into certain preprinted optically encoded symbols on the outward facing non-adhesive surface of the adhesive tape. In certain embodiments the adhesive tape is printed with information. In other embodiments the printed information is a machine-readable symbol such as a bar-code symbol. For example, one or more machine-readable symbols are read when the tape is prepared for use in an automated encoder or, alternatively, during the inlay conversion process and conveyed to an encoder through other data storage means, such as an RFID transponder. In one embodiment, an information encoding method uses either one-dimensional or two-dimensional bar codes. In some embodiments a linear imager is used to read either linear or two-dimensional bar codes as the tape is being unrolled from a spool. Some encoding schemes preprint machine-readable symbols at regular intervals along the length of a roll of adhesive tape. In certain embodiments the spacing of the preprinted symbols is at an interval of one half of the nominal length of each section of adhesive tape. In certain embodiments, the encoded information is used as a reference to one or more data storage locations. In other embodiments the data

storage locations are accessible through a computer network. In some embodiments, the encoded information is a series of sequential numbers. Information relating to data stored in the RFID transponder is stored in data storage locations that are referenced by one or more of the preprinted symbols. In an alternative embodiment more than one type of machine-readable symbols can be read from the surface of a segment of tape. In certain embodiments, more than one machine-readable symbol is used as a reference to the same or closely related data records of information stored in the RFID transponder or inlay, and either can be successfully used to access stored data.

In some encoders used in this step (Block 123) a Trigger Event occurs, which results in the verification that a particular commissioned RFID transponder has been tagged and associated with a specific container. This Trigger Event occurs, in certain embodiments, when an operator pulls a trigger on the encoder. In other embodiments the Trigger Event occurs when certain sensors detect preprogrammed conditions relating to the proximity of the encoder face to an object that is to be tagged.

Finally, (Block 124) the operator applies the RFID transponder on the container and, thus, commissions the transponder. In certain embodiments, the location of the targeted placement of the RFID transponder or wireless sensor on the container is stored in a database, which is referenced or pointed to by information that is stored in the memory of the encoder. In one embodiment, the operator holds the encoder against the face of the container based on the tagging requirements for that particular container. The tagging requirements including the location and orientation of the RFID transponder to be placed is conveyed visually or aurally. For example, the operator receives visual information via a screen or display on the encoder. In certain embodiments, physical indicators are attached to the encoder and extend from its body in a direction

and manner so as to assist the operator in the positioning of the transponder onto the carton. In other embodiments, transponders are applied to the interior of a carton, before it is sealed.

G. METHOD OF COMMISSIONING RFID TRANSPONDERS USING A MOBILE APPLICTOR.

Figure 13 is a block diagram showing a method according to the present invention for commissioning RFID transponders using an encoder, such as the encoder 30, couples to a cartridge containing a plurality of RFID transporters releaseably mounted on a transport sheet or roll. The encoder enables the roll of RFID transponders to advance one position (Block 131), placing the Next Tag in a test 1 position. The Next Tag is tested (Block 133) to ensure that it performs within predetermined parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. One possible method includes encoding a transponder using only a minimal amount of radio-frequency energy. Since transponder encoding requires more energy than reading a transponder, this low power test constitutes a basic test of both minimal activation energy and backscatter signal strength.

An RFID transponder that fails this test (Block 133) results in a "Bad Tag" status and proceeds to the take-up reel of the encoder (Block 135). Thus, any failed transponder remains captive in the cartridge and cannot be released from the encoder by an operator. Optionally, the operator is notified of the failed transponder so the operator can request a newly encoded transponder (Block 137). However, in one embodiment, the notification step occurs automatically, and a newly encoded next transponder is generated without input from the operator.

Block 132 shows that a "good" transponder is positioned in the encoder for the encoding process. The RFID transponder that passes the test 1 position is commissioned with predetermined data based on the container to be tagged. Methods of obtaining, storing, encoding, and commissioning this information on the RFID transponder are discussed elsewhere in this disclosure.

The commissioned transponder undergoes a verification process (Block 134) to determine if the intended information was successfully encoded on the RFID transponder. Certain embodiments combine the verification step with the encoding step to gain operational efficiencies. If this verification test results in a fail condition, the transponder remains in the encoder and ultimately winds on the take-up reel in the cartridge for subsequent post-mortem failure analysis.

Block 136 represents a pass condition. The encoder removes the commissioned RFID transponder from the transport web or release liner, enabling the operator to retrieve the transponder from the encoder and apply the transponder to the container. In an alternative embodiment, the operator holds the encoder against a surface of the container and the encoder places the commissioned RFID transponder directly on the container without operator intervention.

H. METHOD OF PROVIDING RFID TRANSPONDERS TO AN ENCODER.

Figure 14 is a block diagram showing another method according to the present invention. One step, represented by Block 141, includes providing suitable RFID transponders such as the transponder 50 of Fig. 2, which are presented on a sheet or roll, such as sheet 59 of Fig. 4.

Block 142 shows the process step of inserting the roll of RFID transponders into a cartridge of an encoder such as cartridge 42 of Figure 5. Steps 141 and 142 are ideally suited for off-site repairs and replacements of

cartridges. Accordingly, a customer may send a used cartridge to a repair facility, enabling the cartridge to be recycled.

At a point-of-use location, such as a customer's warehouse or packaging facility, a fresh cartridge full of blank, or non-commissioned, RFID transponders attaches to an encoder adapted for such use (Block 143). And is used normally (Block 144), as previously described herein, to identify containers and data to encode on an RFID transponder. Prior to encoding, (Block 145) the encoder verifies that a non-commissioned transponder remains in the cartridge. If such a transponder is available (Block 148) the RFID transponder is commissioned and applied to the container (Block 149) by means previously disclosed herein. If the cartridge is empty (Block 146), the operator is alerted by various known means described herein or otherwise known by those skilled in the art. And, the cartridge is removed (Block 147). The removed cartridge is sent to a recycling, re-use, repair, or re-building center that is either on or off-site, or is discarded.

I. METHOD FOR RECYCLING USED CARTRIDGES OF RFID TRANSPONDERS.

Figure 15, a block diagram, shows a method for recycling cartridges from, for example, a process similar to the one shown in Figure 14. A repair center receives the used cartridge (Block 151). In one embodiment, the repair center is off-site from the customer, and allows specialized repair, reconditioning, re-use, recycling, and replenishment to provide cost-effective and environmentally sensible replacement cartridges.

In certain embodiments, a protective enclosure and RFID transponder recycling center reduces the amount of waste associated with enabling the convenience of tagging and safely handling RFID transponders and devices such as encoders or interrogators. For example, plastics and silicone are non-biodegradable materials that are suitable for recovery, re-use, and recycling.

Certain plastic parts are disassembled, hub-cores are recycled for paper waste, and silicon-coated release liner is accumulated and separated from the recyclable (re-pulpable) paper for proper handling, recovery, and disposal – if needed. In such an embodiment, a customer sends the spent protective enclosure, such as the cartridge 42, to an off-site recycling facility. The spent cartridge is replaced by either a new (virgin) cartridge or a refurbished cartridge, as appropriate and such replacement cartridge is replenished with blank RFID transponders.

Recycling continues with the RFID transponders as well. In certain embodiments, the RFID transponder 50 is configured and adapted for re-use. Accordingly, the data is wiped and re-coded as appropriate. In other embodiments portions of the RFID transponder are recycled. For example, the aluminum antenna separates from the encapsulation layer and is recycled. The paper stock is recovered and re-pulped.

In certain embodiments, replenishment of empty cartridges or magazines is performed as a service at a customer's site such as a warehouse, distribution center, packing plant, 3PL logistics center, or a manufacturing plant.

Figure 16, a block diagram, shows another method according to the present invention and consists of an algorithm for determining when an RFID transponder is commissioned based on predetermined criteria. For example, a shipping container typically includes a mixed lot of products. Accordingly, several different product-identifying barcodes are serially scanned (Block 161) until an end of condition event occurs (Block 162). This end of condition event may be queried after each scan or provided to an interrogator/encoder based on a supplied heuristic (i.e. volume, weight, etc.) , pack list, or other customer-driven data.

Once all data is compiled and stored on the encoder, an RFID transponder is commissioned and encoded with the data or a logical pointer to a storage location of the data (Block 163). Then, it is applied to the container (Block 164) by means discussed previously herein.

While the invention has been particularly shown and described with reference to certain embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

CLAIMS:

I claim:

1. An encoder for commissioning RFID transponders, the encoder comprising:

an RFID interrogator module adapted to enable encoding predetermined data according to a commissioning algorithm and communicating with an internal antenna, the antenna being adapted to encode the predetermined data on the RFID transponder;

a memory storage device for storing at least a portion of the predetermined data;

a processing means for controlling and communicating with the memory storage device, the RFID interrogator and the internal antenna;

a means for providing a supply of RFID transponders, the transponders configured for tensile extraction from the encoder; and

a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable encoding of the predetermined data.

2. The encoder of claim 1 further comprising a wireless communication means for wirelessly receiving at least a portion of the predetermined data or the commissioning algorithm, or both.

3. The encoder of claim 1 further comprising an external housing adapted to enclose the internal antenna and further being adapted to receive a protective

enclosure, the protective enclosure being adapted to enable tensile extraction of the RFID transponders.

4. The encoder of claim 1 wherein the means for presenting the RFID transponder comprises a motor assembly adapted to pull the RFID transponder from a supply reel.

5. The encoder of claim 4 wherein the supply reel rotatably mounts inside a protective enclosure, the protective enclosure adapted to releasably couple to the encoder, the protective enclosure further comprising a take-up reel wherein both the supply reel and the take-up reel include a drive mechanism that selectively engages the motor assembly.

6. The encoder of Claim 4 further comprising a power supply module controlled by the processor and coupled to the motor.

7. The encoder of Claim 6 wherein the power supply module comprises a rechargeable battery.

8. The encoder of Claim 3 wherein the wireless communication means further comprises an external antenna mounted to the housing.

9. The encoder of Claim 1 further comprising a housing assembly for enclosing the internal antenna and a handle-device mounted on a bottom surface of the housing.

10.The encoder of Claim 1 further comprising a housing assembly for enclosing the internal antenna and a belt-clip attachment mechanism mounted on a side surface of the housing.

11.The encoder of Claim 1 further comprising a housing assembly for enclosing the internal antenna and a mounting mechanism for selectively coupling the encoder to a provided structure.

12. The encoder of Claim 1 further comprising means for reading a commissioned RFID transponder.

13. The encoder of Claim 12 wherein the means for reading a commissioned RFID transponder comprises the internal antenna.

14. The encoder of Claim 1 wherein the commissioning algorithm further comprises an encryption subroutine.

15. The encoder of Claim 1 further comprising a user-output device comprising at least one LED light, the LED light adapted to indicate at least one color in response to a predetermined condition and the LED light being controlled by the processor.

16. The encoder of Claim 1 further comprising a user-input device comprising at least one switch coupled to the processor whereby activation of the switch enables a predetermined first function to execute.

17. The encoder of Claim 1 further comprising a user-output device comprising a LCD panel coupled to the processor and adapted to display a user first-information set.

18. The encoder of Claim 1 further comprising an optical reader adapted to read barcodes and transmit data to the processor.

19. The encoder of Claim 1 further comprising dispensing means for verifying that the RFID transponder was encoded and for dispensing an encoded RFID transponder and for not dispensing an un-encoded RFID transponder.

20. The encoder of Claim 19 wherein the dispensing means further comprises a transponder peel-device for removing the encoded RFID transponder from a transport liner and a transport liner collection mechanism for spooling the transport liner on a take-up reel.

21. A system for enabling on-demand, point-of-use commissioning of RFID transponders to uniquely identify an object, the system comprising:

an RFID transponder comprising a self-adhesive layer adapted to adhere the transponder to the object, a release liner releasably coupled to the self-adhesive layer on a first side, an oppositely spaced self-adhesive layer second side couples to a carrier substrate, the carrier substrate adapted to receive an RFID chip and an antenna device, the antenna device coupling to the RFID chip and the antenna device further adapted to wirelessly send and receive data packets corresponding to an information set;

an RFID transponder encoder device having processing means and memory means, the encoder device being adapted to receive at least one RFID

transponder from a first dispensing means, the encoder device further including commissioning means for commissioning the at least one RFID, means for verifying the status of a commissioned transponder, means for selectively removing the release liner and for dispensing the commissioned transponder, and means for selectively capturing an un-dispensed transponder;

an RFID transponder encoding algorithm;

a means for coupling a protective enclosure adapted to contain a supply of the RFID transponders, the transponders being further adapted for tensile extraction from the protective enclosure; and

a remote computer system adapted to wirelessly communicate with the transponder encoder and adapted to selectively enable the encoder to commission the transponder with data encoded according to the encoding algorithm.

22. The system of claim 21 further comprising an interrogator device adapted to wirelessly read the data set encoded on the RFID transponder.

23. The system of claim 21 further comprising an interrogator device adapted to wirelessly encode a new data set on the RFID transponder.

24. An RFID transponder adapted for use in an RFID encoder, the RFID transponder comprising:

a transport liner substrate layer adapted to selectively peel away from a pressure-sensitive adhesive layer when sufficient tension is provided around a peel-device to enable extraction of the RFID transponder from a protective enclosure; and

an RFID inlay comprising an antenna structure coupled to an RFID chip, the RFID inlay coupled to the adhesive layer.

25. The RFID transponder of claim 24 further comprising an ESD-resistant encapsulation.

26. The RFID transponder of claim 24 further comprising a visual-marking layer for enabling machine or human visual recognition of a bar code or other visual marking scheme.

27. A method for tagging a container comprising:

providing an encoder having at least one RFID transponder;

identifying information to be encoded on the RFID transponder;

commissioning the RFID transponder by encoding the information;

associating the RFID transponder with the container; and

presenting the RFID transponder for attachment to the container by pulling a conveyance web or a release liner with transponder attached thereto around a peel-device to extract transponders from a protective enclosure.

28. A method for commissioning RFID transponders comprising:

providing an RFID transponder encoder having a peel-device;

providing information to the encoder;

providing a protective enclosure containing at least one of the RFID transponders;

mounting the RFID transponder to a conveyance web or release liner;

coupling the protective enclosure to the encoder;

advancing the RFID transponder in the encoder; and

encoding the information on the transponder.

29. The method of claim 28 further comprising:

verifying that the information was encoded to the transponder.

30. The method of claim 29 further comprising:

Dispensing the RFID transponder if the information was properly encoded.

31. The method of claim 28 further comprising:

Storing the RFID transponder if the information was not properly encoded.

32. The method of claim 28 further comprising:

providing the encoder with a motor adapted to provide tension in the conveyance web or release liner in a direction along its major axis.

33. A method for commissioning RFID transponders comprising:

providing a roll or sheet of RFID transponders;

providing a cartridge;

providing an encoder;

inserting the roll or sheet in the cartridge;

coupling the cartridge to the encoder;

identifying information to encode; and

encoding the information on at least one RFID transponder.

34. The method of claim 33 further comprising:

verifying that the roll or sheet of RFID transponders has at least one blank transponder;

alerting an operator of an empty condition; and

de-coupling the cartridge.

35. A method for recycling RFID transponders comprising:

providing a cartridge coupled to an encoder;

de-coupling the cartridge from the encoder;

removing any unused or un-commissioned RFID transponders from the cartridge; and

inserting a new set of blank RFID transponders into the cartridge.

36. A method for recycling protective enclosures adapted to enclose RFID transponders, the method comprising:

providing a protective enclosure coupled to an encoder;

de-coupling the protective enclosure from the encoder; and

removing any conveyance web and unused or un-commissioned RFID transponders from the protective enclosure.

ABSTRACT

In one embodiment the present invention is an encoder for commissioning RFID transponders and includes a housing encasing a motor assembly, wireless communication means for transferring instructions and data from and to a remote host, on-board memory, a processor, and an antenna with corresponding mechanism to encode and verify a programmable RFID transponder within a protective enclosure. The present invention further includes novel methods for commissioning RFID transponders, as well as methods for recycling and reusing various components including the protective enclosure and RFID transponders.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SYSTEMS, METHODS, AND DEVICES FOR CONVERTING AND COMMISSIONING WIRELESS SENSORS
First Named Inventor:	CLARKE W. McALLISTER
Filer:	Peter A. Haas
Attorney Docket Number:	ADA-06-REG-01

Filed as Small Entity

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	75	75
Utility Search Fee	2111	1	250	250
Utility Examination Fee	2311	1	100	100
Pages:				
Claims:				
Claims in excess of 20	2202	16	25	400
Independent claims in excess of 3	2201	5	100	500
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1325**

Electronic Acknowledgement Receipt

EFS ID:	1161644
Application Number:	11465712
Confirmation Number:	1724
Title of Invention:	SYSTEMS, METHODS, AND DEVICES FOR CONVERTING AND COMMISSIONING WIRELESS SENSORS
First Named Inventor:	CLARKE W. McALLISTER
Customer Number:	45649
Filer:	Peter A. Haas
Filer Authorized By:	
Attorney Docket Number:	ADA-06-REG-01
Receipt Date:	18-AUG-2006
Filing Date:	
Time Stamp:	17:35:36
Application Type:	Utility
International Application Number:	

Payment information:

Submitted with Payment	yes
Payment was successfully received in RAM	$1325
RAM confirmation Number	390
Deposit Account	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)	Multi Part	Pages

1	Drawings	drawing-d3.pdf	2875497	no	14
Warnings:					
Information:					
2	Oath or Declaration filed	dec.pdf	658051	no	2
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Filed	idsp3.pdf	395447	no	1
Warnings:					
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4	NPL Documents	article.pdf	98538	no	5
Warnings:					
Information:					
5	Information Disclosure Statement (IDS) Filed	idsp1.pdf	150446	no	1
Warnings:					
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6	Information Disclosure Statement (IDS) Filed	idsp2.pdf	156214	no	1
Warnings:					
Information:					
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7	Oath or Declaration filed	POA.pdf	491553	no	1
Warnings:					
Information:					
8		spec.pdf	210908	yes	50
	Multipart Description				
	Doc Desc		**Start**	**End**	

	Specification		1		41
	Claims		42		49
	Abstract		50		50
Warnings:					
Information:					
9	Fee Worksheet (PTO-875)	fee-info.pdf	8577	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	5045231		

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

EXHIBIT

10

PTO/SB/08a (03-08)
Approved for use through 03/31/2008. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	2008-05-21
	First Named Inventor	McAllister, Clarke
	Art Unit	
	Examiner Name	
	Attorney Docket Number	ADA-08-REG-07

U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7066667	A	2006-06-27	CHAPMAN ET AL.	
	2	5899476	A	2005-05-31	BARRUS ET AL.	
	3	6246326	A	2001-06-12	WIKLOF ET AL.	
	4	5382784	A	1995-01-17	EBERHARDT	
	5	6486780	A	2002-11-26	GARBER ET AL.	
	6	5280159	A	1994-01-18	SCHULZ ET AL.	
	7	5763867	A	1998-06-09	MAIN ET AL.	
	8	5962837	A	1999-10-05	MAIN ET AL.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2008-05-21
	First Named Inventor	McAllister, Clarke
	Art Unit	
	Examiner Name	
	Attorney Docket Number	ADA-08-REG-07

	9	5850187	A	1998-12-15	CARRENDER ET AL.	
	10	6078251	A	2000-06-20	CARRENDER ET AL.	
	11	6195053	A	2001-02-27	KODUKULA ET AL.	
	12	6357662	A	2002-03-19	WIKLOF ET AL.	
	13	6593853	A	2003-07-15	BARRETT ET AL.	
	14	6969134	A	2005-11-29	HOHBERGER ET AL.	
	15	6848616	A	2005-02-01	TSIRLINE ET AL.	
	16	7223030	A	2007-05-29	FESSLER ET AL.	
	17	7249819	A	2007-07-31	BURDETTE ET AL.	
	18	7187294	A	2007-03-06	BURDETTE ET AL.	

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U.S.PATENT APPLICATION PUBLICATIONS

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2008-05-21
	First Named Inventor	McAllister, Clarke
	Art Unit	
	Examiner Name	
	Attorney Docket Number	ADA-08-REG-07

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20060080819	A1	2006-04-20	MCALLISTER	
	2	20030227528	A1	2003-12-11	HOHBERGER ET AL.	
	3	20070150219	A1	2007-06-28	Cawker et al.	

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FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2008-05-21
	First Named Inventor	McAllister, Clarke
	Art Unit	
	Examiner Name	
	Attorney Docket Number	ADA-08-REG-07

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2008-05-21
	First Named Inventor	McAllister, Clarke
	Art Unit	
	Examiner Name	
	Attorney Docket Number	ADA-08-REG-07

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/peter a haas/	Date (YYYY-MM-DD)	2008-05-21
Name/Print	PETER A. HAAS	Registration Number	52481

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Systems, Methods, and Devices for Replication of Data onto Wireless Sensors
First Named Inventor/Applicant Name:	CLARKE McALLISTER
Filer:	Peter A. Haas
Attorney Docket Number:	ADA-08-REG-07

Filed as Small Entity

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	75	75
Utility Search Fee	2111	1	255	255
Utility Examination Fee	2311	1	105	105
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**435**

Electronic Acknowledgement Receipt

EFS ID:	3336062
Application Number:	12124768
International Application Number:	
Confirmation Number:	3269
Title of Invention:	Systems, Methods, and Devices for Replication of Data onto Wireless Sensors
First Named Inventor/Applicant Name:	CLARKE McALLISTER
Customer Number:	45649
Filer:	Peter A. Haas
Filer Authorized By:	
Attorney Docket Number:	ADA-08-REG-07
Receipt Date:	21-MAY-2008
Filing Date:	
Time Stamp:	16:55:06
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Electronic Funds Transfer
Payment was successfully received in RAM	$435
RAM confirmation Number	2014
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)

1	Drawings-only black and white line drawings	DRAWING.pdf	648879 81fd57361c544c0e1ab243c686f9a5404eb3d4a6	no	6
Warnings:					
Information:					
2		specfilingdraft.pdf	285122 d2db5eabdd0bf28d221ff7d72c0134024104ac3f	yes	43

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Specification	1	37
	Claims	38	42
	Abstract	43	43

Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Filed	IDS.pdf	40769 b60f52eb4d477210ecfab5011ac7339a76031bd9	no	6
Warnings:					
Information:					
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4	Power of Attorney	powerofatty.pdf	529618 43744e0e31b1aa84fa644affe055250b33cc3733	no	2
Warnings:					
Information:					
5	Oath or Declaration filed	declaration.pdf	733708 f28163e49c3df6567a2f2adb0c988b430d3aeb88	no	4
Warnings:					
Information:					
6	Fee Worksheet (PTO-06)	fee-info.pdf	8397 74eadc05aa95f124d80bb68d21db41ceda8b3569	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2246493		

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SYSTEMS, METHODS, AND DEVICES FOR REPLICATATION OF DATA ONTO WIRELESS SENSORS

Inventor: Clarke McAllister

PRIORITY CLAIM

This present application claims benefit under 35 U.S.C. Section 119(e) of U.S. Provisional Patent Application Serial Number 60/939,603, filed on 22 May 2007, the disclosure of which is expressly incorporated by reference for all purposes.Background

BACKGROUND

The present invention relates to a system, including methods and devices, utilizing wireless sensor devices and RFID (radio-frequency identification) transponders. Specifically, the present invention relates to a system incorporating novel devices and methods that enable point-of-use and on-demand commissioning of RFID transponder-equipped wireless sensors.

Radio-frequency identification (RFID) transponders enable improved identification and tracking of objects by encoding data electronically in a compact transponder or label. And, advantageously, the compact transponder or label does not need external, optically recognizable or human-readable markings. In fact, using the Gen2 EPC specification, a three-meter read-distance for RFID transponders is common – even on high-speed material handling lines.

Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object

with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder.

Current classes of RFID transponders rank into two primary categories: active RFID transponders and passive RFID transponders. Active RFID transponders include an integrated power source capable of self-generating signals, which may be used by other, remote reading devices to interpret the data associated with the transponder. Active transponders include batteries and, historically, are considered considerably more expensive than passive RFID transponders. Passive RFID transponders backscatter incident RF energy to specially designed remote devices such as interrogators.

Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces.

Wireless sensors, made using silicon circuits, polymer circuits, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave (SAW) materials to affect radio frequency or other signaling methods, communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods.

Additional examples of RFID transponders, wireless tags, and wireless sensors are more fully discussed this inventor's co-pending U.S. Patent Application Publication No. 2006/0080819, entitled "Systems and Methods for Deployment and Recycling of RFID

Tags, Wireless Sensors, and the Containers Attached thereto," published on 20 April 2006, which is incorporated by reference for all purposes in this document.

One problem of prior-art systems, such as conventional print labels or barcode systems, includes a requirement for line of sight and an overdependence on the optical quality of the label. Many factors can render such a label unreadable including printing errors, excess ink, insufficient ink, physical destruction of the markings, obstruction of the markings due to foreign matter, and, in extreme cases, outright deception by placing an altered label over the top of such a print label.

RFID transponder labeling eliminates the need for an optically readable print label and overcomes all of the shortcomings related to print quality and the need for line of sight to scan the label. Moreover, RFID transponder labels enable secure data encryption, making outright deception considerably less likely to occur. However, current RFID label systems have their own limitations as well.

One problem of prior-art systems is the total cost for encoding and applying wireless sensors. In the case of manual encoding and application of RFID transponders or wireless sensors, the cost is dominated by labor costs. Therefore business process integration plays a significant role in reducing the total cost of ownership of tagging objects. For example, in many supply chain applications, case picking is performed during the fulfillment of a customer order, this is an operation where individual cases or groups of cases are manually handled. Similarly in receiving of goods at retail, manufacturing, or distribution receiving docks are other business process where individual cases are manually handled. In either of these types of business processes where individual cartons are handled, there is an opportunity to encode and apply an RFID tag or wireless sensor to each carton on a selective basis.

Generating a unique serial number is imperative, and is required for EPCglobal RFID tagging implementations. Serialization requires a central issuing authority of numbers for manufacturers, products, and items to guarantee uniqueness and to avoid duplication of numbers. Blocks of numbers are distributed to remote locations globally.

Unless a product (or SKU) is serialized at one location, the numbering space is usually partitioned according to some method, or each remote location receives each number one-by-one. Either way, there is eventually a reconciliation of serial number usage with a granularity of either one or several numbers at a time.

A preferred method of generating unique serial numbers is to assign unique numbers in a central location, such as in a label converter facility where unique bar coded labels are printed. Each unique label is then packed and shipped to remote locations, usually either in sheets or rolls. Upon arrival at a manufacturing facility, rolls are loaded onto high speed label applicators that apply one serialized label onto each carton. As those serialized cartons move through the supply chain, they may eventually arrive at a case pick location, a receiving dock, or similar location where a serialized carton is selected for having an RFID transponder applied to it. Using a bar code scanner to read one or more bar codes sufficient information can be collected to uniquely encode that data into an RFID transponder and apply it to that carton.

The uniqueness of an identifier is critical to the success of almost any tracking system. Assuring uniqueness is not necessarily simple. A generically descriptive bar code can be matched to authorizations for selected numbering systems that provide additional data fields including a unique serial number or using algorithms that assure uniqueness through numerical representations of time and space.

Authorizations for one or more classes of objects are preferably loaded into encoder 15, 30, or 60, where such authorizations include data fields such as manufacturer ID, item reference, manufacturer code lengths, filter values (that designate packaging levels such as item, case, pallet, etc.), serial number starting point for a block, and other pre-determined parameters. Such information is preferably loaded into the memory of the encoder in advance of tag commissioning operations. Thus if loaded with information for more than one object class, encoder 15, 30, or 60 does not have sufficient information to proceed with encoding a transponder until a single object class is selected for the present RFID transponder to receive; an ambiguity therefore exists that is preferably resolved with

information entered by an operator using either a keypad or a bar code scanner. Reading printed indicia such as a bar code is a preferred method to resolve the ambiguity as to which object class the next RFID transponder is to receive a number from. Bar codes are used to eliminate errors and ambiguities that enable encoder 15, 30, or 60 to locally generate or replicate data for encoding into a data carrier such as an RFID transponder.

This type of data production and/or replication process is very fast and efficient. There is no absolute need to query a database in real time; hence there is no need for continuous wireless network connectivity. This simplification eliminates the possibilities for non-deterministic network delays. Non-deterministic delays are delays that cannot be guaranteed, usually due to the probabilistic nature of packet collisions that are common in Ethernet and WiFi. By eliminating the need to access a network database, the variable non-deterministic delays caused by changing database sizes, changing record counts, and database user load fluctuations are completely circumvented. Reduction or outright elimination of non-deterministic delays helps manual labor operate at maximum efficiency, allowing them to achieve a regular and dependable cadence in their transponder application processes.

Certain prior art systems use printer encoders to merge the printing and RFID transponder encoding operations into a single atomic transaction. This method is more expensive in every respect. It requires mobile distributed printing with nearly perfect networking implementations in order to achieve a smooth, easy, and regular manual transponder application process. This all comes at a higher price, size, and weight. Prior art implementations tend not to be mobile, as represented by U.S. Patent No. 7,066,667 issued to Chapman et al. on 27 June 2006 and include U.S. Patent No. 5,899,476 issued to Barrus et al. on 31 May 2005, or by U.S. Patent No. 6,246,326 issued to Wiklof et al. on 12 June 2001, describe a device that commissions an RFID transponder with a printed label. This approach, however, introduces unnecessary waste, cost, and propensities for error. There is a growing category of applications that do not require anything other than a custom-encoded RFID transponder. This prior art calls for the inclusion of label printer hardware and related consumable materials that are not necessary for many RFID

applications. Unneeded printer mechanisms create unnecessary complexities, size, and weight. In some instances this additional bulk hinders practical mobile applications. The result is that tagging solutions that include printing result in a higher total cost of ownership than a pure RF tag encoding system.

United States Patent Application No. 2003/0227528 by Hohberger et al. published on 11 December 2003 describes another attempt at improving demand-print labels by providing a device that combines two standard, die-cut rolls of media, one of which may be a roll of RFID transponders, and the second, print-label stock, in an attempt to provide on-demand smart labels. As with the aforementioned references, this approach adds unnecessary cost and complexity by combining RFID transponders with demand-printed labels.

United States Patent 5,382,784 by Noel H. Eberhardt issued on Jan. 17, 1995 describes a hand-held dual technology identification tag reading head with a gun-shaped housing and a trigger switch with two different ON positions. This patent discloses a hand-held device with a light transmissive window at one end, through which bar code scanning light passes and around which an RFID reading antenna is positioned. Eberhardt discloses embodiments for reading either bar code or RFID information from a label using a hand-held, dual-position trigger actuated device. This patent fails to offer any methods or devices for reading bar code information and using that information to encode an RFID transponder. In particular this patent fails to disclose any methods for conveyance of RFID transponders as part of a well-controlled transponder encoding process.

United States Patent 6,486,780 by Sharon R. Garber et al issued on Nov. 26 2002 discloses a hand-held item location device using RFID to seek and find library books. The disclosure emphasizes the importance of read range over great distances and large populations of RFID transponders, a quality that runs counter to the present invention that teaches how to localize radio frequency fields for programming only selected RFID transponders presented in succession for well-controlled encoding. Garber teaches techniques for searching and reading large collections of transponders in a library, not

semi-automated transponder commissioning processes. The physics of Garber's invention is poorly suited to programming anything other than one transponder at a time that is carefully isolated by great distances from any other RFID transponder to avoid programming information into the wrong transponder.

United States Patent No. 5,280,159 by Darald R. Schulz et al. issued on Jan. 18, 1994 discloses a pistol-grip RFID reader with a separate hand-held data terminal which together are used to read RFID transponders. Again this invention, like other prior art fails to teach a viable method or apparatus for reliable commissioning large volumes of RFID transponders.

Douglas Walter Main and Tim A. Kassens disclose, in U.S. Patent No. 5,763,867 issued on June 9, 1998, a hand-held data terminal with various scanner modules for the purpose of data acquisition. This patent, along with there subsequent and related disclosure in U.S. Patent No. 5,962,837 issued on October 5, 1999, are examples of hand-held data collection devices for sweeping an RFID interrogation beam about an broad area around an operator (for example, a storage room or bulk-shelf location in a warehouse). This operating distance, however, lies beyond a close-range distance of a couple of inches and is limited to interrogation and data-acquisition, not encoding. Further, such devices are unable to limit their communication to RFID transponders that are in close-proximity of a few inches of the operator holding a hand-held encoder that includes a near field coupler.

Curt L. Carrender, Jeremy A. Landt, and Donald F. Speirs disclose in their December 15, 1998 U.S. Patent No. 5,850,187 another RFID reader that is designed "to allow for identification of objects at locations removed from the remote host unit". This, along with their June 20, 2000 U.S. Patent No. 6,078,251, "retrieve object identification data from a selected object." However, these disclosures fail to address controlling the inherently propagative nature of the electric fields of radio waves in order to restrict their range to within the width of a single transponder.

United States Patent No. 6,195,053 issued to Kodukula and Ackley on 27 February 2001 discloses an antenna consisting of a U-shaped conductive bracket, supports an optical reader and communicates with RFID transponders. However, this disclosure does not address the need for shielding and near-field coupler design to optimize the inherent long-range characteristics of the RFID transponder.

Helton and Wiklof's March 19, 2002 U.S. Patent No. 6,357,662 discloses a device that a user can selectively control a bar code scanner and an RFID reader to acquire information about an asset. However, this disclosure does not address creating and encoding a unique identifier for attachment to and subsequent identification of the asset.

Zebra Technologies Corporation's Principal Engineer Boris Y. Tsirline is the principal inventor of U.S. Patent 6,848,616 (issued on 01 February 2005 to Tsirline et al.) with the title "System and method for selective communication with RFID transponders". In that patent the inventors describe a system having an RFID transceiver that is adapted to communicate exclusively with a single RFID transponder. They disclose that the system includes a printhead and a magnetic flux generator having a planar coil formed as a trace upon a first layer of a printed circuit board. As with the aforementioned references, this approach adds unnecessary cost and complexity by combining RFID transponders with demand-printed labels, and uses a near field coupler design that does not concentrate the magnetic flux as selectively as the present invention disclosed herein.

U.S. Patent 7,223,030 by Fessler et al (issued on 29 May 2007) and U.S. Patents 7,249,819 (issued on 31 July 2007) and 7,187,294 (issued on 06 March 2007) both by Burdette et al, (lead inventors of Lexmark International, Inc.) disclose a printer/encoder system, and attempt to overcome the problems of detecting and locating an RFID inlay that is embedded somewhere in a printed label stock. The present invention overcomes that problem by eliminating the (larger) label, and only encoding RFID transponders, which generally have a physical outer dimension that very closely matches the embedded RFID transponder inlay dimensions.

United States Published Patent Application No. 2007/0150219, published on 28 June 2007 by Cawker et al. of Weyerhaeuser Company, discloses a method of applying and verifying RFID transponders using a conveyor for moving objects along a predetermined path. Their invention makes use of cameras to identify the proper position for a label. The present invention overcomes the size and cost requirements of a system comprised of a conveyor and cameras by using human operators for motion and simple reflective beam sensors for spatial positioning and label placement.

So, despite recent advances in RFID technology, the state-of-the-art does not fully address the needs of simple, FAST, efficient, economical, smooth, reliable commissioning of RFID transponders and wireless sensors. large-scale adoption and deployment of RFID transponders depends on thousands of distributed locations that implement simple and efficient manual transponder commissioning processes. Such systems should further include means and processes for efficient commissioning of batches of RFID transponders, without the need for realtime wireless connectivity to an infrastructure database on a transponder-by-transponder basis.

SUMMARY OF THE INVENTION

The present invention overcomes the shortcomings of the prior-art attempts and, accordingly, provides systems, methods, and devices that commission RFID transponders on-demand and at a point-of-use in a compact solution that is well-suited to mobile use in multiple applications. The present invention is used for reading data from or encoding data onto wireless transponder data carriers with no external authorizations or queries required on a transponder-by-transponder basis. Additionally this invention teaches a preferred method and apparatus for commissioning RFID transponders without requiring continuous use of a screen or keypad to control operations. Further advantages of the present invention will be well-appreciated by those skilled in the art upon reading this disclosure including the appended figures of the drawing.

In one preferred embodiment, the present invention includes a method for commissioning RFID transponders comprising: Providing a roll or sheet of RFID transponders; providing a cartridge or other pre-packaged self-contained supply of RFID transponders; providing an encoder; inserting the roll or sheet in the cartridge or other pre-packaged self-contained supply of RFID transponders; coupling the cartridge to the encoder; acquiring information to encode from printed indicia; encoding the information on at least one RFID transponder; and adapting the process of attachment of the encoded transponder to the target surface along a vector that is nearly parallel to the target surface based upon real time feedback from the surrounding environment.

DRAWINGS

Fig. 1 is a block diagram of the system and environment according to one embodiment of the present invention.

Fig. 2 is a top view of a possible RFID transponder according to one embodiment of the present invention.

Fig. 3 is a material stack specification of an RFID transponder according to one embodiment of the present invention.

Fig. 4 is a side view of a web of release liner containing RFID transponders, provided on a source roll, stretched tight around a peel device, and advanced forward onto a take-up reel according to one embodiment of the present invention.

Fig. 5 is an orthogonal view of a mobile RFID encoder according to one embodiment of the present invention.

Fig. 6 is a side view of a handheld mobile encoder with an integrated bar code scanner according to one embodiment of the present invention.

Fig. 7 is a diagram of a wearable wireless bar code scanner according to one embodiment of the present invention.

Fig. 8 is a flow chart of a first method according to the present invention.

DESCRIPTION OF THE INVENTION

Making reference to various figures of the drawing, possible embodiments of the present invention are described and those skilled in the art will understand that alternative configurations and combinations of components may be substituted without subtracting from the invention. Also, in some figures certain components are omitted to more clearly illustrate the invention. In some figures similar features share common reference numbers.

To clarify certain aspects of the present invention, certain embodiments are described in a possible environment – as identification means for containers. In these instances, certain methods make reference to containers such as loaded pallets, paperboard boxes, corrugated cartons, pharmaceutical containers, and conveyable cases, but other containers may be used by these methods. Certain embodiments of the present invention are directed for use with steel drums, commercial corrugated shipping cartons, tagged pallet-loads of shrink-wrapped cases, consumer-goods packaging, consumer goods, automobile windshields, industrial components, or other methods of identifying objects using RFID transponders or wireless sensors, or both. In certain embodiments the target surface to which a transponder will be attached is a container. In some applications the target surface is moving while the encoder device is stationary. Furthermore the moving target surface may be objects on a conveyor. In yet other embodiments the target surface may be a web of release liner from which encoded transponders will be later removed and applied to an object for identification.

Some terms are used interchangeably as a convenience and, accordingly, are not intended as a limitation. For example, transponders are used interchangeably with the term tags and the term inlay is used interchangeably with inlet. This document generally uses the term tag or RF Tag to refer to passive transponders, which do not include a battery, but include an antenna structure coupled to an RFID chip to form an inlay which is thin and flat and may be constructed on top of a layer of foam standoff, a dielectric material, or a folded substrate structure. Passive transponders typically include a pressure-sensitive adhesive backing. However, certain aspects of the present invention work equally well

with active transponders. A third type: a battery-assist tag is a hybrid RFID transponder that uses a battery to power the RFID chip and a backscatter return link to the interrogator. Programmable transponders enable data to be read, written or stored more than once.

Suitable environments or applications for certain aspects of the present invention include shipside receiving of automobiles, case picking operations that include selective tagging process steps, receiving untagged cartons into an RFID-enabled retail store or a manufacturing plant.

The systems, methods, and devices of the present invention utilize an RFID transponder or wireless sensors as a component. Certain RFID transponders and wireless sensors operate at Low Frequencies (LF), High Frequencies (HF), Ultra High Frequencies (UHF), and microwave frequencies. HF is the band of the electromagnetic spectrum that is centered around 13.56MHz. UHF for RFID applications spans globally from about 860MHz to 960MHz. Transponders and tags responsive to these frequency bands generally have some form of antenna. For LF or HF there is typically an inductive loop. For UHF there is often an inductive element and one or more dipoles or a microstrip patch or other microstrip elements in their antenna structure. Such RFID transponders and wireless sensors utilize any range of possible modulation schemes including amplitude modulation, amplitude shift keying (ASK), double-sideband ASK, phase-shift keying, phase-reversal ASK, frequency-shift keying (FSK), phase jitter modulation, time-division multiplexing (TDM), or Ultra Wide Band (UWB) method of transmitting radio pulses across a very wide spectrum of frequencies spanning several gigahertz of bandwidth. Modulation techniques may also include the use of Orthogonal Frequency Division Multiplexing (OFDM) to derive superior data encoding and data recovery from low power radio signals. OFDM and UWB provide a robust radio link in RF noisy or multi-path environments and improved performance through and around RF absorbing or reflecting materials compared to narrowband, spread spectrum, or frequency-hopping radio systems. Wireless sensors are reused according to certain methods disclosed herein. UWB wireless sensors may be combined with narrowband, spread spectrum, or frequency-hopping inlays or wireless sensors.

A. SYSTEM AND ENCODER OVERVIEW

FIG-1 shows one system 10 according to the present invention in a typical environment, such as a packaging or distribution facility wherein a collection 16 of entities 17 with visual external labels 19 exist and a sub-set (or all entities) need to be associated with a wireless RFID transponder, tag, or label 18. The object 17 needing an RFID transponder 18 could be a packing container. As entities 17 are pulled from the collection 16, an optical reader 13 or 15F reads and decodes the machine readable symbols printed on visual external label 19.

The present invention includes a system for commissioning wireless sensors at a point of use and on-demand. For example, in one embodiment, the present invention incorporates a mobile encoder device 15, 30, or 60 which may be held in the hand of an operator. Mobile encoder device 15, 30, or 60 is preferably powered by rechargeable batteries or a fuel cell.

System 10 includes at least four possible intermittently connected entities if they are present and connected: mobile encoder 15, remote computer or mobile phone 12, optical reader 13, and headset 14. A preferred short range wireless connection means 15A such as a WLAN (Wireless Local Area Network) or PAN (Personal Area Network) may be established from time to time between mobile encoder 15 and remote computer or mobile phone 12, optical reader 13, and/or headset 14. There is a preference for low power wireless connection apparatus within mobile encoder 15 so as to realize the greatest possible battery life in light weight mobile encoder 15. Mobile encoder 15, 30, or 60 is in intermittent wireless communication with a mobile phone or computer 12 typically at close range through wireless communication means 15A. Database and associated host computer 11 may be housed at a remotely located facility that may optionally be accessed over a large distance through remote computer or mobile phone 12. A mobile phone is a preferred bridge between two or more wireless networks, for example a PAN and a wireless subscriber network that supports wireless data services for ultra mobile and

remote tagging applications. Continuous wireless connection to a host database is not required for ongoing tag commissioning process steps disclosed herein.

A preferred embodiment for quasi-autonomous transponder encoding authority is realized when large pre-authorized blocks of serial numbers are made available to encoder 15 or 50 to utilize on object classes as objects of a class are presented for tagging. A preferred method of providing large blocks of pre-authorized blocks of object class serial numbers is to subdivide the entire object class serial number space into sectors that are defined by a limited number of MSB's (Most Significant Bits) of the serial number field. In a preferred embodiment serial number block sizes are sufficient to operate encoder 15 or 50 for extended periods of time without any further external authorization steps. For example autonomous operation for a week or more is possible with sufficiently large block sizes. Block allocations are preferably assigned with reference to how many encoders 15 or 50 are authorized to operate within the facilities of the owner of certain object class numbers.

GS1 is a leading global organization dedicated to the design and implementation of global standards and solutions to improve the efficiency & visibility of supply and demand chains. GS1 defines epcGlobal SGTIN number fields as having a company prefix, an item reference, a partition value, and a filter value that comprise the object class information. A unique serial number is then added to that information to create each unique instance within each object class.

In a preferred embodiment, a block is allocated and managed using three numbers: a starting number that is the first serialized instance of a block, a block size which represents the total number of instances in the block, and a counter or index that represents how much of the block has been used during an encoding process. Using these three numbers and an optional lock bit, a simple database of object class authorizations can be built.

A preferred embodiment utilizes RFID authorization transponder 18A and a printed substrate 18B to physically handle object class serial number issuance

authorizations. Authorization transponder 18A is interrogated by transponder reading/encoding means 15H. Preferred embodiments use the 96-bit EPC memory bank for specifying the block starting number, including the company prefix, item reference, partition value, filter value, and base serial number. The User Memory bank is used to hold and transfer the block size (preferably 16-bits), counter or index value (preferably 16-bits), a 16-bit header to identify the transponder as a valid member of a class of authorization transponder, a lock bit, and a CRC value to detect errors in all of the data fields. For example a CRC error would detect errors in storage, transponder selection, or data transmission. In preferred embodiments reading of data blocks from more than one RFID transponder would be avoided by selecting a transponder, checking that it is the correct type, contains valid authorization data, contains a valid header that signifies that it is an RFID authorization transponder 18A, and that all data read correctly verifies with a dedicated error detection field such as a CRC.

RFID authorization transponder 18A is preferably adhered to printed substrate 18B so that an operator can visually identify what object class or SKU is managed by the affixed authorization transponder 18A. A picture, icon, bar code, or human readable symbols are all useful for identifying the object class. An operator presses a button or scans a barcode that prompts encoder 15 to read and store the tagging authorization held by authorization transponder 18A. Once read, authorization transponder 18A is preferably electronically marked as 'consumed' or 'locked' by transponder encoding means 15H. EPC transponder ID fields that identify a specific type of chip are preferred for selecting the proper transponder, even when other RFID transponders are within range of the antenna or near field coupler of transponder encoding means 15H.

A collection of authorization transponders 18A comprises a database that can be physically transported without the need for a wireless communications link to encoder 15. Once read, database records are preferably stored in internal memory means 15G. In a preferred embodiment 12 to 14 bytes of Flash memory is used for each record to allocate 250 to 65536 instances of an object class, whereby the first byte of an EPC number is a fixed header value can be replaced in Flash memory by 8 bits of the allowable block size.

One or two bytes in RAM are used to count or index through the block allocation as it is used. Thousands of data records of this type can easily fit into the memory space of an economical 8-bit microcontroller. In a preferred embodiment, where the GS1 SGTIN-96 header is replaced in memory with an 8-bit block size authorization, 2000 records for authorizing up to 255 instances per record, can be used to safely manage at least 500,000 tagging records using 24,000 bytes of Flash and 2000 bytes of RAM. Other embodiments using more bits to authorize and control larger blocks of numbers is possible at a slightly larger expense of memory.

Preferred embodiments of encoder 15, 30, or 60 will encode all of the GS1 identity types. Such types include the General Identifier (GID-96), Serialized Global Trade Identification Number (SGTIN), Serial Shipping Container Code (SSCC), Serialized Global Location Number (SGLN), Global Returnable Asset Identifier (GRAI), and the Global Individual Asset Identifier (GIAI). Other preferred embodiments are used to encode numbers that are a part of other numbering systems.

Data records are preferably loaded and stored through commands that are transmitted over wireless communication means 15A. In preferred embodiments, batch mode commands can be used in any of three ways: (1) to immediately affect the current operation by starting a batch tagging process for a specified SKU or object class; (2) to store authorizations in memory means 15G; and (3) to store authorizations in stored-value RFID transponder 18A.

When external connection is necessary, wired or wireless communication with an external host or numbering authority is established. Wireless communication means 15A is preferably a Wi-Fi or Bluetooth connection. A wireless node of a Bluetooth personal area network is used according one embodiment of the present invention. Model 100-SER manufactured by EmbeddedBlue of Poway, California and the BISMS02 from EZURiO Ltd., a subsidiary of Laird Technologies, Inc. of Chesterfield, Missouri are examples of preferred OEM Serial Bluetooth modules. Other wireless interfaces may alternatively be

used to achieve Serial Port Profile and other types of connectivity between encoder 15 and remote computer or mobile phone 12 and/or optical reader 13.

Other preferred embodiments of mobile encoder 15 and system 10 replace wireless communication means 15A with a cable, resulting in an embodiment of mobile encoder 15 with a tethered bar code scanner. A key advantage of an alternative embodiment of system 10 that utilizes a wired connection to optical reader 13 instead of wireless communication means 15A is a very simple solution having virtual immunity to any surrounding RF interference that might raise the noise floor hindering wireless communications.

The operator can cause mobile encoder 15, 30, or 60 to commission a transponder by scanning certain printed bar code symbols received through optical reader 13 which is connected to encoder 15 through wireless communication means 15A. Or alternatively internal optical reader 15F is used to scan printed bar code symbols. In either case data from optical reader 13 or 15F is delivered to processing means 15B. Certain preferred embodiments of system 10 use optical scanners with self-contained symbol decoding capabilities to deliver decoded symbol information to processing means 15B. Certain other embodiments of system 10 relies on processing means 15B to conduct some or all decoding operations to derive information from scanned symbols.

The information derived from the optical reader 13 or 15F is used by mobile encoder 15 to either directly or indirectly encode data into RF transponder 18 while it is still physically within mobile encoder 15. Mobile encoder 30 uses external optical reader 13, and alternatively mobile encoder 60 uses internal optical reader 15F, as embodied in reader 66 of Fig. 6. Preferred embodiments of optical reader 66 are mechanically aligned relative to transponder encoding means 15H or more specifically with the antenna or near field coupler of RFID interrogator 64A. Spatial alignment assures that an operator will be able to comfortably scan bar codes and then encode and apply RFID transponders along a line of movement such that the operator can easily assure proper placement of encoded transponders.

Symbol decoding functions may be physically, electrically, or logically separated from symbol scanning operations. One preferred embodiment of optical reader 13 is a model CHS-7M, CHS-7P, CRS-9M or CRS-9P Bluetooth ring scanner 77 shown in Fig-7 all manufactured by Socket Communications of Newark, California. Ring scanner 77 if not completely self-contained with battery and wireless connection is, in a preferred embodiment tethered to a battery pack and wireless interface 78 strapped to the arm 79 of an operator. Certain preferred embodiments designate ring scanner 77 as the master node of a Bluetooth network. As a master, ring scanner 77 will preferably pair with a specific mobile encoder designated by a unique identifier that is also encoded onto a bar code affixed to the external housing of mobile encoder 15. Ring scanner 77 is used to scan that bar code and decode it to acquire the unique 12-hexadecimal digit Bluetooth address to perform a Bluetooth pairing operation that results in that instance of mobile encoder 15 becoming a slave on that network. Then whenever a bar code 19 is scanned, the Bluetooth-paired instance of mobile encoder 15 is notified of the new bar code data to support RFID transponder encoding operations or command inputs.

Processing scanned commands involves a processing step to determine that a bar code should be interpreted as a command or configuration instructions rather than as bar code 19 that identifies an object that is to be tagged. Commands are used to alter the flow and operation of mobile encoder 15.

Fig. 6 is a preferred embodiment of a mobile encoder wherein optical reader 66 is an OEM bar code scanner manufactured by such companies as Intermec or Motorola and is a preferred embodiment of optional internal optical reader 15F shown in Fig. 1.

In a preferred embodiment one or more bar codes are pre-printed and applied as symbol 19 on entity 17 in a manufacturing facility or other suitable location. Such bar codes are described in ISO/IEC draft document PDTR 24729-1 and are more generally referred to as one or more bar codes having Application Identifiers (AI) 01 and 21 encoded into them, and preferably include header information and other control bits that are required for certain protocols. AI 01 is used to represent the Stock Keeping Unit

(SKU) as a GS1 Global Trade Identification Number (GTIN). AI 21 is used to serialize the SKU. Together the two AI's are used to specify a GS1 serialized GTIN (SGTIN). Bar codes can also be used to specify data payloads that use numbering systems other than the EPC numbering system. The Application Family Identifier (AFI) also plays an important role in designating alternative numbering authorities.

This preferred method that is described by the flow chart in Fig. 8 will allow batch mode operation where there are at best intermittent connections with remote computer 12. This preferred method allows existing label application and/or printing hardware located on existing manufacturing lines to provide in printed symbolic form all data that would be encoded into an RF transponder. By providing printed symbols, manufacturers do not have to incur either the cost of that transponder or the special equipment that is required to encode and apply RF transponders.

Optical reader 13 or 66 is described above and is used as the primary source of real time data input for the mobile encoding system that uses an embodiment such as mobile encoder 30 or 60. Optical reader 13 or 66 is also preferably used to scan special bar codes that instruct mobile encoder 15, 30, or 60 to perform certain prescribed functions which will be described below.

Certain preferred embodiments of system 10 include headset 14 which may be a headset worn by the operator or a Bluetooth-linked loud speaker that is mounted to a pallet jack or fork lift truck. Headset 14 is optionally used by system 10 to give instructions, confirmation signals, or warnings to the operator. Synthesized speech or audible tones are used to interact with the operator through headset 14.

In these aforementioned embodiments, the mobile encoder 15 is a portable device that can be easily mounted in a fixed location, carried such as mobile encoder 60, or worn by a human operator such as mobile encoder 30, or hung from a suspended retractable tool cable. As such, the mobile encoder 15 includes an internal power source 15E or 67D such as a rechargeable lithium-ion battery. Further details of possible configurations of the mobile encoder will be further detailed in subsequent sections of this disclosure.

In the system 10 of Figure 1, the mobile encoder 15 carries a supply of un-commissioned, blank, or securely encodable RFID transponders 15J, 25, 43, or 61E. Once the desired data is accumulated by mobile encoder 15 it advances the transponder commissioning process by encoding an RFID transponder using transponder transport means 15C and transponder encoding means 15H and any one of several preferred encoding algorithms to program an RFID transponder or label 18 for the object 17. Transponder separation means 15D is used to separate a properly encoded transponder 18 from release liner conveyance web 22 by breaking the bond at adhesive layer 21D on the leading edge of transponder 18. Transponder separation means 15D is preferably a peel device 23 as shown in Fig. 4 or peel device 62B in mobile encoder 60. Peel devices 23 or 62B are preferably made from anti-static plastic, metal, or other material that will conduct electrostatic charge away from transponder 18 and release liner 22. The commissioned transponder or label 18 is associated and applied to the target object by known means including a human operator or a machine transfer as will be further described in this disclosure.

B. RFID TRANSPONDERS

Fig-2 shows a possible RFID transponder 18. RFID transponders, essentially, comprise an RFID integrated circuit (IC) device (or "chip") 20 bonded to an antenna apparatus 21C, formed on a substrate that is often plastic such as Mylar (a registered trademark of E. I. Du Pont De Nemours and Company Corporation of Wilmington Delaware, polyester, or PET. One way to form an antenna structure is to etch copper from a substrate. An alternate way includes printing multiple layers of conductive ink onto a substrate. One additional method includes stamping UHF antennae from thin sheets of aluminum or by selective aluminum deposition onto a substrate. In certain embodiments, RFID transponders and wireless sensors are recovered from waste streams for reconditioning, reprogramming, and reuse.

Other suitable RFID transponders include designs that combine a dielectric spacer behind inlay antenna 21C to create a transponder that performs well over a broad range of

packaging conditions or objects by separating the metallic antenna inlay 21C from surrounding metals that may detune it, or liquids that may absorb RF energy from it. The dielectric material is a foam standoff material or an expanding mechanical structure that provides lift from the target object and also a more robust structural integrity to additionally protect the transponder from mechanical damage.

In preferred embodiments, hundreds or thousands of instances of RFID transponder 18 are manufactured on a continuous web of flexible material with a spatial separation between them, preferably at regular intervals. Certain preferred embodiments use adhesive-backed transponders 18 adhered to release liner 22 as shown in Fig-4, while other embodiments use the transponder material as its own conveyance that is severed from the rest of the web at predetermined locations, preferably after encoding and verifying transponder 18 is properly functioning.

In preferred embodiments of the present invention, the face stock material has a physical outline that is not much larger than the physical outline of the inlay itself. This is in contrast to labels which can have at least twice the surface area of the inlay or a direct-printed antenna structure in order to provide space for printed information. By having a label outline that is so much larger than the inlay surface area, there are a many possible combinations of inlay placement within the boundaries of a large printable label. This creates a problem and a challenge for printer/encoders that have to find and locate an inlay before attempting to encode it. By contract, the present invention uses the detectable optical characteristics of the tag's minimal physical outline to position the transponder for encoding. This transponder positioning method is superior and an improvement over prior art that uses printed label stock as a carrier for RFID inlays wherein the physical dimensions of printed labels are not in any way a reliable indication of the location of the RFID inlay within the label. This is another example of how demand label printing further complicates RFID transponder encoding.

In one embodiment that is an exception to the minimal outline transponder design and positioning method described above, is transponders that have a very long physical

shape that can be used to create a loop to secure an encoded transponder to a tree, a bush, or the handle of a piece of luggage. Preferred embodiments of such transponders are folded or rolled in order to package them onto a dispensing roll or packaged into a magazine or cartridge in a fan fold pattern. The resulting bundle of back-and-forth 'Z' folded or fan folded face stock material results in a compact package that minimizes the amount of release liner that needs to be wasted for each tag. Each z-folded transponder is then easily encoded and dispensed from encoder 15, 30 or 60. Transponders that can be encoded, verified, dispensed, and unfolded are advantageously used in forestry, ornamental nurseries, and airline baggage tracking applications where manual tagging is required.

In another embodiment, transponder 18 is pushed out of encoder 15 instead of being pulled out through tensile extraction. A transport mechanism for pushing transponders utilizes a gripping method such as friction or teeth that penetrate the webbing. Although there is a risk of jamming or mutilating the webbing, the advantage is that there is no need for a release liner to pull the transponder supply through encoder 15 using tensile extraction. A preferred 'tractor feed' embodiment mitigates the risk of web mutilation by utilizing a regular pattern of precut holes along one or both edges of the webbing, into which cog members of a drive mechanism engage to advance the webbing. A tractor feed embodiment is part of Transponder Transport Means 15C of Fig-1 whereby a motor and gear train delivers drive torque to the web through friction rollers, penetrating teeth, cogs, or other mechanical engagement means. In such an embodiment, the preferred transponder separation means is a web cutter that is used to separate encoded transponders from unencoded tags. A web cutter can be either active or passive, in other words cutting force can originate with a motorized mechanism or with an operator's handling during dispensing and transponder detachment. A row of plastic or metal saw teeth is a preferred embodiment of a passive transponder separation device.

In another preferred embodiment, transponder 18 is manufactured on a high speed press, a bar code is printed onto face stock of transponder 18 and information that is representative of that bar coded information is also encoded into microchip 20. Then

encoder 30 or encoder 60 preferably read that information from RFID microchip 20 and associate it with a transponder commissioning process that may or may not include the programming of additional information into RFID microchip 20. This is a novel method of reading bar coded information on transponder 18 without using a bar code scanner to do so within encoder 30 or 60.

In one embodiment, additional transponder layers include a thin and flexible energy cell comprising two non-toxic, widely-available commodities: zinc and manganese dioxide. One suitable energy cell is developed by Power Paper Ltd. of 21 Yegia Kapayim Street, Kiryat Arye, Petah Tikva, P.O.B. 3353, ISRAEL 49130, and incorporates an innovative process that enables the printing of caseless, thin, flexible and environment-friendly energy cells on a polymer film substrate, by means of a simple mass-printing technology and proprietary inks. The cathode and anode layers are fabricated from proprietary ink-like materials that can be printed onto virtually any substrate, including specialty papers. The cathode and anode are produced as different mixes of ink, so that the combination of the two creates a 1.5-volt battery that is thin and flexible. Unlike conventional batteries, this type of power source does not require casing.

Fig. 3 illustrates how a top layer of an RFID transponder assembly comprises a paper face-stock 21A, which is a very low-cost material but also is the least environmentally resilient. UV-resistant plastic face-stock generally provide the best survivability in outdoor and rough-service environments, and also provide the best protection for the RFID transponder assembly.

A bottom layer of pressure-sensitive adhesive (PSA) 21D often is used for attachment of transponders to objects and often is referred to as a wet inlay or a wet tag or a wet transponder because of adhesion layer 21B. A web of release liner 22 is used to convey transponders 18 through the transponder encoding process.

Fig.4 also shows how transponders 18 are rolled onto reels in preparation for encoding. Source roll 25 contains a supply of transponders ready for encoding. Release liner 22 conveys transponders 18 around peel device 23. Unless transponders 18 are

mechanically prevented from rotating around peel device 23, they are conveyed onto take-up roll 24. Take-up reel 24 advances forward while source roll 25 lags behind due to drag created by a clutch, brake, motor or other back-torque generating device. Opposing torques of take-up reel 24 and source reel 25 result in tension in release liner web 22. Shape memory in face stock 21A preferably prevents transponder 18 from remaining adhered to release liner 22 as it passes over peel device 23, resulting in the leading edge lifting off and separating from webbing 22. If take-up reel 24 continues to advance, and transponder 18 does not collide with another object, its attachment to release liner 22 on its trailing edge will result in that transponder being passed completely around peel device 23 onto take-up reel 24. Full path rotation is preferably reserved for transponders that fail to properly encode desired information; and is therefore intended to be a reject process for failed transponders. Preferred embodiments result in tension created in web 22 in a process of tensile extraction of transponders from a source reel and selective transfer of good transponders onto an object or a person's finger. Mobile encoder 30 depends on a person's finger to prevent transponders 18 from rotating around peel device 23. Mobile encoder 60 depends on a target object such as carton face 68 to prevent transponder 63B from rotating around peel plate 62B on a path toward take-up reel 61J.

When the conveyance of RFID transponders results in the positioning of a transponder relative to a near field coupler within a signal null, the transponder and transport webbing are preferably nudged forward or backward to improve the signal coupling. This is preferably accomplished by momentarily activating the motor and transponder transport means 15C.

C. MOBILE ENCODER

Figure 1 shows a system 10 according to one embodiment of the present invention including a mobile encoder 15. Fig 5 shows a preferred embodiment for a mobile encoder. Mobile encoder 30 is comprised of housing 32, belt clip 34, antenna 36, on/off switch 33, system ready LED 37, data ready LED 38, and transponder ready LED 39. It is further comprised of auxiliary switch 40, and charger plug 41. A cartridge or other pre-packaged

self-contained supply of transponders 42 is preferably latched, snapped, clicked, popped, inserted, slid, or releasably mounted to the body of housing 32. The cartridge preferably includes a take-up reel 44 for non-dispensed RFID transponders, and a port through which blank or securely encodable transponders emerge from source reel 43. The source reel is preferably comprised of a core which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge 42 to form an axle around which release liner and transponders are wound and subsequently unwound.

In certain preferred embodiments source reel or roll 43 is constructed using materials such as non-petroleum-based plastics, laminated paper layers, and materials primarily comprised of natural fibers. In another preferred embodiment the entire pre-packaged self-contained supply of unused transponders is transported to mobile encoder 15, loaded into it, consumed, and disposed of preferably without generating landfill waste.

A key aspect of this invention is a complete pre-packaged, pre-assembled, pre-threaded, self-contained supply of encodable transponders, preferably unlocked with cryptographic access methods. The supply is preferably configured for efficient transportation and shipping, conveyance to a work site, and easy loading into mobile encoder 15, preferably in a single fluid motion.

Fig. 6 is a preferred embodiment of system 10 wherein printed symbols are optically scanned by internal optical reader 66. The embodiment shown in Fig. 6 uses a preferred method of sensing the linear motion of mobile encoder 60 across a target surface by using an optical mouse sensor 65. Such devices are commonly used to track the hand movements of the operator of a computer. Motion in either the X or Y direction is translated into numerical displacement representations which when timed are converted into linear velocities. Tracking and processing the primary axis of motion parallel to the major axis of the release liner, the web speed is preferably controlled by processing means 15B and transponder transport means 15C such that transponder 63A advances at a rate of speed that matches the velocity of the entire mobile encoder across the target surface. Optical mouse 65 tracks displacement across the target surface and also acts as a tamp

head to strengthen the adhesive bond of each freshly applied tag. The process of attachment of the encoded transponder to the target surface is along a vector that is nearly parallel to the target surface at a speed that is based on real time feedback from the surrounding environment as sensed by the optical mouse or other sensor. Optical mouse sensor 65 preferably illuminates its target surface with either a LED (Light Emitting Diode) or a laser. Avago Technologies of San Jose, California manufactures a variety of mouse sensors, both LED-based and laser-based. Laser illumination provides smooth and accurate motion sensing across a variety of surfaces. The model ADNS-6150 small form factor lens working in conjunction with the ADNS-6530 integrated chip-onboard laser sensor and single-mode vertical-cavity surface emitting laser can be used to not only detect motion in the X and Y directions, but also to some degree in the Z direction. Displacement along the Z (depth) vector is reported by the decrease in the number of resolvable features within the field of view as the target surface fades away from the optical focal point. That measurement is reported in the surface quality (SQUAL) register.

Optical mouse sensor 64B is used to measure the linear velocity of transponders as they move along the path of the release liner toward peel device 62B, as well as sense the gaps and edges between transponders 63A and those adjacent to them. The physical outline 18 of transponders 63A are a reliable indication of the location of RFID inlay 21C located within each transponder 63A and enhance system performance with reliable positioning relative to near field coupler 64A2. The angular velocity of motor 67B and gear train 67A are controlled to achieve a linear transponder velocity that matches the velocity of the mobile encoder itself as it moves across the target surface. Therefore an operator with a fast hand motion is just as successful as a person with a slower hand motion, both will result in a transponder that lays flat, co-planar with the target surface, void of kinks or wrinkles that are characteristic of a poorly controlled transponder application process. In either case, transponder dispensing by transponder transport means 15C will not initiate until optical mouse sensor 65 preferably illuminates the target surface and detects a minimum number of valid features as reported by the SQUAL register internal to the ADNS-6530.

RFID Interrogator 64A encodes RF transponders using either LF (Low Frequency), HF (High Frequency), UHF (Ultra High Frequency), or microwave radio energy. Transponders may be powered by radio energy, light, or stored energy from a source such as a battery. RF coupling is preferably through a near field coupler, an inductive loop or other suitable transducer 64A2 connected to interrogator 64A to focus RF energy on a small area within mobile encoder 15, 30, or 60.

Certain preferred mobile encoder embodiments will not encode RF transponders that fail authenticity tests. In a like manner, RF transponders will preferably not allow themselves to be programmed unless the interrogator can successfully unlock its secured memory banks. This is a preferred method of protecting transponder cartridge and mobile encoder supply chains from counterfeits and knock-offs. Mobile encoder 15 and the transponders loaded into it will only be successful in exchanging certain data if certain data encryption and challenge response protocols are adhered to. In a preferred embodiment each authorized RFID transponder converter company uses one or more encryption keys to generate passwords that lock the RF tags, whereby preventing them from being programmed unless they are unlocked using the same password. Passwords of this type are specified in the EPC Gen 2 specification and in ISO standards. The passwords are preferably generated by processing means 15B using a public key from publicly readable data such as an asset number or a transponder serial number. A shared private key is then used by an encryption algorithm such as AES in order to create a password or a collection of passwords that can be used to lock or unlock one or several RF tags. Other methods may be used that provide a high degree of certainty that the both the transponders and the mobile encoders are from legitimate sources. Individual failures or patterns of authentication failures are preferably reported to a central database through wireless communications means 15A for subsequent fraud investigation.

Peel device 62B is part of the mobile encoder and preferably rotates or pivots about pivot point 62A into position 62C and a corresponding position (not shown) in Fig 6. When cartridge 61 is inserted into applicator body 67F the web is held in a non-interfering position by guide post 61F and its accompanying cartridge guide post such that

peel device 62C can self-thread around the transport web without human effort. This is an improvement over prior art where a peel device is an integral part of the pre-packaged self-contained supply of transponders and requires threading during the cartridge manufacturing process.

Peel device 62B preferably contains a shield on the outer face of the blade, through which radio energy will not pass to encode or interact with a rejected transponder 63B. The dielectric material of the peel device 62B provides sufficient separation from a transponder within the encoding zone and the shield on the back side of the peel device. This is another advantage over a peel device that is part of the cartridge, where the cost sensitivity is much more acute. The shielding on the back side of peel device 62B may be any suitable metal attached or adhered in any reliable or economical manner against the non-conductive dielectric structure of the peel device.

Rejecting transponder 63B requires that mobile encoder transponder peel device 62B have sufficient clearance from target surface 68 as determined by optical mouse sensor 65 using either the SQUAL reading or the shutter readings. Such readings are used to determine if there is sufficient space to advance and rotate a bad transponder 63B around the distal end of peel device 62B.

Several operator indicator lights 67E preferably include a system-ready LED, data-ready LED, tag-ready LED, and battery-ready LED on the housing with appropriately positioned light pipes to enable the operator an easy view of the mobile encoder device status.

Also included on the exterior of the housing are an external, power-cord receptacle so that the on-board lithium-ion, nickel metal hydride, or other appropriate battery 67D may be charged as required. An on/off switch enables the operator to selectively power up the encoder. A reset port, such as a recessed reset button enables an operator to reset the device circuitry on control board 67C as may be required.

A cartridge 61 containing a plurality of RFID transponders releasably mounts to the body of housing 67F. The cartridge further includes a take-up reel 61J for collecting

release liner and non-dispensed RFID transponders, and a port through which blank or securely encodable transponders emerge from source reel 61E. The source reel is comprised of core 61A which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge 61 to form axle 61B around which core 61A rotates. Brake shoes 61C create drag, resulting in back torque on the source core, the magnitude of which is controlled by screw 61D which with a knob (not shown) is used to adjust the force applied by brake shoes 61C. The back torque for cartridge 61 is alternatively developed through a motor or an expandable friction coupling into a brake mechanism attached to encoder body 67F.

Take-up core 61H is driven by a tight coupling with drive hub 61G. This tight coupling is achieved through a combination or selection of tight fit, expandable coupling, and sharp teeth. The result is a hub that will easily slide in or out of core 61H with little effort, but still be capable of delivering a substantial amount of drive torque through that connection without slippage.

Drive torque is delivered from gear motor 67B to hub 61G through drive gear 67A the teeth of which engage with each other as cartridge 61 is set into position and locked into place.

In a preferred embodiment, mobile encoder 30 cryptographically unlocks, encodes, and verifies each transponder one by one. In preferred embodiments, transponders are verified more than once. One time immediately after programming with a desired data payload, and then again a second time after encoder 60 automatically dispenses an RFID transponder 63A onto target surface 68. This second verification step insures that the properties of target surface 68 or other nearby materials do not adversely affect the performance of transponder 63A.

In another preferred embodiment, encoder 60 is used to encode and dispense a pattern of several transponders 63A onto a target surface 68 at regular intervals in order to map the surface of a container for example in order to determine an optimal location for a placement of transponders. This information is then preferably used for engineering and

planning purposes for high-volume transponder application in a production or distribution facility. Transponders may be designed for operation in any or all of the UHF, HF, LF, or microwave frequency bands.

A plurality of cartridges 42 are preferably disassembled for easy recycling. For example, end users may choose to reduce their shipping costs for the recycling of cartridges and release liner by separating them into different recycle waste streams at the point of use. Conversely cartridges 42 are manufactured and assembled by snapping together the mating components with latches, guide pins, slots, and other such features to mechanically secure themselves into a rugged structure, capable of tolerating the abuse that is common for shipping and handling. After each use, cartridges 42 are preferably disassembled such that similar parts of like cartridges all nest within each other to form a dense stack. Each stack can then be accumulated and shipped either together or separately back to a transponder recycling facility. The spent release liner and any rejected transponders may also be accumulated separately and may optionally be sent to a different preferred waste processing facility, possibly in order to reduce shipping costs. One such facility preferably has the ability to reprocess release liner, both silicone and non-silicone-based materials. Certain silicone alternatives include emulsion release coatings that are water-based coatings that offer similar performance to hydrocarbon solvent-based release liner products. Emulsion coatings are compatible with paper repulping processes and are highly preferred. The benefits of the silicone alternative coatings are not normally available to the RFID tagging work flows because proper attention has not been given to solving this environmental problem. Therefore, by controlling both the composition of the outbound materials as well as the inbound recycling processes, this cartridge-based method of transponder encoding offers real promise for reducing stress on the environment.

In the aforementioned embodiments of the mobile encoder 15, 30, or 60, key features commonly shared include means to enable Gen2 EPC or ISO standards compliance. An on-board power source 57D, such as a rechargeable lithium-ion, Nickel Metal Hydride, or other battery enables freedom of movement. Mobility is further

afforded by means for wireless connectivity to a data network, such as the 802.11 wireless LAN (Wi-Fi), Bluetooth, or other standards-based communications protocol. However, a conventional power source that requires connectivity to a power-grid and a cable-based data network connectivity link would work under certain circumstances.

Further, in contemplated embodiments, the fixed or mobile encoder enables selective mounting of a magazine or cartridge filled with un-commissioned RFID transponders, which facilitates rapid and easy loading of the encoder with ready-to-use RFID transponders and further enables re-use, re-commissioning, and recycling of un-dispensed transponders and the associated cartridge. The mobile encoder can be monitored and controlled by virtually any handheld or mobile device, a host computer in a central location, or over the Internet.

The mobile encoder 15 is activated (turned on) when an operator selectively depresses the combination on/off switch. Pushing the on/off switch, possibly in conjunction with a second switch for about three seconds or longer results in a sleep-mode cycle that can be interrupted by re-pressing the on/off-next switch. In sleep mode the operator indicators will turn off. If active, the mobile encoder system-ready LED illuminates and connects to the assigned network. Network connectivity may result in the illumination of both the system-ready LED and the data-ready LED.

Mobile encoders 15 and 30 optionally receive commands and data via the wireless link from the remote computer 12 or optical reader 13. Special bar code commands are scanned by optical reader 13, passed through wireless communication means 15A, and interpreted by processing means 15B mobile encoder 15 to perform certain pre-programmed functions. Commands originating from either computer 12, optical reader 13, or internal bar code scanner 66 (also designated in Fig.1 as internal optical reader 15F) perform functions in categories that include power management, data management, wireless configuration, security, configuration options, and utilization of internal resources.

Data originating from computer 12, optical reader 13, or internal optical reader 15F typically represents information that is to be encoded on an RFID transponder. The information is processed by the encoder's on-board processor 15B and stored in memory 15G and the tag-ready LED of output indicator means 15K rapidly blinks green (cycles on/off to pulsate). An RFID transponder is moved from within cartridge 42 to a position near the distal edge of a peel device for encoding in the encoder and the transponder is encoded with the appropriate information. The transponder is tested, and if it contains the correct data and the encoding was successful then all three indicator LEDs indicate a solid-green color. The encoded RFID transponder is then ready to be attached onto the container of interest when the operator removes it and applies it to the target surface.

In the event that the encoding process failed, the bad transponder is detected and retained by the encoder, where it remains on the take up reel 44 inside cartridge 42. The take up reel also collects the release liner as the encoder 15 dispenses good transponders (properly encoded RFID transponders). The take up roll returns to a recycling center where components are reused or recycled as necessitated. Further, the recycling center can perform failure analysis on returned transponders.

Certain protective enclosures, such as cartridges or magazines 42, are part of a family of interchangeable magazines of similar size, shape, and functionality, which are capable of housing and dispensing certain types, styles, shapes, and sizes of new or used RFID transponders. Transponder sizes typically range from 4mm-thick foam-backed transponders measuring 12mm wide down to thin transponders that are 15mm wide on 19mm pitch.

In at least one embodiment, the magazine or cartridge includes a unique and embedded, RFID transponder which enables automatic interrogation and tracking of cartridge 42. In certain embodiments, to minimize interference, the cartridge-specific and unique RFID transponder or RFID transponder operates in a frequency band that is different than the supply RFID transponder contained within the protective enclosure. Alternatively, other embodiments selectively interrogate cartridge identification

transponders that operate in the same band as transponders within the cartridge that are to be applied.

Certain encoders require replenishment of the battery or other internal, on-board power source, such as a fuel cell, or other energy storage technology. Accordingly, in some embodiments, an encoder 15 further includes a remote, selectively coupling base unit. The base unit enables a replenishment of magazines or cartridges, provides replaceable power sources, recharges the on-board power source, serves as a communications gateway, and provides a user interface for programming and maintenance of the encoder.

As with all ESD-sensitive equipment, care must be taken to avoid a build-up of damaging electrostatic charges. Accordingly, in certain embodiments charge is removed using a variety of conduction methods including wiping or use of special materials that contain short conductive elements optionally arranged within a flexible elastic cord.

In some embodiments, the encoder adapts to use a particular type of RFID transponder. One type of suitable RFID transponder is model number AD-220 or AD-222 from Avery Dennison of Brea, CA, or Raflatac model 300846 from Tampere, Finland, or a Spider transponder or FT-33 FAT tag from RSI ID Technologies of Chula Vista, California. Such a transponder is die cut and adhered to release liner. Additionally, wireless sensors are manufactured to specifications that are compatible with the specific encoder, including such specifications as core diameter, outer diameter, and web width. Alternatively, certain steps are required to prepare a standard roll of transponders for use in an automated encoder, including unrolling from a large roll (up to about 6-inches in core diameter) onto several smaller rolls having a smaller core diameter (of about 1-inch to about 2-inches in core diameter).

For certain encoder embodiments passwords are encoded into transponders or wireless sensors when they are commissioned. Passwords are used to lock certain memory blocks. Passwords are safeguarded using cloaking, obfuscation, cryptographic techniques, secure and trusted channels, locked memory, and other methods that are commonly used

to protect confidential information. Passwords are generated or retrieved from data encoded in an RFID transponder to generate an index into one or more databases that contain a one dimensional array of passwords, a two dimensional array of passwords, a multidimensional array of passwords, or an array of actual or pointers to algorithms used to generate passwords from transponder data, for example. Alternatively, cryptographic algorithms are used to generate passwords from transponder data.

Although this disclosure makes specific reference to a mobile encoder, it is understood that the encoder can easily adapt and be readily configured to a fixed operating environment. For example, it can be mounted to a forklift truck or a high-speed conveyer line and maintain advantages of autonomous encoding, rapid cartridge change-over and other qualities as discussed and developed more fully in this disclosure.

D. METHOD OF TAGGING CONTAINERS

Figure 8 is a flow chart representing a method according to the present invention including applying RFID transponders to objects of interest. One suitable object of interest comprises transport containers such as corrugated cartons or shrink-wrapped cases on a shipping pallet, which is inadequately addressed by the prior-art, particularly for solutions for manually operated automatic encoding and attachment to a container.

Block 80 represents a process step including the identification and selection of a container to be tagged with an RFID transponder or wireless sensor. In one embodiment this step includes a manual selection and verification processes that consists of manual handling, visual sighting, and scanning bar codes with a manually operated optical reader device. This method contemplates that an operator is working from a pick list or customer purchase order or other such records to assure that goods are properly moved and accounted for. Preferred bar code scanners include those that allow an operator to freely handle cartons with two hands. Such scanners include laser bar code scanners or imagers that are worn on either that back of the operator's hand or near the top knuckle of a finger. Such scanners are described above, and preferably have a Bluetooth or similar wireless interface to connect to mobile encoder 15 or 30. Bar code scanner 66 of Fig. 6 is a

preferred embodiment of an alternative device that combines manual bar code scanning and RFID transponder encoding into a single handheld device. The operator may choose to scan bar codes that contain data, application identifiers, commands, or other elements commonly found in automatic data capture applications.

Block 81 represents the process step of processing bar code information to derive the underlying data. Depending on the type of bar code, how it is encoded, and its purpose, different processing steps will be used. In preferred embodiments the bar code may contain SKU information, a GTIN, an SGTIN, EPC data structures, a military UID, an SSSC, an asset number, a file identifier, or other such identifying information. In certain preferred embodiments, the bar code (either one or two dimensional) contains a partial or complete description of the data that is to be encoded into the RF transponder. Such bar codes are described in ISO/IEC draft document PDTR 24729-1. Application identifiers 01 and 21 are combined with additional encoded printed information to fully specify a serialized GTIN (or SGTIN). Using such bar codes does not require the use of additional data in order to generate RF transponder payload data. Mobile encoder 15 may therefore independently receive and process the RF transponder payload information. One type of bar code is used to signal mobile encoder 15, 30, or 60 that it should enter a mode whereby it performs a serialization algorithm without using an AI 21 bar code.

Block 82 represents the process step whereby mobile encoder 15, 30, or 60 encodes an RFID transponder with the information of the previous step (Block 81).

Successful commissioning of the RFID transponder is preferably verified by the encoder as shown in Block 83. In one embodiment, the encoder tests the immediate transponder and determines if it is operating within certain predefined specifications including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder.

If in Block 84 the encoder determines that the transponder is not likely to result in a successful transponder deployment as may be determined by failure on multiple encoding and verification attempts or due to other evidence of physical or electronic

deficiencies or abnormalities, then the operator is optionally informed and the failed or bad transponder is discarded automatically as shown in Block 85.

Block 86 is the process of using motor 67B and/or transponder transport means 15C to pull release liner 22 tighter and tighter such that webbing 22 advances forward to the point that the leading edge of transponder 18 extends past the distal end of peel device 23 or 62B.

In Block 87 web 22 is pulled forward to the point that transponder 18 or 63A begins to rotate around peel device 23 or 62B. It is in this step that either a human finger or some target object needs to be presented in the rotational path of the tipping transponder 18 or 63A must be located. In the case of mobile encoder 30 where the operator is required to handle the encoded tag, it is important that their finger be present as transponder 18 begins to tip, allowing adhesive layer 21D of transponder 18 to make contact and be removed for placement on a target object such as a shipping container, trackable asset, automobile windshield, or other object of interest. In cases where the operator scans a bar code and applies encoded transponder 18 in a single motion, mobile encoder 60 is preferred, wherein as transponder 18 tips as it rotates around peel device 62B adhesive layer 21D sticks directly onto target surface 68. In either case, encoded transponder 18 is caught mid-rotation and adhesive layer 21D provides adhesive forces sufficient to completely detach transponder 18 from release liner 22, thus completing the function of Block 87 where work flow returns to Block 80 for another transponder encoding cycle to begin.

While the invention has been particularly shown and described with reference to certain embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

CLAIMS:

I claim:

1. A mobile encoding system for commissioning RFID transponders, the system comprising:

an RFID interrogator adapted to enable encoding data using an internal antenna, the antenna being adapted to encode the data into an RFID transponder;

at least one memory storage device for storing an authorization to encode unique numbers into RFID transponders;

a bar code scanning means to acquire commands or data;

a processing means for controlling and communicating with the memory storage device, the bar code scanning means, the RFID interrogator and the internal antenna;

a means for constructing transponder data payloads by processing data gathered from bar code scanning means;

a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable reading or encoding of the data payload;

a transponder separation device means; and

a means for providing a cartridge or a pre-packaged self-contained supply of RFID transponders conveyed on a web from which properly encoded transponders are removed.

2. The encoding system of claim 1 wherein the bar code scanning means further comprises: an imager or a laser, the imager or the laser adapted to be mechanically aligned with the internal antenna to read printed symbols which contain some or all of the transponder data payload.

3. The encoding system of claim 1 wherein the bar code scanning means further comprises a wireless communication means for communication with the processing means.

4. The encoding system of claim 1 wherein the means for presenting the RFID transponder comprises a motor assembly adapted to pull the RFID transponder from a supply reel.

5. The encoding system of claim 6 further comprising a pre-packaged self-contained supply of RFID transponders comprising the supply reel and a take-up reel.

6. The pre-packaged self-contained supply of RFID transponders of Claim 5 further comprising a transponder separation device whereby the transponders are separated from a conveyance web.

7. The transponder separation device of Claim 6 further comprising a means for radio frequency shielding and at least one sharp edge, whereby the sharp edge enables a release liner to separate from an adhesive-backed RFID transponder.

8. The encoding system of Claim 1 further comprising a housing assembly for enclosing the internal antenna and a handle coupled to a surface of the housing.

9. The encoding system of Claim 1 further comprising a housing assembly for enclosing the internal antenna and a mounting mechanism for selectively coupling the encoding system to a provided structure.

10. The encoding system of Claim 1 further comprising a means for controlling linear transponder peel rate to a measured velocity, whereby the measured velocity is determined relative to a target object.

11. The encoding system of Claim 1 further comprising a processing means for associating data read from an RFID transponder with new data, whereby the new data is programmed into the RFID transponder.

12. The encoding system of Claim 1 further comprising:

a means for verifying that the RFID transponder was encoded;

means for dispensing an encoded RFID transponder; and

a means for not dispensing an improperly encoded RFID transponder.

13. The encoding system of Claim 1 further comprising a plurality of memory storage devices for storing transponder authorizations wherein at least one of the memory storage devices couples to the processing means via the antenna and RFID interrogator whereby the one memory storage device is not physically coupled to the processing means.

14. A system for enabling on-demand, point-of-use commissioning of RFID transponders to uniquely identify an object, the system comprising:

an RFID transponder comprising a fixed spatial separation means along a conveyance web whereby the transponder adapts to wirelessly send and receive data packets corresponding to an information set;

an RFID transponder encoder device having a processing means and a memory means, the encoder device being adapted to sequentially convey one RFID transponder at a time into an interrogation field, the encoder device further including means for coupling radio frequency signals with one RFID transponder, means for reading and writing authorization of transponders, means for verifying the status of a commissioned

transponder, and means for mechanically separating a transponder from the conveyance web;

a means for encoding authorization from an external authority for a selected numbering system;

a means for coupling a cartridge or other pre-packaged self-contained supply of the RFID transponders, the transponders being further adapted for tensile extraction from said supply; and

a bar code scanner adapted to resolve data ambiguities prior to transponder encoding.

15. The system of claim 14 further comprising a processing means to verify the functionality of a commissioned transponder after separation from the conveyance web.

16. The system of claim 14 further comprising a plurality of authorization transponders adapted to provide the RFID transponder encoder device sets of pre-authorized blocks of unique numbers for specific object classes.

17. A method for commissioning RFID transponders comprising:

providing an RFID transponder encoder having a transponder separation device;

providing information to the encoder;

providing a supply of RFID transponders;

acquiring object class information to encode multiple instances of unique numbers from that object class into an RFID transponder;

advancing the RFID transponder in the encoder;

reading information from the RFID transponder; and

encoding the object class instance information into the transponder.

18. The method of claim 17 further comprising:

providing a conveyance webbing coupled to the RFID transponder;

severing the conveyance webbing to remove each encoded transponder.

19. The method of claim 17 further comprising:

applying the RFID transponder to a target surface only if the information was properly encoded.

20. The method of claim 17 further comprising:

Providing transpoder having a conveyance web or release liner; and

providing the encoder with a motor adapted to provide tension in the conveyance web or release liner in a direction along its major axis.

ABSTRACT

In one embodiment the present invention comprises a bar code scanner and an encoder for commissioning RFID transponders and includes a housing encasing a motor assembly, an RFID interrogator, a wireless communication means for transferring instructions and data from and to a remote host, on-board memory, a processor, and an antenna with corresponding mechanism to encode and verify a programmable RFID transponder on a conveyance web. The present invention further includes novel methods for commissioning RFID transponders, as well as methods for recycling and reusing the protective enclosure.

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Application Number	
Filing Date	21 May 2008
First Named Inventor	McAllister, Clarke
Title	Systems, methods, and devices for r
Art Unit	
Examiner Name	
Attorney Docket Number	ADA-08-REG-06

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Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

SIGNATURE of Applicant or Assignee of Record

Signature		Date	21 May 2008
Name	Clarke McAllister	Telephone	541-968-2988
Title and Company			

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

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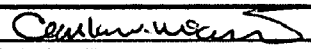
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Signature		Date	20 May 2008
Name	Clarke McAllister	Telephone	541-968-2988
Title and Company			

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☑ Declaration Submitted With Initial Filing **OR** ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (f)) required)

Attorney Docket Number	**ADA-08-REG-07**
First Named Inventor	**McAllister, Clarke**
COMPLETE IF KNOWN	
Application Number	
Filing Date	**21 May 2008**
Art Unit	
Examiner Name	

I hereby declare that: (1) Each inventor's residence, mailing address, and citizenship are as stated below next to their name; and (2) I believe the inventor(s) named below to be the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Systems, Methods, and Devices for Replication of Data onto Wireless Sensors

(Title of the Invention)

the specification of which

☑ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) ☐ as United States Application Number or PCT International Application Number ☐ and was amended on (MM/DD/YYYY) ☐ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

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☐ If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), and any other intellectual property offices in which a foreign application claiming priority to the above-identified application is filed access to the above-identified patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, or other intellectual property office in which a foreign application claming priority to the above-identified application is filed to have access to the application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the application-as-filed with respect to: 1) the above-identified application, 2) any foreign application to which the above-identified application claims priority under 35 USC 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the above-identified US application, and 3) any U.S. application from which benefit is sought in the above-identified application.

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Claim of Foreign Priority Benefits

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Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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NAME OF SOLE OR FIRST INVENTOR:	☐ A petition has been filed for this unsigned inventor
Given Name (first and middle [if any]): **Clarke**	Family Name or Surname: **McAllistor**
Inventor's Signature	Date: **21 MAY 2008**

Residence: City: **Eugene**	State: **OR**	Country: **US**	Citizenship: **US**
Mailing Address: **4060 SUNRIDGE CT**			
City: **Eugene**	State: **OR**	Zip: **97405**	Country: **USA**

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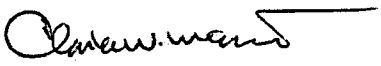
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NAME OF SOLE OR FIRST INVENTOR:	☐ A petition has been filed for this unsigned inventor		
Given Name (first and middle [if any])	Family Name or Surname		
Clarke	McAllister		
Inventor's Signature 			Date 21 May 2008
Residence: City	State	Country	Citizenship
Eugene	OR	US	US
Mailing Address			
4060 Sunridge Drive			
City	State	Zip	Country
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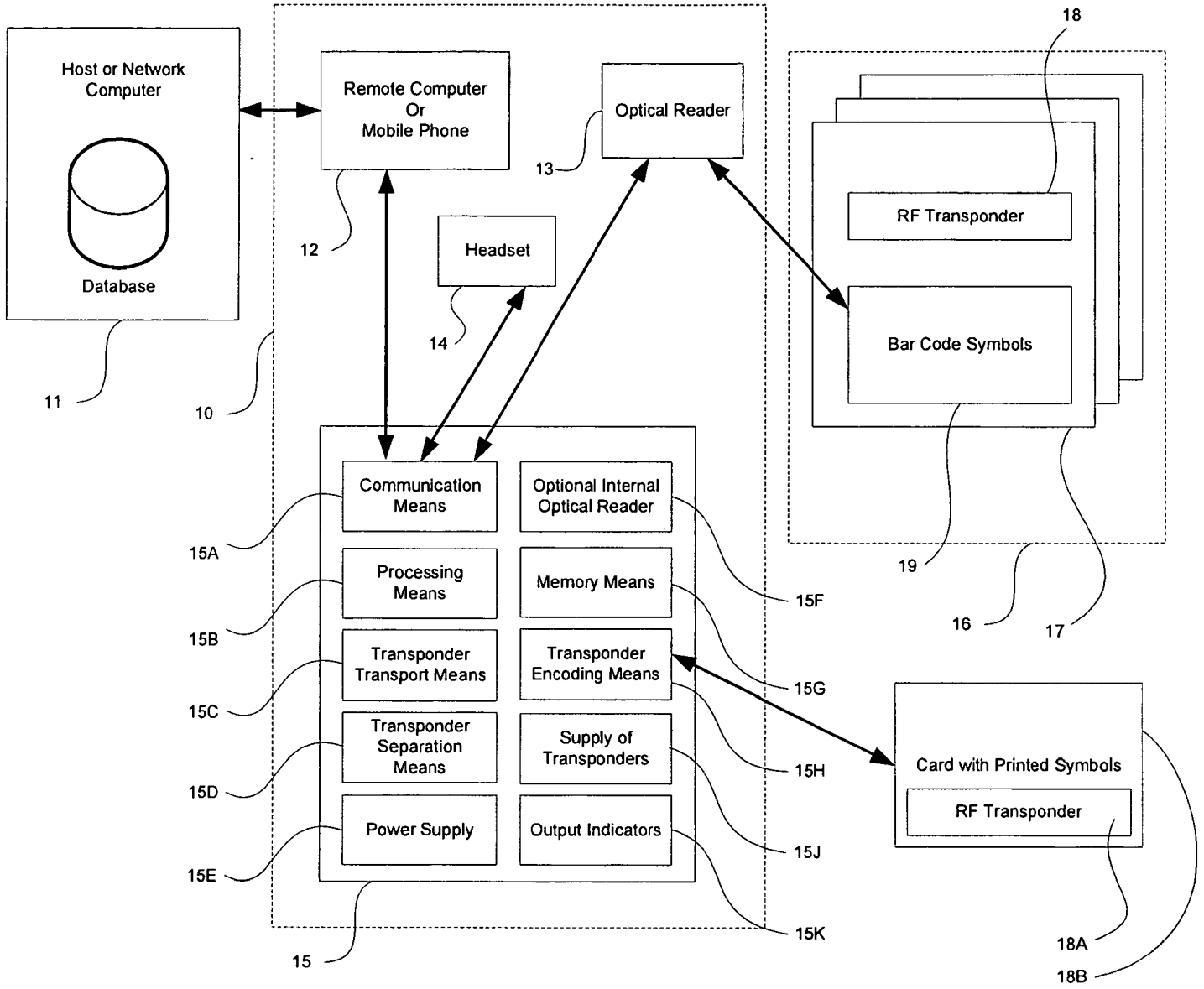

Host or Network Computer
Database
11
Remote Computer Or Mobile Phone
12
Optical Reader
13
Headset
14
10
18
RF Transponder
Bar Code Symbols
19
16
17
Communication Means
Optional Internal Optical Reader
Processing Means
Memory Means
Transponder Transport Means
Transponder Encoding Means
Transponder Separation Means
Supply of Transponders
Power Supply
Output Indicators
15A
15B
15C
15D
15E
15F
15G
15H
15J
15K
15
Card with Printed Symbols
RF Transponder
18A
18B

FIG 1

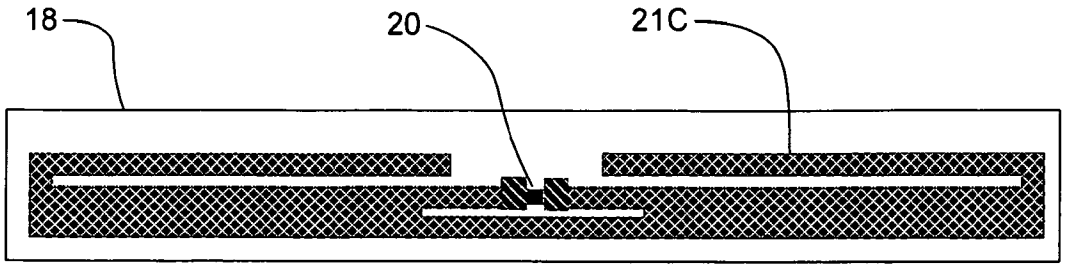


FIG 2

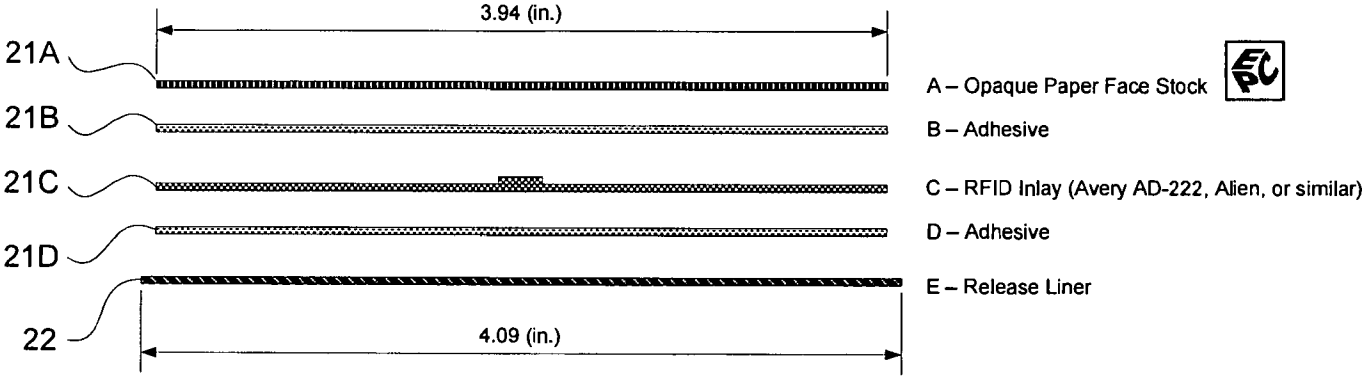


FIG 3

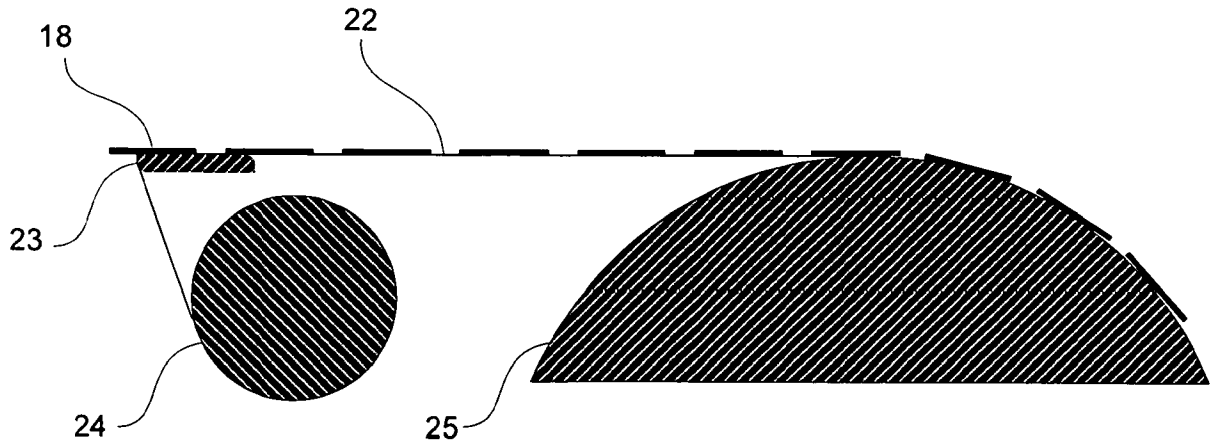


FIG 4

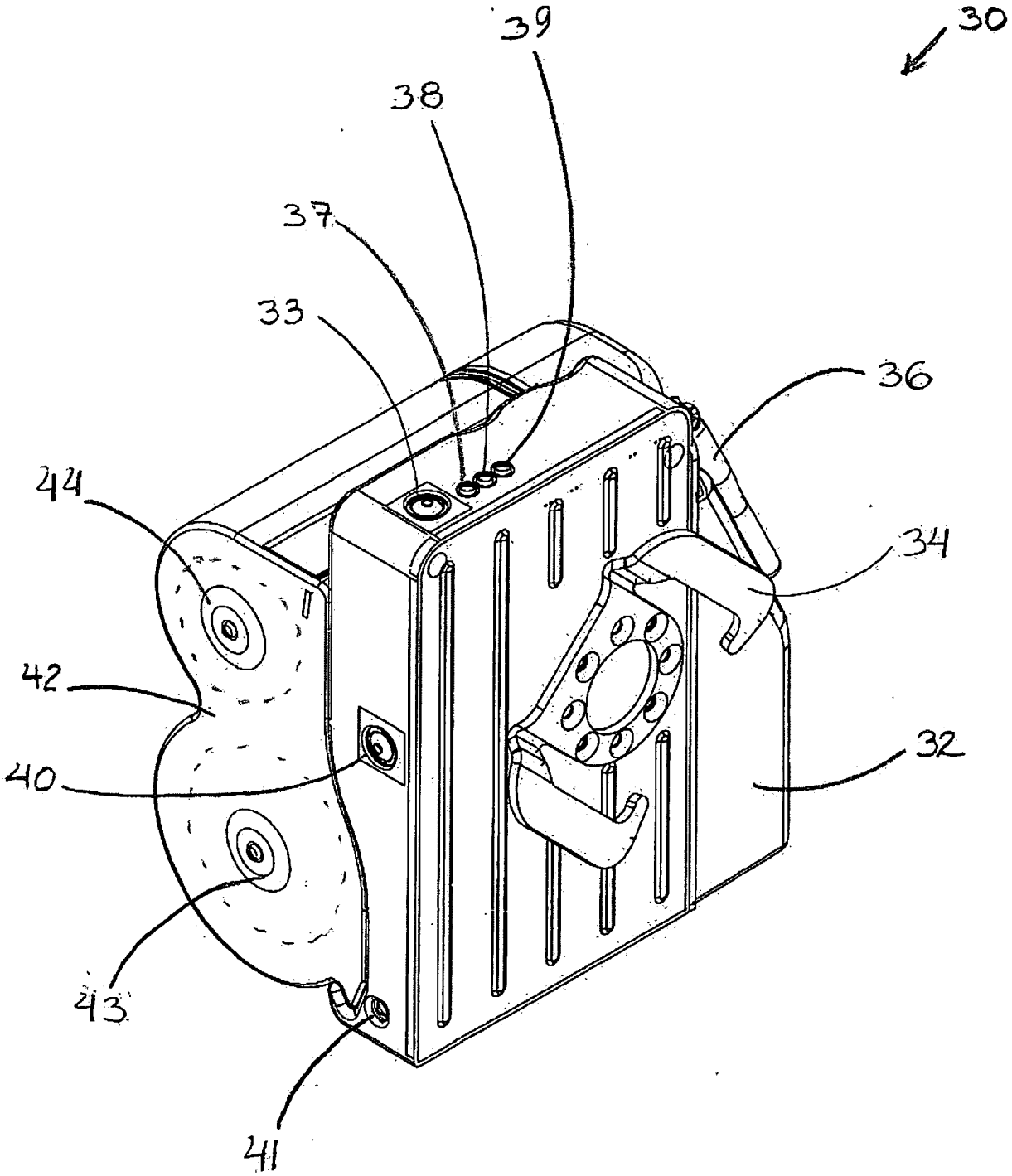


FIG 5

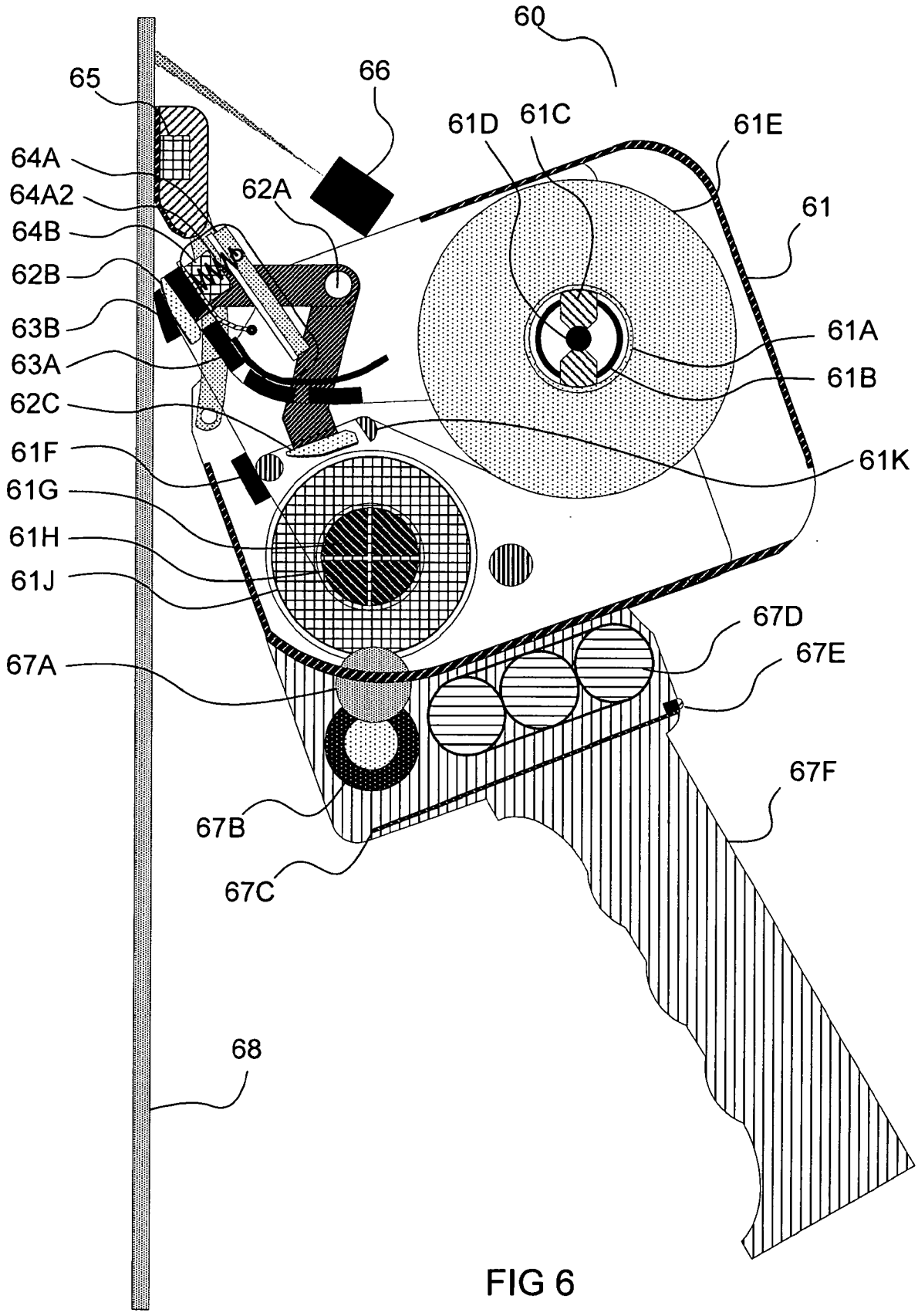

60
65
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61D
61C
61E
64A
64A2
62A
64B
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62B
63B
61A
63A
61B
62C
61K
61F
61G
61H
61J
67D
67A
67E
67F
67B
67C
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FIG 6

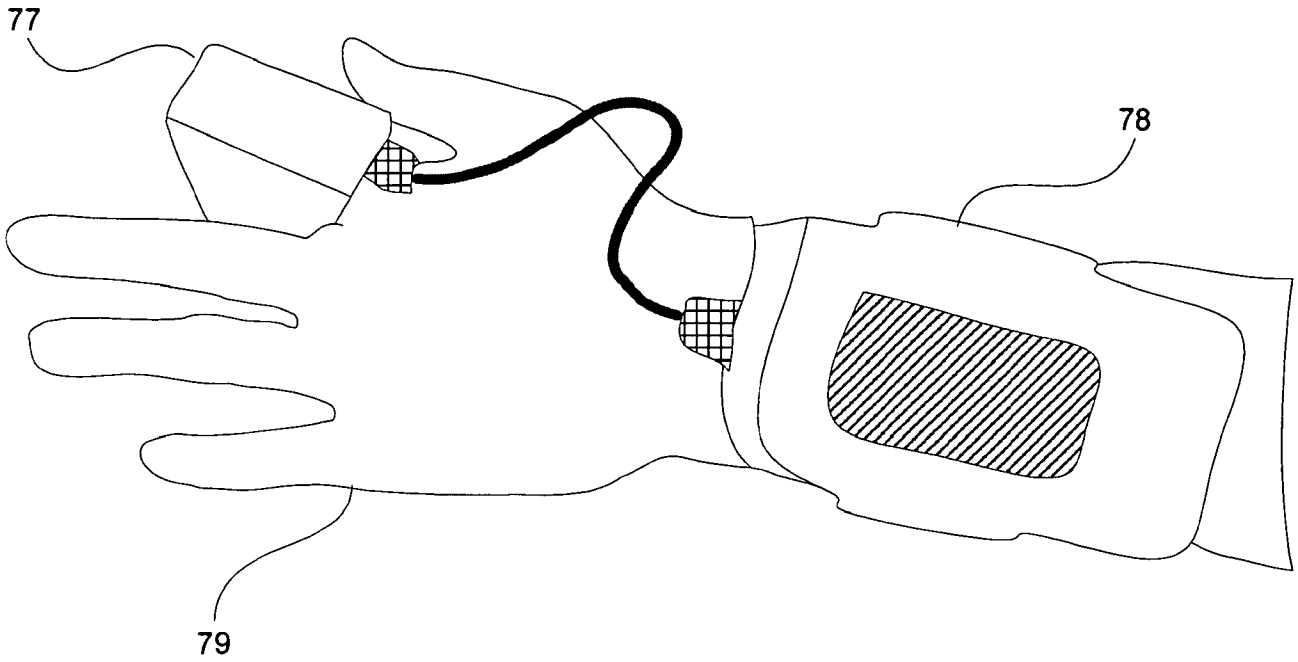


FIG 7

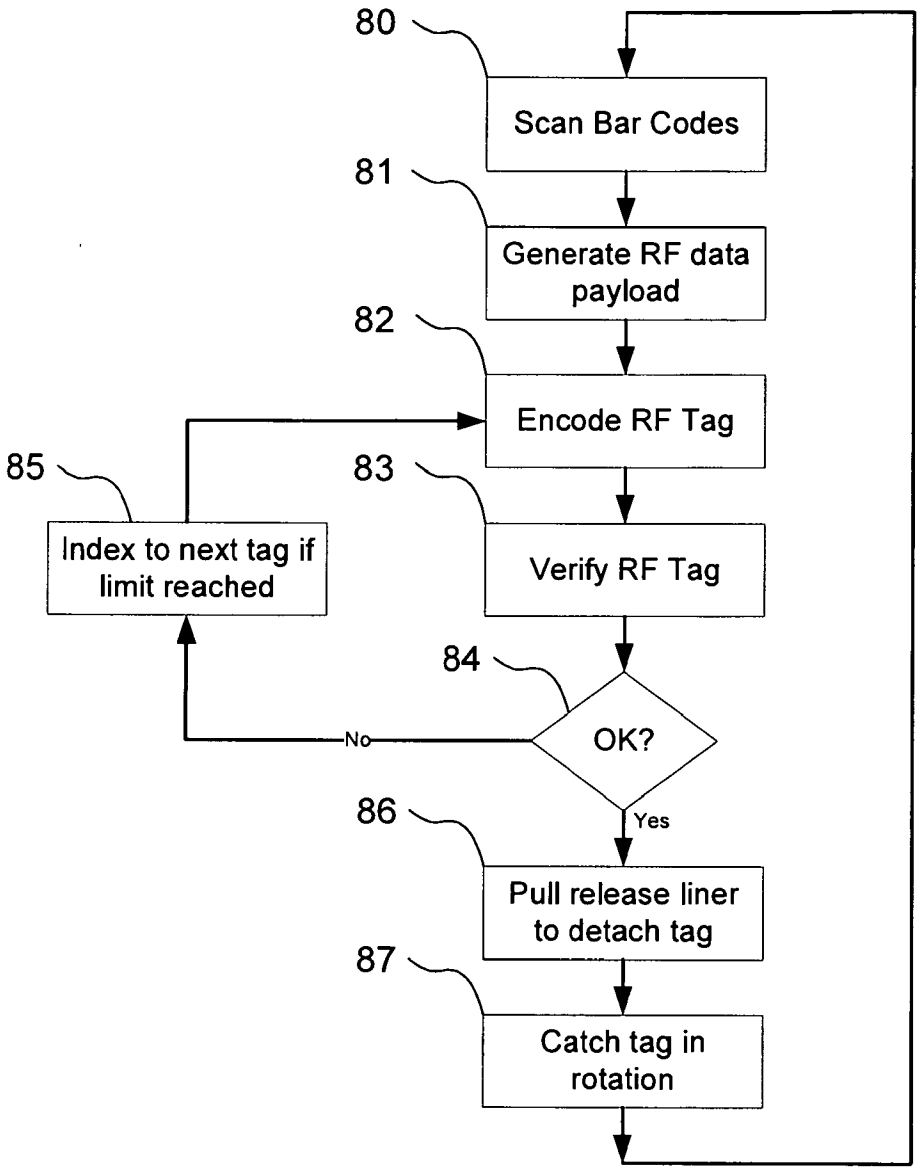

80
Scan Bar Codes
81
Generate RF data payload
82
Encode RF Tag
83
Verify RF Tag
84
OK?
No
Yes
85
Index to next tag if limit reached
86
Pull release liner to detach tag
87
Catch tag in rotation

FIG 8

PTO/SB/06 (12-04)
Approved for use through 7/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number: **12/124,768**

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY FEE ($)	OR	SMALL ENTITY RATE ($)	SMALL ENTITY FEE ($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	255		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	105		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20	*	X 25=		OR	X 50=	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	*	X 100=			X 200=	
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR						
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))			N/A			N/A	
			TOTAL	435		TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED – PART II

AMENDMENT A	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X =		OR	X =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X =		OR	X =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
					TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	

AMENDMENT B	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X =		OR	X =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X =		OR	X =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
					TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/124,768	05/21/2008	2612	435	ADA-08-REG-07	20	3

CONFIRMATION NO. 3269

45649
PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

FILING RECEIPT



Date Mailed: 07/14/2008

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Clarke McAllistor, Eugene, OR;

Power of Attorney:
Peter Haas--52481

Domestic Priority data as claimed by applicant

This appln claims benefit of 60/939,603 05/22/2007

Foreign Applications

Projected Publication Date: To Be Determined - pending completion of Corrected Papers

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

Systems, Methods, and Devices for Replication of Data onto Wireless Sensors

Preliminary Class

340

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent

in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/124,768	05/21/2008	Clarke McAllistor	ADA-08-REG-07

CONFIRMATION NO. 3269

45649
PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

FORMALITIES LETTER

OC000000030940536

Date Mailed: 07/14/2008

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
  - The drawings must be reasonably free from erasures and must be free from alterations, overwriting, interlineations, folds, and copy marks. See Figure(s) 5.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

/cvorachack/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/124,768	05/21/2008	Clarke McAllistor	ADA-08-REG-07

CONFIRMATION NO. 3269

45649
PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

ABANDONMENT/TERMINATION LETTER



Date Mailed: 03/18/2009

NOTICE OF ABANDONMENT UNDER 37 CFR 1.53 (f) OR (g)

The above-identified application is abandoned for failure to timely or properly reply to the Notice to File Missing Parts (Notice) mailed on07/14/2008.

- No reply was received.

If a complete reply to the notice was previously filed by applicant within the time period set forth in the notice, applicant may request for reconsideration of the holding of abandonment within 2 months from the mailing of this notice of abandonment by filing a petition to withdraw the holding of abandonment under 37 CFR 1.181(a). No petition fee is required. The petition must be accompanied by a true copy of the originally filed reply and the item(s) identified in one of the following:

1. A properly itemized date-stamped postcard receipt (see MPEP § 503);

2. If the originally filed reply included a certificate of mailing or transmission in compliance with 37 CFR 1.8(a), a copy of the certificate of mailing or transmission and a statement in compliance with 37 CFR 1.8(b) (see MPEP § 512); or

3. If the reply was filed via "Express Mail," a submission satisfying the requirements of 37 CFR 1.10(e) including, for example, a copy of the "Express Mail" mailing label showing the "date-in" (see MPEP § 513).

Any petition to withdraw the holding of abandonment should be directed to OIPE.

If applicant did not previously file a complete reply within the time period set forth in the notice, applicant may file a petition to revive the application under 37 CFR 1.137.

Under 37 CFR 1.137(a), a petition requesting the application be revived on the grounds of **UNAVOIDABLE DELAY** must be filed promptly after the applicant becomes aware of the abandonment and such petition must be accompanied by: (1) an adequate showing of the cause of unavoidable delay; (2) the required reply to the above-identified Notice; (3) the petition fee set forth in 37 CFR 1.17(l); and (4) a terminal disclaimer if required by 37 CFR 1.137(d). See MPEP § 711.03(c) and Form PTO/SB/61.

Under 37 CFR 1.137(b), a petition requesting the application be revived on the grounds of **UNINTENTIONAL DELAY** must be filed promptly after applicant becomes aware of the abandonment and such petition must be accompanied by: (1) a statement that the entire delay was unintentional; (2) the required reply to the above-identified Notice; (3) the petition fee set forth in 37 CFR 1.17(m); and (4) a terminal disclaimer if required by 37 CFR 1.137(d). See MPEP § 711.03(c) and Form PTO/SB/64.

Any questions concerning petitions to revive should be directed to the "Office of Petitions" at (571) 272-3282.

A copy of this notice MUST be returned with the reply.

/twoldeyes/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Electronic Patent Application Fee Transmittal

Application Number:	12124768
Filing Date:	21-May-2008
Title of Invention:	Systems, Methods, and Devices for Replication of Data onto Wireless Sensors
First Named Inventor/Applicant Name:	Clarke McAllistor
Filer:	Peter A. Haas
Attorney Docket Number:	ADA-08-REG-07

Filed as Small Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Petition-revive unintent. abandoned appl	2453	1	810	810
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**810**

Electronic Acknowledgement Receipt

EFS ID:	5098363
Application Number:	12124768
International Application Number:	
Confirmation Number:	3269
Title of Invention:	Systems, Methods, and Devices for Replication of Data onto Wireless Sensors
First Named Inventor/Applicant Name:	Clarke McAllistor
Customer Number:	45649
Filer:	Peter A. Haas
Filer Authorized By:	
Attorney Docket Number:	ADA-08-REG-07
Receipt Date:	06-APR-2009
Filing Date:	21-MAY-2008
Time Stamp:	09:57:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Electronic Funds Transfer
Payment was successfully received in RAM	$810
RAM confirmation Number	6420
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Petition for review by the Office of Petitions.	petition.pdf	290551 50045572cb56a9b1e64b27cfca10c81d441f00ce	no	3
Warnings:					
Information:					
2	Miscellaneous Incoming Letter	RESPONSECORRECT.pdf	757798 2e6e75ec7cefe92c213d4db7966a41573c2485e5	no	6
Warnings:					
Information:					
3	Fee Worksheet (PTO-06)	fee-info.pdf	30065 591c88e129943ff26b10e1ab41dc85fd408a0a69	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1078414		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/61 (03-09)
Approved for use through 04/30/2009. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNAVOIDABLY UNDER 37 CFR 1.137(a)	Docket Number (Optional) ADA-08-reg-07

First Named Inventor: McAllister, Clarke Art Unit: _____

Application Number: 12/124,768 Examiner: _____

Filed: 2008-05-21

Title: Systems, Methods, and Devices for Replication of Data onto Wireless Sensors.

Attention: Office of Petitions
Mail Stop Petition
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

NOTE: If information or assistance is needed in completing this form, please contact Petitions Information at (571) 272-3282.

The above-identified application became abandoned for failure to file a timely and proper reply to a notice or action by the United States Patent and Trademark Office. The date of abandonment is the day after the expiration date of the period set for reply in the Office notice or action plus any extensions of time actually obtained.

APPLICANT HEREBY PETITIONS FOR REVIVAL OF THIS APPLICATION.

NOTE: A grantable petition requires the following items:
(1) Petition fee.
(2) Reply and/or issue fee.
(3) Terminal disclaimer with disclaimer fee – required for all utility and plant applications filed before June 8, 1995, and for all design applications; and
(4) Adequate showing of the cause of unavoidable delay.

1. Petition fee

☑ Small entity – fee $ 270.00 (37 CFR 1.17(l)). Applicant claims small entity status. See 37 CFR 1.27.

☐ Other than small entity – fee $_____ (37 CFR 1.17(l)).

2. Reply and/or fee

A The reply and/or fee to the above-noted Office action in the form of Response (identify the type of reply):

☐ has been filed previously on _____ .

☑ is enclosed herewith.

B The issue fee of $ _____

☐ has been filed previously on _____ .

☐ is enclosed herewith.

This collection of information is required by 37 CFR 1.137(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop Petition, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNAVOIDABLY UNDER 37 CFR 1.137(a)

3. Terminal disclaimer with disclaimer fee

☑ Since this utility/plant application was filed on or after June 8, 1995, no terminal disclaimer is required.

☐ A terminal disclaimer (and disclaimer fee (37 CFR 1.20(d)) of $ _____ for a small entity or $ _____ for other than a small entity) disclaiming the required period of time is enclosed herewith (see PTO/SB/63).

4. An adequate showing of the cause of the delay, and that the entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition under 37 CFR 1.137(a) was unavoidable, is enclosed.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

/peter a haas /	2009-04-06
Signature	Date
Peter A. Haas	52481
Typed or printed name	Registration Number, if applicable
1929 SW 13th Ave	503-319-3024
Address	Telephone Number
Portland, OR 97201 USA	
Address	

Enclosure ☑ Fee Payment

☑ Reply

☐ Terminal Disclaimer Form

☑ Additional sheets containing statements establishing unavoidable delay

☐ _____

CERTIFICATE OF MAILING OR TRANSMISSION (37 CFR 1.8(a))

I hereby certify that this correspondence is being:

☐ deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to **Mail Stop Petition**, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

☑ transmitted by facsimile on the date shown below to the United States Patent and Trademark Office at (571) 273-8300.

2009-04-06	/ peter a haas/
Date	Signature
	Peter A. Haas
	Typed or printed name of person signing certificate

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNAVOIDABLY UNDER 37 CFR 1.137(a)

NOTE: The following showing of the cause of unavoidable delay must be signed by all applicants or by any other party who is presenting statements concerning the cause of delay.

/ peter a haas/	2009-04-06
Signature	Date
Peter A. Haas.	52481
Typed or printed name	Registration Number, if applicable

(In the space provided below, please explain in detail the reasons for the delay in filing a proper reply.)

Please see attached sheets "misc." paper filed via efs web-based pair on 2009-04-06.

(*Please attach additional sheets if additional space is needed.)*

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	5102838
Application Number:	12124768
International Application Number:	
Confirmation Number:	3269
Title of Invention:	Systems, Methods, and Devices for Replication of Data onto Wireless Sensors
First Named Inventor/Applicant Name:	Clarke McAllistor
Customer Number:	45649
Filer:	Peter A. Haas
Filer Authorized By:	
Attorney Docket Number:	ADA-08-REG-07
Receipt Date:	06-APR-2009
Filing Date:	21-MAY-2008
Time Stamp:	15:34:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Miscellaneous Incoming Letter	sb0061.pdf	144377 c56e7fa510ff726db67a83a39c960d016d0fef3f	no	4

Warnings:	
Information:	

Total Files Size (in bytes):	144377

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PETITION TO REVIVE AND REQUEST FOR REINSTATEMENT OF AN ABANDONED APPLICATION

Applicants:	McAllister, Clarke	Group Art Unit:	
Serial No.:	12/124,768	Examiner:	
Filed:	2008-05-21	Docket No.	ADA-08-REG-07
Title:	Systems, Methods, and Devices for Replication of Data onto Wireless Sensors		

06 April 2009

Mail Stop Petition
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

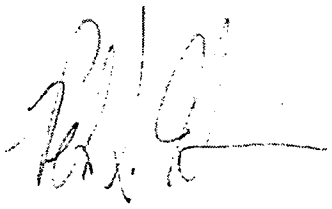
This is a Petition to Revive an unintentionally (or in the alternative unavoidalbly) abandoned application. A statement of facts, signed by the attorney of record, who has first-hand knowledge of the facts related to the delay that resulted in the abandonment accompanies this Petition. The requisite fee (37 CFR 1.17(m)) based on Applicant's small-entity status is also submitted herewith along with a Response and Amendment, thus complying with any and all specific requirements as provided by the statutes, rules, or USPTO policy. All of the aforementioned being timely filed within two months of the date of abandonment and notice thereof.

Peter A. Haas Esquire LLC
1929 S.W. 13th Avenue
Portland, OR 97201 USA
(503) 319-3024

The instant application went abandoned on 18 March 2009 due to a failure to reply to a "Notice to File Corrected Application Papers" for failing to re-submit a replacement drawing Figure 5 of the drawing set. The Notice alleges Figure 5 did not comply with 37 CFR 1.84 and 37 CFR 1.121(d) as required. Because the drawings must be reasonably free from erasures and must be free from alterations, over-writing, interlineations, folds, and copy marks. The failure to timely and completely respond to this Notice was unintentional, as supported by the appended statement of facts. This Notice to File Corrected Application Papers was mailed on 14 July 2008.

Applicant respectfully requests that the Commissioner find that the abandonment of the instant application was caused by a delay that was unintentional or in the alternative that it was unavoidable and to revive and reinstate the instant application to provide co-pending status for the timely filed RCE. Further and alternatively, should the Commissioner find that the delay was unavoidable, applicant respectfully requests a refund of the excess fees paid.

Respectfully submitted,



/ peter a haas/

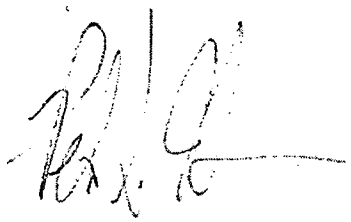
Peter A. Haas
Reg. No. 52,481
Attorney for Applicant
Tel. (503) 319-3024
PETER A. HAAS ESQUIRE LLC
1929 S.W. 13th Avenue
Portland, OR 97201 USA

STATEMENT OF FACTS BY ATTORNEY OF RECORD HAVING FIRST-HAND KNOWLEDGE:

1. I am Peter A. Haas, a registered patent attorney (Reg. No. 52481) located in Portland, Oregon, USA.
2. My office first learned of the Notice of a non-compliant upon receipt of a Notice of Abandonment on or about 23 March 2009.
3. On or about 23 April 2009 I queried the USPTO web-based PAIR system for the status and file-wrapper of this matter and discovered for the first time that there was an outstanding notice of non-compliant Application papers. This was the first time I, or my office, learned of the Notice of non-compliant Application Papers.
4. On or about 25 April 2009 I discussed the matter with the Applicant. Applicant stated that he had not received the Notice for Non-complaint Application Papers.
5. Between 25 April 2009 and 01 April 2009 I investigated my internal mail systems and did not find any indication that my office received the Notice of non-compliant Application papers. Therefore, it is my belief that the Notice for Non-compliant Application papers was misdirected before reaching my office by the U.S. Mail or the USPTO, or both.

I declare under penalty of perjury that the foregoing is true and correct.

By:



On: 06 April 2009

Peter A. Haas, Attorney for Applicant, Registration No. 52481

Peter A. Haas Esquire LLC
1929 S.W. 13th Avenue
Portland, OR 97201 USA
(503) 319-3024

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/124,768	05/21/2008	Clarke McAllistor	ADA-08-REG-07

CONFIRMATION NO. 3269

45649
PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

ABANDONMENT/TERMINATION LETTER



Date Mailed: 03/18/2009

NOTICE OF ABANDONMENT UNDER 37 CFR 1.53 (f) OR (g)

The above-identified application is abandoned for failure to timely or properly reply to the Notice to File Missing Parts (Notice) mailed on07/14/2008.

- No reply was received.

If a complete reply to the notice was previously filed by applicant within the time period set forth in the notice, applicant may request for reconsideration of the holding of abandonment within 2 months from the mailing of this notice of abandonment by filing a petition to withdraw the holding of abandonment under 37 CFR 1.181(a). No petition fee is required. The petition must be accompanied by a true copy of the originally filed reply and the item(s) identified in one of the following:

1. A properly itemized date-stamped postcard receipt (see MPEP § 503);

2. If the originally filed reply included a certificate of mailing or transmission in compliance with 37 CFR 1.8(a), a copy of the certificate of mailing or transmission and a statement in compliance with 37 CFR 1.8(b) (see MPEP § 512); or

3. If the reply was filed via "Express Mail," a submission satisfying the requirements of 37 CFR 1.10(e) including, for example, a copy of the "Express Mail" mailing label showing the "date-in" (see MPEP § 513).

Any petition to withdraw the holding of abandonment should be directed to OIPE.

If applicant did not previously file a complete reply within the time period set forth in the notice, applicant may file a petition to revive the application under 37 CFR 1.137.

Under 37 CFR 1.137(a), a petition requesting the application be revived on the grounds of **UNAVOIDABLE DELAY** must be filed promptly after the applicant becomes aware of the abandonment and such petition must be accompanied by: (1) an adequate showing of the cause of unavoidable delay; (2) the required reply to the above-identified Notice; (3) the petition fee set forth in 37 CFR 1.17(l); and (4) a terminal disclaimer if required by 37 CFR 1.137(d). See MPEP § 711.03(c) and Form PTO/SB/61.

Under 37 CFR 1.137(b), a petition requesting the application be revived on the grounds of **UNINTENTIONAL DELAY** must be filed promptly after applicant becomes aware of the abandonment and such petition must be accompanied by: (1) a statement that the entire delay was unintentional; (2) the required reply to the above-identified Notice; (3) the petition fee set forth in 37 CFR 1.17(m); and (4) a terminal disclaimer if required by 37 CFR 1.137(d). See MPEP § 711.03(c) and Form PTO/SB/64.

Any questions concerning petitions to revive should be directed to the "Office of Petitions" at (571) 272-3282.

A copy of this notice MUST be returned with the reply.

/twoldeyes/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IN THE UNITED STATE PATENT AND TRADEMARK OFFICE
PATENT APPLICATION EXAMINING OPERATIONS

Applicants:	McAllister, Clarke	Group Art Unit:	Missing Parts
Serial No.:	12/124,68	Examiner:	
Filed:	21 May 2008	Docket No.	ADA-08-reg-07
Title:	Systems, Methods, and Devices for Replication of Data onto Wireless Sensors.		

APPLICANT'S REPSONSE TO A NOTICE OF NON-COMPLIANT APPLICATION PAPERS

PETER A. HAAS ESQUIRE LLC
1929 S.W. 13th Avenue
Portland, OR 97201, USA

06 April 2009

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notice to File Corrected Application Papers mailed 14 July 2008, please amend the application as follows:

Amendments to the Drawings begin on page 2 of this paper.

Remarks begin on page 3 of this paper.

An **Appendix** including amended drawing figures is attached following page 3 of this paper.

Amendments to the Drawings:

The attached sheet of drawings includes changes to FIG. 5. This replacement sheet replaces the original sheet including FIG. 5. In the replacement sheet FIG. 5 the drawing is reasonably free from erasures and must be free from alterations, overwriting, interlineations, folds, and copy marks.

Below: Annotated Sheet Showing Changes

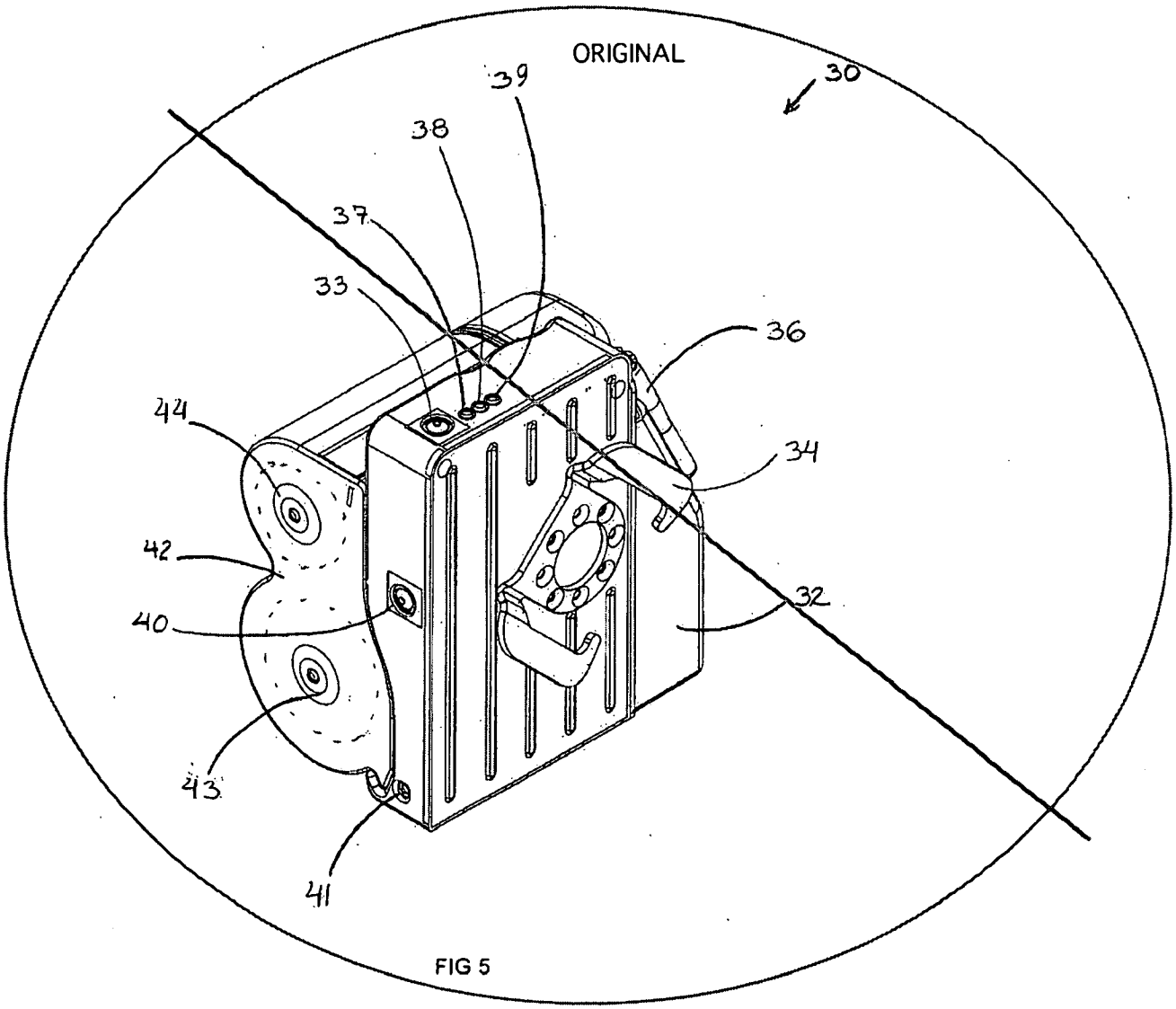


FIG 5

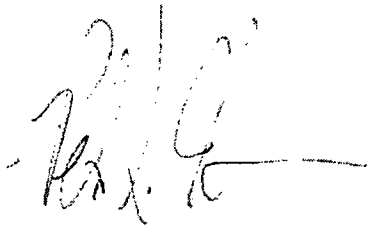
Attachment: Replacement Sheet

Remarks

This preliminary amendment corrects minor errors found during the proofreading of the parent application. No new matter has been added and these amendments should not be objectionable.

Respectfully submitted,

/ peter a haas/



Peter A. Haas
Reg. No. 52,481
Attorney for Applicant
Tel. (503) 319-3024

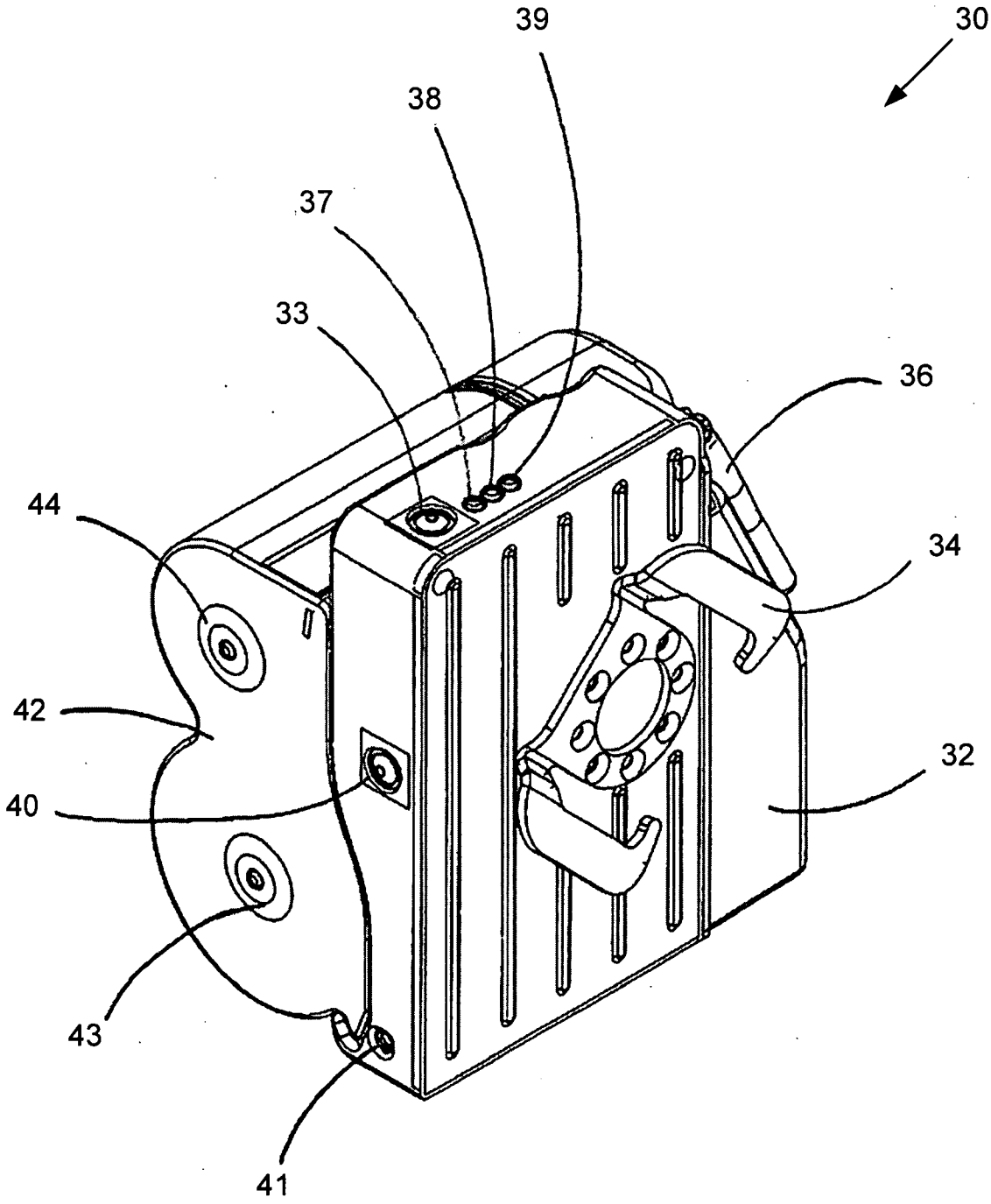


FIG 5

SCORE Placeholder Sheet for IFW Content

Application Number: 12124768 Document Date: 4/6/2009

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

- Drawings – Other than Black and White Line Drawings

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

To access the documents in the SCORE database, refer to instructions developed by SIRA.

At the time of document entry (noted above):

- Examiners may access SCORE content via the eDAN interface.
- Other USPTO employees can bookmark the current SCORE URL (http://es/ScoreAccessWeb/).
- External customers may access SCORE content via the Public and Private PAIR interfaces.

Form Revision Date: February 8, 2006

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND OR 97201

MAILED

APR 22 2009

OFFICE OF PETITIONS

In re Application of :
Clarke McAllistor :
Application No. 12/124,768 : DECISION ON PETITION
Filed: May 21, 2008 :
Attorney Docket No: ADA-08-REG-07 :

This is a decision on the petition under the unintentional provisions of 37 CFR 1.137(b), filed April 6, 2009, to revive the above-identified application.

The petition is **GRANTED**.

The application became abandoned for failure to reply in a timely manner to the Notice to File Corrected Application Papers (Notice) mailed July 14, 2008. The Notice set a period for reply of two (2) months from the mail date of the Notice. No extensions of time under the provisions of 37 CFR 1.136(a) were obtained. Accordingly, the application became abandoned on September 15, 2008. A Notice of Abandonment was mailed March 18, 2009.

The petition satisfies the requirements of 37 CFR 1.137(b) in that petitioner has supplied (1) Replacement drawings; (2) the petition fee of $810.00, and (3) a proper statement of unintentional delay.

Further, 37 CFR 1.137(b)(3) requires a statement that the entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition pursuant to 37 CFR 1.137(b) was unintentional. If the statement contained in the instant petition varies from the language required by 37 CFR 1.137(b)(3), the statement contained in the instant petition is being construed as the statement required by 37 CFR 1.137(b)(3) and petitioner must notify the Office if this is **not** a correct interpretation of the statement contained in the instant petition.

Additionally, petitioner contends that "the Notice for Non-compliant Application papers was misdirected before reaching my office by the U.S. Mail or the USPTO, or both." However, a review of USPTO records reveals no irregularity in the mailing of the Office action, and, in the absence of any irregularity, there is a strong presumption that the

Office action was properly mailed to the practitioner at the address of record. The Notice was not returned to the USPTO as undeliverable and therefore considered received by petitioner. Further, petitioner's filing receipt mailed also on July 14, 2008 clearly states "pending completion of Corrected Papers" and therefore considered a secondary form of notification.

Telephone inquiries concerning this decision should be directed to Joan Olszewski at (571) 272-7751.

This application is being referred to the Office of Patent Application Processing for further processing in accordance with this decision on petition.

/Liana Walsh/
Liana Walsh
Petition Examiner
Office of Petitions

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/124,768		Clarke McAllistor	ADA-08-REG-07

CONFIRMATION NO. 3269

45649
PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

WITHDRAWAL NOTICE

OC000000035691406

Date Mailed: 04/29/2009

Letter Regarding a New Notice and/or the Status of the Application

If a new notice or Filing Receipt is enclosed, applicant may disregard the previous notice mailed on 03/18/2009. The time period for reply runs from the mail date of the new notice. Within the time period for reply, applicant is required to file a reply in compliance with the requirements set forth in the new notice to avoid abandonment of the application.

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web. https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If the reply is not filed electronically via EFS-Web, the reply must be accompanied by a copy of the new notice.

If the Office previously granted a petition to withdraw the holding of abandonment or a petition to revive under 37 CFR 1.137, the status of the application has been returned to pending status.

/sstephanos/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/124,768	05/21/2008	2612	435	ADA-08-REG-07	20	3

CONFIRMATION NO. 3269

45649
PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

UPDATED FILING RECEIPT

OC00000035691435

Date Mailed: 04/29/2009

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Clarke McAllistor, Eugene, OR;

Power of Attorney:
Peter Haas--52481

Domestic Priority data as claimed by applicant

This appln claims benefit of 60/939,603 05/22/2007

Foreign Applications

Projected Publication Date: To Be Determined - pending completion of Security Review

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

Systems, Methods, and Devices for Replication of Data onto Wireless Sensors

Preliminary Class

340

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent

in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/124,768	05/21/2008	Clarke McAllistor	ADA-08-REG-07

CONFIRMATION NO. 3269

NEW OR REVISED PPD NOTICE

45649
PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

OC000000037850894

NOTICE OF NEW OR REVISED PROJECTED PUBLICATION DATE

The above-identified application has a new or revised projected publication date. The current projected publication date for this application is 12/24/2009. If this is a new projected publication date (there was no previous projected publication date), the application has been cleared by Licensing & Review or a secrecy order has been rescinded and the application is now in the publication queue.

If this is a revised projected publication date (one that is different from a previously communicated projected publication date), the publication date has been revised due to processing delays in the USPTO or the abandonment and subsequent revival of an application. The application is anticipated to be published on a date that is more than six weeks different from the originally-projected publication date.

More detailed publication information is available through the private side of Patent Application Information Retrieval (PAIR) System. The direct link to access PAIR is currently http://pair.uspto.gov. Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Questions relating to this Notice should be directed to the Office of Data Management, Application Assistance Unit at (571) 272-4000, or (571) 272-4200, or 1-888-786-0101.

DEPARTMENT OF DEFENSE
ACCESS ACKNOWLEDGEMENT / SECRECY ORDER RECOMMENDATION
FOR PATENT APPLICATION

Application Serial No: DP12124768 Filing Date: Date Referred: 07/18/2008

I hereby acknowledge that the Department of Defense reviewers has inspected this application in administration of 35 USC 181 on behalf of the Agencies/Commands specified below. DoD reviewers will not divulge any information from this application for any purpose other than administration of 35 USC 181.

Defense Agency	Recommendation	Reviewer Name	Date Reviewed
NSA	Secrecy Not Recommended	Robert Morelli	08/04/2008

Type of Recommendations:	*SNR: Secrecy Not Recommended* *SR: Secrecy Recommended* *NC: No Comment*

Instructions to Reviewers:
1. All DoD personnel reviewing this application will be listed on this form regardless of whether they are making a secrecy order recommendation.

2. This form will be forwarded to USPTO once all assigned DoD entities have provided their secrecy order recommendation.

Time for Completion of Review:
Pursuant to 35 USC 184, the subject matter of this application may be filed in a foreign country for the purpose of filing a patent application without a license anytime after the expiration of six (6) months from filing date unless the application becomes the subject of a secrecy order.

The USPTO publishes patent application at 18 months from the earliest claimed filing date. The USPTO will delay the publication of a patent application made available to a defense agency under 35 USC 181 until no earlier than 6 months from the filing date or 90 days from the date of referral to that agency. This application will be cleared for publication 6 months from the filing date or 90 days from the above Date Referred, whichever is later, unless a response is provided to the USPTO regarding the necessary recommendations as to the imposition of a secrecy order.

DoD Completion of Review: Final
Forwarded to USPTO: 09/04/2009 By: Oksana Nesterczuk

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/124,768	05/21/2008	Clarke McAllistor	ADA-08-REG-07	3269

45649 7590 12/22/2009

PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

EXAMINER	
MIKELS, MATTHEW	

ART UNIT	PAPER NUMBER
4175	

MAIL DATE	DELIVERY MODE
12/22/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	12/124,768	MCALLISTOR, CLARKE	
	Examiner	Art Unit	
	MATTHEW MIKELS	4175	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 May 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 April 2009* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *5/21/08*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claims 5-7 are objected to because of the following informalities: claim 5 is dependent on claim 6, which is improper. It appears that claim 5 should be dependent on claim 1, and will be assumed to be so for the purposes of this examination. Claims 6 and 7 inherit the deficiencies of claim 5.

2. Claims 6-13 are objected to because of the following informalities: the word claim is capitalized in each claim, but in all other claims it is not.

3. Claim 20 is objected to because of the following informalities: the first instance of "providing" is capitalized.

4. Appropriate correction is required.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-4 and 12 are rejected under 35 U.S.C. 102(b) as being anticipated by Roberts (US 2005/0283272).

7. Regarding claim 1, Roberts teaches a mobile encoding system for commissioning RFID transponders, the system comprising:

an RFID interrogator adapted to enable encoding data using an internal antenna, the antenna being adapted to encode the data into an RFID transponder (paragraph

0023);

at least one memory storage device for storing an authorization to encode unique numbers into RFID transponders (paragraph 0031);

a bar code scanning means to acquire commands or data (paragraph 0045);

a processing means for controlling and communicating with the memory storage device, the bar code scanning means, the RFID interrogator and the internal antenna (paragraph 0030);

a means for constructing transponder data payloads by processing data gathered from bar code scanning means (paragraph 0023);

a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable reading or encoding of the data payload (paragraph 0023);

a transponder separation device means (paragraph 0044); and

a means for providing a cartridge or a pre-packaged self-contained supply of RFID transponders conveyed on a web from which properly encoded transponders are removed (paragraph 0043).

8. Regarding claim 2, Roberts teaches the bar code scanning means further comprising: an imager or a laser, the imager or the laser adapted to be mechanically aligned (paragraph 0023) with the internal antenna to read printed symbols which contain some or all of the transponder data payload (paragraph 045).

9. Regarding claim 3, Roberts teaches the bar code scanning means further comprising a wireless communication means for communication with the processing means (paragraph 0032).

10. Regarding claim 4, Roberts teaches the means for presenting the RFID transponder comprising a motor assembly adapted to pull the RFID transponder from a supply reel (paragraph 0044).

11. Regarding claim 12, Roberts teaches a means for verifying that the RFID transponder was encoded (paragraph 0024);

means for dispensing an encoded RFID transponder (paragraph 0043); and

a means for not dispensing an improperly encoded RFID transponder (paragraph 0025).

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Roberts.

14. Regarding claim 13, Roberts teaches a memory storage device for storing transponder authorizations (paragraph 0031), wherein the memory storage device couples to the processing means via the antenna and RFID interrogator whereby the memory storage device is not physically coupled to the processing means (paragraph 0032). Roberts does not teach at least a plurality of memory storage devices. However,

it would have been obvious to one having ordinary skill in the art at the time of invention to add one or more memory devices, because having multiple memory device would have been obvious to try, as having multiple memory devices increases the number of different authorizations and instructions that can be stored and communicated at any given time.

15. Claims 5-7, 11, 14-18, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roberts in view of Landt (US 6677852).

16. Regarding claim 5, Roberts teaches the system of claim 1, as discussed above, and a self-contained supply of RFID transponders (paragraph 0043). Roberts does not teach a supply reel and a take up reel. Landt teaches a supply reel and take up reel (Fig. 7 of Landt). It would have been obvious to one having ordinary skill in the art at the time of invention to combine the teachings of Roberts and Landt, because having both a supply reel and take up reel allows for quick and easy disposal of the spent reel, once all the RFID tags are used.

17. Regarding claim 6, Roberts further teaches a transponder separation device whereby the transponders are separated from a conveyance web (paragraph 0044).

18. Regarding claim 7, Roberts teaches the system of claim 1, as discussed above, and the sharp edge enabling a release liner to separate from an RFID transponder (paragraph 0044). Roberts does not teach radio frequency shielding. Landt teaches radio frequency shielding (column 10, lines 40-43). It would have been obvious to one having ordinary skill in the art at the time of invention to combine the teachings of Roberts and Landt, because shielding the transponder being enabled or written

prevents any outside sources of radio frequency to interfere with the enabling or writing process.

19. Regarding claim 11, Roberts teaches the system of claim 1, as discussed above. Roberts does not teach means for associating data read from an RFID transponder with new data, whereby the new data is programmed into the RFID transponder. Landt teaches means for associating data read from an RFID transponder with new data, whereby the new data is programmed into the RFID transponder (column 8, lines 4-8). It would have been obvious to one having ordinary skill in the art at the time of invention because this allows the system to update easily (column 8, line 10).

20. Regarding claim 14, Roberts teaches an RFID transponder comprising a fixed spatial separation means along a conveyance web whereby the transponder adapts to wirelessly send and receive data packets corresponding to an information set (paragraph 0023);

an RFID transponder encoder device (paragraph 0023) having a processing means (paragraph 0030) and a memory means (paragraph 0031), the encoder device being adapted to sequentially convey one RFID transponder at a time into an interrogation field (paragraph 0043), the encoder device further including means for coupling radio frequency signals with one RFID transponder (paragraph 0023), means for reading and writing authorization of transponders (paragraph 0024), means for verifying the status of a commissioned transponder (paragraph 0024), and means for mechanically separating a transponder from the conveyance web (paragraph 0043);

a means for coupling a cartridge or other pre-packaged self-contained supply of

the RFID transponders (paragraph 0043), the transponders being further adapted for tensile extraction from said supply; and

a bar code scanner adapted to resolve data ambiguities prior to transponder encoding (paragraph 0045).

Roberts does not teach a means for encoding authorization from an external authority for a selected numbering system. Landt teaches a means for encoding authorization from an external authority for a selected numbering system (column 11, lines 57-62). It would have been obvious to one having ordinary skill in the art at the time of invention to combine the teachings of Roberts and Landt, because, encoding authorization from an external source allows for reprogramming of the device wirelessly and easily (column 11, lines 63-65).

21. Regarding claim 15, Roberts in view of Landt teaches the device of claim 14, as discussed above. Roberts further teaches a processing means to verify the functionality of a commissioned transponder after separation from the conveyance web (paragraph 0024).

22. Regarding claim 16, Roberts in view of Landt teaches the device of claim 14, as discussed above. Landt further teaches a plurality of authorization transponders adapted to provide the RFID transponder encoder device sets of preauthorized blocks of unique numbers for specific object classes (column 7, lines 46-65). It would have been obvious to one having ordinary skill in the art at the time of invention further modify Roberts in view of Landt with the further teachings of Landt, because having

authorization tags allows for a quick and simple way to upload a new set of authorizations or instructions (column 8, lines 9-10).

23. Regarding claim 17, Roberts teaches a method for commissioning RFID transponders comprising:

providing an RFID transponder encoder having a transponder separation device (paragraph 0043);

providing information to the encoder (paragraph 0023);

providing a supply of RFID transponders (paragraph 0022);

advancing the RFID transponder in the encoder (paragraph 0043); and

reading information from the RFID transponder (paragraph 0023). Roberts does not teach acquiring object class information to encode multiple instances of unique numbers from that object class into an RFID transponder, or encoding the object class instance information into the transponder. Landt teaches acquiring object class information to encode multiple instances of unique numbers from that object class into an RFID transponder (column 7, lines 46-65), and encoding the object class instance information into the transponder (column 8, line 10). It would have been obvious to one having ordinary skill in the art at the time of invention to combine the teachings of Roberts and Landt, because encoding object class information into the transponder allows the system to easily track all transponders.

24. Regarding claim 18, Roberts further teaches providing a conveyance webbing coupled to the RFID transponder (paragraph 0043) and severing the conveyance webbing to remove teach encoded transponder (paragraph 0043).

25. Regarding claim 20, Roberts further teaches providing a transponder having a conveyance web or release liner (paragraph 0043), and providing the encoder with a motor adapted to provide tension in the conveyance web or release liner (paragraph 0044).

26. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Roberts in view of Koenck, et al. (US 5825045, herein referred to as Koenck),

27. Regarding claim 8, Roberts teaches the system of claim 1, as discussed above. Roberts does not teach a housing assembly for enclosing the internal antenna and a handle coupled to a surface of the housing. Koenck teaches a housing assembly (Fig. 2, item 30) for enclosing the internal antenna (column 3, lines 58-60) and a handle coupled to a surface of the housing (Fig.2, the item to the left of the trigger 31). It would have been obvious to one having ordinary skill in the art at the time of invention to combine the teachings of Roberts and Koenck, because enclosing the internal antenna protects the antenna, and a handle makes the system easier to use.

28. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Roberts in view of Nye (US 7421367).

29. Regarding claim 9, Roberts teaches the system of claim 1, as discussed above. Roberts does not teach a housing assembly for enclosing the internal antenna or a mounting mechanism for selectively coupling the encoding system to a provided structure. Nye teaches a housing assembly for enclosing the internal antenna (Fig. 1, item 10) or a mounting mechanism for selectively coupling the encoding system to a provided structure (column 5, lines 50-58). It would have been obvious to one having

ordinary skill in the art at the time of invention to combine the teachings of Roberts and Nye, because a housing protects the antenna, and coupling the system to a structure protects it when not in use, and permits downloading and sharing of data with an external system (column 5, lines 57-58).

30. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Roberts in view of Nikitin, et al. (US 2008/0184177, herein referred to as Nikitin).

31. Regarding claim 10, Roberts teaches the system of claim 1, as discussed above, and controlling the dispensing roll (paragraph 0040 of Roberts). Roberts does not teach measuring velocity. Nikitin teaches measuring the velocity of a roll (paragraph 0049). It would have been obvious to one having ordinary skill in the art at the time of invention to combine the teachings of Roberts and Nikitin, because an accurate measurement of the velocity of the dispensing roll allows for a quick diagnosis if the roll is malfunctioning.

32. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Roberts in view of Landt as applied to claim 17 above, and further in view of Eberhardt, et al. (US 6130613, herein referred to as Eberhardt).

33. Regarding claim 19, Roberts in view of Landt teaches the method of claim 17, as discussed above, and verifying that the RFID transponder is properly encoded. Roberts in view of Landt does not teach applying the RFID transponder to a target surface. Eberhardt teaches applying the RFID transponder to a target surface (column 3, lines 24-27). It would have been obvious to one having ordinary skill in the art at the time of invention to add the teachings of Eberhardt to Roberts in view of Landt, because

attaching the RFID transponder to a surface allows for use in many different locations and settings.

Conclusion

34. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

35. Feltz, et al. (US 2005/0280537) discloses a system for reading and writing to an RFID transponder.

36. Bennett (US 6830181) discloses an combination RFID and barcode scanner.

37. Sureaud, et al. (US 7320432) discloses a system for reading and encoding the output of an identification printer.

38. Sano, et al. (US 2005/0218219) discloses a label and RFID tag issuing apparatus.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW MIKELS whose telephone number is (571)270-5470. The examiner can normally be reached on Monday through Thursday 7AM-5:30PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Robinson can be reached on 571-272-2319. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/M. M./
Examiner, Art Unit 4175
/Jefferey F Harold/
Supervisory Patent Examiner, Art Unit 4192

Notice of References Cited	Application/Control No. 12/124,768	Applicant(s)/Patent Under Reexamination MCALLISTOR, CLARKE	
	Examiner MATTHEW MIKELS	Art Unit 4175	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2005/0283272	12-2005	Roberts, William Peyton	700/231
*	B	US-6,677,852	01-2004	Landt, Jeremy A.	340/10.1
*	C	US-5,825,045	10-1998	Koenck et al.	250/566
*	D	US-7,421,367	09-2008	Nye, Pamela F.	702/127
*	E	US-2008/0186177	08-2008	Nikitin et al.	340/572.1
*	F	US-6,130,613	10-2000	Eberhardt et al.	340/572.7
*	G	US-2005/0280537	12-2005	Feltz et al.	340/572.1
*	H	US-6,830,181	12-2004	Bennett, James D.	235/440
*	I	US-7,320,432	01-2008	Sureaud et al.	235/462.43
*	J	US-2005/0218219	10-2005	Sano et al.	235/383
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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	P					
	Q					
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	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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BIB DATA SHEET

CONFIRMATION NO. 3269

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/124,768	05/21/2008	340	4175	ADA-08-REG-07

APPLICANTS
Clarke McAllistor, Eugene, OR;

**** CONTINUING DATA ***************************
This appln claims benefit of 60/939,603 05/22/2007

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /MATTHEW MIKELS/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		OR	6	20	3

ADDRESS

PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201
UNITED STATES

TITLE

Systems, Methods, and Devices for Replication of Data onto Wireless Sensors

FILING FEE RECEIVED		
435	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

BIB (Rev. 05/07).

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	21	US-7066667-$.DID. OR US-5899476-$.DID. OR US-6246326-$.DID. OR US-5382784-$.DID. OR US-6486780-$.DID. OR US-5280159-$.DID. OR US-5763867-$.DID. OR US-5962837-$.DID. OR US-5850187-$.DID. OR US-6078251-$.DID. OR US-6195053-$.DID. OR US-6357662-$.DID. OR US-6593853-$.DID. OR US-6969134-$.DID. OR US-6848616-$.DID. OR US-7223030-$.DID. OR US-7249819-$.DID. OR US-7187294-$.DID. OR US-20060080819-$.DID. OR US-20030227528-$.DID. OR US-20070150219-$.DID.	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/08 10:01
S2	17261	235/487,492.ccls. or 340/10.$.ccls. or 340/572.$.ccls.	US-PGPUB; USPAT	AND	ON	2009/12/08 10:01
S3	36944	(RFID or (radio adj frequency adj identification))	US-PGPUB; USPAT	AND	ON	2009/12/08 10:03
S4	1501	((mobile or portable) with (commission$4 or activat$4) with (reader or interrogator or sensor))	US-PGPUB; USPAT	AND	ON	2009/12/08 10:19
S5	87	S2 and S3 and S4	US-PGPUB; USPAT	AND	ON	2009/12/08 10:20
S6	28328	(barcode or bar$1code or (bar adj code)) near3 scan$4	US-PGPUB; USPAT	AND	ON	2009/12/08 10:21
S7	23	S5 and S6	US-PGPUB; USPAT	AND	ON	2009/12/08 10:21

S8	33	("20020005774" | "20030227528" | "20040074964" | "20040124235" | "20040141790" | "20050045724" | "20050218219" | "20060080819" | "5227617" | "6246326" | "6279638" | "6280544" | "6332098" | "6379058" | "6409401" | "6415978" | "6478229" | "6481907" | "6517700" | "6532346" | "6805183" | "6830181" | "6848616" | "6857714" | "6884312" | "6899476" | "6963351" | "7066667" | "7069251" | "7073712" | "7075435" | "7114655" | "7320432").PN. OR ("7551087").URPN.	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/08 10:31
S9	210	(label with RFID with (transponder or tag) with (reel or roll))	US-PGPUB; USPAT	AND	ON	2009/12/08 14:11
S10	4	S9 and S4	US-PGPUB; USPAT	AND	ON	2009/12/08 14:12
S11	33	("20020005774" | "20030227528" | "20040074964" | "20040124235" | "20040141790" | "20050045724" | "20050218219" | "20060080819" | "5227617" | "6246326" | "6279638" | "6280544" | "6332098" | "6379058" | "6409401" | "6415978" | "6478229" | "6481907" | "6517700" | "6532346" | "6805183" | "6830181" | "6848616" | "6857714" | "6884312" | "6899476" | "6963351" | "7066667" | "7069251" | "7073712" | "7075435" | "7114655" | "7320432").PN. OR ("7551087").URPN.	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/08 14:13
S12	129	S9 and S2	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/08 15:04

S13	34	S9 and S2 and S6	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/08 15:04
S14	1	(11/465712).APP.	US-PGPUB; USPAT; USOCR	OR	OFF	2009/12/08 15:05
S15	1	"20070040684"	US-PGPUB; USPAT	AND	ON	2009/12/08 15:20
S16	0	("2005280537").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2009/12/08 15:24
S17	1	("20050280537").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2009/12/08 15:24
S18	1	("6677852").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2009/12/08 15:26
S19	1	("6130613").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2009/12/08 15:27
S20	1	("20060117554").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2009/12/08 15:27
S21	1	S17 and (barcode or (bar adj code) or bar$1code)	US-PGPUB; USPAT	AND	ON	2009/12/08 15:37
S22	66	("4739328" | "5030807" | "5382784" | "6246326" | "6318636" | "6415978" | "6523752" | "6545605").PN. OR ("6677852").URPN.	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 07:43
S23	1	("20050283272").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2009/12/09 07:44
S24	52	("20010054005" | "4679154" | "4937581" | "5059951" | "5151684" | "5216233" | "5218187" | "5280159" | "5382784" | "5557096" | "5565858" | "5633487" | "5686888" | "5801371" | "5811784" | "5825045" | "5874724" | "5962834" | "5979758" | "5999294" | "6036348" | "6056169" | "6056199" | "6109526" | "6269342" | "6318631" | "6332098" | "6371375").PN. OR ("6830181").URPN.	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:00

S25	6	S24 and (internal near2 antenna)	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:06
S26	5	S24 and (internal near2 antenna) and mount$5	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:11
S27	302	handheld with ((RF or (radio adj frequency)) and (barcode or bar $1code or (bar adj code)))	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:14
S28	330238	mount$5 near2 (mechanism or hook or latch or unit)	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:14
S29	36	S27 and S28	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:15
S30	131	handheld with ((RF or (radio adj frequency)) with (barcode or bar $1code or (bar adj code)))	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:16
S31	6	S30 and S28	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:16
S32	83	handheld with scan$5 with ((RF or (radio adj frequency)) with (barcode or bar$1code or (bar adj code)))	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:17
S33	59	(mechanism or hook or latch or mount) and S32	US-PGPUB; USPAT; USOCR	AND	ON	2009/12/09 11:17
S34	1	("7421367").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2009/12/09 11:22
S35	1	S34 and antenna	US-PGPUB; USPAT	AND	ON	2009/12/09 11:22
S36	383316	(velocity or speed) with (measur$6 or detect$4 or calculat$5)	US-PGPUB; USPAT	AND	ON	2009/12/09 11:30
S37	17261	235/487,492.ccls. or 340/10.$.ccls. or 340/572.$.ccls.	US-PGPUB; USPAT	AND	ON	2009/12/09 11:31
S38	841	S36 and S37	US-PGPUB; USPAT	AND	ON	2009/12/09 11:31

S39	210	(label with RFID with (transponder or tag) with (reel or roll))	US-PGPUB; USPAT	AND	ON	2009/12/09 11:31
S40	10	S36 and S37 and S39	US-PGPUB; USPAT	AND	ON	2009/12/09 11:31
S41	15173	(velocity or speed) with (measur$6 or detect$4 or calculat$5) with (roll or feed or web)	US-PGPUB; USPAT	AND	ON	2009/12/09 11:33
S42	19	S41 and S37	US-PGPUB; USPAT	AND	ON	2009/12/09 11:33

12/9/2009 3:16:41 PM
C:\Documents and Settings\mmikels\My Documents\EAST\Workspaces\12124768.wsp

Doc code :IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-08)
Approved for use through 03/31/2008. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	2008-05-21
First Named Inventor	McAllister, Clarke
Art Unit	
Examiner Name	
Attorney Docket Number	ADA-08-REG-07

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	2	5899476	A	2005-05-31	BARRUS ET AL.	
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	7	5763867	A	1998-06-09	MAIN ET AL.	
	8	5962837	A	1999-10-05	MAIN ET AL.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.M./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2008-05-21
	First Named Inventor	McAllister, Clarke
	Art Unit	
	Examiner Name	
	Attorney Docket Number	ADA-08-REG-07

	9	5850187	A	1998-12-15	CARRENDER ET AL.	
	10	6078251	A	2000-06-20	CARRENDER ET AL.	
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	12	6357662	A	2002-03-19	WIKLOF ET AL.	
	13	6593853	A	2003-07-15	BARRETT ET AL.	
	14	6969134	A	2005-11-29	HOHBERGER ET AL.	
	15	6848616	A	2005-02-01	TSIRLINE ET AL.	
	16	7223030	A	2007-05-29	FESSLER ET AL.	
	17	7249819	A	2007-07-31	BURDETTE ET AL.	
	18	7187294	A	2007-03-06	BURDETTE ET AL.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2008-05-21
	First Named Inventor	McAllister, Clarke
	Art Unit	
	Examiner Name	
	Attorney Docket Number	ADA-08-REG-07

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20060080819	A1	2006-04-20	MCALLISTER	
	2	20030227528	A1	2003-12-11	HOHBERGER ET AL.	
	3	20070150219	A1	2007-06-28	Cawker et al.	

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FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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EXAMINER SIGNATURE

Examiner Signature	/Matthew Mikels/ (12/09/2009)	Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2008-05-21
	First Named Inventor	McAllister, Clarke
	Art Unit	
	Examiner Name	
	Attorney Docket Number	ADA-08-REG-07

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12124768	MCALLISTOR, CLARKE
	Examiner	Art Unit
	MATTHEW MIKELS	4175

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	12/09/2009								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
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	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12124768	MCALLISTOR, CLARKE
	Examiner	Art Unit
	MATTHEW MIKELS	4175

SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
EAST Search (see attached notes)	12/9/09	MM
Inventor Name Search	12/9/09	MM
235/487,492 (limited with text)	12/9/09	MM
340/10,572 (limited with text)	12/9/09	MM

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/124,768	05/21/2008	Clarke McAllistor	ADA-08-REG-07

CONFIRMATION NO. 3269

45649
PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

PUBLICATION NOTICE

OC00000039357459

Title: Systems, Methods, and Devices for Replication of Data onto Wireless Sensors

Publication No.US-2009-0314829-A1
Publication Date:12/24/2009

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/124,768	05/21/2008	Clarke McAllistor	ADA-08-REG-07	3269

45649 7590 07/16/2010

PETER A. HAAS, ESQUIRE
1929 SW 13TH AVENUE
PORTLAND, OR 97201

EXAMINER	
MIKELS, MATTHEW	
ART UNIT	PAPER NUMBER
2876	
MAIL DATE	DELIVERY MODE
07/16/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of Abandonment	Application No.	Applicant(s)	
	12/124,768	MCALLISTOR, CLARKE	
	Examiner	Art Unit	
	MATTHEW MIKELS	2876	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

This application is abandoned in view of:

1. ☒ Applicant's failure to timely file a proper reply to the Office letter mailed on *22 December 2009*.
   (a) ☐ A reply was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply (including a total extension of time of _____ month(s)) which expired on _____.
   (b) ☐ A proposed reply was received on _____, but it does not constitute a proper reply under 37 CFR 1.113 (a) to the final rejection.
   (A proper reply under 37 CFR 1.113 to a final rejection consists only of: (1) a timely filed amendment which places the application in condition for allowance; (2) a timely filed Notice of Appeal (with appeal fee); or (3) a timely filed Request for Continued Examination (RCE) in compliance with 37 CFR 1.114).
   (c) ☐ A reply was received on _____ but it does not constitute a proper reply, or a bona fide attempt at a proper reply, to the non-final rejection. See 37 CFR 1.85(a) and 1.111. (See explanation in box 7 below).
   (d) ☒ No reply has been received.

2. ☐ Applicant's failure to timely pay the required issue fee and publication fee, if applicable, within the statutory period of three months from the mailing date of the Notice of Allowance (PTOL-85).
   (a) ☐ The issue fee and publication fee, if applicable, was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the statutory period for payment of the issue fee (and publication fee) set in the Notice of Allowance (PTOL-85).
   (b) ☐ The submitted fee of $_____ is insufficient. A balance of $_____ is due.
   The issue fee required by 37 CFR 1.18 is $_____. The publication fee, if required by 37 CFR 1.18(d), is $_____.
   (c) ☐ The issue fee and publication fee, if applicable, has not been received.

3. ☐ Applicant's failure to timely file corrected drawings as required by, and within the three-month period set in, the Notice of Allowability (PTO-37).
   (a) ☐ Proposed corrected drawings were received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply.
   (b) ☐ No corrected drawings have been received.

4. ☐ The letter of express abandonment which is signed by the attorney or agent of record, the assignee of the entire interest, or all of the applicants.

5. ☐ The letter of express abandonment which is signed by an attorney or agent (acting in a representative capacity under 37 CFR 1.34(a)) upon the filing of a continuing application.

6. ☐ The decision by the Board of Patent Appeals and Interference rendered on _____ and because the period for seeking court review of the decision has expired and there are no allowed claims.

7. ☒ The reason(s) below:

A phone call to Peter Haas was made on 7/12/10, but he could not be reached.

/Michael G Lee/
Supervisory Patent Examiner, Art Unit 2876

Petitions to revive under 37 CFR 1.137(a) or (b), or requests to withdraw the holding of abandonment under 37 CFR 1.181, should be promptly filed to minimize any negative effects on patent term.

EXHIBIT

11

US008228198B2

(12) **United States Patent**
McAllister

(10) **Patent No.: US 8,228,198 B2**
(45) **Date of Patent: Jul. 24, 2012**

(54) **SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS**

(75) Inventor: **Clarke McAllister**, Eugene, OR (US)

(73) Assignee: **ADASA Inc.**, Eugene, OR (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/820,109**

(22) Filed: **Jun. 21, 2010**

(65) **Prior Publication Data**

US 2010/0283584 A1 Nov. 11, 2010

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/465,712, filed on Aug. 18, 2006, now Pat. No. 7,830,258, and a continuation-in-part of application No. 12/124,768, filed on May 21, 2008, now abandoned.

(60) Provisional application No. 60/709,713, filed on Aug. 19, 2005, provisional application No. 60/939,603, filed on May 22, 2007.

(51) **Int. Cl.**
G08B 13/14 (2006.01)

(52) **U.S. Cl.** **340/572.1**; 340/10.51; 340/572.8; 340/693.5

(58) **Field of Classification Search** 340/572.1–572.9, 340/10.1–10.6, 693.5
See application file for complete search history.

(56) **References Cited**

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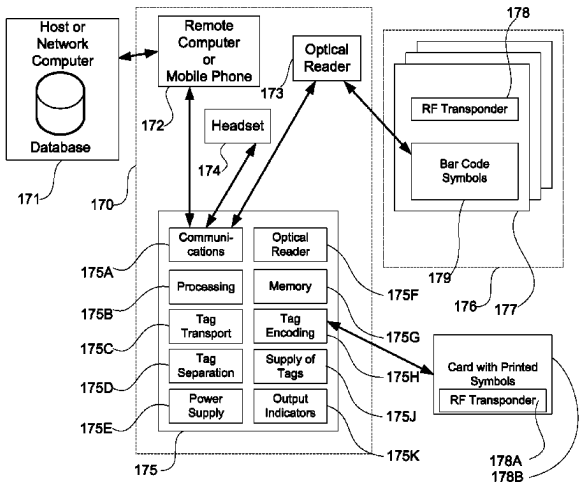
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(Continued)

Primary Examiner — Thomas Mullen
(74) *Attorney, Agent, or Firm* — Peter A. Haas Esquire LLC

(57) **ABSTRACT**

In one embodiment the present invention comprises a bar code scanner and an encoder for commissioning RFID transponders and includes a housing encasing a motor assembly, an RFID interrogator, a wireless communication means for transferring instructions and data from and to a remote host, on-board memory, a processor, and an antenna with corresponding mechanism to encode and verify a programmable RFID transponder. The present invention further includes novel methods for commissioning RFID transponders.

19 Claims, 19 Drawing Sheets



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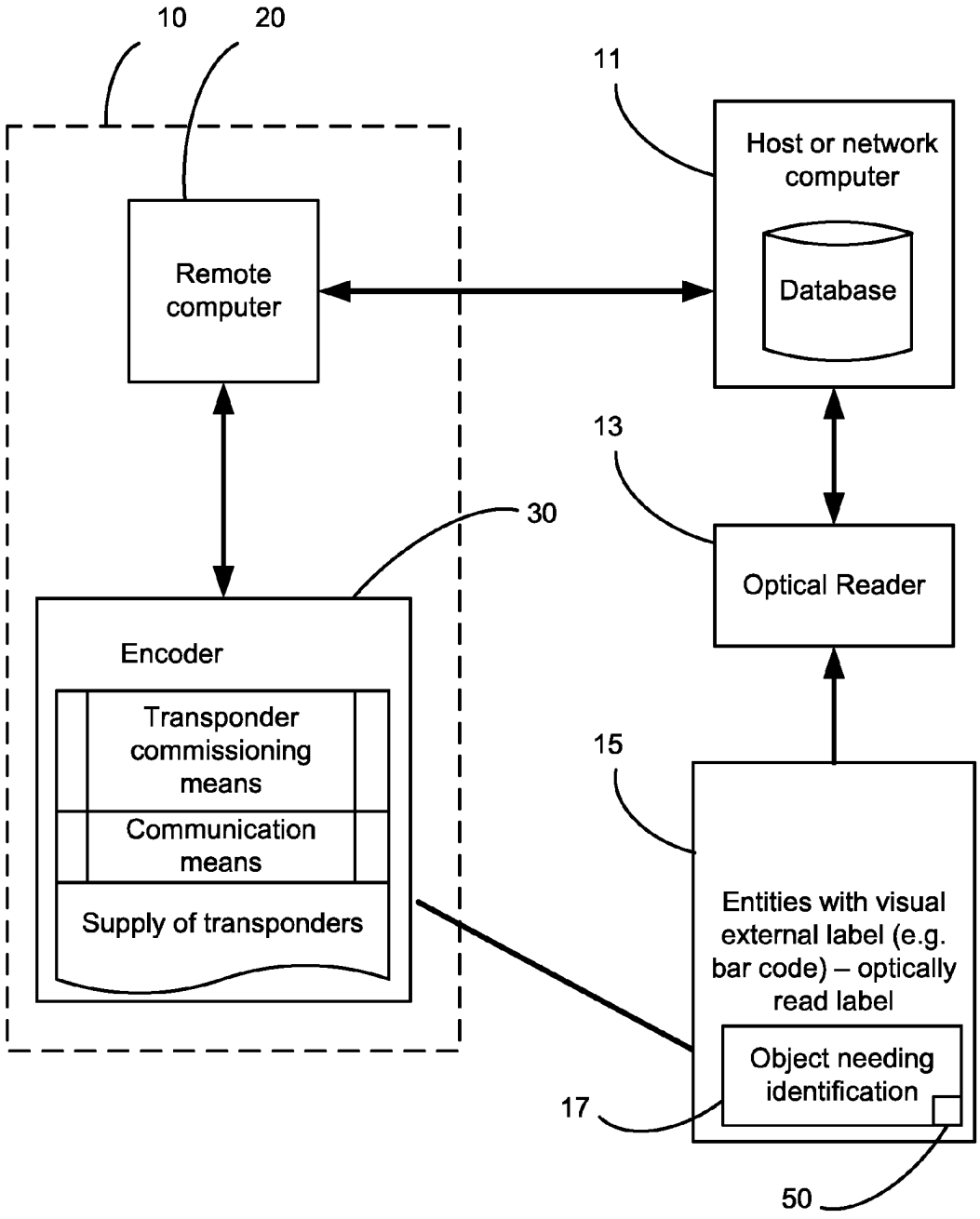

10
20
11
Host or network computer
Database
Remote computer
13
30
Optical Reader
Encoder
Transponder commissioning means
Communication means
Supply of transponders
15
Entities with visual external label (e.g. bar code) – optically read label
Object needing identification
17
50

FIG. 1

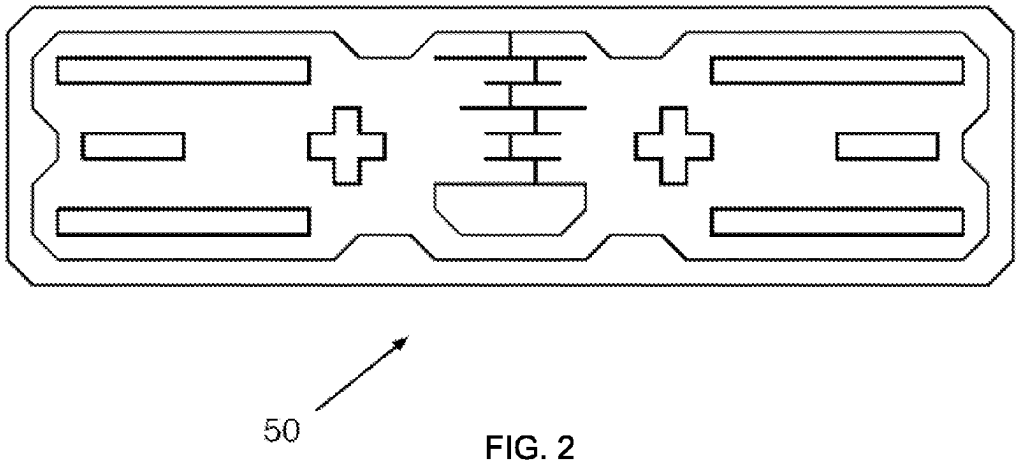


FIG. 2

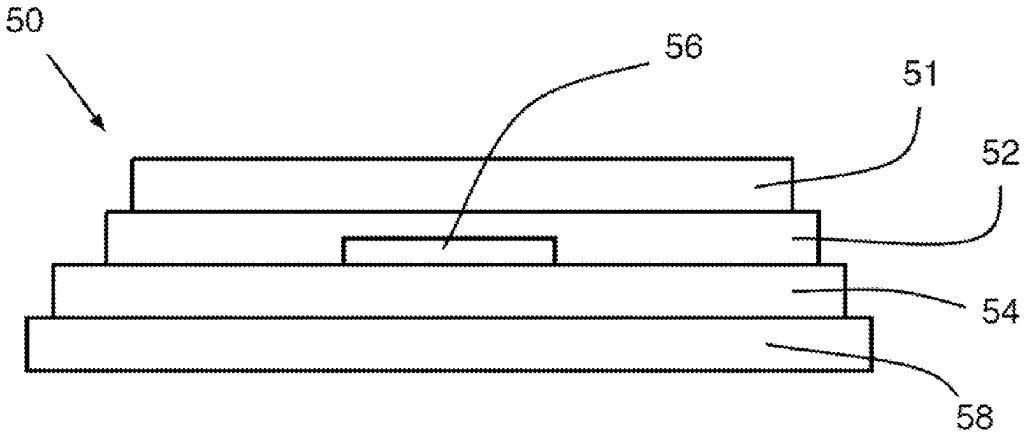


FIG. 3

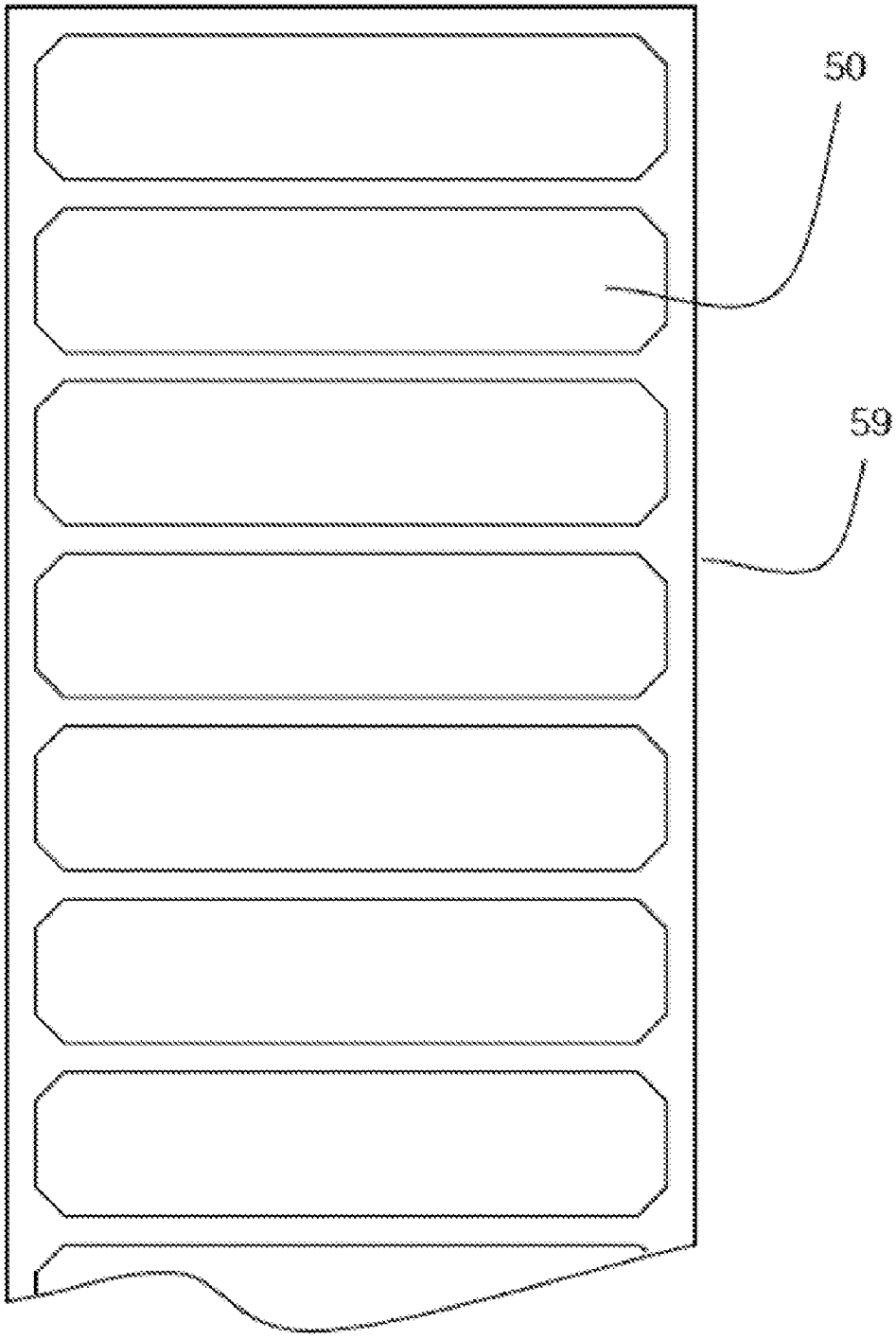


FIG. 4

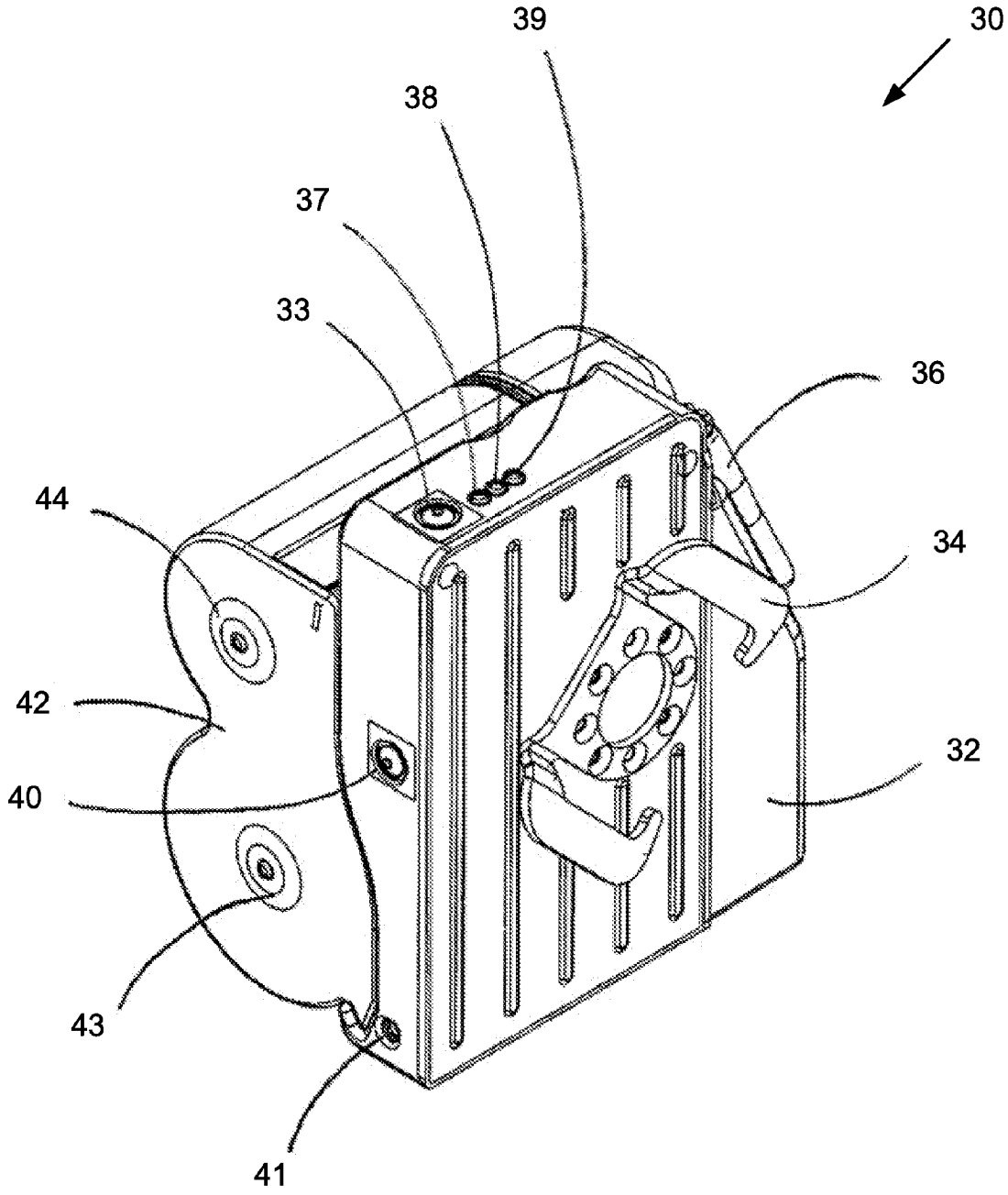


FIG 5

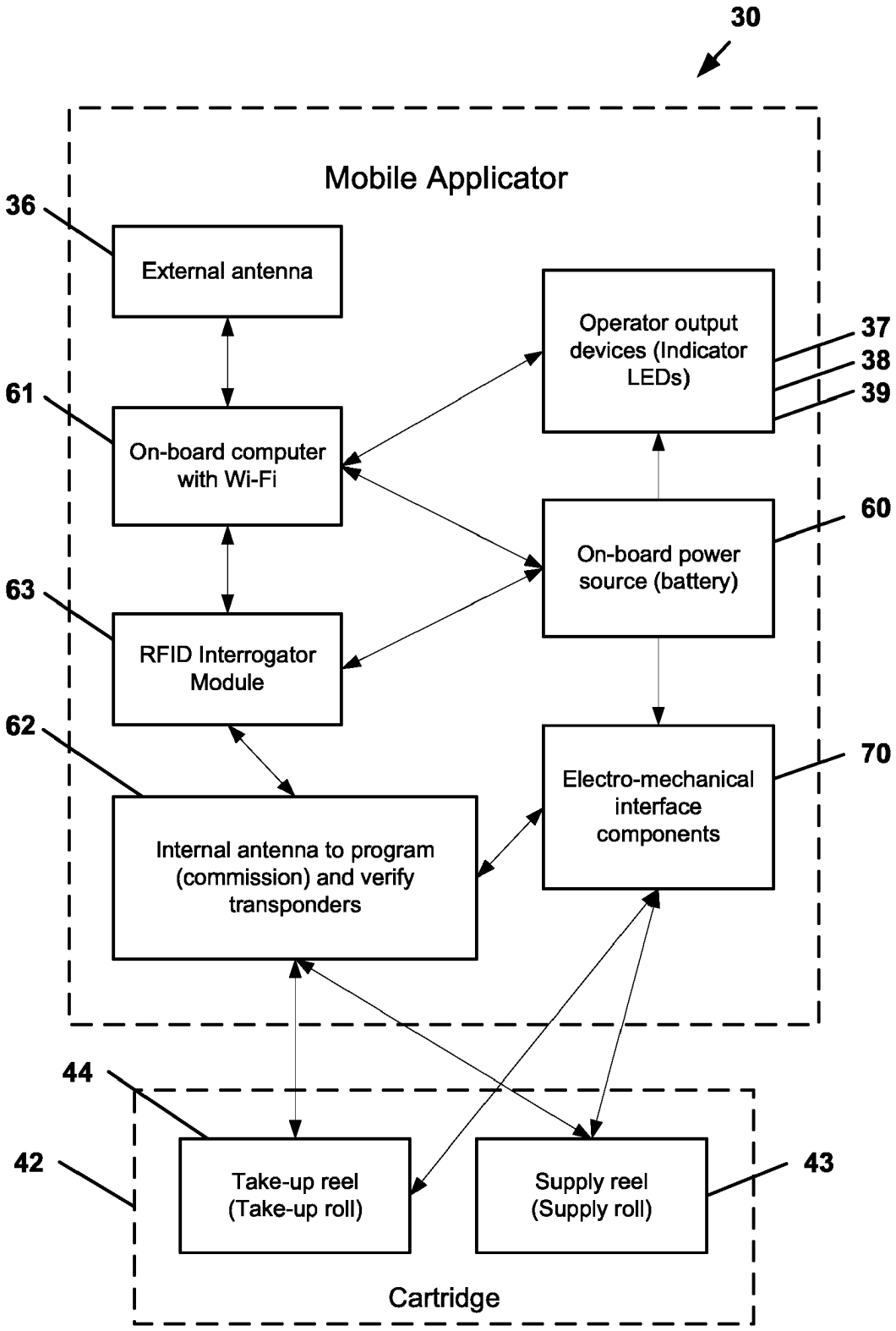

30
Mobile Applicator
36
External antenna
61
On-board computer with Wi-Fi
63
RFID Interrogator Module
62
Internal antenna to program (commission) and verify transponders
Operator output devices (Indicator LEDs)
37
38
39
On-board power source (battery)
60
Electro-mechanical interface components
70
44
42
Take-up reel (Take-up roll)
Supply reel (Supply roll)
43
Cartridge

FIG. 6

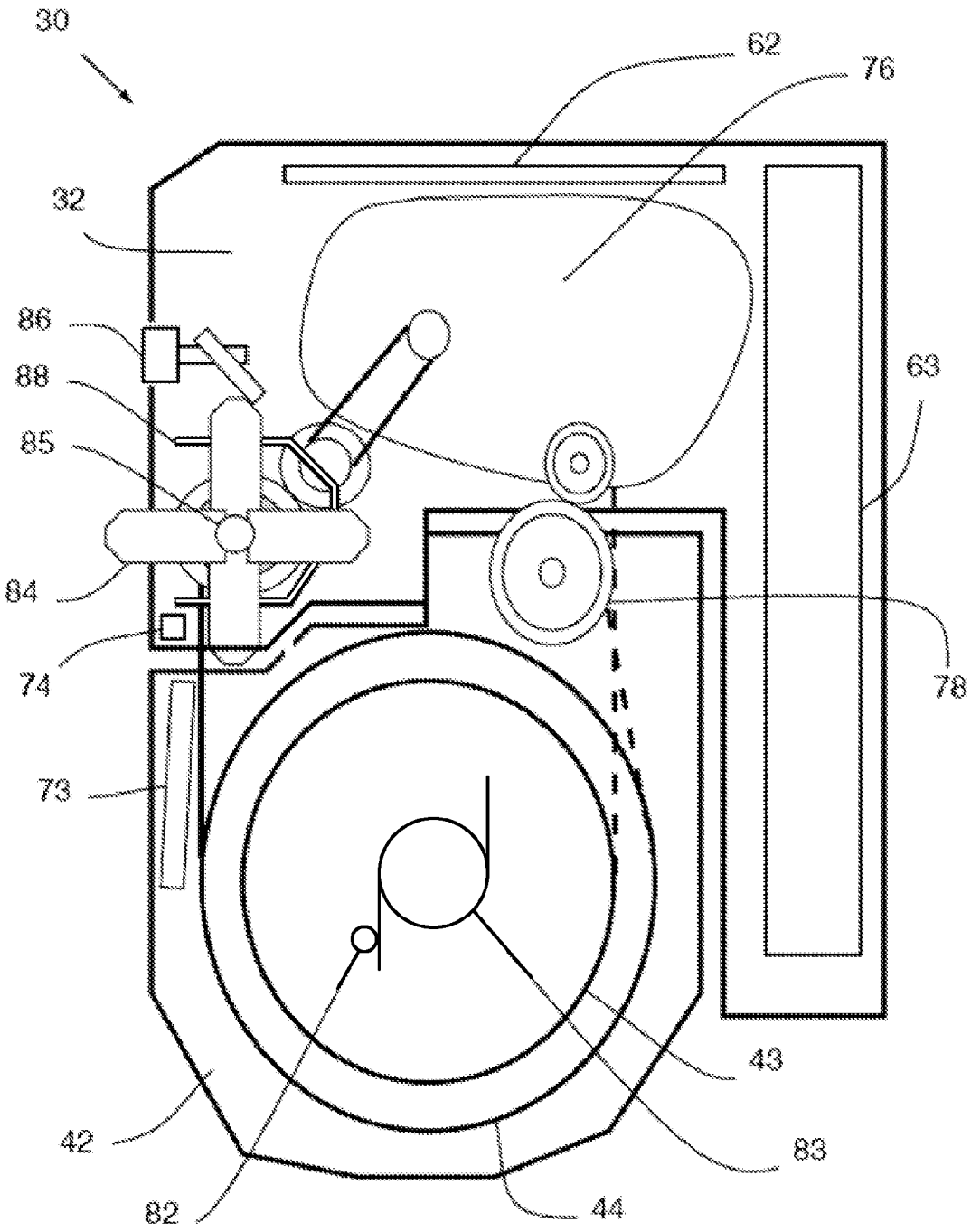


FIG. 7

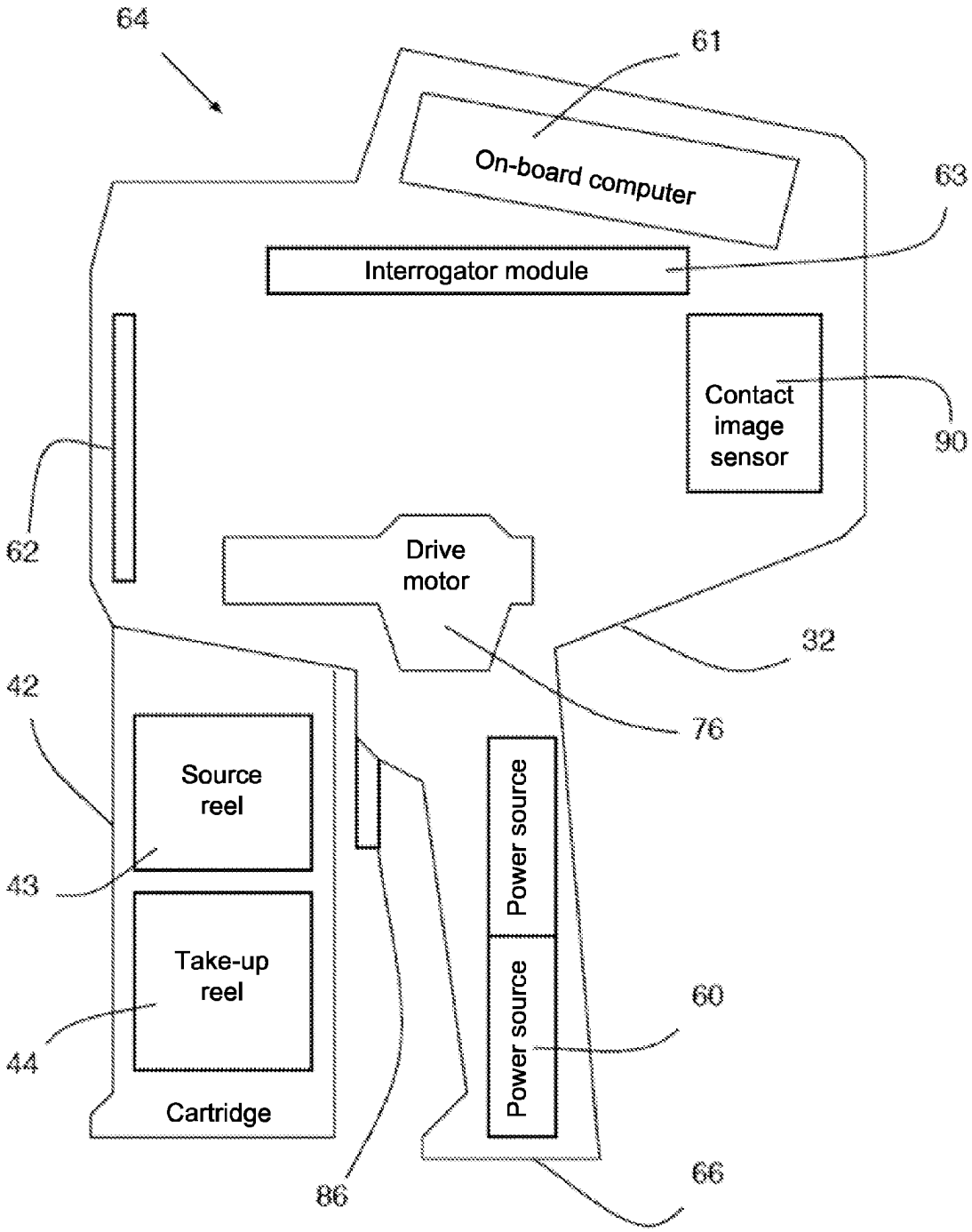

64
61
On-board computer
63
Interrogator module
Contact image sensor
90
62
Drive motor
32
42
76
Source reel
43
Take-up reel
44
Cartridge
Power source
Power source
60
86
66

FIG. 8

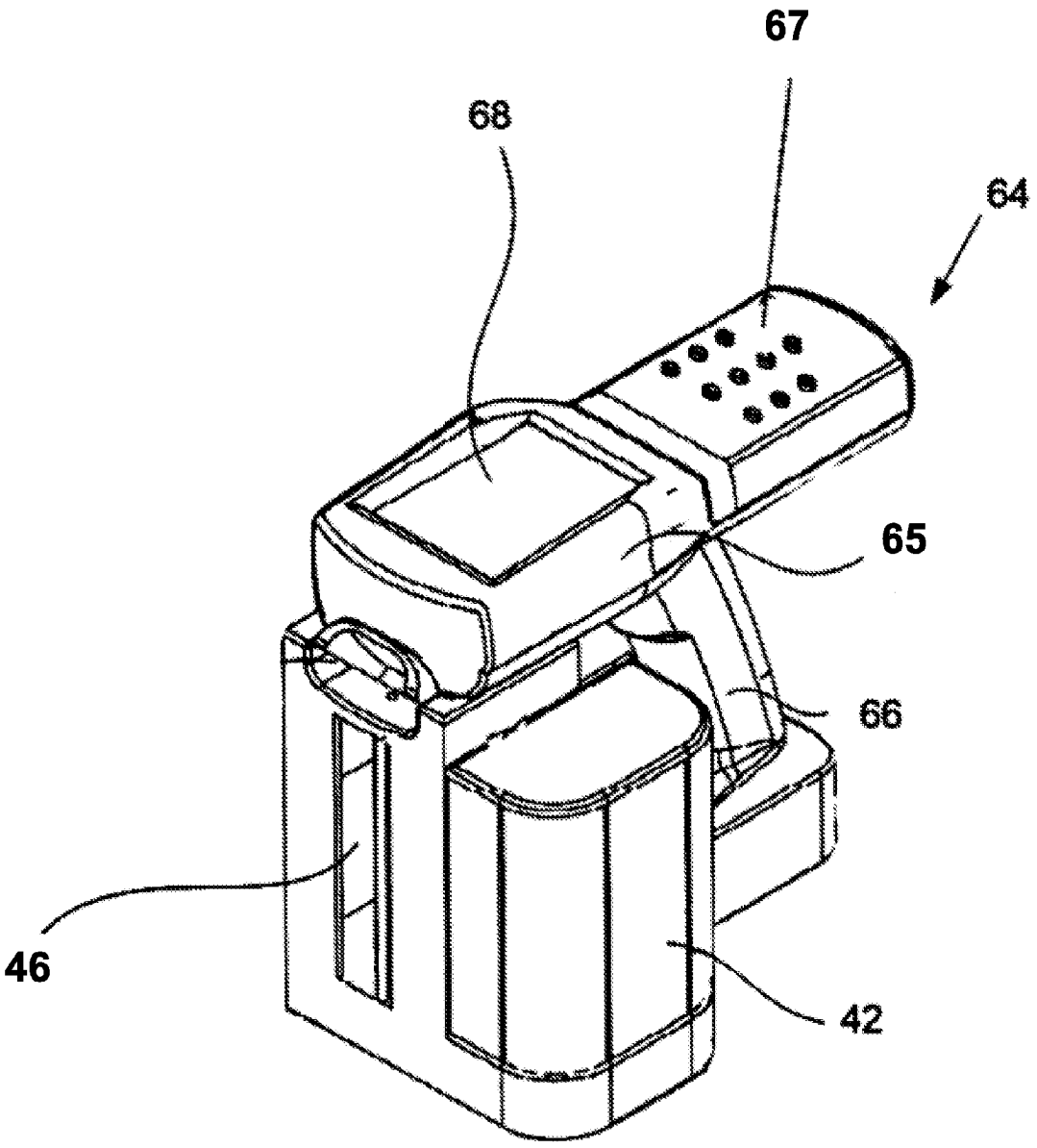


Fig. 9

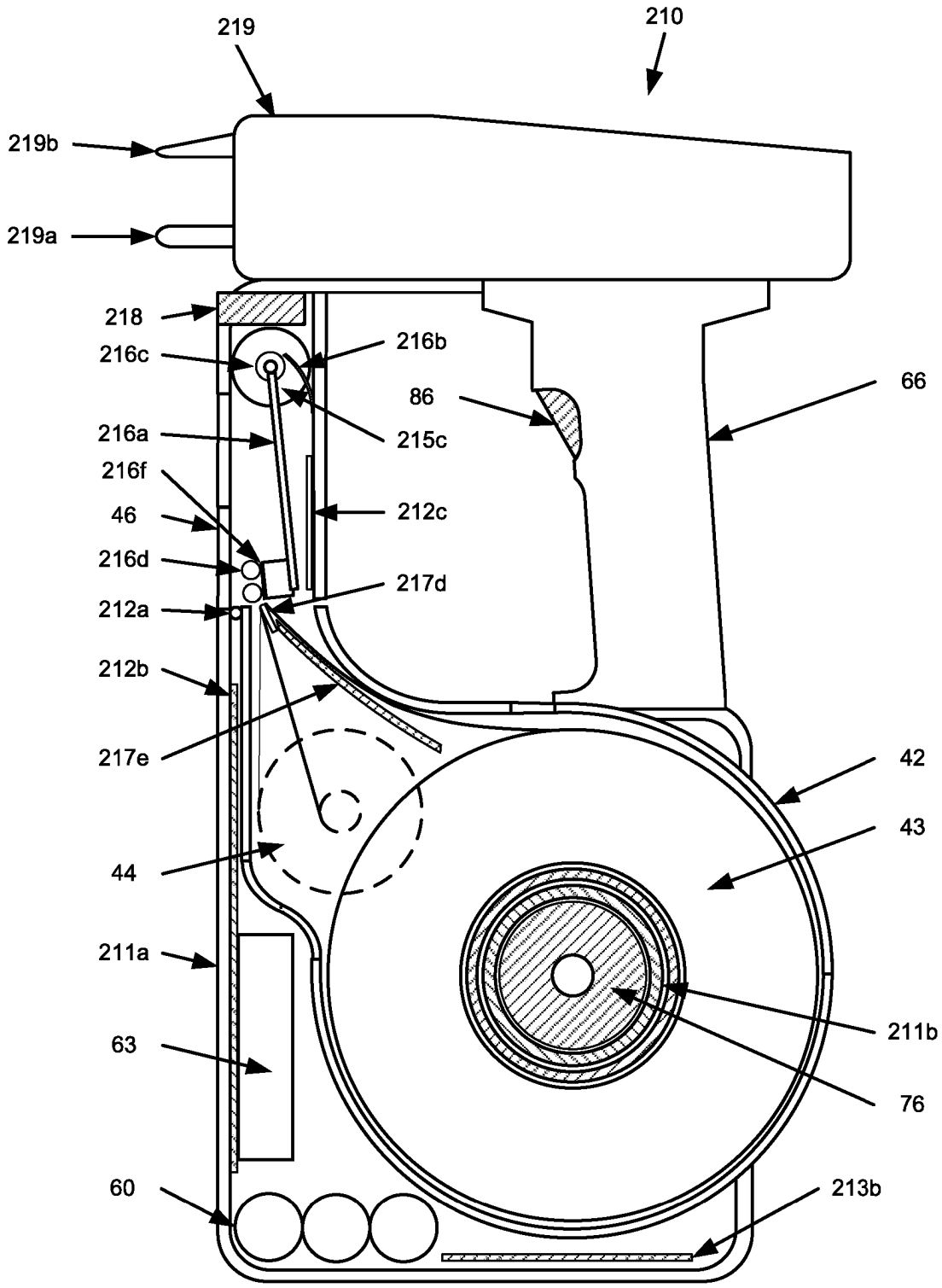

219
210
219b
219a
218
216c
216b
86
66
215c
216a
216f
46
212c
216d
217d
212a
212b
217e
42
43
44
211a
63
211b
76
60
213b

FIG. 10

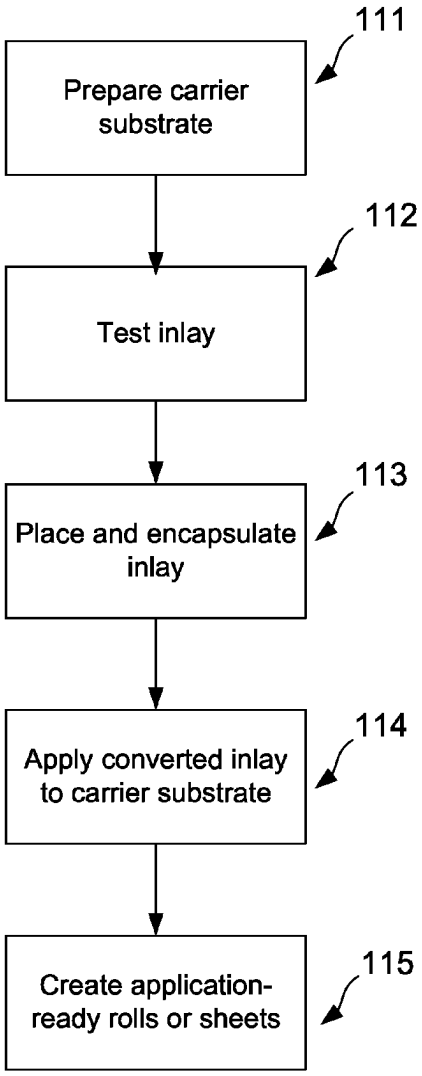

111
Prepare carrier substrate
112
Test inlay
113
Place and encapsulate inlay
114
Apply converted inlay to carrier substrate
115
Create application-ready rolls or sheets

Fig. 11

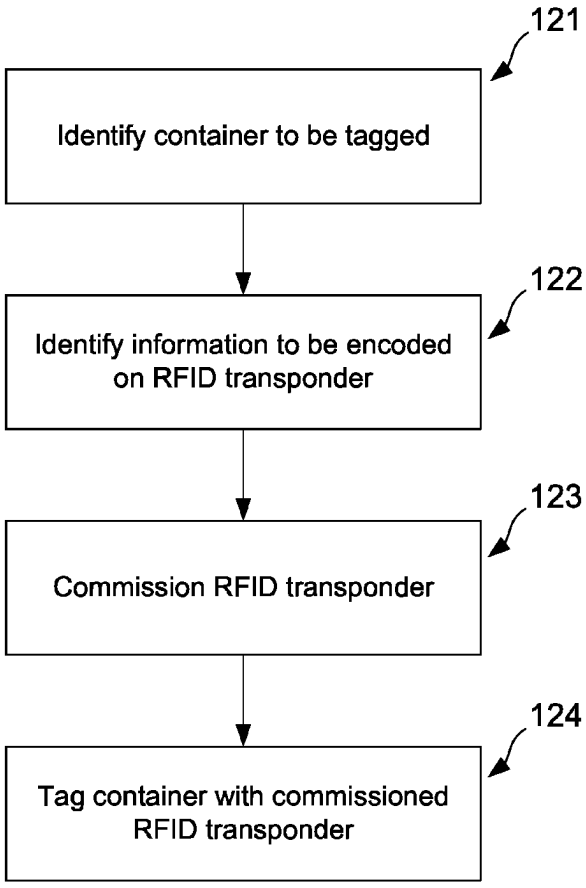

121
Identify container to be tagged
122
Identify information to be encoded on RFID transponder
123
Commission RFID transponder
124
Tag container with commissioned RFID transponder

Fig. 12

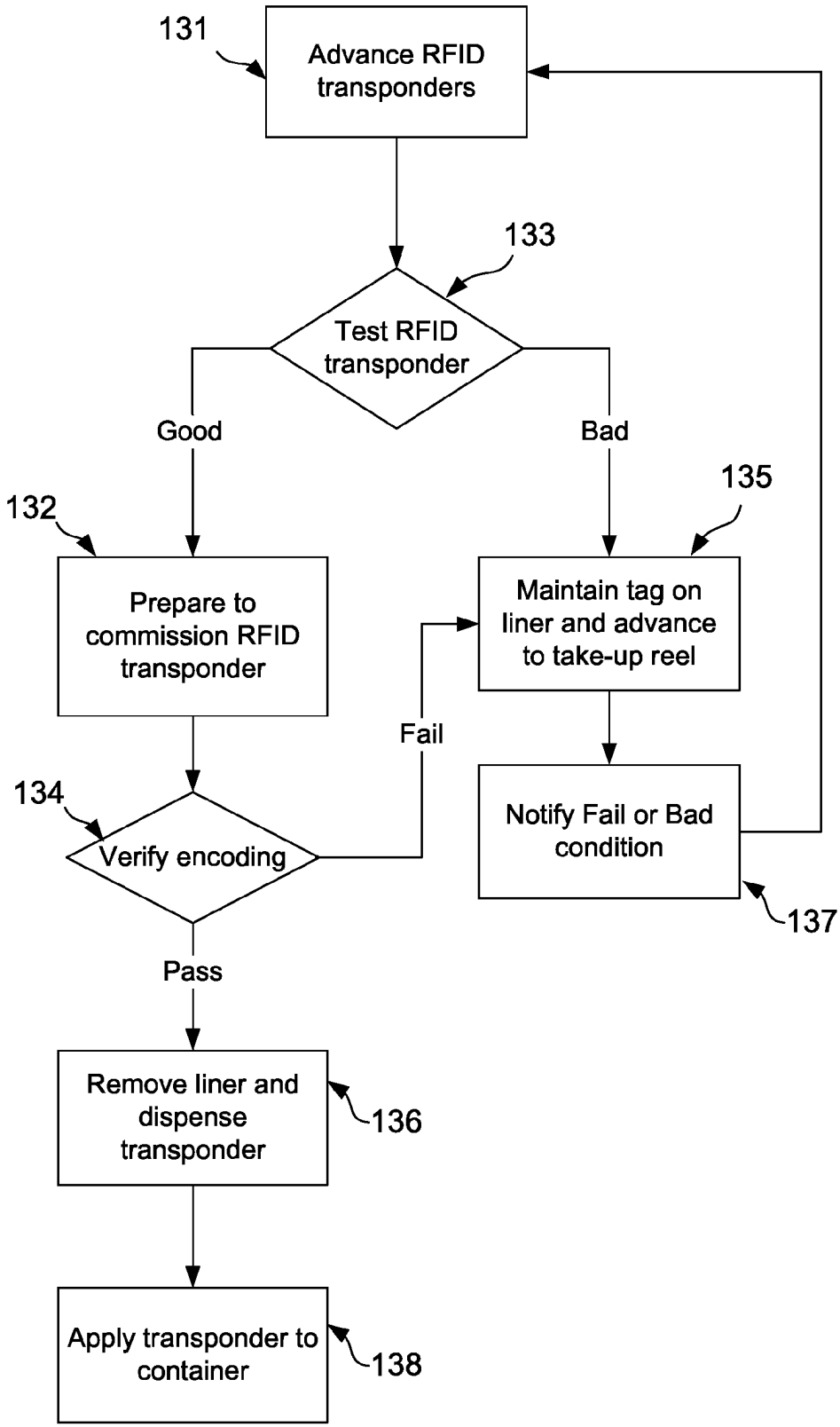

131
Advance RFID transponders
133
Test RFID transponder
Good
Bad
132
Prepare to commission RFID transponder
135
Maintain tag on liner and advance to take-up reel
Fail
134
Verify encoding
Notify Fail or Bad condition
137
Pass
Remove liner and dispense transponder
136
Apply transponder to container
138

Fig. 13

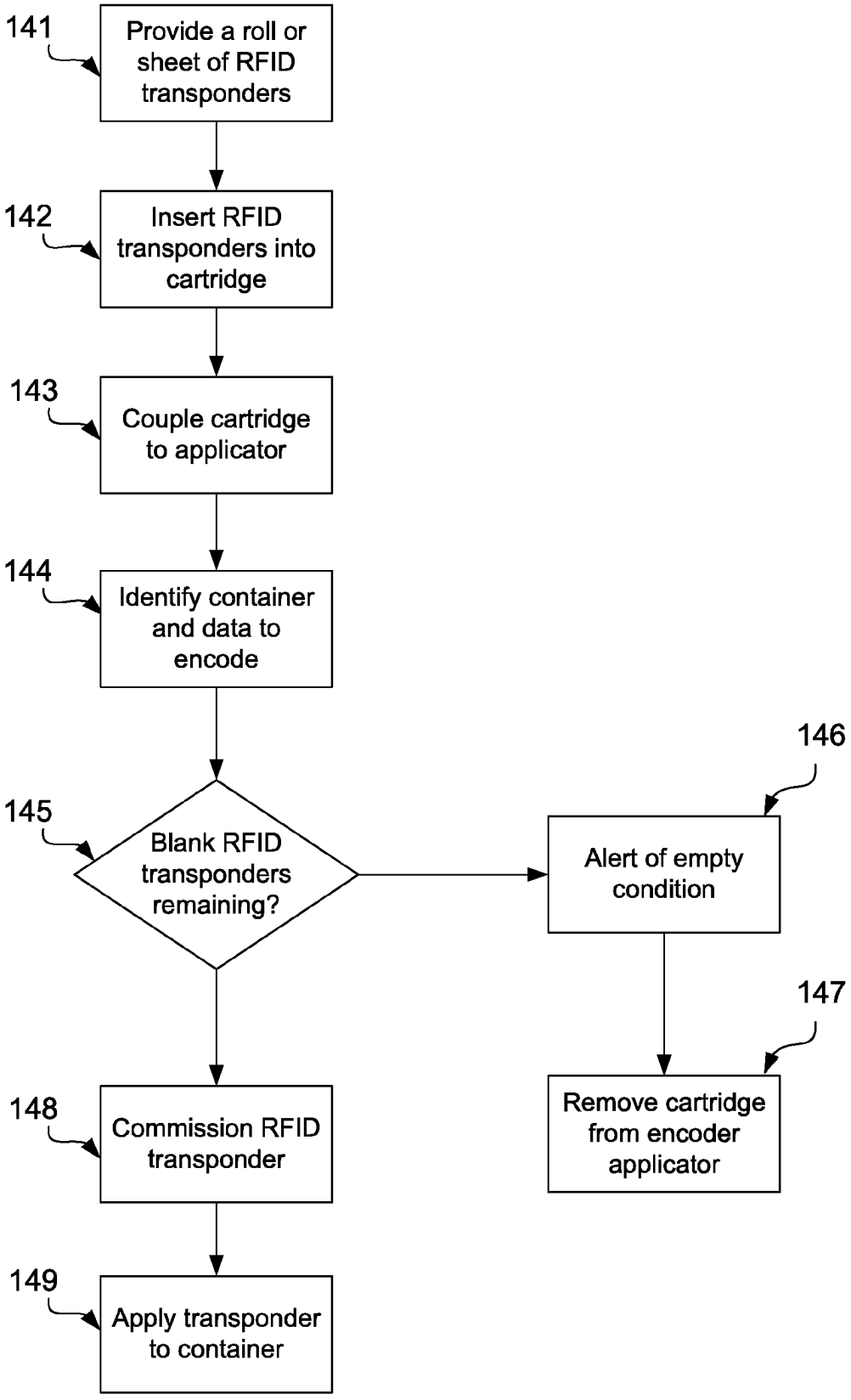

141
Provide a roll or sheet of RFID transponders
142
Insert RFID transponders into cartridge
143
Couple cartridge to applicator
144
Identify container and data to encode
145
Blank RFID transponders remaining?
146
Alert of empty condition
147
Remove cartridge from encoder applicator
148
Commission RFID transponder
149
Apply transponder to container

Fig. 14

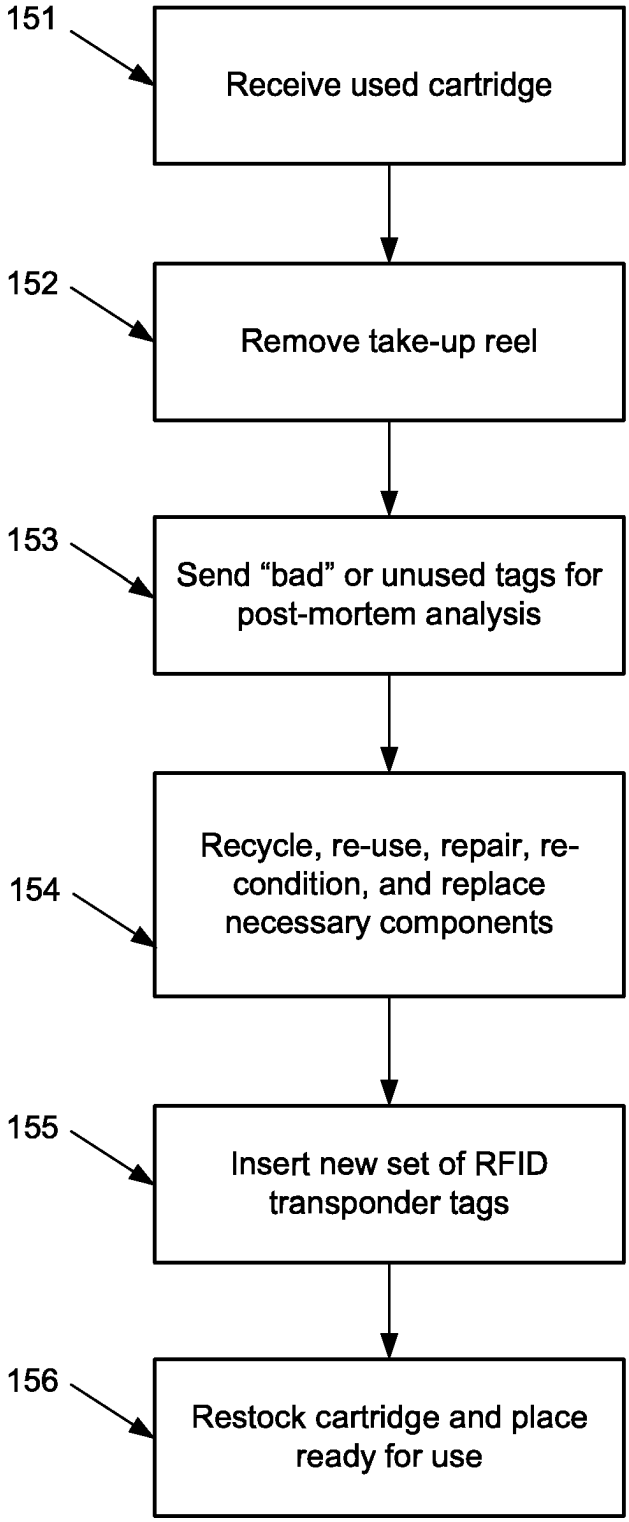

151
Receive used cartridge
152
Remove take-up reel
153
Send "bad" or unused tags for post-mortem analysis
154
Recycle, re-use, repair, re-condition, and replace necessary components
155
Insert new set of RFID transponder tags
156
Restock cartridge and place ready for use

FIG. 15

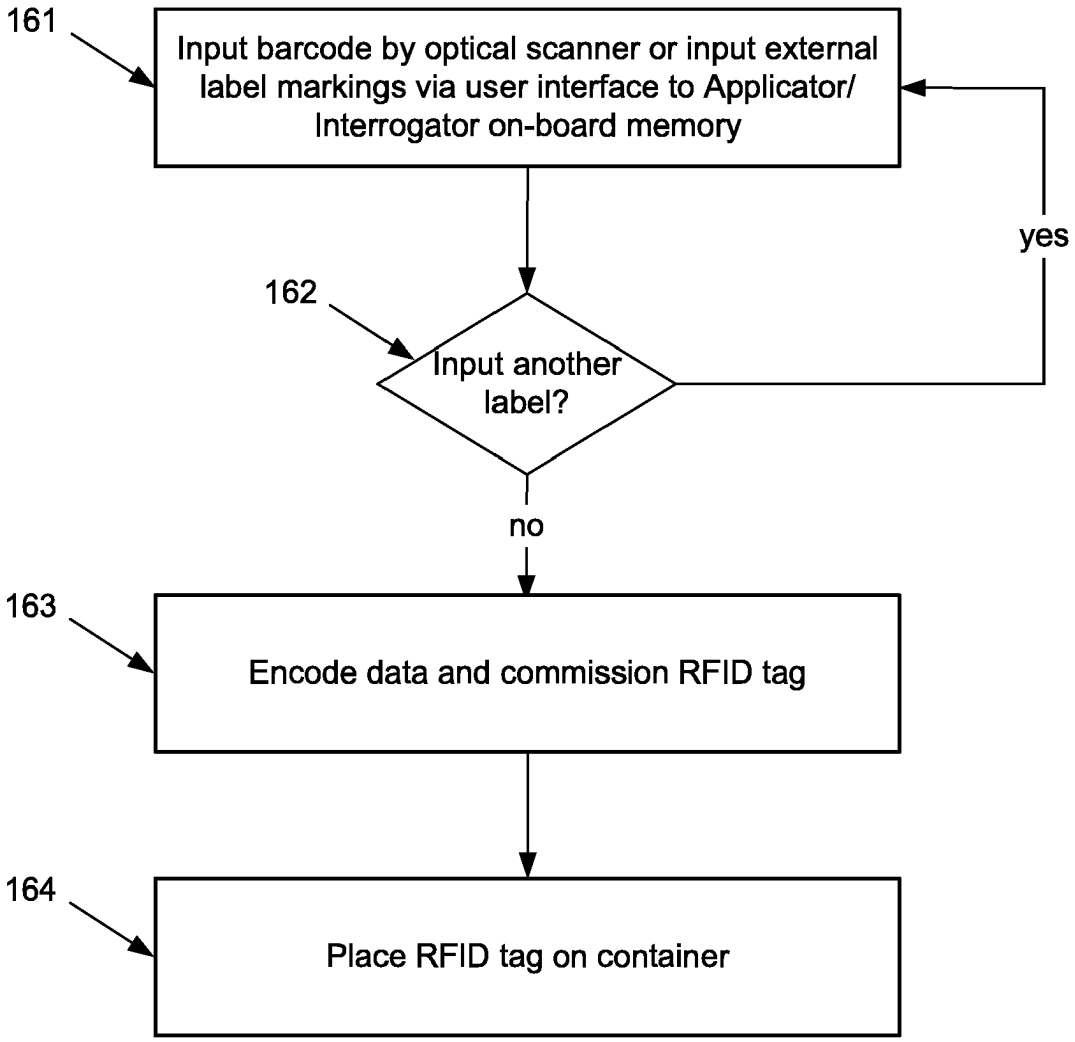

161
Input barcode by optical scanner or input external label markings via user interface to Applicator/ Interrogator on-board memory
yes
162
Input another label?
no
163
Encode data and commission RFID tag
164
Place RFID tag on container

FIG. 16

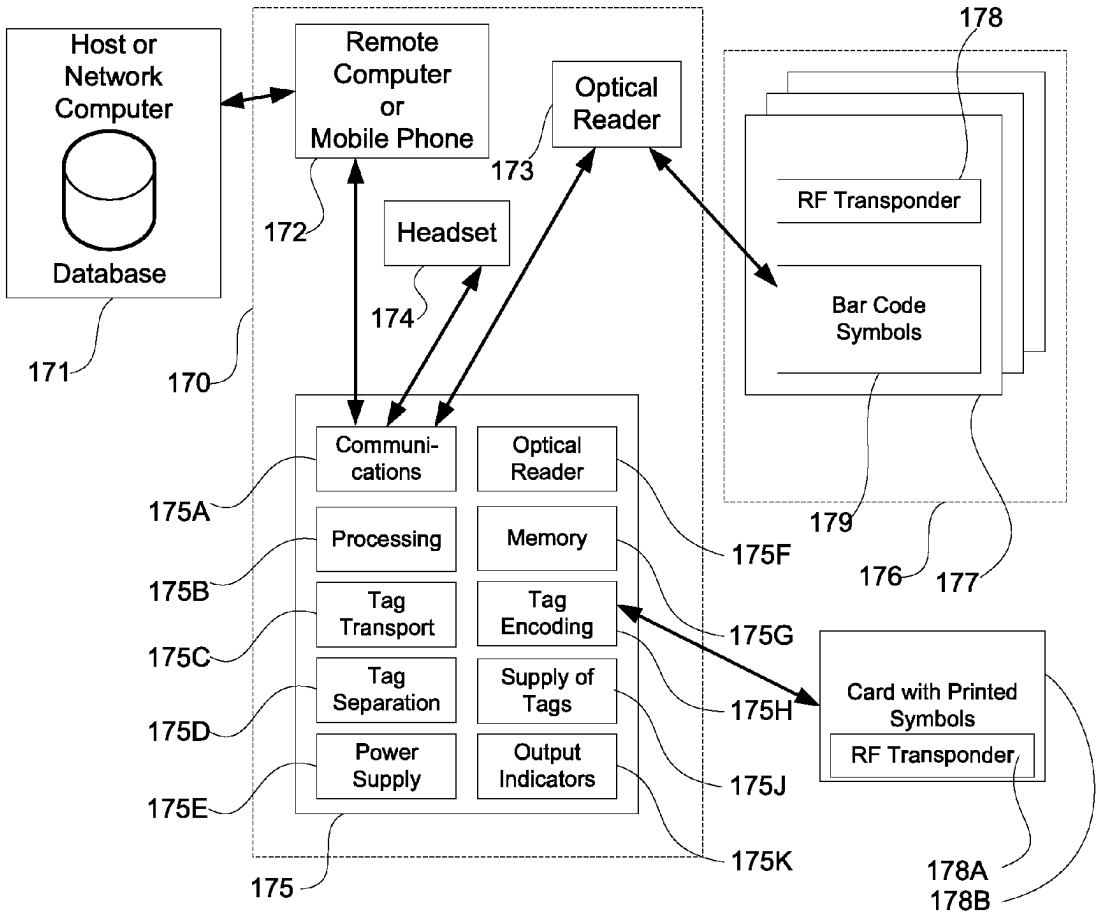

Host or Network Computer
Database
171
Remote Computer or Mobile Phone
172
Optical Reader
173
Headset
174
170
178
RF Transponder
Bar Code Symbols
179
176
177
Communi-cations
Optical Reader
Processing
Memory
Tag Transport
Tag Encoding
Tag Separation
Supply of Tags
Power Supply
Output Indicators
175A
175B
175C
175D
175E
175
175F
175G
175H
175J
175K
Card with Printed Symbols
RF Transponder
178A
178B

FIG. 17

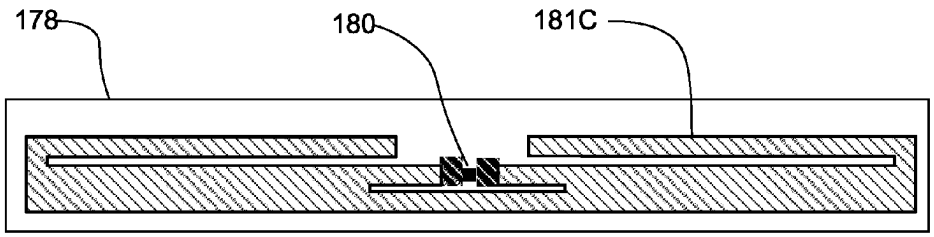


FIG 18

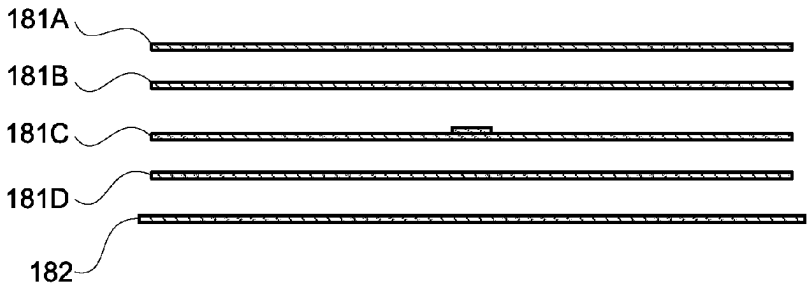


FIG 19

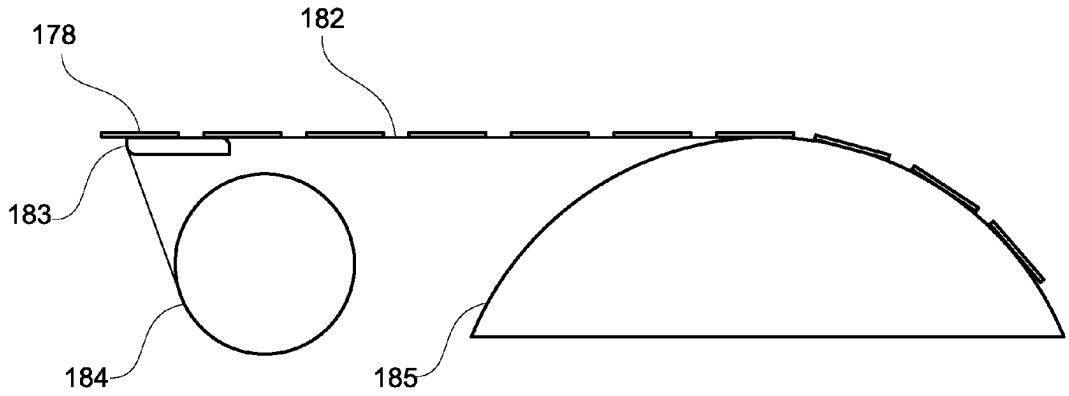


FIG 20

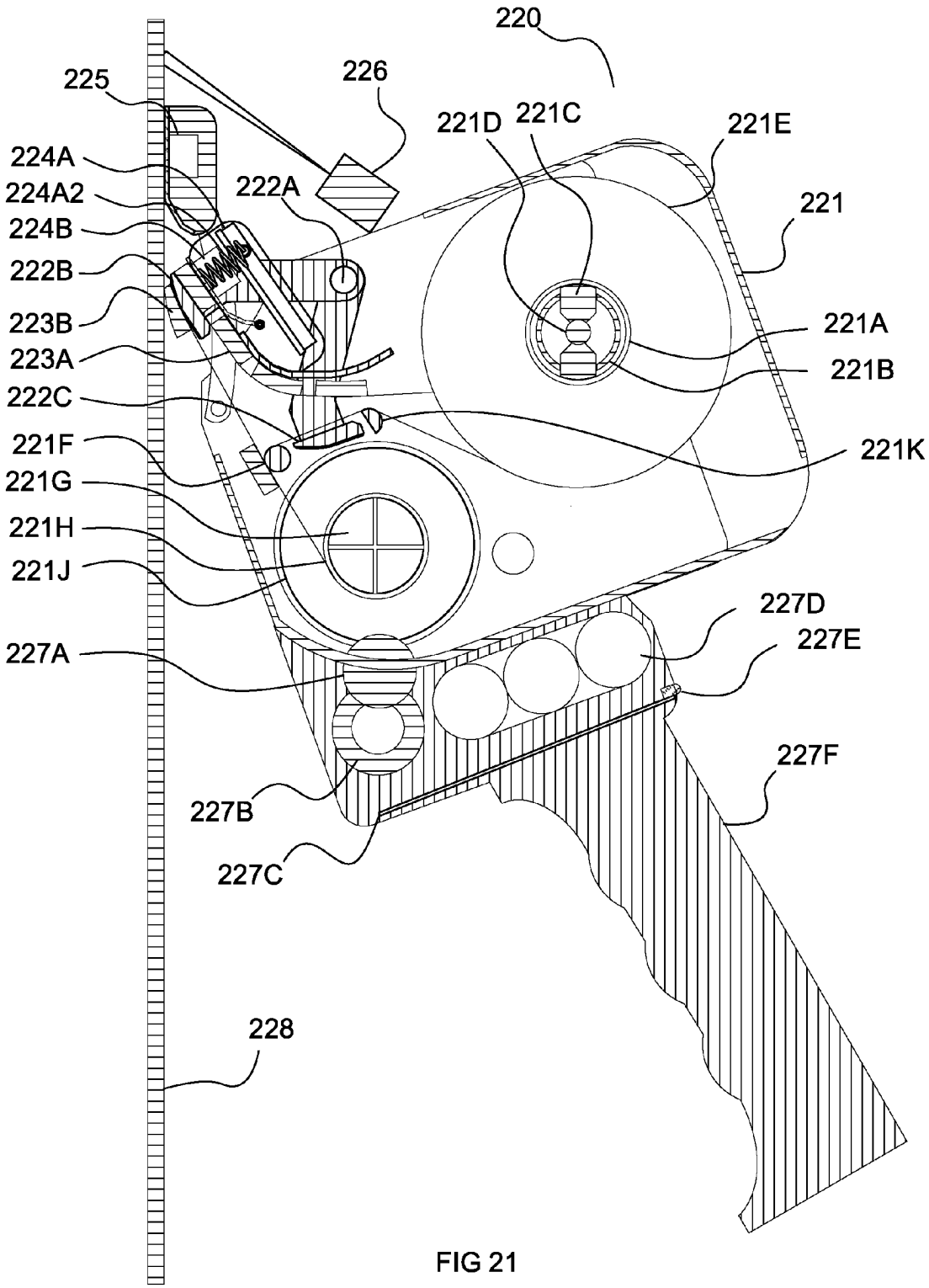

220
225
226
221D
221C
221E
224A
224A2
222A
221
224B
222B
223B
221A
223A
221B
222C
221K
221F
221G
221H
221J
227D
227E
227A
227F
227B
227C
228

FIG 21

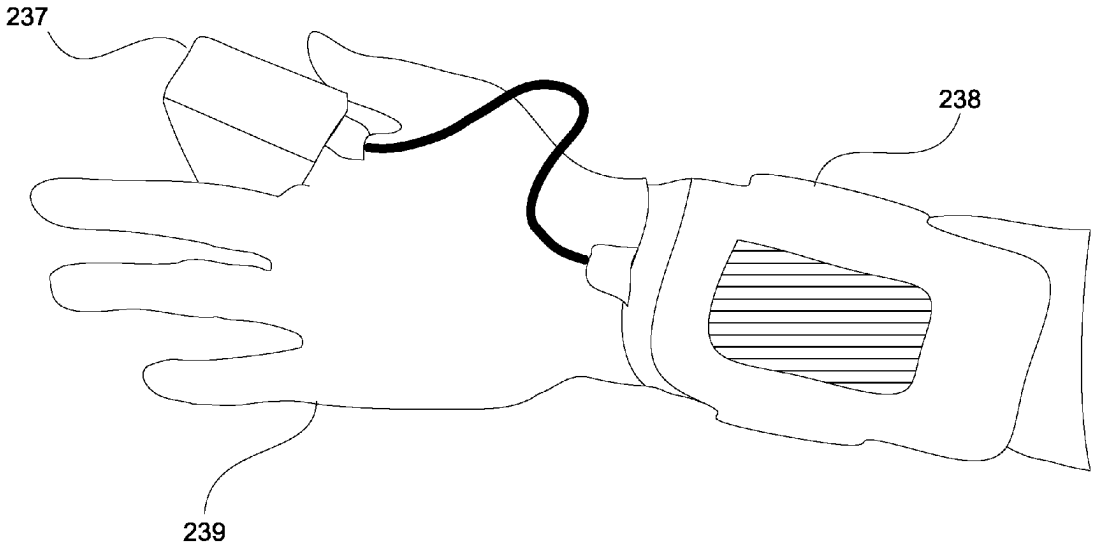


FIG. 22

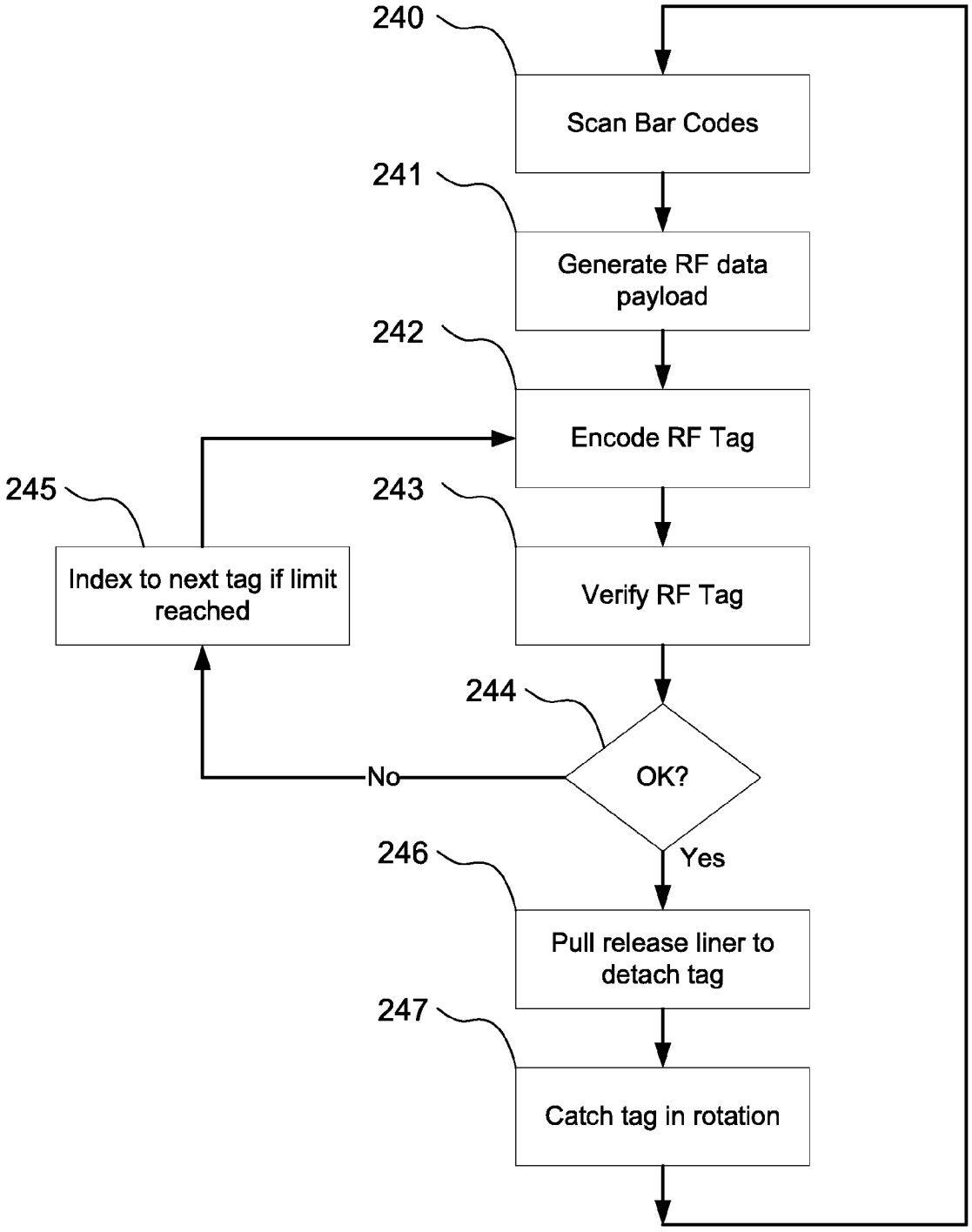

240
Scan Bar Codes
241
Generate RF data payload
242
Encode RF Tag
243
Verify RF Tag
244
OK?
No
Yes
245
Index to next tag if limit reached
246
Pull release liner to detach tag
247
Catch tag in rotation

FIG 23

SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS

RELATED APPLICATIONS

The present application is a continuation-in-part application based on U.S. patent application Ser. No. 11/465,712 (U.S. Pat. No. 7,830,258) filed on 18 Aug. 2006, which claims benefit claims benefit under 35 USC Section 119(e) of U.S. Patent Application No. 60/709,713 filed on 19 Aug. 2005, and a continuation-in-part of U.S. patent application Ser. No. 12/124,768 (abandoned) filed on 21 May 2008, which claims benefit claims benefit under 35 USC Section 119(e) of U.S. Provisional Patent App. No. 60/939,603 filed on 22 May 2007, all by the same inventor Clarke W. McAllister. The present application is based on and claims priority from these applications, the disclosures of which are hereby expressly incorporated herein by reference.

BACKGROUND

The present invention relates to a system, including methods and devices, utilizing wireless sensor devices and RFID (radio-frequency identification) transponders. Specifically, the present invention relates to a system incorporating novel devices and methods that enable point-of-use and on-demand commissioning of RFID transponder-equipped wireless sensors.

Radio-frequency identification (RFID) transponders enable improved identification and tracking of objects by encoding data electronically in a compact tag or label. And, advantageously, the compact tag or label does not need external, optically recognizable or human-readable markings. In fact, using the Gen2 EPC specification, a three-meter read-distance for RFID transponders is common—even on high-speed material handling lines.

Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder.

Current classes of RFID transponders rank into two primary categories: active RFID transponders and passive RFID transponders. Active RFID transponders include an integrated power source capable of self-generating signals, which may be used by other, remote reading devices to interpret the data associated with the transponder. Active transponders include batteries and, historically, are considered considerably more expensive than passive RFID transponders. Passive RFID transponders backscatter incident RF energy to specially designed remote devices such as interrogators.

Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces.

Wireless sensors, made using silicon circuits, polymer circuits, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave (SAW) materials to affect radio frequency or other signaling methods, communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods.

Additional examples of RFID transponders, wireless tags, and wireless sensors are more fully discussed in this inventor's co-pending U.S. Patent Application Publication No. 2006/0080819, entitled "Systems and Methods for Deployment and Recycling of RFID Tags, Wireless Sensors, and the Containers Attached thereto," published on 20 Apr. 2006, which is incorporated by reference for all purposes in this document.

One problem of prior-art systems, such as conventional print labels or bar code systems includes a requirement for line of sight and an overdependence on the optical quality of the label. Many factors can render such a label unreadable including printing errors, excess ink, insufficient ink, physical destruction of the markings, obstruction of the markings due to foreign matter, and, in extreme cases, outright deception by placing an altered label over the top of such a print label.

RFID transponder labeling eliminates the need for an optically readable print label and overcomes all of the shortcomings related to print quality and the need for line of sight to scan the label. Moreover, RFID transponder labels enable secure data encryption, making outright deception considerably less likely to occur. However, current RFID label systems have their own limitations as well.

One shortfall of prior-art RFID systems is the total cost for encoding and applying wireless sensors. In the case of manual encoding and application of RFID transponders or wireless sensors, the cost is dominated by labor costs. Therefore business process integration plays a significant role in reducing the total cost of ownership of tagging objects. For example, in many supply chain applications, case picking is performed during the fulfillment of a customer order, this is an operation where individual cases or groups of cases are manually handled. Similarly in receiving of goods at retail, manufacturing, or distribution receiving docks are other business process where individual cases are manually handled. In either of these types of business processes where individual cartons are handled, there is an opportunity to encode and apply an RFID tag or wireless sensor to each carton on a selective basis.

Generating a unique serial number is imperative, and is required for EPCglobal RFID tagging implementations. Serialization requires a central issuing authority of numbers for manufacturers, products, and items to guarantee uniqueness and to avoid duplication of numbers. Blocks of numbers are distributed to remote locations globally. Unless a product (or SKU) is serialized at one location, the numbering space is usually partitioned according to some method, or each remote location receives each number one-by-one. Either way, there is eventually a reconciliation of serial number usage with a granularity of either one or several numbers at a time.

A preferred method of generating unique serial numbers is to assign unique numbers in a central location, such as in a label converter facility where unique bar coded labels are

printed. Each unique label is then packed and shipped to remote locations, usually either in sheets or rolls. Upon arrival at a manufacturing facility, rolls are loaded onto high speed label applicators that apply one serialized label onto each carton. As those serialized cartons move through the supply chain, they may eventually arrive at a case pick location, a receiving dock, or similar location where a serialized carton is selected for having an RFID transponder applied to it. Using a bar code scanner to read one or more bar codes sufficient information can be collected to uniquely encode that data into an RFID transponder and apply it to that carton.

The uniqueness of an identifier is critical to the success of almost any tracking system. Assuring uniqueness is not necessarily simple. A generically descriptive bar code can be matched to authorizations for selected numbering systems that provide additional data fields including a unique serial number or using algorithms that assure uniqueness through numerical representations of time and space.

Certain prior art systems use printer encoders to merge the printing and RFID transponder encoding operations into a single atomic transaction. This method is more expensive in every respect. It requires mobile distributed printing with nearly perfect networking implementations in order to achieve a smooth, easy, and regular manual transponder application process. This all comes at a higher price, size, and weight. Prior art implementations tend not to be mobile, as represented by U.S. Pat. No. 7,066,667 issued to Chapman et al. on 27 Jun. 2006 and include U.S. Pat. No. 5,899,476 issued to Barrus et al. on 31 May 2005, or by U.S. Pat. No. 6,246,326 issued to Wiklof et al. on 12 Jun. 2001, describe a device that commissions an RFID transponder with a printed label. This approach, however, introduces unnecessary waste, cost, and propensities for error. There is a growing category of applications that do not require anything other than a custom-encoded RFID transponder. This prior art calls for the inclusion of label printer hardware and related consumable materials that are not necessary for many RFID applications. Unneeded printer mechanisms create unnecessary complexities, size, and weight. In some instances this additional bulk hinders practical mobile applications. The result is that tagging solutions that include printing result in a higher total cost of ownership than a pure RF tag encoding system.

U.S. Patent Application No. 2003/0227528 by Hohberger et al. published on 11 Dec. 2003 describes another attempt at improving demand-print labels by providing a device that combines two standard, die-cut rolls of media, one of which may be a roll of RFID transponders, and the second, print-label stock, in an attempt to provide on-demand smart labels. As with the aforementioned references, this approach adds unnecessary cost and complexity by combining RFID transponders with demand-printed labels.

U.S. Pat. No. 5,382,784, published on Jan. 17, 1995, inventor Eberhardt describes a hand-held dual technology identification tag reading head with a gun-shaped housing and a trigger switch with two different ON positions. This patent discloses a hand-held device with a light transmissive window at one end, through which bar code scanning light passes and around which an RFID reading antenna is positioned. Eberhardt discloses embodiments for reading either bar code or RFID information from a label using a hand-held, dual-position trigger actuated device. This patent fails to offer any methods or devices for reading bar code information and using that information to encode an RFID transponder. In particular this patent fails to disclose any methods for conveyance of RFID transponders as part of a well-controlled transponder encoding process.

U.S. Pat. No. 6,486,780, published on Nov. 26 2002, inventors Garber et al disclose a hand-held item location device using RFID to seek and find library books. The disclosure emphasizes the importance of read range over great distances and large populations of RFID transponders, a quality that runs counter to the present invention that teaches how to localize radio frequency fields for programming only selected RFID transponders presented in succession for well-controlled encoding. Garber teaches techniques for searching and reading large collections of transponders in a library, not semi-automated transponder commissioning processes. The physics of Garber's invention is poorly suited to programming anything other than one transponder at a time that is carefully isolated by great distances from any other RFID transponder to avoid programming information into the wrong transponder.

U.S. Pat. No. 5,280,159, published on Jan. 18, 1994, inventors Schulz et al. discloses a pistol-grip RFID reader with a separate hand-held data terminal which together are used to read RFID transponders. Again this invention, like other prior art fails to teach a viable method or apparatus for reliable commissioning large volumes of RFID transponders.

Inventors Main and Kassens disclose in U.S. Pat. No. 5,763,867 published on Jun. 9, 1998, a hand-held data terminal with various scanner modules for the purpose of data acquisition. This patent, along with their subsequent and related disclosure in U.S. Pat. No. 5,962,837 published on Oct. 5, 1999, are examples of hand-held data collection devices for sweeping an RFID interrogation beam about an broad area around an operator (for example, a storage room or bulk-shelf location in a warehouse). This operating distance, however, lies beyond a close-range distance of a couple of inches and is limited to interrogation and data-acquisition, not encoding. Further, such devices are unable to limit their communication to RFID transponders that are in close-proximity of a few inches of the operator holding a hand-held encoder that includes a near field coupler.

Inventors Carrender, Landt, and Speirs disclose in their Dec. 15, 1998 U.S. Pat. No. 5,850,187 another RFID reader that is designed "to allow for identification of objects at locations removed from the remote host unit". This patent along with their Jun. 20, 2000 U.S. Pat. No. 6,078,251, "retrieve object identification data from a selected object." fail to address controlling the inherently propagative nature of the electric fields of radio waves in order to restrict their range to within the width of a single transponder.

U.S. Pat. No. 6,195,053 published on 27 Feb. 2001 by inventors Kodukula and Ackley discloses an antenna consisting of a U-shaped conductive bracket, which supports an optical reader and communicates with RFID transponders. However, this disclosure does not address the need for shielding and near-field coupler design to optimize the inherent long-range characteristics of the RFID transponder.

Inventors Helton and Wiklof's 19 Mar. 2002 U.S. Pat. No. 6,357,662 discloses a device that a user can selectively control a bar code scanner and an RFID reader to acquire information about an asset. However, this disclosure does not address creating and encoding a unique identifier for attachment to and subsequent identification of the asset.

Zebra Technologies Corporation's Tsirline is the principal inventor of U.S. Pat. No. 6,848,616 (published on 1 Feb. 2005 to Tsirline et al.) with the title "System and method for selective communication with RFID transponders". In that patent the inventors describe a system having an RFID transceiver that is adapted to communicate exclusively with a single RFID transponder. They disclose that the system includes a printhead and a magnetic flux generator having a planar coil

formed as a trace upon a first layer of a printed circuit board. As with the aforementioned references, this approach adds unnecessary cost and complexity by combining RFID transponders with demand-printed labels, and uses a near field coupler design that does not concentrate the magnetic flux as selectively as the present invention disclosed herein.

U.S. Pat. No. 7,223,030 by Fessler et al (published on 29 May 2007) and U.S. Pat. Nos. 7,249,819 (issued on 31 Jul. 2007) and 7,187,294 (issued on 6 Mar. 2007) both by Burdette et al, (inventors of Lexmark International, Inc.) disclose a printer/encoder system, and attempt to overcome the problems of detecting and locating an RFID inlay that is embedded somewhere in a printed label stock. The present invention overcomes that problem by eliminating the (larger) label, and only encoding RFID transponders, which generally have a physical outer dimension that very closely matches the embedded RFID transponder inlay dimensions.

United States Published Patent Application No. 2007/0150219, published on 28 Jun. 2007, inventor Cawker et al. of Weyerhaeuser Company, discloses a method of applying and verifying RFID transponders using a conveyor for moving objects along a predetermined path. Their invention makes use of cameras to identify the proper position for a label. The present invention overcomes the size and cost requirements of a system comprised of a conveyor and cameras by using human operators for motion and simple reflective beam sensors for spatial positioning and label placement.

Inventor Roberts in U.S. Published Patent Application No. 2005/0283272, published on 22 Dec. 2005, teaches of a mobile encoding system for commissioning RFID transponders. Wherein, Roberts claims an apparatus for dispensing and activating electronic monitoring devices comprising: a) a receptacle capable of storing a supply of unactivated electronic monitoring devices; b) a separator cooperating with said receptacle for removing respective individual monitoring devices from the receptacle; c) an activator cooperating with said separator and configured to communicate an activation signal to an individual monitoring device removed from the receptacle by the separator; d) a verifier configured to communicate with the individual monitoring device subsequent to the activation signal to obtain a verification signal confirming that the individual monitoring device has been activated; and e) a dispenser cooperating with said verifier and operable for dispensing the individual monitoring device after receipt of a verification signal confirming that the individual monitoring device has been activated. Roberts patent application 2005/0283272 does not teach how an EM device is attached to an object that will be monitored. There is no mention of adhesives, screws, or any other means of attachment. This is in contrast to the present invention where adhesives are used to attach an RFID transponder to an object of the proper object class. In the case of an SGTIN, the term object class refers to the GTIN (Global Trade Item Number) or SKU (Stock Keeping Unit). The term object class would correspond to other class definitions for other GS1 key types that are for example defined in the EPCglobal Tag Data Standards. An object is an instance of the corresponding object class and an object class instance number is a numerical representation of an object class instance. In fact, it can be inferred that Roberts' EM devices have no exposed adhesive while they are being encoded, sorted, and stacked. Exposing an adhesive during these steps would obviously result in an unintended grouping of EM devices, stuck together, preventing passage of any additional EM devices. The problems addressed by the present invention require an additional and vital step that is not taught by Roberts' patent application: to associate and preferably attach an EM device to the correct type of object. Associating an encoded EM device of the correct type to an object of the correct type, is a vital step that is significantly prone to human error. Roberts does not teach any method for advancing and detaching programmed EM devices or RFID tags from a roll of conveyance web or release liner. Roberts only teaches that tags can be cut from a roll of EM devices that are separated by a perforation, but does provide any explanation regarding forward advancement of such a roll in coordination with the programming of EM devices: if the process is a continuous motion, or a start-stop action that is coordinated with the tag programming process. This is in contrast to Roberts' detailed explanation of the movements of other parts of the EM device dispensing apparatus. Detaching adhesive-backed tags is a critical process that leads to a transfer and subsequent attachment to an object that is only of the correct object class type.

Inventor Landt in U.S. Pat. No. 6,677,852, published on 13 Jan. 2004, teaches a: supply reel and take up reel means; radio frequency shielding; a means for associating data read from an RFID transponder with new data; a means for encoding authorization from an external authority for a selected numbering system; a plurality of authorization transponders adapted to provide the RFID transponder encoder device sets of preauthorized blocks of unique numbers for specific object classes; and acquiring object class information to encode multiple instances of unique number from that object class instance information in the transponder. Landt fails to describe how the uniqueness of numbers is assured. In fact, the issue of uniqueness is not adequately addressed in his U.S. Pat. No. 6,677,852. His only mention of uniqueness is suggested only as a possibility, whereas it is actually imperative to the proper functioning of a global tracking system such as that which is enabled by the EPCglobal numbering system. Landt fails to describe any authorizations that are related to numerical uniqueness. Instead, Landt's authorization keys must match a security field that is already present within a tag. Therefore Landt's authorization tags are like a password that unlocks a tag to enable it to receive new data. This is in contrast to an authorization to a tag encoder to authorize it to issue unique numbers to tags, regardless of any password requirements that may or may not exist. Despite Landt's efforts to broadly describe the instructions, he falls short of showing that he in any way anticipates the need for or challenges of writing unique serial numbers to uniquely identify RFID tags. His only mention of tag ID, number field 208, only relates to the essential presence of the field and the possible need to search through a population of tags by using the tag ID field. Furthermore, Landt demonstrates a lack of appreciation for the vital importance of having a unique tag ID, which is central to the premise of tracking objects within a global supply chain, when he states "The tag ID number field 204 provides a serial number or other identifying number for the data tag 102, which may be a unique number.", which indicates that Landt did not understand that uniquely numbered tags are an essential part of using numbering systems such as the GS1 EPCglobal system. To further illustrate this point, Landt makes no mention of any numbering system that would be well known to those skilled in the art to assure numerical uniqueness in a tag ID field 204 or any other field disclosed in his invention. In Landt's discussion of writing to RFID tags, he never provides any information that would suggest that his invention is capable of assuring that unique tag ID's are written to tags, nor even describes writing tag ID's in any manner. Therefore it is apparent that U.S. Pat. No. 6,677,852 falls short of disclosing a data carrier of any kind that carries with it unique authorizations that are to be used by an RFID tag encoder for assuring that any tag ID's written to an RFID

tag originate from a central number-issuing authority (such as from Uniform Code Council, GS1, Auto-ID Center, EPCglobal, ISO, etc.).

In U.S. Pat. No. 7,114,655, published on 3 Oct. 2006, inventor Chapman teaches the use of an RFID printer system, a printer programming language that contains RFID encoding instructions, and a conveyor system to move objects through the printing and encoding process. The prior art teaches how to encode data into an RFID label. The present invention teaches how to encode data into an RFID tag. An RFID tag is not an RFID label. An RFID label contains additional face stock material as a printing surface. That surface is printed with human readable and or optically machine-readable indicia. The printed information is not required for reading data using a radio frequency signal.

Chapman's invention requires a conveyor which is not required for the solution that the present invention teaches. In fact, a conveyor would in many instances be either an added capital expense or a hindrance to a business process for tagging products away from a conveyor line.

Chapman's invention teaches that preset spatial relationships exist between the bar code label and the RFID tag that is to be placed onto a package. A key assumption of the prior art is that the surface of the package or the contents thereof will not interfere with the proper operation of the RFID tag. This is in contrast to the present invention whereby specifically identified locations are marked on the package that indicate where the RFID will function properly. Specifically what Chapman fails to address in his invention is the need for placement of an RFID tag in a location on a carton such that the carton and its contents do not interfere with the nominal operation of the tag as it would have operated in free space. In stark contrast to Chapman's teachings and suggestions, the present invention, by way of the motion of a human hand and arm, can achieve full six degrees of freedom for the placement of an RFID tag in a location that corresponds to the sweet spot of each particular carton or package. The present invention addresses the need for six-axes of motion, placement on a predefined sweet spot, correlation to each specific type of product, and the possible need for tags to have a thickness dimension.

Chapman's invention does not teach the use of a trigger that is responsive to the applicator's position and orientation relative to a tagging sweet spot. In the present invention, several means are disclosed for triggering the application of an encoded tag only when the applicator is within striking distance of the target location. Such a trigger goes beyond the temporal or spatial inaccuracies that would result from using a conventional human-operated trigger from a button-press or keypad input.

Lastly, Chapman's invention requires the data stream to also contain information that describes the location of the RFID inlay within the RFID label or tag. Without that information, the prior art is unable to direct the RFID interrogation fields to the correct area on each label. The prior art depends on having these external programming instructions for proper functioning.

Inventor Waters in U.S. Pat. No. 7,077,489, published on 18 Jul. 2006, teaches an apparatus for printing and memory tag application onto a base medium. Waters fails to make the case for achieving the required functionality on a typical RFID tag. Water's invention is restricted to the use of specially prepared RFID tags that have adhesive on both sides of the tag. This unconventional tag configuration must overcome the adhesive forces that attach the tag to the webbing by having stronger adhesive forces that provide the force that is necessary to overcome the first adhesive bond. Waters fails to explain this acute short coming and relies upon this critical factor for successful transfer of the tag on each "thump". In the absence of a proper control of this critical factor, the tags will not release, or will partially release, causing the applicator to clog or jam. The present invention overcomes these sever short comings by using a conventional RFID tag with adhesive on only one side, eliminating any chance of a misbalance between adhesive forces between a first and a second side of the RFID tag. This is a significant and novel differentiation from the Waters patent.

Inventor Koenck in U.S. Pat. No. 5,825,045, published on 20 Oct. 1998, teaches a housing assembly for enclosing the internal antenna and a handle coupled to a surface of the housing. Koenck is among many inventors who disclose hand-held devices that function in an automatic data capture role, including bar code scanners, portable data terminals, and RFID tag readers. However, the present invention stands apart from this and other prior art in providing an ergonomically superior solution for a human-operated RFID tag encoder that directly applies encoded RFID tags to the face of a target object. Neither Koenck nor a myriad of other inventors disclose how RFID tags are to be uniquely encoded, verified, and efficiently applied to objects using a single swipe of an operator's hand and arm motion.

In U.S. Pat. No. 6,963,351, published on 8 Nov. 2005, inventors Squires et al describe a radio frequency identification tag non-destructively connected to the core adjacent the first or second end thereof to allow non-destructive removal of the tag, the tag having an aperture formed there through that is configured to allow passage through the tag of at least a portion of the spindle when the core is disposed on the spindle, and the aperture being aligned with the rotation axis. Attachment to the spindle requires a circular shaped loop antenna element which those skilled in the art understand involves more manufacturing steps than a conventional UHF RFID tag of the present invention. The additional steps include critical mechanical dimensioning to both ensure proper mechanical clearances as well as maintaining proper tuning of the antenna across the full range of operating conditions whereby full or empty rolls of media have the propensity to differently alter the tuning characteristics of the circular RFID device. The present invention overcomes the limitations of the need for an RFID memory device that it attached to the spindle of a roll of consumable items.

Inventor Nye in U.S. Pat. No. 7,421,367, published on 22 Jun. 2006, teaches a housing assembly for enclosing the internal antenna or a mounting mechanism for selectively coupling the encoding system to a provided structure. The present invention encloses the antenna, interrogator, drive train, and most other components in a housing for protection, but also to allow the operator of the encoding device to easily attach and remove an RFID transponder cartridge. The novel design of the housing and chassis allows this by grouping and hiding all other components that do not need to be accessed by the operator. By doing so, it's obvious to the operator at first sight where and how the cartridge attaches. Nye's intention is to simply use the housing and structure to mount all components and to protect those components. The present invention's housing design goes beyond Nye's intention by allowing the operator of the encoder to easily mount a cartridge given the housing and structure design.

Inventor Nikitin in U.S. Published Patent Application No. 2008/0184177, published on 7 Aug. 2008, teaches the measuring of the angular velocity of a moving roll in order to monitor the performance of that roll. Nikitin is measuring the angular velocity of a roll, not the rate at which a transponder peels from the release liner. The present invention is con-

cerned with matching the peel rate of a transponder to that that of the rate of movement of the target surface, both linear velocity measurements. Additionally, the rate measurements are used in the present invention not to simply monitor a system, but used as input data in an algorithm to successfully apply an RFID transponder to a target surface in one swipe of the operators arm.

Inventor Eberhardt in U.S. Pat. No. 6,130,613, published on 10 Oct. 2000, teaches of applying an RFID transponder to a target surface. Eberhardt discloses the design and production of a RF enabled stamp that a postal consumer can use like a traditional stamp. This includes the customer peeling the stamp off a release liner, or licking the back of stamp; then applying the stamp to a letter or parcel. The underlying concern of the present invention is reducing the cost of encoding and applying an RFID transponder to an object. The methods of applying an RF stamp to a target surface, as disclosed by Eberhardt, are not easily and quickly conducted. The consumer is going through multiple steps, unnecessary motions to apply an RF stamp. The present invention allows the operator of an RF encoder to encode and apply an RFID transponder in one motion of the operator's arm. This is certainly not the case intended by U.S. Pat. No. 6,130,613.

Inventor Feltz in U.S. Published Patent Application No. 2005/0280537, published on 22 Dec. 2005, discloses a system for reading and writing to an RFID transponder. The present invention cannot be anticipated by Feltz because an encoder is no more a printer than a tag is a label. Labels, particularly "SmartLabels" include a significant amount of printable surface area on the face stock material for printing symbols that are both human and machine readable. RFID tags and transponders may or may not contain such printable area, instead RFID tags and transponders provide wireless identification functions that are meant to supplement the optically readable functions of labels.

Tags are not Labels.

A key characteristic of the encoder of the present invention is that the encoder encodes tags of many different types, shapes, sizes, and thicknesses; which includes efficiently encoding thick tags, tags that are thicker than a sheet of paper because a foam layer is present. Such a tag design is advantageous for tagging metals or liquid containers.

Feltz illustrates in FIG. 2 the type of RFID transponder that is added to labels in order to make them compliant with retailer and DOD mandates. It is well known to those skilled in the art that such an RFID transponder will not operate when placed near metal or liquid. Those skilled in the art know that metal detunes the RFID transponder's antenna, and that liquids absorb radio energy just as they would in a microwave oven, resulting in heat, not RF communication. There are two dominant and notoriously well known mandates—Wal-Mart and the DOD. Both of those mandates clearly stated that only an RFID transponder had to be added to the previous labeling requirements. Those mandates also required that the transponders work after they were applied to the goods.

Retailer and DOD tagging mandates were clear, that the goods being tagged had to read, regardless of their construction, even foil-wrapped cartons, metalized mylar wrappers, and cases of liquids of all types had to read. This posed a problem for customers that bought RFID printers from Feltz's company. They found that the RFID tags that were encoded on his printer were not able to function when placed onto about 20% of the goods that are normally found in a retail supply chain. As such, Feltz does not really solve the mandate problem that he refers to in his paragraph [0005] where he makes the inaccurate statement that "One requirement is that certain record members e.g., compliance labels contain transponders". Feltz has it backwards; the U.S. Department of Defense and Wal-Mart RFID tagging requirements did not require any new labels at all. In fact, both mandates (which were the dominant, if not the only ones at the time) were written to provide their suppliers with a full range of compliance options, including the option of embedding an RFID transponder directly into a corrugated carton (for example), which would completely eliminate the need for any kind of label whatsoever.

Feltz' printer mechanism did not actually need print heads, ribbons, or ink to comply with the mandates; yet his design is completely based around these unnecessary elements. Even worse, those elements prevent his invention from dispensing the thicker type of RFID tag that actually works on what those skilled in the art refer to as "RF-challenged" goods that contain metal or liquid. Specifically, the anticipating reference is inoperable with thicker tags because the fixed spacing between platen roll 63 and print head 69 of the Feltz printer invention is sized for thin paper-like labels, not thick dielectric-backed tags. Attempting to encode tags with a dielectric foam spacer would clog the printer with a mass of sticky detached RFID tags that would quickly accumulate in a useless clump at print head 69. The extra bulk reduces the mobility of his printer and consumes significantly more power, whereby ruling out any anticipation of a battery operated mobile encoder.

Tags: Thick or Thin.

The encoder of the present invention programs and verifies tags and transponders of almost any type including transponders with a dielectric spacer built into them. Note that this type of compliance tag is much thicker than the labels that Feltz discloses in his FIG. 2. A transponder with a dielectric spacer is at least ⅛" thick and will easily pass through the feed mechanism of the present invention.

Smaller Tags.

Since the mandates did not require any more labels, and the items that are to be tagged include branded items and containers, the brand owners do not want their brand images and products with big stickers all over them. Therefore, smaller and less obvious is better and more appealing to consumers and brand owners. Feltz struggled with this, as is stated in his paragraphs [0005] and [0007] wherein he states that his invention provides for labels that have transponders spaced at a distance of 6 inches, which is an improvement over prior art. It is obvious that Feltz understands that smaller is better when it comes to dispensing large amounts of unnecessary label material.

Poor Resolution.

Had Feltz anticipated the elimination of the print head 69 he could have moved his encoding antenna 500 and 500' closer to delaminator 64'. This would have allowed him to use a smaller label (or even a tag) with a pitch on the order of 0.6" instead of 6". This would have allowed him to put 10 times more tags onto a roll and create far less waste. It is obvious that Feltz did not anticipate any of these things because his antenna selectivity is inadequate for that. His use of microstrip antennae 500' or 550' do not have enough selectivity as shown in his spatial signal strength plots of FIGS. 28 and 29 and his statements in his paragraph [0068] that the tightest recommended tag spacing is 2 inches. Had Feltz anticipated a printerless encoder, he would have strived for spacing that is much tighter than 2 inch tag pitch.

Inventor Bennett in U.S. Pat. No. 6,830,181, published on 14 Dec. 2004, discloses a combination RFID and bar code scanner. Wherein an operator holds a handheld device in one location without moving the device and is able to read a bar code and read/write to an RFID transponder in the near vicin-

ity. In the scenario that the RFID transponder is already on the package, Bennett's invention is an efficient device to encode RFID transponders with information gathered from the bar code scan. Though in the scenario that the RFID transponder is not already on the package, Bennett's novel ideas are no longer of much value. At which point, a majority of the operator's time and energy will go towards peeling an RFID transponder from its release liner and placing it on the package. The present invention increases the operator's efficiency by peeling and encoding the RFID transponder before it is placed on the package. In the present invention, the encoding occurs after the operator scans the bar code on the package and before the operator is able to reach and remove the transponder from the encoder. As such, the present invention allows an operator to be that much more efficient in commissioning RFID transponders by not waiting on encoding and peeling. By not having a means to peel an RFID transponder from its release liner, Bennett's invention is at a major disadvantage in tagging large volumes of item level consumer goods.

Inventor Sureaud in U.S. Pat. No. 7,320,432, published on 25 Jan. 2005, discloses a system for reading and encoding the output of an identification printer. The system provides a portable device that can be adapted to the output of standard bar code printers, capable of reading the bar code of labels produced by the printer and encoding the chip of the same label with the information read without any modification and interaction being required with the system installed to which the printer is attached. The system disclosed by Sureaud applies to the niche application of luggage RFID labels. When compared to the application of item level consumer good tagging, the prior art fails to address 1) the difficulty of efficiently applying RFID transponders to an object, and 2) the difficulty of producing a unique data identifier based off the items stock-keeping unit (SKU). The invention disclosed by Sureaud simply coverts a bar codes numerical string to a binary string. Whereas, the present invention is reading in a SKU, converting that SKU to a unique identifier, and encoding an RFID transponder with that unique identifier. It's important to note that a SKU is not a unique identifier. For example, two packages of identical socks will have the same SKU, but the data encoded into their RFID transponders will be unique to each package. The bar code scanner presented in the present invention is in one way novel in how the data read from the bar code scanner is used in producing the data encoded into an RFID transponder.

Inventors Sano et al in U.S. Published Patent Application No. 2005/0218219, published on 6 Oct. 2005, discloses a label and RFID tag issuing apparatus. Wherein, the label and RFID tag issuing apparatus, comprises: a sensor for detecting presence of an RFID tag attached to a container; a printer for recording information that corresponds to a bar-code affixed to the container; a bar-code reader for reading the bar-code recorded on the container; an RFID tag reader/writer for writing information corresponding to the bar-code to the RFID tag; and a controller for controlling all of said components. Sano is addressing a niche application of RFID technology (factory automation); whereas the present invention is concerned with item level consumer good tagging. Inventor Sano's invention fails to address the needs unique to item level tagging, wherein: no mention or concern is expressed regarding operator efficiency in encoding and apply RFID tags, and no means is provided to ensure unique serialization of an RFID tag while operating off network. Lastly, as mentioned previously, the bar code scanner presented in the present invention is in one way novel in how the data read from the bar code scanner is used in producing the data encoded into an RFID transponder.

In U.S. Pat. No. 6,884,312, published 26 Apr. 2005, inventors Mitchell et al describe a tape applicator with no reference to RFID tags.

In U.S. Patent Application No. 2005/0045724, published 3 Mar. 2005, inventors Tsirline et al describe a printer system comprised of a printhead and RFID components to solve object identification problems. By contrast, the present invention clearly demonstrates that all aspects of printing on, with, or near RFID tags to facilitate identification is a wasteful and unnecessary encumbrance to efficient RFID tagging operations.

In U.S. Patent Application No. 2002/0059880, published 2 Sep. 2008, inventors Klinefelter et al describe a card supply for use with an identification card printing system comprising: a card hopper containing a stack of cards; and a supply circuit mounted to the card hopper and having a memory containing supply information relating to parameters of the card supply. This patent application in contrast to the present invention fails to address the challenges of using a radio frequency identification transponder to provide information about encoding a supply of unencoded RFID transponders. In the present invention the same RFID interrogator that is used to encode RFID transponders is also capable of reading an RFID transponder mounted to the loaded cartridge, and is also preferably capable of filtering out its response to interrogation or programming of RFID transponders. Although Klinefelter describes a dispensing system that remotely resembles the present invention, the inventor clearly fails to address the complexities and interactions between transponders if he had even remotely considered the possibility that the card that are dispensed from his hopper are RFID tags. Furthermore, he fails to address the use of a single RFID interrogator for encoding cards (or tags) as well as interrogating the memory device that contains information about the card supply. The present invention addresses and overcomes these challenges.

In U.S. Pat. No. 7,664,257, published on 16 Feb. 2010, inventors Hohberger and Tsirline disclose a system for authenticating consumable media such as plastic cards, ink, or ribbon cartridges that include an anti-piracy deterrent. The inventors disclose the use of RFID transponders with anti-collision protocols but fail to anticipate that the consumable media could also be a supply of RFID transponders. This is evident in the omission of any attempt to filter out or separate responses from transponders that are themselves consumable media, nor do Hohberger and Tsirline address the challenges of encoding such consumable media using the same interrogator that is used to identify the supply of media. The present invention addresses and solves these challenges.

The present invention manages EPC binary encodings. This is unlike U.S. Pat. No. 7,827,200 wherein serialization of EPC identifiers is managed using the unserialized portion of an EPC ID URN. Encoders read and write the binary encodings of EPC tags, and are therefore able to directly manage object class uniqueness at that level. This avoids inconsistencies that may arise from improper use of the GS1 Tag Data Standard, specifically where the standard teaches that the filter bits are not part of the pure identity. However, in reality GTIN bar codes are frequently used to identify items at item, case, or pallet level when commissioning tags. This poses a problem for a uniqueness-assuring method that only uses the pure identity because a GTIN-14 case level bar code can be scanned in order to identify objects for tagging at the item level. This is frequently encountered during tag-ups where entire warehouses must be encoded with item-level tags.

Using the pure URI method described in U.S. Pat. No. 7,827,200 would result in items that are improperly encoded using case level URI's. The present invention compensates for this real world phenomenon by using the filter value as a correct indication of the intended packaging level and is used to correctly manage the uniqueness of the object class.

A second reason that the present invention is an improvement over prior art for real world EPC encoding is for in-store tagging. Frequently suppliers fail to commission RFID tags onto items as the retailer may have instructed. In that event, the retailer has to quickly muster resources to apply RFID tags to items as they arrive in their stores or distribution centers. Following a strict pure identity serialization method described by U.S. Pat. No. 7,827,200 would result in each supplier having to allocate blocks of serialized numbers to each retailer, each retailer's distribution center, and each retailer's store either in advance or in real time. In a strict pure-identity-managed system that approach is indeed required, but does not scale globally nor operate efficiently. The present invention, by managing the uniqueness of EPC binary encodings circumvents this problem by allowing the retailer to designate an unused or unconventional partition value to create a separately managed numbering space that is independent from the space that would be managed by the pure identity approach. The supplier would for example use PV=x, while each retailer that they ship their goods to would use PV=y where y is not x. Although the resulting pure identity would be the same, the EPC binary encodings would be different. Therefore the prior art does not adequately solve real world serialization problems at the encoder level that are overcome by the present invention.

US Patent Application 2007/0229267 by Ken Traub also has the same problem by teaching a system that operates on pure identities, a solution that lacks the ability to operate properly when embedded within an RFID tag encoder.

US Patent Applications 2005/0253722 and 2005/0252970, U.S. Pat. No. 7,322,523, and U.S. Pat. No. 7,336,175 all similarly describe a network-based tag provisioning system that uses a MAC address and/or DHCP to create unique EPC codes. Such a system incurs non-deterministic delays and is not suitable for embedding within an RFID encoder where the operator depends on maintaining a regular and predictable cadence in the tag commissioning process.

So, despite recent advances in RFID technology, the state-of-the-art does not fully address the needs of simple, efficient, economical, high-volume, reliable deployment and commissioning of RFID transponders and wireless sensors. Large-scale adoption of RFID transponders depends on systems utilizing reliable, low-cost transponders deployed at thousands of distributed locations that implement simple and efficient manual transponder commissioning means. Such systems should further include processes for efficient commissioning of batches of RFID transponders, without the need for realtime wireless connectivity.

SUMMARY OF THE INVENTION

The present invention overcomes the shortcomings of the prior-art attempts and, accordingly, provides systems, methods, and devices that commission RFID transponders on-demand and at a point-of-use utilizing wireless data transfer in a compact package that is well-suited to portable, mobile, or fixed use in multiple applications. The present invention is used for reading data from or encoding data onto wireless transponder data carriers with no external authorizations or queries required on a transponder-by-transponder basis. Additionally this invention teaches a preferred method and apparatus for commissioning RFID transponders without requiring continuous use of a screen or keypad to control operations. Further advantages of the present invention will be well-appreciated by those skilled in the art upon reading this disclosure including the appended figures of the drawing.

Authorizations for one or more classes of objects are preferably loaded into the encoder; where such authorizations include data fields such as manufacturer ID, item reference, manufacturer code lengths, filter values (that designate packaging levels such as item, case, pallet, etc.), serial number starting point for a block, and other pre-determined parameters. Such information is preferably loaded into the memory of the encoder in advance of tag commissioning operations. Thus if loaded with information for more than one object class, the encoder does not have sufficient information to proceed with encoding a transponder until a single object class is selected for the present RFID transponder to receive; an ambiguity therefore exists that is preferably resolved with information entered by an operator using either a keypad or a bar code scanner. Reading printed indicia such as a bar code is a preferred method to resolve the ambiguity as to which object class the next RFID transponder is to receive a number from. Bar codes are used to eliminate errors and ambiguities that enable the encoder to locally generate or replicate data for encoding into a data carrier such as an RFID transponder.

This type of data production and/or replication process is very fast and efficient. There is no absolute need to query a database in real time; hence there is no need for continuous wireless network connectivity. This simplification eliminates the possibilities for non-deterministic network delays. Non-deterministic delays are delays that cannot be guaranteed, usually due to the probabilistic nature of packet collisions that are common in Ethernet and WiFi. By eliminating the need to access a network database, the variable non-deterministic delays caused by changing database sizes, changing record counts, and database user load fluctuations are completely circumvented. Reduction or outright elimination of non-deterministic delays helps manual labor operate at maximum efficiency, allowing them to achieve a regular and dependable cadence in their transponder application processes.

For example, in one embodiment the present invention consists of an encoder for commissioning RFID transponders. The encoder consists of an RFID interrogator module adapted to enable encoding predetermined data according to a commissioning algorithm and communicating with an internal antenna, the antenna being adapted to encode the predetermined data on the RFID transponder; a memory storage device for storing at least a portion of the predetermined data; a processing means for controlling and communicating with the memory storage device, the RFID interrogator and the internal antenna; a means for providing a supply of RFID transponders, the transponders configured for tensile extraction from the encoder or, preferably from means for providing a supply of RFID transponders comprising a cartridge; and a means for presenting the RFID transponder within an operable range of the internal antenna or near field coupler to enable encoding of the predetermined data.

In further embodiments, the present invention includes a method for commissioning RFID transponders comprising: providing a roll or sheet of RFID transponders; providing a cartridge or other pre-packaged self-contained supply of RFID transponders; providing an encoder; inserting the roll or sheet in the cartridge or other pre-packaged self-contained supply of RFID transponders; coupling the cartridge to the encoder; acquiring information to encode from printed indicia; encoding the information on at least one RFID transponder; and adapting the process of attachment of the encoded

transponder to the target surface along a vector that is nearly parallel to the target surface based upon real time feedback from the surrounding environment.

DRAWING

FIG. **1** is a block diagram of the system and environment according to one embodiment of the present invention.

FIG. **2** is a top view of a possible RFID transponder according to one embodiment of the present invention.

FIG. **3** is a schematic end-view of the RFID transponder of FIG. **2**.

FIG. **4** is a top view schematic drawing of a sheet or roll of a plurality of RFID transponders of FIG. **3**.

FIG. **5** is an offset orthogonal view of a mobile encoder according to one embodiment of the present invention.

FIG. **6** is a schematic block diagram showing some components of the mobile encoder of FIG. **5**.

FIG. **7** is a schematic cross section view showing electromechanical components of one embodiment of a mobile encoder.

FIG. **8** is a schematic cross section of an encoder according to the present invention.

FIG. **9** is a frontal-offset view of a hand-held, mobile encoder according to the present invention.

FIG. **10** is a schematic cross section of another encoder according to the present invention.

FIG. **11** is a flow chart of a first method according to the present invention.

FIG. **12** is a flow chart of a second method according to the present invention.

FIG. **13** is a flow chart of a third method according to the present invention.

FIG. **14** is a flow chart of a fourth method according to the present invention.

FIG. **15** is a flow chart of a fifth method according to the present invention.

FIG. **16** is a flow chart of a sixth method according to the present invention.

FIG. **17** is a block diagram of the system and environment according to one embodiment of the present invention.

FIG. **18** is a top view of a possible RFID transponder according to one embodiment of the present invention.

FIG. **19** is a material stack specification of an RFID transponder according to one embodiment of the present invention.

FIG. **20** is a side view of a web of release liner containing RFID transponders, provided on a source roll, stretched tight around a peel device, and advanced forward onto a take-up reel according to one embodiment of the present invention.

FIG. **21** is a side view of a handheld mobile encoder with an integrated bar code scanner according to one embodiment of the present invention.

FIG. **22** is a diagram of a wearable wireless bar code scanner according to one embodiment of the present invention.

FIG. **23** is a flow chart of a first method according to the present invention.

DESCRIPTION OF THE INVENTION

Making reference to various figures of the drawing, possible embodiments of the present invention are described and those skilled in the art will understand that alternative configurations and combinations of components may be substituted without subtracting from the invention. Also, in some figures certain components are omitted to more clearly illustrate the invention. In some figures similar features share common reference numbers.

To clarify certain aspects of the present invention, certain embodiments are described in a possible environment—as identification means for containers. In these instances, certain methods make reference to containers such as loaded pallets, paperboard boxes, corrugated cartons, pharmaceutical containers, and conveyable cases, but other containers may be used by these methods. Certain embodiments of the present invention are directed for use with steel drums, commercial corrugated shipping cartons, tagged pallet-loads of shrink-wrapped cases, consumer-goods packaging, consumer goods, automobile windshields, industrial components, or other methods of identifying objects using RFID transponders or wireless sensors, or both. In certain embodiments the target surface to which a transponder will be attached is a container. In some applications the target surface is moving while the encoder device is stationary. Furthermore the moving target surface may be objects on a conveyor. In yet other embodiments the target surface may be a web of release liner from which encoded transponders will be later removed and applied to an object for identification.

Some terms are used interchangeably as a convenience and, accordingly, are not intended as a limitation. For example, transponders is a term for wireless sensors that is often used interchangeably with the term tags and the term inlay, which is used interchangeably with inlet. This document generally uses the term tag or RF tag to refer to passive inlay transponders, which do not include a battery, but include an antenna structure coupled to an RFID chip to form an inlay which is generally thin and flat and substantially co-planar and may be constructed on top of a layer of foam standoff, a dielectric material, or a folded substrate. One common type of passive inlay transponder further includes a pressure-sensitive adhesive backing positioned opposite an inlay carrier layer. However, certain aspects of the present invention work equally well with active inlay transponders. A third type: a battery-assist tag is a hybrid RFID transponder that uses a battery to power the RFID chip and a backscatter return link to the interrogator. Further, this document uses programmable RFID transponders interchangeably with RFID transponders. Programmable transponders enable data to be written or stored more than once.

Suitable environments or applications for certain aspects of the present invention include: traditional conveyor line or other high-speed machinery with automated transponder printing, encoding, and attachment; hand attachment of transponders (a method that often is referred to as "slap and ship"); and a novel category of mobile transponder encoders (as will be more fully described herein); shipside receiving of automobiles; case picking operations that include selective tagging process steps; and receiving untagged cartons into an RFID-enabled retail store or a manufacturing plant.

The systems, methods, and devices of the present invention utilize an RFID transponder or wireless sensors as a component. Certain RFID transponders and wireless sensors operate at Low Frequencies (LF), High Frequencies (HF), Ultra High Frequencies (UHF), and microwave frequencies. HF is the band of the electromagnetic spectrum that is centered around 13.56 MHz. UHF for RFID applications spans globally from about 860 MHz to 960 MHz. Transponders and tags responsive to these frequency bands generally have some form of antenna. For LF or HF there is typically an inductive loop. For UHF there is often an inductive element and one or more dipoles or a microstrip patch or other microstrip elements in their antenna structure. Such RFID transponders and wireless

sensors utilize any range of possible modulation schemes including: amplitude modulation, amplitude shift keying (ASK), double-sideband ASK, phase-shift keying, phase-reversal ASK, frequency-shift keying (FSK), phase jitter modulation, time-division multiplexing (TDM), or Ultra Wide Band (UWB) method of transmitting radio pulses across a very wide spectrum of frequencies spanning several gigahertz of bandwidth. Modulation techniques may also include the use of Orthogonal Frequency Division Multiplexing (OFDM) to derive superior data encoding and data recovery from low power radio signals. OFDM and UWB provide a robust radio link in RF noisy or multi-path environments and improved performance through and around RF absorbing or reflecting materials compared to narrowband, spread spectrum, or frequency-hopping radio systems. Wireless sensors are reused according to certain methods disclosed herein. UWB wireless sensors may be combined with narrowband, spread spectrum, or frequency-hopping inlays or wireless sensors.

A. System and Encoder Overview

Referring to FIG. **1** the present invention includes a system for commissioning wireless sensors at a point of use and on-demand. For example, in one embodiment, the present invention incorporates a mobile encoder device **30**, which may be attached to a belt of an operator and powered by rechargeable batteries **60**. The mobile encoder is in wireless communication with a remotely located host computer. The operator can selectively (on-demand) enable the mobile encoder to commission a transponder based on various criteria, including input received from a mobile bar code scanner, for example.

FIG. **1** shows one system **10** according to the present invention in a typical environment, such as a packaging facility wherein a collection of entities with visual external labels **15** exist and a sub-set (or all entities) need to be associated with a wireless RFID transponder, tag, or label. The object **17** needing an RFID transponder could be a packing container having an assorted collection of entities **15**. As entities **15** are pulled from collection **176**, a traditional optical reader **13** (human or machine) interprets the visual external label. Information from the external, visual label is correlated to information stored in a centralized location, represented by a network computer **11** having a database. The information taken by the optical reader **13** is transmitted to the network computer **11**. System **10** includes a wireless connection between the remote computer **20** and the mobile encoder **30** either directly or through a common wireless access point. Additionally, a wireless connection could occur between the remote computer **20** and the host computer **11**, and in this embodiment, the remote computer **20** is in physical connection with the mobile encoder. In yet another embodiment, the remote computer **20** wirelessly connects to both the mobile encoder **30** and the host computer **11**. Optionally, the optical reader **13** can be incorporated in the encoder **30**.

Referring to FIGS. **3** and **4**, in further embodiments, the present invention incorporates a mobile encoder device **175**, **30**, or **220** which may be held in the hand of an operator. Mobile encoder device **175**, **30**, or **220** is preferably powered by rechargeable batteries or a fuel cell. System **170** includes at least four possible intermittently connected entities if they are present and connected: mobile encoder **175**, remote computer or mobile phone **172**, optical reader **173**, and headset **174**. A preferred short range wireless connection means **175**A such as a WLAN (Wireless Local Area Network) or PAN (Personal Area Network) may be established from time to time between mobile encoder **175** and remote computer or mobile phone **172**, optical reader **173**, and/or headset **174**. There is a preference for low power wireless connection apparatus within mobile encoder **175** so as to realize the greatest possible battery life in light weight mobile encoder **175**. Mobile encoder **175**, **30**, or **220** is in intermittent wireless communication with a mobile phone or computer **172** typically at close range through wireless communication means **175**A. Database and associated host computer **171** may be housed at a remotely located facility that may optionally be accessed over a large distance through remote computer or mobile phone **172**. A mobile phone is a preferred bridge between two or more wireless networks, for example a PAN and a wireless subscriber network that supports wireless data services for ultra mobile and remote tagging applications. Continuous wireless connection to a host database is not required for ongoing tag commissioning process steps disclosed herein.

RFID tags such as those using EPCglobal numbers requires uniqueness of the numbers that are encoded. GS1 is a central authority that prescribes a set of hierarchies for each key type (type of identity such as an SGTIN) whereby GS1 designates itself as the central issuing authority for each key type. Authority is passed down in a hierarchical manner to member companies. Each member company has the authority to further allocate numbers from its upper level database to as many lower database levels as it deems necessary to distribute number authority throughout its enterprise.

Quasi-autonomous RFID transponder encoding authority is achieved when an external number issuance authority allocates to the encoder blocks of numbers for specific object classes. A preferred embodiment for quasi-autonomous transponder encoding authority is realized when large pre-authorized blocks of serial numbers are made available to encoder **175** or **30** to utilize on object classes as objects of a class are presented for tagging. A preferred method of providing pre-authorized blocks of object class serial numbers is to subdivide the entire object class serial number space into sectors that are defined by a limited number of MSB's (Most Significant Bits) of the serial number field. The object class serial number space is defined by the number of serial number bits that are used in a specific standard, such as a particular EPCglobal key type, for example an SGTIN-96 and is defined in a corresponding specification such as the GS1 EPCglobal EPC Tag Data Standard. Again using the SGTIN-96 as an example, there are a total of 38 bits used to define the entire serial number space which contains 2^{38} unique numbers. For example the upper 14 bits could be designated as the most significant bits for a particular embodiment. In that case the object class serial number space would be comprised of 16,384 sectors. Since in this example there are 14 most significant bits within a 38 bit serial number field, there must be 38 minus 14 bits of lesser significance, which equals 24 bits. Therefore the lower 24 bits represent 16,777,216 unique serial number values. Once a sector is allocated to a lower level within an authority hierarchy, it is referred to as a block. Each allocated block of serial numbers represents authority for encoding objects of an object class that can either be used by an encoder for encoding transponders, or allocated to a lower level in the authority hierarchy.

In a preferred embodiment serial number block sizes are sufficient to operate encoder **175** or **30** for extended periods of time without any further external authorization steps. For example autonomous operation for a week or more is possible with sufficiently large block sizes. In the previous example the encoder could encode over 16 million objects of an object class without the need to reconnect with a higher level authority. If 10,000 objects of an object class are encoded each day, then the encoder could operate in a quasi-autonomous mode

for up to 1677 days or over four years without receiving further authorizations from a higher level authority. Block allocations are preferably assigned with reference to how many encoders **175** or **30** are authorized to operate within the facilities of the owner of certain object class numbers.

Authorizations for one or more classes of objects are preferably loaded into encoder **175**, **30**, or **220** from an external authority where such authorizations include data fields such as manufacturer ID, item reference, manufacturer code lengths, filter values (that designate packaging levels such as item, case, pallet, etc.), serial number starting point for a block, and other pre-determined parameters. Such information is preferably loaded into the memory of the encoder in advance of tag commissioning operations. Thus if loaded with information for more than one object class, encoder **175**, **30**, or **220** does not have sufficient information to proceed with encoding a transponder until a single object class is selected for the present RFID transponder to receive; an ambiguity therefore exists that is preferably resolved with information entered by an operator using either a keypad or a bar code scanner. Reading printed indicia such as a bar code is a preferred method to resolve the ambiguity as to which object class the next RFID transponder is to receive a number from. Bar codes are used to eliminate errors and ambiguities that enable encoder **175**, **30**, or **220** to locally generate or replicate data for encoding into a data carrier such as an RFID transponder.

GS1 is a leading global organization dedicated to the design and implementation of global standards and solutions to improve the efficiency and visibility of supply and demand chains. GS1 defines EPCglobal SGTIN number fields as having a company prefix, an item reference, a partition value, and a filter value that comprise the object class information. A unique serial number is then added to that information to create each unique instance within each object class.

In a preferred embodiment, a block is allocated and managed using three numbers: a starting number that is the first serialized instance of a block, a block size which represents the total number of instances in the block, and a counter or index that represents how much of the block has been used during an encoding process. Using these three numbers and an optional lock bit, a simple database of object class authorizations can be built.

A preferred embodiment utilizes RFID authorization transponder **178**A and a printed substrate **178**B to physically handle object class serial number issuance authorizations. Authorization transponder **178**A is interrogated by transponder reading/encoding means **175**H. Preferred embodiments use the 96-bit EPC memory bank for specifying the block starting number, including the company prefix, item reference, partition value, filter value, and base serial number. The User Memory bank is used to hold and transfer the block size (preferably 16-bits), counter or index value (preferably 16-bits), a 16-bit header to identify the transponder as a valid member of a class of authorization transponder, a lock bit, and a CRC value to detect errors in all of the data fields. For example a CRC error would detect errors in storage, transponder selection, or data transmission. In preferred embodiments reading of data blocks from more than one RFID transponder would be avoided by selecting a transponder, checking that it is the correct type, contains valid authorization data, contains a valid header that signifies that it is an RFID authorization transponder **178**A, and that all data read correctly verifies with a dedicated error detection field such as a CRC.

RFID authorization transponder **178**A is preferably adhered to printed substrate **1788** so that an operator can visually identify what object class or SKU is managed by the affixed authorization transponder **178**A. A picture, icon, bar code, or human readable symbols are all useful for identifying the object class. An operator presses a button or scans a bar code that prompts encoder **175** to read and store the tagging authorization held by authorization transponder **178**A. Once read, authorization transponder **178**A is preferably electronically marked as 'consumed' or 'locked' by transponder encoding means **175**H. EPC transponder ID fields that identify a specific type of chip are preferred for selecting the proper transponder, even when other RFID transponders are within range of the antenna or near field coupler of transponder encoding means **175**H.

A collection of authorization transponders **178**A comprises a database that can be physically transported without the need for a wireless communications link to encoder **175**. Once read, database records are preferably stored in internal memory means **175**G. In a preferred embodiment 12 to 14 bytes of Flash memory is used for each record to allocate 250 to 65536 instances of an object class, whereby the first byte of an EPC number is a fixed header value can be replaced in Flash memory by 8 bits of the allowable block size. One or two bytes in RAM are used to count or index through the block allocation as it is used. Thousands of data records of this type can easily fit into the memory space of an economical 8-bit microcontroller. In a preferred embodiment, where the GS1 SGTIN-96 header is replaced in memory with an 8-bit block size authorization, 300 records for authorizing up to 255 instances per record, can be used to safely manage at least 500,000 tagging records using 24,000 bytes of Flash memory and 2000 bytes of RAM. Other embodiments using more bits to authorize and control larger blocks of numbers is possible at a slightly larger expense of memory.

Preferred embodiments of encoder **175**, **30**, or **220** will encode all of the GS1 identity types. Such types include the General Identifier (GID-96), Serialized Global Trade Item Number (SGTIN), Serial Shipping Container Code (SSCC), Serialized Global Location Number (SGLN), Global Returnable Asset Identifier (GRAI), and the Global Individual Asset Identifier (GIAI). Other preferred embodiments are used to encode numbers that are a part of other numbering systems.

Data records are preferably loaded and stored through commands that are transmitted over wireless communication means **175**A. In preferred embodiments, batch mode commands can be used in any of three ways: (1) to immediately affect the current operation by starting a batch tagging process for a specified SKU or object class; (2) to store authorizations in memory means **175**G; and (3) to store authorizations in stored-value RFID transponder **178**A.

When external connection is necessary, wired or wireless communication with an external host or numbering authority is established. Wireless communication means **175**A is preferably a Wi-Fi or Bluetooth connection. A wireless node of a Bluetooth personal area network is used according one embodiment of the present invention. Model 100-SER manufactured by EmbeddedBlue of Poway, Calif. and the BISMS02 from EZURiO Ltd., a subsidiary of Laird Technologies, Inc. of Chesterfield, Mo. are examples of preferred OEM Serial Bluetooth modules. Other wireless interfaces may alternatively be used to achieve Serial Port Profile and other types of connectivity between encoder **175** and remote computer or mobile phone **172** and/or optical reader **173**.

Other preferred embodiments of mobile encoder **175** and system **170** replace wireless communication means **175**A with a cable, resulting in an embodiment of mobile encoder **175** with a tethered bar code scanner. A key advantage of an alternative embodiment of system **170** that utilizes a wired

connection to optical reader **173** instead of wireless communication means **175**A is a very simple solution having virtual immunity to any surrounding RF interference that might raise the noise floor hindering wireless communications.

The operator can cause mobile encoder **175**, **30**, or **220** to commission a transponder by scanning certain printed bar code symbols received through optical reader **173** which is connected to encoder **175** through wireless communication means **175**A. Or alternatively internal optical reader **175**F is used to scan printed bar code symbols. In either case data from optical reader **173** or **175**F is delivered to processing means **175**B. Certain preferred embodiments of system **170** use optical scanners with self-contained symbol decoding capabilities to deliver decoded symbol information to processing means **175**B. Certain other embodiments of system **170** relies on processing means **175**B to conduct some or all decoding operations to derive information from scanned symbols.

The information derived from the optical reader **173** or **175**F is used by mobile encoder **175** to either directly or indirectly encode data into RF transponder **178** while it is still physically within mobile encoder **175**. Mobile encoder **30** uses external optical reader **173**, and alternatively mobile encoder **220** uses internal optical reader **175**F, as embodied in reader **226** of FIG. **21**. Preferred embodiments of optical reader **226** are mechanically aligned relative to transponder encoding means **175**H or more specifically with the antenna or near field coupler of RFID interrogator **224**A. Spatial alignment assures that an operator will be able to comfortably scan bar codes and then encode and apply RFID transponders along a line of movement such that the operator can easily assure proper placement of encoded transponders.

Symbol decoding functions may be physically, electrically, or logically separated from symbol scanning operations. One preferred embodiment of optical reader **173** is a model CHS-7M, CHS-7P, CRS-9M or CRS-9P Bluetooth ring scanner **237** shown in FIG. **22** all manufactured by Socket Communications of Newark, Calif. Ring scanner **237** if not completely self-contained with battery and wireless connection is, in a preferred embodiment tethered to a battery pack and wireless interface **238** strapped to the arm **239** of an operator. Certain preferred embodiments designate ring scanner **237** as the master node of a Bluetooth network. As a master, ring scanner **237** will preferably pair with a specific mobile encoder designated by a unique identifier that is also encoded onto a bar code affixed to the external housing of mobile encoder **175**. Ring scanner **237** is used to scan that bar code and decode it to acquire the unique 12-hexadecimal digit Bluetooth address to perform a Bluetooth pairing operation that results in mobile encoder **175** becoming a slave on that network. Then whenever a bar code **179** is scanned, the Bluetooth-paired instance of mobile encoder **175** is notified of the new bar code data to support RFID transponder encoding operations or command inputs.

Processing scanned commands involves a processing step to determine that a bar code should be interpreted as a command or configuration instructions rather than as bar code **179** that identifies an object that is to be tagged. Commands are used to alter the flow and operation of mobile encoder **175**.

FIG. **21** is a preferred embodiment of a mobile encoder wherein optical reader **226** is an OEM bar code scanner manufactured by such companies as Intermec or Motorola and is a preferred embodiment of optional internal optical reader **175**F shown in FIG. **17**.

In a preferred embodiment one or more bar codes are pre-printed and applied as symbol **179** on entity **177** in a manufacturing facility or other suitable location. Such bar codes are described in ISO/IEC draft document PDTR 24729-1 and are more generally referred to as one or more bar codes having Application Identifiers (AI) 01 and 21 encoded into them, and preferably include header information and other control bits that are required for certain protocols. AI 01 is used to represent the Stock Keeping Unit (SKU) as a GS1 Global Trade Item Number (GTIN). AI 21 is used to serialize the SKU. Together the two AI's are used to specify a GS1 serialized GTIN (SGTIN). Bar codes can also be used to specify data payloads that use numbering systems other than the EPC numbering system. The Application Family Identifier (AFI) also plays an important role in designating alternative numbering authorities.

This preferred method that is described by the flow chart in FIG. **23** will allow batch mode operation where there are at best intermittent connections with remote computer **172**. This preferred method allows existing label application and/or printing hardware located on existing manufacturing lines to provide in printed symbolic form all data that would be encoded into an RF transponder. By providing printed symbols, manufacturers do not have to incur either the cost of that transponder or the special equipment that is required to encode and apply RF transponders.

Optical reader **173** or **226** is described above and is used as the primary source of real time data input for the mobile encoding system that uses an embodiment such as mobile encoder **30** or **220**. Optical reader **173** or **226** is also preferably used to scan special bar codes that instruct mobile encoder **175**, **30**, or **220** to perform certain prescribed functions which will be described below.

Certain preferred embodiments of system **170** include headset **174** which may be a headset worn by the operator or a Bluetooth-linked loud speaker that is mounted to a pallet jack or fork lift truck. Headset **174** is optionally used by system **170** to give instructions, confirmation signals, or warnings to the operator. Synthesized speech or audible tones are used to interact with the operator through headset **174**.

In these aforementioned embodiments, the mobile encoder **30** is a portable device that can be easily mounted in a fixed location, carried such as mobile encoder **220**, or worn by a human operator such as mobile encoder **30**, or hung from a suspended retractable tool cable. As such, the mobile encoder **30** includes an internal power source **175**E such as a rechargeable lithium-ion battery and would further include a handle or a belt-clip for ease of use. In another embodiment, the mobile encoder can be attached to a high-speed conveyor line. In such an application, the on-board battery could be replaced or augmented by a physical connection to a remote power source. Further, the computer **20** could have wired connects to the host network **11**. Further details of possible configurations of the mobile encoder will be further detailed in subsequent sections of this disclosure.

In the system **10** of FIG. **1**, the mobile encoder **30** carries a supply of un-commissioned (or blank), or securely encodable RFID transponders **175**J, **185**, **42**, or **221**E. Once the desired data is accumulated and presented to the encoder **30** from the computer **20**, the encoder commissions an RFID transponder, using transponder transport means **175**C and transponder encoding means **175**H and any one of several preferred encoding algorithms to program, creating an RFID tag or label **50** for the object **177**. Transponder separation means **175**D is used to separate a properly encoded transponder **178** from release liner conveyance web **182** by breaking the bond at adhesive layer **181**D on the leading edge of transponder **178**. Transponder separation means **175**D is preferably a peel device **183** as shown in FIG. **20** or peel device **222**B in mobile encoder **220**. Peel devices **183** or **222**B are preferably made

from anti-static plastic, metal, or other material that will conduct electrostatic charge away from transponder **178** and release liner **182**. The commissioned tag or label **50** can then be applied, linked, or otherwise associated with the object by known means including a human operator or a machine transfer.

B. RFID Transponders

FIG. **2** shows a preferred embodiment of an RFID transponder **50**. RFID transponders, in some embodiments, comprise an RFID integrated circuit (IC) device (or "chip") **56** of FIG. **3** or **180** of FIG. **18** bonded to an antenna apparatus, formed on a substrate that is often plastic such as Mylar®, polyester, or PET. One way to form an antenna structure is to etch copper from a substrate. An alternate printed transponder includes printing multiple layers of conductive ink onto a substrate. One additional method includes stamping UHF antennae from thin sheets of aluminum, or by selective aluminum deposition onto a substrate. In certain embodiments, RFID transponders and wireless sensors are recovered from waste streams for reconditioning, reprogramming, and reuse.

Other suitable RFID transponders include designs that combine a dielectric spacer behind the antenna by separating the metallic antenna inlay **181**C from surrounding metals that may detune it, or liquids that may absorb RF energy from it. The dielectric spacer creates a transponder that performs well over a broad range of packaging conditions. The dielectric material is a foam standoff material or an expanding mechanical structure that provides lift from the target object and also a more robust design also includes features to protect the transponder from damage.

In certain embodiments, the RFID transponder is both programmable and mechanically configured for tensile extraction from a protective enclosure.

In preferred embodiments, hundreds or thousands of instances of RFID transponder **178** are manufactured on a continuous web of flexible material with a spatial separation between them, preferably at regular intervals. Certain preferred embodiments use adhesive-backed transponders **178** adhered to release liner **182** as shown in FIG. **20**, while other embodiments use the transponder material as its own conveyance that is severed from the rest of the web at predetermined locations, preferably after encoding and verifying transponder **178** is properly functioning.

In preferred embodiments of the present invention, the face stock material has a physical outline that is not much larger than the physical outline of the inlay itself. This is in contrast to labels which can have at least twice the surface area of the inlay or a direct-printed antenna structure in order to provide space for printed information. By having a label outline that is so much larger than the inlay surface area, there are a many possible combinations of inlay placement within the boundaries of a large printable label. This creates a problem and a challenge for printer/encoders that have to find and locate an inlay before attempting to encode it. By contrast, the present invention uses the detectable optical characteristics of the tag's minimal physical outline to position the transponder for encoding. This transponder positioning method is superior and an improvement over prior art that uses printed label stock as a carrier for RFID inlays wherein the physical dimensions of printed labels are not in any way a reliable indication of the location of the RFID inlay within the label. This is another example of how demand label printing further complicates RFID transponder encoding.

In one embodiment that is an exception to the minimal outline transponder design and positioning method described above, transponders that have a very long physical shape can be used to create a loop to secure an encoded transponder to a tree, a bush, or the handle of a piece of luggage. Preferred embodiments of such transponders are folded or rolled in order to package them onto a dispensing roll or packaged into a magazine or cartridge in a fan fold pattern. The resulting bundle of back-and-forth 'Z' folded or fan folded face stock material results in a compact package that minimizes the amount of release liner that needs to be wasted for each tag. Each z-folded transponder is then easily encoded and dispensed from encoder **175**, **30** or **220**. Transponders that can be encoded, verified, dispensed, and unfolded are advantageously used in forestry, ornamental nurseries, and airline baggage tracking applications where manual tagging is required.

In another embodiment, transponder **178** is pushed out of encoder **175** instead of being pulled out through tensile extraction. A transport mechanism for pushing transponders utilizes a gripping method such as friction or teeth that penetrate the webbing. Although there is a risk of jamming or mutilating the webbing, the advantage is that there is no need for a release liner to pull the transponder supply through encoder **175** using tensile extraction. A preferred 'tractor feed' embodiment mitigates the risk of web mutilation by utilizing a regular pattern of precut holes along one or both edges of the webbing, into which cog members of a drive mechanism engage to advance the webbing. A tractor feed embodiment is part of Transponder Transport Means **175**C of FIG. **17** whereby a motor and gear train delivers drive torque to the web through friction rollers, penetrating teeth, cogs, or other mechanical engagement means. In such an embodiment, the preferred transponder separation means is a web cutter that is used to separate encoded transponders from unencoded tags. A web cutter can be either active or passive, in other words cutting force can originate with a motorized mechanism or with an operator's handling during dispensing and transponder detachment. A row of plastic or metal saw teeth is a preferred embodiment of a passive transponder separation device.

In another preferred embodiment, transponder **178** is manufactured on a high speed press, a bar code is printed onto face stock of transponder **178** and information that is representative of that bar coded information is also encoded into microchip **180**. Then encoder **30** or encoder **220** preferably read that information from RFID microchip **180** and associate it with a transponder commissioning process that may or may not include the programming of additional information into RFID microchip **180**. This is a novel method of reading bar coded information on transponder **178** without using a bar code scanner to do so within encoder **30** or **220**.

In one embodiment, additional transponder layers include a thin and flexible energy cell comprising two non-toxic, widely-available commodities: zinc and manganese dioxide. One suitable energy cell is developed by Power Paper Ltd. of 21 Yegia Kapayim Street, Kiryat Arye, Petah Tikva, P.O.B. 3353, ISRAEL 49130, and incorporates an innovative process that enables the printing of caseless, thin, flexible and environment-friendly energy cells on a polymer film substrate, by means of a simple mass-printing technology and proprietary inks. The cathode and anode layers are fabricated from proprietary ink-like materials that can be printed onto virtually any substrate, including specialty papers. The cathode and anode are produced as different mixes of ink, so that the combination of the two creates a 1.5-volt battery that is thin and flexible. Unlike conventional batteries, this type of power source does not require casing.

A top layer of an RFID transponder assembly optionally comprises a paper face-stock **181**A, which is a very low-cost material but also is the least environmentally resilient. UV-

resistant plastic face-stock **181**A generally provides the best survivability in outdoor and rough-service environments, and also provides the best protection for the RFID transponder assembly.

A bottom layer of pressure-sensitive adhesive (PSA) **181**D often is used for attachment of transponders to objects and often is referred to as a wet inlay or a wet tag or a wet transponder because of adhesion layer **181**B. Alternatively, a layer of clear, translucent, or opaque adhesive-backed film or tape is used to attach the transponder or wireless sensor to object or container. The tape, any thin, low cost, flexible material with a self-adhesive backing, such as a conventional packing tape, is well-suited for this method of attachment. The tape may be formed into various shapes to achieve the requirements of this method. Certain embodiments may use tape that is preprinted with certain logos, marks, symbols, bar codes, colors, and designs. Suitable adhesive-backed tape must not—or at least minimally—absorb radio frequencies within the range of frequencies used by the transponder or tag. The tape material, also, must not corrode the device or otherwise hamper its functionality.

Certain embodiments use a type of packing manufactured specifically for a given encoder. Packing tape can be single-coated pressure-sensitive adhesive tape or, alternatively, media constructed with multiple layers including a backing layer. Certain backing layers are constructed on a plastic film having one or more layers. Certain backing layers are made from plastic resins such as polypropylene (PP), polyethylene (PE), or copolymers of PP, PE, PVC, polyesters, or vinyl acetates. Certain embodiments of PP are mono-axially oriented polypropylene (MOPP), bi-axially oriented polypropylene (BOPP), or sequentially and bi-axially oriented polypropylene (SBOPP). Certain backing layers are biodegradable. Certain backing layers are coated with a pressure sensitive adhesive on one side and a low adhesion release coating on the other side to reduce the amount of power required for the encoder to unroll the tape for application.

FIG. **3** shows a possible embodiment of an RFID transponder **50** that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer **52** bonds with antenna layer **54** that is bonded to inlay substrate layer **58** and integrated circuit **56**. Inlay substrate layer **58** and face-stock layer **51** provide resistance against electrostatic discharge (ESD) into antenna layer **54** or chip **56**.

Other constructions for RFID transponders include one or more additional layers of high-dielectric material that encapsulate or substantially cover the inlay. In general, the thicker the dielectric layer the higher the voltage must be to initiate a flow of electrons through a dielectric layer. This results in higher ESD voltage ratings. Also, it is well known to those skilled in the art that thicker dielectric layers between antenna layer **54** and any other metal or liquid also tends to reduce parasitic loading of the antenna whereby maintaining antenna tuning for proper coupling to interrogators within a specified UHF band. In such embodiments, the integrated circuit chip and antenna bond to an adhesive layer and are protected from a discharge path through the tape layer by its particular thickness of dielectric material. A second dielectric layer bonds to the inlay substrate by a second adhesive layer, so that a low voltage discharge path is nonexistent around the two layers of tape substrate.

In another possible embodiment of an RFID transponder, the inlay substrate provides a second layer of ESD resistance against a discharge path through an outward-facing tape layer and associated adhesive layer. This construction protects the antenna and chip from electrostatic discharge originating from any direction. The encapsulation tape layer bonds to the antenna and chip via an adhesive layer and provides no adhesive bond to the transport container when the transponder is commissioned, and therefore depends on separate adhesive zones to attach to the container of interest.

In another possible embodiment, an RFID transponder includes multiple layers of ESD resistant material. For example, an outer layer substrate bonds to an inner substrate by an intermediate adhesive layer. A second adhesive layer bonds with the chip and antenna. The inlay substrate faces inward and presses against a transport container when the transponder is commissioned.

The contemplated adhesives in the various RFID transponder embodiments create strong and permanent bonds between tapes and inlay layers over a certain practical range of operating temperatures.

Because RFID transponders are designed to adhere to a container, one face of an external layer includes a pressure-sensitive adhesive. This external adhesive, however, must not cause mechanisms associated with the commissioning devices to jam. To prevent unwanted sticking of the RFID transponder, a transport layer protects the sticky, external adhesive. The transport layer is either a release liner such as a silicone-treated paper liner or a net (or mesh) web. A net or mesh web offers two principal advantages: less weight and being recyclable or reusable. A comparison of the weight of a net with a higher percentage of open area to a typical sheet of release liner reveals that the netting is lighter for any given section of comparable size. Environmental problems of disposal of release liner are well known. Mesh or netting, comprised of recyclable resins, is recovered after each use so that the mesh or net can be either reused or recycled for its constituent materials.

In one possible embodiment the mesh or netting is made of plastic such as nylon, polypropylene, polyethylene, HDPE, Teflon, or other resins. In other embodiments the mesh or netting is fabricated from metal or carbon-impregnated plastic to provide a conductive path to bleed electric charge away from points of accumulation.

Other advantages of a net or mesh transport layer include a substantial percentage of the adhesive not in contact with anything during storage and commissioning. When stored in a roll, a small percentage of the adhesive layer makes contact with the backside of the roll through the openings in the mesh. Thus, a small amount of energy is required to unroll the spool during transponder commissioning, yet there exists a certain amount of adhesion to prevent a converted spool from unraveling.

In other possible embodiments, the RFID transponders can include a surface suitable for human or machine readable, visible, external markings including bar-code symbols or alpha-numeric sequences.

FIG. **4** shows another embodiment of RFID transponders **50** grouped on sheet stock **59** such as rolls or z-folded sheets that enables a plurality of transponders to be carried on a continuous web or traditional release liner. Other certain embodiments use transponders that are stacked and loaded into magazines for transport, handling, and automated dispensing. In certain embodiments, the magazines contain metallic shielding to protect transponders and inlays from electrostatic discharges (ESD).

In certain embodiments an RFID encoder is combined with a sensor suite **218** as shown in FIG. **10** to enable semi-automated tag application to desired objects. In one embodiment, a semi-automatic encoder/applicator is created by integrating a single sensor device. The sensor responds to changes in light, capacitance, pressure, acoustics, or optical path length

to a transport container. In another embodiment a suite of sensors are used to detect the attachment location of a commissionable transponder.

For example, changes in capacitance are detectable using certain QProx charge transfer capacitance sensors available from Quantum Research Group Ltd. of Hamble, England. Ultrasonic range sensors are available from supplier such as muRata Manufacturing Co., Ltd. of Kyoto Japan under the trade name Piezotite. Optical path length sensors are available from Keyence Corporation of Osaka, Japan. Sharp manufactures a compact distance-measuring sensor GP2D02 that is responsive in the range from 5 to 100 cm. Thus, when a predetermined set of conditions is realized, the sensor triggers, enables, or selects a desired action. In one embodiment, proximity or contact of sensor suite with the targeted transport container causes a second type of Trigger Event, resulting in the commissioning and dispensing of a transponder by an encoder.

In other embodiments, sensor **218** is designed to determine the distance an encoder resides from an object that is to be tagged. Range information is acquired and processed in real time to determine if the encoder is in Close Proximity, Near, or Far from a transport container. In certain embodiments a controller is programmed to alter threshold distances between each range category and to associate a function with each range. In certain embodiments, range category Close Proximity is associated with transponder programming and application functions. For example, the range category Near is reserved for transponder verification and/or reading functions; and Far is reserved for bar code scanning functions to verify that bar code information aligns properly with RFID transponder data.

In other embodiments a sensor suite is responsive to certain colors or patterns and uses that information to instruct the placement or detect the correct locations for applying good transponders and separate locations for discharging bad transponders.

FIG. **20** also shows how transponders **178** are rolled onto reels in preparation for encoding. Source roll **185** contains a supply of transponders ready for encoding. Release liner **182** conveys transponders **178** around peel device **183**. Unless transponders **178** are mechanically prevented from rotating around peel device **183**, they are conveyed onto take-up roll **184**. Take-up reel **184** advances forward while source roll **185** lags behind due to drag created by a clutch, brake, motor or other back-torque generating device. Opposing torques of take-up reel **184** and source reel **185** result in tension in release liner web **182**. Shape memory in face stock **181**A preferably prevents transponder **178** from remaining adhered to release liner **182** as it passes over peel device **183**, resulting in the leading edge lifting off and separating from webbing **182**. If take-up reel **184** continues to advance, and transponder **178** does not collide with another object, its attachment to release liner **182** on its trailing edge will result in that transponder being passed completely around peel device **183** onto take-up reel **184**. Full path rotation is preferably reserved for transponders that fail to properly encode desired information; and is therefore intended to be a reject process for failed transponders. Preferred embodiments result in tension created in web **182** in a process of tensile extraction of transponders from a source reel and selective transfer of good transponders onto an object or a person's finger. Mobile encoder **30** depends on a person's finger to prevent transponders **178** from rotating around peel device **183**. Mobile encoder **220** depends on a target object such as carton face **228** to prevent transponder **223**B from rotating around peel plate **222**B on a path toward take-up reel **221**J.

When the conveyance of RFID transponders results in the positioning of a transponder relative to a near field coupler within a signal null, the transponder and transport webbing are preferably nudged forward or backward to improve the signal coupling. This is preferably accomplished by momentarily activating the motor and transponder transport means **175**C.

C. Mobile Encoder

FIG. **17** shows a system **170** according to one embodiment of the present invention including a mobile encoder **175**. FIG. **5** shows a preferred embodiment for a mobile encoder. Mobile encoder **30** is comprised of housing **32**, belt clip **34**, antenna **36**, on/off switch **33**, system ready LED **37**, data ready LED **38**, and transponder ready LED **39**. It is further comprised of auxiliary switch **40**, and charger plug **41**. A cartridge or other pre-packaged self-contained supply of transponders **42** is preferably latched, snapped, clicked, popped, inserted, slid, or releasably mounted to the body of housing **32**. The cartridge preferably includes a take-up reel **44** for non-dispensed RFID transponders, and a port through which blank or securely encodable transponders emerge from source reel **43**. The source reel is preferably comprised of a core which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge **42** to form an axle around which release liner and transponders are wound and subsequently unwound.

In certain preferred embodiments source reel or roll **43** is constructed using materials such as non-petroleum-based plastics, laminated paper layers, and materials primarily comprised of natural fibers. In another preferred embodiment the entire pre-packaged self-contained supply of unused transponders is transported to mobile encoder **175**, loaded into it, consumed, and disposed of preferably without generating landfill waste.

A key aspect of this invention is a complete pre-packaged, pre-assembled, pre-threaded, self-contained supply of encodable transponders, preferably unlocked with cryptographic access methods. The supply is preferably configured for efficient transportation and shipping, conveyance to a work site, and easy loading into mobile encoder **175**, preferably in a single fluid motion.

FIG. **21** is a preferred embodiment of system **170** wherein printed symbols are optically scanned by internal optical reader **226**. The embodiment shown in FIG. **21** uses a preferred method of sensing the linear motion of mobile encoder **220** across a target surface by using an optical mouse sensor **225**. Such devices are commonly used to track the hand movements of the operator of a computer. Motion in either the X or Y direction is translated into numerical displacement representations which when timed are converted into linear velocities. Tracking and processing the primary axis of motion parallel to the major axis of the release liner, the web speed is preferably controlled by processing means **175**B and transponder transport means **175**C such that transponder **223**A advances at a rate of speed that matches the velocity of the entire mobile encoder across the target surface. Optical mouse **225** tracks displacement across the target surface and also acts as a tamp head to strengthen the adhesive bond of each freshly applied tag. The process of attachment of the encoded transponder to the target surface is along a vector that is nearly parallel to the target surface at a speed that is based on real time feedback from the surrounding environment as sensed by the optical mouse or other sensor. Optical mouse sensor **225** preferably illuminates its target surface with either a LED (Light Emitting Diode) or a laser. Avago Technologies of San Jose, Calif. manufactures a variety of mouse sensors, both LED-based and laser-based. Laser illumination provides

smooth and accurate motion sensing across a variety of surfaces. The model ADNS-6150 small form factor lens working in conjunction with the ADNS-6530 integrated chip-onboard laser sensor and single-mode vertical-cavity surface emitting laser can be used to not only detect motion in the X and Y directions, but also to some degree in the Z direction. Displacement along the Z (depth) vector is reported by the decrease in the number of resolvable features within the field of view as the target surface fades away from the optical focal point. That measurement is reported in the surface quality (SQUAL) register.

Optical mouse sensor **224**B is used to measure the linear velocity of transponders as they move along the path of the release liner toward peel device **222**B, as well as sense the gaps and edges between transponders **223**A and those adjacent to them. The physical outline **178** of transponders **223**A are a reliable indication of the location of RFID inlay **181**C located within each transponder **223**A and enhance system performance with reliable positioning relative to near field coupler **224**A**2**. The angular velocity of motor **227**B and gear train **227**A are controlled to achieve a linear transponder velocity that matches the velocity of the mobile encoder itself as it moves across the target surface. Therefore an operator with a fast hand motion is just as successful as a person with a slower hand motion, both will result in a transponder that lays flat, co-planar with the target surface, void of kinks or wrinkles that are characteristic of a poorly controlled transponder application process. In either case, transponder dispensing by transponder transport means **175**C will not initiate until optical mouse sensor **225** preferably illuminates the target surface and detects a minimum number of valid features as reported by the SQUAL register internal to the ADNS-6530.

RFID Interrogator **224**A encodes RF transponders using either LF (Low Frequency), HF (High Frequency), UHF (Ultra High Frequency), or microwave radio energy. Transponders may be powered by radio energy, light, or stored energy from a source such as a battery. RF coupling is preferably through a near field coupler, an inductive loop or other suitable transducer **224**A**2** connected to interrogator **224**A to focus RF energy on a small area within mobile encoder **175**, **30**, or **220**.

Certain preferred mobile encoder embodiments will not encode RF transponders that fail authenticity tests. In a like manner, RF transponders will preferably not allow themselves to be programmed unless the interrogator can successfully unlock its secured memory banks. This is a preferred method of protecting transponder cartridge and mobile encoder supply chains from counterfeits and knock-offs. Mobile encoder **175** and the transponders loaded into it will only be successful in exchanging certain data if certain data encryption and challenge response protocols are adhered to. In a preferred embodiment each authorized RFID transponder converter company uses one or more encryption keys to generate passwords that lock the RF tags, whereby preventing them from being programmed unless they are unlocked using the same password. Passwords of this type are specified in the EPC Gen 2 specification and in ISO standards. The passwords are preferably generated by processing means **175**B using a public key from publicly readable data such as an asset number or a transponder serial number. A shared private key is then used by an encryption algorithm such as AES in order to create a password or a collection of passwords that can be used to lock or unlock one or several RF tags. Other methods may be used that provide a high degree of certainty that the both the transponders and the mobile encoders are from legitimate sources. Individual failures or patterns of authentication failures are preferably reported to a central database through wireless communications means **175**A for subsequent fraud investigation.

Peel device **222**B is part of the mobile encoder and preferably rotates or pivots about pivot point **222**A into position **222**C and a corresponding position (not shown) in FIG. **21**. Peg **221**K helps guide the web to peel device **222**B. When cartridge **221** is inserted into applicator body **227**F the web is held in a non-interfering position by guide post **221**F and its accompanying cartridge guide post such that peel device **222**C can self-thread around the transport web without human effort. This is an improvement over prior art where a peel device is an integral part of the pre-packaged self-contained supply of transponders and requires threading during the cartridge manufacturing process.

Peel device **222**B preferably contains a shield on the outer face of the blade, through which radio energy will not pass to encode or interact with a rejected transponder **223**B. The dielectric material of the peel device **222**B provides sufficient separation from a transponder within the encoding zone and the shield on the back side of the peel device. This is another advantage over a peel device that is part of the cartridge, where the cost sensitivity is much more acute. The shielding on the back side of peel device **222**B may be any suitable metal attached or adhered in any reliable or economical manner against the non-conductive dielectric structure of the peel device.

Rejecting transponder **223**B requires that mobile encoder transponder peel device **222**B have sufficient clearance from target surface **228** as determined by optical mouse sensor **225** using either the SQUAL reading or the shutter readings. Such readings are used to determine if there is sufficient space to advance and rotate a bad transponder **223**B around the distal end of peel device **222**B.

FIG. **1** shows a system **10** according to one embodiment of the present invention including a mobile encoder **30**. And, FIG. **5** details one possible mobile encoder **30**. In this embodiment, the encoder can attach to the belt of an operator, accordingly, mounted on the housing **32** is a belt mounting means such as belt-clip **34**, which easily adjusts for left-handed or right-handed operation and corresponding mounting on the belt (not shown) of the operator. An external antenna **36** enhances wireless connectivity to a host or network computer (not shown in this view), or to a remote-mounted computer device such as a PDA or bar code reader. Several operator indicator lights **227**E including a system-ready LED **37**, data-ready LED **38**, and tag-ready LED **39** mount on the housing enabling the operator an easy view of the device status.

Also included on the exterior of the housing are an external, power-cord receptacle **41** so that the on-board lithium-ion, nickel metal hydride, or other appropriate battery **227**D may be charged as required. A combination on/off-next switch **33** enables the operator to selectively power up the encoder. A reset port, such as a recessed reset button (not shown in this view), enables an operator to reset the software settings of the device circuitry on control board **227**C as may be required.

A cartridge **42** containing a plurality of RFID transponders releasably mounts to a face of the housing **32**. The cartridge further includes a take-up reel **44** for non-dispensed RFID transponders, a port **46** (above take-up reel **44** but not shown in FIG. **5**) for dispensing commissioned transponders, and a supply reel **43** for holding blank RFID transponders prior to commissioning.

In further embodiments, a cartridge **221** containing a plurality of RFID transponders releasably mounts to the body of housing **227**F. The cartridge further includes a take-up reel **221**J for collecting release liner and non-dispensed RFID

transponders, and a port through which blank or securely encodable transponders emerge from source reel **221**E. The source reel is comprised of core **221**A which may be made from plastic or a recyclable kraft paper fiber to form a wound tube. A tube extends from the walls of cartridge **221** to form axle **221**B around which core **221**A rotates. Brake shoes **221**C create drag, resulting in back torque on the source core, the magnitude of which is controlled by screw **221**D which with a knob (not shown) is used to adjust the force applied by brake shoes **221**C. The back torque for cartridge **221** is alternatively developed through a motor or an expandable friction coupling into a brake mechanism attached to encoder body **227**F.

Take-up core **221**H is driven by a tight coupling with drive hub **221**G. This tight coupling is achieved through a combination or selection of tight fit, expandable coupling, and sharp teeth. The result is a hub that will easily slide in or out of core **221**H with little effort, but still be capable of delivering a substantial amount of drive torque through that connection without slippage. Drive torque is delivered from gear motor **227**B to hub **221**G through drive gear **227**A the teeth of which engage with each other as cartridge **221** is set into position and locked into place.

In a preferred embodiment, mobile encoder **30** cryptographically unlocks, encodes, and verifies each transponder one by one. In preferred embodiments, transponders are verified more than once. One time immediately after programming with a desired data payload, and then again a second time after encoder **220** automatically dispenses an RFID transponder **223**A onto target surface **228**. This second verification step insures that the properties of target surface **228** or other nearby materials do not adversely affect the performance of transponder **223**A.

In another preferred embodiment, encoder **220** is used to encode and dispense a pattern of several transponders **223**A onto a target surface **228** at regular intervals in order to map the surface of a container for example in order to determine an optimal location for a placement of transponders. This information is then preferably used for engineering and planning purposes for high-volume transponder application in a production or distribution facility. Transponders may be designed for operation in any or all of the UHF, HF, LF, or microwave frequency bands.

In one alternative embodiment, the mobile encoder **64** includes a handle (as FIG. **9** shows, for example) for hand operation of the encoder. In another contemplated embodiment, the mobile encoder is fixed to an assembly line in a stationary manner. Accordingly, the stationary-mounted encoder further includes machine-controlled devices for extracting a commissioned RFID transponder from the encoder and places the transponder on the container of interest by means well understood in the art.

In the aforementioned embodiments of the mobile encoder **30** (or hand-held encoder **64** of FIG. **8** or FIG. **9**, for example) key features commonly shared include means for enable Gen2 EPC or ISO standards compliance and multiple printer-emulation modes. On-board power source **60**, such as a rechargeable lithium-ion, Nickel Metal Hydride, or other battery enables freedom of movement as does means for wireless connectivity to a data network, such as the 802.11 wireless LAN (Wi-Fi), Bluetooth, or other standards-based communications protocol. However, a conventional power source that requires connectivity to a power-grid and a cable-based data network connectivity link would work under certain circumstances.

Further, in contemplated embodiments, the fixed or mobile encoder enables selective mounting to a magazine or cartridge filled with un-commissioned RFID transponders, which facilitates rapid and easy loading of the encoder with ready-to-use RFID transponders and further enables re-use, re-commissioning, and recycling of un-dispensed transponders and the associated cartridge. The mobile encoder can be monitored and controlled by virtually any handheld or mobile device, a host computer in a central location, or over the Internet.

Certain features and methods described and explained with relation to handheld applicators are also relevant to non-mobile RFID tag applicators that use a magazine, cartridge, reel, or roll to handle, transport, and dispense RFID tags, inlays, transponders, or wireless sensors. Magazines, cartridges, reels, and rolls are preferably capable of carrying either new or used tags and are preferably capable of being used in either mobile or nonmobile applicators. Magazines, cartridges, and reels are preferably refilled and reused. Magazines and cartridges preferably protect RFID tags from ESD.

Cartridges preferably indicate their empty/full status with a visible indicator such as: an LED, an LCD, a mechanical flag, a window with a view into the source reel, or other such indicators that help an operator choose which cartridge from which to next consume tags.

The mobile encoder **30** is activated (turned on) when an operator selectively depresses the combination on/off-next switch **33**. However, depressing the on/off-next switch for about three seconds or longer results in a sleep-mode cycle that can be interrupted by re-pressing the on/off-next switch. In sleep mode the operator indicators (LEDS **37**, **38**, and **39**) will turn off. If active, the mobile encoder system-ready LED **37** illuminates and connects to the assigned network. Network connectivity results in the illumination of both the system-ready LED **37** and the data-ready LED **38**.

Mobile encoders **175** and **30** optionally receive commands and data via the wireless link from the remote computer **172** or optical reader **173**. Special bar code commands are scanned by optical reader **173**, passed through wireless communication means **175**A, and interpreted by processing means **175**B mobile encoder **175** to perform certain pre-programmed functions. Commands originating from either computer **172**, optical reader **173**, or internal bar code scanner **226** (also designated in FIG. **1** as internal optical reader **175**F) perform functions in categories that include power management, data management, wireless configuration, security, configuration options, and utilization of internal resources.

The encoder receives commands and data via the wireless link from the remote computer **20** or host network computer **11** (of FIG. **1**). The data represents information to be encoded on an RFID transponder. The information is stored in the encoder's on-board memory and the tag-ready LED **39** or **175**K rapidly blinks green (cycles on/off to pulsate). An RFID transponder is moved from within the cartridge **42** to a position on the top edge of the cartridge for encoding in the encoder and the transponder is encoded with the appropriate information. The transponder is tested and if it is good—contains the data and encoding was successful—all three indicator LEDs indicate a solid-green color. The operator removes the encoded RFID transponder from the encoder and places it on the container of interest.

In the event that the encoding process failed, the bad transponder is detected and retained by the encoder, where it remains on the take up reel **44** inside the cartridge **42**. The take up reel also collects the release liner as the encoder **30** dispenses good transponders (properly encoded RFID transponders). The take up reel returns to a re-cycling center where

components are re-used or recycled as necessitated. Further, the re-cycling center can perform failure analysis on returned transponders.

FIG. **7** is a schematic diagram of additional electro-mechanical components **70** (as generally referred to in FIG. **6**) and logic components of a possible encoder **30**. An RFID Module **63**, such as a MP9311 UHF reader module available from Sirit Technologies, 1321 Valwood Parkway, Suite 620, Carrollton, Tex., 75006, USA, communicates with a vertical polarized YAGI antenna **62** with a downward side lobe to low-power program (commission) RFID transponders to create an RFID transponder, and the same downward side lobe and verify transponders at low power also can read far-field transponders at a higher, second power. Additional components include a mechanical paddle trigger **86** for operator-selected override of the reel of RFID transponder stored in the supply or source reel **43** in the cartridge **42**. A drive motor **76** coupled to a dual output shaft gearbox drives the source transponder reel **43** via an intermediate take-up reel gear interface **78** at the cartridge mouth. Another gear assembly along with a spring couple **85** advances and positions the tag feeder paddle **84** with feedback from paddle position sensor **88**. A tag sensor **74** detects the location of the RFID transponder to-be commissioned by the YAGI antenna **62**. As the reel of RFID transponder advances inside the encoder, the lead edge passes the ratchet post **82**. If the now-commissioned transponder is read by the antenna **62** as "good", a ratcheting-back torque spring **83** enables a peel device, such as the shield and tag peel edge **73**, to engage, forcing the commissioned tag to peel away from the carrier layer, which continues on to the take up reel **44**. In the event of a "bad" tag—that is, the antenna **62** reads the RFID transponder and determines an error has occurred—the shield **73** does not engage, allowing the defective transponder to remain on the carrier layer and proceed to the take-up reel. Once the good transponder is removed from the encoder, the tag sensor **74** detects the condition and enables the encoder to stand-by for the next event. Transponders are read, written, and verified when an operator initiates an action such pulling a trigger **86**, pushing a button, or some other command sequence.

Certain protective enclosures, such as cartridges **42** or magazines, are part of a family of interchangeable magazines of similar size, shape, and functionality, which are capable of housing and dispensing certain types, styles, shapes, and sizes of new or used RFID transponders. Transponder sizes typically range from 4 mm-thick foam-backed transponders measuring 12 mm wide down to thin transponders that are 15 mm wide on 19 mm pitch.

In at least one embodiment, the magazine or cartridge **42** includes a unique and embedded, RFID transponder which enables automatic interrogation and tracking of cartridge **42**. In certain embodiments, to minimize interference, the cartridge-specific and unique RFID tag or RFID transponder operates in a frequency band that is different than the supply of RFID transponders contained within the protective enclosure. Alternatively, other embodiments selectively interrogate cartridge identification transponders that operate in the same band as transponders within the cartridge that are to be applied.

Certain encoders require replenishment of the battery or other internal, on-board power source **60**, such as a fuel cell, or other energy storage technology. Accordingly, in some embodiments, an encoder **30** (or encoder **64** or encoder **210** of FIGS. **8**, **9**, and **10**) further includes a remote, selectively coupling base unit. The base unit enables a replenishment of magazines or cartridges, provides replaceable power sources, recharges the on-board power source, serves as a communications gateway, and provides a user interface for programming and maintenance of the encoder. For example, spare transponder magazines/cartridges are retained in cartridge pockets where they are protected from damage. Cartridges indicate their empty/full status with a visible indicator such as: an LED, an LCD, a mechanical flag, a window with a view into the source reel, or other such indicators that help an operator choose which cartridge from which to next consume transponders. The encoder, also, is retained by a protective pocket to prevent damage and to make any required electrical or mechanical connections to the base unit. In some embodiments a base unit mounts to diverse operating locations including various models of fork lift trucks. In such applications, the base unit includes a variety of wired and wireless communications options to enable omni directional communication with the encoder, cartridges, a host computer, vehicle mount terminal, a fork truck computer, or other relevant computing devices. The base unit includes a power system that is suitable for the application, including power filtering and energy storage capabilities such as batteries or fuel cells.

As with all ESD-sensitive equipment, care must be taken to avoid a build-up of damaging electrostatic charges. Accordingly, in certain embodiments charge is removed using a variety of conduction methods including wiping, air, and humidity controls, or use of special materials that contain short conductive elements optionally arranged within a flexible elastic cord.

In some embodiments, the encoder adapts to use a particular type of RFID transponder. One type of suitable RFID transponder is model number AD-220 from Avery Dennison of Brea, Calif. or, alternatively, Raflatac model 300846 from Tampere, Finland, or a Spider transponder or FT-33 FAT tag from RSI ID Technologies of Chula Vista, Calif. Such a transponder is die cut and adhered to release liner. Additionally, wireless sensors are manufactured to specifications that are compatible with the specific encoder, including such specifications as core diameter, outer diameter, and web width. Alternatively, certain steps are required to prepare a standard roll of ALL-9338-02 tags for use in an automated encoder, including unrolling from a large roll (up to about 6-inches in core diameter) onto several smaller rolls having a smaller core diameter (of about 1-inch to about 2-inches in core diameter).

Encoder **30** communicates with a remote computer and includes options to physically, electrically, and communicatively integrate with a portable data terminal (PDT) or a mobile computing platform. Certain PDT's have a variety of wireless connections including PAN and WLAN. Certain PDT's include a bar code scanner comprising a laser, an imager, or other means. In other suitable PDT's an RFID interrogator and antenna are built-in, while certain others have a card slot manufactured to a standard such as PCMCIA, CompactFlash, or Secure Digital, into which interrogator/antenna is plugged into. An example of such a card is the MPR 5000 that plugs into a PCMCIA Type II slot and is available from WJ Communications of San Jose, Calif. The MPR 5000 is compatible with handheld computers such as the Hewlett Packard iPAQ5550 or other models that accommodate smaller card-form factors, enabling them to read and write EPCglobal or ISO 18000 compatible UHF RFID transponders.

Other events, information, and status—such as changes in transponder readiness, transponders remaining on the source roll, remaining charge in the battery, changes in range-status between certain predefined states such as Close, Near, and Far—are communicated to the associated PDT. Other possible information, including certain power management func-

tions, commands, status, and data-to-be-encoded into each readied transponder, is provided to the PDT over a wireless connection. Such a configuration puts the encoder in the role of a peripheral device to the PDT **219**, with PDT **219** managing the primary user interface and most computation functions.

In some embodiments the encoder adapts to exchange information with a host device, including a PDT, in either a batch-mode or through a real time connection. Batch mode uses a periodically connected data transfer channel such as a wired connection. Certain wired connections include serial data, infrared, optical, Universal Serial Bus, a parallel port, or other physical data connection. Certain real-time connections include wireless data links including Personal Area Network (PAN), Wireless Local Area Network (WLAN), and Wide Area Network (WAN). Certain PAN connections include Bluetooth and Zigbee. Certain suitable WLAN connections include IEEE 802.11a, IEEE 802.11b, and IEEE 802.11g.

For certain encoder embodiments passwords are encoded into transponders or wireless sensors when they are commissioned. Passwords are safeguarded using cloaking, obfuscation, cryptographic techniques, secure and trusted channels, locked memory, and other methods that are commonly used to protect confidential information. Passwords are generated or retrieved from data encoded in an RFID transponder to generate an index into one or more databases that contain a one dimensional array of passwords, a two dimensional array of passwords, a multidimensional array of passwords, or an array of actual or pointers to algorithms used to generate passwords from transponder data, for example. Alternatively, cryptographic algorithms are used to generate passwords from transponder data.

Although this disclosure makes specific reference to a mobile encoder, it is understood that the encoder can easily adapt and be readily configured to a fixed operating environment. For example, it can be mounted to a forklift truck or a high-speed conveyer line and maintain advantages of wireless communication, rapid change-over and other qualities as discussed and developed more fully in this disclosure.

D. Interrogator Apparatus

Working as a stand-alone device, or combined with an encoder, certain embodiments of the present invention include an RFID transponder reader, also called an interrogator. The interrogator, in one embodiment, is a physically separate device that is solely in wireless communication with the encoder. In another embodiment the interrogator includes a wired connection to the encoder. In yet another embodiment, the interrogator connects to the encoder via an intermediate processor, such as a remote computer, or some other intermediate device. In yet another embodiment, the intermediate device is a shared processor in a physically integrated encoder/interrogator apparatus.

Regardless of the physical configuration of the interrogator, its function is to encode and/or verify a RFID transponder's (including wireless sensors) functionality. Certain embodiments use a mobile handheld reader to verify transponder functionality after carton attachment. Certain handheld readers also read bar codes that either partially or completely specify the data that is to be programmed into a transponder. Accordingly, an optical path from the interrogator to a location for reading bar code labels is used to identify certain information about the objects or containers that are to be tagged. Additional transponder encoding instructions and data is acquired through an integral network interface or a batch mode memory in the interrogator.

In certain embodiments, a shield structure incorporated in a combined interrogator/encoder prevents RF fields from interrogating or reprogramming RFID transponders yet-to-be-commissioned that are resident in the combined interrogator/encoder device.

In one embodiment, shown as a cross-sectional schematic in FIG. **8**, a contact image sensor (CIS) **90** or a linear optical array is used to scan along the length of an RFID transponder before it is applied to a container. CIS **90** produces a video stream that is decoded and then interpreted and stored by an on-board Computer **61**. CIS or a similar linear array sensor is capable of reading both linear and two-dimensional bar codes. In certain embodiments, CIS reads two-dimensional bar codes before attachment to inlay or transponder. The on-board computer creates a logical association between bar codes and the commissioned RFID transponder. Encoder **64** reads and associates all bar code symbols on a single segment with the RFID transponder or inlay adhered to it.

In FIG. **10** when an operator pulls the trigger **86**, which is either a mechanical trigger or an electro-mechanical device, the on-demand commissioning of the RFID transponder occurs and nearly simultaneously is pressed against a container within a fraction of a second. In certain embodiments, mechanisms internal to encoder **64** transfer mechanical force to the RFID transponder tag through the use of air, springs, motors, plungers, elastomers, or other energy storing or delivering methods. Reloading of the next tag (next transponder) and readying of the system are performed within a time interval that is acceptable to the operator and enables a high degree of productivity for tagging cartons, pallets, or other transport containers.

In certain embodiments of a combined interrogator/application, a trigger **86** couples to an electrical switch having one or more stable positions that are detectable by a controller. In certain modes of operation trigger-switch state is coupled with range information from a sensor suite **218** to execute functions at predetermined ranges at predetermined times. The result is a trigger that functions based upon detected range from a container or other object of interest. This advantageously improves operator efficiency and productivity as one trigger executes several different functions that are typically involved with RFID tagging including the tagging of bar-coded cartons that have been selected to receive wireless sensors.

Verification of bar code occurs either before or after an RFID transponder is commissioned and the tag applied to the container by merely stepping back to a point where the sweep angle of a laser beam or field of view of an imager can read a bar code label. In certain embodiments ranges shorter than that, but not in Close Proximity, are used for sweeping a radio frequency interrogation signal across the faces of multiple cartons to assure that the correct tags, the correct number of transponders, and the correct data within that transponders were all properly programmed.

In certain embodiments Close Proximity range is reserved exclusively for programming, applying, and verifying one transponder, all in a single pull of trigger. In other embodiments, the interrogator includes programmable conditions that enable Trigger Events to interact with external devices or nearby equipment. For example, at a predetermined range from the interrogator, activation of the trigger causes the encoder to transmit a coded signal to an external device as an indication of an operator action: at a Far-range the signal to requests an external device to read a bar code and the bar code information is decoded and transmitted back to encoder. In another embodiment, decoded barcode information is processed by a portable data terminal (PDT), a vehicle mount terminal, or other computing device.

The on-board computer **61** controls the operation of the RFID Interrogator Module **63** to read, write, and verify RFID tags, inlays, transponders, and wireless sensors that are applied or are within range of the interrogation fields produced by antenna **62**. The encoder **30**, capable of reading multiple RFID transponders near it, can, in certain embodiments, produce a linearly polarized radio field via the internal antenna **62**. In another embodiment, the internal antenna produces a horizontally polarized RF field. A commissioned transponder can be read both before and after it is applied to a transport container. When multiple transponders are within the interrogation field of the encoder **30** with an interrogator module **63** the on-board computer **61** determines which transponders are commissioned and dispensed versus those transponder that have not. In certain embodiments, the on-board computer maintains records of transponders recently applied in order to properly determine how to interact with each transponder in the field of the internal antenna or other antennae under the control of RFID Interrogator.

In one possible embodiment, the interrogator/encoder utilizes preprinted information on a set of RFID transponders. The pre-printed information includes one or more logos, an EPC-global Seal, and other informative alpha-numeric or bar-code data. Certain preferred embodiments of encoder/applicators **30**, **64**, and **210** correlate RFID tag data with data encoded in certain preferred bar codes. In certain preferred embodiments, applicators such as applicator **30** read the bar code preferably using a sensor such as CIS **90** as the tape is unrolled from a spool. In certain other preferred embodiments, an RFID tag is located on cartridge **42** and contains a numerical value that is directly or indirectly representative of the numerical values optically encoded into the bar codes preferably at least indicating the starting numerical values of a number sequence. Other additional information is also encoded in the RFID tag in certain preferred embodiments, including the number of tag positions, the number of good tags, the ending sequence number, the date, time and place of tag conversion or other preferred commercial, logistic, or manufacturing information. In certain preferred embodiments of applicators **30**, or **210** certain wireless tags attached to cartridge **42** are capable of being read. In certain preferred embodiments the interrogator such as interrogator **63** is capable of reading an RFID tag mounted to the loaded cartridge, and is also preferably capable of filtering out its response to interrogation or programming of RFID tags.

Certain embodiments have a motorized tape drive and dispensing system. Certain embodiments contain some or all of the following: a rechargeable battery, an operator display, a wireless interface, a network stack, an IP address, a PCMCIA port, a Compact Flash port, a USB cable, a serial cable, a dock port, a window to allow the operator to view the transponder attachment process, or a bar code scanner.

One suitable interrogator includes model MP9311 available from Sirit Technologies of 1321 Valwood Parkway, Suite 620 Carrollton, Tex. 75006, USA. Other RFID transponder or wireless sensor interrogator modules with other feature sets are also possible for use in the interrogator/encoder.

FIGS. **8** and **9** show one possible interrogator/encoder **64** according to the present invention. The interrogator/encoder **64** comprises a housing **65** having a user input device **67**, such as a key pad or key board, and a user output device, such as an LCD screen **68**, for displaying optically scanned label data, RF interrogated data from a transponder, and other information including on-board diagnostic functions, bios status, and external information provided from a remote computer as sent over a wireless network, for example. A handle structure **66** enables point-of-use deployment while cartridge **42** enables on-demand commissioning of RFID transponders, which are dispensed from the transponder port **46**. In this embodiment, an integrated YAGI antenna **62** creates a large forward-looking main lobe of radio frequency energy for interrogation of commissioned RFID transponders. The internal antenna also produces side lobes of RF energy that although attenuated from the main lobe by several dB, couple enough power into nearby readied transponder to interrogate and write to it.

As further depicted in FIG. **10**, a reflector **219***b* passively reflects RF signals from an upper side lobe downward toward readied tag **216***f*. Backscatter from tag **216***f* propagates to both antenna **219***a* and reflector **219***b* for processing by the interrogator. Having such an antenna embedded in PDT **219** and mounted to the structure of the encoder housing enables the PDT **219** to encode and verify readied transponder **216***f* while commanding the encoder to commission and dispense a tag when a particular Trigger Event or a predetermined range status change occurs.

An antenna, or alternatively, leaky coax **212***a* or a near-field coupler is located outside of protective enclosure of cartridge **42** in a location very close to the tag attachment zone in front of a tamp head or tag application roller and holding rollers **216***d* or hammer **216***a*.

In some embodiments antenna **212***b* is a patch antenna with a radiation pattern toward the tag attachment zone. In other embodiments the antenna is a near field coupler. Alternatively, leaky coax, a type of coaxial cable having slits, slots, or perforations that allow radio frequencies to leak in or out, is used in encoders according to the present invention. A coupled-mode cable, which does not radiate as well as radiating-mode cable, is constructed with closely spaced slots in a corrugated outer conductor. Radiating-mode cable typically has a foil outer conductor with non-uniformly spaced slots arranged in a periodic pattern. Coupled-mode cable is a slow-wave structure. In free space its external fields are closely bound to the cable and do not radiate, except for minor end effects according to "Prediction of Indoor Wireless Coverage by Leaky Coaxial Cable Using Ray Tracing" by Samuel P. Morgan of Bell Laboratories, Lucent Technologies.

In certain embodiments an interrogator drives a signal into a leaky coax that is terminated in a purely resistive load of about 50 ohms. An RF-switch selects between radiating and non-radiating loads including an antenna or leaky coax and, therefore, avoids mismatched load impedance.

In other embodiments internal antenna **212***b* or **212***c* is a patch antenna with its strongest lobes oriented toward the tag holding and placement area in the region of holding rollers **216***d*. Antenna **212***c* or leaky coax **212***a* work with an interrogator to produce electromagnetic fields to interrogate, program, and verify wireless sensors. Shield **217***e* prevents interrogation or programming of RFID transponders until they arrive at separation roller or tag peel edge **217***d*. A reflector is used in certain embodiments to reflect RF radiation toward a readied transponder. In the event that verification fails, the operator is informed that the bad tag (or inoperable transponder) is to be discharged onto a surface of a third object other than the encoder or the transport container, for post-mortem analysis.

Referring to FIG. **10** drive motor **76** is preferably located inside the center of source reel **43** within the circular walls of applicator housing **211***b*, around which cartridge **42** is nested when mated to interrogator/encoder/applicator **210**.

Motor **76** is mounted to the structural frame of applicator **210** and preferably transfers mechanical power to certain drive points preferably using gears, belts, or drive shafts within applicator housing **201***a* or **211***a*. In certain preferred

embodiments of applicator **210** certain preferred drive points include take-up reel **44**, source reel **43**, or hammer arm **216***a*.

Trigger **86**, preferably embedded within trigger handle **66** is actuated by an operator, preferably causing a Trigger Event. In certain preferred embodiments, there is more than one kind of Trigger Event. In certain preferred embodiments of applicator **210** certain types of either mechanical or electromechanical actuators are preferably used to cause hammer mechanism **216***a* to trip, being driven toward readied tag **216***f*, through port **46** for placement on a transport container at the face of bulkhead **211***a*.

Another means of electromechanical actuation from a Trigger Event initiated by sensor suite **218** is illustrated in FIG. **10** whereby DC motor **215***c* runs in a reverse direction causing ratchet **216***b* to become disengaged, allowing hammer **216***a* to accelerate toward tag **216***f* due to the torque exerted by spring **216***c*. Hammer **216***a* passes between holding rollers **216***d* to press tag **216***f* against the face of a transport container.

Interrogator **212***d* is preferably capable of working with controller **213***b* to recognize which tags have been recently programmed or applied so as to filter out their response to interrogations of other tags, especially those tags that are being prepared for attachment. Interrogator **212***d* is preferably capable of modulating its transmitted radio power to affect the range and signal to noise ratio of its coupling to wireless tags.

E. Method of Inlay Conversion

FIG. **11** shows one method according to the present invention and includes preparing a carrier substrate (Block **111**) for use in an RFID transponder or in a wireless sensor that includes both an RFID transponder and sensor device. This process contemplates utilizing adhesive-backed packing tape or some similar material suitable for adhering a commissioned RFID transponder to a container or other object of interest. Certain embodiments for this step include machines to cut large rolls of mesh or net into numerous small rolls with the desired width, length, and core diameter. For example, a supply-roll of stock mesh or net measures about 14-feet wide and about 5000-feet long, rolled onto a core. In one embodiment the supply-roll must be trimmed to fit the width suitable for use in a mobile encoder **30** or similar encoder/interrogator as described in this disclosure.

For certain embodiments, the carrier substrate width is about the length of a simple UHF dipole inlay, as shown, for example, in FIG. **1**. In one embodiment the carrier substrate width measures about 4-inches. The length of the carrier substrate depends on many factors including the target cost per transponder of the cartridge and all of its components. Other factors that determine the length of the carrier substrate include the target size and weight of the cartridge and/or the mobile encoder. A possible machine that converts large supply-rolls into smaller ones, in one embodiment, consists of a stand-alone industrial machine. However, in other embodiments, the trimming function is part of an integrated machine.

Block **112** represents the testing process of an RFID inlay comprising, at least, an RFID chip and antenna device. The testing, or interrogation, of the inlay, in one embodiment, includes an interrogator and an antenna or a near field coupler, which read the inlay. This process further includes monitoring various parameters such as activation energy, backscatter signal strength, sensor performance, and other indicators of the quality of the RFID transponder or wireless sensor. Any transponder or tag that does not meet certain minimum performance criteria is discarded. Good transponder or tags are subsequently programmed, encoded, or commissioned with new information relating to the associated object of interest. Such information resides or stores in non-volatile memory within the RFID inlay. Inlays that fail to perform to adequate levels of performance are immediately separated from the process.

Block **113** represents a third process step consisting of applying and encapsulating good inlays in an encapsulation layer or encapsulation zone of the RFID transponder. One possible encapsulation layer comprises a packing tape constructed from pressure sensitive acrylic adhesive and backed by a substrate layer of bi-axially oriented polypropylene film. In certain configurations such packing tapes provide up to about 25,000 volts of ESD resistance when properly applied in about 0.002-inch thick layers of encapsulation. Other packing tapes, available in thicknesses of about 0.001-inches, when combined in layers provide higher ESD voltage resistance ratings. The inlay substrate contributes additional ESD resistance in certain contemplated configurations.

Block **114** represents another process step consisting of applying the converted RFID transponder to an interposing transport media. Such media preserves the tackiness of the exposed adhesive. One possible adhesive includes a pressure-sensitive adhesive, which adheres to most surfaces with very slight pressure and retains tackiness above their melting point of about negative-65 (−65) to about negative-90 (−90) degrees centigrade. In another embodiment, silicone-based release liner is used to transport and preserve pressure sensitive adhesive tags and labels. In other embodiments, the transport media includes utilizing air pockets bounded by regions having tensile strength such as fibers: for example, plastic or metal fibers. Certain plastic resins have a low surface energy and prevent strong adhesive bonds from forming and are bound together to form a mesh or net. Mesh (or net) constructions offer a means of handling converted tags without allowing a substantial percentage of the available adhesive to make contact with any other solids until the tag is commissioned.

Block **115** represents another process step consisting of winding converted transponders onto a spool with the interposing transport media. The core diameter, number of transponders, layer thickness, the thickness of any dielectric foam spacer layer, and outer diameter are all optimized for efficient, economical, and convenient deployment in transponder commissioning processes disclosed herein. Finished spools are packaged in a manner to prevent ESD damage. Certain enclosures include anti-static bags, foil-lined cartons, metal plated cartridges, and carbon-impregnated plastic enclosures. Certain enclosures are reusable. Certain enclosures of application-ready rolls or Z-folded transponders having low energy interposing transport media mate directly with encoders as described in this disclosure.

F. Method of Tagging Containers

FIG. **12** is a block diagram representing a second method according to the present invention including applying RFID transponders to objects of interest. One suitable object of interest comprises transport containers such as corrugated cartons or shrink-wrapped cases on a shipping pallet, which is inadequately addressed by the prior-art, particularly for solutions for manually operated automatic encoding and attachment to a container.

Block **121** represents a process step including the identification and selection of a container to be tagged with an RFID transponder or wireless sensor. In one embodiment this step includes a manual selection and verification processes that consists of manual handling, visual sighting, and scanning bar codes with a hand-held optical reader device. This method contemplates that a transponder encoding scheme is ready in advance and synchronized with a pick list, customer purchase order, advanced shipping notice, and other such records to

assure that goods are properly moved and accounted for. Preferred bar code scanners include those that allow an operator to freely handle cartons with two hands. Such scanners include laser bar code scanners or imagers that are worn on either that back of the operator's hand or near the top knuckle of a finger. Such scanners are described above, and preferably have a Bluetooth or similar wireless interface to connect to mobile encoder **175** or **30**. Bar code scanner **226** of FIG. **21** is a preferred embodiment of an alternative device that combines manual bar code scanning and RFID transponder encoding into a single handheld device. The operator may choose to scan bar codes that contain data, application identifiers, commands, or other elements commonly found in automatic data capture applications.

Block **122** represents the process step of processing bar code information to derive the underlying data. Depending on the type of bar code, how it is encoded, and its purpose, different processing steps will be used. In preferred embodiments the bar code may contain SKU information, a GTIN, an SGTIN, EPC data structures, a military UID, an SSSC, an asset number, a file identifier, or other such identifying information. In certain preferred embodiments, the bar code (either one or two dimensional) contains a partial or complete description of the data that is to be encoded into the RF transponder. Such bar codes are described in ISO/IEC draft document PDTR 24729-1. Application identifiers 01 and 21 are combined with additional encoded printed information to fully specify a serialized GTIN (or SGTIN). Using such bar codes does not require the use of additional data in order to generate RF transponder payload data. Mobile encoder **175** may therefore independently receive and process the RF transponder payload information. One type of bar code is used to signal mobile encoder **175**, **30**, or **220** that it should enter a mode whereby it performs a serialization algorithm without using an AI 21 bar code. This process step of identifying the information to be encoded may be included in the step represented by Block **121**. In this step (Block **122**), an operator may use a bar code reader or an encoder/interrogator of this disclosure. Alternatively, the operator may receive instructions delivered to a hand-held PDT or other mobile data terminal connected to a wireless network. This information is delivered to an encoder, such as encoder **30**.

Block **123** represents another process step whereby, using a mobile encoder, the operator then commissions an RFID transponder with the information of the previous step (Block **122**). Optionally, successful commissioning of the RFID transponder is verified by the encoder. In one embodiment, the encoder tests the next transponder and determines if it is operating within certain predefined specifications including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. If the encoder determines that the transponder is not likely to result in a successful transponder deployment as may be determined by failure on multiple encoding and verification attempts or due to either physical or electronic deficiencies or abnormalities, then the operator is informed and the failed or bad transponder is discarded automatically or when an operator pulls a trigger under an operator-acknowledged transponder failure condition.

This step (Block **123**) also includes processes to read or determine by dead reckoning the information encoded into certain preprinted optically encoded symbols on the outward facing non-adhesive surface of the adhesive tape. In certain embodiments the adhesive tape is printed with information. In other embodiments the printed information is a machine-readable symbol such as a bar-code symbol. For example, one or more machine-readable symbols are read when the tape is prepared for use in an automated encoder or, alternatively, during the inlay conversion process and conveyed to an encoder through other data storage means, such as an RFID transponder. In one embodiment, an information encoding method uses either one-dimensional or two-dimensional bar codes. In some embodiments a linear imager is used to read either linear or two-dimensional bar codes as the tape is being unrolled from a spool. Some encoding schemes preprint machine-readable symbols at regular intervals along the length of a roll of adhesive tape. In certain embodiments the spacing of the preprinted symbols is at an interval of one half of the nominal length of each section of adhesive tape. In certain embodiments, the encoded information is used as a reference to one or more data storage locations. In other embodiments the data storage locations are accessible through a computer network. In some embodiments, the encoded information is a series of sequential numbers. Information relating to data stored in the RFID transponder is stored in data storage locations that are referenced by one or more of the preprinted symbols. In an alternative embodiment more than one type of machine-readable symbols can be read from the surface of a segment of tape. In certain embodiments, more than one machine-readable symbol is used as a reference to the same or closely related data records of information stored in the RFID transponder or inlay, and either can be successfully used to access stored data.

In some encoders used in this step (Block **123**) a Trigger Event occurs, which results in the verification that a particular commissioned RFID transponder has been tagged and associated with a specific container. This Trigger Event occurs, in certain embodiments, when an operator pulls a trigger on the encoder. In other embodiments the Trigger Event occurs when certain sensors detect preprogrammed conditions relating to the proximity of the encoder face to an object that is to be tagged.

Finally, (Block **124**) the operator applies the RFID transponder on the container and, thus, commissions the transponder. In certain embodiments, the location of the targeted placement of the RFID transponder or wireless sensor on the container is stored in a database, which is referenced or pointed to by information that is stored in the memory of the encoder. In one embodiment, the operator holds the encoder against the face of the container based on the tagging requirements for that particular container. The tagging requirements including the location and orientation of the RFID transponder to be placed is conveyed visually or aurally. For example, the operator receives visual information via a screen or display on the encoder. In certain embodiments, physical indicators are attached to the encoder and extend from its body in a direction and manner so as to assist the operator in the positioning of the transponder onto the carton. In other embodiments, transponders are applied to the interior of a carton, before it is sealed.

G. Method of Commissioning RFID Transponders Using a Mobile Applicator.

FIG. **13** is a block diagram showing a method according to the present invention for commissioning RFID transponders using an encoder, such as the encoder **30**, couples to a cartridge or protective enclosure containing a plurality of RFID transporters releasably mounted on a transport sheet or roll. The encoder enables the roll of RFID transponders to advance one position (Block **131**), placing the Next Tag in a test 1 position. The Next Tag is tested (Block **133**) to ensure that it performs within predetermined parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder. One possible method includes encoding a transponder using only a

minimal amount of radio-frequency energy. Since transponder encoding requires more energy than reading a transponder, this low power test constitutes a basic test of both minimal activation energy and backscatter signal strength.

An RFID transponder that fails this test (Block **133**) results in a "Bad Tag" status and proceeds to the take-up reel of the encoder (Block **135**). Thus, any failed transponder remains captive in the cartridge and cannot be released from the encoder by an operator. Optionally, the operator is notified of the failed transponder so the operator can request a newly encoded transponder (Block **137**). However, in one embodiment, the notification step occurs automatically, and a newly encoded next transponder is generated without input from the operator.

Block **132** shows that a "good" transponder is positioned in the encoder for the encoding process. The RFID transponder that passes the test 1 position is commissioned with predetermined data based on the container to be tagged. Methods of obtaining, storing, encoding, and commissioning this information on the RFID transponder are discussed elsewhere in this disclosure.

The commissioned transponder undergoes a verification process (Block **134**) to determine if the intended information was successfully encoded on the RFID transponder. Certain embodiments combine the verification step with the encoding step to gain operational efficiencies. If this verification test results in a fail condition, the transponder remains in the encoder and ultimately winds on the take-up reel in the cartridge for subsequent post-mortem failure analysis.

Block **136** represents a pass condition. The encoder removes the commissioned RFID transponder from the transport web or release liner, enabling the operator to retrieve the transponder from the encoder and in Block **138** apply the transponder to the container. In an alternative embodiment for Block **138**, the operator or a fixture holds the encoder against a surface of the container and the encoder places the commissioned RFID transponder directly on the container without operator intervention.

H. Method of Providing RFID Transponders to an Encoder.

FIG. **14** is a block diagram showing another method according to the present invention. One step, represented by Block **141**, includes providing suitable RFID transponders such as the transponder **50** of FIG. **2**, which are presented on a sheet or roll, such as sheet **59** of FIG. **4**.

Block **142** shows the process step of inserting the roll of RFID transponders into a cartridge of an encoder such as cartridge **42** of FIG. **5**. Steps **141** and **142** are ideally suited for off-site repairs and replacements of cartridges. Accordingly, a customer may send a used cartridge to a repair facility, enabling the cartridge to be recycled.

At a point-of-use location, such as a customer's warehouse or packaging facility, a fresh cartridge full of blank, or non-commissioned, RFID transponders attaches to an encoder adapted for such use (Block **143**) and is used normally (Block **144**), as previously described herein, to identify containers and data to encode on an RFID transponder. Prior to encoding, (Block **145**) the encoder verifies that a non-commissioned transponder remains in the cartridge. If such a transponder is available (Block **148**) the RFID transponder is commissioned and in certain embodiments applied to the container (Block **149**) by means previously disclosed herein. If the cartridge is empty (Block **146**), the operator is alerted by various known means described herein or otherwise known by those skilled in the art. And, the cartridge is removed (Block **147**). The removed cartridge is sent to another location, a recycling, re-use, repair, or re-building center that is either on or off-site, or is discarded.

I. Method for Recycling Used Cartridges of RFID Transponders.

FIG. **15**, a block diagram, shows a method for recycling cartridges from, for example, a process similar to the one shown in FIG. **14**. A repair center receives the used cartridge (Block **151**). In one embodiment, the repair center is off-site from the customer, and allows specialized repair, reconditioning, re-use, recycling, and replenishment to provide cost-effective and environmentally sensible replacement cartridges.

A plurality of cartridges **42** are preferably disassembled for easy recycling. For example, end users may choose to reduce their shipping costs for the recycling of cartridges and release liner by separating them into different recycle waste streams at the point of use. Conversely cartridges **42** are manufactured and assembled by snapping together the mating components with latches, guide pins, slots, and other such features to mechanically secure themselves into a rugged structure, capable of tolerating the abuse that is common for shipping and handling. After each use, cartridges **42** are preferably disassembled such that similar parts of like cartridges all nest within each other to form a dense stack. Each stack can then be accumulated and shipped either together or separately back to a transponder recycling facility. The spent release liner and any rejected transponders may also be accumulated separately and may optionally be sent to a different preferred waste processing facility, possibly in order to reduce shipping costs. One such facility preferably has the ability to reprocess release liner, both silicone and non-silicone-based materials. Certain silicone alternatives include emulsion release coatings that are water-based coatings that offer similar performance to hydrocarbon solvent-based release liner products. Emulsion coatings are compatible with paper repulping processes and are highly preferred. The benefits of the silicone alternative coatings are not normally available to the RFID tagging work flows because proper attention has not been given to solving this environmental problem. Therefore, by controlling both the composition of the outbound materials as well as the inbound recycling processes, this cartridge-based method of transponder encoding offers real promise for reducing stress on the environment.

In certain embodiments, a protective enclosure and RFID transponder recycling center reduces the amount of waste associated with enabling the convenience of tagging and safely handling RFID transponders and devices such as encoders or interrogators. For example, plastics and silicone are non-biodegradable materials that are suitable for recovery, re-use, and recycling. Certain plastic parts including take-up reels are disassembled and removed in Step **152**, hub-cores are recycled for paper waste, and silicon-coated release liner is accumulated and separated from the recyclable (re-pulpable) paper for proper handling, recovery, and disposal—if needed. In Step **153**, failed tags from Step **134** of FIG. **13** are preferably subjected to post-mortem analysis. In Step **154** cartridge **42** is replaced by either a new (virgin) cartridge or a refurbished cartridge, as appropriate and such replacement cartridge is in Step **155** replenished with blank RFID transponders, such that in Step **156** the cartridge **42** is restocked, ready for use.

Recycling continues with the RFID transponders as well. In certain embodiments, the RFID transponder **50** is configured and adapted for re-use. Accordingly, the data is wiped and re-coded as appropriate. In other embodiments portions of the RFID transponder are recycled. For example, the aluminum antenna separates from the encapsulation layer and is recycled. The paper stock is recovered and re-pulped.

In certain embodiments, replenishment of empty cartridges or magazines is performed as a service at a customer's site such as a warehouse, distribution center, packing plant, 3PL logistics center, or a manufacturing plant.

FIG. **16**, a block diagram, shows another method according to the present invention and consists of an algorithm for determining when an RFID transponder is commissioned based on predetermined criteria. For example, a shipping container typically includes a mixed lot of products. Accordingly, several different product-identifying bar codes are serially scanned (Block **161**) until an end of condition event occurs (Block **162**). This end of condition event may be queried after each scan or provided to an interrogator/encoder based on a supplied heuristic (i.e. volume, weight, etc.), pack list, or other customer-driven data.

Once all data is compiled and stored on the encoder, an RFID transponder is commissioned and encoded with the data or a logical pointer to a storage location of the data (Block **163**). Then, it is applied to the container (Block **164**) by means discussed previously herein.

Block **242** represents the process step whereby mobile encoder **175**, **30**, or **220** encodes an RFID transponder with the information of the previous step (Block **241**).

Successful commissioning of the RFID transponder is preferably verified by the encoder as shown in Block **243**. In one embodiment, the encoder tests the immediate transponder and determines if it is operating within certain predefined specifications including parameters such as activation energy, backscatter signal strength, sensor performance, and other indications of the quality of the transponder.

If in Block **244** the encoder determines that the transponder is not likely to result in a successful transponder deployment as may be determined by failure on multiple encoding and verification attempts or due to other evidence of physical or electronic deficiencies or abnormalities, then the operator is optionally informed and the failed or bad transponder is discarded automatically as shown in Block **245**.

Block **246** is the process of using motor **227**B and/or transponder transport means **175**C to pull release liner **182** tighter and tighter such that webbing **182** advances forward to the point that the leading edge of transponder **178** extends past the distal end of peel device **183** or **222**B.

In Block **247** web **182** is pulled forward to the point that transponder **178** or **223**A begins to rotate around peel device **183** or **222**B. It is in this step that either a human finger or some target object needs to be presented in the rotational path of the tipping transponder **178** or **223**A must be located. In the case of mobile encoder **30** where the operator is required to handle the encoded tag, it is important that their finger be present as transponder **178** begins to tip, allowing adhesive layer **181**D of transponder **178** to make contact and be removed for placement on a target object such as a shipping container, trackable asset, automobile windshield, or other object of interest. In cases where the operator scans a bar code and applies encoded transponder **178** in a single motion, mobile encoder **220** is preferred, wherein as transponder **178** tips as it rotates around peel device **222**B adhesive layer **181**D sticks directly onto target surface **228**. In either case, encoded transponder **178** is caught mid-rotation and adhesive layer **181**D provides adhesive forces sufficient to completely detach transponder **178** from release liner **182**, thus completing the function of Block **247** where work flow returns to Block **240** for another transponder encoding cycle to begin.

While the invention has been particularly shown and described with reference to certain embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

I claim:

1. A method that provides unique object numbers for on-demand commissioning of RFID transponders using an RFID encoder having an internal memory to intermittently receive allocations of blocks of subdivided object class serial number space from an external numbering authority, the method comprised of:

the external numbering authority allocating blocks from the allocations of blocks of subdivided object class serial number space, from a larger object class serial number space, to the encoder's internal memory for encoding unique object numbers into the RFID transponders as objects of an object class are presented to the encoder for RFID transponder encoding;

the allocations of blocks of subdivided object class serial number space being allocated by subdividing the larger object class serial number space into sectors that are defined by a limited number of most significant bits of the object class serial numbers; and

assigning to the RFD encoder the allocated blocks with reference to the starting number of each of the allocated blocks and the size of each of the allocated blocks that the RFID encoder is authorized to encode within an object class.

2. The method of claim **1** further comprising the step of determining which object class the RFID transponders are to be encoded to by reading a bar code which contains a partial description of the data that is to be encoded into the RFID transponders.

3. The method of claim **2** wherein the bar code contains SKU information.

4. The method of claim **2** wherein the bar code can be either one or two dimensional.

5. The method of claim **2** wherein the bar code is read and the encoded RFID transponders are each individually applied to a different one of the objects in a single motion.

6. The method of claim **1** wherein the allocated blocks of subdivided object class serial number space are issued to the encoder by a host computer or mobile phone.

7. The method of claim **1** wherein the allocated blocks of subdivided object class serial number space are issued to the encoder by an RFID authorization transponder.

8. The method of claim **7** wherein the RFID authorization transponder is read by the encoder and is then electronically marked as 'consumed' or 'locked' by the encoder.

9. The method of claim **1** further comprising the step of using a counter or index to manage each allocated block.

10. The method of claim **1** wherein the encoding of unique object numbers uses a near field coupler.

11. An encoder and applicator device for commissioning RFID transponders on-demand, allowing an operator of the device to encode and apply an RFID transponder in a single motion, the device comprising:

an operator handle;

a trigger embedded within the handle adapted to be actuated by the operator;

a transponder separation means, used to separate a properly encoded RFID transponder from its release liner conveyance web, the means comprised of a peel device which allows an encoded RFID transponder to tip as it rotates around the peel device and allows its adhesive layer to stick directly onto a target surface;

an internal bar code scanner that is used to acquire information to encode from printed indicia, the bar code

scanner spatially aligned with the transponder separation means along a line of movement such that the operator can easily assure proper placement of the properly encoded RFID transponder in a single motion;

a sensor that tracks displacement of the encoder and applicator device across the target surface allowing the attachment of the properly encoded transponder to the target surface along a vector that is nearly parallel to the target surface; and

an interrogator used to encode an RFID transponder and verify the encoded RFID transponder immediately after encoding the RFID transponder and then again after the encoder and applicator device applies the properly encoded RFID transponder onto the target surface.

12. The device of claim **11** wherein the encoder and applicator device is able to be mounted in a fixed location, worn by a human operator, or hung from a suspended retractable tool cable.

13. The device of claim **11** wherein the trigger is a mechanical trigger or an electro-mechanical device.

14. The device of claim **11** wherein the sensor that tracks displacement of the encoder and applicator device across the target surface is an optical sensor.

15. The device of claim **11** wherein the target surface is moving.

16. A plurality of commissioned RFID transponders each comprising a unique object number encoded by an encoder having an internal memory with at least one allocated block of subdivided object class serial number space stored therein;

the allocated block having been allocated to the encoder's internal memory;

the allocated block assigned to the encoder with reference to a block starting serial number and a block size number within a larger object class serial number space;

the allocated block being one of a plurality of allocations intermittently received from an external encoding authority;

the external encoding authority comprised of subdivisions of the larger object class serial number space into sectors that are defined by a limited number of most significant bits of the object class serial numbers; and

the unique object number encoded into one of the plurality of RFID transponders as an object of the object class is presented to the encoder.

17. The plurality of transponders of claim **16**, each transponder further comprising a single unique object number.

18. The plurality of transponders of claim **16**, each transponder further comprising a unique object number that is part of a serialized global trade item number.

19. An object number encoded into an RFD transponder of the plurality of transponders according to claim **16** wherein the object number is encoded using a near field coupler.

* * * * *

EXHIBIT

12

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	McAllister
Serial No.	:	13/526,520
Filed	:	June 19, 2012
For	:	Systems, Methods, And Devices For Commissioning Wireless Sensors
Group Art Unit	:	2685
Confirmation No.	:	2749
Examiner	:	Thomas J. Mullen

Mail Stop: Amendments
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

In response to the Non-Final Office Action mailed May 27, 2015, in the above-identified application, please enter the following amendments and consider the following remarks.

IN THE CLAIMS:

1-16. (Cancelled)

17. (New) An RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space, and

wherein the unique serial number space has an allocated block stored therein defined by a limited number of most significant bits of the unique serial number space as designated by an external numbering authority.

18. (New) The RFID transponder of claim 17, wherein remaining bits of lesser significance of the unique serial number space are encoded with a unique serial number for the object class.

19. (New) The RFID transponder of claim 17, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

20. (New) The RFID transponder of claim 17, wherein the unique object number is a portion of a serialized global trade item number.

21. (New) The RFID transponder of claim 20, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

22. (New) The RFID transponder of claim 17, wherein the unique serial number space is at least 38 bits.

23. (New) The RFID transponder of claim 17, wherein the allocated block is defined by at least 3 most significant bits.

24. (New) The RFID transponder of claim 17, wherein the allocated block is assigned based at least in part on a block starting serial number and a block size number within the unique serial number space.

25. (New) The RFID transponder of claim 17, wherein the allocated block is one of a plurality of allocations intermittently received by an encoder from an external numbering authority.

26. (New) The RFID transponder of claim 17, wherein the RFID integrated circuit chip is comprised of silicon.

27. (New) The RFID transponder of claim 17, wherein the RFID integrated circuit chip is comprised of polymer.

28. (New) The RFID transponder of claim 17, wherein the substrate, antenna structure, and RFID integrated circuit chip are covered by a face stock material.

29. (New) The RFID transponder of claim 17, wherein the RFID integrated circuit chip is disposed on the substrate.

30. (New) A RFID transponder comprising:

a substrate;

an antenna structure formed on the substrate; and

an RFID integrated circuit chip which is electrically coupled to the antenna structure,

wherein the RFID integrated circuit chip is encoded with a global trade item number including a unique object number, the unique object number comprising an

object class information space including a block of at least 50 bits and a unique serial number space including a block of at least 38 bits, and

wherein the unique serial number space has at least one allocated block stored therein defined by at least 3 most significant bits of the unique serial number space as designated by an external numbering authority.

31. (New) The RFID transponder of claim 30, wherein remaining bits of lesser significance of the unique serial number space are encoded with a unique serial number for the object class.

32. (New) An integrated circuit, comprising:

a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator;

control logic; and

a memory,

wherein the memory is configured with a unique object number space, the unique object number space comprising an object class information space and a unique serial number space, and

wherein the unique serial number space is encoded with an allocated block defined by a limited number of most significant bits of the unique serial number space as designated by an external numbering authority.

33. (New) The integrated circuit of claim 32, wherein remaining bits of lesser significance of the unique serial number space are encoded with a unique serial number for the object class.

34. (New) The integrated circuit of claim 32, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

35. (New) The integrated circuit of claim 32, wherein the unique object number is a portion of a serialized global trade item number.

36. (New) The integrated circuit of claim 35, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.

REMARKS

I. INTRODUCTION

Claims 1-16 have been cancelled. Claims 17-36 have been added. No new matter has been added. Thus, claims 17-36 are pending in the present application. Applicant respectfully submits that all presently pending claims are in condition for allowance.

The undersigned has been granted Power of Attorney by the Applicant and the present response is the first response being filed by the undersigned in this application. Thus, the Examiner is invited to contact the undersigned to discuss any matters arising out of this response.

II. THE CLAIM OBJECTIONS

Claims 1-16 were objected to for failing to particularly point out and distinctly claim the subject matter that the Applicant regards as the invention. (*See* 5/27/15 Office Action, p. 2). Claims 1-16 have been cancelled. Where the same terms have been used in new claims 17-36, the Applicant has addressed the objections raised by the Examiner. Accordingly, the objections should be withdrawn.

III. THE 35 USC § 112(b) REJECTIONS

Claims 1-16 stand rejected under 35 USC § 112(b) as being indefinite for failing to particularly point out and distinctly claim the subject matter that the Applicant regards as the invention. (*See* 5/27/15 Office Action, pp. 2-4). Claims 1-16 have been cancelled. The Applicant has addressed the rejections raised by the Examiner in new claims 17-36. Accordingly, the 35 USC § 112(b) rejections should be withdrawn.

IV. THE DOUBLE PATENTING REJECTIONS

Claims 1-16 stand rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1, 6, 10 and 16-19 of US Patent 8,228,198. (*See* 5/27/15 Office Action, pp. 4-5). Claims 1-16 have been cancelled. Since no claims have been allowed at this time, this rejection is a provisional rejection. The Applicant will address the double patenting

rejection when claims have been indicated as allowable. Thus, the Applicant respectfully submits that the Examiner address any double patenting rejections based on allowed claims.

V. NEW CLAIMS

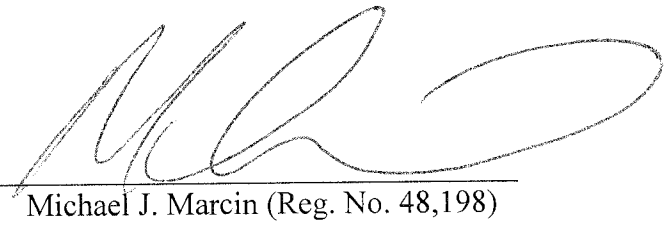
The newly added claims 17-36 are supported throughout the originally filed specification, including, but not limited to paragraphs [0004], [0051], [0054], [0056], [0061], [0077], and [0190] of the published application.

CONCLUSION

In view of the foregoing, it is respectfully submitted that all of the currently pending claims are in condition for allowance. All issues raised by the Examiner having been addressed, an early and favorable action on the merits is earnestly solicited.

Respectfully submitted,

Dated: July 29, 2015

By: 

Michael J. Marcin (Reg. No. 48,198)

Fay Kaplun & Marcin, LLP
150 Broadway, Suite 702
New York, NY 10038
Phone: 212-619-6000
Fax: 212-619-0276

EXHIBIT

13

PTO/SB/14 (08-05)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEAS-02024US6
	Application Number	
Title of Invention	RFID Edge Server Improvement	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kenneth	R.	Traub	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Lexington	State/Province	MA	Country of Residence i	US

Citizenship under 37 CFR 1.41(b) i: US

Mailing Address of Applicant:

Address 1	
Address 2	

City		State/Province	
Postal Code		Country i	

Applicant 2 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Steven		Rosenthal	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Lexington	State/Province	MA	Country of Residence i	US

Citizenship under 37 CFR 1.41(b) i: US

Mailing Address of Applicant:

Address 1	
Address 2	

City		State/Province	
Postal Code		Country i	

Applicant 3 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Marc		Horowitz	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Burlington	State/Province	MA	Country of Residence i	US

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEAS-02024US6
	Application Number	
Title of Invention	RFID Edge Server Improvement	

Citizenship under 37 CFR 1.41(b) i					
Mailing Address of Applicant:					
Address 1					
Address 2					
City		**State/Province**			
Postal Code		**Country**i			

Applicant 4 Remove

Applicant Authority (•) Inventor ( ) Legal Representative under 35 U.S.C. 117 ( ) Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Eric		Gieseke	

Residence Information (Select One) (•) US Residency ( ) Non US Residency ( ) Active US Military Service

City	Burlington	**State/Province**	MA	**Country of Residence** i	US
Citizenship under 37 CFR 1.41(b) i					
Mailing Address of Applicant:					
Address 1					
Address 2					
City		**State/Province**			
Postal Code		**Country**i			

Applicant 5 Remove

Applicant Authority (•) Inventor ( ) Legal Representative under 35 U.S.C. 117 ( ) Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Peter		Gast	

Residence Information (Select One) (•) US Residency ( ) Non US Residency ( ) Active US Military Service

City	Burlington	**State/Province**	MA	**Country of Residence** i	US
Citizenship under 37 CFR 1.41(b) i					
Mailing Address of Applicant:					
Address 1					
Address 2					
City		**State/Province**			
Postal Code		**Country**i			

Applicant 6 Remove

Applicant Authority (•) Inventor ( ) Legal Representative under 35 U.S.C. 117 ( ) Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Manju		James	

Residence Information (Select One) (•) US Residency ( ) Non US Residency ( ) Active US Military Service

City	Burlington	**State/Province**	MA	**Country of Residence** i	US
Citizenship under 37 CFR 1.41(b) i					

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEAS-02024US6
	Application Number	
Title of Invention	RFID Edge Server Improvement	

Mailing Address of Applicant:					
Address 1					
Address 2					
City		**State/Province**			
Postal Code		**Country**[i]			

Applicant 7 Remove

Applicant Authority (•) Inventor ( ) Legal Representative under 35 U.S.C. 117 ( ) Party of Interest under 35 U.S.C. 118

Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Marina		Popova	

Residence Information (Select One) (•) US Residency ( ) Non US Residency ( ) Active US Military Service

City	Burlington	**State/Province**	MA	**Country of Residence** [i]	US

Citizenship under 37 CFR 1.41(b) [i]

Mailing Address of Applicant:					
Address 1					
Address 2					
City		**State/Province**			
Postal Code		**Country**[i]			

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	23910		
Email Address	officeactions@fdml.com	Add Email	Remove Email

Application Information:

Title of the Invention	RFID Edge Server Improvement		
Attorney Docket Number	BEAS-02024US6	**Small Entity Status Claimed**	☐
Application Type	Provisional		
Subject Matter	Utility		
Suggested Class (if any)		**Sub Class (if any)**	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	49	**Suggested Figure for Publication (if any)**	

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEAS-02024US6
	Application Number	
Title of Invention	RFID Edge Server Improvement	

Publication Information:
☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not been and will not be the subject of an application filed in another country, or under a multilateral agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ US Representative (37 CFR 11.9)
Customer Number	23910		

Domestic Priority Information:

This section allows for the applicant to claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c). Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)

Additional Domestic Priority Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

			Remove
Application Number	Country [i]	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			○ Yes ◉ No

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.

Assignee 1	Remove
If the Assignee is an Organization check here. ☒	

PTO/SB/14 (08-05)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEAS-02024US6
	Application Number	
Title of Invention	RFID Edge Server Improvement	

Organization Name	BEA Systems, Inc.		
Mailing Address Information:			
Address 1	2315 North First Street		
Address 2			
City	San Jose	**State/Province**	CA
Country [i] US		Postal Code	95131
Phone Number		Fax Number	
Email Address			
Additional Assignee Data may be generated within this form by selecting the **Add** button.		Add	

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Joseph P. O'Malley/			Date (YYYY-MM-DD)	2006-11-07
First Name	Joseph P.	Last Name	O'Malley	Registration Number	36226

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

BEAS-02024US1
RFID EDGE SERVER ALLOWING CONFIGURATION UPDATES WITHOUT RESTART
Inventors: Kenneth R. Traub; Steven Rosenthal; Marc Horowitz; Eric Gieseke; Peter Gast

BEAS-02024US2
METADATA-BASED CONFIGURATION OF RFID READERS
Inventors: Kenneth R. Traub; Steven Rosenthal; Marc Horowitz; Eric Gieseke; Peter Gast

BEAS-02024US3
GRAPHICAL INTERFACE FOR RFID EDGE SERVER
Inventors: Kenneth R. Traub; Peter Gast

BEAS-02024US4
EPC PROVISIONING SYSTEM
Inventors: Kenneth R. Traub; Manju James; Mairna Popova

BEAS-02024US5
EPC PROVISIONING SYSTEM USING BUSINESS RULES
Inventors: Kenneth R. Traub; Manju James; Marina Popova

CLAIMS OF PRIORITY

[0001] This application claims priority to U.S. Provisional Application No. 60/763,781 entitled "RFID Edge Server Improvements" filed January 31, 2006 [Atty. Docket No. BEAS-2024US0] and U.S. Provisional Application No. 60/821,643 entitled "RFID Edge Server Improvement" filed August 7, 2006 [Atty. Docket No. BEAS-02024US1] which is herein incorporated by reference.

BACKGROUND OF INVENTION

[0002] A Radio Frequency Identification (RFID) system may consist of several components: RFID tags, tag readers, edge servers, middleware, and application software.

[0003] RFID tags typically contain Integrated Circuits (ICs) and antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver. Passive tags require no internal power source, whereas active tags use a power source.

[0004] The RFID tag can include a unique electronic product code (EPC). The RFID transceiver can emit a signal activating the RFID tag which then can reply with the EPC code.

[0005] The EPCs currently can have either a 64- or 96-bit code numbering scheme, but additional versions can be supported in the future. The EPC includes sections that indicate the product and manufacturer of a given item as well as a section to uniquely identify an object. Currently, an EPC number can contain:

- A Header, identifying the length, type, structure, version and generation of EPC
- The Manager Number, which identifies the company or company entity
- Object Class, similar to a Stock Keeping Unit or (SKU)

[0006] RFID readers can typically produce very large amounts of data. The RFID data can be filtered at an RFID edge server by applications using an Application-Level Events(ALE) interface. ALE allows applications to indicate what information it wants from the raw stream of RFID reads. Through ALE, an application can specify:

- Which locations it wants to read from (where a location maps to one or more RFID readers or antennas)
- What interval of time to accumulate data (absolute time, triggered by external events such as motion detectors, etc.)
- How to filter the data (e.g., include only Acme products, exclude all item-level tags)
- How to group the results (e.g., by company, by product or each tag separately)
- Whether to report currently visible tags or just additions or deletions
- And whether to report actual EPCs or just a count of the tags that are read.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Figure 1 illustrates the use of a RFID edge server to configure RFID readers.

[0008] Figure 2 illustrates the use of a metadata based description to configure RFID readers.

[0009] Figure 3 illustrates the use of a graphical interface to select ALE filters.

[0010] Figures 4A-4B illustrate a dynamic EPC providing system.

[0011] Figures 5A-5H illustrate console screens of an exemplary console for a RFID edge filter.

[0012] Figures 6A-6J illustrate an exemplary dynamic RFID reader configuration system.

[0013] Figures 7A-7B illustrate an exemplary ALE configuration API.

[0014] Figures 8A-8C illustrate an exemplary configuration API.

[0015] Figures 9A-9R illustrate an exemplary ALE GUI.

[0016] Figure 10 illustrates an exemplary ALE GUI logic model.

[0017] Figures 11A-11S illustrate an exemplary ALE GUI.

[0018] Figures 12A-12I illustrate an exemplary EPC provisioning system design.

[0019] Figures 13A-13G illustrate an exemplary EPC provisioning system interface.

DETAILED DESCRIPTION

[0020] One embodiment of the present invetion is an RFID edge server 102 to configure multiple associated RFID readers 106. The RFID edge server 102 receives configuration info for at least one of the associated RFID readers. The RFID edge server can update the configuration of the at least one of the associated RFID readers 106 without restarting at least one other RFID reader 104 of the associated RFID readers.

[0021] Such a dynamic configuration system allows the system to continuously run rather than being shut down temporarily for a change of configuration.

[0022] The configuration info also can be maintained as a metadata-based description at the RFID edge server. The configuration can be sent to the RFID reader 106 in a format specific to the RFID reader. The at least one of the RFID readers 106 can produce RFID data for a software application 100. The RFID edge server 102 can restart the at least one RFID reader 106 without restarting the software application 108. The at least one RFID reader 106 can be restarted in between the timed transfers of the RFID data to the RFID edge server 102. The RFID readers can be from different vendors with their own native configuration arrangements.

[0023] One embodiment of the present invetion is an RFID edge server 102 to configure multiple associated RFID readers 104 and 106. The RFID edge server 102 can receive configuration info for at least one of the RFID readers 106. The at least one of the RFID readers 106 providing data for a software application 108. The RFID edge server 102 can restart the at least one RFID reader 106 without interrupting the operations of the software application 108.

[0024] One embodiment of the present invention is a computer implemented method comprising receiving configuration info for at least one associated RFID reader 106 at a RFID edge server 102 and updating the configuration of the at least one associated RFID reader 106 without restarting at least one other RFID reader associated with the RFID edge server.

[0025] One embodiment of the present invention is a computer implemented method comprising receiving at a RFID edge server 102 configuration info for at least one associated

RFID reader 106. The associated RFID reader 106 providing RFID data for a software application 108 and initiating restart of the associated RFID reader 106 without interrupting the operation of the software application 108. The configuration can be sent to the RFID reader in a format specific to the RFID reader.

[0026] One embodiment of the present invention is a computer readable medium with a metadata-based description 202 of the configuration of an RFID reader, wherein an RFID edge server is adapted to interact with the medadata-based description 202 to configure the RFID reader.

[0027] The metadata-based description can include configuration parameters. The configuration parameters can include parameter name, description, type and default value. The metadata can be used to produce an interface, such as a console, to get configuration information from a user. The RFID edge server can use the interface to set configuration data. Different metadata-based descriptions can be used for different types of RFID readers. In one embodiment, the Metadata description can be used for filters, such as ALE filters, as well as for the RFID reader configuration.

[0028] One embodiment of the present invention is a computer-based method comprising receiving a metadata-based description of RFID reader and using the metadata-based description to produce an interface, such as a console page, to input a configuration for the RFID reader.

[0029] One embodiment of the present invention is a console for an RFID edge server 302, including a graphical interface 304 to receive ALE filter information such that the graphical interface 304 can be used to select the ALE filtering on the RFID edge server 302. The filters can be associated with an RFID reader 306. A list of available ALE filters can be displayed. The graphical interface 304 can allow the selection of one of the available ALE filters. The graphical interface 304 can show filters in a filter chain. The graphical interface 304 can allow the repositioning of filters in a filter chain.

[0030] One embodiment of the present invention is a computer implemented method comprising using a graphical interface 304 to select an ALE filter and using the selected ALE filter to filter RFID tag data at an RFID edge server.

[0031] One embodiment of the present invention is a computer readable medium including code to receive a selected ALE filter from a graphical interface 304 and use the selected ALE filter to filter RFID tag data at an RFID edge server 302.

[0032] A system of one embodiment comprises using an EPC server 402 to dynamically provide EPC code blocks 404 and 406 for one product to multiple client sites 408 and 410. The client sites 408 and 410 can use the EPC codes 412, 414, 416 and 418 of the EPC code block for RFID tags 402, 422, 424 and 426.

[0033] In one embodiment, the EPC server can create pools of EPC codes. The EPC codes can be created based on business policies that can be used to indicate business information in the EPC code. The RFID edge servers can obtain EPC codes from the pool, store these EPC codes into a local cache and then use these EPC codes in the construction of RFID tags, such as with an RFID tag printer. Unused RFID tags can be returned from the cache to the pool.

[0034] The client sites 408 and 410 can be, or can include, RFID edge servers. The EPC server can use business rules to assign the EPC code blocks. The EPC code blocks can be assigned so as to indicate business information such as lot number and/or location. The client sites 408 and 410 can cache EPC codes for later use. The client sites can request EPC code blocks 404 and 406.

[0035] One embodiment of the present invention is a computer implemented method comprising dynamically providing EPC code blocks 404 and 406 for one product to multiple client sites and using EPC codes of the EPC code blocks 404 and 406 for RFID tags at the client sites 408 and 410.

[0036] One embodiment of the present invention is a computer readable medium including code to dynamically provide EPC code blocks 404 and 406 for one product to multiple client sites 408 and 410; and using the EPC codes 412, 414, 416 and 418 of the EPC code blocks 404 and 406 for RFID tags 420, 422, 424 and 426 at the client sites 408 and 410.

[0037] One embodiment of the present invention is an EPC provisioning system 400 comprising a EPC server 402 adapted to dynamically provide EPC code blocks 404 and 406 for one product to multiple client sites. The EPC server 402 can use business rules to determine the EPC codes for the multiple client sites 408 and 410.

[0038] The client sites 408 and 410 can be RFID edge servers. The client sites can use the EPC codes 412, 414, 416 and 418 for RFID tags 420, 422, 424 and 426. The EPC code blocks can be assigned to as to indicate lot number. The EPC code blocks can be assigned so as to indicate location. The client sites 408 and 410 can cache EPC codes for later use. The client sites 408 and 410 can request the EPC code blocks 404 and 406.

[0039] One embodiment of the present invention is a computer implemented method using business rules to determine EPC code blocks for multiple client sites and providing the EPC code blocks to the multiple client sites.

[0040] One embodiment of the present invention is a computer readable medium including code to use business rules to determine EPC code blocks for multiple client sites and providing the EPC code blocks to multiple client sites.

DETAILS OF EXEMPLARY EMBODIMENTS

[0041] The following embodiments are merely exemplary and are not meant to limit the scope of the present invention.

[0042] A Dynamic Reader Configuration interface can be used by an Admin Console. The interface can be public facing, or for internal use by other applications, including the Admin Console and workflow applications. A centralized control server may use the interface to provision RFID Edge Servers.

[0043] In one embodiment, the dynamic reader configuration can:

1. Provide an interface to obtain plug-in meta information.
2. Provide an interface to configure plug-in instances

[0044] Clients can determine the available plug-in drivers supported by the Edge Server. For a given plug-in driver, clients can retrieve meta information describing the plug-in and each of the associated configuration parameters. Plug-in meta information can include the name of the plug-in, the plug-in type (e.g. Reader or Filter), the associated physical device name, and a description of the plug-in. Meta information for configuration parameters can include the parameter name, description, type, constraints, required flag, default value, and an index indicating importance relative to other parameters.

[0045] A plug-in instance can provide the connection between the Edge Server and the physical device (e.g. Matrix Reader). Clients can be able to list, get configuration details of, define, redefine and un-define plug-in instances. Creation of a plug-in instance can require the combination of a plug-in driver and configuration. The driver can provide access to the physical device, where the configuration provides the driver parameters. The presence of the physical device need not be required when defining, redefining or un-defining plug-in instances.

[0046] Dynamic Plugin configuration changes can be coordinated so that the operation of the edge server is not interrupted.

[0047] In one embodiment, the reader configuration can support updates of the reader drivers on the edge server. If a new reader driver is added to the edge server, the reader driver configuration can allow the configuration of new reader driver instances using the new driver.

[0048] Plug-in configuration changes can be persistent. The changes do not need to be reflected in the Reader configuration files.

[0049] In one embodiment, a dual mode operation can be supported with a configuration flag, such as EnableDynamicConfiguration. If set, all configuration can be read from the persisted dynamic configuration and configuration modifications can be supported through the dynamic configuration API. If the configuration parameter is not set, then the configuration information can be read from the reader configuration file, not from the persisted dynamic configuration. Also, the Dynamic Configuration will operate in a read only mode, allowing dynamic inspection of Plugin Meta and Configuration the configuration, but not supporting modification to the Plugin Configuration.

[0050] The implementation of the dynamic reader configuration can be extensible so that other types of plug-ins can be added in the future without extensive changes to the dynamic reader configuration framework (e.g. Trigger Driver, Notification Driver, and Filter Driver).

[0051] In one embodiment the following APIs can be exposed:

listPluginMetaInfo(pluginRole : String) : List <PluginMetaInfo>

Returns list of PluginMetaInfo instances identifying each of the plugins supported by the edge server. If pluginRole is not null, return only the drivers of the given role. For release 1.3, the type will be limited to Reader and CompositeReader.

getPluginMeta(pluginRole: String, pluginMetaName : String) : PluginMeta

Returns the PluginMeta instance for the pluginMeta with the specified name.

definePlugin(pluginRole : String, pluginName : String, pluginConfig : PluginConfig) : void

Defines a new Plugin instance with the given name and configuration.

redefinePlugin(pluginRole : String, pluginName : String, pluginConfig : PluginConfig) : void

Updates an existing Plugin instance.

undefinePlugin (pluginRole : String, pluginName : String) : void

Undefines an existing Plugin with the specified name

getPlugin(pluginRole : String, pluginName : String) : Plugin

Return the plugin for the given plugin name and type.

listPlugins(pluginRole : String) : List <PluginConfig>

List all plug-in instances of the specified type. If type is null, include all plug-in types. For Release 1.3, only CompositeReader, Reader, Filter are supported.

listRoles( ) : List <String>

List all known Plugin roles.

[0052] The Plug-in driver meta information and plug-in instance configuration interfaces can be exposed through a web service hosted by the edge server. An XML schema can define the parameters passed in the SOAP interface.

[0053] A Java API can support access to the Reader Configuration API. The Java API can provide a wrapper around the SOAP interface and provide Java classes for handling the plug-in driver meta information and configuration. The Java API can also be used internally within the edge server to interact with the plug-in configuration information.

[0054] The Admin Console can be a client of the Dynamic Reader Configuration interface provided by the Edge Server. The Admin Console can contain new panels to provide read write access to the reader configuration.

[0055] In one embodiment:

1. The Admin Console can query the interface to determine the extent of reader drivers, and display the results.
2. The Admin Console can query the interface to determine the configured reader drivers and display the results.
3. The Admin Console can request meta information on the configuration parameters for a particular reader. The meta information can be used to dynamically create configuration forms.
4. The Admin Console can support the specification of parameters for a driver configuration.
5. The Admin Console can define a new reader driver instance passing the plug-in driver name and the configuration.
6. The Admin Console can redefine existing reader driver instance passing the plug-in driver name and the configuration.
7. The Admin Console can un-define existing reader driver instances passing the plug-in driver name.

[0056] The Dynamic Reader Configuration design can provide an open framework for supporting dynamic configuration of plug-ins. The initial implementation can be limited to supporting two types of plug-ins: Readers and Composite Readers.

[0057] The class diagram of Figure 6A provides an overview of the Edge Server, Reader, CompositeReader, Trigger, Filter and related classes of one embodiment.

[0058] As shown in figure 6A a Reader can model a physical RFID reader, for example a Matrix reader. Readers can aggregate one or more antennas. An Antenna can model an individual physical antenna. The relation between Readers and Antenna can be defined as part of the Reader Configuration. The Reader Configuration can also include parameters required by the reader driver. Example configuration can include the IP address and port number used to communicate with the physical device.

[0059] The LogicalReader can be referenced by ECSpecs and PCSpecs as a source for tag read/writes. The logical reader can be an abstract base class for Antennas and Composite Readers.

[0060] The Antenna can model a physical Antenna.

[0061] A CompositeReader can aggregate a collection of Logical Readers independent of physical reader and antenna configuration.

[0062] The edge server can provide an aggregation point for the collection of CompositeReaders and Readers.

[0063] The PhysicalReader can represent an actual physical reader connected to one or more antennas.

[0064] The Physical Antenna can represent an actual physical antenna connected to a physical reader. The Antenna acts as a RFID transducer.

[0065] The Filter can used to filter tags read by the Antenna. One or more filters may be associated with an Antenna.

[0066] The concept of a Plugin can be used to support an extensible configuration mechanism. The Plugin can provide a base class for configurable entities within the Edge Server. The analysis model of figure 6B describes the resulting Plugin class hierarchy of one embodiment.

[0067] The Plugin can provide the root type for all configurable entities. The Plugin can contain a Configuration that defines the parameters (i.e. name value pairs) required for operation of the Plugin. The class Plugin_X can be a placeholder for other Plugin types to be added in the future. The class Reader_X can be a place holder for other types of readers currently supported and to be added in the future.

[0068] The design can be composed of three main components:

1. Plugin Meta

2. Plugin
3. Plugin Config API

[0069] The Plugin Meta component can manage a list of Plugin Meta instances. Each Plugin Meta instance can contain meta information that describes the class that implements the Plugin and associated configuration parameters.

[0070] The Plugin component can manage Plugin instances. Plugin instances can aggregate a PluginConfig with a PluginDevice. A Plugin instance can be defined by an associated Plugin Meta instance.

[0071] The Plugin API component can provide a SOAP interface for accessing Plugin Meta information and configuring Plugin instances. The Plugin API can also provide a Java API that includes a java client stub for the API, and a set of Java classes used to model the data objects marshaled through the API.

[0072] Figure 6C shows Plugin Components such as, Plugin Instances, Plugin Meta Info, and Plugin API of one embodiment.

[0073] Figure 6D shows an implementation class diagram for the Plug-in Framework of one embodiment.

[0074] Figure 6E shows an UML class diagram describes the Plugin Meta Component classes of one embodiment.

[0075] The PluginMetaManager can provide a container for management of PluginMeta instances. The PluginMetaManager can also manage PluginMeta Persistence.

`add( role: String, name: String, pluginMeta : PluginMeta ) : void, throws DuplicatePluginMetaException`

Adds a new PluginMeta instance with given role and name. Throws DuplicatePluginMetaException if a PluginMeta instance already exist with the same name and type.

`lookup(role: String, name: String): PluginMeta, throws PluginMetaException`

Looks up and returns the PluginMeta instance with matching role and name. Throws PluginMetaException if a matching PluginMeta instance is not found.

`remove(role: String, name: String): void, throws PluginMetaException`

Removes the PluginMeta instance with matching role and name. Marks the PluginMeta instance as void. Throws a PluginMetaException if a matching PluginMeta instance is not found.

`remove( plugin: PluginMeta) : void, throws PluginMetaException`

Removes the PluginMeta instance and marks the PluginMeta instance as void.

`getPluginMetaList(role: String) : List <PluginMeta>`

Returns the extent of PluginMeta instances for the given Plugin Role. If the specified Plugin Role is null, the extent for all PluginRoles is returned.

`listRoles() : List <String>`

Returns the list of known Plugin Roles (e.g. Composite Reader, Reader)

[0076] The PluginMeta class can describe a Plugin. The meta information can include the Plugin name, role, description, and parameters used to configure the Plugin.

Methods can include:

`getClassName(): String`

Returns the fully qualified class name for the class used to implement the plugin.

`getName(): String`

Returns the descriptive name for the Plugin (e.g. Mercury4Reader). This name is referenced when creating a Plugin instance.

`getPluginRole(): String`

Returns the string representation of the Plugin Role for this plugin. (e.g. "READER" or "COMPOSITE_READER")

`validate(plugin: Plugin): void, throws PluginValidationException`

Validates the specified Plugin by validating each of the contained parameters. If invalid, throws PluginValidationException.

[0077] The PluginParameterMeta class can describe a PluginParameter. The meta information can include the PluginParameter name, type, description, required flag, and index.

Attributes can include:

`keyName: String (non i18n)`

Provides a uniuqe name for the parameter

`name: String (i18n)`

Provides a descriptive name for the parameter

`type: PluginParameterType`

Defines the type for the parameter; numeric or string. The supported types include:

- NUMERIC
- STRING
- LIST <String>
- ANTENNA

`description: String (i18n)`

Provides a descriptive text for associated PluginParameter.

`required: Boolean`

Boolean indicating whether or not the parameter is required.

`index: int`

Parameter index indicating ordering with respect to other parameters.

`defaultValue: String (non i18n)`

Default value of this plugin parameter. It may be null if there is no default.

Methods can include:

`getChildren(): List <PluginParamameterMeta>`

Returns a list of child (i.e. contained) PluginParameterMeta instances.

`validate(pluginParameter: PluginParameter): void, throws PluginValidationException`

Validates the specified PluginParameter with the associated PluginParameterConstraint. If invalid, throws PluginValidationException.

[0078] The PluginParameterConstraint class can define constraints for the associated PluginParameterMeta instance. The constraint information can include a description and parameter value contstraints. This class can be abstract, concrete derived classes include PluginParameterConstraintRangeNumeric and PluginParameterConstraintRegEx.

Methods can include:

`getDescription(): String`

Return a descriptive text string defining the Plugin Constraint, for example: "[1-1000]".

`validate(parameter: PluginConfigParameter): void, throws PluginValidationException`

Validates the specified PluginConfigParameter. If invalid, throws PluginValidationException. This method is defined as abstract and must be overridden by derived classes.

[0079] The PluginParameterConstraintRangeNumeric class can be derived from PluginParameterConstraint and defines a value constraint for a PluginParameter of type numeric.

Attributes can include:

`minValue : long`

The minimum allowable value for the constraint

`maxValue : long`

The maximum allowable value for the constraint.

[0080] The PluginParameterConstraintRegEx class can be derived from PluginParameterConstraint and defines a value constraint for a PluginParameter of type String.

Attributes can include:

`regEx : String`

Defines a regular exception for validation of a String Constraint.

`minLength: int`

Return the minimum allowable length for the string.

`maxLength: int`

Return the maximum allowable length for the string, or 0 if no limit.

[0081] The PluginParameterConstraintEnum class can be derived from PluginParameterConstraint and defines a value constraint for a PluginParameter of type List <String>.

Attributes can include:

`EnumerationList : List <String>`

Defines a list of allowable String values.

[0082] The PropsRawConfig class can be used to persist PluginMeta instances to files.

[0083] Figure 6F shows UML class diagram that describes the Plugin Component classes of one embodiment.

[0084] Figure 6G shows a sample instance diagram showing Plugins and the relation to PluginConfig, PluginConfigParameter, and PluginDevice instances of one embodiment. The PluginManager singleton can manage all Plugin instances.

[0085] The PluginManager can be a singleton and provide a container for management of Plugin instances. The PluginManager can support Plugin configuration requests through the Plugin API. The PluginManager can also manage Plugin Persistence. Persistence can be supported in one of two ways; through the edge.properties file or through the dynamic configuration persistence. The mode of persistence operation can be controlled through the EnableDynamicConfiguration Boolean property. If this value is set to true, then the dynamic configuration persistence mechanism can be enabled. When the edge server starts, all Plugin instances can be read from the dynamic configuration store. The dynamic configuration store can be in the form of a set of PropsRawConfig files within the var/edgestate/plugin directory.

[0086] In one embodiment, if the EnableDynamicConfiguration Boolean property is set to false, then the plugin configuration can be read from the edge.props file. This allows for backward compatibility with existing RFID edge server installations. In this mode, the Plugin Configuration API can be restricted to read only access, so that no modification may be made through the Plugin Configuration API. In this mode, current configuration may be discovered through the Plugic Configuration API.

Methods can include:

`add(role : String, name : String, plugin : Plugin) : void, throws PluginValidationException`

Adds a new Plugin instance with given role, name and Plugin instance. Throws DuplicateNameException if a Plugin instance with the same name and role already exist. Throws PluginValidationException if there is a problem validating the configuration parameters. The add command persist the newly defined Plugin to the persistent store.

`lookup(role : String, name : String): Plugin, throws PluginException`

Looks up and returns the Plugin instance with matching role and name. Throws NoSuchPluginException if a matching Plugin instance is not found.

`remove(role : String, name : String): void, throws NoSuchPluginException`

Removes the Plugin instance with matching role and name. Marks the Plugin instance as void. Throws a NoSuchPluginException if a matching Plugin instance is not found. The associated Plugin is removed from the persistent store.

`remove(plugin : Plugin) : void, throws PluginException`

Removes the Plugin instance and marks the Plugin instance as void. The associated Plugin is removed from the persistent store.

`getPluginList(role : String) : List <Plugin>`

Returns the extent of Plugin instances for the given Plugin Role. If Plugin Role is null, the extent for all Plugin Roles is returned.

[0087] The Plugin class can model a configured Plugin instance. It can be responsible for management of the PluginConfiguration instance and the PluginDevice instance. The Plugin class can support the redefine operation by shutting down, reconfiguring and restarting the PluginDevice.

Methods can include:

`getName(): String`

Returns the assigned name of the Plugin. Together, the Name and Role uniquely identify the plugin instance.

`getState(): PluginState`

Returns an instance of the PluginState enumeration class that defines the state of the Plugin. (e.g. Active, Disabled).

`getPluginConfig(): PluginConfig`

Returns the associated PluginConfig instance, containing the configuration for the Plugin instance.

`setPluginConfig(pluginConfig: PluginConfig) : void, throws PluginException`

Replaces the existing configuration with the specified configuration. Executes following steps:

1. Validates the specified configuration
2. Shutdown the associated PluginDevice instance.
3. Either reinitialize the existing PluginDevice with the new configuration and restart or create a new PluginDevice with the new configuration.

If any of the above steps fail, a PluginException is thrown.

`getPluginMeta() : PluginMeta`

Returns the associated PluginMeta instance.

`getPluginRole() : String`

Returns the instance of the PluginType enumeration. (e.g. READER, COMPOSITE_READER, FILTER, TRIGGER)

`getPluginDevice() : PluginDevice, throws PluginDeviceException`

Returns the associated PluginDevice. PluginDevice is an Interface for instances of ReaderDrivers, etc. Throws PluginDeviceException if the PluginDevice is not available.

`validate(): void , throws PluginValidationException`

Validates the Plugin configuration. If not valid, a PluginValidationException is thrown.

`isEnabled(): boolean`

Returns true if the plugin is enabled. The plugin may be disabled in the course of a redefine operation that fails due to invalid configuration.

`getSource(): PluginSource`

Returns the source of the Plugin Configuration information, either the Edge Server properties file or the Dynamic Plugin Configuration store.

[0088] The PluginConfig class can provide a holder for plugin configuration parameters. There can be a single PluginConfig instance for each Plugin. Optional parameters can be omitted if values are not provided.

Methods can include:

`getParameter(index : int) : PluginConfigParameter`

Returns the plugin configuration parameter for the associated index.

`getParameterCount() : int`

Returns the count of Plugin parameters.

[0089] The PluginConfigParameter class can provide a container for a plugin configuration parameter. An instance of the PluginConfigParameter class can be created for each specified parameter.

Attributes can include:

`name : String`

The name of the parameter, this name maps to the UniqueKey specified by the associated PluginParameterMeta instance.

`value : String`

[0090] The PluginDevice interface can be implemented by devices managed by the Plugin class. Example implementations of the PluginDevice can include Reader Drivers, Triggers and Filters. The PluginDevice instances can be created from the actual driver classes that are instantiated when a new driver is created.

[0091] The driver classes can implement the PluginDevice interface and implement the getStatus(), initialize(), shutdown(), and getPluginMeta() methods.

Methods can include:

`getStatus() : PluginStatus`

Returns the PluginStatus enumeration value that defines the current state of the PluginDevice. This method is used by the parent Plugin to provide status information.

`initialize(rawConfig : RawConfig): void , throws PluginDeviceException`

Initializes the PluginDevice with the specified rawConfig. Throws PluginDeviceException on error.

`shutdown(): void, throws PluginDeviceException`

Requests that the PluginDevice shutdown. Throws PluginDeviceException on error.

This method is to support the redefine operation where an existing reader is updated with a new configuration.

`getPluginMeta(): PluginMeta, throws PluginDeviceException`

Returns that the PluginMeta information associated with the Pluging. Throws PluginDeviceException on error. Existing Plugins and new plugins must implement this method to provide accurate Plugin Meta Information.

[0092] The PluginStatus class can provide an enumeration of Plugin states defined as Strings:

- ACTIVE (in use)
- INACTIVE

[0093] The PluginType class can provide an enumeration of Plugin types defined as Strings:

- READER
- COMPOSITE_READER
- TRIGGER
- FILTER

[0094] The Plugin API can be composed of two parts: the Plugin Meta API and the Plugin Configuration API. The Plugin API can be implemented as a SOAP interface defined with a WSDL file. The objects referenced within the interface can be defined in an XML Schema definition and serialized through the SOAP interface. The Plugin API can also be exposed to clients with a Java API.

[0095] The PluginMeta API can provide methods for read only access to the Plugin Meta Information.

Methods can include:

`listPluginMeta(pluginRole: String) : List <PluginMeta>`

Returns a list of PluginMeta objects for the given Plugin Role.

`getPluginMeta(pluginRole: String, name : String) : PluginMeta, throws NoSuchPluginMetaException`

Returns the PluginMeta instance with matching role and name. Throws NoSuchPluginMetaException if a matching PluginMeta instance is not found.

`listRoles() : List <String>`

Returns a list of the available Plugin Roles.

[0096] The Plugin configuration API can provide methods for creating, modifying, removing and listing Plugins. Plugins can live within the scope of the EdgeServer.

Methods can include:

`listPlugin(pluginRole: String) : List <PluginConfig>, throws PluginException`

Returns a list of Plugins defined on the Edge Server that match the specified pluginType.

`definePlugin(pluginRole: String, pluginName: String, pluginConfig: PluginConfig): void, throws PluginException`

Defines the plugin with role, name, and plugin configuration on the edge server. Throws PluginException if the plugin already exist or the configuration is incorrect.

`redefinePlugin(pluginRole: String, pluginName: String, pluginConfig: PluginConfig) : void, throws PluginException`

Redefines the plugin with matching role and name, applying the new pluginConfig. Throws PluginException if the plugin is not already defined or the plugin configuration is not valid.

`undefinePlugin(pluginRole: String, pluginName: String) : void, throws PluginException`

Un-defines the plugin with matching role and name. Throws PluginException if the plugin is not already defined.

`getPlugin(pluginRole: String, pluginName: String,): PluginConfig, throws NoSuchPluginException`

Returns the Plugin instance with matching role and name. Throws a NoSuchPluginException if the Plugin is not found.

[0097] The ability to dynamically update a Plugin Configuration can result in a synchronization problem with the Event Cycle engine. The synchronization issue results due to the interdependences between ECSpecs, PCSpecs, Readers, Logical Readers (i.e. Composite Readers and Antennas (a.k.a. Reader Point)) and Filters. Figure 6H is an analysis model that provides an overview of the dependencies of one embodiment.

[0098] Figure 6I shows an exemplary dependency graph.

[0099] Figure 6J shows an exemplary event cycle dependency graph of one embodiment.

[00100] EventCycles can be at the root of the dependency graph. Event Cycles can manage the processing of an active ECSpec or PCSpec. Event Cycles can be invoked by the client through the following interface calls:

1. Poll
2. Immediate
3. Subscribe

[00101] An Event Cycle can directly depend on:

- ECSpec
- PCSpec

[00102] ECSpecs can define the characteristics of an event cycle. ECSpecs can be modified by the client through calls to the following methods:

1. Define
2. Redefine
3. Undefine

[0100] ECSpec and PCSpec can directly depend on:

- Logical Reader
  - Composite Reader
  - Antenna

[0101] Concrete implementations of Logical Reader can include Composite Reader and Antenna. A Composite Reader can be a composite for Logical Reader. Composite Readers can be defined by the client through the plugin interface. An Antenna is defined as part of the configuration for a Reader. Where the Reader can model a physical Reader (e.g. MatrixAR4000) and the Antenna can model a physical antenna (e.g. uhf1Antenna) attached to the Reader.

[0102] An Antenna can directly depend on a filter:

[0103] A filter can support filtering of EPCs at the Antenna source. A Filter can be defined by the client through the Plugin API. In one embodiment, a filter has no dependencies.

[0104] A Configuration Event can result from a configuration change to one of the EventCycle entities (i.e. CompositeReader, Reader, or Filter). A configuration event can generate a change event notification. The Change Notification can be sent to each of the observers of the entity. Depending on the entity and configuration, there may be 0, 1 or more observers. Observers of the entity can normally include consumers of the entity. For example, observers of a filter can include any Antennas that reference the filter.

[0105] When an observer receives a Change Notification, the observer can take an appropriate action. In some cases, no action will be required.

[0106] If the receiver of a Change notification has registered observers, the change event can be forwarded to those observers.

[0107] In one embodiment, changes to Filters may only occur through configuration events. Consumers of filters can be limited to the Antenna subtype of Logical Readers.

Addition:

- Add the new Filter to the filter manager.
- No notification required.

Modification can include:

1. Create a new Filter object with new configuration.
2. Notify Logical Readers to replace the old Filter with the new Filter.
3. Disable and remove the old Filter.

Removal can include:

1. Create a placeholder Filter object.
2. Notify Logical Readers to replace the old filter with placeholder Filter.
3. Disable and remove old Filter

[0108] In one embodiment, changes to Readers may occur through configuration events. Addition can include:

Add the new Reader and Logical Readers defined by the configuration.
Process addition of each Logical Readers defined by the Reader

Modification can include:

- Process removal of each Logical Reader associated with the old Reader instance
- Disable old Reader Object
- Create new Reader Object
- Process addition of each Logical Reader associated with the new Reader instance

Removal can include:

Process removal of each Logical Reader
Disable old Reader instance

Changes to Logical Readers:
Addition can include:

1. If there is a matching placeholder Logical Reader, then:
    2. Create new Logical Reader
    3. Notify Event Cycles to update references to use new Logical Reader
    4. Remove old Placeholder Logical Reader
5. Validate, execute and persist changes.
6. Otherwise, no action since the Logical Reader is not currently required by any active EventCycles

Modification can include:

Error condition. Conflicts with another active logical reader.

Removal:

1. Create a placeholder Logical Reader (if it is currently referenced by an active Event Cycle).
2. Notify Event Cycles to update reference to use new placeholder object
3. Remove old Logical Reader

[0109] Updates to ECSpecs can continue to use current mechanism to handle define, redefine and undefine events.

[0110] In one embodiment, if EnableDynamicConfig Boolean property is set to true:

1. Get plugin data from Dynamic Plugin Configuration persistent store
2. If a logical reader is missing, create a placeholder for use by referencing ECSpecs and Composite Readers.

[0111] In one embodiment, if EnableDynamicConfig Boolean property is set to false:

1. Use edge.props for plugin configuration information.

[0112] The Java API can include the following set of classes.

- PluginMeta
- PluginParameterMeta
- PluginParameterConstraint
- PluginParameterConstraintRangeNumeric
- PluginParameterConstratintRegEx
- PluginConfig
- PluginConfigParameter
- PluginType
- PluginStatus

[0113] The Java API can also support a client stub to expose the methods defined by the Plugin API.

[0114] Schema definition can be added to support the serialization into XML of the following classes:

- PluginMeta
- PluginParameterMeta
- PluginParameterConstraint
- PluginParameterConstraintRangeNumeric
- PluginParameterConstratintRegEx
- PluginConfig
- PluginConfigParameter
- PluginType
- PluginStatus

[0115] A new boolean configuration parameter "EnableDynamicPluginConfiguration" can be added to the edge.props file. This configuration parameter can determine the mode of operation for handling Plugin Instance creation and persistence. The default setting can be true.

[0116] The edge.properties file can support static declaration of readers, composite readers, triggers, and filters.

[0117] PluginMeta information can be provided by the getPluginMeta() method of all Plugin drivers.

[0118] The Plugin information can be stored in the form of PropsRawConfig files. These files can be constructed and updated dynamically in response to definePlugin, redefinePlugin and undefinePlugin API method invocations.

[0119] The Admin Console can be updated to support read only access to Plugin Meta information and read/write access to Plugin information using the Plugin Java API.

[0120] An edge server can be configured by means of an configuration file, such as an `edge.props` file, which can be a Java-properties formatted file that configures:

1. The name of the edge server and the port on which its Soap server listens for connections.
2. Internal matters such as thread concurrency and queue depths.
3. Location(s) of EPC company prefix index translation tables.
4. Other settings for: persistence, telemetry, notification drivers and default notification delivery failure handling.
5. Physical readers: driver class, and per-driver configuration items.
6. Composite readers.
7. Filters for logical readers.
8. Triggers: driver class, and per-driver configuration items.

[0121] The "Admin Console" can be currently the primary user-visible manifestation of a RFID edge server deployment. This can be where all edge servers are listed and monitored, where ECSpecs and PCSpecs are authored and deployed, and where telemetry and alerts are marshalled. The Admin Console can be extended to allow the configuration of an edge server to be viewed and manipulated via the ALE Configuration API, for example allowing new readers to be defined and configured, triggers to be created, etc.

[0122] Figure 7A shows the relationship between the readers/triggers, edge servers, the admin console, discovery system, and control server of one embodiment.

[0123] Using the ALE Configuration API, an edge server can be configured to work with one or more readers and zero or more triggers. The ALE Configuration API can be accessible to the admin console, so that an administrator may view and manipulate the reader/trigger definitions in an edge server.

[0124] The ALE Configuration API can also be available to a discovery system that is responsible for noting the comings and goings of readers on the site network. The discovery system can use the ALE Configuration API to configure an edge server to use a discovered reader.

[0125] A control server can use the ALE Configuration API to manipulate the configuration of multiple edge servers.

[0126] The ALE Configuration API can provide methods that expose and manipulate various aspects of an edge server's configuration. This API may be considered to be a public interface to an underlying object model.

[0127] Figure 7B shows an exemplaryentity-relationship diagram of one embodiment. In the interest of simplicity, triggers are not shown.

[0128] The «named» stereotype indicates that the entity is a collection of instances, each of which has a distinct name (akin to the primary key in a relational model). For example, an edge server can have any number of `ECSpec` instances, each of which has a unique name. In one embodiment, the ALE Configuration API, such entities are always reference by their name. When one entity references another, it does so via the name of the referenced entity (like a foreign key). `ECSpecs` and `PCSpecs` are created via the `ALE` and `ALEPC` APIs, respectively. Each `ECSpec` (or `PCSpec`) refers to one or more "client" readers, each of which is either a logical reader or a composite reader. A composite reader can be created by use of the ALE Configuration API, and can simply be a collection of logical readers and/or composite readers. A physical reader entity can be created by use of the ALE Configuration API, by specifying a driver implementation class and a set of properties, interpreted by the driver, that configure the physical reader instance. Each physical reader can define one or more logical readers. In one embodiment, Logical readers are not created directly by the ALE Configuration API, but instead are owned by a physical reader. Filters can be created by use of the ALE Configuration API. Each logical reader may have an ordered sequence of filters configured for use during read cycle processing.

[0129] Like the other ALE APIs, the ALE Configuration API can be organized as a set of top-level methods, helper objects, and exceptions. In this section we present the ALE Configuration API, with the top-level methods organized and grouped according to function. The API can be presented using pseudo-Java syntax. Fundamentally, the API can be exposed as a SOAP-based remote invocation wire protocol, with a Java client binding provided to encapsulate the SOAP layer. In addition to the exceptions listed below, all methods can also throw `EngineException` and `RemoteException`.

Physical Reader Methods can include:

```
List getAllPhysicalReaderNames();

void definePhysicalReader(String physicalReaderName, EntitySpec spec)
    throws DuplicatePhysicalReaderNameException,
           DuplicateLogicalReaderNameException,
           EntitySpecValidationException,
           NoSuchDriverException

void undefinePhysicalReader(String physicalReaderName)
    throws NoSuchPhysicalReaderException

void undefinePhysicalReader(String physicalReaderName, ReferentialIntegrity riControl)
    throws NoSuchPhysicalReaderException,
           InUseException

void redefinePhysicalReader(String physicalReaderName, EntitySpec spec)
    throws NoSuchPhysicalReaderException,
           DuplicateLogicalReaderNameException,
           EntitySpecValidationException,
           NoSuchDriverException

void redefinePhysicalReader(String physicalReaderName, EntitySpec spec,
                            ReferentialIntegrity riControl)
    throws NoSuchPhysicalReaderException,
           DuplicateLogicalReaderNameException,
           EntitySpecValidationException,
           NoSuchDriverException,
           InUseException

EntitySpec getPhysicalReaderSpec(String physicalReaderName)

List getLogicalReaderNames(String physicalReaderName)
    throws NoSuchPhysicalReaderException

List getPhysicalReaderDriverNames()

// TBD: methods to list PCBpecs/PCBpecs that depend on a given physical reader?
//      Not here-- such methods should be part of the ALE and ALEPC
//      APIs.
```

[0130] The following helper object can be used by all of the methods that define entity instances and return information about them:

```
class EntitySpec
{
    String driverName;
    Map config;
}
```

[0131] The `driverName` can identify the driver class responsible for this entity. The `config` can be a set of name/value pairs, and is interpreted by the driver class. Each driver class should specify what names it looks for in the map and how it treats their values.

The following enum can be used by methods that could possibly break inter-entity references:

```
enum ReferentialIntegrity
{
    ENFORCE,   // throw InUseException rather than break reference
    RELAX      // allow reference to dangle
    // UPDATE  // remove the reference
}
```

[0132] If ENFORCE is specified, a method such as undefinePhysicalReader() can throw InUseException if the operation would cause a reference to be broken (such as an ECSpec that references a logical reader defined by the to-be-undefined physical reader).

[0133] In one embodiment, if RELAX is specified, then enforcement of referential integrity constraints is not performed. This introduces the possibility of dangling references. For example, if a physical reader is undefined, and an ECSpec lists a logical reader which no longer exists as a result of undefining the physical reader, then we say that the ECSpec has a dangling reference to a non-existent logical reader. In all such cases, can carefully specify the resulting behavior. In the present example, the ECSpec can operate as if the missing logical reader exists but always produces read errors (say).

[0134] UPDATE can maintain referential integrity by modifying a referencing entity so that it no longer references the deleted entity. For example, ECSpecs and PCSpecs can be altered to remove an undefined reader from their list of logical readers.

[0135] Logical Reader Methods can include:

```
List getAllLogicalReaderNames()

boolean supportsReading(String logicalReaderName)
    throws NoSuchLogicalReaderException

boolean supportsWriting(String logicalReaderName)
    throws NoSuchLogicalReaderException

List getFilterChain(String logicalReaderName)
    throws NoSuchLogicalReaderException

void setFilterChain(String logicalReaderName, List filterNames)
    throws NoSuchLogicalReaderException,
           NoSuchFilterException

void prependFilterToChain(String logicalReaderName, String filterName)
    throws NoSuchLogicalReaderException,
           NoSuchFilterException

void appendFilterToChain(String logicalReaderName, String filterName)
    throws NoSuchLogicalReaderException,
           NoSuchFilterException

void removeFilterFromChain(String logicalReaderName, String filterName)
    throws NoSuchLogicalReaderException,
           NoSuchFilterException

String getPhysicalReaderName(String logicalReaderName)
    throws NoSuchLogicalReaderException

// This method should be part of ALE: getECSpecsForReader
//List getECSpecNamesUsingReader(String clientReaderName)
//    throws NoSuchClientReaderException

// This method should be part of ALEPC: getPCSpecsForReader
//List getPCSpecNamesUsingReader(String clientReaderName)
//    throws NoSuchClientReaderException
```

```
List getCompositeReaderNamesUsingReader(String clientReaderName)
    throws NoSuchClientReaderException
```

[0136] Filter Methods can include:

```
List getAllFilterNames()

void defineFilter(String filterName, EntitySpec spec)
    throws DuplicateFilterNameException,
           EntitySpecValidationException,
           NoSuchDriverException

void undefineFilter(String filterName)
    throws NoSuchFilterException

void undefineFilter(String filterName, ReferentialIntegrity riControl)
    throws NoSuchFilterException,
           InUseException

void redefineFilter(String filterName, EntitySpec spec)
    throws NoSuchFilterException,
           EntitySpecValidationException,
           NoSuchDriverException

void redefineFilter(String filterName, EntitySpec spec, ReferentialIntegrity riControl)
    throws NoSuchFilterException,
           EntitySpecValidationException,
           NoSuchDriverException,
           InUseException

EntitySpec getFilterSpec(String filterName)

List getLogicalReaderNamesUsingFilter(String filterName)
    throws NoSuchFilterException

List getFilterDriverNames()
```

[0137] Composite Reader Methods can include:

```
List getAllCompositeReaderNames()

void defineCompositeReader(String compositeReaderName,
                           List clientReaderNames, boolean reportFailedMembers)
    throws DuplicateCompositeReaderNameException,
           NoSuchClientReaderException,
           CyclicDefinitionException

void undefineCompositeReader(String compositeReaderName)
    throws NoSuchCompositeReaderException

void undefineCompositeReader(String compositeReaderName, ReferentialIntegrity riControl)
    throws NoSuchCompositeReaderException,
           InUseException

void redefineCompositeReader(String compositeReaderName,
                             List clientReaderNames, boolean reportFailedMembers)
    throws NoSuchCompositeReaderException,
           NoSuchClientReaderException,
           CyclicDefinitionException

void redefineCompositeReader(String compositeReaderName,
                             List clientReaderNames, boolean reportFailedMembers,
                             ReferentialIntegrity riControl)
    throws NoSuchCompositeReaderException,
           NoSuchClientReaderException,
           CyclicDefinitionException,
           InUseException

void addReaderToComposite(String compositeReaderName, String clientReaderName)
    throws NoSuchCompositeReaderException,
           CyclicDefinitionException
```

```
void addReadersToComposite(String compositeReaderName, List clientReaderNames)
    throws NoSuchCompositeReaderException,
           CyclicDefinitionException

void removeReaderFromComposite(String compositeReaderName, String clientReaderName)
    throws NoSuchCompositeReaderException

boolean getReportFailedMembers(String compositeReaderName)
    throws NoSuchCompositeReaderException

List getClientReaderNames(String compositeReaderName)
    throws NoSuchCompositeReaderException
```

[0138] Trigger Methods can include:

```
List getAllTriggerNames()

void defineTrigger(String triggerName, EntitySpec spec)
    throws DuplicateTriggerNameException,
           EntitySpecValidationException,
           NoSuchDriverException

void undefineTrigger(String triggerName)
    throws NoSuchTriggerException

void undefineTrigger(String triggerName, ReferentialIntegrity riControl)
    throws NoSuchTriggerException,
           InUseException

void redefineTrigger(String triggerName, EntitySpec spec)
    throws NoSuchTriggerException,
           EntitySpecValidationException,
           NoSuchDriverException

void redefineTrigger(String triggerName, EntitySpec spec, ReferentialIntegrity riControl)
    throws NoSuchTriggerException,
           EntitySpecValidationException,
           NoSuchDriverException,
           InUseException

EntitySpec getTriggerSpec(String triggerName)

// This method should be part of ALE: getECSpecsForTrigger
//List getECSpecNamesUsingTrigger(String triggerName)
//    throws NoSuchTriggerException

// This method should be part of ALEPC: getPCSpecsForTrigger
//List getPCSpecNamesUsingTrigger(String triggerName)
//    throws NoSuchTriggerException
```

[0139] The definitions for readers, filters, triggers, etc. can be all persisted in a persistent store, such as the `var/edgestate` repository along with ECSpecs, subscriptions, EPC caches, etc.

[0140] The `ClearEdgeServerState` utility can have options to control which persistent state is cleared.

[0141] In one embodiment, dynamic changes to an edge server's configuration can have an effect on that edge server's ongoing processing activities.

[0142] In one embodiment, the general strategy can be twofold. First, we notify affected entities of a change to something they refer to. So for example, if a filter is changed, then affected logical readers can be notified. If a reader is changed, then affected event cycles and/or programming cycles can be notified.

[0143] Second, if an entity is undefined in RELAX mode, then other entities that refer to it can replace their reference with a reference to a "placeholder" object of the same name, where the placeholder object provides an appropriate neutral behavior (for example, a placeholder filter's behavior can be pass-through). Later, if an entity is defined again to the same name, then such placeholder references can be replaced (such as, in the change-notification logic) with a reference to the newly defined entity of the same name as the previously undefined entity.

[0144] Normally, defining a new physical reader (and so one or more logical readers), filter, composite reader, or trigger would not affect any existing ECSpecs or PCSpecs, because the ECSpecs and PCSpecs are already bound to existing entities and don't care about any additional readers etc.

[0145] However, a RELAX-mode change to configuration could have left an ECSpec or PCSpec with a "dangling" reference to a reader or trigger (or a logical reader could have a dangling reference to a filter, etc.), in which case defining a "new" entity could really be re-establishing a previous referential relationship.

[0146] Thus, even new entity definitions should be treated as potentially affecting ongoing processing activity.

[0147] All event cycles (and programming cycles) can be told (by queuing a change notification event) whenever:

- a new client reader (logical or composite) is defined. The change notification is decorated with the reader's name and a reference to the reader instance.
- a new trigger is defined. The change notification is decorated with the trigger's name and a reference to the trigger instance.
- a composite reader is updated due to a new logical reader being defined, with the effect of replacing a placeholder reference in the composite reader.

[0148] When the event cycle processes the queued change notification, it can check its client reader list (or trigger specs) to see if any placeholder references thereon are to be replaced with a reference to a newly defined reader (or trigger). If so, the event cycle can re-performs any of its validations or computations related to its reader list (or trigger specs).

[0149] Whenever a new filter is defined, the reader manager can notify all logical readers (via a new method to be defined in the `LogicalReader` interface), identifying the name of the new filter and providing the filter definition (factory, in the parlance of our implementation). Each logical reader can determine whether it has any placeholder references that should be re-bound to an instance of the newly defined filter, and if so, create an instance of the new filter and replaces the placholder with it, and commence using the new filter in the logical reader's filter chain.

[0150] If a new logical reader is defined (indirectly, by (re)defining a physical reader), then the `CompositeReaderManager` can be notified so that it can update its tables, replacing placeholder references as appropriate. In addition, all event/programming cycles can be notified of the change, as mentioned above.

[0151] Whenever an entity is undefined in `RELAX` mode, all entities that reference it can be notified, so that the references to the undefined entity can be replaced with "placeholder" references. Placeholder references can be used so that if the just-undefined entity is later re-defined, the redefined entity will take the place of the previously undefined original in all referencing entities.

[0152] When an entity is undefined, the telemetry subsystem can be notified. Any TelemetrySpecs that reference the just-undefined entity can replace the entity with a placeholder, and optionally also generate a report to subscribers notifying them that the device has been undefined.

[0153] When a physical reader is undefined in `RELAX` mode, resulting in one or more logical readers being undefined, then any referencing ECSpecs or PCSpecs (and composite readers) can replace their reference to the just-undefined logical reader with a reference to a placeholder logical reader.

[0154] In one embodiment, a placeholder logical reader is not visible through the ALE Configuration API methods, and so for example placeholder logical readers are not part of the `getAllLogicalReaderNames()` collection. But an ECSpec (or PCSpec, or composite) that references a placeholder logical reader can include the logical reader name among its list of client readers.

[0155] When an active event cycle (or programming cycle) attempts to use a placeholder logical reader, the placeholder logical reader can complete its operation with an "undefined

logical reader" failure status, and the event cycle (or programming cycle) can behave as it normally does when a logical reader fails.

[0156] When a composite reader is undefined in `RELAX` mode, then any referencing ECSpecs or PCSpecs (or other composite readers) can replace their reference to the just-undefined composite reader with a reference to a placeholder composite reader. In one embodiment, a placeholder composite reader is not visible through the ALE Configuration API methods, and so for example placeholder composite readers are not part of the `getAllCompositeReaderNames()` collection. An ECSpec (or PCSpec, or another composite) that references a placeholder composite reader can include the composite reader name among its list of client readers. A placeholder composite reader can simply behave as a composite reader with no entries.

[0157] When a filter is undefined in `RELAX` mode, then any referencing logical readers can replace their reference to the just-undefined filter with a reference to a placeholder filter. In one embodiment, a placeholder filter is not visible through the ALE Configuration API methods, and so for example placeholder filters are not part of the `getAllFilterNames()` collection. In one embodiment, a logical reader that references a placeholder filter can include the filter name in its chain of filters. A placeholder filter can behave as a pass-through (identity) function, leaving the `EPCBuffer` contents unchanged.

[0158] When a trigger is undefined in `RELAX` mode, then any referencing ECSpecs or PCSpecs can replace their reference to the just-undefined trigger with a reference to a placeholder trigger. A placeholder trigger is not visible through the ALE Configuration API methods, and so for example placeholder triggers are not part of the `getAllTriggerNames()` collection. A ECSpec (or PCSpec) that references a placeholder trigger can continue to include the trigger name in its specification. A placeholder trigger can behave as a "dead" trigger, one that can be subscribed/unsubscribed, but never actually fires.

[0159] When a physical reader is redefined, this can cause new logical readers to be defined or existing logical readers to be undefined (because the replacement physical reader's spec can define a different set of logical readers as the original physical reader spec). Handling of newly defined (or undefined) logical readers can be handled as described above. In addition, the read/write capability of an existing logical reader may be changed as a result of redefining

the physical reader that defines the logical reader. Affected ECSpecs and PCSpecs can re-evaluate the usability of their logical readers whenever such a change occurs.

[0160] When a composite reader is redefined, affected ECSpecs and PCSpecs can be notified so that they can re-expand the composite and continue working with the resulting list of logical readers.

[0161] When a filter is redefined, affected logical readers can be notified so that they can replace their corresponding filter chain entries with a reference to a replacement filter instance.

[0162] When a trigger is redefined, affected ECSpecs and PCSpecs can be notified so that they can replace their reference to the previous trigger with a reference to the new trigger.

[0163] The dynamic configuration API can expand the configuration API discussion below.

[0164] The Configuration API can provide a mechanism for applications to decouple the form of a configuration file (properties, XML, database, etc) from the usage of that configuration. It can thus easy to add a new configuration file format without changing the application code which uses the configuration data. It can also be easy to delegate description and validation of configuration to the module which makes use of that configuration. In one embodiment, configuration items may be Boolean values, integers, strings, files, and may also be extended to include new types. Configuration items may be organized into subconfigurations, or into concepts, which allow an arbitrary number of similar configurations to be created.

[0165] The design can consists of three separate parts. First is the RawConfig class. This class can represent configuration which is read directly from a configuration source, before any parsing and validation. It is also possible to create a RawConfig class by taking a piece of an existing RawConfig.

[0166] The next part of the system can be the ConfigItem and its derived classes. A ConfigItem represents one bit of configuration data. Each derived class can determine the semantics of a particular type, including validation criteria such as format and ranges. The derived class can also acts as a holder for the typed configuration item.

[0167] Finally, the ValidatedConfig class can tie together RawConfig and ConfigItems. This class can represent a description of configuration for a specific component of the system. A ValidatedConfig object can be composed of a set of ConfigItem objects. After the ValidatedConfig is created and all its ConfigItem objects are set, the ValidatedConfig can be tied

to a RawConfig object. The ValidatedConfig object can read items from the RawConfig for each ConfigItem, and uses the ConfigItem to verify and store the value. After this step, the application can read the values from the ValidatedConfig object, from holder ConfigItem objects, or create a new RawConfig which represents a slice of the RawConfig which is associated with the ValidatedConfig.

[0168] The properties can be imported into the configuration system by crearing a PropsRawConfig object using these properties. The prefix can indicate that only properties with this prefix should be considered.

[0169] The first two properties are simple ConfigItems. The first can be an integer, and the second can be string. They could be described using addIntItem() and addStringItem(), or they could be described using addItem() and explicitly created ConfigInt and ConfigString objects. Once ValidatedConfig.readFrom() is called to parse the RawConfig, their values can be retrieved using getIntValue() and getStringValue() on the ValidatedConfig object, or by calling ConfigInt.intValue() and ConfigString.stringValue(). com.connecterra.ale.servicePort = 6060

```
com.connecterra.ale.siteID = DistributionCenter
```

[0170] The next two values can introduce the idea of subconfiguration. The persistence subsystem of ALE can take a set of config values. Rather than having the persistence subsystem aware of the structure of the entire application, the application can create a slice of the configuration space by calling getSubConfig("persistence") on either the RawConfig or ValidatedConfig objects. Then, the persistence subsystem can treat the directory and interval items as simple items. If the configuration of the subsystem is known in advance, ValidatedConfig.addSubConfig() can be used to partially or fully describe it. ValidatedConfig.readFrom() will then validate and read into the subconfig as well.

```
com.connecterra.ale.persistence.directory =
/opt/rfta/var/edgestate
com.connecterra.ale.persistence.interval = 3600
```

[0171] The final aspect of configuration can be concepts and instances. It is sometimes useful to use configuration to describe an open-ended set. In the example below, we describe two instances of a concept "reader", named "dock1" and "dock2". A common pattern will be to create a simple inferior ValidatedConfig containing only the items common across all instances (in this case, "class"), add that to the main validated config with the addConcept() method.

When readFrom() is called, the configuration implementation can verify that each instance of the concept which is given contains the necessary properties. The inferior ValidatedConfig can be filled in with arbitrary data at this point. Next, the caller can use listInstanceNames() to get a list of all of the instances, and then use getInstance() to construct a slice of the configuration which can be passed to the specific initialization code for further validation. The specific initialization code can treat its configuration as simple items. The readFromInstance() sugar method can combine a call to getInstance() with a call to readFrom().

```
com.connecterra.ale.reader.dock1.class =
com.connecterra.ThingMagic
com.connecterra.ale.reader.dock1.hostname =
thingmagic.example.com
com.connecterra.ale.reader.dock2.class = com.connecterra.Matrics
com.connecterra.ale.reader.dock2.defaultRate = 500
```

[0172] Figure 8A shows a configuration UML interaction diagram of one embodiment.

[0173] The API can be used in two ways. The higher level interface can use sugar methods to add configuration items to the ValidatedConfig and to retrieve their values. This can result in less code for the common case (no subConfigs or concepts, and only native or String types). It can be used in other situations, but will generally require downcasts which can only be correctly verified at runtime.

[0174] The low level interface can use ConfigItem objects as holders. It can involve more code, but allows complex configurations to be built while still permitting compile-time checking for all types, including new ConfigItem types for which no sugar methods exist.

[0175] Figure 8B shows a diagram of a high level configuration API of one embodiment.

[0176] Figure 8C shows a diagram of a low level configuration API of one embodiment.

[0177] In one embodiment, there are three places where exceptions need to be considered

- When a configuration item is invalid according to ConfigItem.setValue()
  In this case, a ConfigItemException checked exception is thrown. The reason string for this exception will give a human-readable description of the configuration error.
- When Config*Foo*.*foo*Value() or ValidatedConfig.get*Foo*Value() has no value to return, because the underlying value was optional and not specified.
  In this case, an UnsetItemException unchecked exception, which derives from IllegalStateException, is thrown.
- When the validation performed by readFrom() fails.

[0178] When the ValidatedConfig.readFrom() method runs, it can attempt to collect as much information about the configuration problems it sees as it can, so that the user can respond

to them all at once, instead of repeating a run-error-fix-retry cycle. To accomplish this, ConfigValidationException, which derives from com.connecterra.util.MultiException, can be used. When setValue() throws a ConfigItemException, this exception can be added to a ConfigValidationException, which can be thrown at the end of the validation process. The ConfigItemException can also be decorated with additional information to determine the context, such as the property name, XML path, file line number, etc.

[0179] Figure 5A shows an exemplary administration console window for use with a system of the present invention. Active edge servers can be organized into a site/server hierarchy, based on the SiteID and ServerID configured at the edge. Each edge server node in the tree can have children that represent different parts of the edge server. Readers, Triggers, ECSpecs, PCSpecs, and Composite Readers can be nodes in the tree.

[0180] Figure 5B shows an exemplary administration console RFID Devices Panel window. When the "RFID Devices" node is selected in the tree, the right-hand panel can show the RFID Devices Panels. In the RFID Devices subpane, the "New" button can always be enabled, allowing the user to configure a new device.

[0181] When a device is selected from the list, the Logical Readers list panel can update, displaying a list of Logical Readers associated with that device. Also, the panel can enables the Clone, Configure, and Delete buttons. The Clone button can act like the New button, beginning the creation of a new RFID Device entry on the server, but it can also fill in the configuration dialog fields with values from the currently-selected device. The Configure button can display the configuration dialog for the device, allowing the user to change configuration values as desired. The Delete button can ask the user to confirm their intention to remove the device's configuration from the Edge Server.

[0182] In the Logical Readers subpane, when a logical reader is selected, the Configure Filters button can be enabled. Also, if the selected reader supports reading tags, the Read Tags button can be enabled; likewise with the Write Tags button. The Read Tags and Write Tags buttons can activate their respective User Interfaces. The Configure Filters button can allow the user to configure the edge server filters associated with the reader at the device level.

[0183] As shown in Figure 5C, when a composite reader is selected from the list, the panel can enable the Clone, Configure, and Delete buttons. The Clone button can create a new composite reader and populate the new configuration dialog with the selected reader's

configuration. The Configure button can display the configuration dialog for the selected reader, allowing the user to modify its reader list as desired. The Delete button can ask the user to confirm their intention to remove the selected reader from the Edge Server.

[0184] Read Tags and Write Tags can work on a Composite Reader as they do on a Logical Reader. When the user selects "New Reader...", the Reader Configuration dialog can be displayed with empty fields. The Reader Driver combo box selection can read "Select a Driver..." and the parameter area of the screen can be left empty until an initial driver selection.

[0185] The first time the user tries to create or edit a Reader on a given Edge Server, the list of available drivers can be requested from the remote server. Once we have the list of drivers for a server, we can assume that it won't change while we believe the Edge Server is running. If the Edge Server ever appears to be unavailable, we can clear this memorized list of drivers, since this could be the result of a restart operation. Also, if the user chooses to manually refresh an Edge's device tree, that server's list of drivers can be cleared.

[0186] The list of drivers can be used to populate the Reader Driver pulldown combo box of one embodiment is shown in figure 5D. The Reader Configuration dialog can be dynamically generated from server-provided information about the configuration options supported by the currently-selected driver. When the driver changes, the dialog can remember all values associated with their internal key name, and attempts to configure the new driver with the remembered values. If there is sufficient room to display the parameters and the driver need to be configured, the dialog can simply consist of a set of parameter edit fields, allowing the user to enter values for each parameter. If there are too many parameters to fit gracefully, these parameters can be embedded in a scrolling pane.

[0187] Each parameter edit field can display the human-readable parameter name (if this is provided by the Config API – if not, it can display the internal parameter name), a text entry field, a "required field" indicator, and a description of the field constraint, if such a description is available through the Config API. When the user completes the form, entries can be validated and the specified reader saved to the server.

[0188] Figure 5E shows a screen for managing the ALE filters of one embodiment. The list of available filters on an Edge Server can be obtained in a just-in-time basis, and cached for the lifetime of an Edge Server connection. Like the list of available reader drivers, the cached version of this list can be invalidated if we lose connection to the Edge. This screen of Figure 5E

can be used to edits the filter chain associated with a logical reader. The "Add" button can add the currently selected filter from the Filters list to the bottom of the chain. Adding a filter to the chain need not remove it from the Filters list, since a filter can be include multiple times in a given reader's chain. The "Move Up" and "Move Down" button can move the selected filter earlier or later in the filter chain. "Remove" can remove the selected filter from the chain.

[0189] In one embodiment, the Add button is only enabled if there is a filter selected in the Filters list and the Move Up, Move Down, and Remove buttons need only enabled if there is a filter selected in the Filter Chain. When the user presses the "Revert" button, the filter chain is reverted to the list of filters it contained when the dialog was initialized. "Cancel" can exit the dialog box without saving changes. The "Ok" button can commit the changes to the filter chain to the edge server.

[0190] In one embodiment, when the user configures or creates a composite reader, the admin console can present the Composite Reader Configuration Dialog as shown in Figure 5F. The Available Readers list box can list Logical Readers that are configured, but not included in the Composite Reader. The Included Readers list box can list all Logical Readers that are included in this Composite Reader. Two arrow buttons can allow "moving" a logical reader from one side to the other. Double-clicking a reader in either list can move it to the other side.

[0191] The "Failure Reporting" radio buttons can let the user choose the form a failure report takes in the ECReports object for an ECSpec that lists the CompositeReader. In one embodiment, the user can only add currently configured Logical Readers to a Composite Reader. The user is given a warning if he attempts to remove an unconfigured Logical Reader from the Composite Reader: "The Logical Reader you are removing is not configured. You will not be able to add it back to this Composite Reader without reconfiguring it first."

[0192] An EC Spec Editor can be used to indicate when a EC Spec is suspended, rather than adding another column to the pane, the suspended state will be indicated by added "(suspended)" to the Subscriber Count and by changing the row to have a yellow background, similar to the warnings on the Alerts page. The EC Spec table to be sorted by the various columns (using TableSorter), and enable the user to open an EC Spec, Filter or Report by double clicking on the appropriate line in the corresponding table.

[0193] "Deploy" and "Deploy As" can be added to the ECSpec file menu to join "Export" and "Close". Add "Import" and "Revert" can be also added to the Leave "Test" as the only item in Tools menu.

[0194] View menu can include "EC Spec Editer", "As XML" and "As Text" with one of them grayed out at any given time. The icons for these three functions can always be visible, with one grayed out.

[0195] The Attributes section can be added to allow the user to specify whether to include the EC Spec in each EC Report. It can be below the Stop section and above the Application Data section. In the Stop section, the user can be able to specify Duration (Milliseconds), Duration (Read Cycles), Stable Field Interval (Milliseconds) and Stable Field Interval (Read Cycles) independently.

[0196] In the Start section, the label Milliseconds can be positioned to the left of the repeat period text box to be consistent with Duration and Stable Set Interval in the Stop section.

[0197] There need not be three tabs at the bottom of the screen to switch to View by Text or View by XML, or back to the editor. Instead these functions can be accessed through the menu or toolbar.

[0198] Include can be renamed Include Filters, Exclude can be renamed to Exclude Filters, and there can be a new entry named Grouping in that tree. Selecting Grouping can call up a list of the grouping patterns, just like the filters table. The input grouping pattern screen can look just like the input filter screen except that there is a fourth option for each field "Group By" inserted between "Any" and "Specific". When the user enters a grouping pattern, an abbreviated URI representation can appear in the tree on the left, similar to the filters.

[0199] In one embodiment, validation of the EC Spec will not be done as the user enters data. Validation can be left to the edge server whenever possible. The messages section need not be a tabbed pane. It can be a simple pane with a blue grouping box similar to the sections in the EC Spec Edit pane above it.

[0200] The Report Type section can be renamed "Report Contents:". It can have 5 check boxes in a column, "EPC List", "Tag List", "Raw Hexadecimal List", "Raw Decimal List" and "Count". EPC List is checked by default. This list need not be validated. Validation can be left to the Edge Server. The "Behavior when Empty" section can be replaced by "Omit Report:" section. In this section is "Omit if empty", "Omit if unchanged from last cycle" and "If omitted,

suppress all EC Reports this cycle". The last of these can be grayed out if the first two are both unchecked as it would not have an effect.

[0201] When the EC Report comes back, it can be viewed in a new frame The title can include the EC Spec Name and a Timestamp. It can have a menu bar (not Save and OK buttons). The File menu can contain "Export" and "Close". The Help menu can contain "EC Reports Help". The frame can be non-modal.

[0202] There can be a progress dialog that says "Please wait while we communicate with the Edge Server", it can have an animated gif like an hourglass or an endlessly repeating progress bar. It can have a single button Cancel. This dialog can be modal and appears roughly half a second after the message is sent to the Edge Server if the response hasn't come back. This may be accomplished by creating the dialog immediately and setting a timer that will display it. The cursor can change to a watch cursor (with an hourglass) as soon as the user clicks, and the user will be prevented from clicking around.

[0203] This dialog need not be used for Activate Once or Test (on an edited EC Spec). Instead the EC Report View dialog can be called up instead, and initially says something like "waiting for results from the edge server." That dialog can be non-modal.

[0204] Figure 5G shows a Read Tags dialog that can come up when a user presses the "Read Tags" toolbar button from the Logical Readers table or the Composite Readers table. The Admin Console can repeatedly perform immediate tag reads on the selected reader, displaying the results in the tag values list box. The first column can be an indicator of tag status; a red X shows a tag that has left the reader's field. Once 5 minutes have passed without seeing a tag, that tag can be deleted from the list. The Read count can show how many times a tag has been read. The % Seen column can be calculated as a percentage of read cycles in which the tag has been detected since the tag was first seen. Thus, a tag can start out at 100%, and if the tag is removed from the field its percentage can decrease until the tag entry expires from the list in five minutes. This column can be most valuable for measuring intermittent tags. When the reader is running, the user can press the "Stop" button to suspend reads. If a read returns an error, reads can be suspended. When reads are suspended, the "Start" and "Clear" buttons can be enabled. "Restart" can continue reading. In one embodiment, the values in the table do not update while reads are suspended, and tags do not expire from the list.

[0205] Figure 5H shows a Write Tags dialog that can come up when a user presses the "Write Tags" toolbar button from the Logical Readers table or the Composite Readers table. If a reader was selected in that table, the Logical Reader field can be populated with the selected reader's name.

[0206] When the user presses the "Program" button, the Admin Console can validate the tag value, put together a PC Spec with the specified tag value (using certain hard-coded defaults for PC Spec parameters) and attempt to write the tag. If there is an error, a Tag Programming Error dialog can come up with descriptive text. Otherwise, the console can either dismiss the dialog or update it, depending on the value of the "Autoincrement Tag Value" checkbox.

[0207] This document describes a part of the design for the ALE GUI. Specifically, it provides a controller and model design on which the ALE GUI views are to be built. These components may also be reused by other user interfaces which make use of the RFID Edge Server, ALE and telemetry APIs.

[0208] This section lists key terms and definitions as utilized in the design of one embodiment:

- Model – A data container that holds a view-independent version of system information. Often, models notify registered listeners when changes have occurred in the underlying data.
- Controller – An object that provides a mechanism for getting data into the Model in an application-specific way. The Controller is the link between the Model/View and the real world.
- Telemetry – The RFID Edge Server can have a Telemetry API that provides device status and time-series information on a subscription basis. The client subscribes to a telemetry stream, and the Edge Server begins pushing data to the client, until either the client unsubscribes, or there are enough consecutive delivery failures.
- Time-series information – Various devices on the Edge Server export time-series data streams via the Telemetry API. These data streams are either time/value pairs, or time/gauge pairs, and the names of these streams are device-specific.
- Gauge – a stock-ticker style data point with a high-water mark, low-water mark, and average value for any given time.

[0209] The design encompasses separate controllers and models for the ALE API and the Telemetry API. They can share a few classes which describe edge servers, since this is the common point of reference for both APIs. Each controller can provide methods which can be used to monitor changes to some edge server data. The interface can hide details such as whether a publish/subscribe model or a polling model is used, so as protocols are enhanced, the

GUI can work more efficiently without making changes to the view code. Each controller can also provide access to their underlying connection pools, to provide managed access to server connections for other tasks.

[0210] The use case for these classes can be GUI clients which use network calls which may take a long time to complete or fail, and which the user may wish to cancel. These operations can take place on separate threads so that the interface does not appear to hang to the user.

[0211] The Admin Console GUI can have panels that monitor the state of the edge server and its constituent devices. The device browser can maintain a graphical display of device status in its tree view; the display can update asynchronously, when the edge server can push new telemetry information to the console application.

[0212] When certain device nodes are selected, the device information panel can display the device's associated time-series telemetry charts. When the user can select such a node, the application can send the edge server a telemetry subscription request, and when the user deselects the node, the application can unsubscribe.

[0213] The ECSpec information panel can display an edge server's ECSpecs in a table, and update that information periodically. The ALEController can provide a subscription-like interface to this information so that the pattern of subscribing when the "ECSpecs" node is selected and unsubscribing when leaving the node parallels the device telemetry stream pattern.

[0214] In one embodiment, the design of the ALE GUI can take into account a complex set of requirements.

- The GUI can manage multiple edge servers. This management can use several different APIs (ALE and Telemetry, and possibly others in the future)
- For good user interaction, the GUI can never appear to block. Instead, any long-lived operation can be performed on a separate thread.
- For efficient use of resources, multiple calls to the same API on the same edge server can share a single connection.
- The user can be allowed to cancel operations, even though the underlying network protocol implementation does not always provide a mechanism to interrupt an operation in progress.
- Some of the information needed can be subscribed to, but other information can be polled.

[0215] This design can provide an interface for a local caching model for the ALE API, one for the Telemetry API, and another for the Config API. The model can also include a

listener/event mechanism so that the view can automatically updated when the model is changed. A controller can provide methods which cause periodic updates to the local model to be made which can then be acted on by listeners.

[0216] Figure 9A shows a model exposed by this architecture is a confluence of information and operational methods into one interface that hides the underlying mechanism used to implement the requests. Information from the various edge server interfaces can be merged into this one model; the GUI does not need to know that device status information comes from the telemetry. In one embodiment, the model can hide the fact that, while the association of logical reader name to physical reader comes from the Configuration API, the capability of that logical reader – whether it can read tags, write tags, or both – can be gleaned from the ALE API.

[0217] In one embodiment, while the ConfigAPIModel exposes Readers and CompositeReaders as plugins, the EdgeGUIModel can treat these specially, hiding the reader and composite reader "roles" in favor of specific interfaces for accessing the models. Other plugin-type objects (filters and triggers) can be handled through the plugin role interface, since the admin console should be able to handle new types of objects as they are introduced underneath.

[0218] Figure 9B shows an Endpoint model that encapsulates the information necessary to connect to an edge server. This can simply be a host and port, since the ALE, Config, and Telemetry API URI paths can all be generated from this information. The Endpoint can be constructed from a host/port combination or a string representation. The string representation can be a legacy URI, for backwards compatibility with older Admin Console configurations, or simply a host/port pair of the form "host:port". When the admin console writes the configuration back out, though, legacy URLs can be converted to the new form, "host:port". The URI-based constructor can throw an InvalidURIException, if the String is a malformed URI, or if it is not one of the expected legacy forms.

[0219] In one embodiment, the Endpoint is immutable; to change an edge server endpoint, the endpoint must be removed from the EndpointList under the old value, and re-added with the new value. This object is the key identifier for any edge server connection.

[0220] The Admin Console initialization can generate this configuration manager and passes it into ConsoleGUIModel. As shown in figure 9C, in one embodiment, the ConsoleGUIModel gets its list of endpoints from this object. The config manager can simply handles transfer of the list of endpoints to and from persistence.

[0221] The ConsoleGUIModel can be the top-level Model object for the Admin Console application. It can represent the tree structure of the device browser. It can also hold the ConfigurationManager passed in from the application. It can get the list of connections to edge servers from that object, and uses it to persist changes to that list.

[0222] When an Endpoint is removed from the edge server list, the ConsoleGUIModel can be responsible for making sure that the associated EdgeGUIModel disconnects from the server and that it's associated node is removed from the device tree.

[0223] The Admin Console can read the edge list configuration into a ConsoleConfigurationManager and passes that object to the ConsoleGUIModel constructor. The constructor can create a preliminary EdgeIDTreeModel tree structure with each edge server in the "Unknown" path, and create EdgeModels for each edge server. As the telemetry service returns device path information for each edge server, it can update the EdgeIDTreeModel tree structure to sort those servers into the reported device path.

[0224] The EdgeTreeModel can be a tree structure maintained by the ConsoleGUIModel. The tree structure can mirror the structure present in the device ID paths returned each Edge Server's telemetry. The following invariant can apply to this tree – any node with children is not an endpoint node, and has no associated EdgeGUIModel; all leaves are endpoint nodes that contain a reference to an EdgeGUIModel object.

[0225] As shown in figures 9D and 9E, the EdgeGUIModel can provide a subtree for the ConsoleGUIModel's device tree to include. It can also consolidate the information from the ALEGUIModel, TelemetryGUIModel, and ConfigGUIModel into one full representation.

[0226] An EdgeGUIModel can be constructed to provide access to a single edge server specified by an Endpoint object. It can create an ALEGUIModel, a TelemetryGUIModel, and a ConfigGUIModel with that endpoint and holds those objects. When the EdgeGUIModel is in "active" mode, it can start the TelemetryGUIModel monitoring the telemetry for the associated Edge Server. The EdgeGUIModel can also expose the TelemetrySetModel that holds the edge server's "edge device" telemetry. The EdgeGUIModel can provide access to the edge server's associated devices; readers and composite readers bypass the generic "role" mechanism provided to parallel the ConfigAPI, but other devices can be referenced first by their role on the edge server. Readers can be instead accessed through the getReaderNames/getReader interface, since

these devices have meaning even to an edge server that does not support the Config API. Composite Readers can be the same.

[0227] EdgePluginRole can represent a type of configurable device the Edge Server exposes via the Configuration API. This can simply provide read-only access to filters, per the limitations of the Configuration API. Readers and composite readers can bypass this mechanism, accessed through specific APIs on the EdgeGUIModel; the "reader" and "composite reader" roles can be kept hidden at this layer.

[0228] The EdgePlugin can represent a configurable device exposed by the server's Configuration API. The getConfigurationMeta() method can return the Config API's native PluginMeta object for the associated PluginDevice's Plugin. This dependency on the Config API can be useful because the parameter information structure is complex; it may be useful for these classes to be moved into a more shared component in the future.

[0229] A Reader can represent a Physical Reader device on the edge server. The device can have configuration information (with accessors inherited from the EdgePlugin object) and a TelemetrySet associated with it. It can also have ReadPoints associated with it, each of which has a Logical Reader.

[0230] As shown in figure 9F, in one embodiment, the ALEGUIModel can expose a more UI-centric interface to the information in the ALEController and ALEModel. It can provide direct access to the underlying caching ALEModel and the ECSpecModel. The class can also provide direct access to the ALEController's "Live ALE" object – this object is a wrapper around the ALE interface that automatically checks out a connection, makes the requested call, and then checks the connection back in.

[0231] As shown in figure 9G, in one embodiment, the ECSpecsModel can be a thin extension over the ALEModel (which itself implements the ALE interface to provide cached information). The Admin Console can inform the ECSpecsModel which ECSpecs are "active" – active ECSpecs can have their ECSpecInfo periodically polled and updated in the ECSpecsModel. Similarly, the ALEGUIModel can maintain information on which ECSubscriptions are active.

[0232] As shown in figure 9H, the model/controller abstraction over the ALE API is multi-layered, adding a distinct set of new function at each level. The lowest level, the Connection Pool can enable server connection sharing. The FactoryConnectionPool can use an

AxisALEConnectionFactory to create a simple Axis-based connection to the Edge Server's ALE service and wraps that ALE object in a layer that detects exceptions that are related to the connection to the server. If the connection goes down, that wrapper can mark the associated connection object "suspect." Then when the connection is checked back into the connection pool, the pool knows to remove it. The next level can consist of two classes, the ALEController and the ALEModel. The ALEController can wrap the Connection's ALE object – the ALEController's wrapper maintains the link between data seen over the ALE connection and the cached information in the ALEModel. The ALEController can also have a polling thread that watches for changes in edge server's ECSpecs. Operations on ALEModel can always refer to the cache and never block on network traffic. The ALEModel can implement certain package-private setter methods for use by the ALEController's ALE wrapper. ALEModel can call to define, undefine, redefine, poll, or immediate result in an IllegalOperationException. The ECSpecModel can be a thin layer over ALEModel that provides a connection back to the ALEConnection's polling mechanism.

[0233] As shown in figure 9I, in one embodiment, the next level is the ALEGUIModel, which combines the ALEController and ALEModel into one interface. It can expose the ALEController's live ALE connection, the Worker Queue, and the ECSpecModel.

[0234] This class can implement methods for requesting updates to ECSpecs or ECSubscriptions on an edge server. This can be implemented with a polling thread. If the ALE API can be enhanced or a ConnecTerra-private API is developed in the future to support a subscription mechanism for changes in this data, the implementation can be updated to take advantage of that. The ALEController can use the AlarmClock mechanism from the ConnecTerra Util component to perform this periodic polling.

[0235] The ALEController can also provide a "Live ALE" object which implements the ALE API by wrapping calls with checkout and checkin operations to the ALE Connection pool. This can be useful for callers to perform specific ALE operations, such as creating or deleting ECSpecs, within the ALEController's connection management framework.

[0236] The ALEConnectionFactory instance can return AxisALEClient instances directly or the AxisALEClient object can be wrapped in another class which implements the ALE interface. For each method in the ALE interface which can alter the model, this wrapper class can update the model, perhaps issuing additional ALE method calls if the arguments and return

value are insufficient to understand the model changes. In this way, changes made as a result of user calls can be automatically updated in the model, and if appropriate listeners are in place, the view as well. Additionally, exceptions that indicate an error with the connection can label the associated ALEConnection object as suspect, causing the ConnectionPool to discard the connection and attempt to generate a new one. The ALEController can use the FactoryConnectionPool to adapt this factory class into a connection pool.

[0237] Operations on ALEModel can refer to the cache and never block on network traffic. The ALEModel can implement certain package-private setter methods for use by the ALEController's ALE wrapper. ALEModel calls to define, undefine, redefine, poll, or immediate can result in an IllegalOperationException. The ALEModel object can store the local cached data for all the edge servers which the system is monitoring. There can be methods for adding and removing listeners which receive events whenever the model changes. There can be getter methods for the view to query the model in order to build UI objects. And, there can be setter methods which are used by the controller to update the model, either as a result of a subscription or poll operation, or by the ALE instance wrapper. The ECSpecModel can be a thin layer over ALEModel that provides a connection back to the ALEConnection's polling mechanism.

[0238] As shown in figure 9J, in one embodiment, these listener interfaces can monitor the ALEModel and ECSpecsModel for changes. Each leaf of the tree can listen for a specific type of change. When the listener is added to a model object, the model can maintain list of differentiated listener interfaces, and adds the listener to each list that matches that type. That way, an object can implement as many or as few of these interfaces as it wishes, but it only has to get passed into the model addListener call once to be added to all the relevant internal lists.

[0239] As shown in figure 9K, the TelemetryGUIModel can expose a GUI-specific representation of the telemetry for a given Edge Server. It can lists the device types, and the devices in each type. It can also provide a DeviceTelemetryModel for each device, combining all the telemetry data (alerts, time-series, and attributes) into one object. In one embodiment, only the selected device can have a subscription to telemetry data. The TelemetryGUIModel can subscribe to device status information for all devices, however, and the returned DeviceStatusModel for each device maintains its state based on that. In one embodiment, when the TelemetryGUIModel is disconnected, associated DeviceStatusModels can stop updating.

[0240] As shown in figure 9L, the Device TelemetryModel can represent the information the Edge telemetry provides for any given device. Alert and DeviceAttribute Alert and DeviceAttribute can be objects that implement the interfaces from the Telemetry API.

[0241] As shown in figure 9M, the TelemetrySetListener can be a listener for the DeviceTelemetryModel. The DeviceTelemetryListener can follow the ALEListener pattern with the specific list of interfaces the listener implements being used to dispatch the appropriate

[0242] As shown in figure 9N and 9O, in one embodiment, the Telemetry API can abstracted in a similar way as the ALE API, with succeeding layers adding new functionality to the underlying layer.

[0243] It can implement methods for monitoring device telemetry, which are implemented by subscribing and unsubscribing to TelemetrySpecs. This permits the admin console to subscribe just to the telemetry needed to update whatever UI objects are visible to the user. It also can include methods for checking a Telemetry connection object out of the connection pool, and checking it back in when done. Additionally, the TelemetryController can keep track of failed unsubscription attempts; if telemetry associated with a terminated subscription arrives, it can assume the connection has been reestablished, and it attempts to resend the unsubscribe request.

[0244] In one embodiment, when the TelemetryController attempts to unsubscribe to a telemetry stream and fails for some transient reason, it does not expose that failure to its callers. Instead, it can pass information about the failed subscription to its contained TelemetryModelUnsubscriptionHandler object. This object can subscribe to telemetry information from the HTTP server, and when it recognizes data associated with a failed unsubscription, it can attempt again to unsubscribe from that telemetry stream. A race condition could arise if the UI attempts to subscribe to a stream that has, during a previous interaction, had a failed unsubscription attempt. In this situation the TelemetryUnsubscriptionListener could potentially unsubscribe shortly after the new subcription is established. To avoid this, the TelemetryController can inform the TelemetryUnsubscriptionListener of new subscription requests before making the subscription request. The TelemetryUnsubscriptionListener can detect a match in its list of failed unsubscriptions and remove matching entries from its list. The Worker Queue mechanism can be used to serialize these requests, making sure the removal from the Handler's list completes before the new subscription is attempted.

[0245] As shown in figure 9P, in one embodiment, the TelemetryHTTPServer can be an HTTP server thread that receives Telemetry streams from Edge Servers, converts the received XML data into TelemetryReports objects (from the TelemetryAPI component) and passes them on to listeners. In one embodiment, the TelemetryModel and the TelemetryUnsubscriptionListener are the only two objects that will listen to the streams at this level of abstraction.

[0246] As shown in figure 9Q, in one embodiment, the ConfigGUIModel can hide the Reader and Composite Reader roles from the Config Model and exposes the reader devices through a specific interface. This can parallel the fact that the GUI will treat these devices specially, and the plugin interface exposed out of this layer can be used in a generic fashion to display the rest of the configurable objects. PhysicalReader can wrap a reader-type EdgePlugin. It can implement the getLogicalReaderNames call by going through the configuration for the reader and assuming all parameters of type "logical reader name" represent a logical reader defined by this physical reader.

[0247] PhysicalReader can wrap a composite reader-type EdgePlugin. It can understand the configuration specifics of the composite reader and exports a specific interface for that configuration task. The ConfigModel can be a cache for all of the configuration on an Edge Server. The ConfigController can be responsible for keeping the ConfigModel up to date. A refresh can be triggered manually at the GUI level, though this may easily be extended to involve the AlarmClock with a polling interval, as in the ALEController. It can depend on the use case; the configuration is not expected to change often.

[0248] As shown in figure 9R, ConfigListener can follow the pattern established by ALEListener and TelemetryListener. Additional specific change listeners can be added as they are needed.

[0249] Figure 10 shows an exemplary logical model. The TelemetryController can coordinate all monitoring data (counters, gauges, subscription status, last activated counts, etc.) coming from the edgeserver. (Note that some of the data comes from traditional telemetry methods, and other parts of it come from ALE APIs). Whether the actual data is pulled or pushed doesn't matter, it can be stored and retrieved by this controller by mapping telemetry data items to deviceID. In one embodiment, get operations may be implemented differently – pull operations would be executed when gets are called, whereas push operations would retrieve

stored data as it comes in from the edgeserver. The end result however, is that the rest of the GUI application does not need to distinguish between push/pull modes, which will make it easy to change these modes for various data as desired in the future. Models can be thread safe since they will be accessed/modified from various threads, including the main dispatch thread.

[0250] The EdgeServerController can maintain the configuration data for edgeservers, as well as maintaining a mapping of deviceID to various EdgeServer client interfaces. Since the rest of the GUI application speaks of selectable devices in terms of their "deviceID", they may ask the EdgeServerController for AxisALEClient interfaces or TelemetryClient interfaces by "deviceID" instead of having to ask for the service URL. AxisALEClient can be used rather than the more general ALEClient or ALE because access to the underlying factory methods is necessary for much of the construction work required of things like the ECSpec frame, etc.

[0251] The DeviceBrowserController can take care of building and maintaining the main tree control for the application. It can use the EdgeServerController to iterate all the configured Edgeservers and list devices/specs/subscribers. It also can use the TelemetryController to detect changes in device status.

[0252] Tasks that may take a long time are typically tasks using the EdgeServer in some way. In one embodiment, these tasks may be initiated in the following contexts:

- the task needs to execute synchronously – i.e. other user action is not allowed to occur, however wait_cursor is updated during this task over the affected frames.
- the task may execute asynchronously – i.e. the user can browse other items while this task is completing. Visual feedback that an action is being processed can be given in the form of a progress dialog.

Examples of tasks:

1. populating the device browser tree – (asynchronous trickle – user should be able to select while other parts of tree are loading rather than have to wait for the entire tree to load at once and on every update.) By and large this can be handled in the implementation of TelemetryController, which will spawn a worker thread for interrogating pull data, and have separate listener threads for receiving push data.
2. populating monitor data (ecspec monitor, subscribers monitor, etc) – again can be handled by telemetryController.
3. edit, deploy, activate once, test – any of these operations can open a progress dialog. They all can have have well known end states: the progress dialog closes and
    a. edit – the ECSpec or ECSubscriber edit frame opens. (on success only)
    b. commit the ECSubscriber – ECSubscriber edit frame closes. (on success only)
    c. deploy – the ECSpec edit frame closes. (on success only)
    d. activate once – the TextView frame opens with the ECReport (success only)

e. test - the TextView frame opens with the ECReport (success only)

[0253] Figure 11A shown an example of site ID selection of one embodiment.

[0254] Figure 11B illustrates the configuration edge server and preferences of one embodiment.

[0255] Figure 11C illustrates telemetry selection of one embodiment.

[0256] Figure 11D illustrates alert selection of one embodiment.

[0257] Figure 11E illustrates attribute selection of one embodiment.

[0258] Figure 11F illustrates monitor selection of one embodiment.

[0259] Figure 11G illustrates PC specs folder selection of one embodiment.

[0260] Figure 11H illustrates EPCSpce selection of one embodiment.

[0261] The read-only view of a ecspec can display the collapsed view for every leaf node, and can expand every non-leaf node. Collapsed leaf nodes can display the full content of information summarized. No nodes can be collapsed or expanded in read-only mode – they are a fixed presentation. Any editable fields can be locked during read-only mode. A fall-back alternative to this kind of display is to use a text-view representation of the ECSPec and just make this a text control.

[0262] Figures 11I and 11J illustrate an ECSpec frame of one embodiment.

[0263] The components in this section can be expandable and collapsible views. Each leaf node can have a collapsible view; all non-leaf nodes can be collapsible in edit view, but not in read-only view as described in the preceding section. Selecting "Deploy" or "Redeploy" closes the ECSpec being edited after successfully deploying.

[0264] Figures 11K, 11L, 11M, 11N and 11O illustrate the configuring of an ECSpec of one embodiment.

[0265] Figures 11P, 11Q and 11R illustrate a subscriber frame windows of one embodiment.

[0266] Figure 11S illustrates a text view frame of one embodiment.

[0267] This document outlines an exemplary EPC Provisioning Service.

[0268] This section lists key terms and definitions as utilized in the design of one embodiment. EPC Pool: A named list of EPCs maintained in the provisioning system. EPCs may be checked out or checked in to the pool by outside applications. Identity Type: As used in

EPC Tag Data Standards document. Examples of some identity types used in this design doc are GTIN, SSCC, DoD Construct. Pool Name, Cache Name: This design assumes that the name of a cache in the Edge Server is the same as the pool name in the provisioning service. Therefore the terms pool name and cache name can be used interchangeably in this document.

[0269] Tag writing systems can use a central authority from which they can receive unique EPCs. The EPC Provisioning Service is designed to satisfy this need. In addition to providing a service to give out unique EPCs, a design goal is also to make it easy for administrators to define and maintain pools. Administrators can be able to specify parameters based on which naming of pools and EPC allocations to pool can be done automatically. The service can be generic enough to work with different server products as well as third party products.

- Local workflow can check out EPCs from the provisioning service by specifying the parameters for the checkout. An example of the parameters specified is (GTIN=10037000308048, TAG_LENGTH=64, LOCATION_ID=tag@ship-station-1). The provisioning service can check to see if the set of parameters has access to a pool and then returns EPCs to the local workflow. In this process, as required, the provisioning service may create a new pool and allocate EPCs to it. The EPCs given out will be marked as 'allocated' by the provisioning service.
- Provisioning system can receive a tag-cache-low report from the RFID Edge Server. The provisioning service will checkout EPCs from the correct pool and replenish the cache in the Edge Server.
- Administrator finds out that a product or station must no longer be allowed to get EPCs from the provisioning service. Administrator can make changes to the provisioning service and requests with those parameters will be denied access.
- An edge server tag cache can be reset and the EPCs left in the cache is released back to the provisioning service. The provisioning service removes these from allocated list and puts them back in the available list.
- Administrator finds out that a tagging station needs to switch from using 64 bit tags to 96 bit tags. Administrator can set up pool naming policy and pool population policy to enable that.

[0270] The provisioning service system can be composed of 2 main components:

1. EPC Provisioning Service: This can be a web service that will provide generic provisioning related operations like administering EPC pools, checkout or check-in from EPC pools etc.
2. Integration Component: This component is used to integrate between the RFID Edge Server and the provisioning service. This component can accept cache-low notifications from the edge server and replenish the cache.

[0271] There can be a web based GUI for administering the provisioning system. This GUI will be developed using Java Server Faces (JSF) technology and communication with the provisioning service can be through the web service interface. Local workflows can communicate with the EPC Provisioning Service or RFTA Integration Component as needed.

[0272] Figure 12 A illustrates an exemplary providing architecture of one embodiment.

[0273] Figure 12B shows interaction between local workflow components, edge server and EPC provisioning system when the local workflow encounters a new item for which it may need to define a cache at the edge server of one embodiment.

[0274] Figure 12C shows the interactions between the edge server, RFTA Integration Component and EPC Provisioning Service when the edge server detects that a cache's size has reached the low threshold value of one embodiment.

[0275] The design overview diagram for a EPC provisioning web service can be similar to other web services in Enterprise Server.

[0276] VCC components for this can be:

1. EPCPS_API: This will contain the public facing interfaces (java, wsdl and xsd)
2. EPCPS_Axis: Axis generated classes common to client and server sides of an axis service. Also contains adapter classes for axis generated classes.
3. EPCPS_Client: Implementation of public facing java interface.
4. EPCPS_Engine: Server side implementation of public facing java interfaces which will be used by all the different web service implementations.
5. EPCIS_Service: Different web-service implementations (for example: Axis, BEA) of the provisioning service.

[0277] The component can accept EPC Cache Low report from the edge server and replenish the corresponding cache. This can be accomplished using a message driven bean that will accept 2 kinds of messages:

1. Define cache parameters: This message can associate a cache with its edge server URL, filter value, tag size and chunk size. A cache can identified using the cache name and savant ID.
2. EPC Cache low report: This report will be sent by the edge server when the cache falls below a certain pre-specified value. The message driven bean can get EPCs for replenishment from the provisioning service and replenish the cache (the URL for the edge server can be specified by message 1).

[0278] The message driven bean can delegate all the business logic work to a simple java class, so that supporting other communication mechanisms in the future will be easy. RFID integration component can communicate with the EPC Provisioning Service through local EJB interfaces to avoid communication overheads.

[0279] Figure 12D illustrates an exemplary embodiment of one embodiment.

[0280] Figure 12E illustrates an exemplary key classes UML of one embodiment.

[0281] Pool attributes can represent attributes like which GTIN this pool was created for ([GTIN, <gtin-value] will be the name-value pair in this case) or what tag-length the pool is for etc. Allocated EPCs can give EPCs that were allocated and opaque id of the destination of the EPCs. In one embodiment, an EPC Pool cannot contain EPCs of more than one tag-type. The EPCs can be stored as pure identities.

[0282] Figure 12F illustrates exemplary EPC provisioning policy changes of one embodiment.

[0283] Com.connecterra.epcps.api.policyConfiguration.PoolAllocationConfiguration Class can serve as the super-type for different pool allocation configurations that may be supported by the provisioning service. Using the pool allocation configuration administrator can define which pool gets allocated for a given set of pool definition parameters and also define how the pool may get populated.

[0284] com.connecterra.epcps.api.policyConfigurations.SimplePoolAllocationConfiguration Class can allows you to make associations between an EPCPoolDefinitionParameters, identity type, and a serial number range. This association can define how to select a pool and how the pool gets populated initially. The order of the associations can be maintained and is used when matching an input request with the definitions. On receiving a request for an EPC pool based on an input EPCPoolDefinitionParameters, the first AllocationForPoolDefinition that matches the input EPCPoolDefinitionParameters can be selected. Using this, you can get the pool name and if needed, the initial range for the pool.

[0285] com.connecterra.epcps.api.policyConfigurations.PoolAccessConfiguration Class can be a Super-type for different pool access configurations that may be supported by the provisioning service.

[0286] com.connecterra.epcps.api.policyConfigurations.SimplePoolAccessConfiguration Class can be an interface lets you disallow access to EPC pools for certain pool definition parameters. This can be a simple configuration where you only configure negative entries. If any of the parameters in an input request matches any of the denied parameters, the request need not be granted access to an EPC pool.

[0287] Figure 12G shows key class UML for an EPC provisioning service engine of one embodiment.

[0288] com.connecterra.epcps.engine.PoolAccessPolicy Class can be the contract for pool access policies. com.connecterra.epcps.engine.SimplePoolAccessPolicy Class can be the Class that implements pool access policy using the SimplePoolAccessConfiguration. com.connecterra.epcps.engine.IdentityTypeExtractor can be the Class Interface that lets you get to a IdentityType from a given EPCPoolDefinitionParameters object.com.connecterra.epcps.engine.NameBasedExtractor Class can be the Class that gets a IdentityType by looking for identity type names (defined in IdentityTypeName) in the parameter list. com.connecterra.epcps.engine.PoolSelectionPolicy Class can be the contract for policies that let you select a pool name from a given EPCPoolDefinitionParameter. com.connecterra.epcps.engine.PoolPopulationPolicy Class can be the contract for policies that gives you the range for populating a pool based on an EPCPoolDefinitionParamter. com.connecterra.epcps.engine.SimplePoolAllocationPolicy Class can implement PoolSelectionPolicy and PoolPopulationPolicy. It can use the SimplePoolAllocationConfiguration that may be specified by the administrator.

[0289] Figure 12H is a sequence diagram showing how the different classes interact with each other on a validatePool call of one embodiment:

[0290] Exemplary EPC provisioning data structure.

EPC_Pool

Column Name	Column Type	Constraints
pool_id	integer	Primary Key
pool_name	varchar2(255)	Unique Index
creation_date	date	
last_modified_date	date	

Pool_Attributes

Column Name	Column Type	Constraints
attr_row_id	Integer	Primary Key
pool_id	integer	Indexed
attr_name	varchar2(255)	Indexed
attr_value	varchar2(255)	Indexed

[0291] Separate tables can be used for allocated and unallocated EPCs in a pool. This can be done so that searches on the unallocated EPC pattern list will not be slowed down because of all the allocated EPCs. The allocated EPC pattern list can be assumed to grow very long.

[0292] Similarly, different tables can be used to store different types of tag, instead of one table storing the EPC pattern string. This way searching on individual fields in the pattern in the database can be efficient. We can search on the individual fields when assigning EPCs to a pool, allocating EPCs to a client, checking in EPCs etc.

[0293] Exemplary Tables for allocated and unallocated EPCs for SGTIN patterns are shown below:

SGTIN_Unallocated_Epcs

Column Name	Column Type	Constraints
Unallocated_epcs_id	integer	Primary Key
pool_id	integer	Indexed
company_prefix	varchar2(12)	Indexed
item_ref_and_ind	varchar2(7)	Indexed
serial_range_start	long	Indexed
serial_range_end	long	Indexed
creation_date	date	

SGTIN_Allocations

Column Name	Column Type	Constraints
allocation_id	integer	Primary Key
pool_id	integer	Indexed
company_prefix	varchar2(12)	Indexed
item_ref_and_ind	varchar2(7)	Indexed
serial_range_start	long	Indexed
serial_range_end	long	Indexed

SGTIN_Allocation_Details

Column Name	Column Type	Constraints
allocation_details_id	integer	Primary Key
allocation_id	integer	Indexed
Destination_id	varchar2(255)	Indexed
serial_range_start	long	Indexed
serial_range_end	long	Indexed
allocation_date	date	

[0294] Exemplary Pool Access Policy Configuration

Access_Parameters

Column Name	Column Type	Constraints
parameter_name	varchar2(255)	Primary Key

Access_Parameter_Values

Column Name	Column Type	Constraints
row_id	integer	Primary Key
parameter_name	varchar2(255)	Indexed
parameter_value	varchar2(255)	

[0295] Exemplary Pool Allocation Policy Configuration

Pool_Allocation_Configuration

Column Name	Column Type	Constraints
config_row_id	integer	Primary Key
identity_type_name	varchar2(255)	Indexed
range_start	long	
range_end	long	
Ordinal	int	

Pool_Allocation_Parameters

Column Name	Column Type	Constraints
row_id	integer	Primary Key
config_row_id	integer	Indexed
parameter_name	varchar2(255)	Indexed
parameter_value	varchar2(255)	Indexed

[0296] Figure 12I shows an exemplary integration component of one embodiment.

[0297] Admin application can provide the following functionality:

- Defining EPC pool configurations – "Define Pool Configuration" screen
- Viewing and editing existing pool configurations – "View Pool Configurations" screen
- Viewing details of existing EPC pools – "View Pools" screen

[0298] Admin application can be implemented as a Web Application deployable into any Application Server (JBoss, WebLogic, etc.) as a WAR file. Main implementation technologies can be JSP and JSF (Java Server Faces).

[0299] Figure 13A shws an exemplary EPC pool page of one embodiment.

[0300] Figure 13B provides detailed information about existing pool configurations. Pool configurations can be represented in a table format in the correct order of one embodiment. The rows of the table (individual pool configurations) can be:

- deleted by checking the check-box in the leftmost column and clicking the "Delete" button located underneath the table
- re-ordered by using "Up" and "Down" buttons associated with the rows

- edited by clicking "Edit" buttons associated with the rows. This action will bring up a pop-up window with the "Define Pool Configuration" screen defined in the next section populated with the data of the selected pool configuration

[0301] A new pool configuration can be created by clicking on the "Create New Configuration" button. This can open a new screen, "Define Pool Configuration".

[0302] This screen can be used by an administrator to define parameters of a new pool configuration. The same screen is used for editing parameters of an existing pool configuration. The following pool configuration options can be set here:

- Identity Type – a pull-down menu with pre-defined supported identity types (GTIN or SSCC, for example)
- Pool Parameters – Name/Value pairs of pool parameters (for example, location_id). Represented in a table format. Table rows can be added or deleted.
- EPC Pool range start and end values – range of EPCs allowed in this pool

[0303] Figure 13C shows a draft representation of a screen of one embodiment.

[0304] Figure 13D shows a screen containing information about existing EPC pools of one embodiment. The screen can be divided into two parts. The upper half can contain a table with the list of existing pools and some brief information about the pools.

[0305] Each row (pool) can have an associated "View" button. Clicking on the view button can brings up detailed information about selected pool into the table in the lower half of the screen.

[0306] Figure 13E shows checked out EPCS of one embodiment.

[0307] Available EPCs can be deleted from the pool by checking the check boxes of the corresponding table rows and clicking on the "Delete EPCs" button. More EPCs can be added to the pool by clicking on the "Add EPCs" button. As a result, a pop-up window can appear where a range of EPCs to be added can be specified.

[0308] Figure 13F illustrates a screen for adding EPCs.

[0309] Figure 13G illustrates a screen for checking in EPCs.

[0310] Checked out EPCs can be checked back into the pool by clicking the "Check In" button.

[0311] One embodiment may be implemented using a conventional general purpose of a specialized digital computer or microprocessor(s) programmed according to the teachings of the present disclosure, as will be apparent to those skilled in the computer art. Appropriate software coding can readily be prepared by skilled programmers based on the teachings of the present

discloser, as will be apparent to those skilled in the software art. The invention may also be implemented by the preparation of integrated circuits or by interconnecting an appropriate network of conventional component circuits, as will be readily apparent to those skilled in the art.

[0312] One embodiment includes a computer program product which is a storage medium (media) having instructions stored thereon/in which can be used to program a computer to perform any of the features present herein. The storage medium can include, but is not limited to, any type of disk including floppy disks, optical discs, DVD, CD-ROMs, micro drive, and magneto-optical disks, ROMs, Rams, EPROMs, EEPROMs, Drams, Rams, flash memory of media or device suitable for storing instructions and/or data.

[0313] Stored on any one of the computer readable medium (media), the present invention includes software for controlling both the hardware of the general purpose/specialized computer or microprocessor, and for enabling the computer or microprocessor to interact with a human user or other mechanism utilizing the results of the present invention. Such software may include, but is not limited to, device drivers, operating systems, execution environments/containers, and user applications.

[0314] The forgoing description of preferred embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations will be apparent to one of ordinary skill in the relevant arts. For example, steps preformed in the embodiments of the invention disclosed can be performed in alternate orders, certain steps can be omitted, and additional steps can be added. The embodiments where chosen and described in order to best explain the principles of the invention and its practical application, thereby enabling others skilled in the art to understand the invention for various embodiments and with various modifications that are suited to the particular used contemplated. It is intended that the scope of the invention be defined by the claims and their equivalents.

CLAIMS

What is claimed is:

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1. An RFID edge server to configure multiple associated RFID readers, the RFID edge server receiving configuration info for at least one of the associated RFID readers, the RFID edge server updating the configuration of at least one of the associated RFID readers without restarting at least one other RFID reader of the associated RFID readers.

2. The RFID edge server of claim 1, wherein the configuration info is maintained as metadata-based description at the RFID edge server.

3. The RFID edge server of claim 2, wherein the configuration is sent to the RFID reader in a format specific to the RFID reader.

4. The RFID server of claim 1, wherein the at least one of the RFID readers providing data for a software application.

5. The RFID edge server of claim 4, wherein the RFID edge server restarts the at least one RFID reader without restarting the software application.

6. The RFID edge server of claims 1, wherein the at least one RFID reader is restarted in between the timed transfer of RFID data to the RFID edge server.

7. An RFID edge server to configure multiple associated RFID readers, the RFID edge server receiving configuration info for at least one of the RFID readers, the at least one RFID readers providing data for a software application, wherein the RFID edge server restarts the at least one RFID reader without interrupting the operation of the software application.

8. The RFID edge server of claim 7, wherein the configuration info is maintained as metadata-based description at the RFID edge server.

9. The RFID edge server of claim 8, wherein the configuration is sent to the RFID reader in a format specific to the RFID reader.

10. The RFID edge server of claims 7, wherein the at least one RFID reader is restarted in between the timed transfer of RFID data to the RFID edge server.

11. A computer implemented method comprising:

receiving configuration info for at least one associated RFID reader at a RFID edge server; and

updating the configuration of the at least one associated RFID reader without restarting the at least one other RFID reader associated with the RFID edge server.

12. The computer implemented method of claim 11, wherein the configuration info is maintained as metadata-based description at the RFID edge server.

13. The computer implemented method of claim 12, wherein the configuration is sent to the RFID reader in a format specific to the RFID reader.

14. The computer implemented method of claim 11, wherein the at least one of the RFID readers providing data for a software application.

15. The computer implemented method of claim 14, wherein the RFID edge server restarts the at least one RFID reader without restarting the software application.

16. The computer implemented method of claims 11, wherein the at least one RFID reader is restarted in between the timed transfer of RFID data to the RFID edge server.

17. A computer implemented method comprising:

receiving at a RFID edger server configuration info for at least one associated RFID reader, the associated RFID reader providing RFID data for a software application; and

initiating restart of the associated RFID reader without interrupting the operation of the software application.

18. The computer implemented method of claim 17, wherein the configuration is sent to the RFID reader in a format specific to the RFID reader.

19. The computer implemented method of claim 17, wherein the at least one of the RFID readers run a software application.

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BEAS-2024US2

1. A computer readable medium with a metadata-based description of the configuration of an RFID reader, wherein an RFID edge server is adapted to interact with the medadata-based description to configure the RFID reader.

2. The computer readable medium of claim 1, wherein the metadata-based description includes configuration parameters.

3. The computer readable medium of claim 2, wherein the configuration parameters include parameter name.

4. The computer readable medium of claim 2, wherein the configuration parameters include description.

5. The computer readable medium of claim 2, wherein the configuration parameters include type.

6. The computer readable medium of claim 2, wherein the configuration parameters includes default value.

7. The computer readable medium of claims 1, wherein the RFID edge server uses a console to input configuration data.

8. The computer readable medium of claim 7, wherein there are different metadata based descriptions are used for different RFID readers.

9. The computer readable medium of claim 1, wherein the RFID edge server converts data input by users into a configuration for an RFID readers.

10. The computer readable medium of claim 1, wherein the metadata is used to produce an interface to get configuration data.

11. The computer readable medium of claims 1, wherein at least one filter has a metadata-based description.

12. A computer based method comprising:

receiving a metadata based description of RFID reader and configuration; and

using the metadata based description to produce an interface to input a configuration for the RFID reader.

13. The computer based method of claim 12, wherein the metadata-based description includes configuration parameters.

14. The computer based method of claim 13, wherein the configuration parameters include parameter name.

15. The computer based method of claim 13, wherein the configuration parameters include description.

16. The computer based method of claim 13, wherein the configuration parameters include type.

17. The computer based method of claim 13, wherein the configuration parameters include default value.

18. The computer based method of claims 12, wherein the RFID edge server uses a console to input configuration data.

19. The computer based method of claim 18, wherein there are different metadata based descriptions are used for different RFID readers.

20. The computer based method of claim 12, wherein the RFID edge server converts data input by users into a configuration for an RFID readers.

21. The computer based method of claim 12, wherein the metadata is used to produce an interface to get configuration data.

22. The computer based method of claims 12, wherein at least one filter has a metadata-based description.

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4. A console for an RFID edge server including a graphical interface to receive ALE filer information such that the graphical interface allows the selection of ALE filters on an RFID edge server.

5. The console of claim 1, wherein the filters are associated with an RFID reader.

6. The console of claim 1, wherein a list of available ALE filters is displayed.

7. The console of claim 3, wherein the graphical interface allows the selection of one of the available ALE filters.

8. The console of claim 1, wherein the graphical interface shows filters in a filter chain.

9. The console of claim 1, wherein the graphical interface allows the repositioning of filters in the filter chain.

10. A computer implemented method comprising:
using a graphical interface to select an ALE filter; and
using the selected ALE filter to filter RFID tag data at an RFID edge server.

11. The computer implemented method of claim 7, wherein the filters are associated with an RFID reader.

12. The computer implemented method of claim 7, wherein a list of available ALE filters is displayed.

13. The computer implemented method of claim 9, wherein the graphical interface allows the selection of one of the available ALE filters.

14. The computer implemented method of claim 7, wherein the graphical interface shows filters in a filter chain.

15. The computer implemented method of claim 7, wherein the graphical interface allows the repositioning of filters in the filter chain.

16. A computer readable medium including code to:
receiving a selection of an ALE file filter from a graphical interface; and
using the selected ALE filter to filter RFID tag data at an RFID edge server.

17. The computer readable medium of claim 13, wherein the filters are associated with an RFID reader.

18. The computer readable medium of claim 13, wherein a list of available ALE filters is displayed.

19. The computer readable medium of claim 15, wherein the graphical interface allows the selection of one of the available ALE filters.

20. The computer readable medium of claim 13, wherein the graphical interface shows filters in a filter chain.

21. The computer readable medium of claim 13, wherein the graphical interface allows the repositioning of filters in the filter chain.

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8. A system comprising:

a EPC server adapted to dynamically provide EPC code blocks for one product to multiple client sites; and

the client sites using EPC codes of the EPC code block for RFID tags.

9. The system of claim 1, wherein the client sites are RFID edge servers.

10. The system of claim 1, wherein the EPC server is adapted to use business rules to assign the EPC code blocks.

11. The system of claim 3, wherein EPC codes are assigned so as to indicate lot number.

12. The system of claim 3, wherein the EPC codes are assigned so as to indicate location.

13. The system of claim 1, wherein the client sites cache EPC codes for later use.

14. The system of claim 1, wherein the client sites request the EPC code blocks.

15. A computer-implemented method comprising:
dynamically providing EPC code blocks for one product to multiple client sites; and
using EPC codes of the EPC code blocks for RFID tags at the client sites.

16. The computer-implemented method of claim 8, wherein the client sites are RFID edge servers.

17. The computer-implemented method of claim 8, wherein the EPC server is adapted to use business rules to assign the EPC codes.

18. The computer-implemented method of claim 8, wherein EPC codes are assigned so as to indicate lot number.

19. The computer-implemented method of claim 8, wherein the EPC codes are assigned so as to indicate location.

20. The computer-implemented method of claim 8, wherein the client sites cache EPC codes for later use.

21. The computer-implemented method of claim 8, wherein the client sites request the EPC code blocks.

22. A computer readable medium including code to:
dynamically provide EPC code blocks for one product to multiple client sites; and
using the EPC codes of the EPC code blocks for RFID tags at the client sites.

23. The computer readable medium of claim 15, wherein the client sites are RFID edge servers.

24. The computer readable medium of claim 15, wherein the EPC server is adapted to use business rules to assign the EPC codes.

25. The computer readable medium of claim 15, wherein EPC codes are assigned so as to indicate lot number.

26. The computer-implemented method of claim 15, wherein the EPC codes are assigned so as to indicate location.

27. The computer-implemented method of claim 15, wherein the client sites cache EPC codes for use later.

28. The computer-implemented method of claim 15, wherein the client sites request the EPC code blocks.

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7. An EPC provisioning system comprising:

a EPC server adapted to dynamically provide EPC code blocks for one product to multiple client sites, the EPC server adapted to use business rules to determine the EPC codes for the multiple client sites.

8. The system of claim 1, wherein the client sites are RFID edge servers.

9. The system of claim 1, wherein the client sites using the EPC codes for RFID tags.

10. The system of claim 3, wherein EPC code blocks are assigned so as to indicate lot number.

11. The system of claim 3, wherein the EPC code blocks are assigned so as to indicate location.

12. The system of claim 1, wherein the client sites cache EPC codes for later use.

13. The system of claim 1, wherein the client sites request the EPC code.

14. A computer implemented method comprising:
using business rules to determine the EPC code blocks for multiple sites; and
providing the EPC code blocks to multiple sites.

15. The computer implemented method of claim 8, wherein the client sites are RFID edge servers.

16. The computer implemented method of claim 8, wherein the client sites use the EPC codes for RFID tags.

17. The computer implemented method of claim 10, wherein EPC codes are assigned so as to indicate lot number.

18. The computer implemented method of claim 10, wherein the EPC codes are assigned so as to indicate location.

19. The computer implemented method of claim 8, wherein the client sites cache EPC codes for use later.

20. The computer implemented method of claim 8, wherein the client sites request the EPC code blocks.

21. A computer readable medium including code to:
use business rules to determine the EPC code blocks for multiple client sites; and

provide the EPC code blocks to multiple client sites.

22. The computer readable medium of claim 15, wherein the client sites are RFID edge servers.

23. The computer readable medium of claim 15, wherein the client sites use the EPC codes for RFID tags.

24. The computer readable medium of claim 17, wherein EPC codes are assigned so as to indicate lot number.

25. The computer readable medium of claim 17, wherein the EPC codes are assigned so as to indicate location.

26. The computer readable medium of claim 15, wherein the client sites cache EPC codes for later use.

27. The computer readable medium of claim 15, wherein the client sites request the PEC code blocks.

ABSTRACT

BEAS-2024US1

An RFID edge server can receive configuration info for an associated RFID reader. The RFID edge server can update the configuration of the associated RFID reader without restarting another RFID reader of the associated RFID readers.

BEAS-2024US2

A computer readable medium can be a metadata-based description of the configuration of an RFID reader. An RFID edge server can interact with the medadata-based description to configure the RFID reader.

BEAS-2024US3

A console for an RFID edge server can include a graphical interface to receive ALE filer information such that the graphical interface allows the selection ALE filters on an RFID edge server.

BEAS-2024US4

An EPC server can dynamically provide EPC code blocks for one product to multiple client sites. The client sites can use EPC codes of the EPC code block for RFID tags.

BEAS-2024us5

An EPC provisioning system comprising a EPC server can dynamically provide EPC code blocks for one product to multiple client sites. The EPC server can use business rules to determine the EPC codes for the multiple client sites.

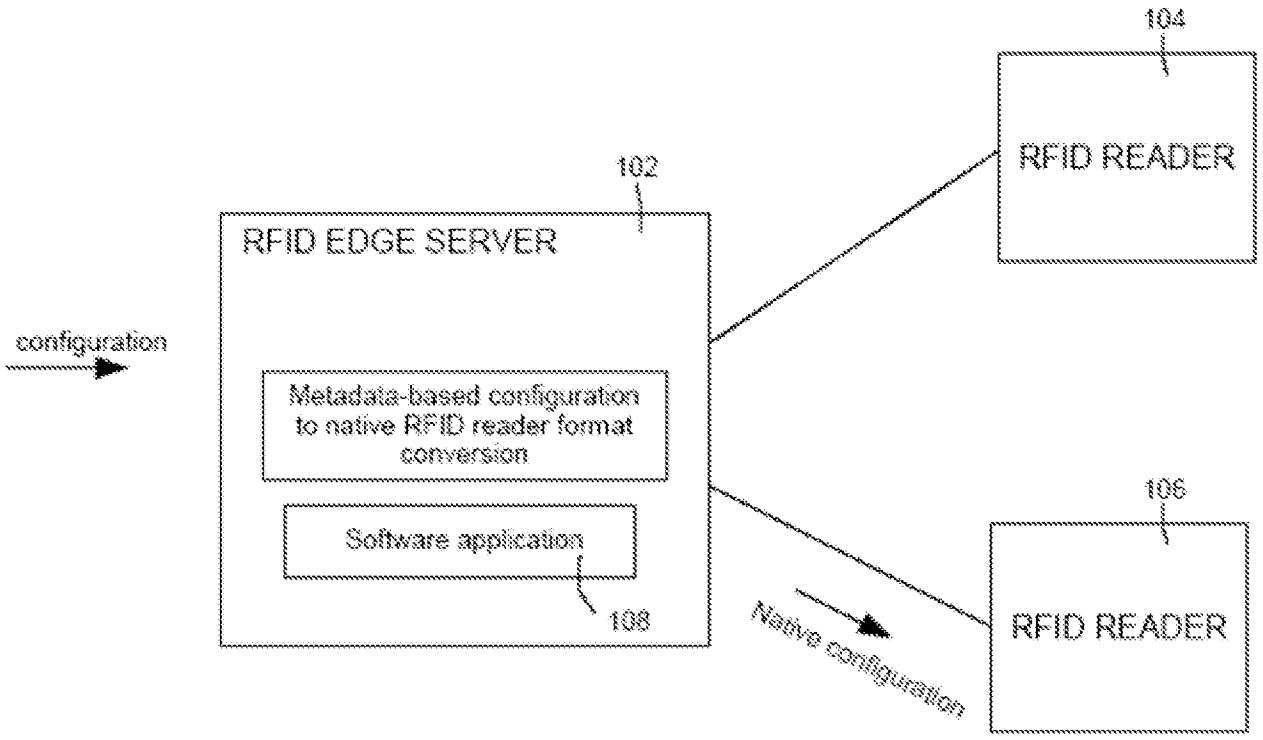

104
RFID READER
102
RFID EDGE SERVER
configuration
Metadata-based configuration to native RFID reader format conversion
Software application
108
106
RFID READER
Native configuration

FIGURE 1

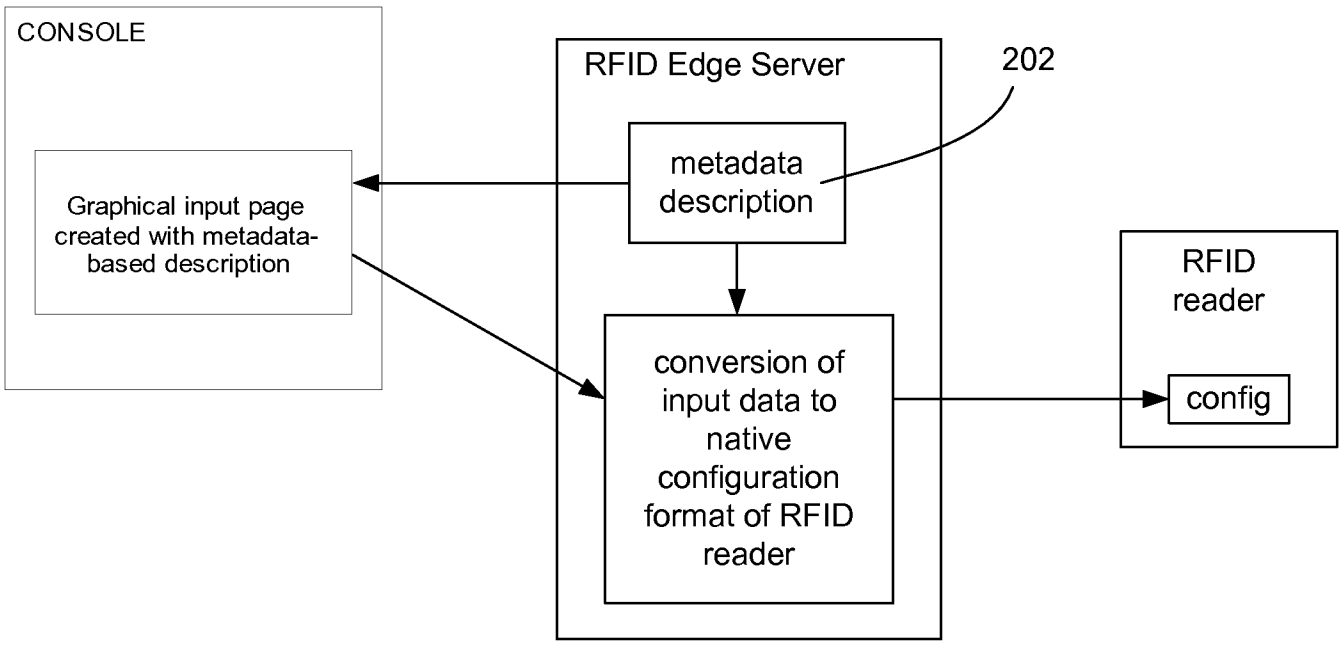

CONSOLE
Graphical input page created with metadata-based description
RFID Edge Server
202
metadata description
conversion of input data to native configuration format of RFID reader
RFID reader
config

FIGURE 2

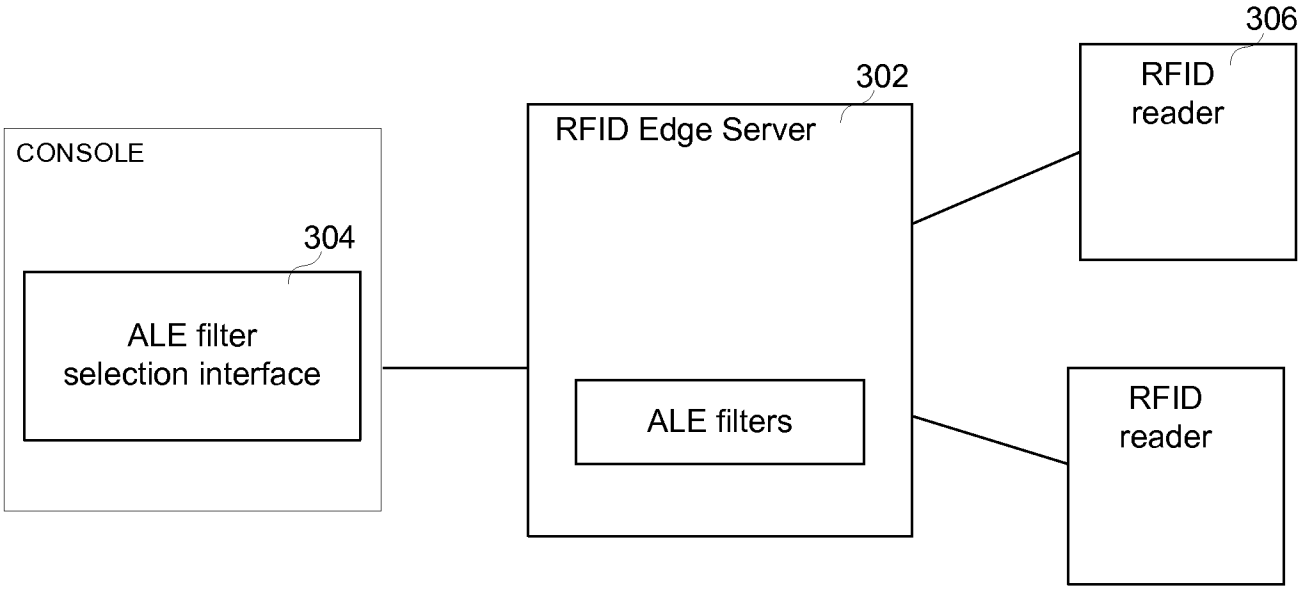

306
RFID
reader
302
RFID Edge Server
CONSOLE
304
ALE filter
selection interface
ALE filters
RFID
reader

FIGURE 3

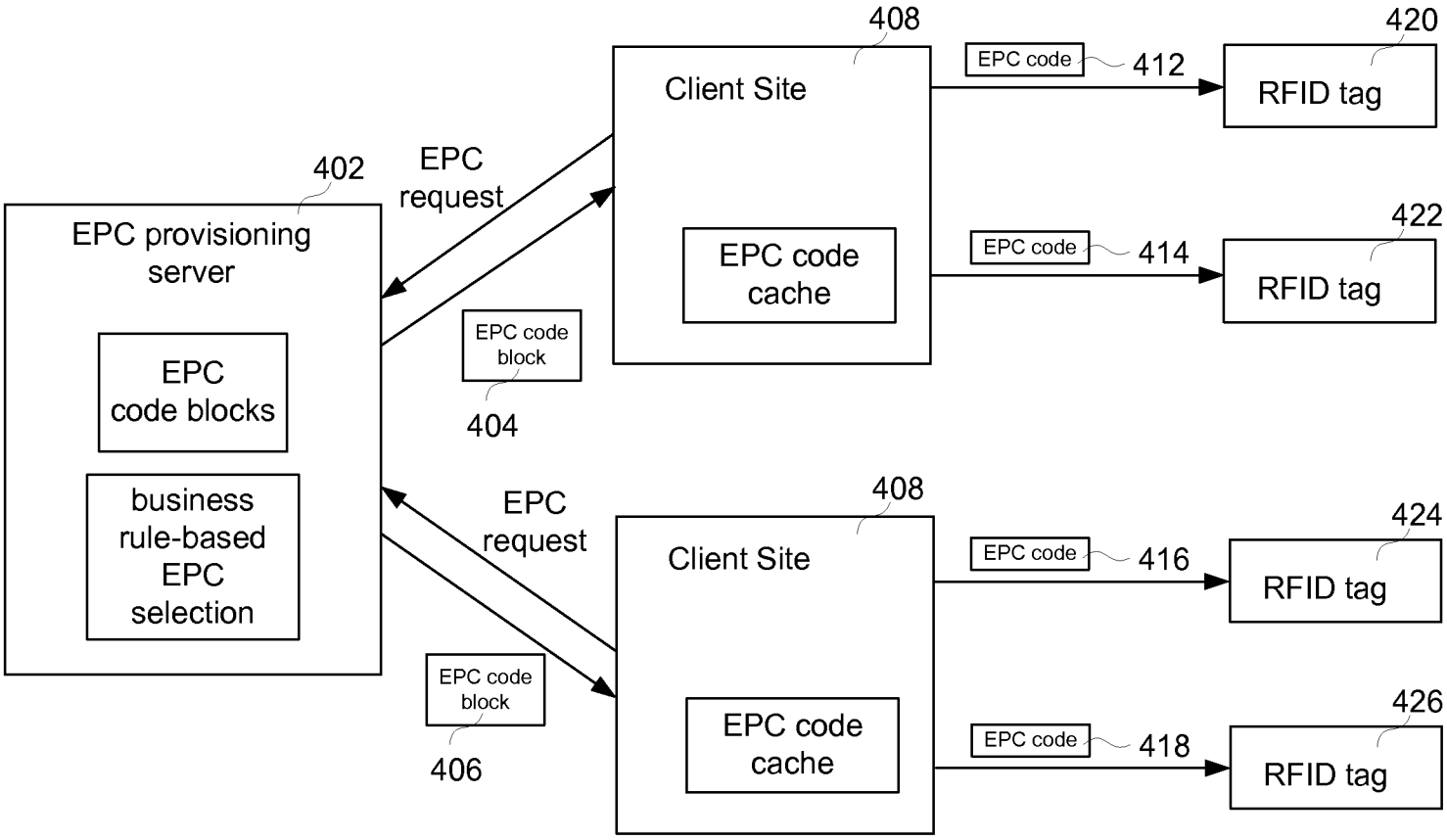

408
420
EPC code
412
Client Site
RFID tag
402
EPC
request
EPC provisioning
server
EPC code
cache
422
EPC code
414
RFID tag
EPC code
block
404
EPC code
blocks
business
rule-based
EPC
selection
EPC
request
408
424
Client Site
EPC code
416
RFID tag
EPC code
block
406
EPC code
cache
426
EPC code
418
RFID tag

FIGURE 4A

header	company	product id	serial number

header	company	product id	loc	lot #	serial #

header	company	product id	loc	serial #

header	company	product id	lot #	serial #

FIGURE 4B

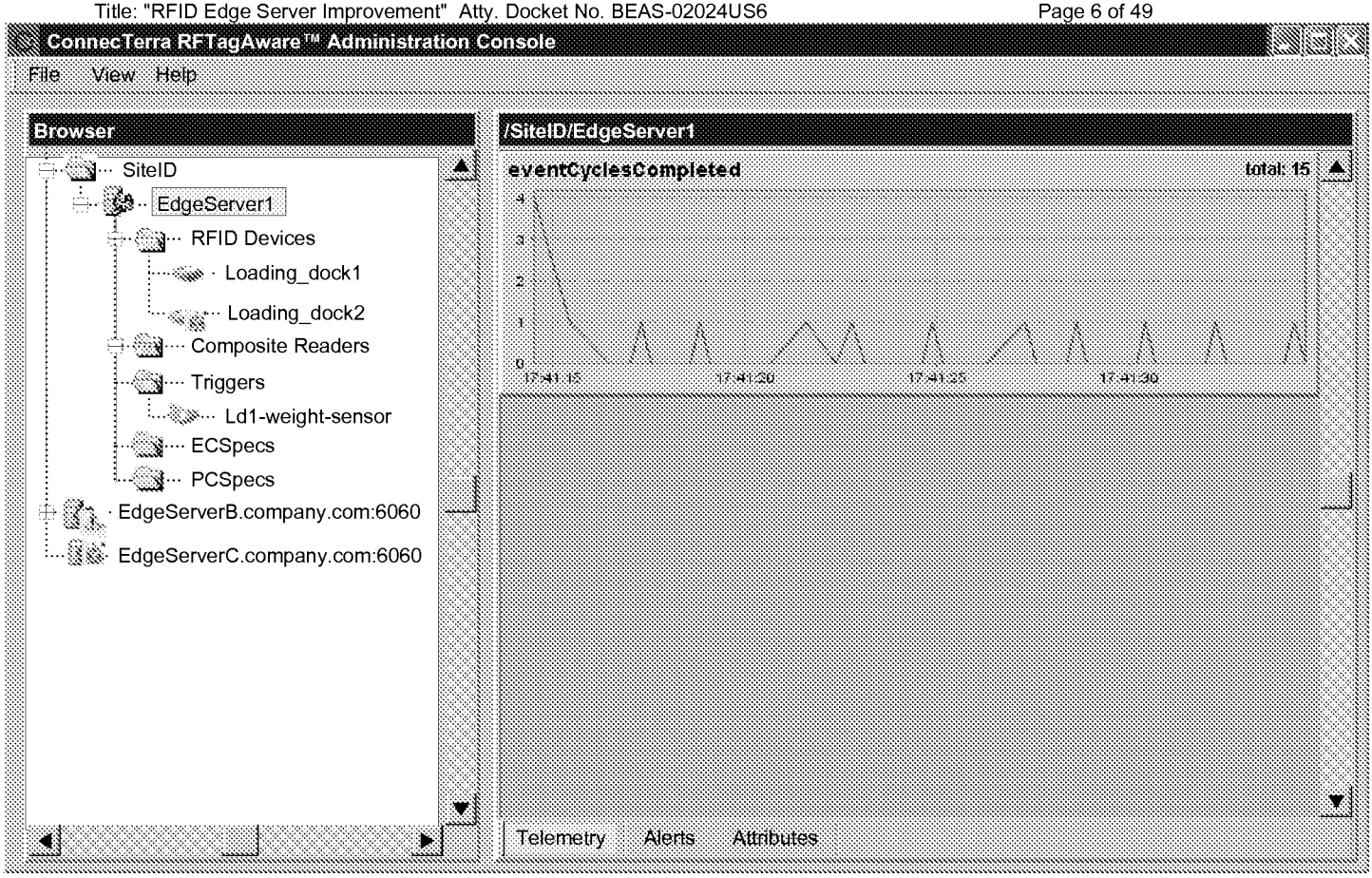


FIGURE 5A

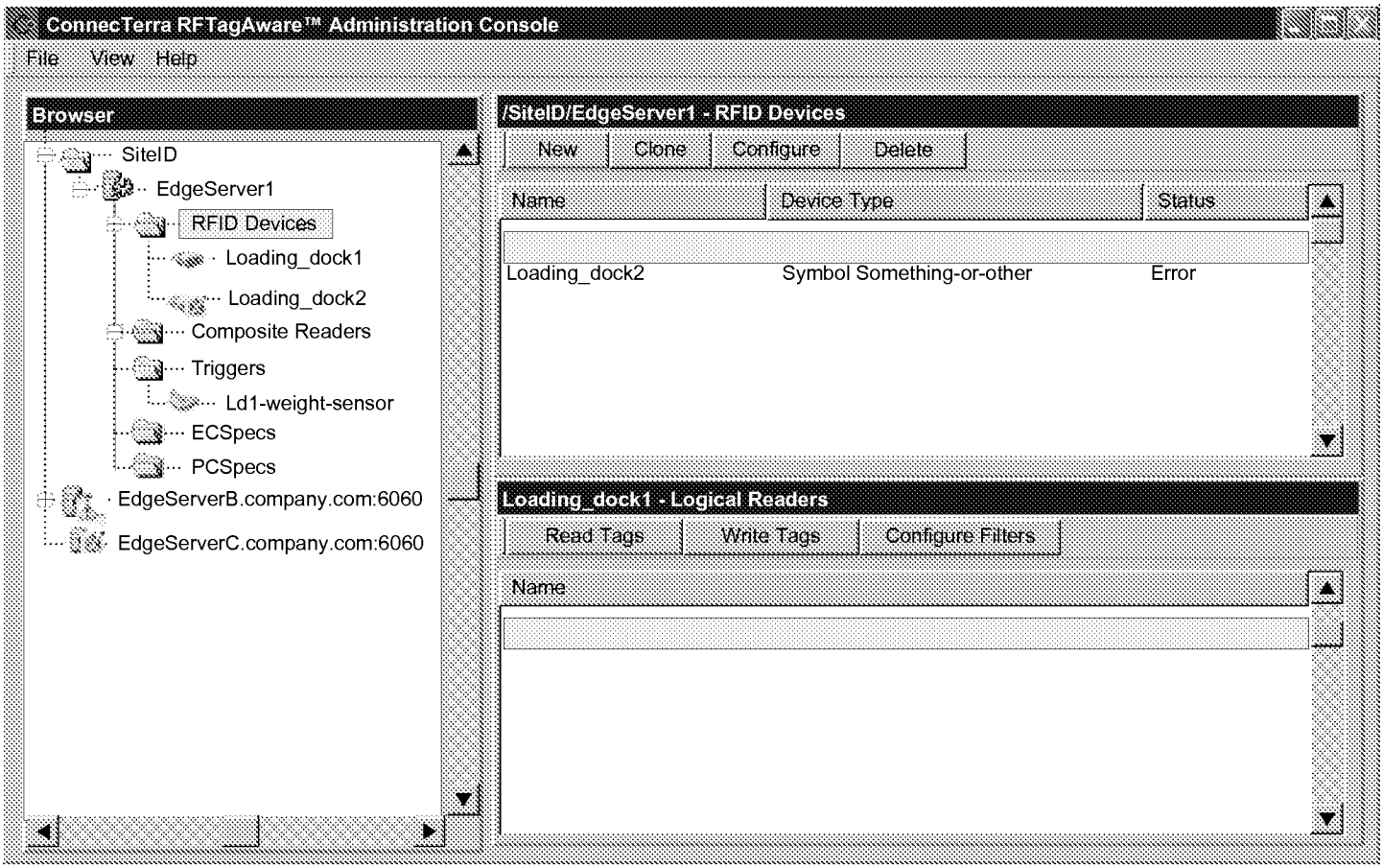


FIGURE 5B

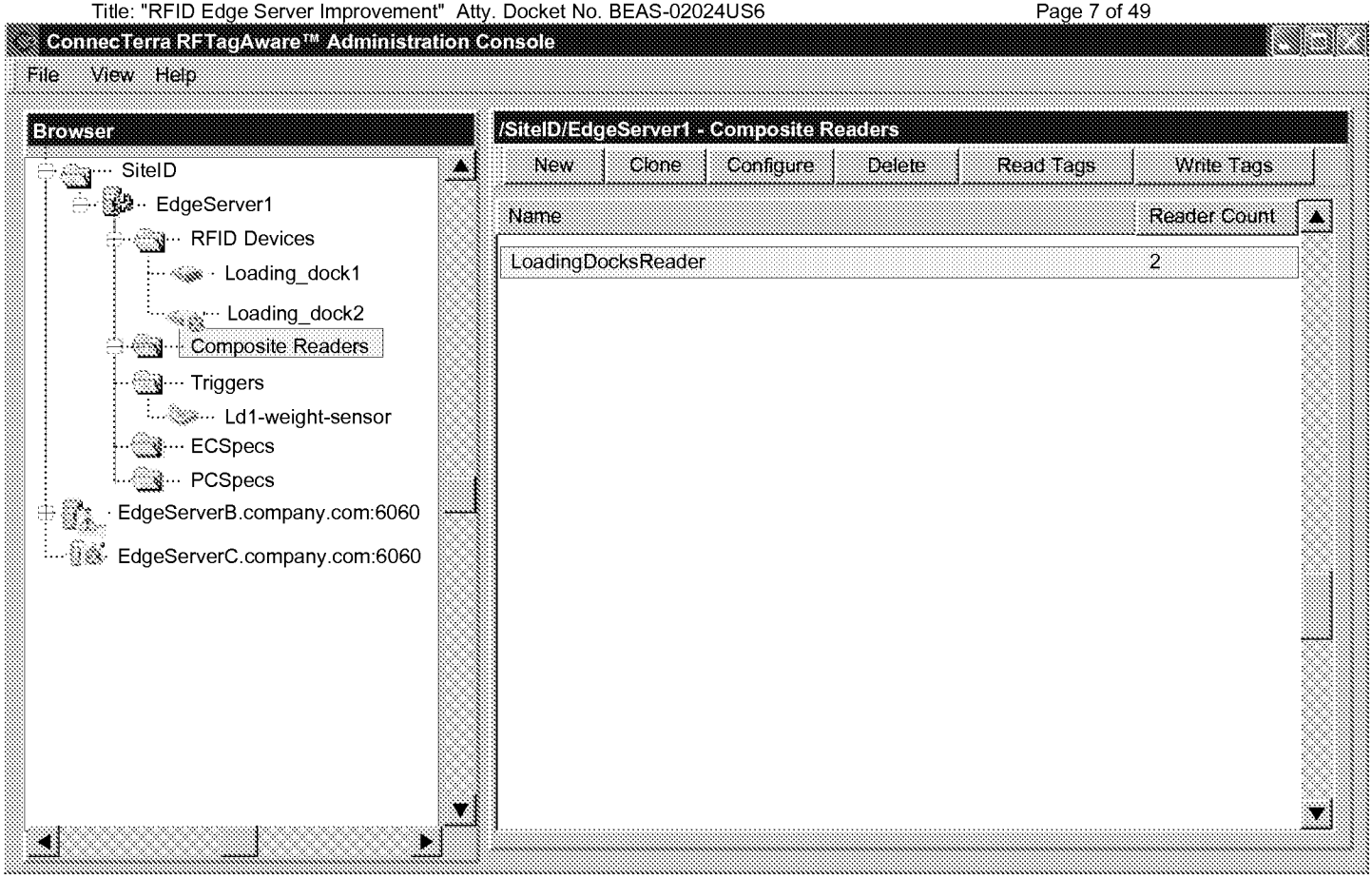


FIGURE 5C

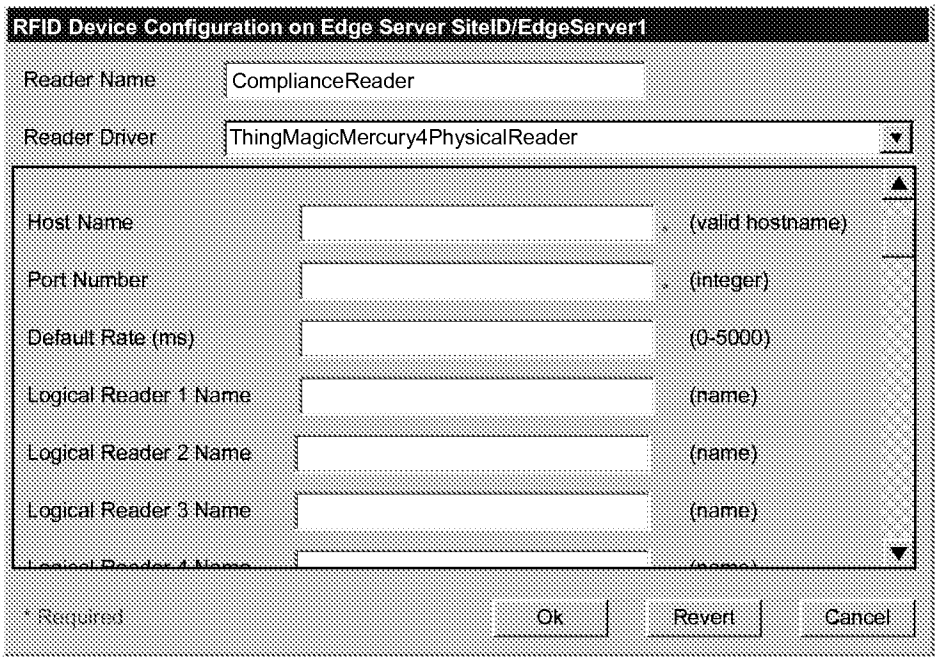


FIGURE 5D

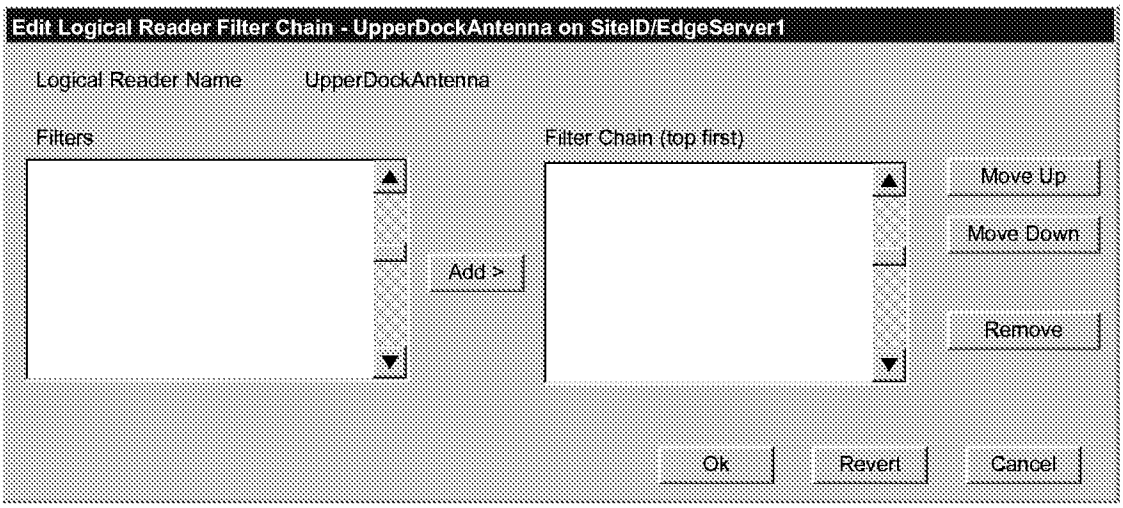


FIGURE 5E

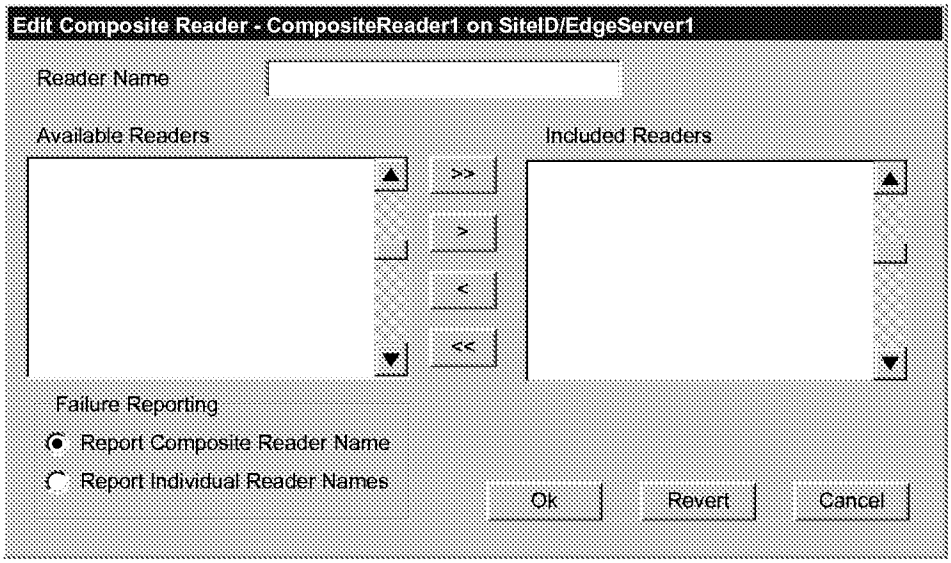


FIGURE 5F

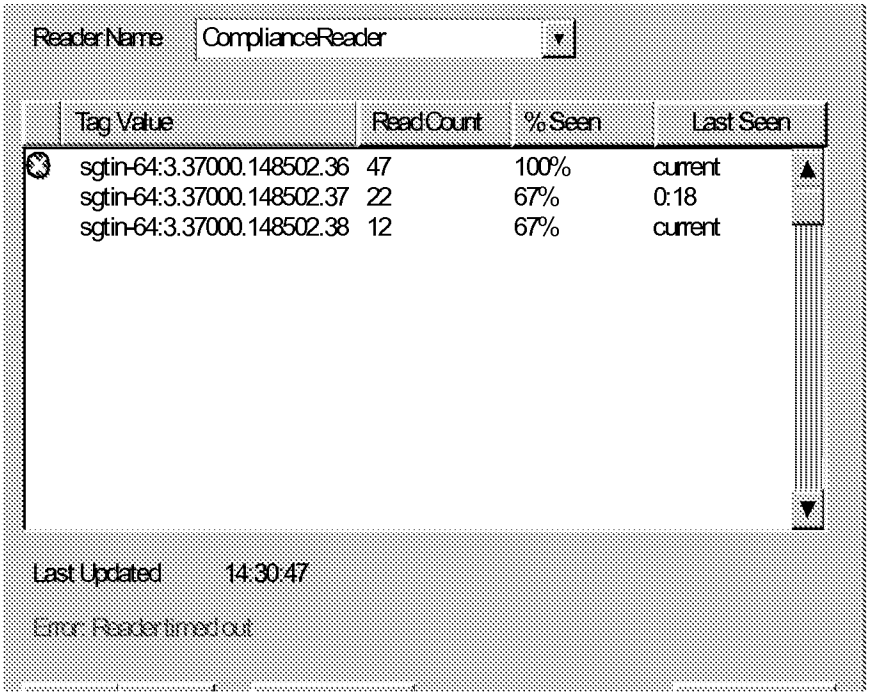


FIGURE 5G

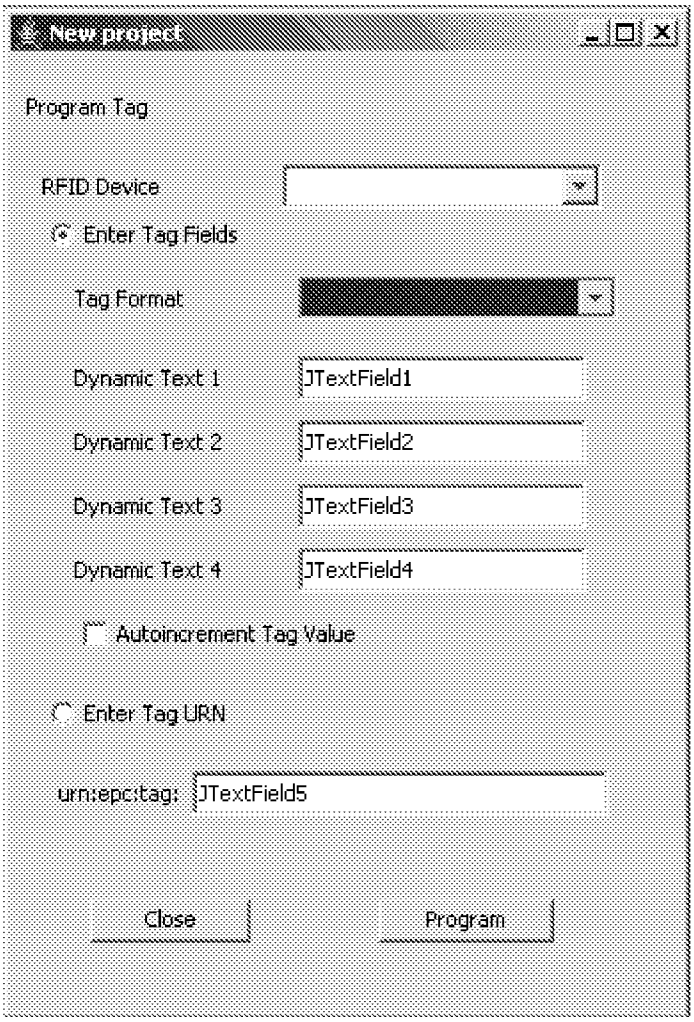


FIGURE 5H

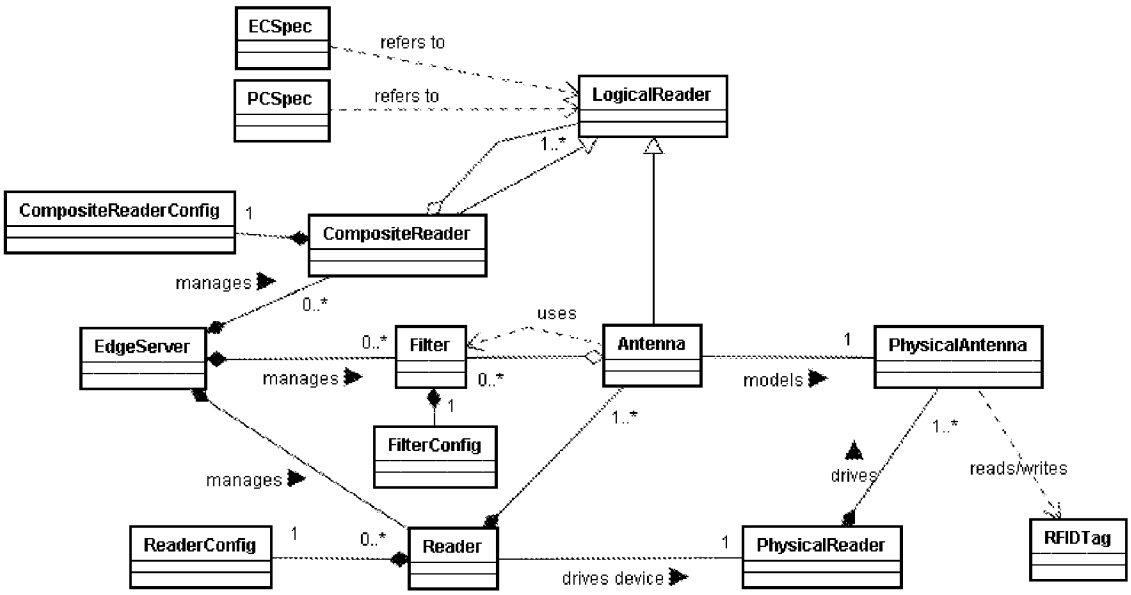


FIGURE 6A

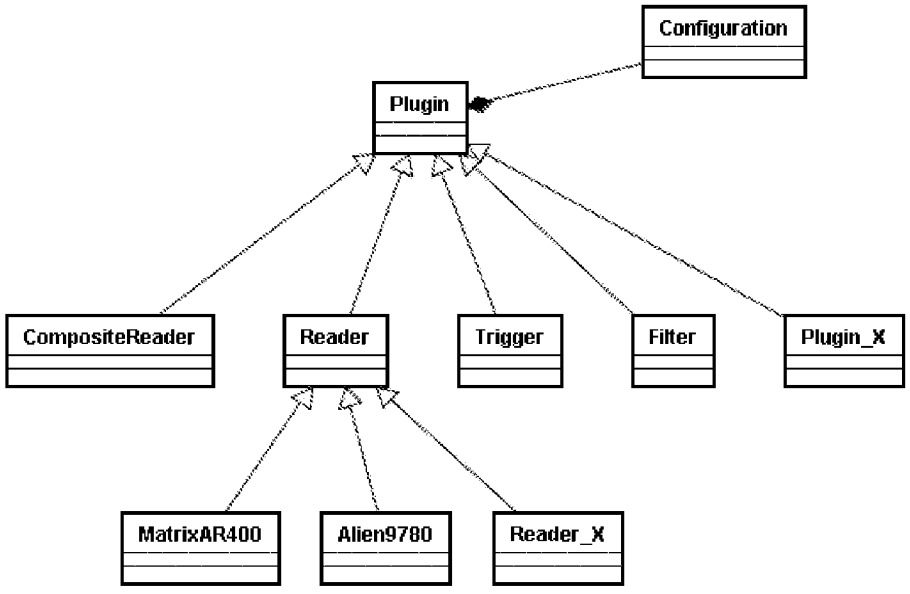
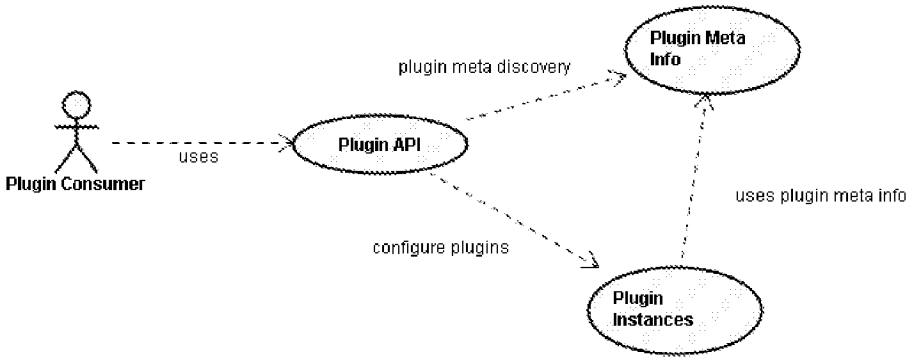
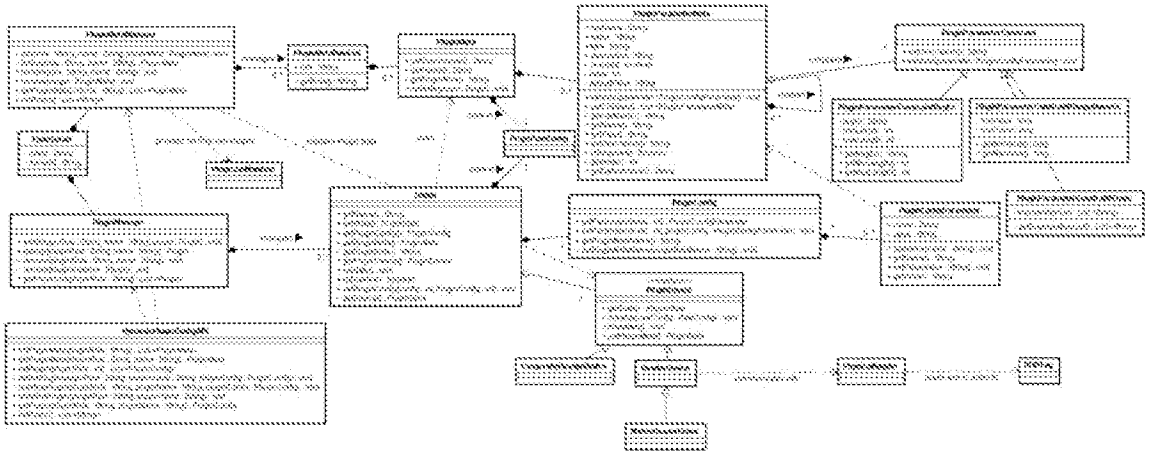


FIGURE 6B


Plugin Meta Info
plugin meta discovery
Plugin Consumer
uses
Plugin API
uses plugin meta info
configure plugins
Plugin Instances

6C



6D

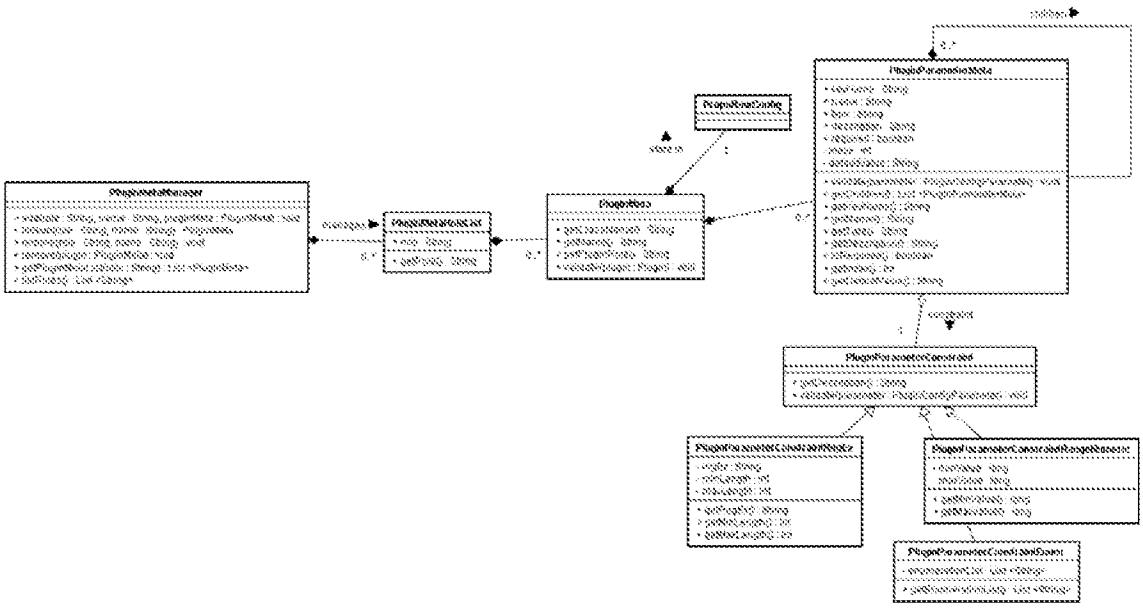


FIGURE 6E

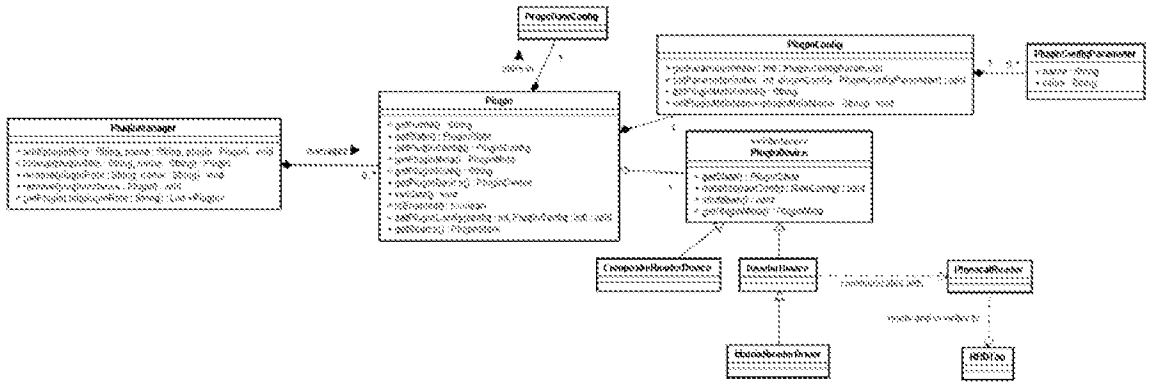


FIGURE 6F

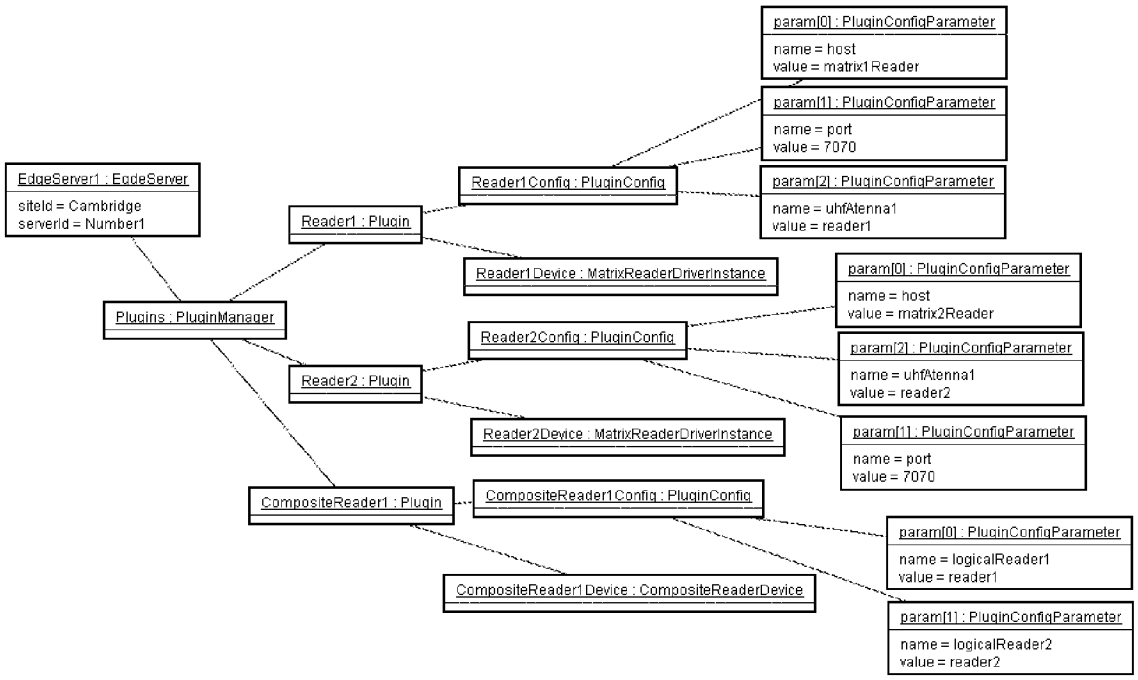


FIGURE 6G

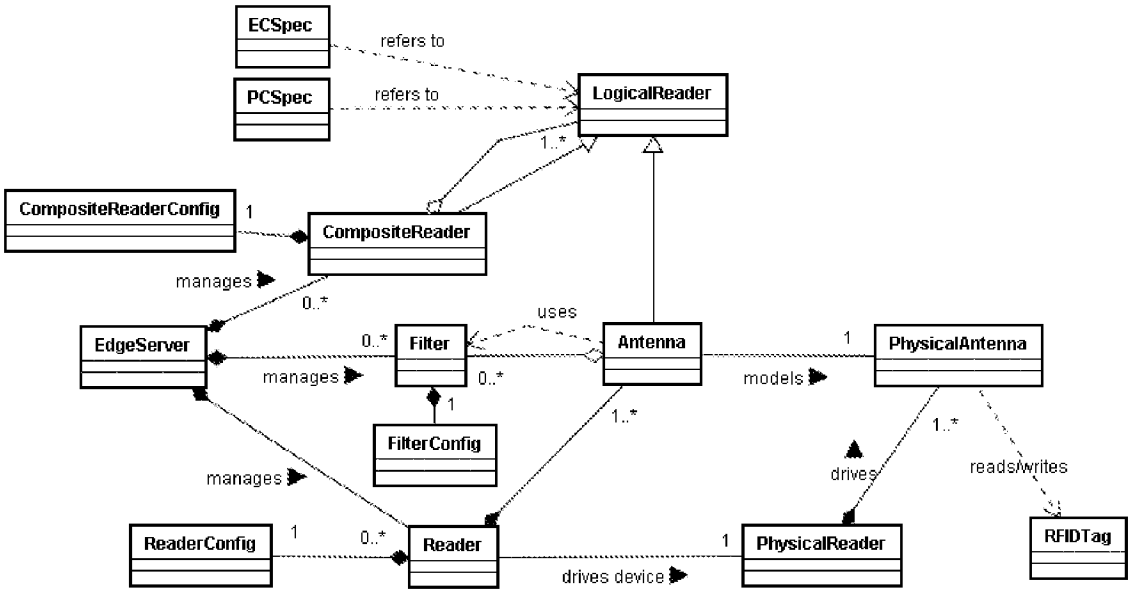


FIGURE 6H

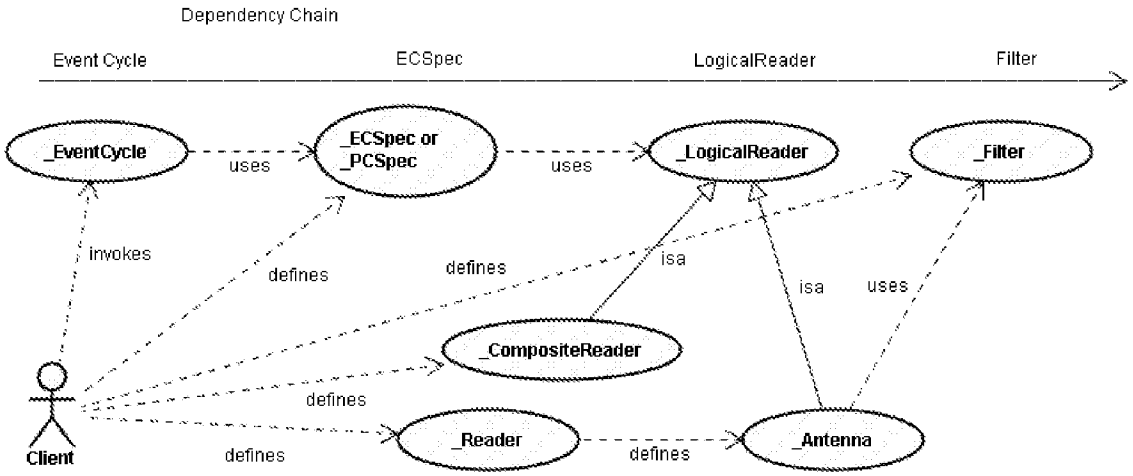


FIGURE 6I

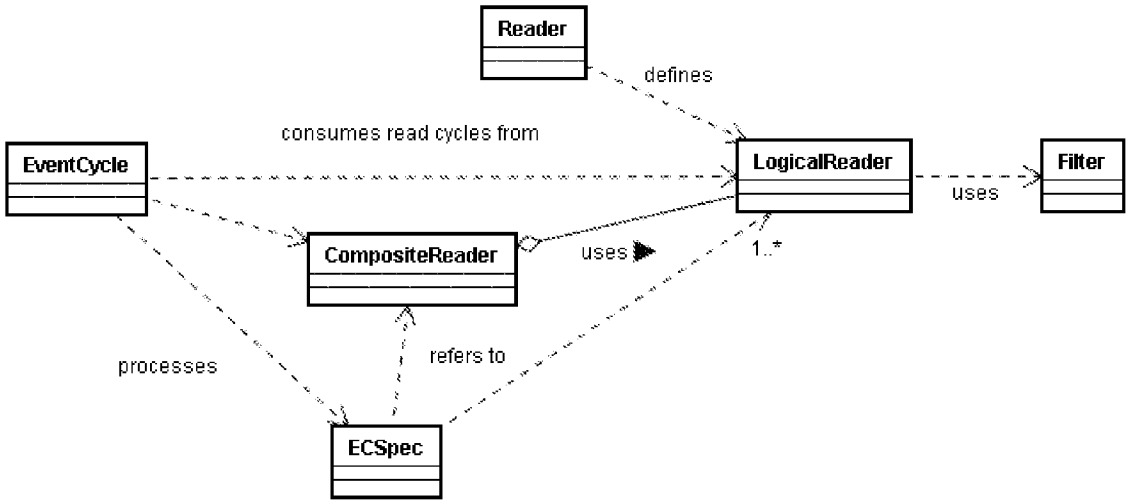


FIGURE 6J

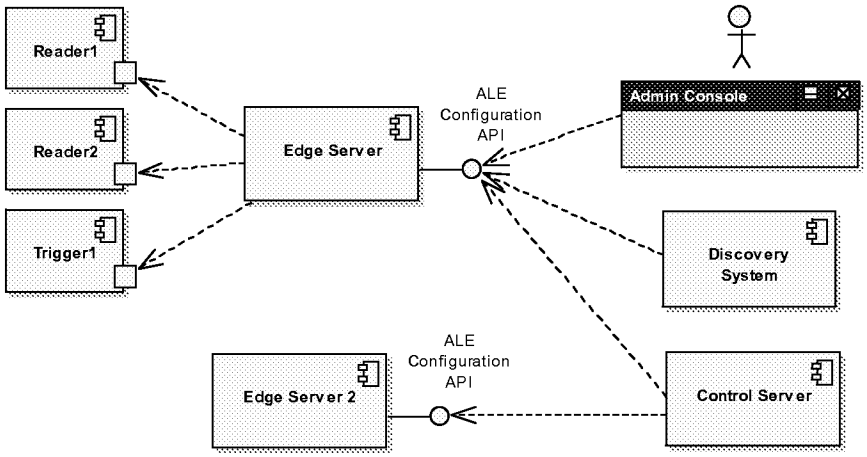


FIGURE 7A

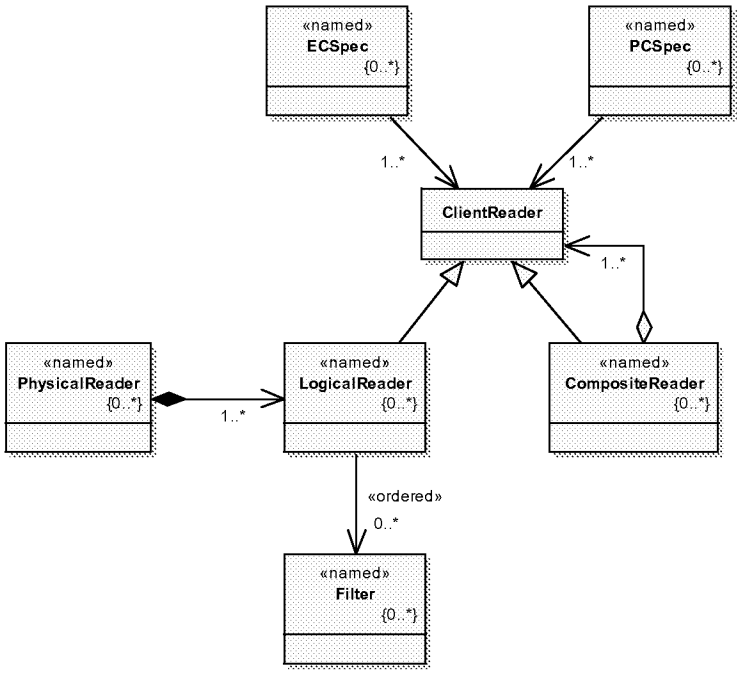


FIGURE 7B

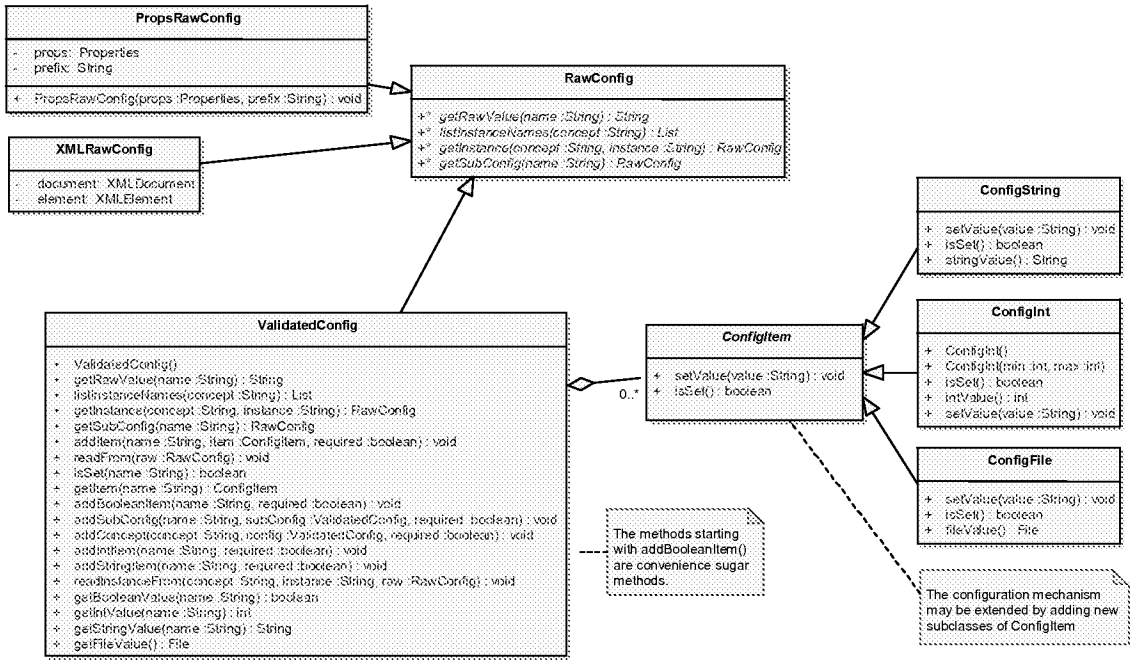


FIGURE 8A

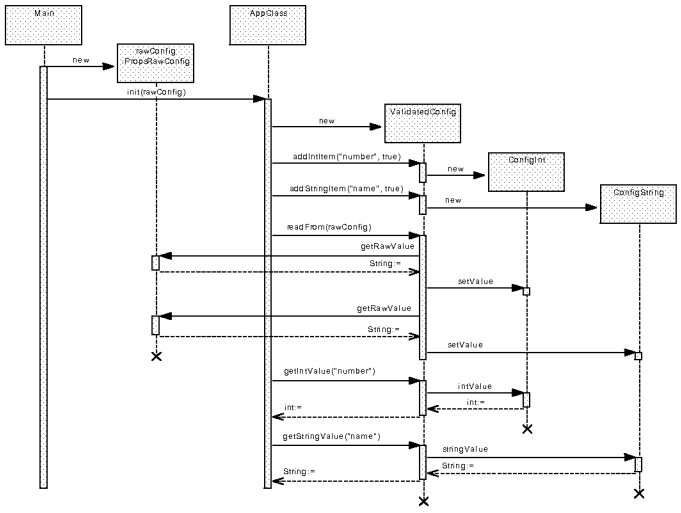


FIGURE 8B

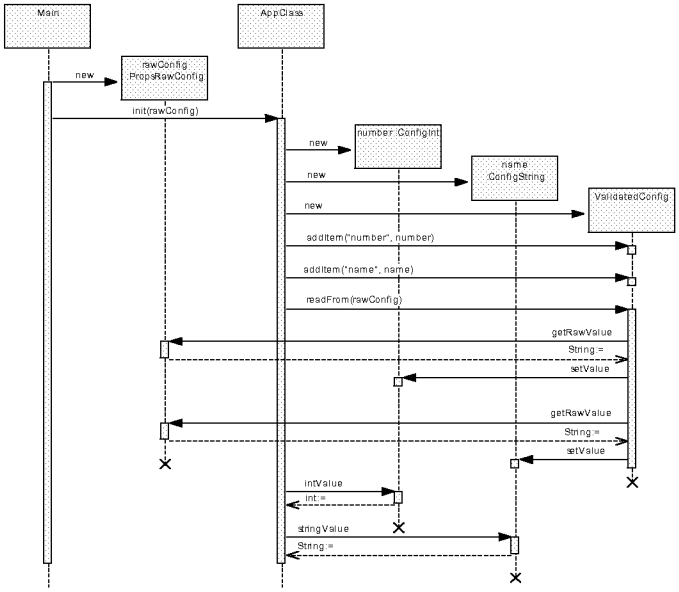

Main
AppClass
rawConfig: PropsRawConfig
new
init(rawConfig)
number: ConfigInt
new
name: ConfigString
new
ValidatedConfig
new
addItem("number", number)
addItem("name", name)
readFrom(rswConfig)
getRswValue
String:=
setValue
getRswValue
String:=
setValue
intValue
int:=
stringValue
String:=

FIGURE 8C

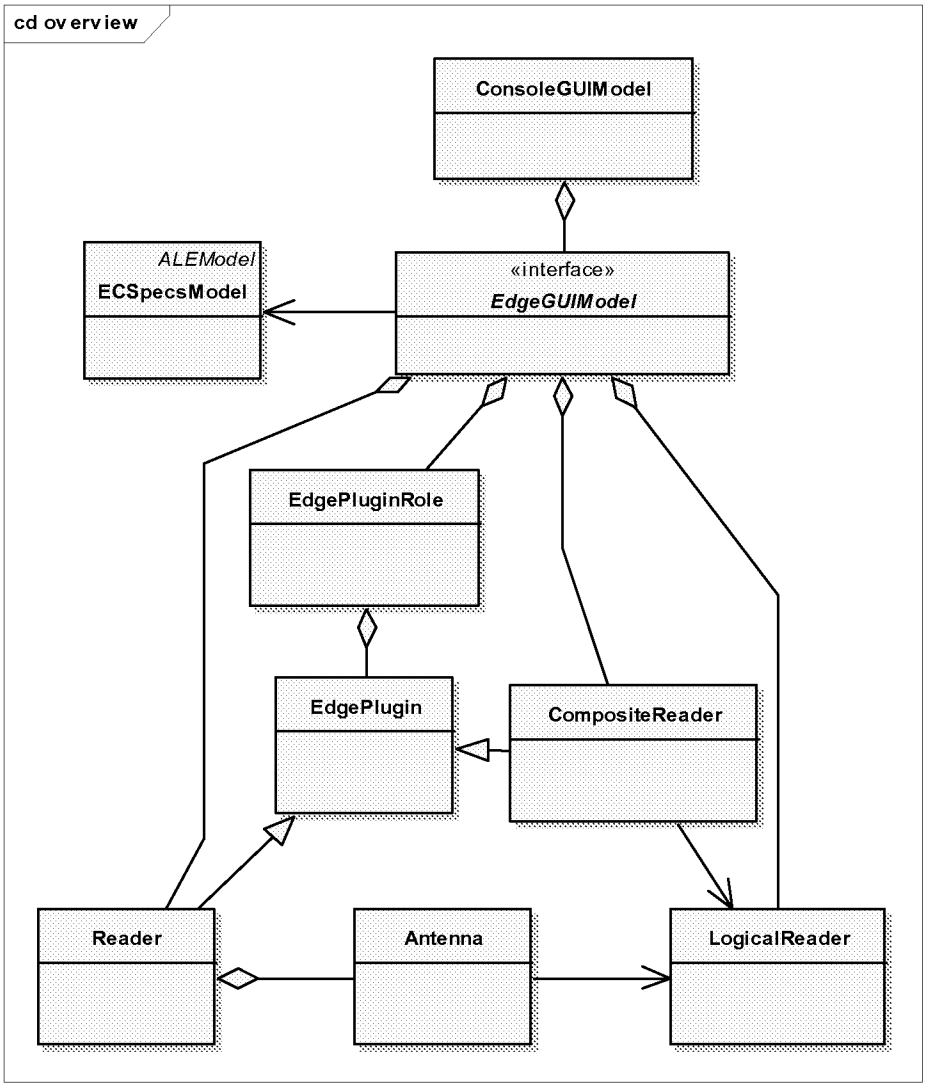


FIGURE 9A

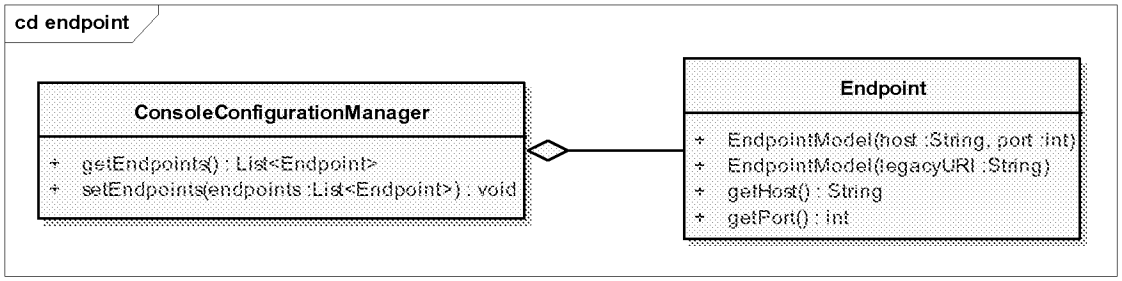


FIGURE 9B

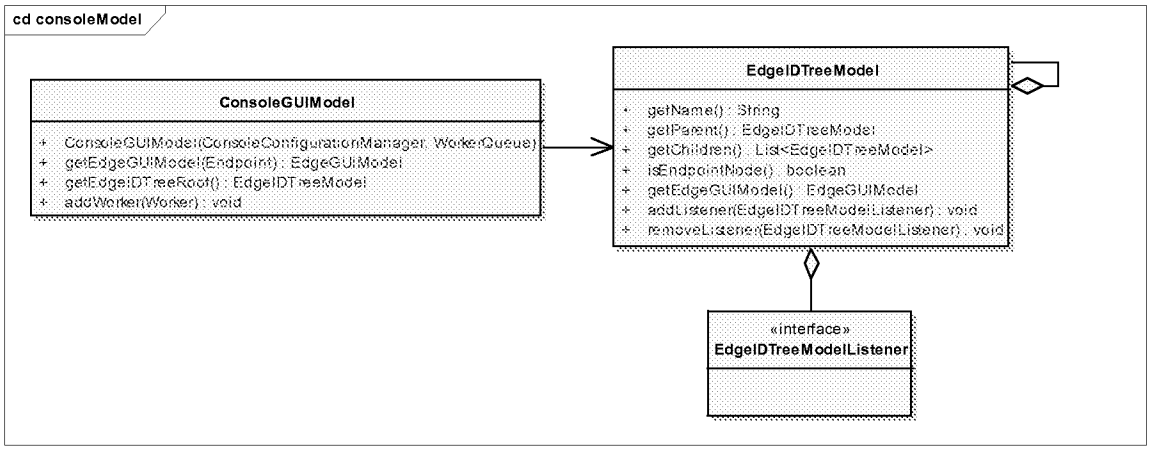


FIGURE 9C

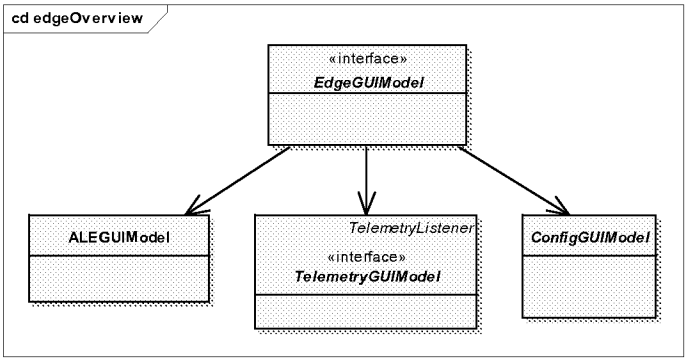


FIGURE 9D

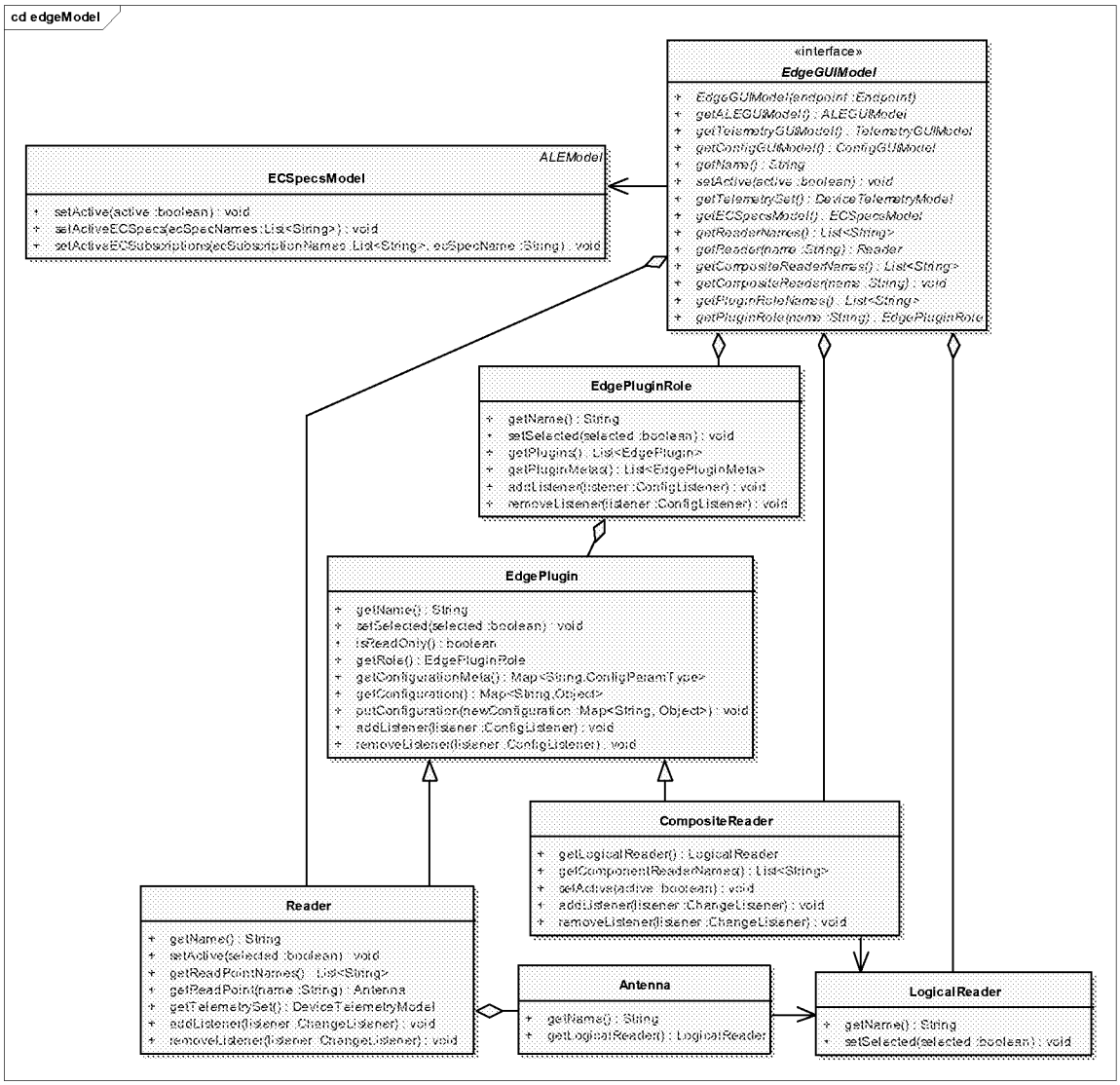


FIGURE 9E

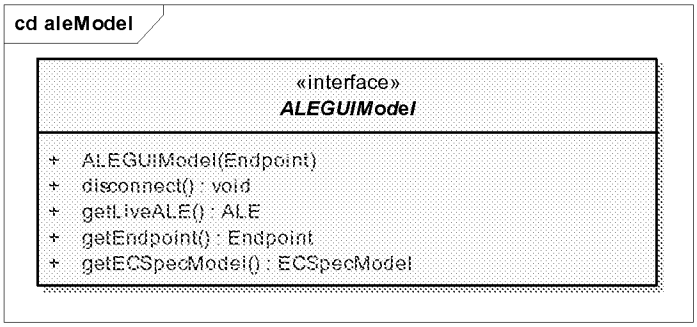


FIGURE 9F

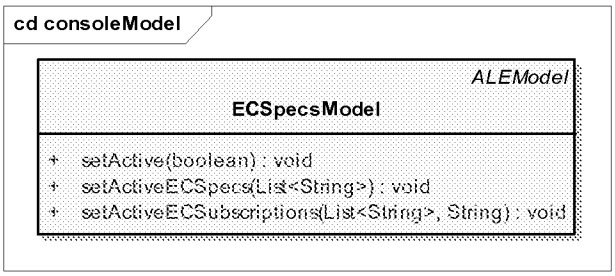


FIGURE 9G

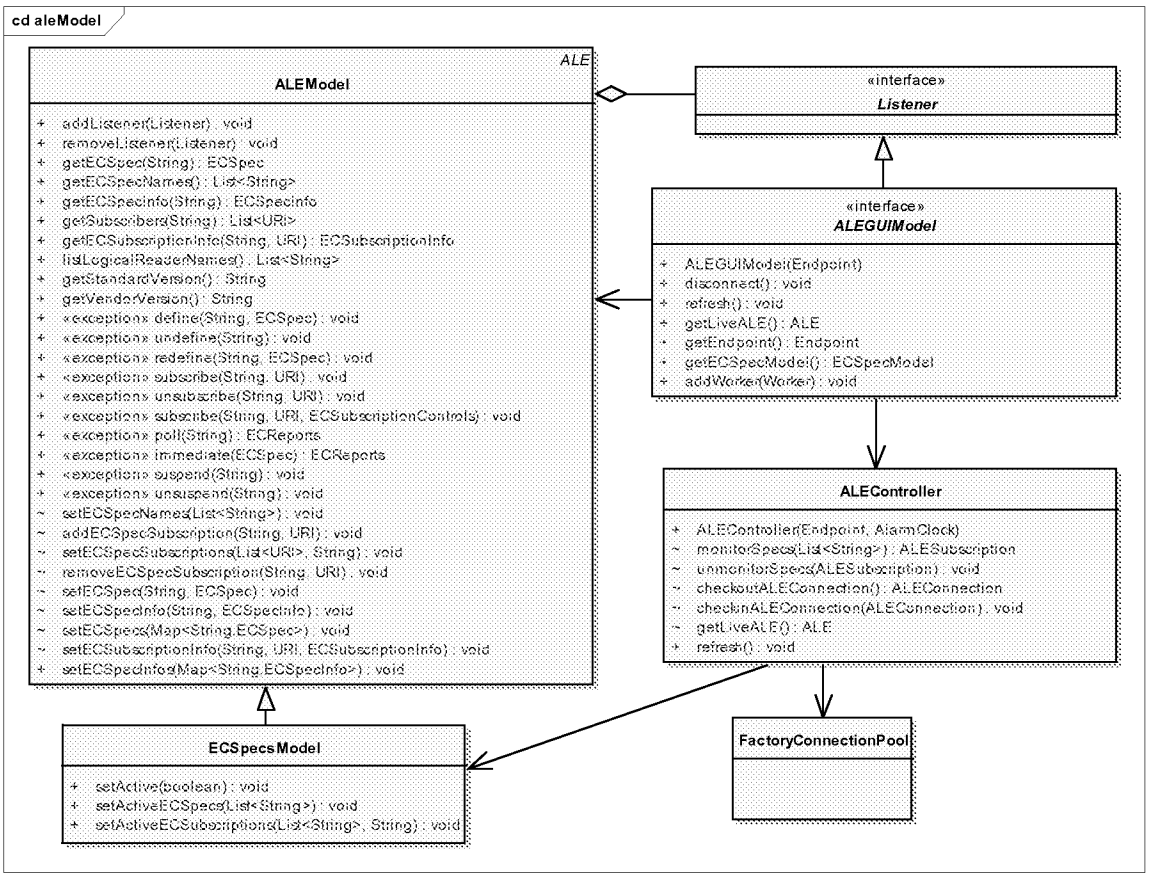


FIGURE 9H

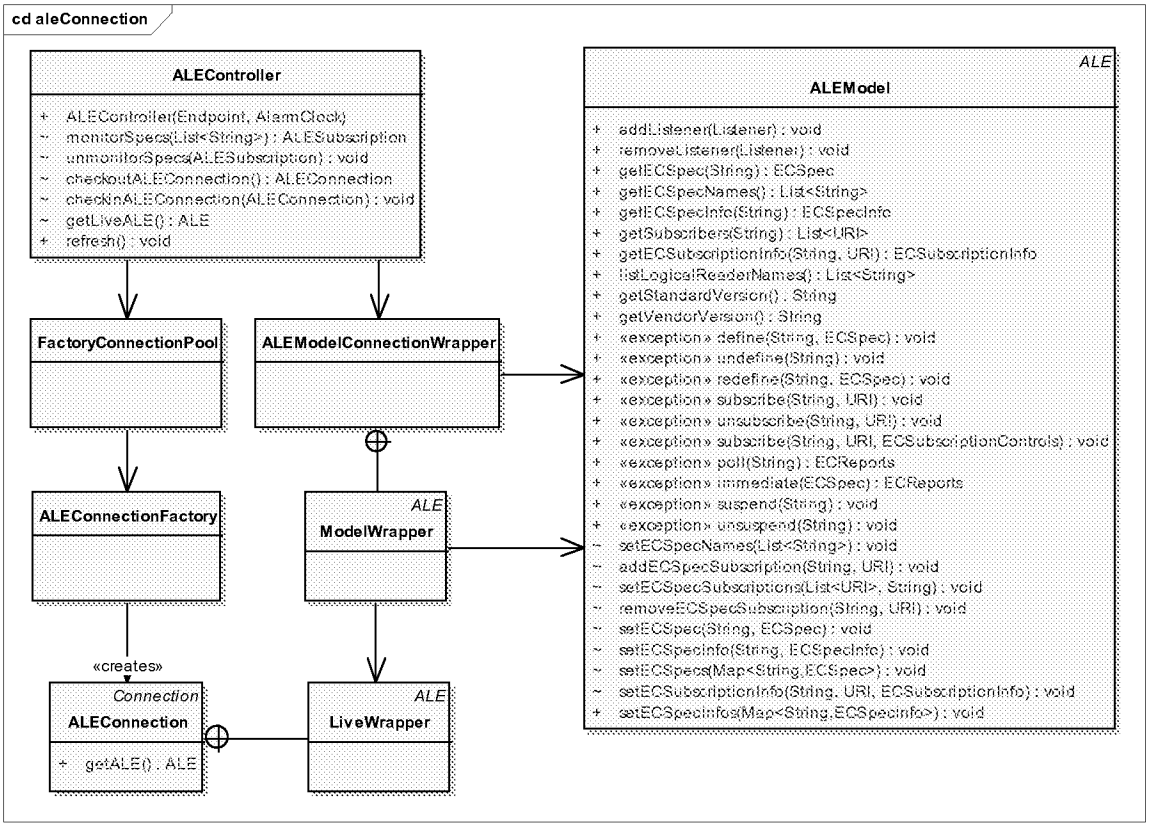


FIGURE 9I

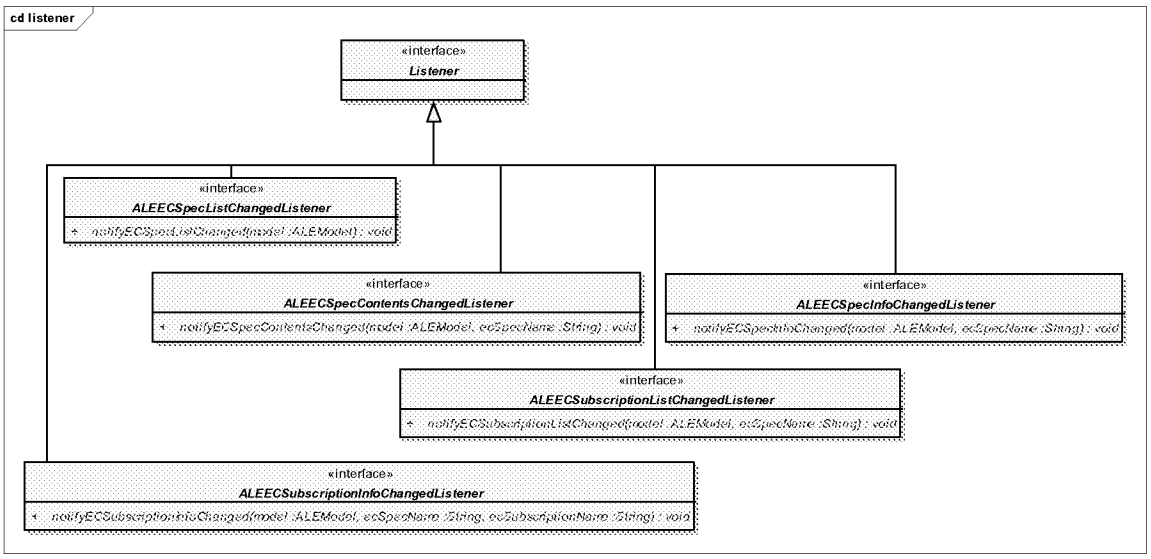


FIGURE 9J

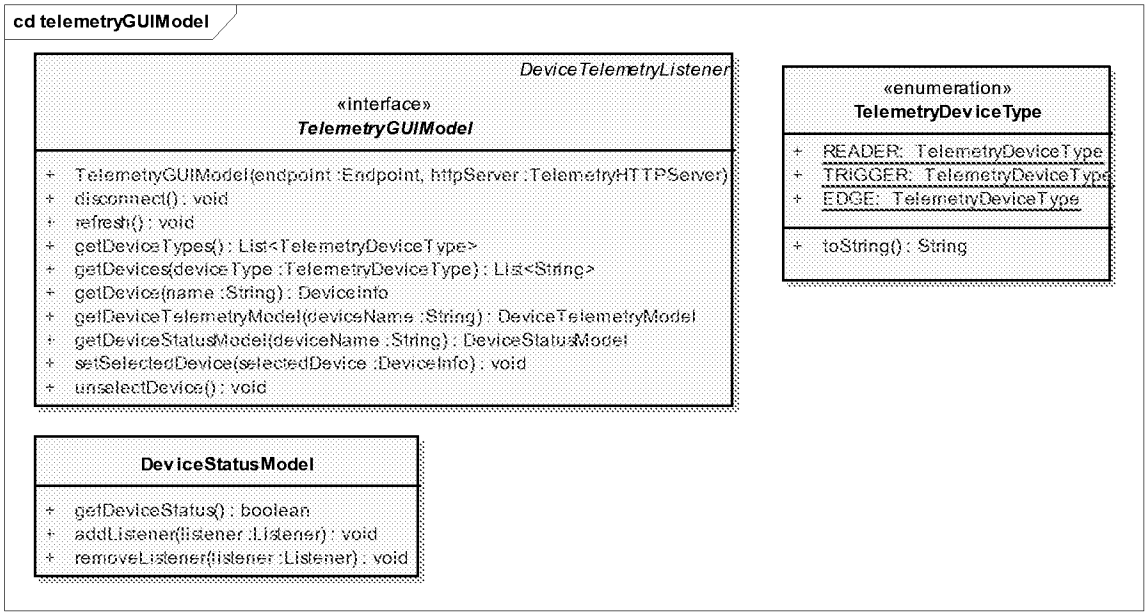


FIGURE 9K

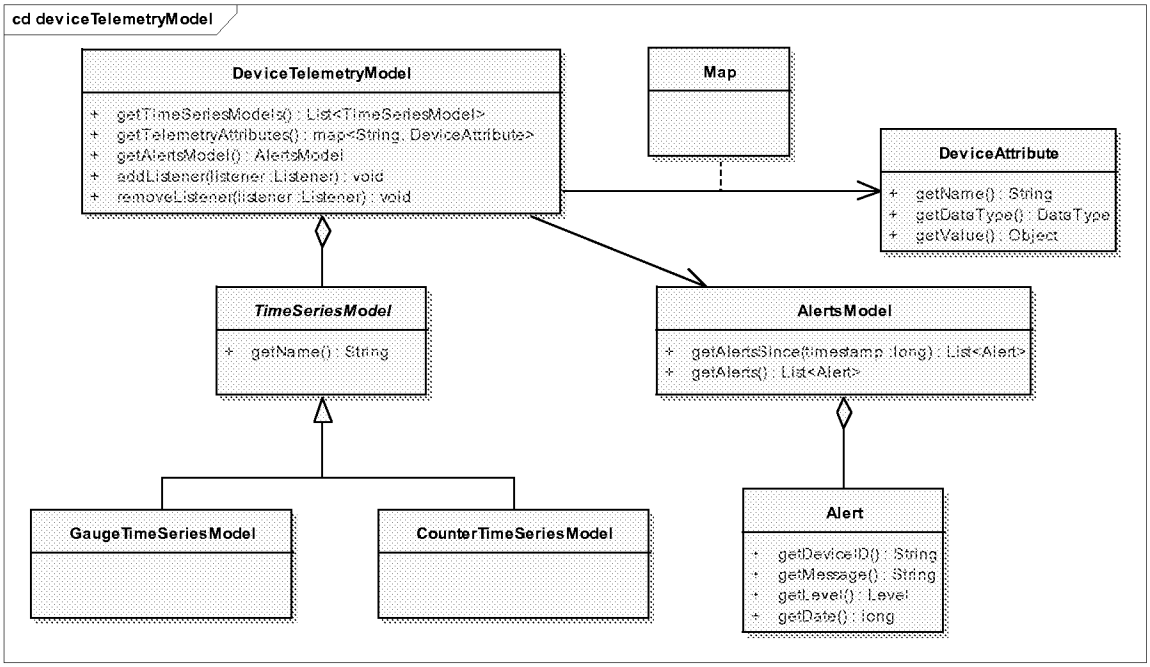


FIGURE 9L

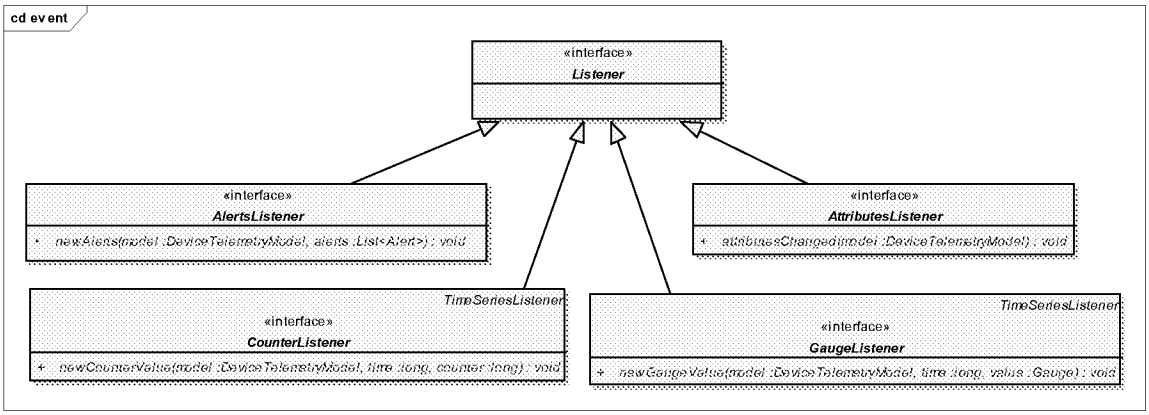


FIGURE 9M

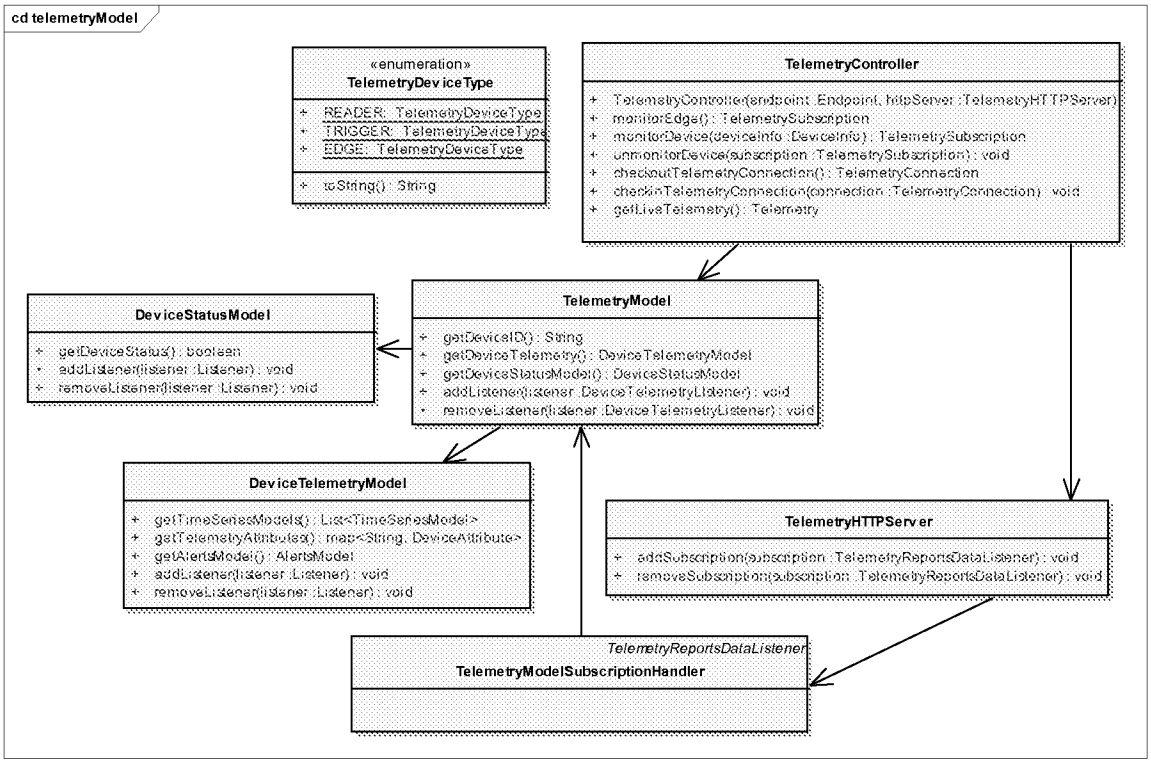


FIGURE 9N

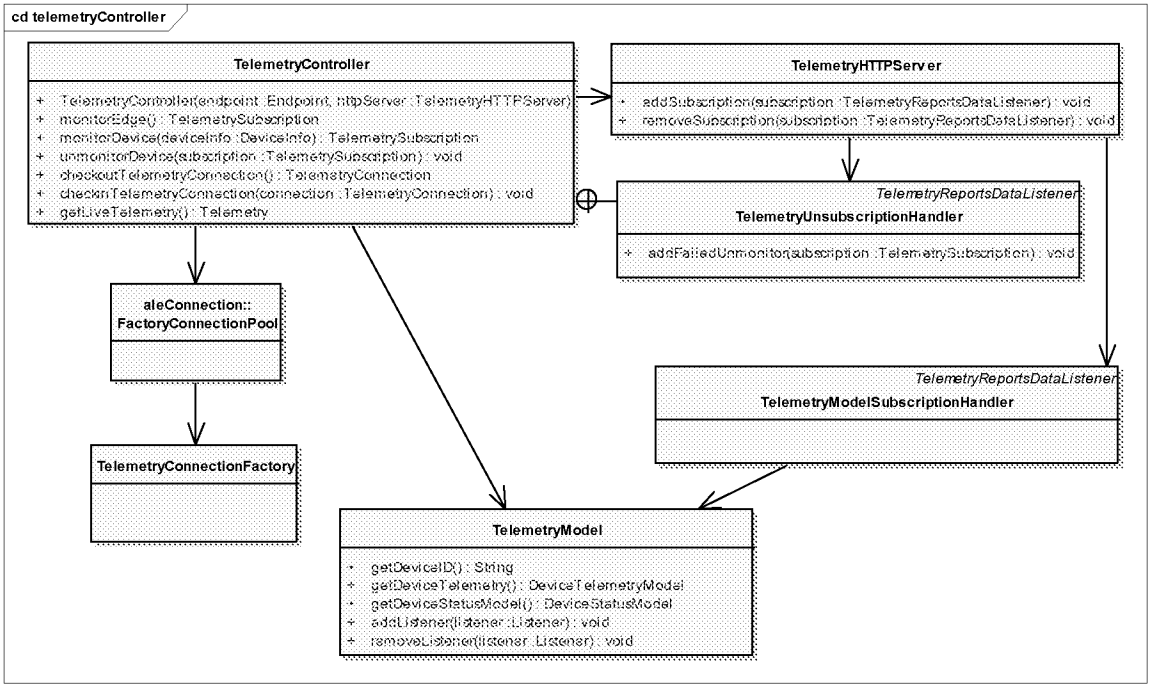


FIGURE 9O

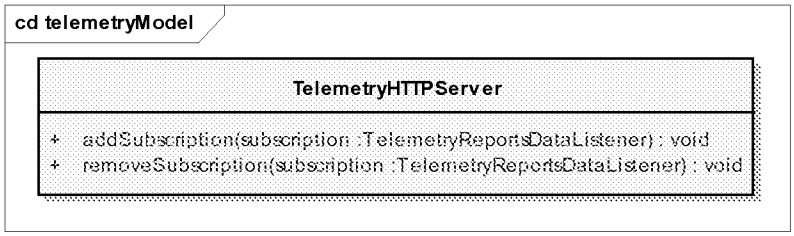


FIGURE 9P

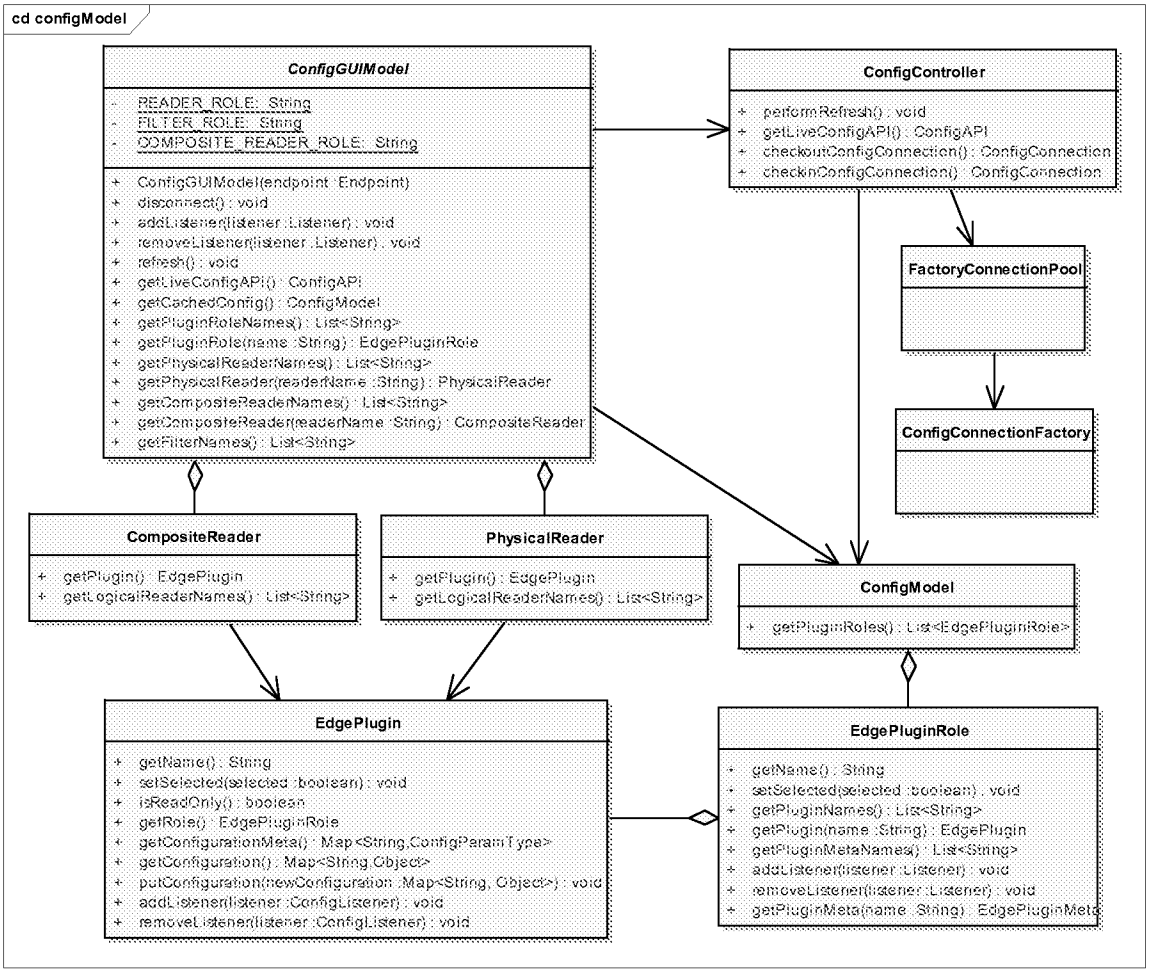


FIGURE 9Q

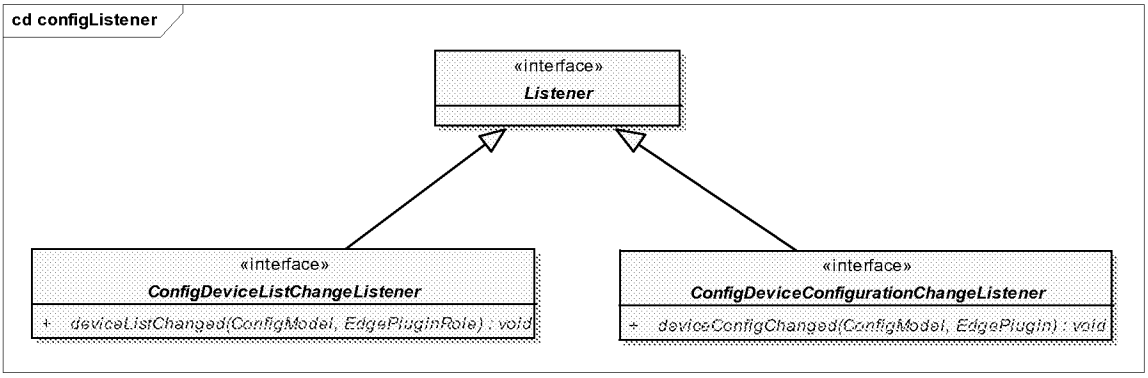


FIGURE 9R

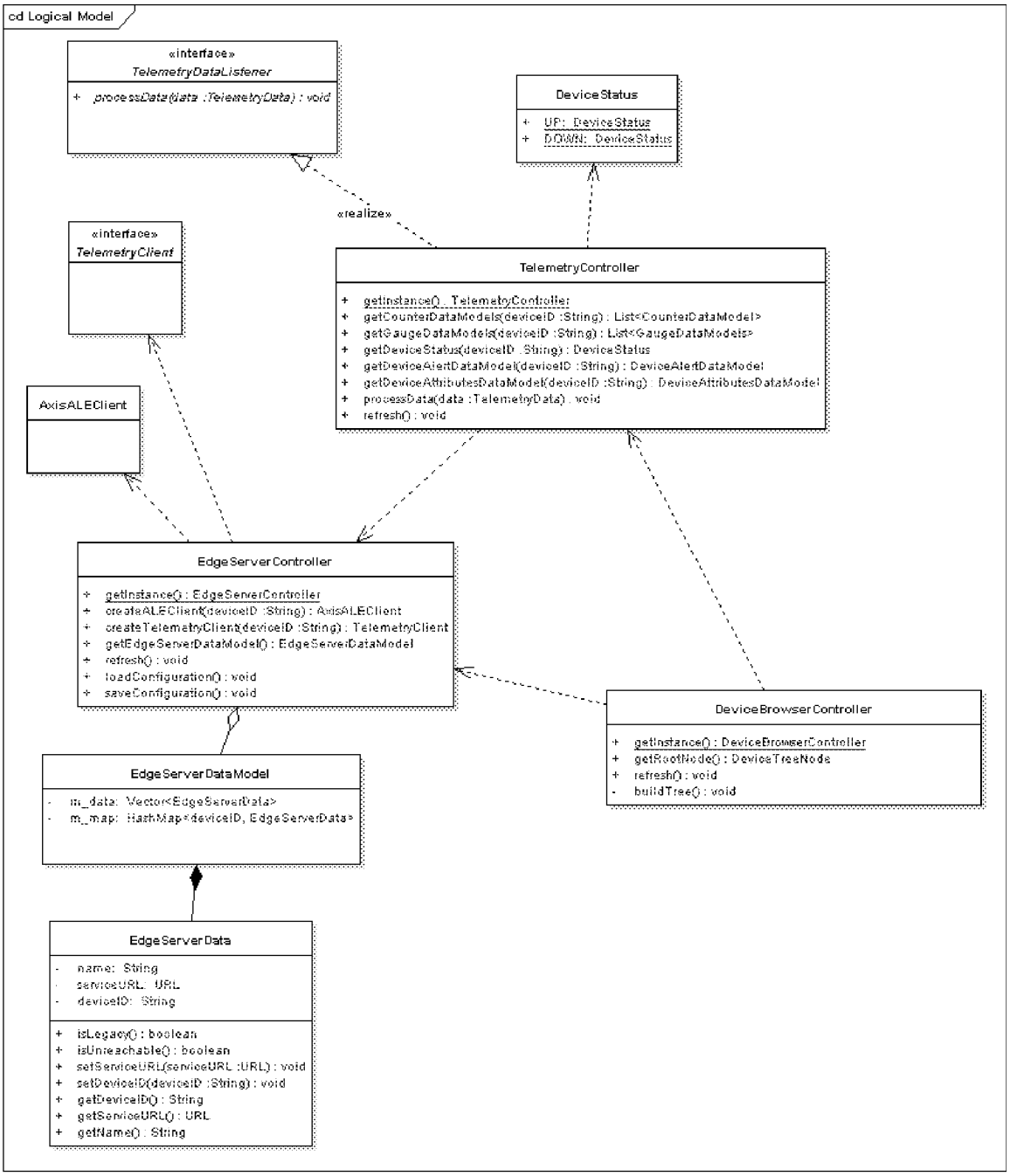
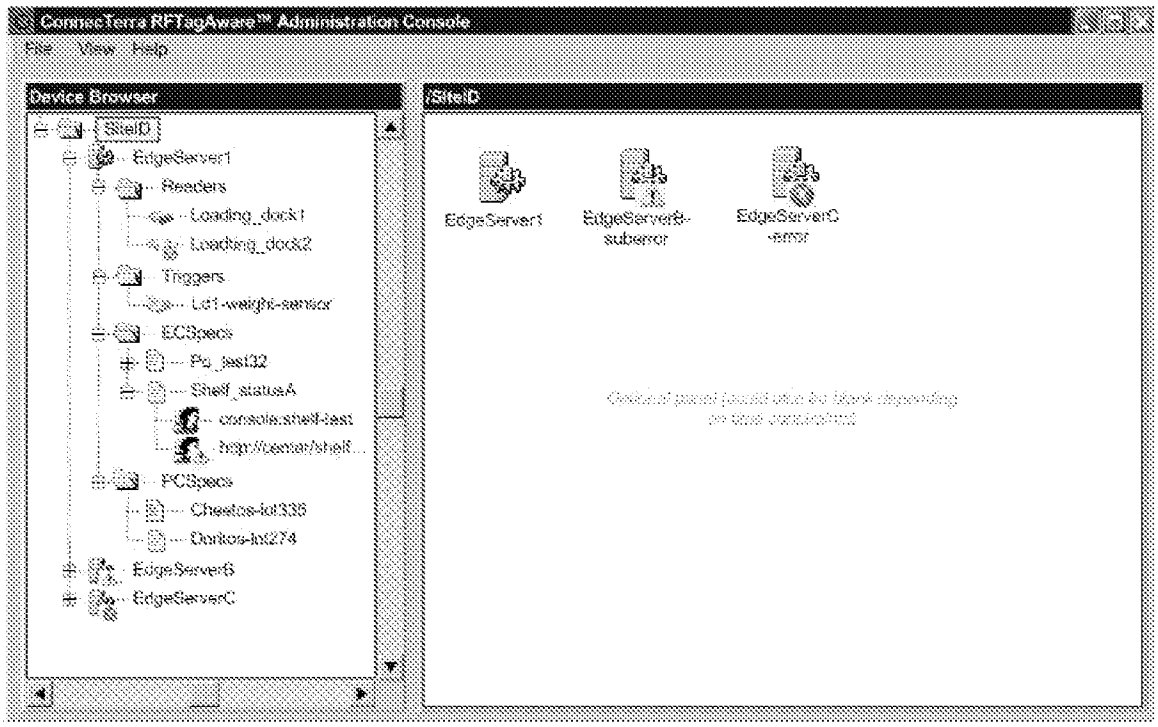

cd Logical Model
«interface»
TelemetryDataListener
+ processData(data :TelemetryData) : void
DeviceStatus
+ UP: DeviceStatus
+ DOWN: DeviceStatus
«realize»
«interface»
TelemetryClient
TelemetryController
+ getInstance() : TelemetryController
+ getCounterDataModels(deviceID :String) : List<CounterDataModel>
+ getGaugeDataModels(deviceID :String) : List<GaugeDataModels>
+ getDeviceStatus(deviceID :String) : DeviceStatus
+ getDeviceAlertDataModel(deviceID :String) : DeviceAlertDataModel
+ getDeviceAttributesDataModel(deviceID :String) : DeviceAttributesDataModel
+ processData(data :TelemetryData) : void
+ refresh() : void
AxisALEClient
EdgeServerController
+ getInstance() : EdgeServerController
+ createALEClient(deviceID :String) : AxisALEClient
+ createTelemetryClient(deviceID :String) : TelemetryClient
+ getEdgeServerDataModel() : EdgeServerDataModel
+ refresh() : void
+ loadConfiguration() : void
+ saveConfiguration() : void
DeviceBrowserController
+ getInstance() : DeviceBrowserController
+ getRootNode() : DeviceTreeNode
+ refresh() : void
- buildTree() : void
EdgeServerDataModel
- m_data: Vector<EdgeServerData>
- m_map: HashMap<deviceID, EdgeServerData>
EdgeServerData
- name: String
- serviceURL: URL
- deviceID: String
+ isLegacy() : boolean
+ isUnreachable() : boolean
+ setServiceURL(serviceURL :URL) : void
+ setDeviceID(deviceID :String) : void
+ getDeviceID() : String
+ getServiceURL() : URL
+ getName() : String

FIGURE 10


ConnecTerra RFTagAware™ Administration Console
File View Help
Device Browser
SiteID
EdgeServer1
Readers
Loading_dock1
Loading_dock2
Triggers
Lc1-weight-sensor
ECSpecs
Po_test32
Shelf_statusA
console.shelf-test
http://center/shelf...
PCSpecs
Cheetos-lot336
Doritos-lot274
EdgeServer6
EdgeServerC
/SiteID
EdgeServer1
EdgeServer6-
suberror
EdgeServerC
-error

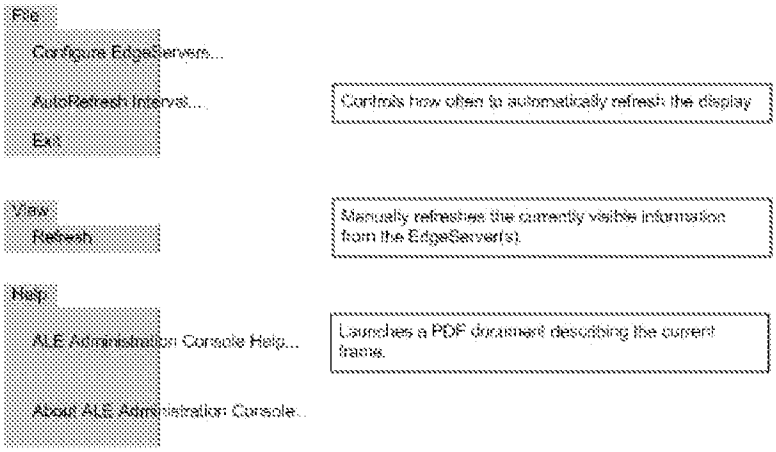

File
Configure EdgeServers...
AutoRefresh Interval...
Exit
Controls how often to automatically refresh the display
View
Refresh
Manually refreshes the currently visible information from the EdgeServer(s).
Help
ALE Administration Console Help...
About ALE Administration Console...
Launches a PDF document describing the current frame.

FIGURE 11A

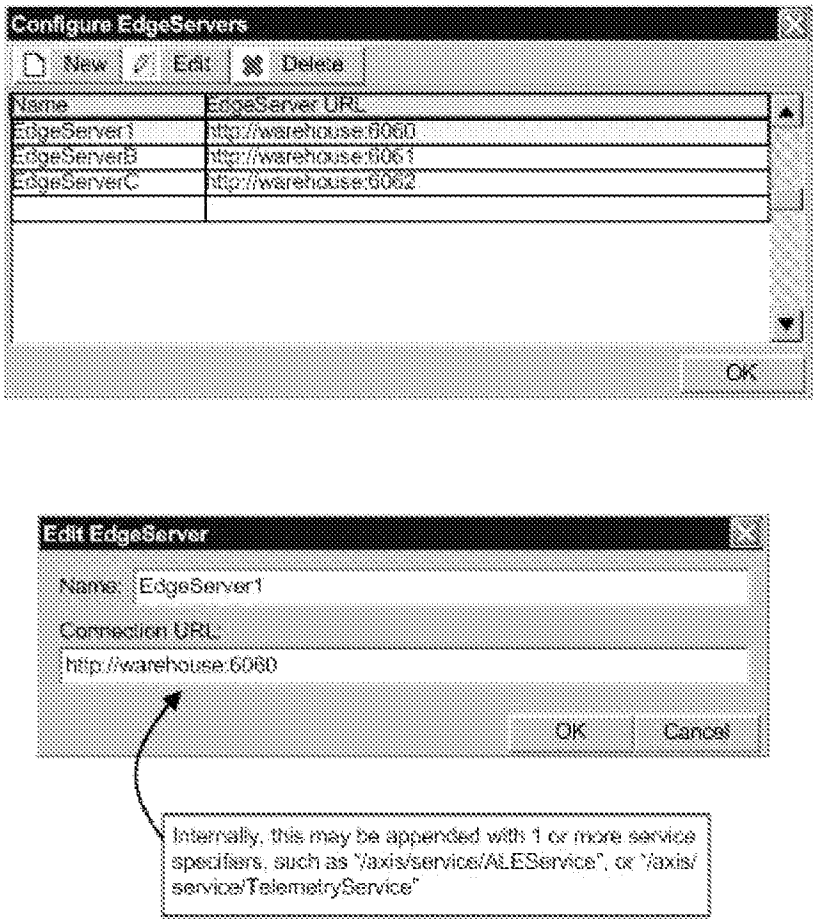

Configure EdgeServers
New
Edit
Delete
Name
EdgeServer URL
EdgeServer1
http://warehouse:6060
EdgeServerB
http://warehouse:6061
EdgeServerC
http://warehouse:6062
OK
Edit EdgeServer
Name: EdgeServer1
Connection URL:
http://warehouse:6060
OK
Cancel
Internally, this may be appended with 1 or more service specifiers, such as "/axis/service/ALEService", or "/axis/service/TelemetryService"
AutoRefresh Interval
This setting controls how often certain status information is refreshed from configured EdgeServers. If the interval is greater than 0, then the application automatically refreshes the current view every interval. If the interval is 0, then the user must manually select View.Refresh in order to refresh the current view.
Automatic Refresh may be useful when monitoring RFTagAware deployments. See the User Guide for details.
Automatic Refresh Interval: 250 ms
OK

FIGURE 11B

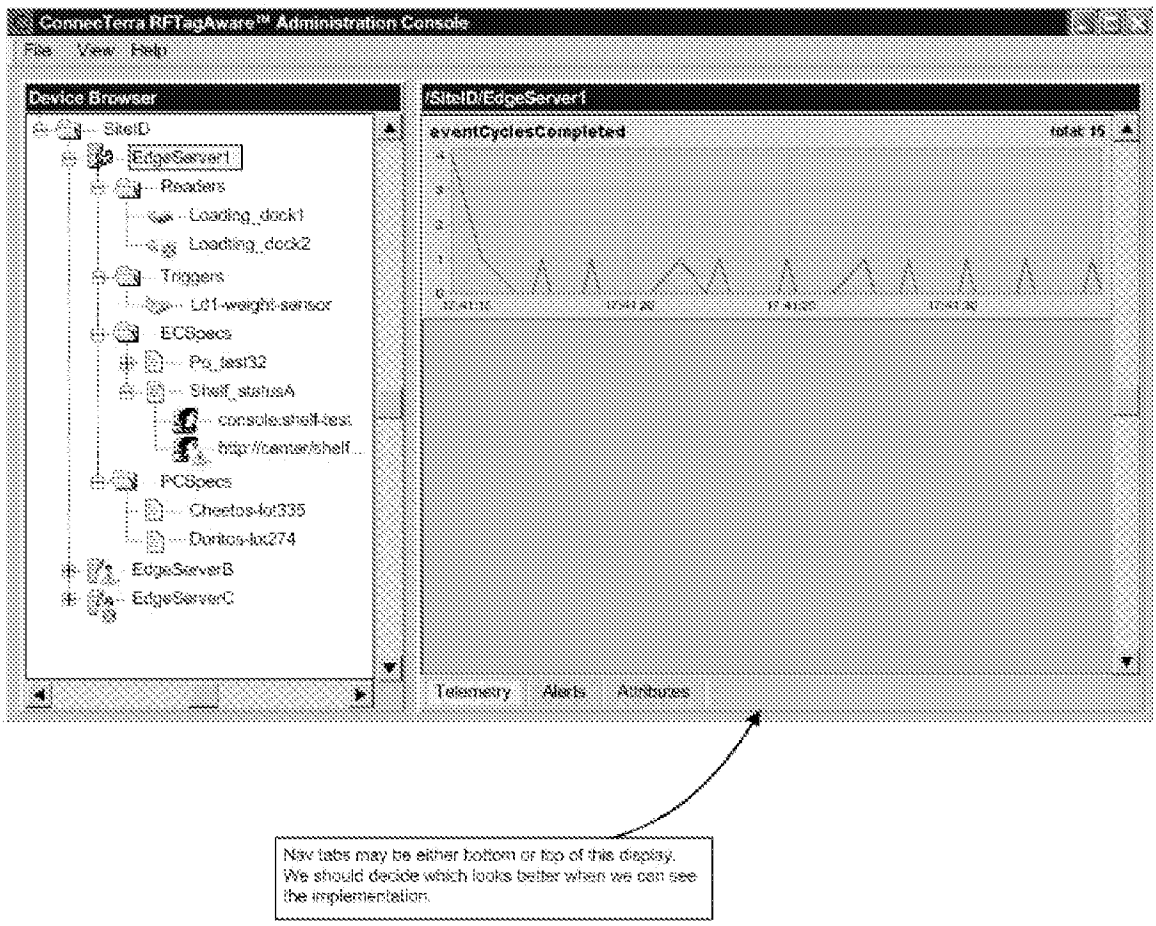


FIGURE 11C

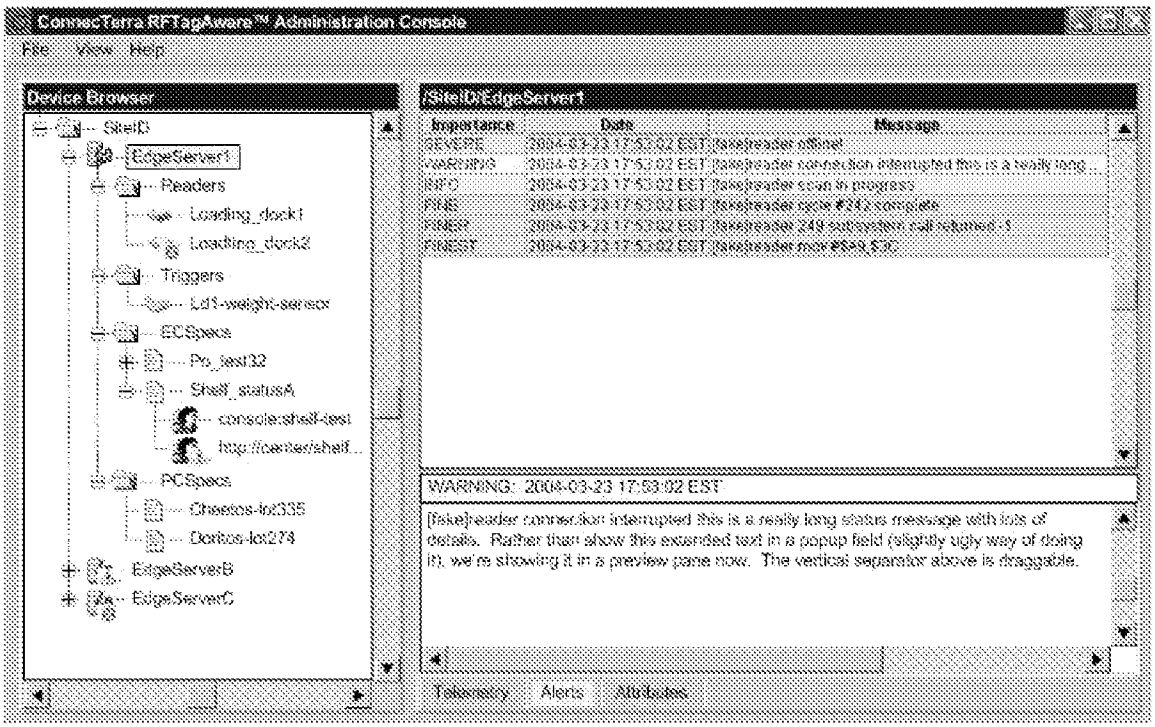


FIGURE 11D

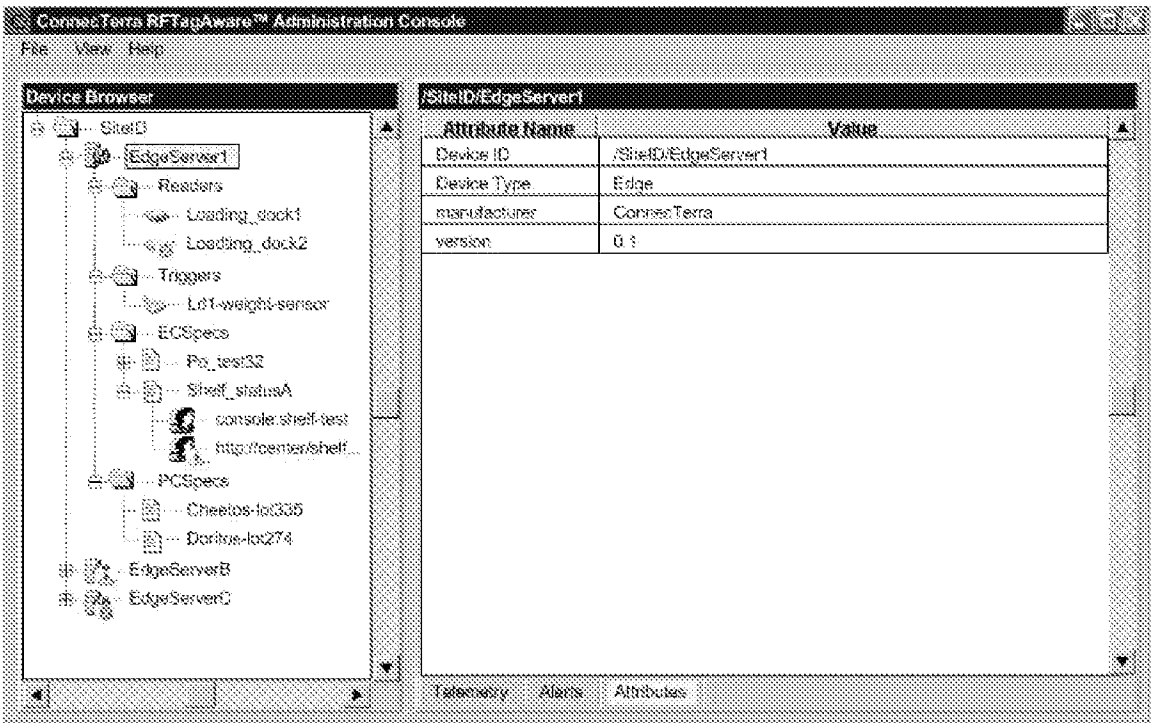


FIGURE 11E

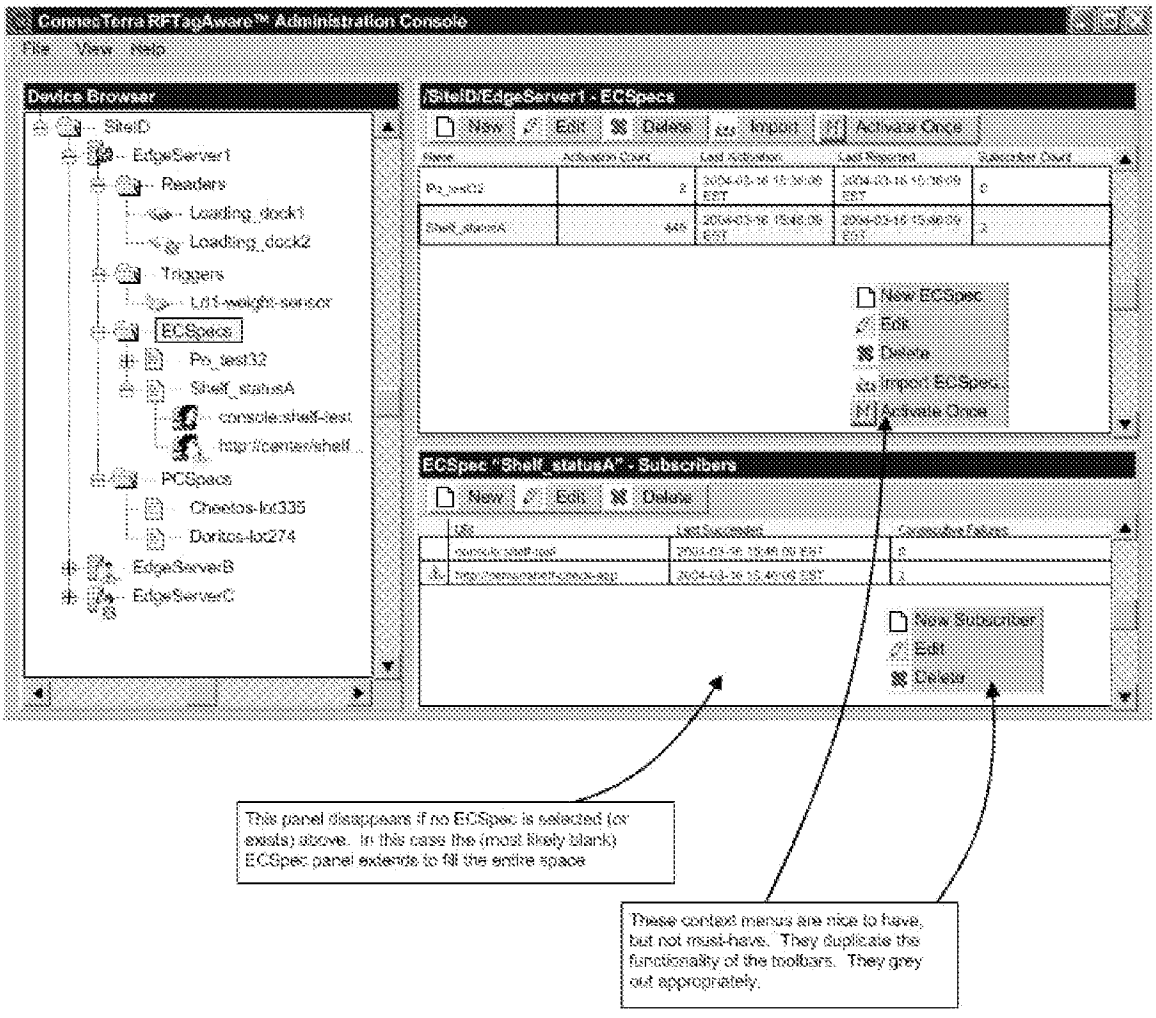


FIGURE 11F

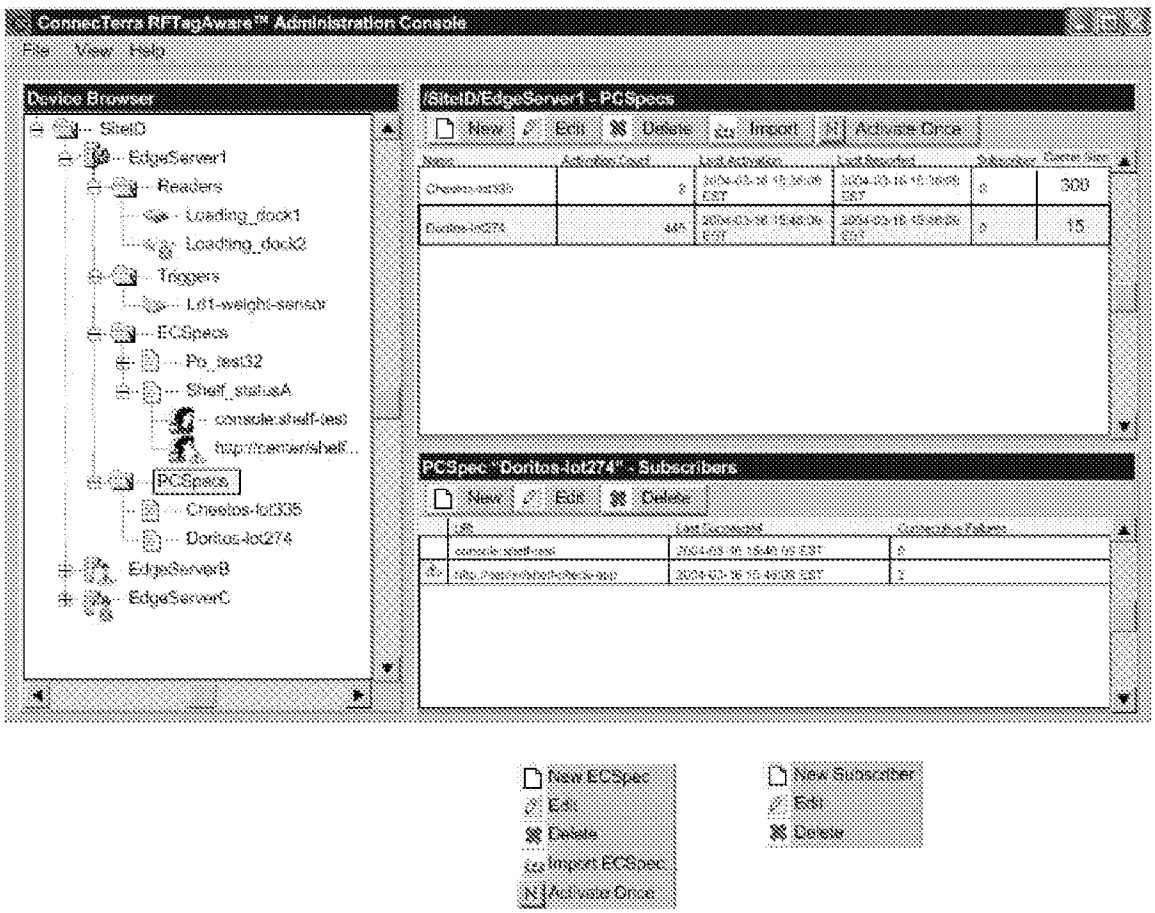


FIGURE 11G

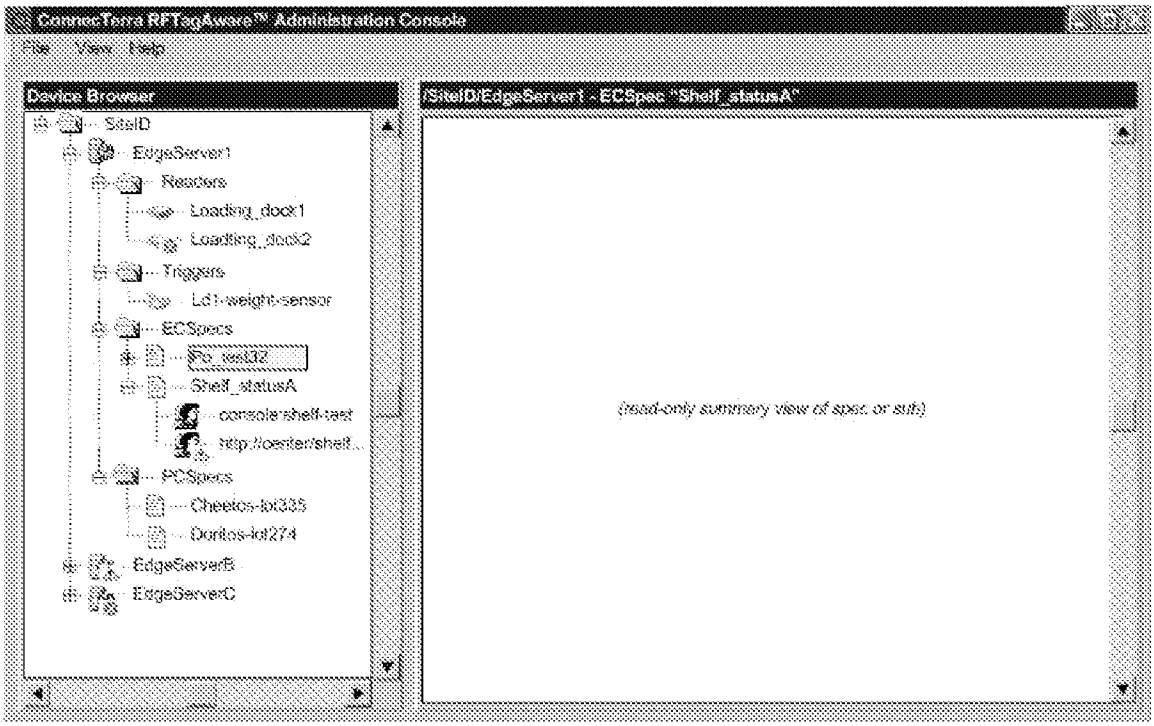


FIGURE 11H

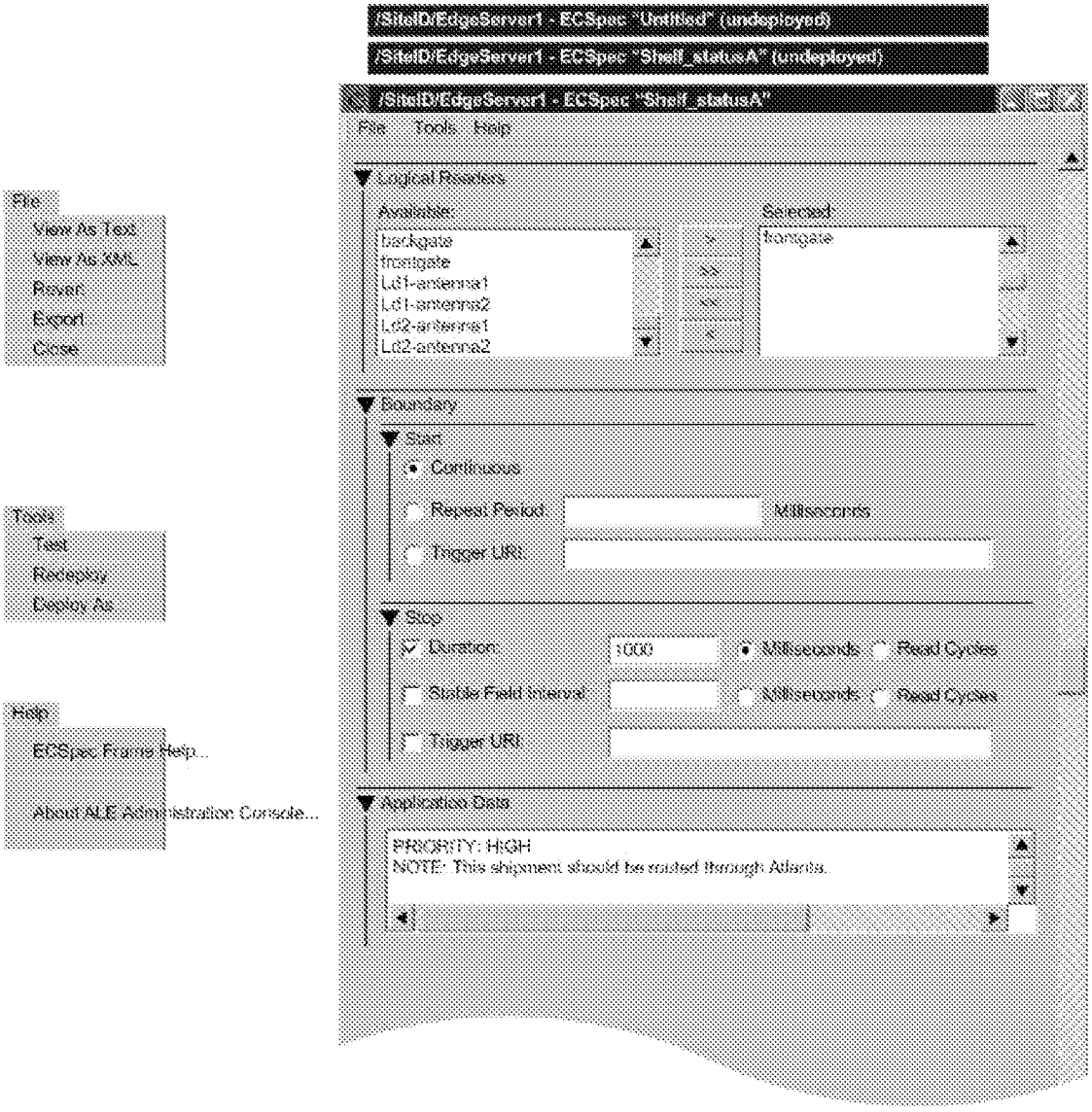

/SiteID/EdgeServer1 - ECSpec "Untitled" (undeployed)
/SiteID/EdgeServer1 - ECSpec "Shelf_statusA" (undeployed)
/SiteID/EdgeServer1 - ECSpec "Shelf_statusA"
File Tools Help
File
View As Text
View As XML
Revert
Export
Close
Tools
Test
Redeploy
Deploy As
Help
ECSpec Frame Help...
About ALE Administration Console...
Logical Readers
Available:
backgate
frontgate
Ld1-antenna1
Ld1-antenna2
Ld2-antenna1
Ld2-antenna2
Selected:
frontgate
Boundary
Start
Continuous
Repeat Period:
Milliseconds
Trigger URI:
Stop
Duration:
1000
Milliseconds
Read Cycles
Stable Field Interval:
Milliseconds
Read Cycles
Trigger URI:
Application Data
PRIORITY: HIGH
NOTE: This shipment should be routed through Atlanta.

FIGURE 11I

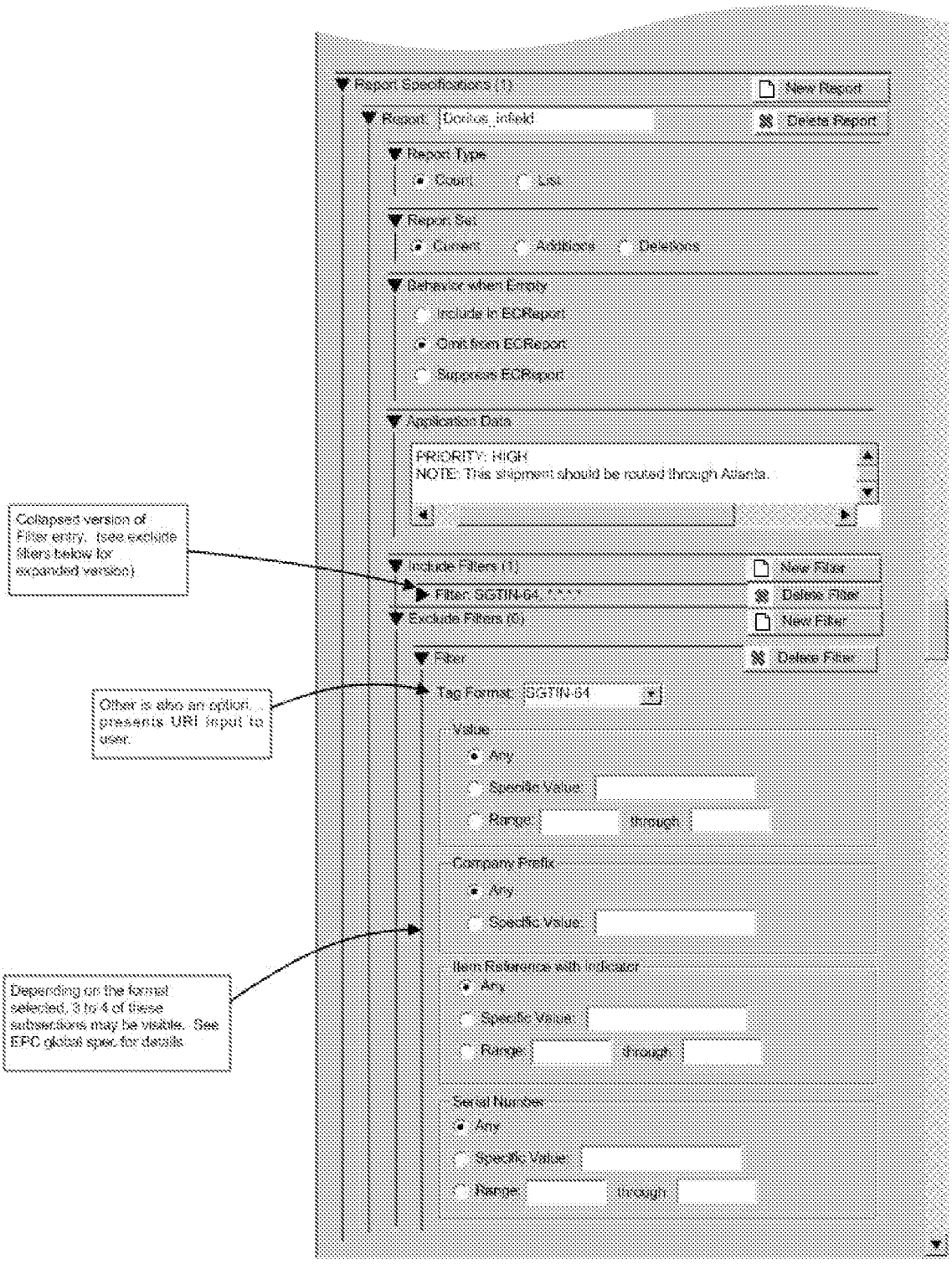

Report Specifications (1)
New Report
Report: Dockss_infield
Delete Report
Report Type
Count
List
Report Set
Current
Additions
Deletions
Behavior when Empty
Include in ECReport
Omit from ECReport
Suppress ECReport
Application Data
PRIORITY: HIGH
NOTE: This shipment should be routed through Atlanta.
Include Filters (1)
New Filter
Filter: SGTIN-64 *.*.*
Delete Filter
Exclude Filters (0)
New Filter
Filter
Delete Filter
Tag Format: SGTIN-64
Value
Any
Specific Value:
Range:
through
Company Prefix
Any
Specific Value:
Item Reference with Indicator
Any
Specific Value:
Range:
through
Serial Number
Any
Specific Value:
Range:
through
Collapsed version of Filter entry. (see exclude filters below for expanded version)
Other is also an option... presents URI input to user.
Depending on the format selected, 3 to 4 of these subsections may be visible. See EPC global spec for details.

FIGURE 11J

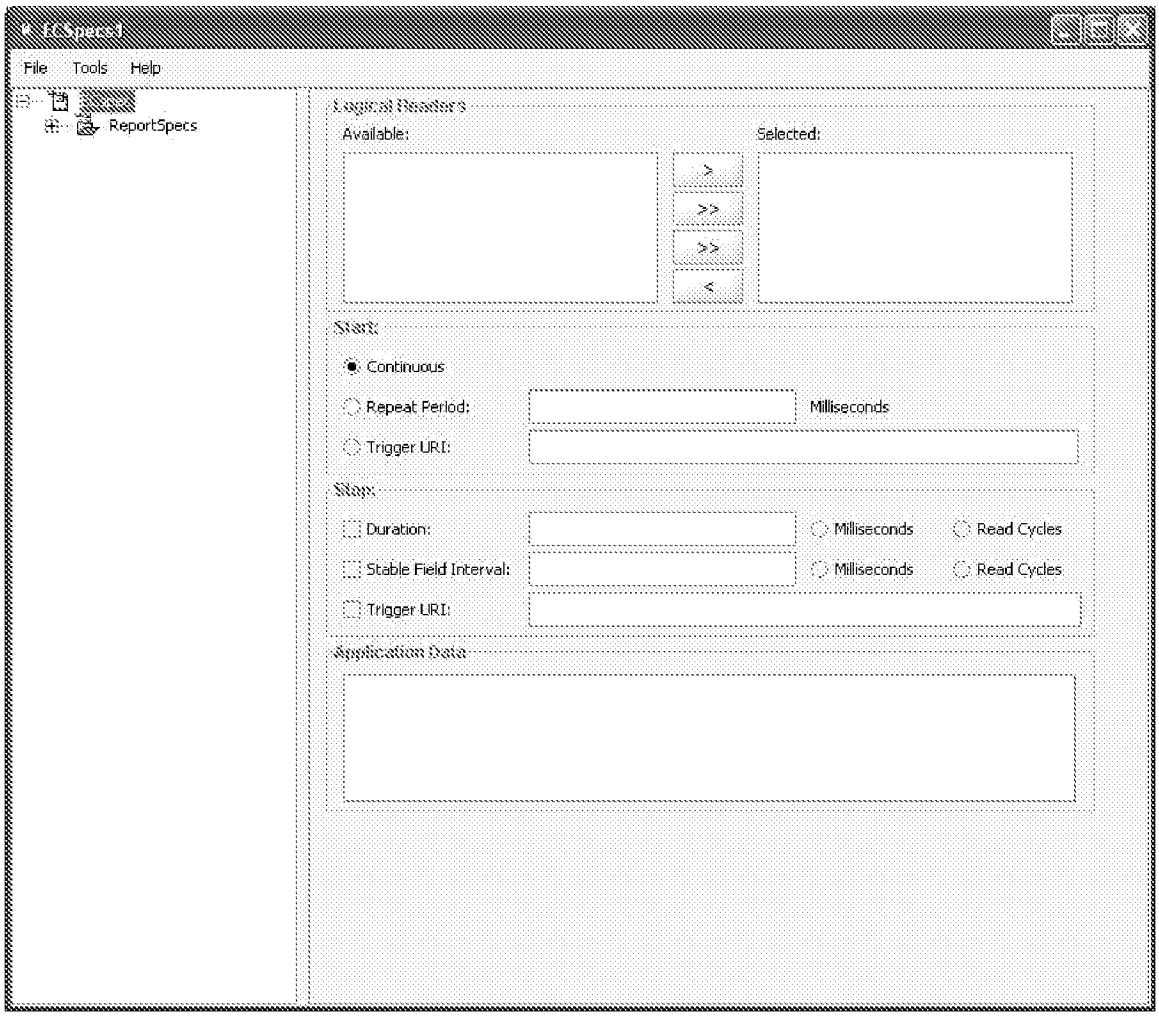


FIGURE 11K

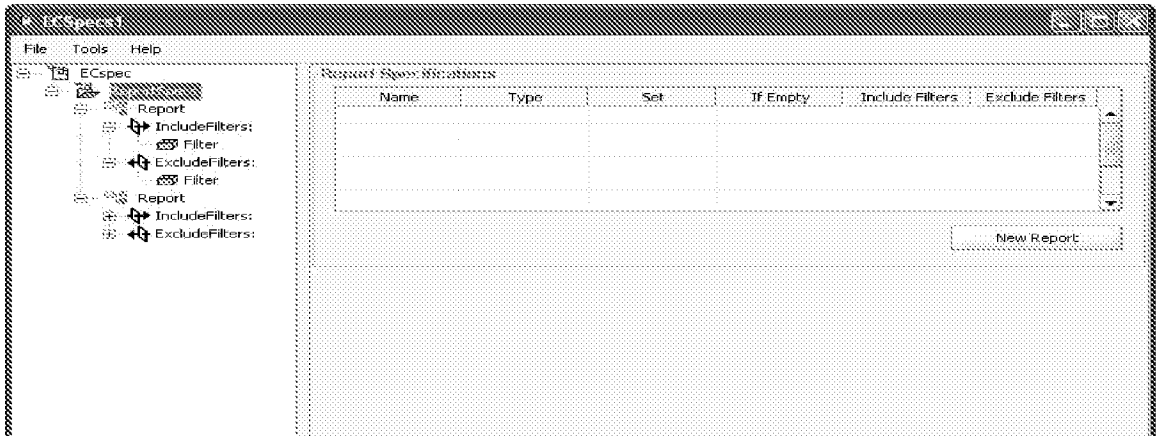


FIGURE 11L

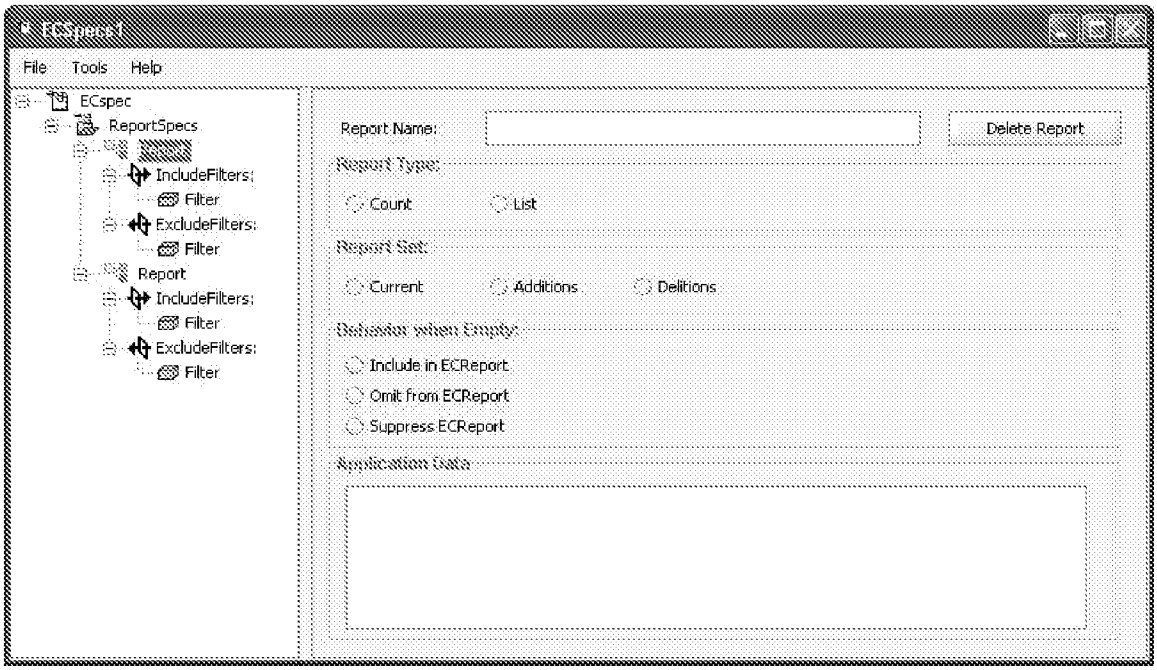


FIGURE 11M

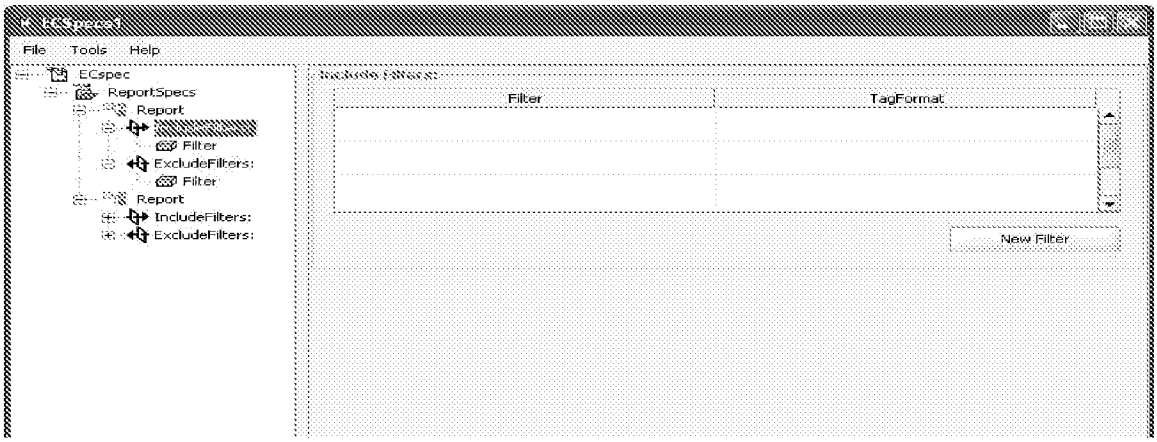


FIGURE 11N

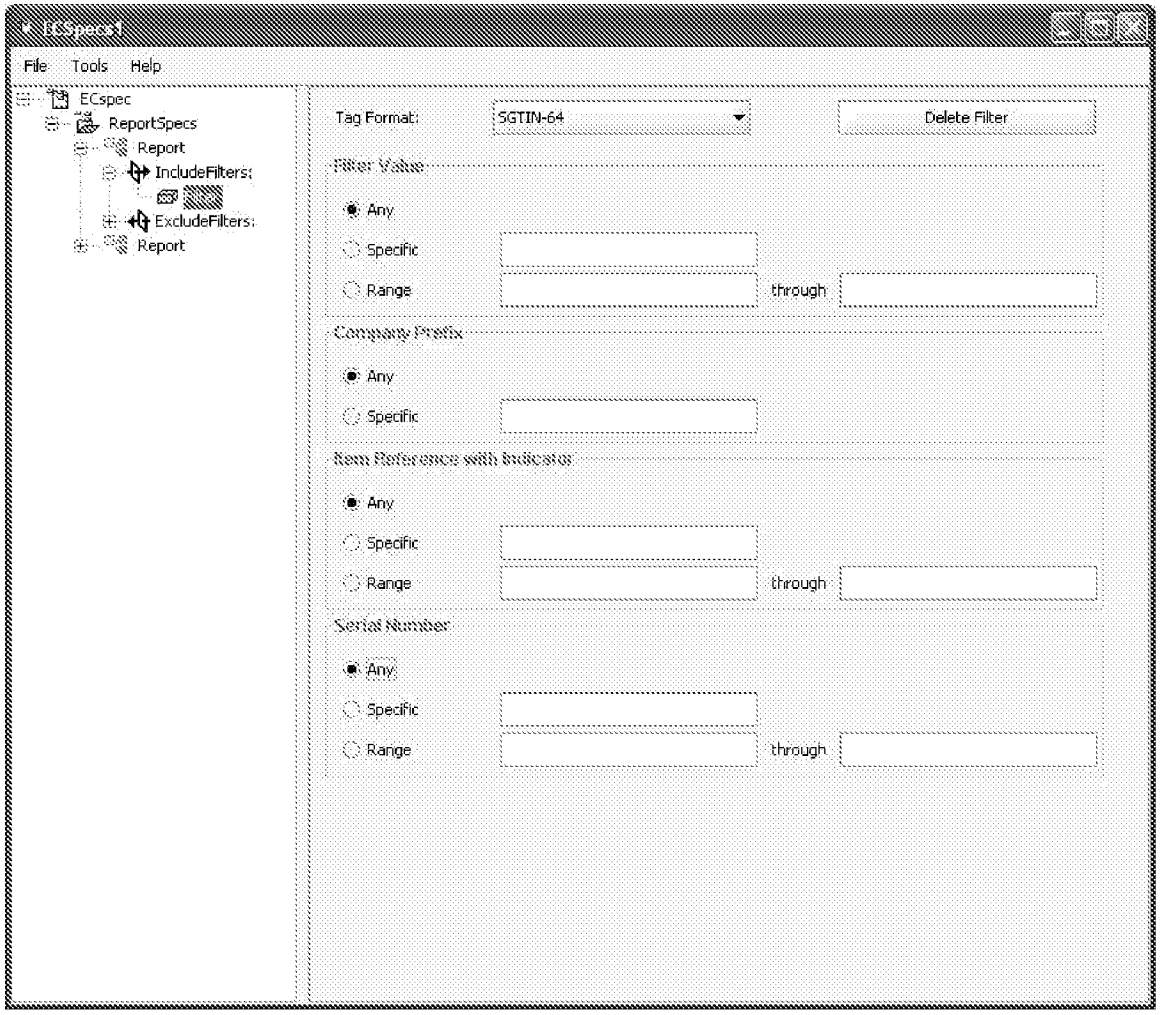

ECSpec1
File
Tools
Help
ECspec
ReportSpecs
Report
IncludeFilters:
ExcludeFilters:
Report
Tag Format:
SGTIN-64
Delete Filter
Filter Value
Any
Specific
Range
through
Company Prefix
Any
Specific
Item Reference with Indicator
Any
Specific
Range
through
Serial Number
Any
Specific
Range
through

FIGURE 11O

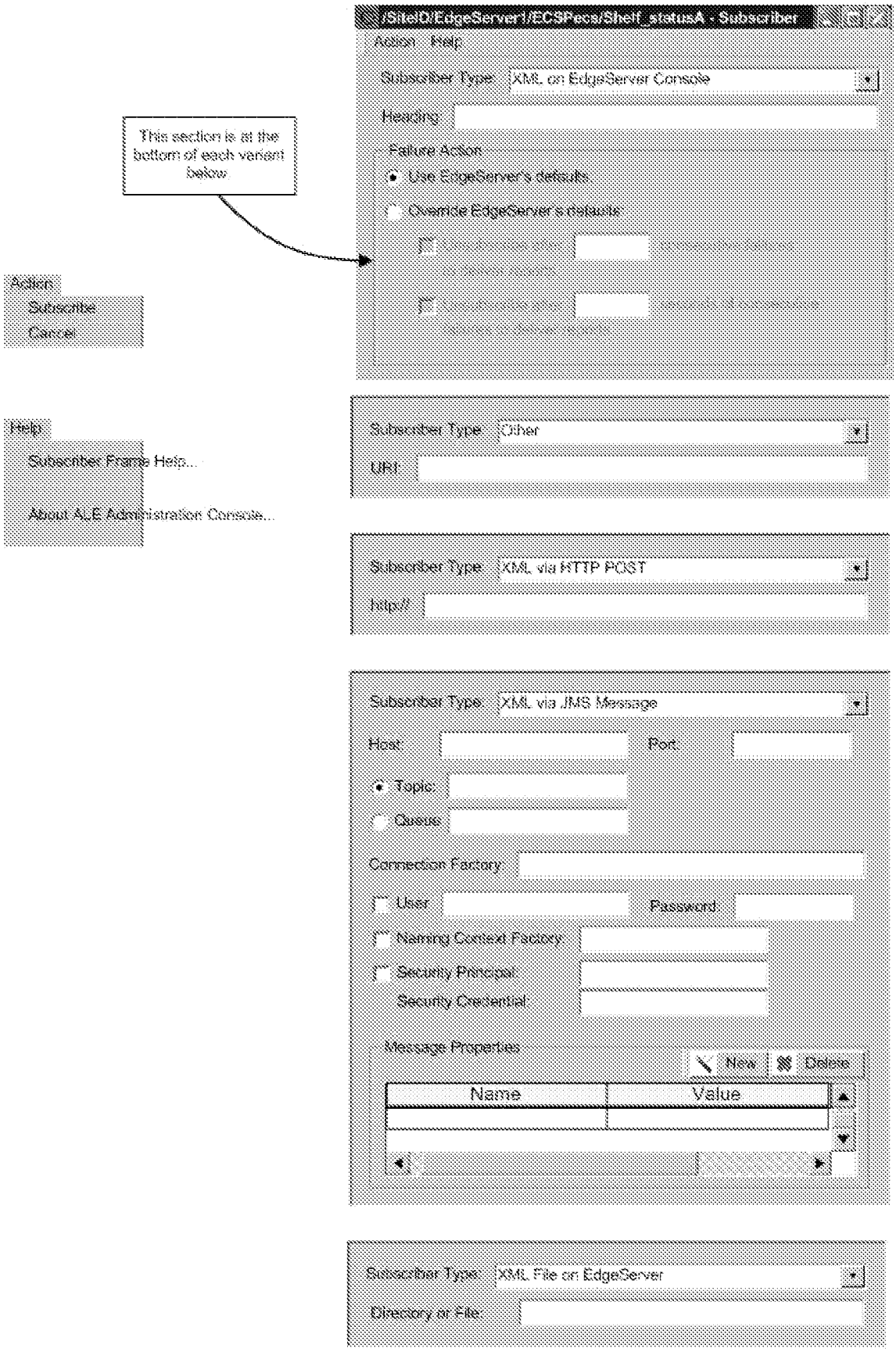

/SiteID/EdgeServer/ECSPecs/Shelf_statusA - Subscriber
Action Help
Subscriber Type: XML on EdgeServer Console
Heading:
Failure Action
Use EdgeServer's defaults
Override EdgeServer's defaults
This section is at the bottom of each variant below
Action
Subscribe
Cancel
Help
Subscriber Frame Help...
About ALE Administration Console...
Subscriber Type: Other
URI:
Subscriber Type: XML via HTTP POST
http://
Subscriber Type: XML via JMS Message
Host:
Port:
Topic:
Queue:
Connection Factory:
User:
Password:
Naming Context Factory:
Security Principal:
Security Credential:
Message Properties
New
Delete
Name
Value
Subscriber Type: XML File on EdgeServer
Directory or File:

FIGURE 11P

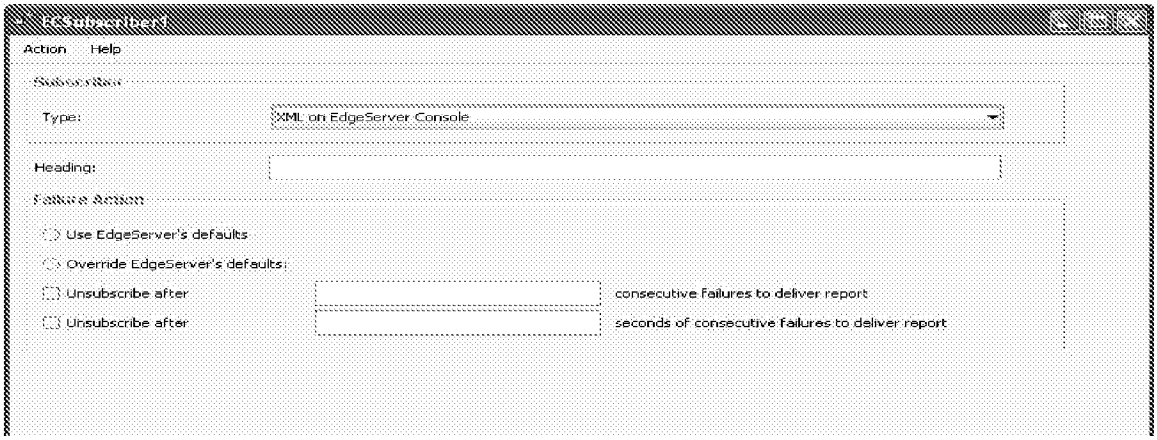

Action
Help
Type:
XML on EdgeServer Console
Heading:
Use EdgeServer's defaults
Override EdgeServer's defaults:
Unsubscribe after
consecutive failures to deliver report
Unsubscribe after
seconds of consecutive failures to deliver report

FIGURE 11Q

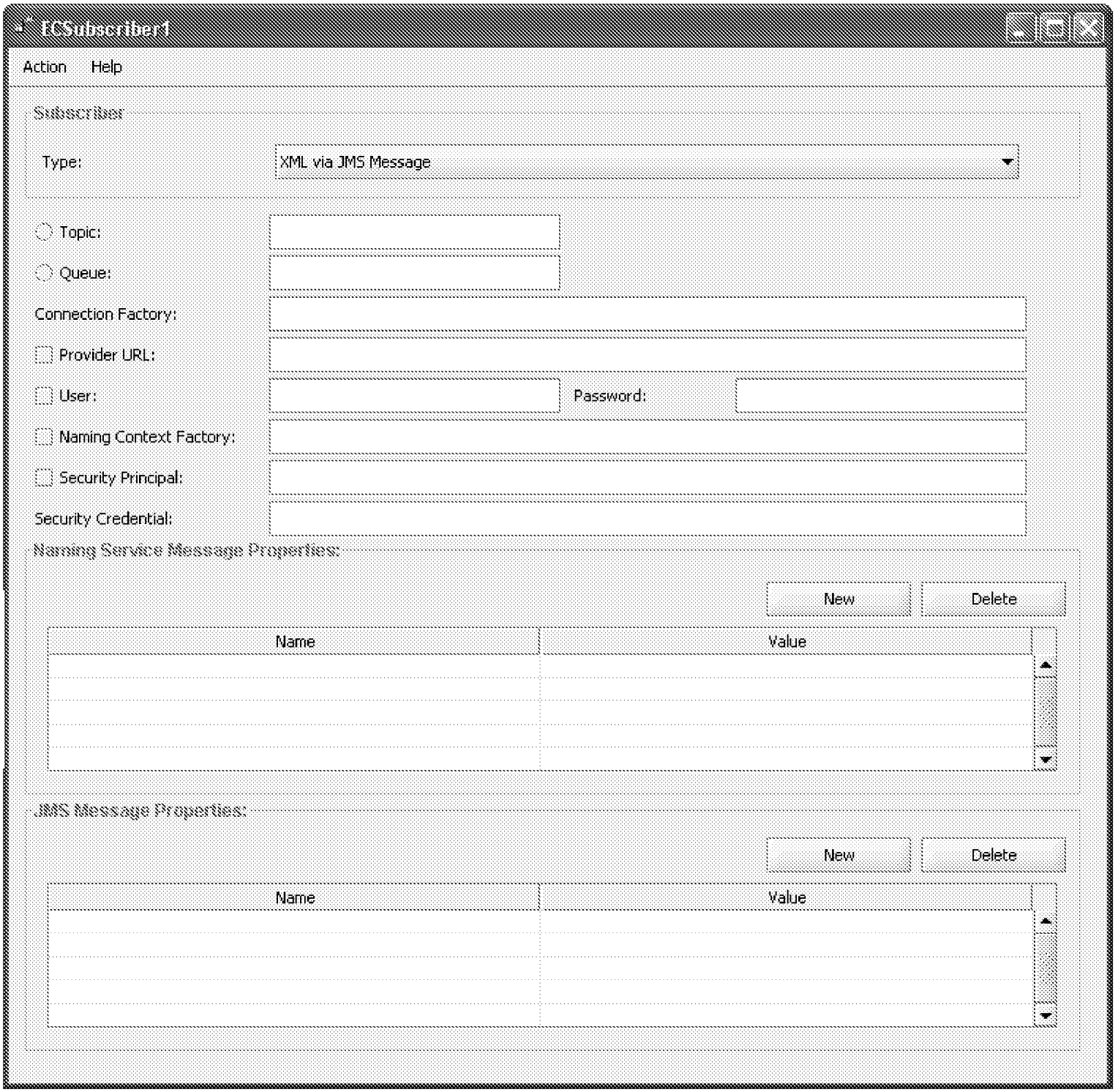

ECSubscriber1
Action
Help
Subscriber
Type:
XML via JMS Message
Topic:
Queue:
Connection Factory:
Provider URL:
User:
Password:
Naming Context Factory:
Security Principal:
Security Credential:
Naming Service Message Properties:
New
Delete
Name
Value
JMS Message Properties:
New
Delete
Name
Value

FIGURE 11R

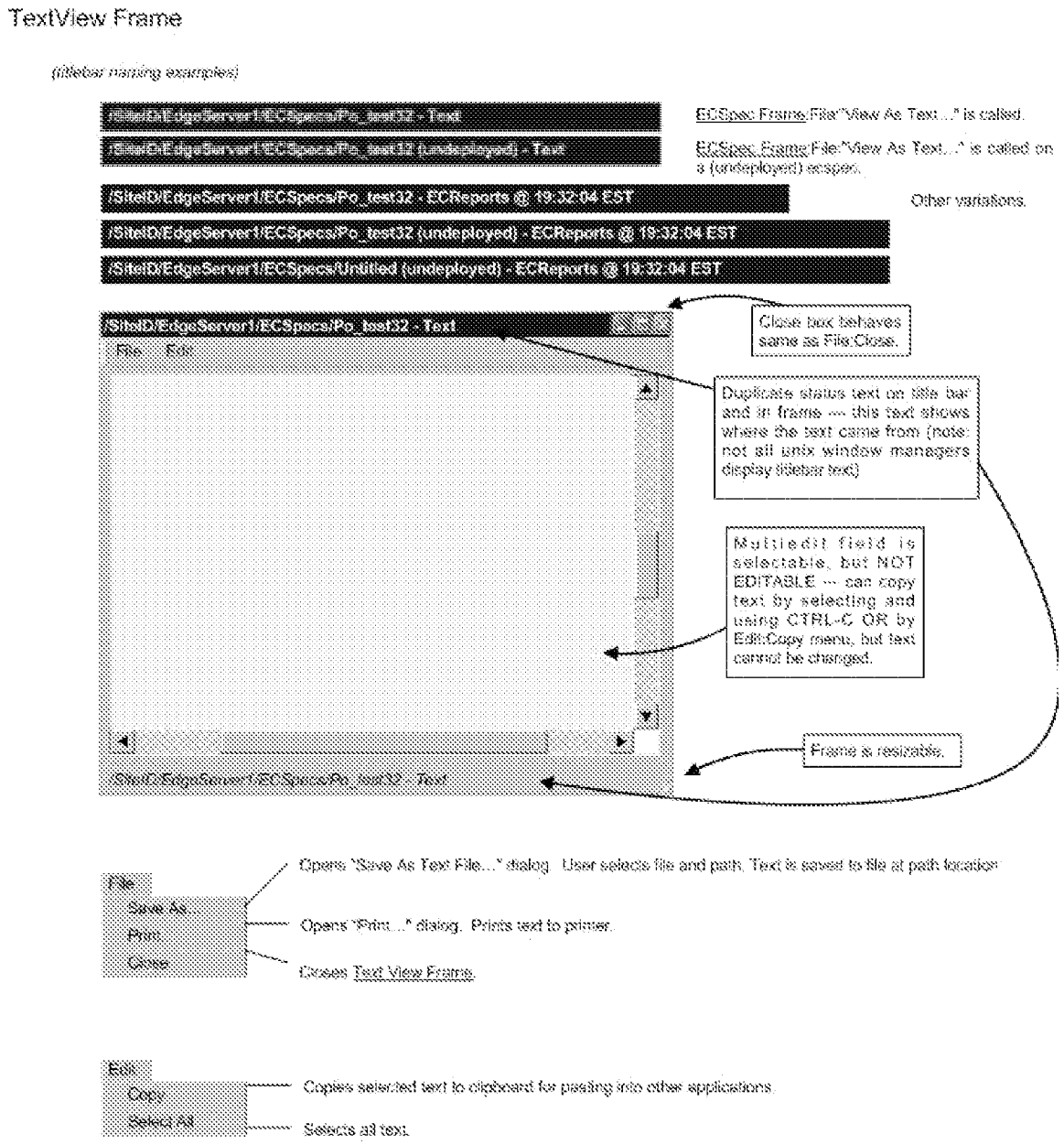

TextView Frame
(titlebar naming examples)
ECSpec Frame:File:"View As Text..." is called.
ECSpec Frame:File:"View As Text..." is called on a (undeployed) ecspec.
Other variations.
/SiteID/EdgeServer1/ECSpecs/Po_test32 - ECReports @ 19:32:04 EST
/SiteID/EdgeServer1/ECSpecs/Po_test32 (undeployed) - ECReports @ 19:32:04 EST
/SiteID/EdgeServer1/ECSpecs/Untitled (undeployed) - ECReports @ 19:32:04 EST
/SiteID/EdgeServer1/ECSpecs/Po_test32 - Text
File Edit
Close box behaves same as File:Close.
Duplicate status text on title bar and in frame — this text shows where the text came from (note: not all unix window managers display titlebar text)
Multiedit field is selectable, but NOT EDITABLE — can copy text by selecting and using CTRL-C OR by Edit:Copy menu, but text cannot be changed.
Frame is resizable.
/SiteID/EdgeServer1/ECSpecs/Po_test32 - Text
File
Save As...
Print
Close
Opens "Save As Text File..." dialog. User selects file and path. Text is saved to file at path location.
Opens "Print..." dialog. Prints text to printer.
Closes Text View Frame.
Edit
Copy
Select All
Copies selected text to clipboard for pasting into other applications.
Selects all text.

FIGURE 11S

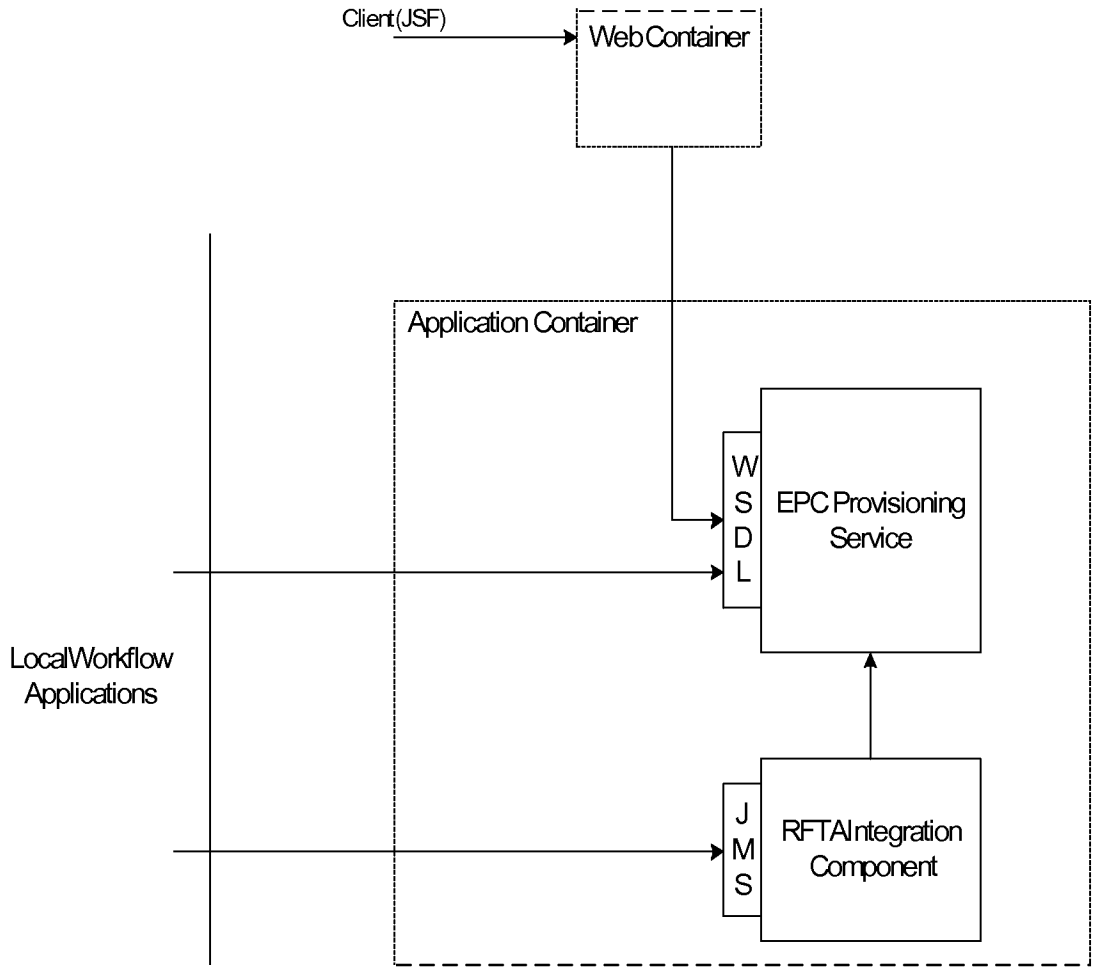


FIGURE 12A

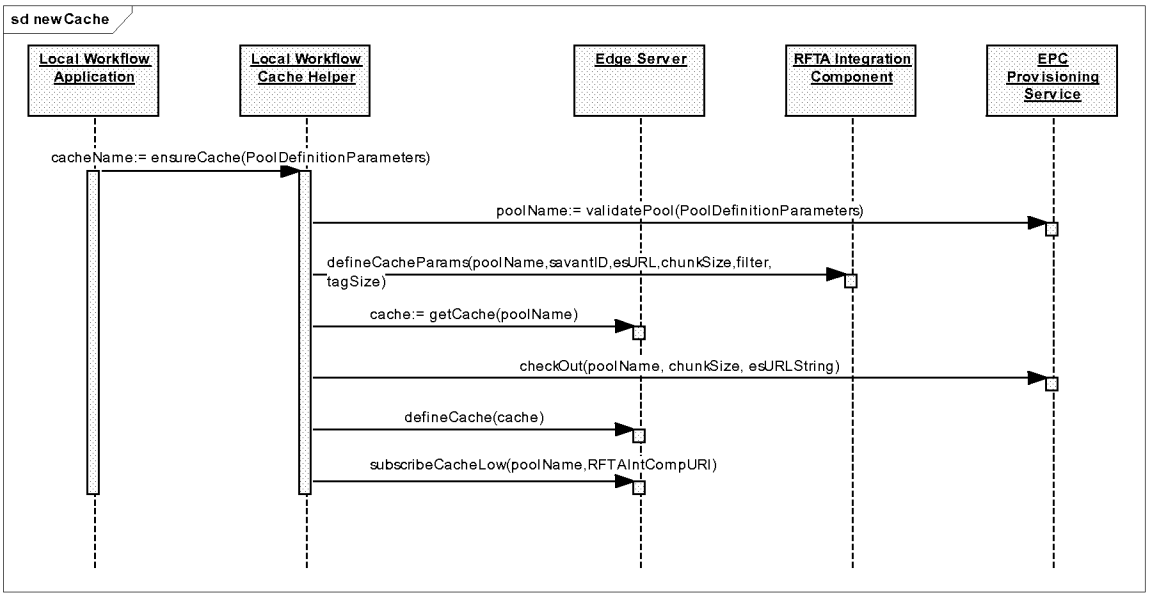


FIGURE 12B

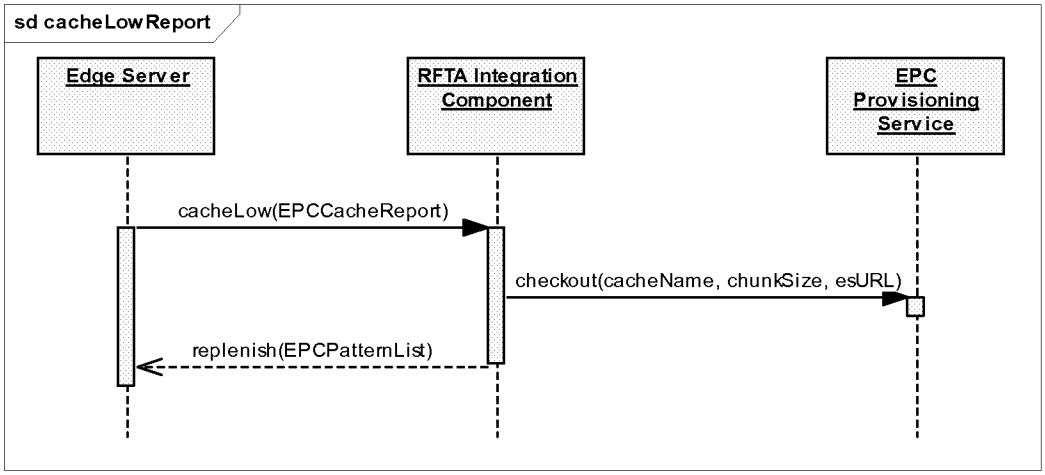


FIGURE 12C

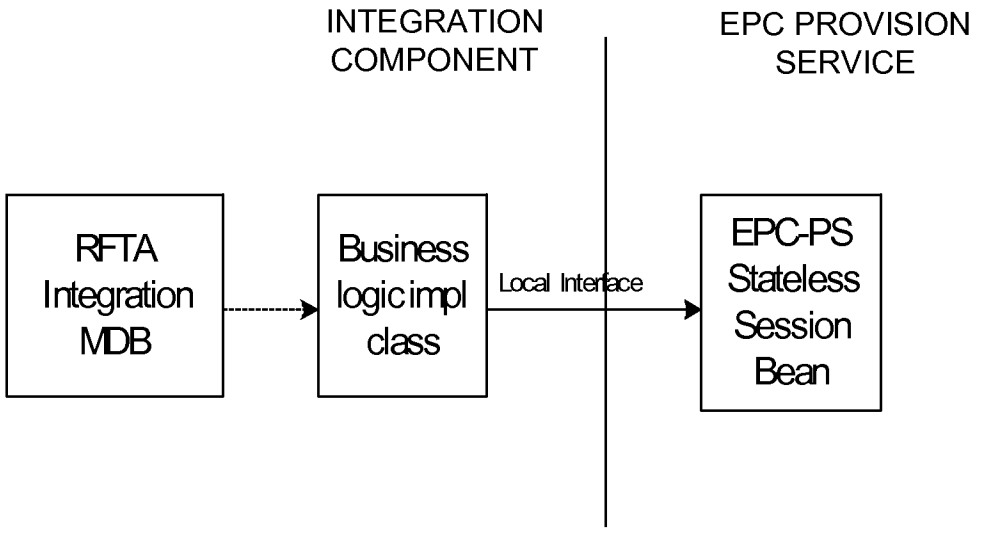


FIGURE 12D

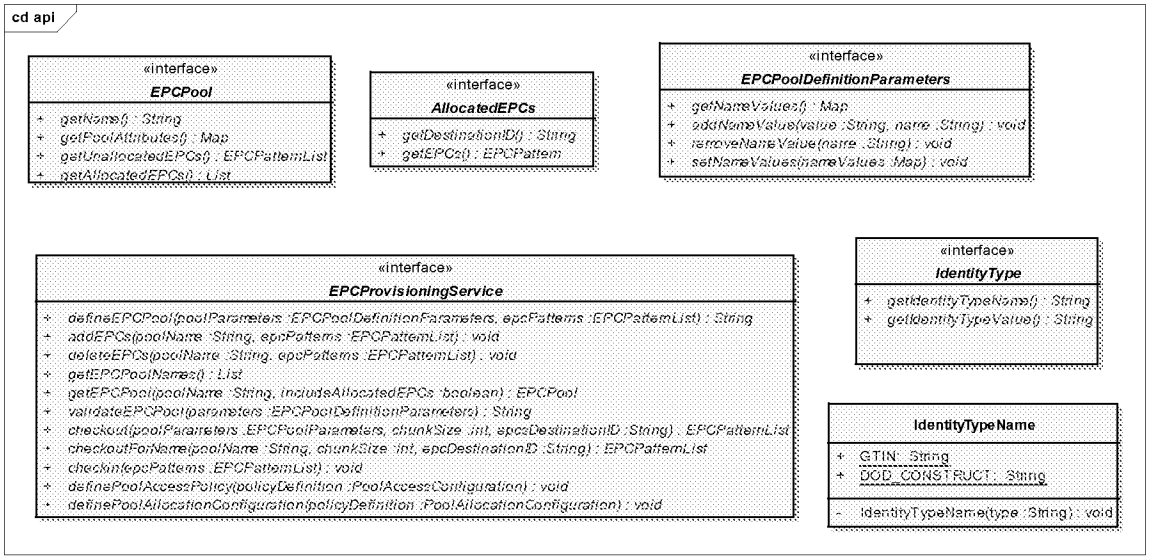


FIGURE 12E

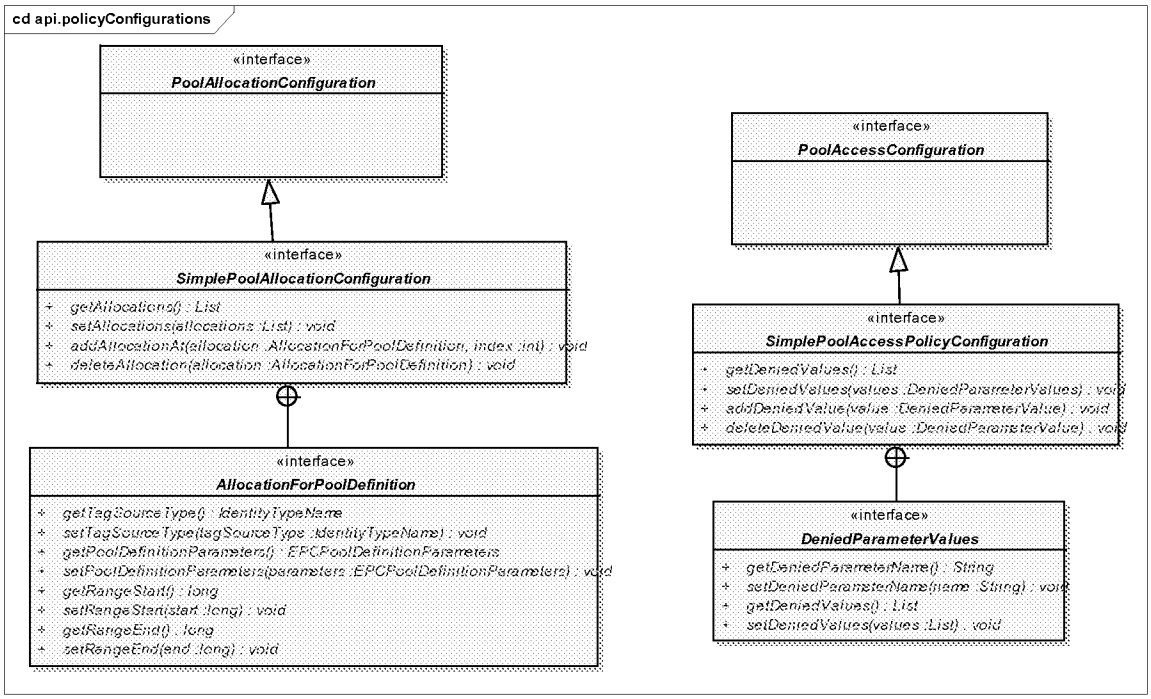


FIGURE 12F

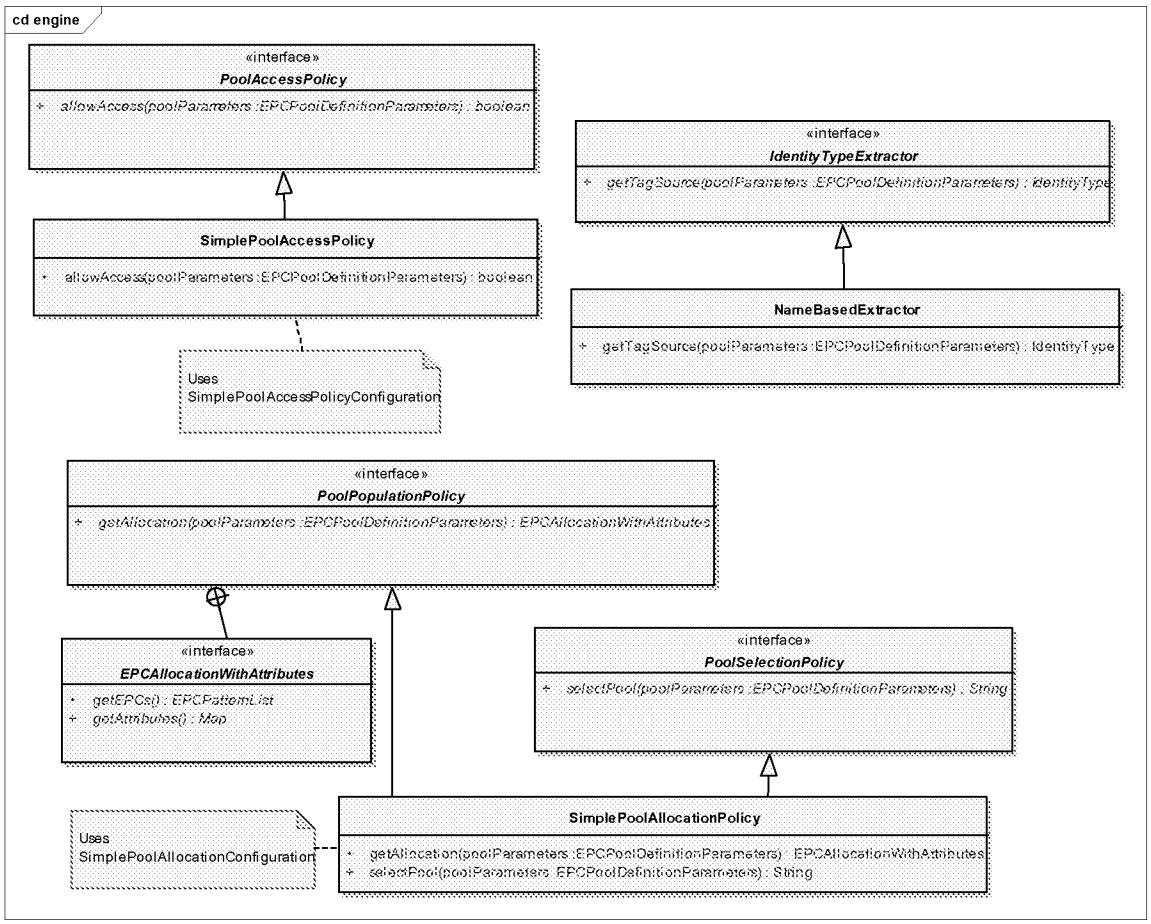


FIGURE 12G

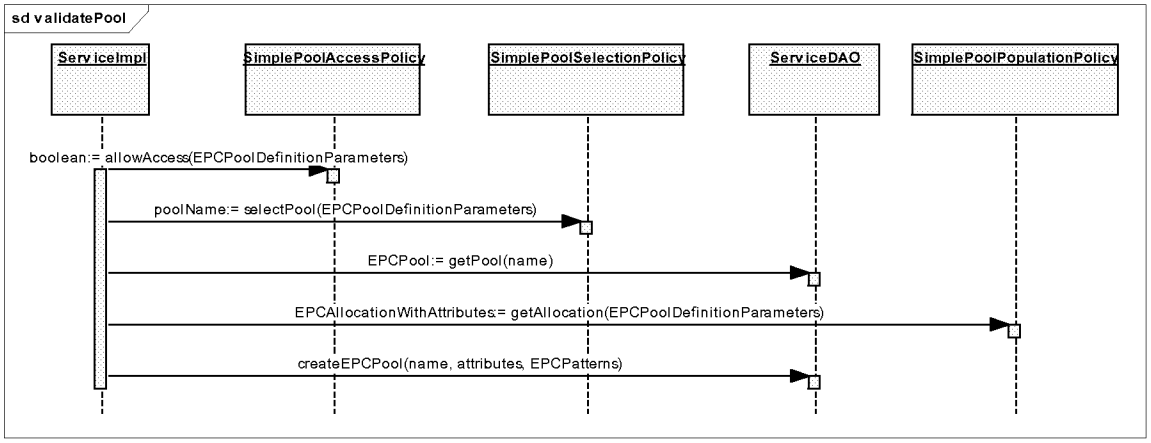


FIGURE 12H

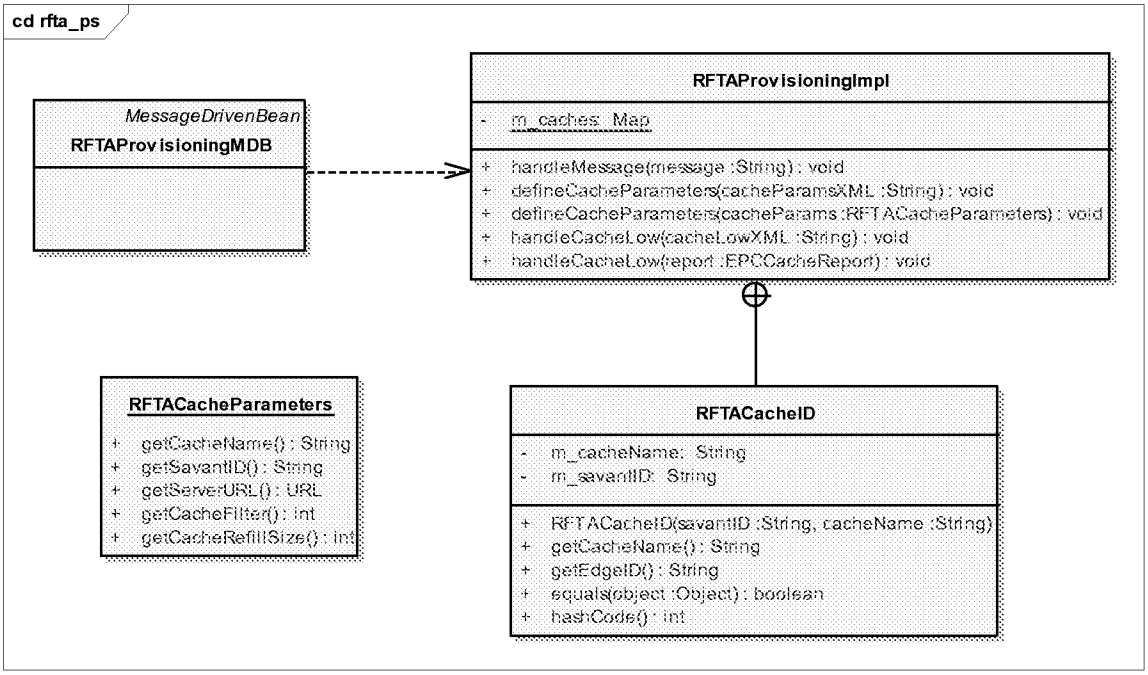

cd rfta_ps
MessageDrivenBean
RFTAProvisioningMDB
RFTAProvisioningImpl
- m_caches: Map
+ handleMessage(message :String) : void
+ defineCacheParameters(cacheParamsXML :String) : void
+ defineCacheParameters(cacheParams :RFTACacheParameters) : void
+ handleCacheLow(cacheLowXML :String) : void
+ handleCacheLow(report :EPCCacheReport) : void
RFTACacheParameters
+ getCacheName() : String
+ getSavantID() : String
+ getServerURL() : URL
+ getCacheFilter() : int
+ getCacheRefillSize() : int
RFTACacheID
- m_cacheName: String
- m_savantID: String
+ RFTACacheID(savantID :String, cacheName :String)
+ getCacheName() : String
+ getEdgeID() : String
+ equals(object :Object) : boolean
+ hashCode() : int

FIGURE 12I

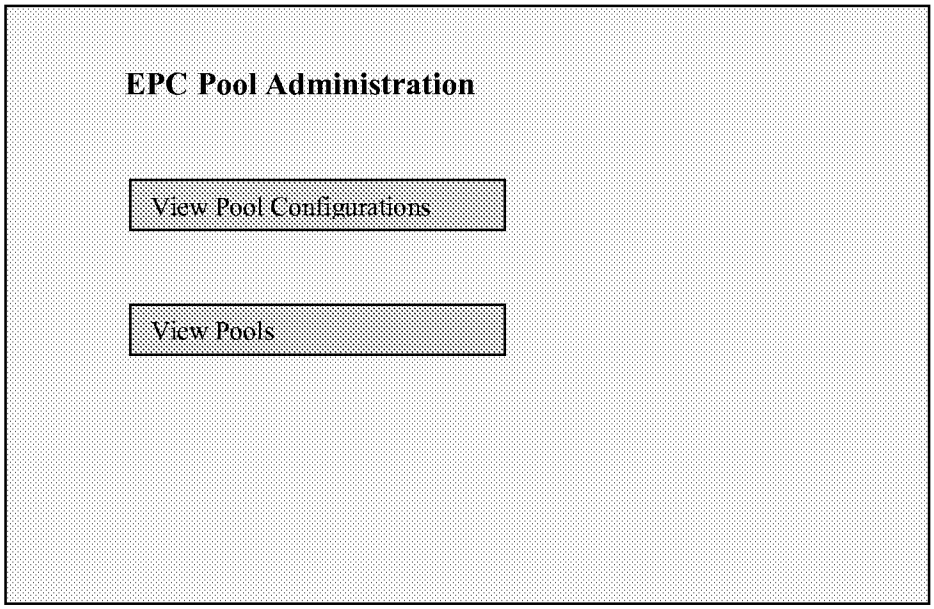


FIGURE 13A

	Identity Type	Parameters		Range		Actions
		Name	Value	Start	End	
?	GTIN	location_id	picking01	0	10000	Up Down Edit
		GTIN_value				
?	SSCC					Up Down Edit

Delete Define New

FIGURE 13B

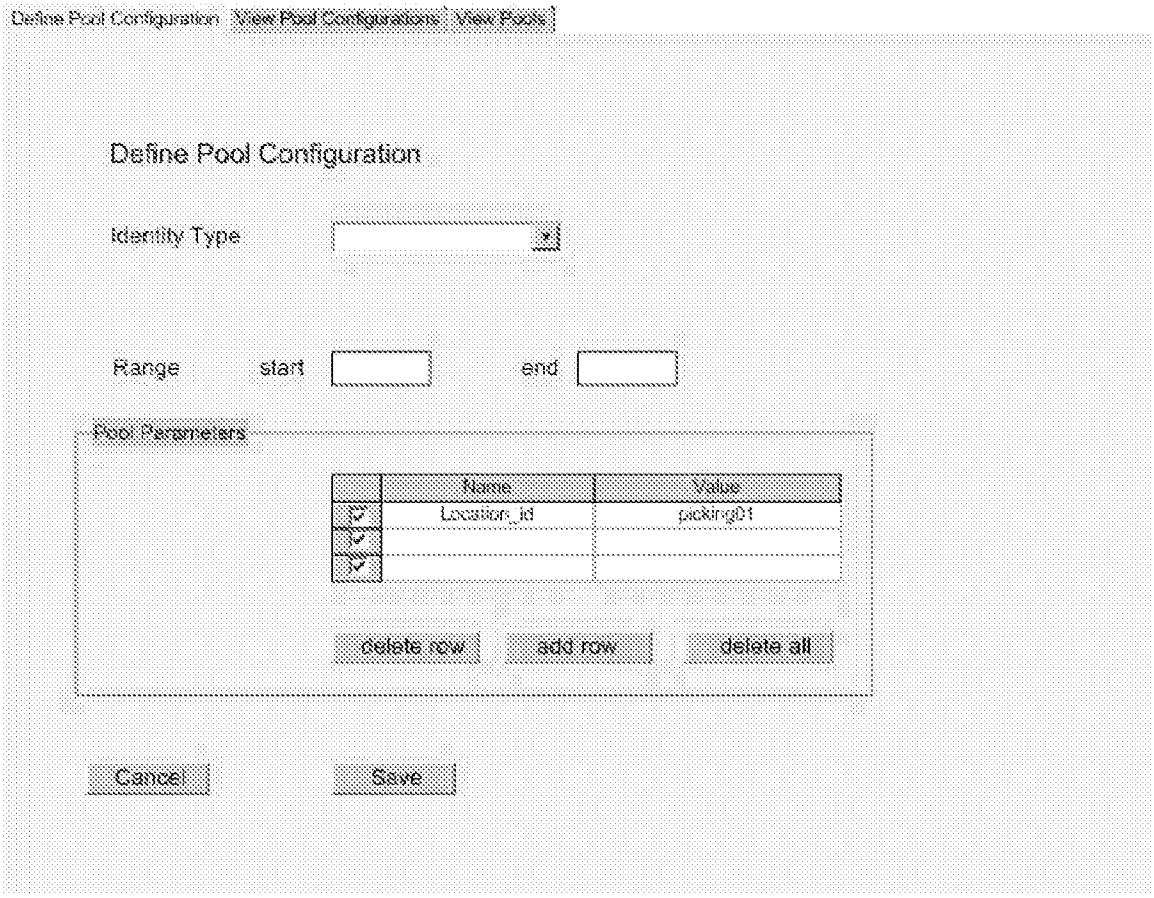


FIGURE 13C

Pool Name	Creation Date	Pool Attributes		Checked out EPCs count	Available EPCs count	Actions
		Name	Value			
Name_1	06-01-05 12:00 PM	location_id	picking01	24000000	45000000	Vie
		GTIN_value				
Name_2						Vie

FIGURE 13D

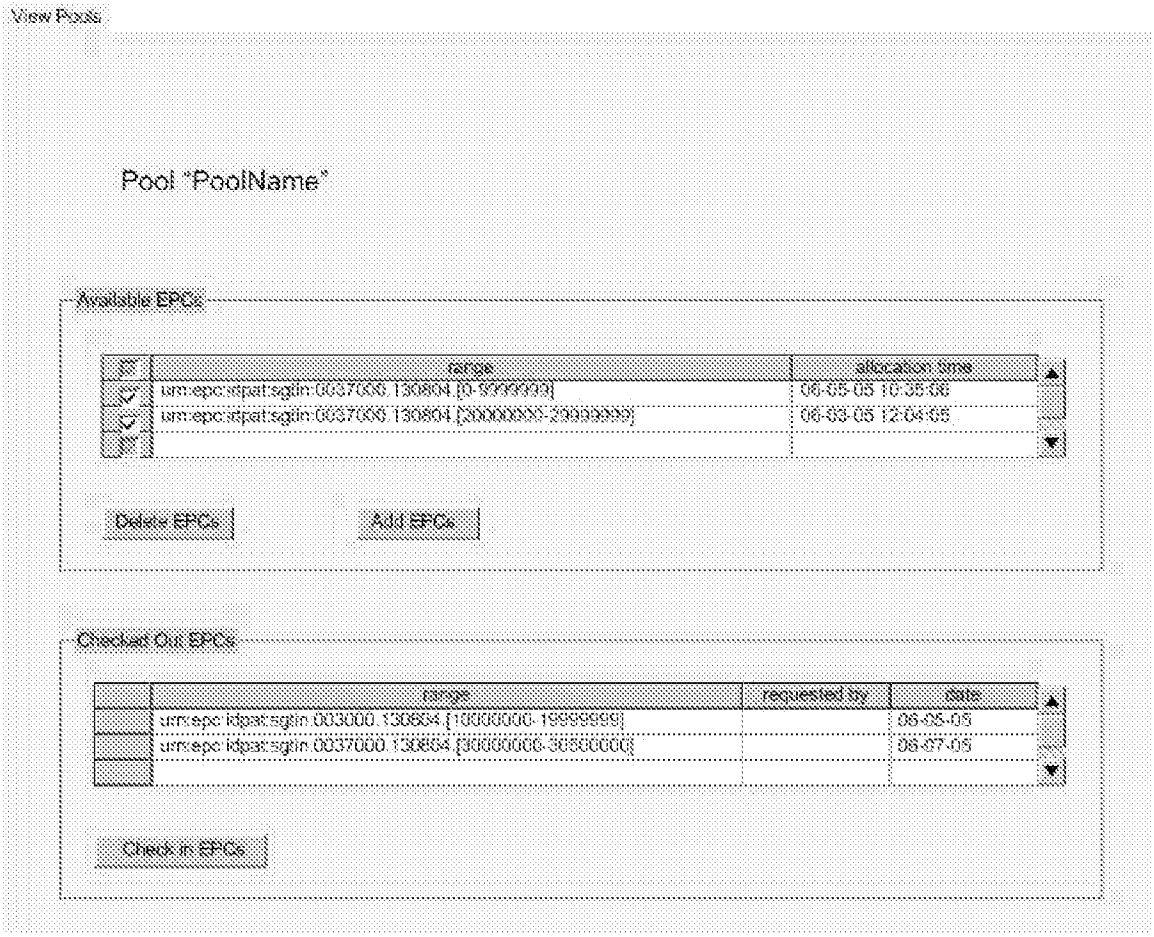


FIGURE 13E

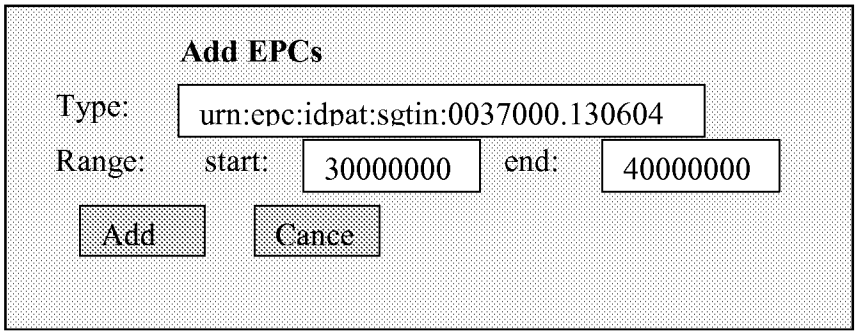


FIGURE 13F

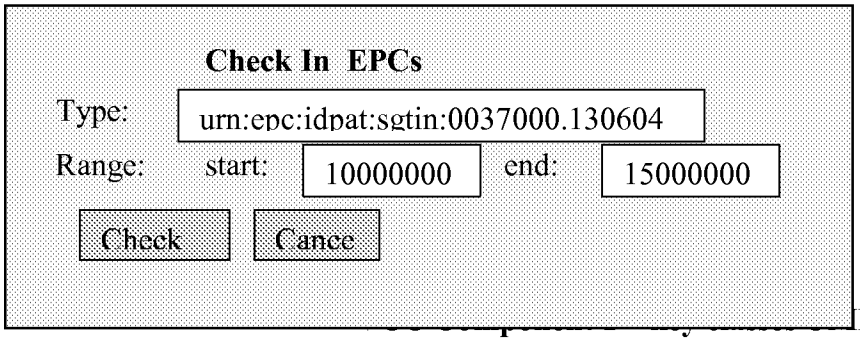


FIGURE 13G

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	RFID Edge Server Improvement
First Named Inventor/Applicant Name:	Kenneth R. Traub
Filer:	Joseph P. O'Malley/Teri Muir
Attorney Docket Number:	BEAS-02024US6

Filed as Large Entity

Provisional Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Provisional application filing	1005	1	200	200
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**200**

Electronic Acknowledgement Receipt

EFS ID:	1299165
Application Number:	60864759
International Application Number:	
Confirmation Number:	1538
Title of Invention:	RFID Edge Server Improvement
First Named Inventor/Applicant Name:	Kenneth R. Traub
Customer Number:	23910
Filer:	Joseph P. O'Malley/Teri Muir
Filer Authorized By:	Joseph P. O'Malley
Attorney Docket Number:	BEAS-02024US6
Receipt Date:	07-NOV-2006
Filing Date:	
Time Stamp:	19:17:17
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment was successfully received in RAM	$200
RAM confirmation Number	722
Deposit Account	061325
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 and 1.17	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	ADS.pdf	1288053	no	6
Warnings:					
Information:					
2		Application.pdf	9641553	yes	68

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Specification	1	56
	Claims	57	67
	Abstract	68	68

Warnings:					
Information:					
3	Drawings	Drawings.pdf	2997306	no	49
Warnings:					
Information:					
4	Fee Worksheet (PTO-875)	fee-info.pdf	8107	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	13935019		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	DRAWINGS	TOT CLAIMS	IND CLAIMS
60/864,759	11/07/2006		200	BEAS-02024US6	49		

CONFIRMATION NO. 1538

FILING RECEIPT

23910
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Date Mailed: 01/16/2007

Receipt is acknowledged of this provisional Patent Application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please mail to the Commissioner for Patents P.O. Box 1450 Alexandria Va 22313-1450. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).**

Applicant(s)

Kenneth R. Traub, Lexington, MA;
Steven Rosenthal, Lexington, MA;
Marc Horowitz, Burlington, MA;
Eric Gieseke, Burlington, MA;
Peter Gast, Burlington, MA;
Manju James, Burlington, MA;
Marina Popova, Burlington, MA;

Power of Attorney: The patent practitioners associated with Customer Number 23910

If Required, Foreign Filing License Granted:

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

Title

RFID Edge Server Improvement

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application

generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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6/6/07

ACCESS ACKNOWLEDGEMENT
and
SECRETCY ORDER RECOMMENDATION BY DEFENSE AGENCY

Application Serial Number: ~~11/~~ 60/ ~~050~~ 864759
Filing Date:

Defense Agency: DOE
Referred Date:

I hereby acknowledge as indicated by my signature on this form that I have inspected this application in administration of 35 USC on behalf of Agency/Command specified below. I promise not to divulge any information from this application for any purpose other than administration of 35 USC 181.

Recommendation
(e.g. 'Secrecy Not Recommended (SNR)')

Reviewer(s) Signature/Date/Command

SNR	Douglas E. Zimmerman / DOE / **03/30/2007**
	Douglas E. Zimmerman

Instructions to Reviewers:

1. All individuals reviewing this application are required under 35 USC 181 to sign and date this form regardless of whether they are making a secrecy order recommendation.

2. The attached copy of the application, any copies made there from and this form this form must be returned to the PTO once a recommendation not to impose secrecy has been made or a secrecy order has been rescinded.

Time for Completion of review:

Pursuant to 35 U.S.C. 184, the subject matter of this application maybe be filed in a foreign country for the purpose of filing a patent application without a license any time after the expiration of 6 months from the filing date unless the application becomes the subject of a secrecy order.

The USPTO publishes patent applications at 18 months from the earliest claimed filing date. The USPTO will delay the publication of a patent application made available to a defense agency under 35 USC 181 until no earlier than 6 months from the filing date or 90 days from the date of referral to that agency.

This application will be cleared for publication 6 months from the filing date or 90 days from the above 'Date Referred' whichever is later, unless a response is provided to the USPTO regarding thenecessary recommendation as to the imposition of a secrecy order.

DEPARTMENT OF DEFENSE

ACCESS ACKNOWLEDGEMENT / SECRECY ORDER RECOMMENDATION FOR PATENT APPLICATION

Application Serial No: DP60864759 Filing Date: Date Referred: 01/09/2007

I hereby acknowledge that the Department of Defense reviewers has inspected this application in administration of 35 USC 181 on befalf of the Agencies/Commands specified below. DoD reviewers will not divulge any information from this application for any purpose other than administration of 35 USC 181.

Defense Agency	Recommendation	Reviewer Name	Reviewer Command	Date Reviewed
NSA	Secrecy Not Recommended	Eric Froehlich		04/06/2007

Type of Recommendations:	*SNR: Secrecy Not Recommended* *SR: Secrecy Recommended* *NC: No Comment*

Instructions to Reviewers:

1. All DoD personnel reviewering this application will be listed on this form regardless of whether they are making a secrecy order recommendation.

2. This form will be forwarded to USPTO once all assigned DoD entities have provided their secrecy order recommendation.

Time for Completion of Review:

Pursuant to 35 USC 184, the subject matter of this applicaiton may be filed in a foreign country for the purposed of filing a patent application without a license anytime after the expriation of six (6) months from filing date unless the application becomes the subject of a secrecy order.

The USPTO publishes patent application at 18 months from the earliest claimed filing date. The USPTO will delay the publication of a patent application made available to a defense agency under 35 USC 181 until no earlier than 6 months from the filing date or 90 days from the date of referral to that agency. This application will be cleared for publication 6 months from the filing date or 90 days from the above Date Referred, whichever is later, unless a response is is provided to the USPTO regarding the necessary recommendations as to the imposition of a secrecy order.

DoD Completion of Review: Final

Forwarded to USPTO: 04/09/2007 By: Luis Marrero

PTO/SB/08a (07-09)
Approved for use through 11/30/2020. OMB 0651-0031
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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet | | of | |

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	
Art Unit	
Examiner Name	
Attorney Docket Number	

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US- 2007/0040684	02/22/2007	McAllister	
		US- 7,827,200	11/02/2010	Rowe	filed 07/14/2006
		US- 8,373,545	02/12/2013	Traub	filed 01/29/2007
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
		EPCglobal Tag Data				
		Standards Version 1.3	03/08/2006	2006 EPC Standard		

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/SB/57 (09-16)
Approved for use through 09/30/2018. OMB 0651-0064
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(Also referred to as FORM PTO-1465)

REQUEST FOR *EX PARTE* REEXAMINATION TRANSMITTAL FORM

Address to:
Mail Stop *Ex Parte* Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attorney Docket No.: 029101.6

Date: 11/29/2017

1. ☑ This is a request for *ex parte* reexamination pursuant to 37 CFR 1.510 of patent number 9,798,967 issued October 24, 2017. The request is made by:
   ☐ patent owner. ☑ third party requester.
2. ☑ The name and address of the person requesting reexamination is:
   Avery Dennison, Inc.
   8080 Norton Parkway, Mentor, OH 44060
3. Requester asserts ☐ small entity status (37 CFR 1.27) or ☐ certifies micro entity status (37 CFR 1.29). Only a patent owner requester can certify micro entity status. Form PTO/SB/15A or B must be attached to certify micro entity status.
4. ☐ a. A check in the amount of $_____ is enclosed to cover the reexamination fee, 37 CFR 1.20(c)(1);
   ☑ b. The Director is hereby authorized to charge the fee as set forth in 37 CFR 1.20(c)(1) to Deposit Account No. 50-1349;
   ☐ c. Payment by credit card. Form PTO-2038 is attached; **or**
   ☐ d. Payment made via EFS-Web.
5. ☑ Any refund should be made by ☐ check or ☑ credit to Deposit Account No. 50-1439. 37 CFR 1.26(c). If payment is made by credit card, refund must be to credit card account.
6. ☑ A copy of the patent to be reexamined having a double column format on one side of a separate paper is enclosed. 37 CFR 1.510(b)(4).
7. ☐ CD-ROM or CD-R in duplicate, Computer Program (Appendix) or large table
   ☐ Landscape Table on CD
8. ☐ Nucleotide and/or Amino Acid Sequence Submission
   If applicable, items a. – c. are required.
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM (2 copies) or CD-R (2 copies); **or**
      ii. ☐ paper
   c. ☐ Statements verifying identity of above copies
9. ☐ A copy of any disclaimer, certificate of correction or reexamination certificate issued in the patent is included.
10. ☑ Reexamination of claim(s) 1-20 is requested.
11. ☑ A copy of every patent or printed publication relied upon is submitted herewith including a listing thereof on Form PTO/SB/08, PTO-1449, or equivalent.
12. ☐ An English language translation of all necessary and pertinent non-English language patents and/or printed publications is included.

This collection of information is required by 37 CFR 1.510. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) a request for reexamination. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop *Ex Parte* Reexam, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

13. ☑ The attached detailed request includes at least the following items:

a. A statement identifying each substantial new question of patentability based on prior patents and printed publications. 37 CFR 1.510(b)(1).

b. An identification of every claim for which reexamination is requested, and a detailed explanation of the pertinency and manner of applying the cited art to every claim for which reexamination is requested. 37 CFR 1.510(b)(2).

14. ☐ A proposed amendment is included (only where the patent owner is the requester). 37 CFR 1.510(e).

15. ☑ It is certified that the statutory estoppel provisions of 35 U.S.C. 315(e)(1) or 35 U.S.C. 325(e)(1) do not prohibit requester from filing this *ex parte* reexamination request. 37 CFR 1.510(b)(6).

16. ☑ a. It is certified that a copy of this request (if filed by other than the patent owner) has been served in its entirety on the patent owner as provided in 37 CFR 1.33(c).

The name and address of the party served and the date of service are:

Michael J. Marcin FAY KAPLUN & MARCIN, LLP 150 Broadway, Suite 702 New York, NY 10038

Date of Service: 11/28/17; or

☐ b. A duplicate copy is enclosed since service on patent owner was not possible. An explanation of the efforts made to serve patent owner **is attached**. See MPEP 2220.

17. Correspondence Address: Direct all communication about the reexamination to:

☑ The address associated with Customer Number: 24633

OR

☐ Firm or Individual Name

Address

City	State	Zip
Country		
Telephone	Email	

18. ☐ The patent is currently the subject of the following concurrent proceeding(s):

☐ a. Copending reissue Application No.

☐ b. Copending reexamination Control No.

☐ c. Copending Interference No

☑ d. Copending litigation styled:

Adasa Inc. v. Avery Dennison Corporation (6:17-cv-01685-TC) filed on October 24, 2017 in the United States District Court for the District of Oregon

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

/Theodore J. Mlynar/ — Authorized Signature

11/29/2017 — Date

Theodore J. Mlynar — Typed/Printed Name

40,096 — Registration No.

☐ For Patent Owner Requester

☑ For Third Party Requester

Docket No. 029101.6

REQUEST FOR EX PARTE REEXAMINATION OF U.S. PATENT 9,798,967

Theodore J. Mlynar (Reg. No. 40,096)
E: ted.mlynar@hoganlovells.com
Ira J. Schaefer (Reg. No. 26,802)
E: ira.schaefer@hoganlovells.com

HOGAN LOVELLS US LLP
875 Third Avenue
New York, NY 10022
T: (212) 918-3000
F: (212) 918-3100

Counsel for Requester Avery Dennison, Inc.

I. Identification Of Claims For Which Reexamination Is Requested

In accordance with 37 CFR 1.510, Requester Avery Dennison, Inc. ("**Requester**") submits that there is a substantial new question of patentability for Claims 1-20 of U.S. Patent 9,798,967 (the " **'967 patent**") (Exhibit 1) under 35 U.S.C. §103 in view of the following prior art patents and printed publications not considered by the U.S.P.T.O. during prosecution of the '967 patent:

U.S. 2007/0040684 published February 22, 2007 (" **'684 publication**") (Exhibit 2)
U.S. Patent 7,827,200 (the " **'200 patent**") (Exhibit 3)
U.S. Patent 8,373,545 (the " **'545 patent**") (Exhibit 4)
EPCglobal Tag Data Standards Version 1.3 – March 8, 2006 ("**2006 EPC Standard**") (Exhibit 5)

Reexamination of claims 1, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, and 20 is requested in view of the '684 publication and the '200 patent or the '545 patent under 35 U.S.C. §103, and reexamination of claims 2, 3, 4, 5, 17, 18, and 19 is requested further in view of the 2006 EPC Standard under 35 U.S.C. §103.

The '967 patent is the subject of a patent litigation between the patent owner and the Requester in an action entitled *Adasa Inc. v. Avery Dennison Corporation* (6:17-cv-01685-TC) filed on October 24, 2017 in the United States District Court for the District of Oregon.

Requester certifies that the statutory estoppel provisions of 35 U.S.C. §315(e)(1) or 35 U.S.C. §325(e)(1) do not prohibit the Requester from filing this *ex parte* reexamination request.

II. Statement Pointing Out Each Substantial New Question Of Patentability

The '967 patent relates to a radio frequency identification (RFID) device (sometimes referred to as a "tag" or "transponder"), the integrated circuit used in the RFID device, and specifically to the provisioning of unique serial numbers in such devices. '967 patent at 1:25-31 and 40-45. As will be explained in more detail hereinafter, there are substantial new questions of patentability under 35 U.S.C. §103 over U.S. 2007/0040684 (published 2/22/2007 and prior art under 35 U.S.C. §102(b)) and either U.S. 7,827,200 (filed 7/16/2006 and prior art under 35 U.S.C. 102(e)) or U.S. 8,373,545 (filed 8/7/2006 and prior art under 35 U.S.C. §102(e)), and for some claims further in view of the 2006 EPC Standard (published 5/2006 and prior art under 35 U.S.C. §102(b)).

The '967 patent issued from an application that claimed priority under 35 U.S.C. §120 to a number of provisional and non-provisional parent applications. *See* '967 patent, cover page. In order for a patent claim to receive the benefit of the filing date of a parent non-provisional application under 35 U.S.C. §120, the parent application must meet all of the requirements of 35 U.S.C. §112 for that patent claim, including the written description requirement under ¶1. *Eiselstein v. Frank*, 52 F.3d 1035, 1038 (Fed. Cir. 1995). In the analysis below, Requester demonstrates that because the specifications in the parent applications of the '967 patent do not satisfy the written description requirement of 35 U.S.C. §112 ¶1 any

earlier than May 21, 2008, the effective filing date of claims 1-20 of the '967 patent is no earlier than May 21, 2008.

A. The BRI Of "Limited Number" and "At Least 3"

Claims 1-20 of the '967 patent recite the limitation: "the allocated block being assigned a limited number of most significant bits" (the "**Limited Number**" limitation). In addition, claims 6 and 13-15 recite that "at least 3 most significant bits" define or correspond to the allocated block (the "**At Least 3**" limitation).

The claim term "limited number" is not defined in the '967 patent. "Limited number" is used to refer to a number of bits in a serial number space that itself has a fixed number of bits. '967 patent at 8:4-36 and 33:14-24. The only example provided is at 8:21-31, where the number of bits in the serial number space is 38 bits and the "limited number" of bits are the 14 most significant bits. Obviously, the "limited number" of bits cannot be zero bits, because then there would be no allocated blocks at all. Similarly, the "limited number" of bits cannot be all of the bits, because then the number of bits would be not "limited" and there would only be one serial number in the serial number space while the claims require multiple serial numbers. "Limited" is defined in the dictionary as "restricted." Exhibit 6.

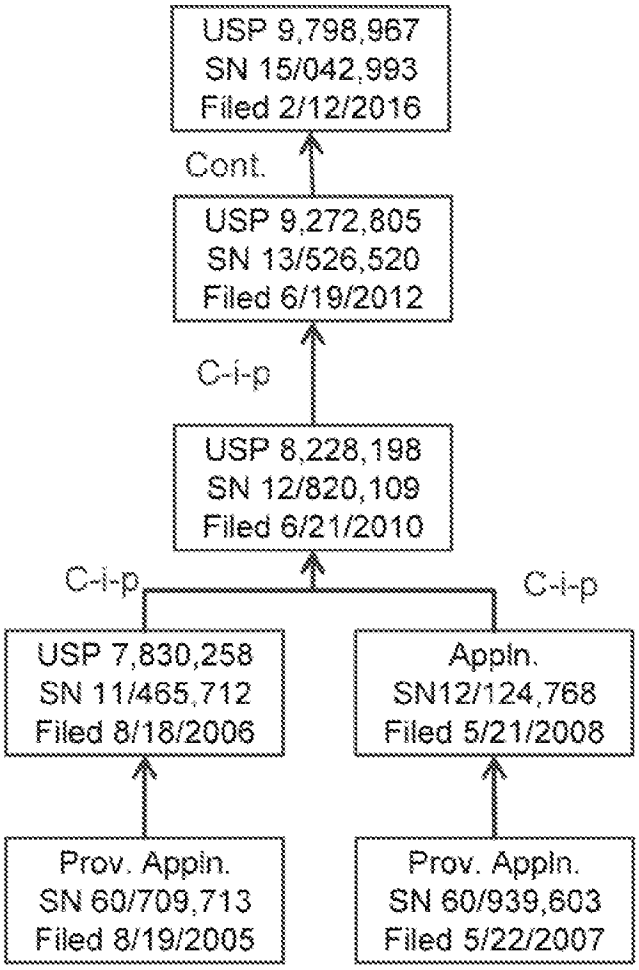
Since the example provided in the '967 patent is consistent with the ordinary meaning of "limited number," the broadest reasonable interpretation for "limited number of most significant bits" is "a fixed number of most significant bits that is

more than zero bits and less than all of the bits."

The ordinary meaning of "at least three" is "three or more" and there is nothing in the '967 patent that contradicts that ordinary meaning.

1. The Prosecution File History Of The '967 Patent

The '967 patent issued from a chain of provisional and non-provisional applications as shown below in graphical form:



A word search of the two provisional applications 60/709,713 and 60/939,603 and the non-provisional application 11/465,712 for the terms "limited

number" and "most significant bits" confirms there is no disclosure of the unique serial number space having an allocated block defined by a limited number of most significant bits. Although the written description requirement does not require an *ipsis verbis* recitation, a further review of those applications does not reveal any disclosure of the concept of the unique serial number space having an allocated block defined by a limited number of most significant bits. Copies of those applications are attached hereto as Exhibits 7, 8, and 9, respectively.

The first instance in the chain of applications of a disclosure of the Limited Number limitation is in Application 12/124,768 filed on May 21, 2008 (the "**'768 application**"). That disclosure can be found at page 15 of the application at lines 3-14. A copy of the file history of the '768 application is attached as Exhibit 10. There is no evidence of any earlier disclosure of the Limited Number limitation and, therefore, the earliest effective filing date of claims 1-20 is May 21, 2008.

A careful review of the '768 application and the predecessor applications reveals no disclosure of the At Least 3 limitation at all. Application 12/820,109 was filed on June 21, 2010 and issued as U.S. 8,228,198 (the "**'198 patent**"). The '198 patent is attached as Exhibit 11. Although the '198 patent discloses an example of 14 most significant bits as the "limited number" of most significant bits, at 18:34-38 and 45-53, there is no disclosure of the At Least 3 limitation.

Continuation-in-part Application 13/526,520 was filed on June 19, 2012 (the

" **'520 application**") and issued as U.S. 9,272,805 (the " **'805 patent**"). As originally filed, the '520 application, did not include any disclosure of the At Least 3 limitation. That limitation was not included in the original claims as filed. The At Least 3 limitation first appeared in an amendment dated July 29, 2015 in claims 23 and 30, which correspond to issued claims 7 and 14 of the '805 patent. *See* Exhibit 12.

2. Lack of Written Description for At Least 3 Limitation

The '967 patent issued from application serial number 15/042,993 filed on February 12, 2016 (the " **'993 application**") which is a continuation of the '520 application. The fact that there was no written description of the At Least 3 limitation in the original specification and claims of the '520 application means that claims incorporating the At Least 3 limitation in the '967 patent cannot claim priority under 35 U.S.C. §120. Claims added during prosecution that were not part of the original disclosure cannot be relied upon for written description support under 35 U.S.C. §112, ¶ 1. *Cisco v. Cirrex*, Nos. 2016-1143, 2016-1144, *slip op.* at 16 (Fed. Cir. May 10, 2017).

Moreover, the simple disclosure of the words "a limited number" or the example of a limited number being "14," is not a written description of "at least three." "To fulfill the written description requirement, the patent specification

'must clearly allow persons of ordinary skill in the art to recognize that [the inventor] invented what is claimed.'" *In re Gosteli*, 872 F.2d 1008, 1012 (Fed.Cir. 1989)(citation omitted). An applicant complies with the written description requirement "by describing the invention, with all its claimed limitations." *Gentry Gallery, Inc. v. Berkline Corp.*, 134 F.3d 1473, 1479 (Fed. Cir. 1998).

There is no disclosure of the limitation "at least 3" from the more general expression "limited number" nor from the single specific number 14. *See Eiselstein* at 1040 (disclosure of 45-55% does not provide a written description for 50-60%); *Appl. of MacLean*, 454 F.2d 756, 759 (CCPA 1972) (disclosing 93% by weight of water does not provide a written description of "preponderance of water (above 50%)"); and *Appl. of Lukach*, 442 F.2d 967, 969 (CCPA 1971) (disclosing 2.6 does not provide a written description for the range 2.0 to 3.0).

Since rejection under 35 U.S.C. §112, ¶1 for lack of written description cannot be raised in reexamination (MPEP 2217), it is assumed for the purposes of this request, that claims 6 and 13-15 have a priority date of February 12, 2016 (the filing date of the '993 application).

B. The BRI of "Allocated Block"

An "allocated block" is defined in the '967 patent in column 8, lines 5-20. In the example given, the serial number space has 38 bits and the limited number of most significant bits is 14 which constitutes 16,384 sectors. The lesser 24 bits

represent 16,777,216 serial number values in each sector. Once a sector is allocated to an encoder, "it is referred to as a block." '967 patent 8:29-32. "Each allocated block of serial numbers … can be used by an encoder for encoding transponders …." '967 patent 8:32-36. In Figure 14, allocated block 141c includes "serial numbers from within the range of numbers that are defined by that allocate [sic] block 141c." '967 patent 34:18-23.

Accordingly, the term "allocated block" is used in the '967 patent to mean "a defined range of serial numbers."

C. The BRI Of Other Claim Terms

Claims 1-15 are directed to an "RFID transponder." The '967 patent defines "transponder" at 5:64-6:1:

> Some terms are used interchangeably as a convenience and, accordingly, are not intended as a limitation. For example, transponders is a term for wireless sensors that is often used interchangeably with the term tags and the term inlay, which is used interchangeably with inlet.

RFID transponders are described in the "Background" section of the specification as "typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification." '967 patent at 1:40-45.

Claims 16-20 are directed to an "integrated circuit" for backscattering a

signal to be processed by an RFID interrogator. The claimed "integrated circuit" is the "integrated circuit chip" of an RFID transponder referred to in the '967 patent at 1:40-45.

Aside from the limitations discussed above, all of the remaining claim language should be construed with their plain and ordinary meanings.

D. The Prior Art

1. U.S. 2007/0040684

The '684 publication corresponds to application 11/465,712 in the '967 patent family tree. Because it was published on February 22, 2007, more than one year before the earliest effective filing date of the '967 patent claims, it is prior art under pre-AIA 35 U.S.C. §102(b).

The '684 publication discloses all of the RFID transponder and integrated circuit limitations of claims 1-20 of the '967 patent. The '684 publication also discloses that such tags are suitable for encoding the EPC. '684 publication at [0002]. The '684 publication was not considered by the Examiner during prosecution of the '967 patent.

The '684 publication describes prior art RFID tags in paragraph [0003]:

> Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency

> circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder.

Id. at [0003] (emphasis added). The reference describes a RFID transponder in paragraph [0041] in connection with Figure 2 (excerpted below):

> FIG. 2 shows a possible RFID transponder 50. RFID transponders, essentially, comprise an RFID integrated circuit (IC) device (or "chip") bonded to an antenna apparatus, formed on a substrate that is often plastic such as Mylar. RTM., polyester, or PET. One way to form an antenna structure is to etch copper from a substrate. An alternate way includes printing multiple layers of conductive ink onto a substrate. One additional method includes stamping UHF antennae from thin sheets of aluminum. In certain embodiments, RFID transponders and wireless sensors are recovered from waste streams for reconditioning, reprogramming, and reuse."

FIG. 2

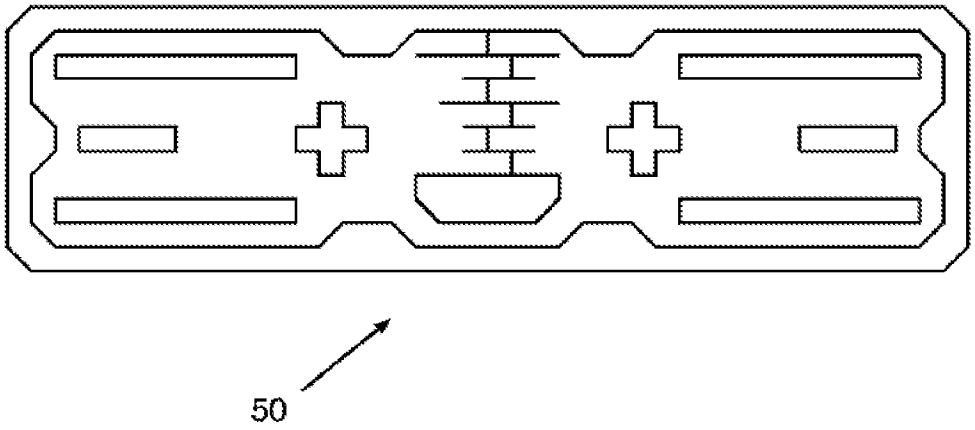


Figure 3 (excerpted below) of the '684 publication shows one embodiment of the transponder 50 and is described in paragraph [0049] as follows:

> FIG. 3 shows a possible embodiment of an RFID transponder 50 that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer 52 bonds with antenna layer 54 that is bonded to inlay substrate layer 58 and integrated circuit 56. Inlay substrate layer 58 and face-stock layer 51 provide resistance against electrostatic discharge (ESD) into antenna layer 54 or chip 56.

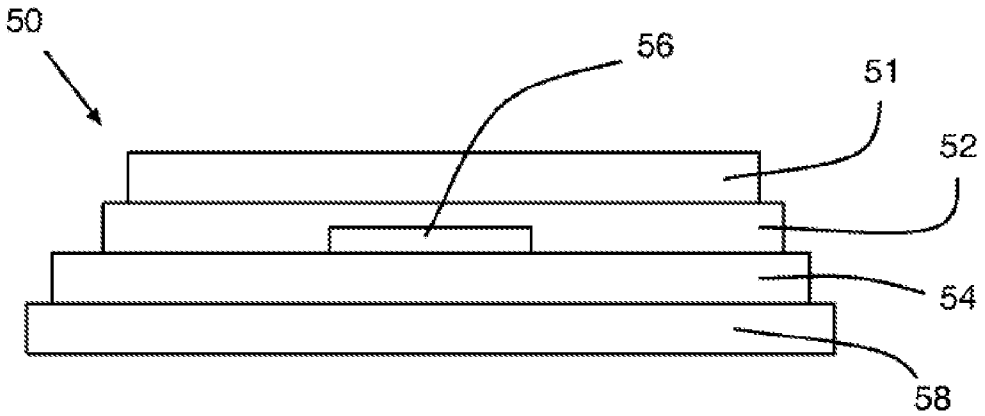


FIG. 3

The '684 publication also discloses that a transponder RFID chip can comprise silicon or a polymer:

> [0005] Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces.
>
> [0006] Wireless sensors, made using silicon circuits, polymer circuits, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods."[1]

Id. at [0005-6] (emphasis added).

2. U.S. Patent 7,827,200

The '200 patent was filed on July 14, 2006, issued on November 2, 2010, and is, therefore, prior art under 35 U.S.C. §102(e). The '200 patent was not considered by the U.S.P.T.O. during prosecution of the '967 patent.

The '200 patent discloses a unique serial number space that includes an allocated block defined by a limited number of most significant bits (2 bits or 5

[1] It should be noted that the disclosure at paragraphs [0005]-[0006] is identical to the disclosure of the '967 patent at 1:65-2:20, which is the only support for claim 9 in the '967 patent.

bits). Because the '200 patent is directed to the encoding and provisioning of Electronic Product Code ("EPC") RFID tags, it would have been obvious to a person of ordinary skill in the art ("POSITA") to combine it with the '684 publication under 35 U.S.C. §103 as will be explained below.

The '200 patent is entitled "Solution for Managing Serialization of EPC Identifiers For Use With RFID Tags." The '200 patent explains:

> RFID tag 104 is typically a small object that can be attached or incorporated into object 102 that includes a transponder, silicon chips, and/or an antenna. An RFID tag 104 is able to respond to radio frequency queries from an RFID transceiver. RFID tags 104 can store data that is selectively transmitted to authorized RFID transceivers. RFID tags 104 can be passive devices having no internal power supply …"

'200 patent at 3:19-25. The '200 patent also describes different types of EPCs, including the SGTIN (at 3:46-47) and that it includes a non-serialized portion and a serialized portion to uniquely identify an object (at 3:56-64). The non-serialized object space includes a company prefix and object classification. *Id.* at 3:65-4:7. The serialized portion includes a serial number space. *Id.* at 4:8-12.

The '200 patent describes a number of embodiments for assigning serial numbers, including one where "different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated." *Id.* at 5:5-11. In that embodiment:

> a serial number generation function used by … a first division can assign

> serial numbers in the range of one to a million and the second division can assign serial numbers in a range of three to four million. It should be appreciated that the different divisions can be communicatively linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification."

Id. at 5:11-22.

A POSITA understands that a block of 1 million serial numbers is represented with 20 bits (2^{20} = 1,048,576). Therefore, the disclosed "first division" has serial numbers from one to one million nominally expressed in binary as:[2]

00000000000000000001- 00111111111111111111

The disclosed "second division" assigns serial numbers from three million to four million nominally expressed in binary as:[3]

11000000000000000000-11111111111111111111

The first two digits of each number are in red because they differentiate between the numbers assigned to the "first division" and the "second division." As can be seen from the above, the two most significant bits 00 represent the "first division" and the two most significant bits 11 represent the "second division" as assigned by the "centralized system."[4]

The '200 patent explains that this numbering scheme can be used for SGTIN-64 where the serial number space has 25 bits. *Id.* at 6:3-8. In that example, the assignment of serial numbers to the first and second divisions would

[2] One million is precisely 00111101000010010000000.
[3] Three million is precisely 10110111000110110000000. Four million is precisely 11101000010010000000.
[4] Or, more precisely, the two most significant bits 10 and 11 represent the "second division."

be nominally expressed in binary as:[5]

00000000000000000000001- 00000111111111111111111

00011000000000000000000- 00011111111111111111111

For SGTIN-64, the serial number space of 25 bits includes the 5 most significant bits (in red) for identifying different manufacturing divisions that produce objects having the same object classification and the 20 lesser significant bits define the assigned blocks of one million serial numbers for each division.

The '200 patent also discloses a retailer's suppliers applying encoded RFID transponders to goods. "Various retailers including WAL-MART, TARGET, and the US Department of Defense (DoD) are requiring suppliers to tag material with an EPC identifier encoded on an RFID tag in order to increase visibility of goods moving within a supply chain." '200 patent at 1:21-25. "[T]he assigned EPC can be encoded into an RFID tag that can be physically linked to the object. *Id.* at 6:56-58.

The '684 publication teaches all of the elements of claims 1-20 relating to RFID transponders and RFID integrated circuits, whereas the '200 patent discloses that the unique serial number space has an allocated block defined by a limited number of most significant bits (2 bits or 5 bits) allocated to correspond to an encoder that encodes the RFID transponder or integrated circuit memory. It would

[5] *See* footnotes 2, 3, and 4 *infra* but add three leading zeros.

have been obvious for a POSITA to use the serial number assignment method of the '200 patent with the RFID transponders and integrated circuits of the '684 publication in view of the fact that they are both directed to implementing EPC with RFID devices.

Because the teachings of the '684 publication and the '200 patent disclose the subject matter of claims 1, 6-16 and 20 not taught in any prior art cited during prosecution of the '967 patent, the combined teachings of the '684 publication and the '200 patent raise a substantial new question of patentability.

3. U.S. Patent 8,373,545

The '545 patent was filed on January 29, 2007, issued on February 12, 2013, and is, therefore, prior art under 35 U.S.C. §102(e). The '545 patent claims priority to provisional application 60/864,759 filed November 7, 2006 (attached as Exhibit 13)(the " '759 provisional"). The disclosures of the '545 patent relied upon herein were fully disclosed in that provisional application.

The '545 patent discloses a unique serial number space having an allocated block defined by the six (6) most significant bits. Because the '545 patent is directed to the encoding and provisioning of EPC RFID tags, it would have been obvious to a POSITA to combine it with the '684 publication under 35 U.S.C. §103. The '545 patent was not considered by the U.S.P.T.O. during prosecution of the '967 patent.

The '545 patent is entitled "EPC Provisioning System Using Business Rules." In relation to RFID tags, the '545 patent explains:

> The RFID tag can include a unique electronic product code (EPC). The RFID transceiver can emit a signal activating the RFID tag which then can reply with the EPC code. The EPCs currently can have either a 64- or 96-bit code numbering scheme, but additional versions can be supported in the future. The EPC includes sections that indicate the product and manufacturer of a given item as well as a section to uniquely identify an object. Currently, an EPC number can contain:
> A Header, identifying the length, type, structure, version and generation of EPC
> The Manager Number, which identifies the company or company entity
> Object Class, similar to a Stock Keeping Unit or (SKU)

'545 patent at 1:25-38.

Figure 4B of the '545 patent shows the serial number space as part of the EPC code:

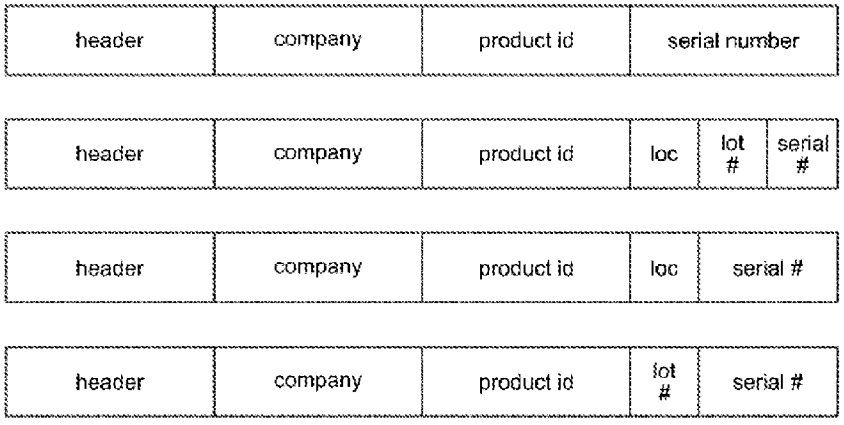


FIG. 4B

In connection with Figure 4A below, the '545 patent describes a system for provisioning RFID tags with serial numbers.

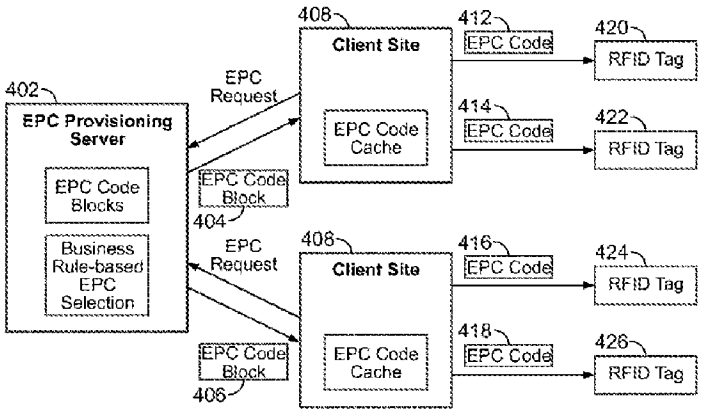


FIG. 4A

EPC server 402 functions to allocate EPC code blocks to correspond to an encoder that encodes the RFID transponder or integrated circuit memory:

> A system of one embodiment comprises using an EPC server 402 to dynamically provide EPC code blocks 404 and 406 for one product to multiple client sites 408 and 410. The client sites 408 and 410 can use the EPC codes 412, 414, 416 and 418 of the EPC code block for RFID tags 402, 422, 424 and 426."

'545 patent at 3:34-39.

The '545 patent teaches that the client sites 408 and 410 are assigned blocks of serial numbers based upon, for example, location and that the client sites use the serial numbers to create RFID tags.

> The client sites 408 and 410 can be, or can include, RFID edge servers. The EPC server can use business rules to assign the EPC code blocks. The EPC code blocks can be assigned so as to indicate business information such as lot number and/or location. The client sites 408 and 410 can cache EPC codes for later use. The client sites can request EPC code blocks 404 and 406.
>
> The client sites 408 and 410 can be RFID edge servers. The client sites can use the EPC codes 412, 414, 416 and 418 for RFID tags 420, 422, 424 and

> 426. The EPC code blocks can be assigned [s]o as to indicate lot number. The EPC code blocks can be assigned so as to indicate location. The client sites 408 and 410 can cache EPC codes for later use. The client sites 408 and 410 can request the EPC code blocks 404 and 406.

'545 patent at 3:48-54 and 4:5-12 (emphasis added).

The client sites "print" the serial numbers into the tags, which a POSITA understands to mean encoding.

> In one embodiment, the EPC server can create pools of EPC codes. The EPC codes can be created based on business policies that can be used to indicate business information in the EPC code. The RFID edge servers can obtain EPC codes from the pool, store these EPC codes into a local cache and then use these EPC codes in the construction of RFID tags, such as with an RFID tag printer. Unused RFID tags can be returned from the cache to the pool.

'545 patent at 3:40-47.

The '545 patent explains how blocks of EPC codes are assigned to different locations by EPC server 402. Figure 13D, excerpted below, indicates that a pool of 45 million EPC serial number codes are available. *Id.* at 40:12-16. A POSITA knows that the number 45,000,000 is represented in binary by 26 bits.

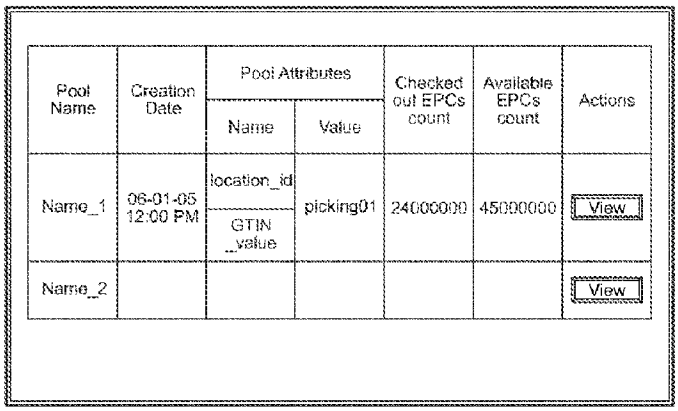


FIG. 13D

A POSITA would understand that given the required 26 bits for 45 million serial numbers, the six (6) most significant bits are used to identify the lot number, or location of the edge server, and the 20 least significant bits define blocks of one million serial numbers for each lot number or location. The binary notation for this is illustrated below with the 6 most significant bits in red.

Ranges for the blocks of serial numbers are disclosed in the figures of the '545 patent. In Figure 13E, reproduced below, the range of 0-9999999 and the range of 20000000-29999999 are allocated as "available." *Id.* at 40:21-27. Those ranges are nominally expressed in binary as:

00000000-9999999 000000000000000000000000-001001111111111111111111[6]

20000000-29999999 010100000000000000000000-011101111111111111111111

By contrast, the range of 10000000-19999999 and the range of 30000000-30500000 are allocated as "checked out." *Id.* Those ranges are nominally expressed in binary as:[7]

10000000-19999999 001010000000000000000000-010011111111111111111111

30000000-30500000 011110000000000000000000-011110011111111111111111[8]

[6] More precisely, 9999999 is 001001100010010110011111111; 20000000 is 010011000100101101010000000; and 29999999 is 011100100111000011011111111.

[7] More precisely, 10,000,000 is 001001100010010110100000000; 19,999,999 is 010011000100101101011111111; 30,000,000 is 011100100111000011100000000; and 30,500,000 is 011101000101100101010100000.

[8] Only 500,000 serial numbers are allocated which are not distinguished by the six most-significant bits.

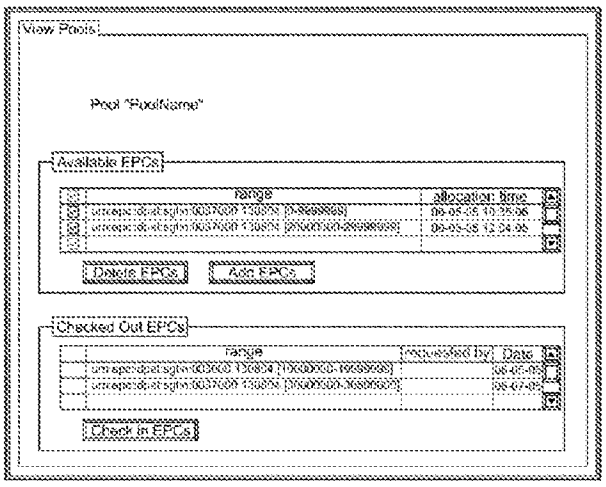


FIG. 13E

In Figure 13F, the range of 30000000-40000000 is allocated and in Figure 13G, the range of 10000000-15000000 is allocated. *Id*. at 40:28-32. Those ranges are nominally expressed in binary as:[9]

10000000-15000000 00101000000000000000000000-00111100000000000000000000

30000000-40000000 01111000000000000000000000-10100000000000000000000000

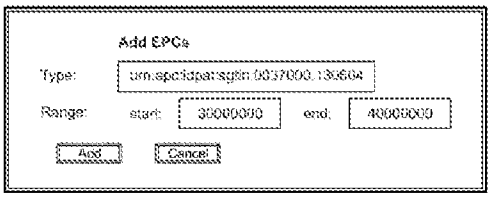


FIG. 13F

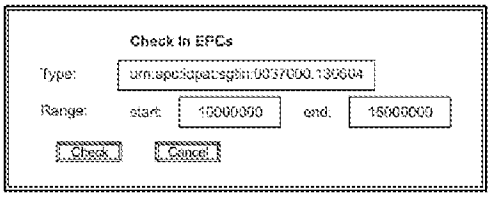


FIG. 13G

[9] More precisely, 10,000,000 is 00100110001001011010000000; 15,000,000 is 00111001001110000111000000; 30,000,000 is 01110010011100001110000000; and 40,000,000 is 10011001001011010000000000.

For the SGTIN-96 format with a serial number space of 38 bits, a POSITA would understand that the same block assignments would provide an additional 12 bits (18 total) for identifying even more lot numbers or locations.

The '684 publication teaches all of the limitations in claims 1, 8-11, 13 and 16 relating to RFID transponders and RFID integrated circuits, whereas the '545 patent discloses that the unique serial number space has an allocated block stored therein defined by a limited number (6 bits) of most significant bits of the unique serial number space as designated by an external numbering authority. It would have been obvious for a POSITA to use the commissioning method of the '545 patent with the RFID transponders and integrated circuits of the '684 publication in view of the fact that they are both directed to the EPC coding scheme.

Because the teachings of the '684 publication and the '545 patent disclose the subject matter of claims 1, 6-12, 16, and 20 not taught in any prior art cited during prosecution of the '967 patent, the combined teachings of the '684 publication and the '545 patent raise a substantial new question of patentability.

4. EPCglobal Tag Data Standards Version 1.3 – March 8, 2006

The EPCglobal Tag Data Standards Version 1.3 is dated November 21, 2005, was ratified on March 8, 2006, and was published March 8, 2006. *See Ex parte Schenecker*, No. 2015-002348 at 3 (PTAB 2016). It is therefore prior art under 35 U.S.C. §102(b). The 2006 EPC Standard was not considered by the

Examiner during the prosecution of the '967 patent.

The 2006 EPC Standard is directed to the details of the SGTIN-96 coding scheme recited in a number of claims of the '967 Patent. Since the 2006 EPC Standard is directed to the same EPC subject matter as the '684 publication, the '200 patent, and the '545 patent, it would have been obvious to a POSITA to combine the 2006 EPC Standard with the '684 publication, the '200 patent, and the '545 patent under 35 U.S.C. §103.

EPCglobal is a consortium of companies whose aim was to establish standards for RFID tags that would incorporate the Electronic Product Code (EPC). By design, the 2006 EPC Standard:

> … applies to RFID tags conforming to "EPC Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID Protocol for Communications at 860 MHz-960MHz Version 1.0.9" ("Gen2 Specification"). Such tags will be referred to as "Gen 2 Tags" in the remainder of this document. These standards define completely that portion of EPC tag data that is standardized, including how that data is encoded on the EPC tag itself (i.e. the EPC Tag Encodings) ….

2006 EPC Standard at 3.

The 2006 EPC Standard is the standard referred to in the '967 patent at 1:32-39. In particular, the standard provides that "[t]he EPC Tag Encodings include a Header field followed by one or more Value Fields. The Header field defines the overall length and format of the Value[] Fields. The Value Fields contain a unique EPC Identifier and a required Filter Value when the latter is judged to be important

to encode on the tag itself." 2006 EPC Standard at 3.

Since the EPC is used on a variety of goods, the 2006 EPC Standard provides for a number of formats tailored to different industries. For example, the Serialized Global Trade Identification Number (SGTIN) is defined to include a company prefix assigned to a particular company, an item reference assigned to a particular object class, and a serial number space. *Id.* at 12 (section 2.1.2.1). The SGTIN-64 scheme is further defined to include 96 bits. *Id.* at 25-29 (section 3.5). The format for the scheme is excerpted below:

688 **3.5.1 SGTIN-96**
689 In addition to a Header, the SGTIN-96 is composed of five fields: the *Filter Value*, *Partition*,
690 *Company Prefix*, *Item Reference*, and *Serial Number*, as shown in Table 4.

	Header	Filter Value	Partition	Company Prefix	Item Reference	Serial Number
SGTIN-96	8	3	3	20-40	24-4	38
	0011 0000 (Binary value)	(Refer to Table 5 for values)	(Refer to Table 6 for values)	999,999 – 999,999,999,999 (Max. decimal range*)	9,999,999 – 9 (Max. decimal range*)	274,877,906,943 (Max. decimal value)

Id. at 25 (section 3.5.1).

As shown above, the fields for the SGTIN-96 scheme include a Header, a Filter Value, a Partition, a Company Prefix, an Item Reference, and a Serial Number that includes 38 bits.

Importantly, the 2006 EPC Standard also confirms the use of nominal decimal values in binary ranges in the relevant time frame. In the "Item

Reference" column, the decimal value "9,999,999" corresponds to 24 bits even though the precise maximum value of 24 bits is actually 16,777,215, and the decimal value "9" corresponds to 4 bits even though the precise maximum value of 4 bits is actually 15. Similarly, in the "Company Prefix" column, the decimal value "999,999" corresponds to 20 bits even though the precise maximum value of 20 bits is actually 1,048,575, and the decimal value "999,999,999,999" corresponds to 40 bits even though the precise maximum value of 40 bits is nearly 1.1 trillion.

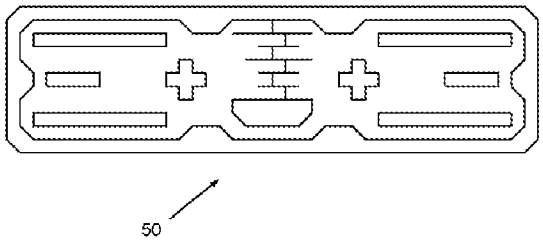
The 2006 EPC Standard discloses all of the details of the SGTIN-96 scheme recited in claims 2-5, 13-15, and 17-19. A POSITA would have combined the disclosures of the 2006 EPC Standard with the combination of the '684 publication and the '200 patent or the combination of the '684 publication and the '545 patent, both of which are directed to encoding RFID tags and integrated circuits with the EPC coding scheme.

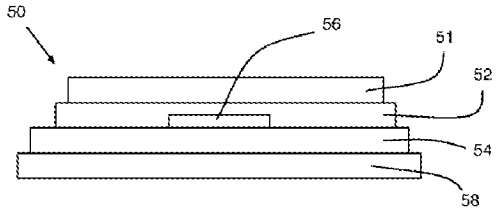
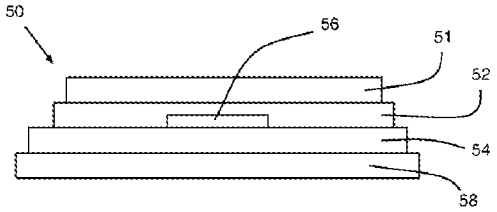
Because the teachings of the '684 publication and the '200 patent in view of the 2006 EPC Standard disclose the subject matter claimed by claims 2-5, 13-15, and 17-19, that was not taught in any prior art cited during prosecution of the '967 patent, the combined teachings of the '684 publication, the '200 patent, and the 2006 EPC Standard raise a substantial new question of patentability. Similarly, because the teachings of the '684 publication and the '545 patent in view of the

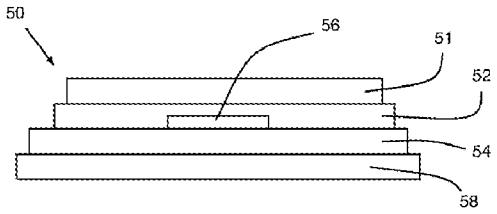
2006 EPC Standard disclose the subject matter claimed by claims 2-5, 13, and 17-19, that was not taught in any prior art cited during prosecution of the '967 patent, the combined teaches of the '684 publication, the '545 patent, and the 2006 EPC Standard raise a substantial new question of patentability.

III. Detailed Explanation Under 37 CFR 1.510(b)

Requester has set forth below a chart of claims 1-20 along with the application of the references to all of the claims to show invalidity under 35 U.S.C. §103.

U.S. 9,798,967 (effective filing date no earlier than 5/21/2008)	Claim 1 is obvious under 35 U.S.C. §103 over: '684 publication (published 2/22/2007 - 35 U.S.C. §102(b) prior art) and either (A) U.S. 7,827,200 (filed 7/16/2006 - 35 U.S.C. §102(e) prior art) or (B) U.S. 8,373,545 (filed 8/7/2006 - 35 U.S.C. §102(e) prior art)
1[P]. An RFID transponder comprising:	'684 publication discloses transponder 50. "FIG. 2 shows a possible RFID transponder 50. RFID transponders, essentially, comprise an RFID integrated circuit (IC) device (or "chip") bonded to an antenna apparatus, formed on a substrate that is often plastic such as Mylar.RTM., polyester, or PET. One way to form an antenna structure is to etch copper from a substrate. An alternate way includes printing multiple layers of conductive ink onto a substrate. One additional method includes stamping UHF antennae from thin sheets of aluminum. In certain embodiments, RFID transponders and wireless sensors are recovered from waste streams for reconditioning, reprogramming, and reuse." '684 publication at [0041]. FIG. 2 

[1A] a substrate;	'684 publication discloses substrate 58. "FIG. 3 shows a possible embodiment of an RFID transponder 50 that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer 52 bonds with antenna layer 54 that is bonded to inlay substrate layer 58 and integrated circuit 56. Inlay substrate layer 58 and face-stock layer 51 provide resistance against electrostatic discharge (ESD) into antenna layer 54 or chip 56." '684 publication at [0049].  FIG. 3
[1B] an antenna structure formed on the substrate; and	'684 publication discloses antenna layer 54. "FIG. 3 shows a possible embodiment of an RFID transponder 50 that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer 52 bonds with antenna layer 54 that is bonded to inlay substrate layer 58 and integrated circuit 56. Inlay substrate layer 58 and face-stock layer 51 provide resistance against electrostatic discharge (ESD) into antenna layer 54 or chip 56." '684 publication at [0049].  FIG. 3
[1C] an RFID integrated circuit chip which is electrically coupled to the antenna structure,	'684 publication discloses integrated circuit 56. "FIG. 3 shows a possible embodiment of an RFID transponder 50 that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer 52 bonds with antenna layer 54 that is bonded to inlay substrate layer 58 and integrated circuit 56. Inlay substrate layer 58 and face-stock layer 51 provide resistance against electrostatic discharge (ESD) into antenna layer 54 or chip 56." '684 publication at [0049].

	 FIG. 3 The antenna is coupled to the integrated circuit chip. "For example, transponders are used interchangeably with the term tags and the term inlay is used interchangeably with inlet. This document generally uses the term tag to refer to passive inlay transponders, which do not include a battery, but include an antenna structure coupled to an RFID chip which are generally a thin and flat and substantially coplanar and located on a substrate." '684 publication at [0033].
[1D] wherein the RFID integrated circuit chip is encoded with a unique object number,	'684 publication discloses that the RFID integrated circuit chip has a unique object number. "Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object with a unique RFID transponder." '684 publication at [0003].
[1E] the unique object number comprising an object class information space and a unique serial number space,	'200 patent discloses the non-serialized portion 112 and serialized portion 114 of EPC 110. Because the '200 patent is directed to the encoding and provisioning of Electronic Product Code ("EPC") RFID tags, it would have been obvious to a person of ordinary skill in the art ("POSITA") to combine it with the '684 publication under 35 U.S.C. §103. "Regardless of the EPC type, each EPC 110 has a pure identity that includes a nonserialized portion 112 and a serialized portion 114." '200 patent at 3:56-58.

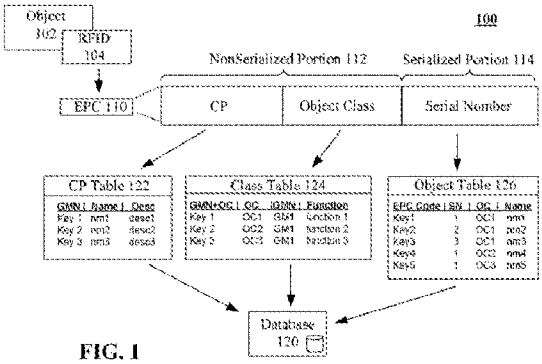
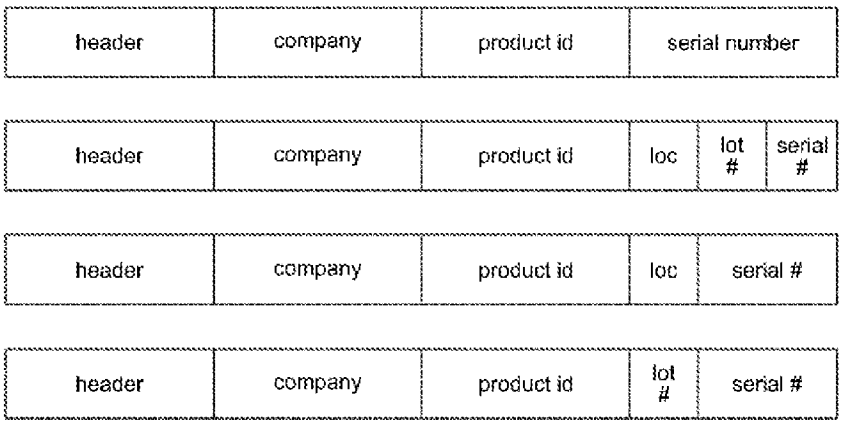


FIG. 1

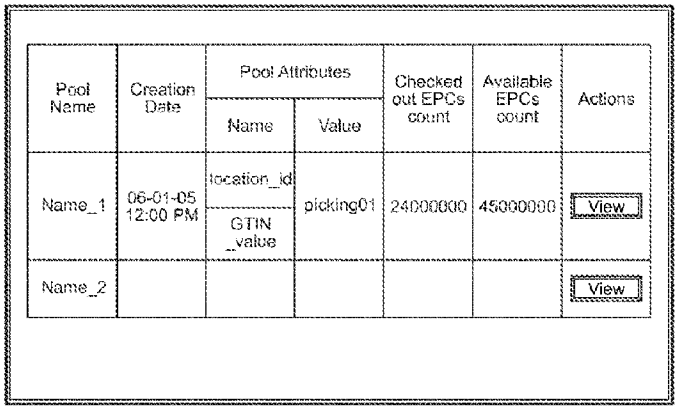
'545 patent discloses Object Class comprising an object class (product id) and a serial number. Because the '545 patent is directed to the encoding and provisioning of EPC RFID tags, it would have been obvious to a POSITA to combine it with the '684 publication under 35 U.S.C. §103.

"The RFID tag can include a unique electronic product code (EPC). The RFID transceiver can emit a signal activating the RFID tag which then can reply with the EPC code. The EPCs currently can have either a 64- or 96-bit code numbering scheme, but additional versions can be supported in the future. The EPC includes sections that indicate the product and manufacturer of a given item as well as a section to uniquely identify an object. Currently, an EPC number can contain:
A Header, identifying the length, type, structure, version and generation of EPC
The Manager Number, which identifies the company or company entity
Object Class, similar to a Stock Keeping Unit or (SKU)"
'545 patent at 1:25-38.

Figure 4B of the '545 patent shows the Serial Number space as part of the EPC code:

	 **FIG. 4B**
[1F] wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and	The '200 patent discloses that a centralized system allocates blocks of serial numbers stored therein defined by a limited number of most significant bits (2 or 5) of the unique serial number space. The '200 patent describes a number of embodiments for assigning serial numbers, it addresses an embodiment wherein "different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated." '200 patent at 5:7-11. In that embodiment:"a serial number generation function used by … a first division can assign serial numbers in the range of one to a million and the second division can assign serial numbers in a range of three to four million. It should be appreciated that the different divisions can be communicatively linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification." '200 patent at 5:11-22. The '200 patent also discloses a retailer's suppliers applying encoded RFID transponders to goods. "Various retailers including WAL-MART, TARGET, and the US Department of Defense (DoD) are requiring suppliers to tag material with an EPC identifier encoded on an RFID tag in order to increase visibility of goods moving within a supply chain." '200 patent at 1:21-25. "[T]he assigned EPC can be encoded into an RFID tag that can be physically linked to the object. *Id.* at 6:56-58. A POSITA understands that a block of 1 million serial numbers corresponds to 2^{20} or 20 bits. Therefore the first division has serial numbers from one to one million which is nominally expressed in binary numbers as follows: 00000000000000000001- 00111111111111111111 The second division can assign serial numbers from three million to four million which is nominally expressed in binary numbers as follows: 11000000000000000000-11111111111111111111

	The first two digits of each number are in red because they differentiate between the numbers assigned to the first division and the second division. As can be seen from the above, the two most significant bits 00 represent the first division and the two most significant bits 11 represent the second division as assigned by the "centralized system." In the alternative, for precise values, see footnotes 2, 3, and 4 *infra.* The '200 patent explains that this numbering scheme can be used for SGTIN-64 where the serial number space has 25 bits. '200 patent at 6:3-8. In that example, the assignments of serial numbers to the first and second divisions would be expressed in binary numbers as follows: 00000000000000000000000001- 00000111111111111111111 00011000000000000000000000- 00011111111111111111111 For SGTIN-64, the serial number space of 25 bits includes the 5 most significant bits (in red) for identifying different manufacturing divisions that produce objects having the same object classification and the 20 lesser significant bits define the assigned blocks of one million serial numbers for each division. In the alternative, for precise values, see footnote 5 *infra.* '545 patent discloses that EPC server 402 allocates blocks of serial numbers stored therein defined by a limited number of most significant bits (6) of the unique serial number space to encoders that encode each transponder or integrated circuit memory with a single unique serial number. "A system of one embodiment comprises using an EPC server 402 to dynamically provide EPC code blocks 404 and 406 for one product to multiple client sites 408 and 410. The client sites 408 and 410 can use the EPC codes 412, 414, 416 and 418 of the EPC code block for RFID tags 402, 422, 424 and 426." '545 patent at 3:34-39. The EPC server 402 can create blocks of EPC codes for RFID edge servers at client sites 408, based upon location: "The client sites 408 and 410 can be, or can include, RFID edge servers. The EPC server can use business rules to assign the EPC code blocks. The EPC code blocks can be assigned so as to indicate business information such as lot number and/or location. The client sites 408 and 410 can cache EPC codes for later use. The client sites can request EPC code blocks 404 and 406." '545 patent at 3:48-54. "The client sites 408 and 410 can be RFID edge servers. The client sites can use the EPC codes 412, 414, 416 and 418 for RFID tags 420, 422, 424 and 426. The EPC code blocks can be assigned to as to indicate lot number. The EPC code blocks can be assigned so as to indicate location. The client sites 408 and 410 can cache EPC codes for later use. The client sites 408 and 410 can request the EPC code

	blocks 404 and 406." '545 patent at 4:5-12 The client sites "print" the serial numbers into the tags, which a POSITA understands to mean encoding. "In one embodiment, the EPC server can create pools of EPC codes. The EPC codes can be created based on business policies that can be used to indicate business information in the EPC code. The RFID edge servers can obtain EPC codes from the pool, store these EPC codes into a local cache and then use these EPC codes in the construction of RFID tags, such as with an RFID tag printer. Unused RFID tags can be returned from the cache to the pool." '545 patent at 3:40-47. The '545 patent explains how blocks of EPC codes are assigned to different locations by the EPC server 402. Figure 13D excerpted below indicates that a pool of 45 million EPC serial number codes are available. '545 patent at 40:12-16. The number 45 million requires 26 bits of serial number to represent.  FIG. 13D The different ranges of the blocks of serial numbers are illustrated in other figures of the '545 patent. In Figure 13E below, the range of 0-9999999, the range of 10000000-19999999, and the range of 20000000-29999999 are allocated. '545 patent at 40:21-27.

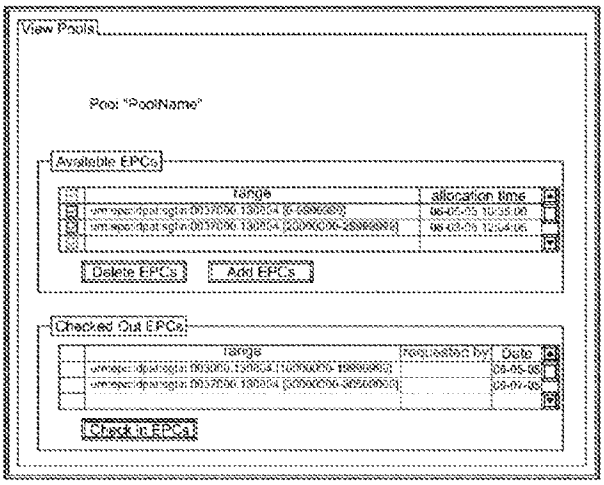


FIG. 13E

In Figure 13F, the range of from 30000000-40000000 is allocated and in Figure 13G, the range of 10000000-15000000 is allocated. '545 patent at 40:28-32.

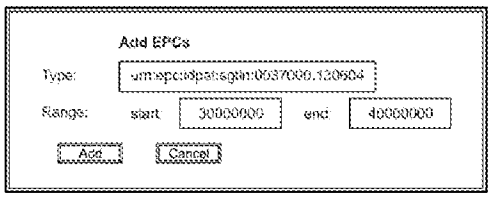


FIG. 13F

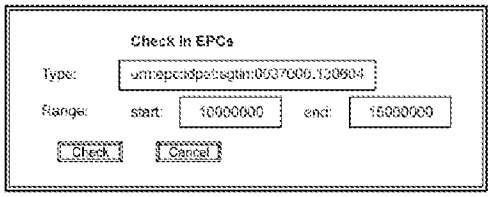


FIG. 13G

A POSITA would understand that given the required 26 bits for 45 million serial numbers, the serial number space would have 6 of the most significant bits identify the lot number, or location of the edge server, and the 20 least significant bits for defining blocks of one million serial numbers for each lot number or location. The corresponding nominal binary values are illustrated below with the 6 most significant bits in red:

00000000-9999999 000000-00000000000000000000-00100111111111111111111111

10000000-15000000 001001-00000000000000000000-00111100000000000000000000

20000000-29999999 010100-00000000000000000000-01110111111111111111111111

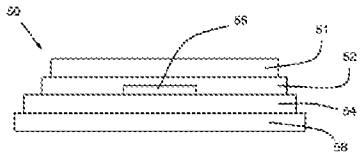
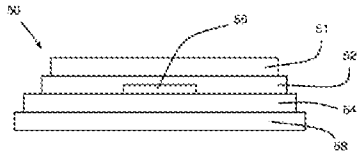
	30000000-4000000 01111000000000000000000000-10000000000000000000 For the SGTIN-96 format with a serial number space of 38 bits, a POSITA would understand that the same block assignments would use an additional 12 bits (a total of 18 bits) for identifying more lot numbers or locations.
[1G] wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.	'200 patent discloses the 20 lesser significant bits are part of the unique serial number along with the limited number of most significant bits. "In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated. … In another example, a first division can assign serial numbers in the range of one to a million and the second division can assign serial numbers in a range of three to four million. It should be appreciated that the different divisions can be communicatively linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification." '200 patent at 5:7-22. A POSITA understands that a block of 1 million serial numbers corresponds to 2^{20} or 20 bits. Therefore the first division has serial numbers from one to one million which is nominally expressed in binary numbers as follows: 00000000000000000001- 00111111111111111111 The second division can assign serial numbers from three million to four million which is nominally expressed in binary numbers as follows: 11000000000000000000-11111111111111111111 The first two digits of each number are in red because they differentiate between the numbers assigned to the first division and the second division. As can be seen from the above, the two most significant bits 00 represent the first division and the two most significant bits 11 represent the second division as assigned by the "centralized system." The '200 patent explains that this numbering scheme can be used for SGTIN-64 where the serial number space has 25 bits. '200 patent at 6:3-8. In that example, the assignments of serial numbers to the first and second divisions would be nominally expressed in binary numbers as follows: 00000000000000000000001- 00001111111111111111111 00011000000000000000000- 00011111111111111111111 For SGTIN-64, the serial number space of 25 bits includes the 5 most significant bits (in red) for identifying different manufacturing divisions that produce objects having the same object classification and the 20 lesser significant bits define the assigned blocks of one million serial numbers for each division.

	'545 patent discloses 26 lesser significant bits are part of the unique serial number along with the limited number of most significant bits. A POSITA would understand that given the required 26 bits for 45 million serial numbers, the serial number space would have 6 of the most significant bits identify the lot number, or location of the edge server, and the 20 least significant bits for defining blocks of one million serial numbers for each location. The corresponding nominal binary representation for this is illustrated below with the 6 most significant bits in red: 00000000-9999999 00000000000000000000000000-00100111111111111111111111 10000000-15000000 00100110000000000000000000-00101011100000000000000000000 20000000-29999999 00101100000000000000000000-00110011111111111111111111 30000000-4000000 00110100000000000000000000-00111000000000000000000000 For the SGTIN-96 format with a serial number space of 38 bits, a POSITA would understand that the same block assignments would use an additional 12 bits (a total of 18 bits) for identifying more lot numbers and locations.
	Claims 2-5 are obvious under 35 U.S.C. §103 over: the '684 publication (published 2/22/2007 and prior art under 35 U.S.C. §102(b)) and either (A) U.S. 7,827,200 (filed 7/16/2006 and prior art under 35 U.S.C. 102(e)) or (B) U.S. 8,373,545 (filed 8/7/2006 and prior art under 35 U.S.C. §102(e)), each in view of the 2006 EPC Standard (published 5/2006 and prior art under 35 U.S.C. §102(b))
2. The RFID transponder of claim 1, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.	The '200 patent relates to the EPC coding of RFID tags. "An ELECTRONIC PRODUCT CODE (EPC) is an identification scheme for universally identifying physical objects via Radio Frequency Identification (RFID) tags and other means. EPC was the creation of the MIT Auto-ID Center that is currently managed by EPCglocal Inc. The EPC scheme is designed to meet the needs of various industries, while guaranteeing uniqueness for all EPC-compliant tags. The format and contents of an EPC-compliant tag are governed by the EPCglobal Tag Data Specification (TDS)." '200 patent at 1:12-20. The '545 patent relates to the EPC coding of RFID tags. "The RFID tag can include a unique electronic product code (EPC). The RFID transceiver can emit a signal activating the RFID tag which then can reply with the EPC code." '545 patent at 1:25-27. The 2006 EPC Standard includes object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.

	688 **3.5.1 SGTIN-96** 689 In addition to a Header, the SGTIN-96 is composed of five fields, the *Filter Value*, *Partition*, 690 *Company Prefix*, *Item Reference*, and *Serial Number*, as shown in Table 4. Table 4. SGTIN-96 Bit Allocation | | Header | Filter Value | Partition | Company Prefix | Item Reference | Serial Number | | SGTIN-96 | 8 | 3 | 3 | 20-40 | 24-4 | 38 | | | 0011 0000 (Binary value) | (Refer to Table 5 for values) | (Refer to Table 6 for values) | 999,999 – 999,999,999,999 (Max. decimal range*) | 9,999,999 – 9 (Max. decimal range*) | 274,877,906,943 (Max. decimal value) | 2006 EPC Standard at 25. The 2006 EPC Standard is directed to the details of the SGTIN-96 coding scheme recited in a number of claims of the '967 Patent. Since the 2006 EPC Standard is directed to the same EPC subject matter as the '684 publication, the '200 patent, and the '545 patent, it would have been obvious to a POSITA to combine the 2006 EPC Standard with the '684 publication, the '200 patent, and the '545 patent under 35 U.S.C. §103.
3. The RFID transponder of claim 1, wherein the unique object number is a portion of a serialized global trade item number.	The 2006 EPC Standard unique object number is a portion of a serialized global trade item number (SGTIN-96). See Claim **[2]**.
4. The RFID transponder of claim 4, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.	The 2006 EPC Standard serialized global trade item number is SGTIN-96. See Claim **[2]**.
5. The RFID transponder of claim 1, wherein the unique serial number space is at least 38 bits.	The 2006 EPC Standard serialized global trade item number SGTIN-96 has a 38 bit serial number space. See Claim **[2]**.
	Claims 6-12 are obvious under 35 U.S.C. §103 over: the '684 publication and U.S. 7,827,200 or U.S. 8,373,545
6. The RFID transponder of claim 1, wherein the allocated block is defined by at least 3 most significant bits.	'200 patent discloses that the allocated block is defined by the 5 most significant bits. See Claim [**1F**]. '545 patent discloses that the allocated block is defined by the 6 most significant bits. See Claim [**1F**].

7. The RFID transponder of claim 1, wherein the allocated block is one of a plurality of allocations intermittently received by an encoder.	The '200 patent teaches a plurality of allocations intermittently received by an encoder. "FIG. 3 is a flow chart of a method 300 for serializing EPCs in accordance with an embodiment of the inventive arrangements disclosed herein. Method 300 can begin in step 305, where multiple pools of numbers and/or number assignment functions can be associated with values for nonserialized portions of EPCs. In step 310, a new taggable object can be identified that needs an EPC. In step 315, a classification for the new object can be determined. In step 320, an unserialized portion of the EPC can be constructed from the classification information, in step 325, a pool of numbers and/or a number assignment function associated with the unserialized portion can be identified. In step 330, a last previously allocated serial number in the identified pool can be located. In step 335, the next unallocated serial number can be extracted from the pool and used as the serialized portion of the EPC. In step 340, the new EPC can be assigned to the new taggable object. In step 345, variables associated with the pool or function used to generate the assigned number can be updated to ensure that the assigned serial number is not reassigned to a different object having the same unserialized portion of an EPC. In step 350, the assigned EPC can be encoded into an RFID tag that can be physically linked to the object." '200 patent at 6:37-58. The centralized system that assigns subsets of serial numbers to different manufacturing divisions sends the allocations intermittently. "In one embodiment, different manufacturer divisions that produce objects having the same object classification can be assigned a subset of numbers from a number pool of unassigned numbers to ensure that unique serial numbers are always generated. … In another example, a first division can assign serial numbers in the range of one to a million and the second division can assign serial numbers in a range of three to four million. It should be appreciated that the different divisions can be communicatively linked to a centralized system that assigns serial numbers, which would ensure that serial numbers are uniquely assigned per object classification." '200 patent at 5:7-22. '545 patent teaches an encoder requesting and caching a plurality of allocated blocks which would be understood by a POSITA to include an inherently intermittent reception of the blocks by the encoder. "A system of one embodiment comprises using an EPC server 402 to dynamically provide EPC code blocks 404 and 406 for one product to multiple client sites 408 and 410. The client sites 408 and 410 can use the EPC codes 412, 414, 416 and 418 of the EPC code block for RFID tags 402, 422, 424 and 426.

	In one embodiment, the EPC server can create pools of EPC codes. The EPC codes can be created based on business policies that can be used to indicate business information in the EPC code. The RFID edge servers can obtain EPC codes from the pool, store these EPC codes into a local cache and then use these EPC codes in the construction of RFID tags, such as with an RFID tag printer. Unused RFID tags can be returned from the cache to the pool. The client sites 408 and 410 can be, or can include, RFID edge servers. The EPC server can use business rules to assign the EPC code blocks. The EPC code blocks can be assigned so as to indicate business information such as lot number and/or location. The client sites 408 and 410 can cache EPC codes for later use. The client sites can request EPC code blocks 404 and 406." '545 patent at 3:34-54.
8. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of silicon.	'684 publication discloses the RFID integrated circuit chip is comprised of silicon: "[0005] Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces. [0006] Wireless sensors, made using **silicon circuits**, polymer circuits, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods." '684 publication at [0005]-[0006] (emphasis added).
9. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is comprised of polymer.	'684 publication discloses the RFID integrated circuit chip is comprised of polymer: "[0005] Combining the benefits of the latest technology in RFID transponders with sensing devices, a broader class of devices called wireless sensors is emerging. Wireless sensors have a unique identity, sense one or more attributes within its environment, and report its identity and data corresponding to the sensed attributes. For example, a wireless sensor interprets environmental conditions such as temperature, moisture, sunlight, seismic activity, biological, chemical

	or nuclear materials, specific molecules, shock, vibration, location, or other environmental parameters. Wireless sensors are distributed nodes of computing networks that are interconnected by wired and wireless interfaces. [0006] Wireless sensors, made using silicon circuits, **polymer circuits**, optical modulation indicia, an encoded quartz crystal diode, or Surface Acoustic Wave communicate wirelessly to other devices. For example, certain embodiments of wireless sensors communicate on a peer-to-peer basis to an interrogator or a mobile computer. Communication methods include narrow band, wide band, ultra wide band, or other means of radio or signal propagation methods." '684 publication at [0005]-[0006] (emphasis added).
10. The RFID transponder of claim 1, wherein the substrate, antenna structure, and RFID integrated circuit chip are covered by a face stock material.	'684 publication discloses the substrate 58, antenna structure 54, and RFID integrated circuit chip 56 are covered by a face stock material 51. "FIG. 3 shows a possible embodiment of an RFID transponder 50 that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer 52 bonds with antenna layer 54 that is bonded to inlay substrate layer 58 and integrated circuit 56. Inlay substrate layer 58 and face-stock layer 51 provide resistance against electrostatic discharge (ESD) into antenna layer 54 or chip 56." '684 publication at [0049] and Fig. 3.  FIG. 3
11. The RFID transponder of claim 1, wherein the RFID integrated circuit chip is disposed on the substrate.	'684 publication discloses an RFID integrated circuit chip 56 disposed on substrate 58. The substrate 58, antenna structure 54, and RFID integrated circuit chip 56 are covered by a face stock material 51. "FIG. 3 shows a possible embodiment of an RFID transponder 50 that does not include an encapsulation layer comprising a separate tape. In this example, an adhesive layer 52 bonds with antenna layer 54 that is bonded to inlay substrate layer 58 and integrated circuit 56. Inlay substrate layer 58 and face-stock layer 51 provide resistance against electrostatic discharge (ESD) into antenna layer 54 or chip 56." '684  FIG. 3

	publication at [0049] and Fig. 3.
12. The RFID transponder of claim 1, wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.	'200 patent discloses that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder or integrated circuit memory. See Claim [**1F**]. '545 patent discloses that the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder or integrated circuit memory. See Claim [**1F**].
	Claims 13-15 are obvious under 35 U.S.C. §103 over: the '684 publication and either U.S. 7,827,200 or U.S. 8,373,545, or both, in view of the 2006 EPC Standard
13[P]. A RFID transponder comprising:	See Claim **[1P]**.
[13A] a substrate;	See Claim **[1A]**.
[13B] an antenna structure formed on the substrate; and	See Claim **[1B]**.
[13C] an RFID integrated circuit chip which is electrically coupled to the antenna structure,	See Claim **[1C]**.
[13D] wherein the RFID integrated circuit chip is encoded with a global trade item number including a unique object number, the unique object number comprising an object class information space including a block of at least 50 bits and a unique serial number space including a block of at least 38 bits, and	See Claim **[1D], 1[E]** and Claims **[2]-[5]**.
[13E] wherein the unique serial number space has one serial number instance from	See Claim **[1F]**

an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits, and	
[13F] wherein the unique serial number space comprises at least 3 most significant bits corresponding to the allocated block.	See Claim **[6]**.
14. The RFID transponder of claim 13, wherein the unique serial number space further comprises remaining bits of lesser significance that together with the at least 3 most significant bits comprise the one serial number instance.	See Claim **1[G]**.
15. The RFID transponder of claim 13, wherein the at least 3 most significant bits that correspond to the allocated block further correspond to an encoder that encodes the RFID transponder.	See Claim **[12]**
	Claim 16 is obvious under 35 U.S.C. §103 over the '684 publication and U.S. 7,827,200 or U.S. 8,373,545
16[P]. An integrated circuit, comprising:	See Claim **[1C].**
[16A] a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator;	'684 publication discloses a radio frequency circuit configured to backscatter a return link signal for processing by an RFID interrogator: "Current classes of RFID transponders rank into two primary categories: active RFID transponders and passive RFID transponders. Active RFID transponders include an integrated power source capable of self-generating signals, which may be used by other, remote reading devices to interpret the data associated with the transponder. Active transponders include batteries and, historically, are considered considerably more expensive than passive RFID transponders. Passive RFID transponders backscatter incident RF energy to specially

	designed remote devices such as interrogators." '684 publication at [0004].
[16B] control logic; and	'684 publication discloses control logic in the integrated circuit. "Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency circuits, **control logic**, memory and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder." '684 publication at [0003] (emphasis added).
[16C] a memory,	'684 publication: discloses a memory in the integrated circuit. "Radio-frequency identification (RFID) transponders, typically thin transceivers that include an integrated circuit chip having radio frequency circuits, control logic, **memory** and an antenna structure mounted on a supporting substrate, enable vast amounts of information to be encoded and stored and have unique identification. Commissioning, the process of encoding specific information (for example, data representing an object identifier, the date-code, batch, customer name, origin, destination, quantity, and items) associated with an object (for example, a shipping container), associates a specific object with a unique RFID transponder. The commissioned transponder responds to coded RF signals and, therefore, readily can be interrogated by external devices to reveal the data associated with the transponder." '684 publication at [0003] (emphasis added).
[16D] wherein the memory is configured with a unique object number space, the unique object number space comprising an object class information space and a unique serial number space, and	See Claim **[1E]**.
[16E] wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial	See Claim **[1F].**

numbers, the allocated block being assigned a limited number of most significant bits, and	
[16F] wherein the unique serial number space comprises the limited number of most significant bits corresponding to the allocated block and remaining bits of lesser significance that together comprise the one serial number instance.	See Claim **[1G]**.
	Claims 17-19 are obvious under 35 U.S.C. §103 over: the '684 publication and either U.S. 7,827,200 or U.S. 8,373,545, or both, in view of the 2006 EPC Standard
17. The integrated circuit of claim 16, wherein the object class information space is encoded with information comprising a company prefix, an item reference, a partition value, and a filter value.	See Claim **[2]**.
18. The integrated circuit of claim 16, wherein the unique object number is a portion of a serialized global trade item number.	See Claim **[3].**
19. The integrated circuit of claim 19, wherein the serialized global trade item number is an EPC SGTIN-96 encoding.	See Claim **[4].**
	Claim 20 is obvious under 35 U.S.C. §103 over the '684 publication and U.S. 7,827,200 or U.S. 8,373,545
20. The integrated circuit of claim 16,	See Claim **[12]**.

wherein the limited number of most significant bits that correspond to the allocated block further correspond to an encoder that encodes the memory of the integrated circuit.	

IV. Conclusion

For the reasons set forth above, reexamination of claims 1-20 of U.S. patent 9,798,967 is requested.

Fees

The requisite fees are submitted herewith. If any additional fees are due at any time during the proceeding, the undersigned authorizes the Office to charge such fees to Deposit Account No. 50-1349.

Respectfully submitted,

/Theodore J. Mlynar/

Theodore J. Mlynar (Reg. No. 40,096)
E: ted.mlynar@hoganlovells.com

Ira J. Schaefer (Reg. No. 26,802)
E: ira.schaefer@hoganlovells.com

HOGAN LOVELLS US LLP
875 Third Avenue
New York, NY 10022
T: (212) 918-3000
F: (212) 918-3100

Counsel for Requester Avery Dennison, Inc.

CERTIFICATE OF SERVICE

I certify that on November 29, 2017, a copy of this REQUEST FOR EX PARTE REEXAMINATION OF U.S. PATENT 9,798,967 was served on the patent owner via FedEx at the following address:

Michael J. Marcin
FAY KAPLUN & MARCIN, LLP
150 Broadway, Suite 702
New York, NY 10038

/Tina M. Fluharty/
IP Specialist
HOGAN LOVELLS US LLP

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS
First Named Inventor/Applicant Name:	Clarke W. McAllister
Filer:	Teresa A. Lavenue
Attorney Docket Number:	029101.6

Filed as Large Entity

Filing Fees for ex parte reexam

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
REQUEST FOR EX PARTE REEXAMINATION	1812	1	12000	12000
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**12000**

Electronic Acknowledgement Receipt

EFS ID:	31073826
Application Number:	90014052
International Application Number:	
Confirmation Number:	4770
Title of Invention:	SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS
First Named Inventor/Applicant Name:	Clarke W. McAllister
Customer Number:	24633
Filer:	Teresa A. Lavenue
Filer Authorized By:	
Attorney Docket Number:	029101.6
Receipt Date:	29-NOV-2017
Filing Date:	
Time Stamp:	14:20:18
Application Type:	Reexam (Third Party)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$12000
RAM confirmation Number	113017INTEFSW00000728501349
Deposit Account	501349
Authorized User	Tina Fuharty

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit1.pdf	600006 81e25b80bbe427881a3f19a22b6883f2214bfb38	no	41
Warnings:					
Information:					
2	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit2.pdf	407497 0b827186a536912c8489888e7504bc21214f7bd4	no	29
Warnings:					
Information:					
3	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit3.pdf	147842 e37d77216c4e097953fc37f937e566b58a6f5c38	no	9
Warnings:					
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4	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit4.pdf	1321608 0adc3c0ec40315e152ceb002aeef44a7c81d1f39	no	86
Warnings:					
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5	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit5.PDF	5330060 66c914f7c3264787f5c2c74b695f346de0ec21d1	no	98
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6	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit6.pdf	243433 973b1c500276341cb8d5f0d9d7319e49138085aa	no	3
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7	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit7.pdf	2095658 47d3c0d813d93bf3ce984234a10c0532b382afdf	no	50
Warnings:					
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8	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit8.pdf	2281128 d7d44f4416c7bb0df62f3972404cfc018b95f23d	no	49
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9	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit9.pdf	2872481 d1f4fce5176e5996ba1b4fde34c383a288dbbb89	no	76
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10	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit10.pdf	5330087 e4277bac9d8109b2c7b98ddb01939dfad5e78558	no	132
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11	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit11.pdf	625094 21138860e21920d9512d93f05f2ddce5ce917fc8	no	46
Warnings:					
Information:					
12	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit12.pdf	241978 a557a1563029be5c2367a2f97375f5cbdafb1a59	no	9
Warnings:					
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13	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit13.pdf	11624158 83e3ae5f3c0cbe8b209d110241298c547895497a	no	133
Warnings:					

Information:					
14		029101-6-requestforreexamtransmittal.pdf	1136274 886f87daa3cf982e75bec87676f9b07ca0fca878	yes	3
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Reexam - Info Disclosure Statement Filed by 3rd Party		3	3	
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15	Receipt of Orig. Ex Parte Request by Third Party	029101-6-requestforreexam.pdf	439476 f04129703169e31e8c30a4df512ad87386f3c3d1	no	47
Warnings:					
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16	Fee Worksheet (SB06)	fee-info.pdf	29869 c8c4c39fdf09e44eea8e4e93b9e4260aa2459e65	no	2
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		Total Files Size (in bytes):	34726649		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Bib Data Sheet

CONFIRMATION NO. 4770

SERIAL NUMBER	FILING OR 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
90/014,052	11/29/2017 RULE	340	3992	029101.6

AIA (First Inventor to File): YES

INVENTORS

9798967, Residence Not Provided;
ADASA INC., EUGENE, OR;
AVERY DENNISON INC. (3RD PTY REQ.), MENTOR, OH;

APPLICANTS

HOGAN LOVELLS US LLP IP GROUP, WASHINGTON, DC

**** CONTINUING DATA ***************************

This application is a REX of 15/042,993 02/12/2016 PAT 9798967
which is a CON of 13/526,520 06/19/2012 PAT 9272805
which is a CIP of 12/820,109 06/21/2010 PAT 8228198 *
which is a CIP of 11/465,712 08/18/2006 PAT 7830258
which claims benefit of 60/709,713 08/19/2005
and said 12/820,109 06/21/2010
is a CIP of 12/124,768 05/21/2008 ABN
which claims benefit of 60/939,603 05/22/2007
(*)Data provided by applicant is not consistent with PTO records.

**** FOREIGN APPLICATIONS *********************

Foreign Priority claimed	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ yes ☐ no			20	3
35 USC 119 (a-d) conditions met ☐ yes ☐ no ☐ Met after Allowance				
Verified and Acknowledged Examiner's Signature Initials				

ADDRESS
30636

TITLE

SYSTEMS, METHODS, AND DEVICES FOR COMMISSIONING WIRELESS SENSORS

FILING FEE RECEIVED 12000	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

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