Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0357-02904
	Application Number	
Title of Invention	CHIRP NETWORKS	

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.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Francis		DACOSTA	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Santa Clara	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	3355 Benton Street		
Address 2			
City	Santa Clara	State/Province	CA
Postal Code	95051	Country i	US

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	27197		
Email Address	mail@cherskov.com	Add Email	Remove Email

Application Information:

Title of the Invention	CHIRP NETWORKS		
Attorney Docket Number	0357-02904	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	72	Suggested Figure for Publication (if any)	58

Filing By Reference

IPR2025-01303
Cisco Systems, Inc. v. Dynamic Mesh Networks
Cisco's Exhibit 1018
EX1018, Page 1

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0357-02904
	Application Number	
Title of Invention	CHIRP NETWORKS	

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country i

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 and will not** be the subject of an application filed in another country, or under a multilateral international 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).
Either enter 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	○ Limited Recognition (37 CFR 11.9)
Customer Number	27197		

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c),or386(c) or indicate National Stage entry from a PCT application. 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.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Claims benefit of provisional	62/012,196	2015-06-13
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation in part of	13/764,008	2013-02-11
Prior Application Status	Patented		Remove

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0357-02904
	Application Number	
Title of Invention	CHIRP NETWORKS	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13/764,008	Continuation in part of	13/627,883	2012-09-26	8,923,18	2014-12-30

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13/627,883	Claims benefit of provisional	61/615,802	2012-03-26

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13/627,883	Claims benefit of provisional	61/555,400	2011-11-03

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13/627,883	Claims benefit of provisional	61/621,926	2012-04-09

Prior Application Status	Pending	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation in part of	13/571,294	2012-08-09

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13/571,294	Continuation in part of	12/696,947	2010-01-29	8,520,69	2013-08-27

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12/696,947	Claims benefit of provisional	61/148,803	2009-01-30

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13/571,294	Continuation in part of	12/352,457	2009-01-12	8,477,76	2013-06-02

Prior Application Status	Pending	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation in part of	13/541,446	2012-07-03

Prior Application Status	Pending	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation in part of	14/523,778	2015-02-12

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14/523,778	Continuation of	12/625,365	2009-11-24	8,514,85	2013-08-20

Prior Application Status	Expired	Remove

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0357-02904
	Application Number	
Title of Invention	CHIRP NETWORKS	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12/625,365	Claims benefit of provisional	61/117,502	2008-11-24

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. 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. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country i	Filing Date (YYYY-MM-DD)	Access Code (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☒ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0357-02904
	Application Number	
Title of Invention	CHIRP NETWORKS	

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant 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, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 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 instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :	

If the Applicant is an Organization check here. ☒

Organization Name	MeshDynamics

Mailing Address Information:

Address 1	3355 Benton Street		
Address 2			
City	Santa Clara	**State/Province**	CA
Country i	US	Postal Code	95051
Phone Number		Fax Number	

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0357-02904
	Application Number	
Title of Invention	CHIRP NETWORKS	

Email Address	

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications

Signature	/Szymon M. Gurda/				
First Name	Szymon	Last Name	Gurda	Registration Number	58451

Additional Signature may be generated within this form by selecting the Add button.

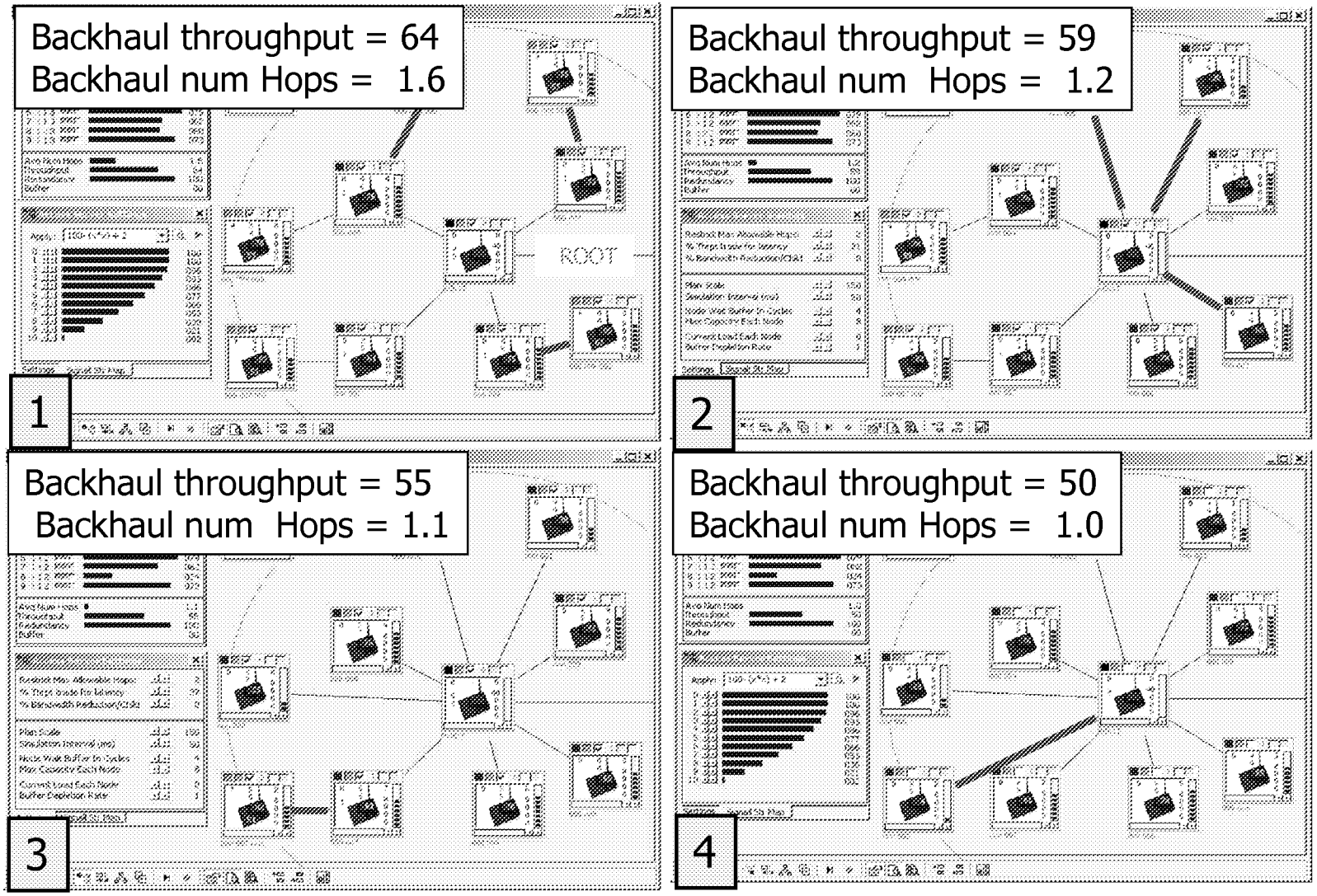

Backhaul throughput = 64
Backhaul num Hops = 1.6
ROOT
1
Backhaul throughput = 59
Backhaul num Hops = 1.2
2
Backhaul throughput = 55
Backhaul num Hops = 1.1
3
Backhaul throughput = 50
Backhaul num Hops = 1.0
4

Figure 1

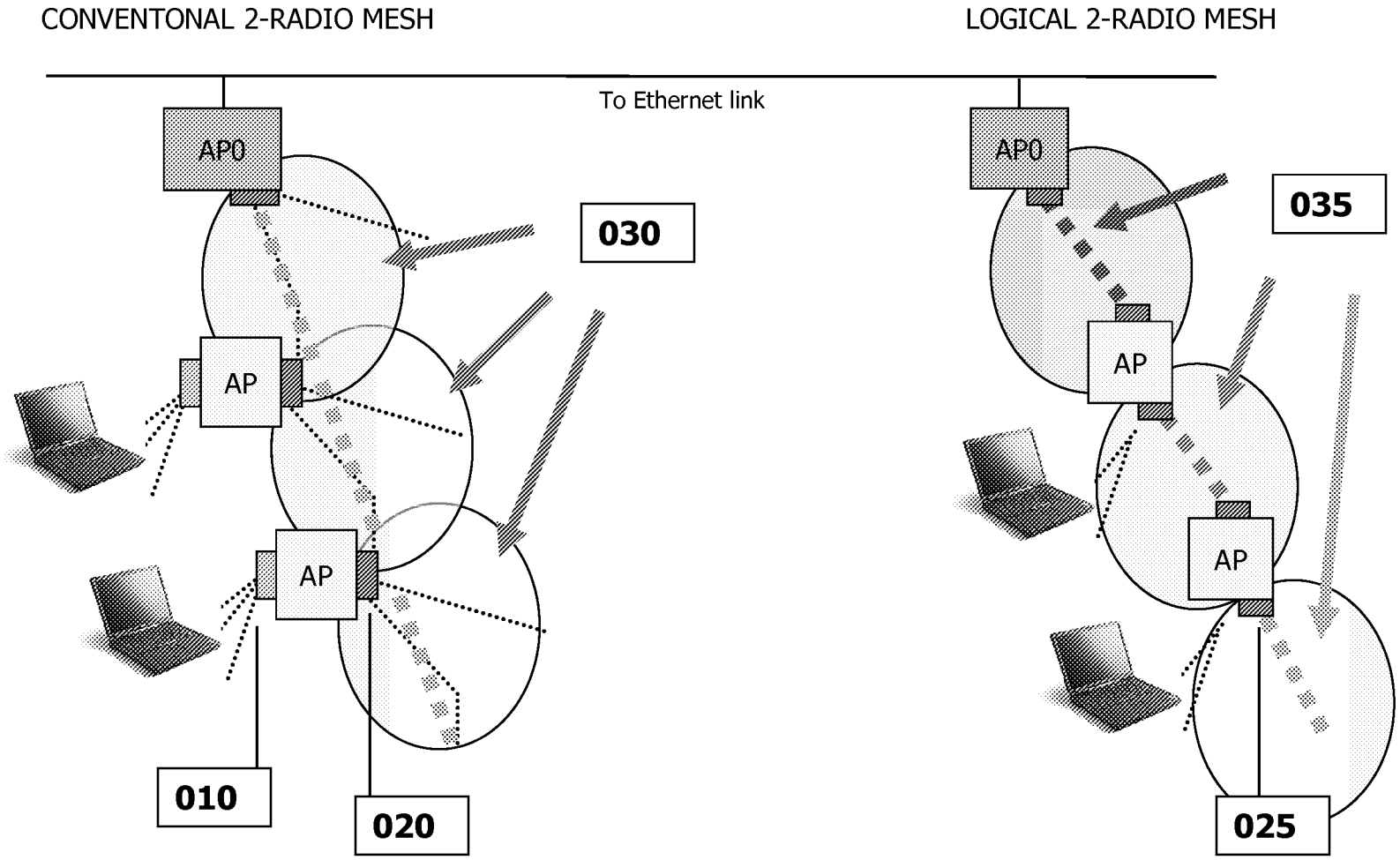
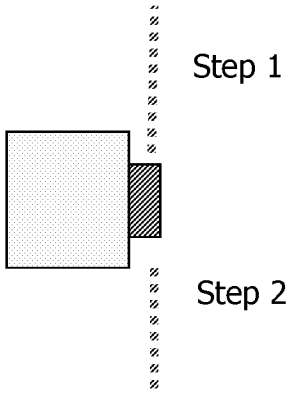


Figure 2

EX1018, Page 8

010 1-Radio Relay / Backhaul



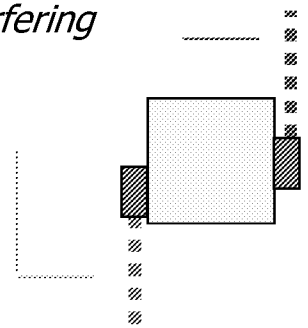
Step 1. Receive Packet
Step 2. Relay (on same channel)

Relay / Backhaul Radios

020 2-Radio Relay / Backhaul

Non-Interfering Channels

030



Simultaneous Receive/Send

Figure 3

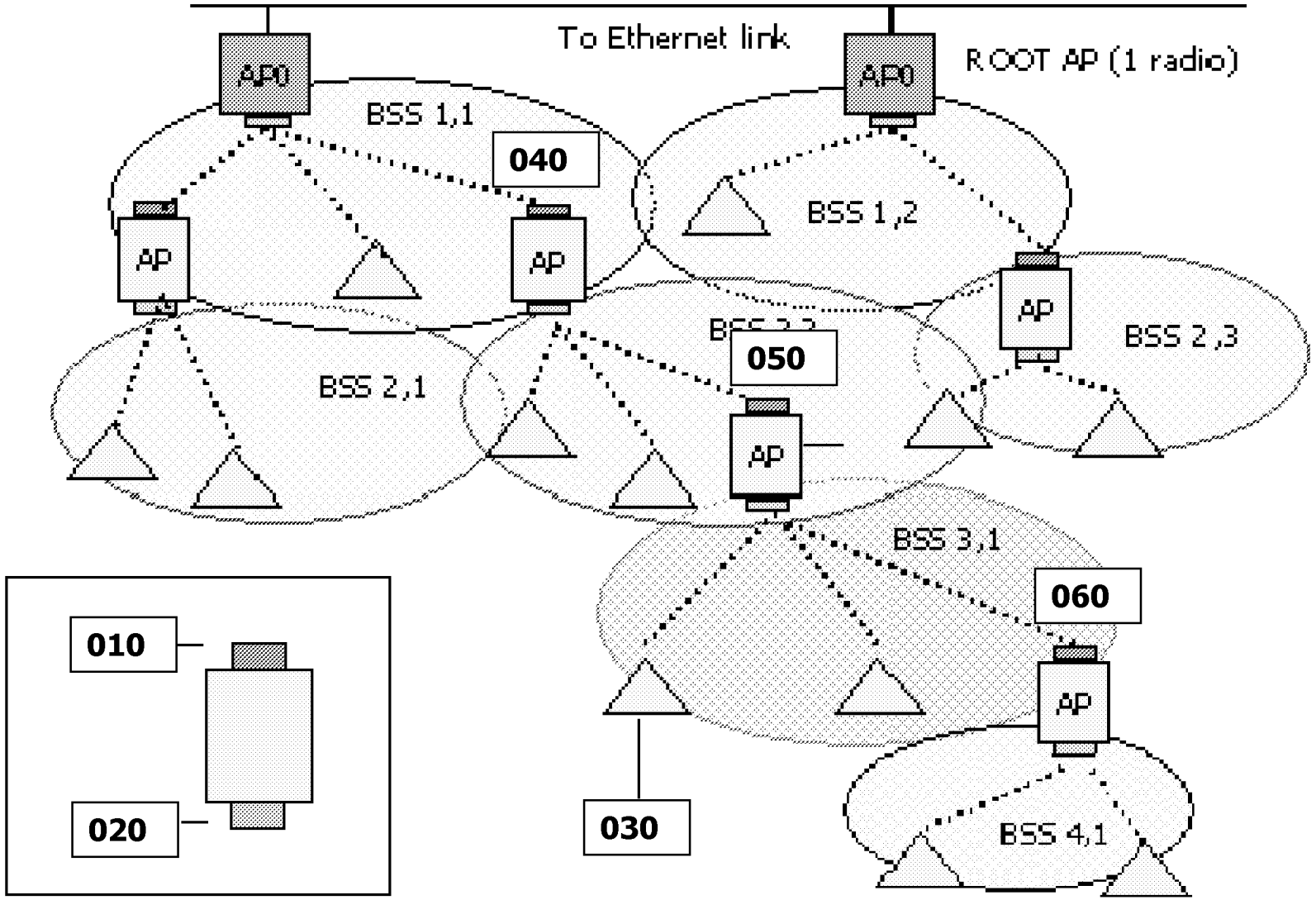

To Ethernet link
ROOT AP (1 radio)
AP0
AP0
BSS 1,1
040
BSS 1,2
AP
AP
AP
BSS 2,3
050
BSS 2,1
AP
BSS 3,1
060
AP
010
020
030
BSS 4,1

FIGURE 4

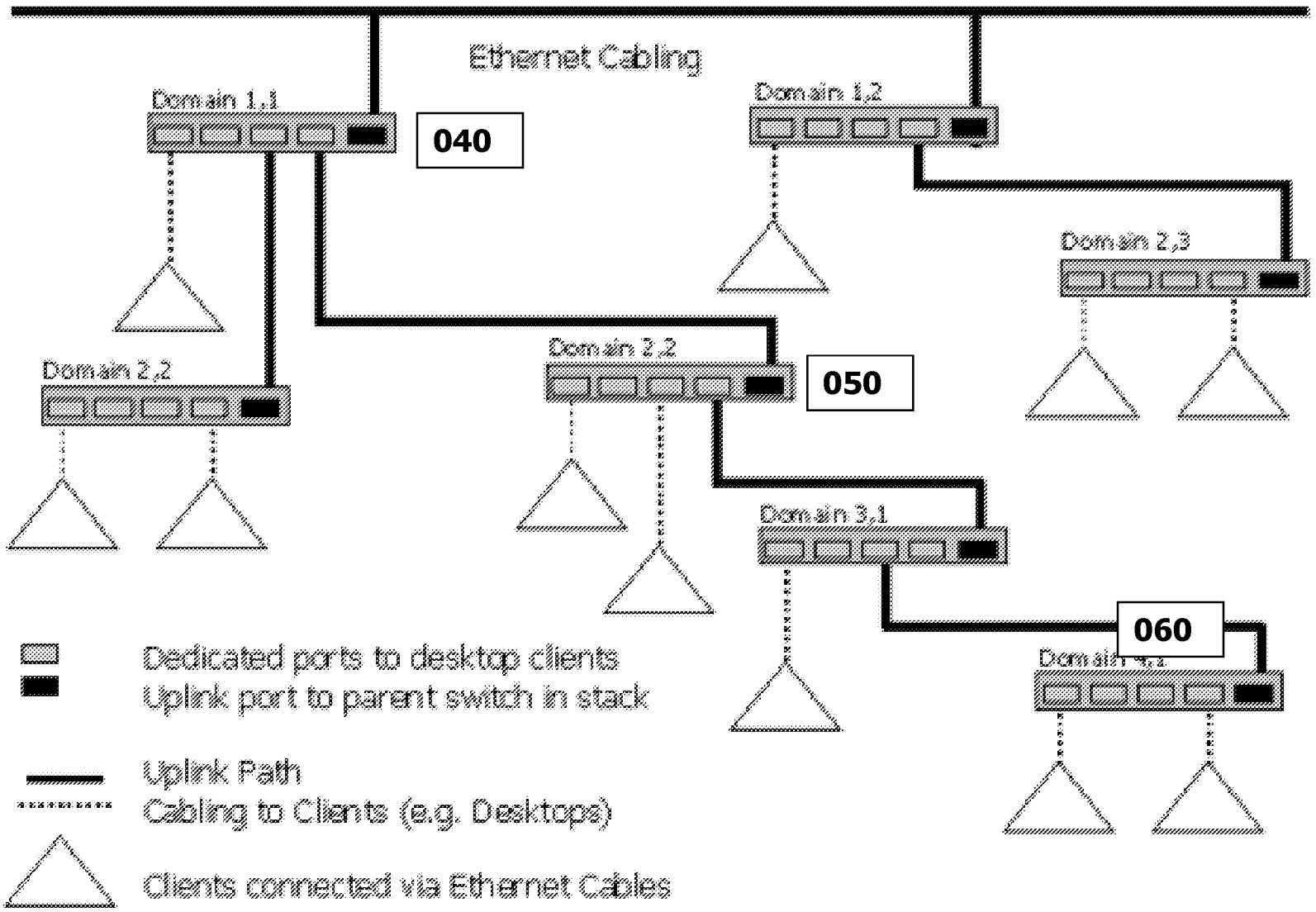

Ethernet Cabling
Domain 1,1
040
Domain 1,2
Domain 2,3
Domain 2,2
Domain 2,2
050
Domain 3,1
060
Dedicated ports to desktop clients
Uplink port to parent switch in stack
Uplink Path
Cabling to Clients (e.g. Desktops)
Clients connected via Ethernet Cables

Figure 5

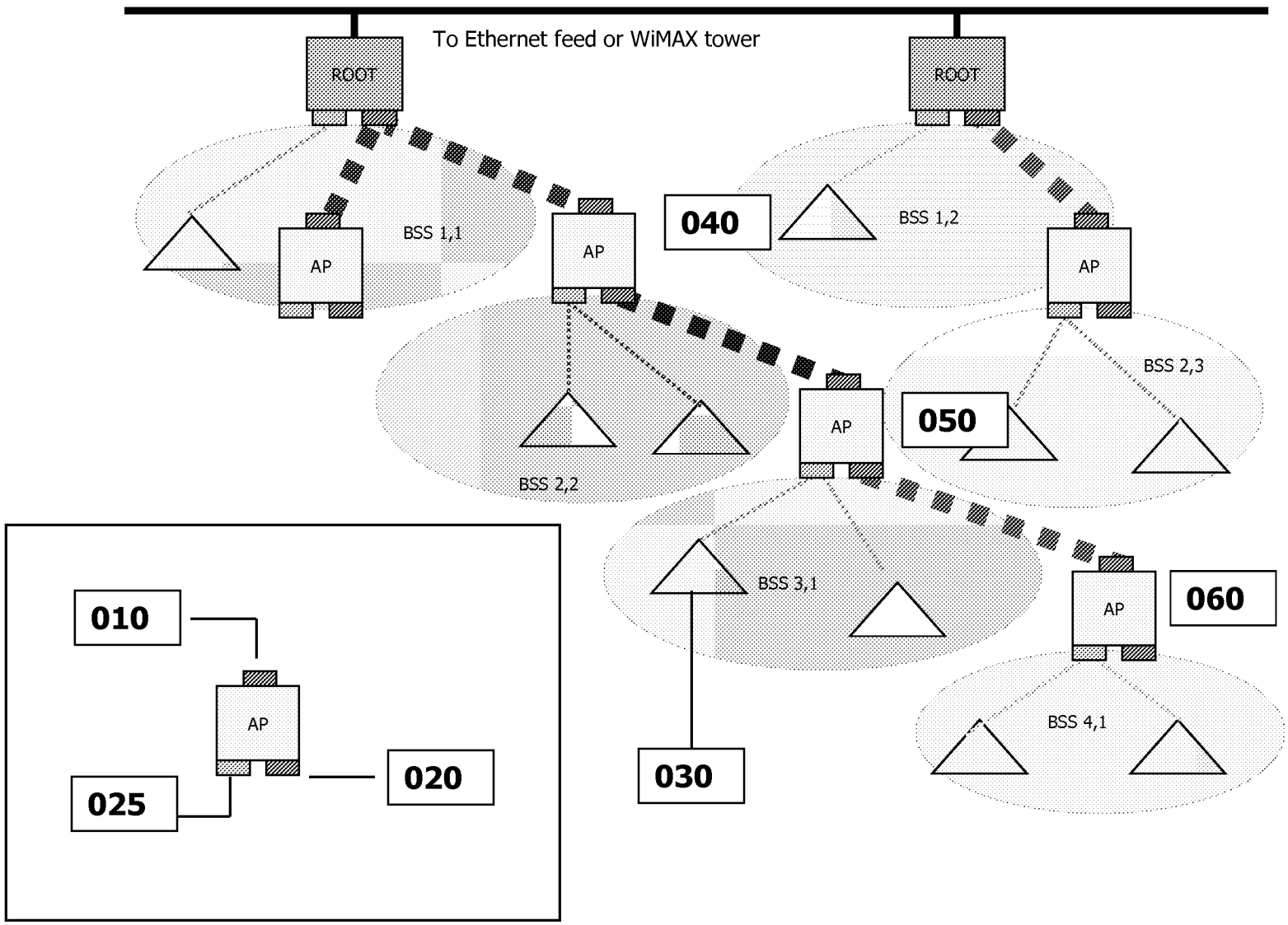

To Ethernet feed or WiMAX tower
ROOT
ROOT
BSS 1,1
AP
AP
040
BSS 1,2
AP
BSS 2,3
AP
050
BSS 2,2
BSS 3,1
AP
060
BSS 4,1
030
010
AP
025
020

Figure 6

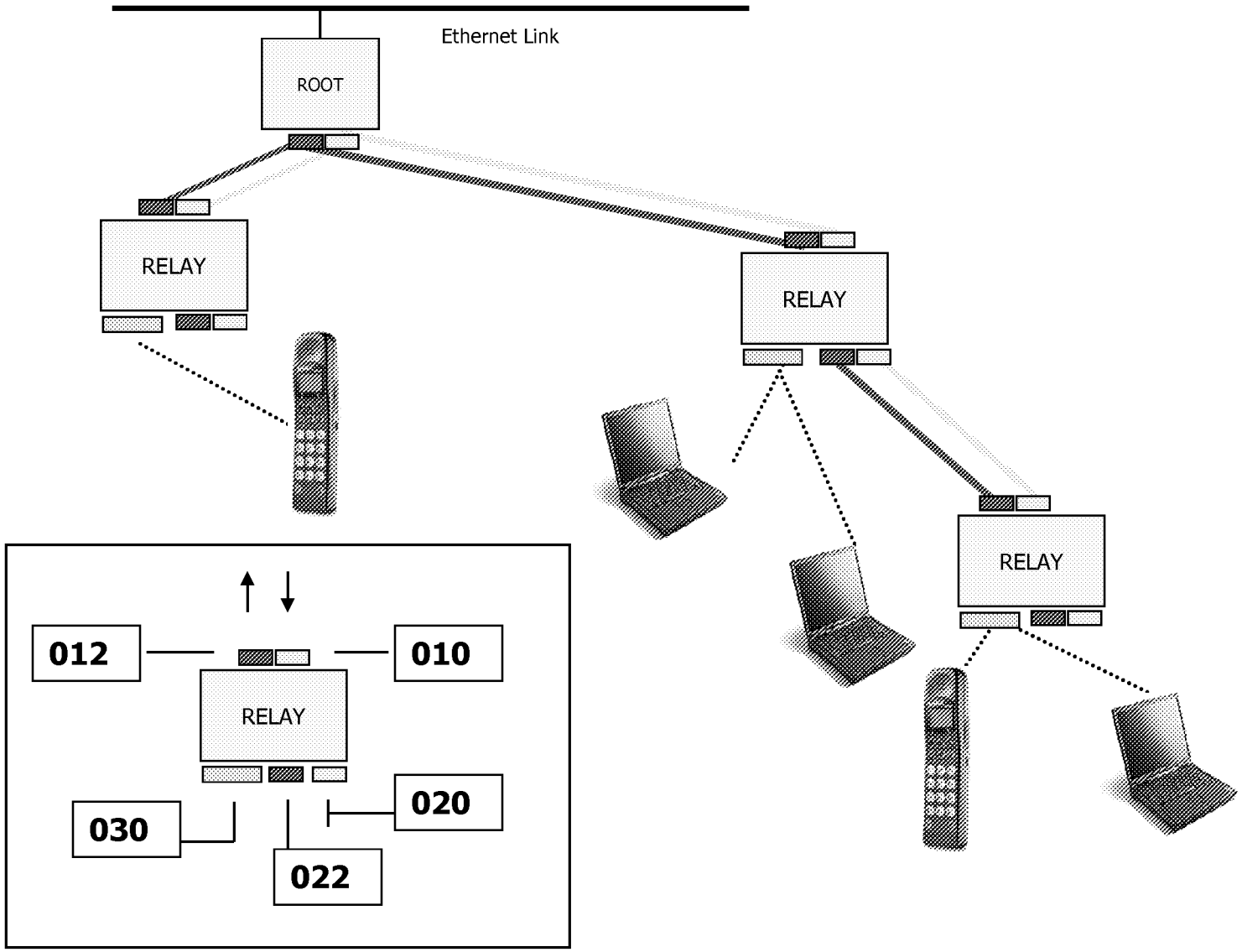

Ethernet Link
ROOT
RELAY
RELAY
RELAY
012
010
RELAY
020
030
022

Figure 7

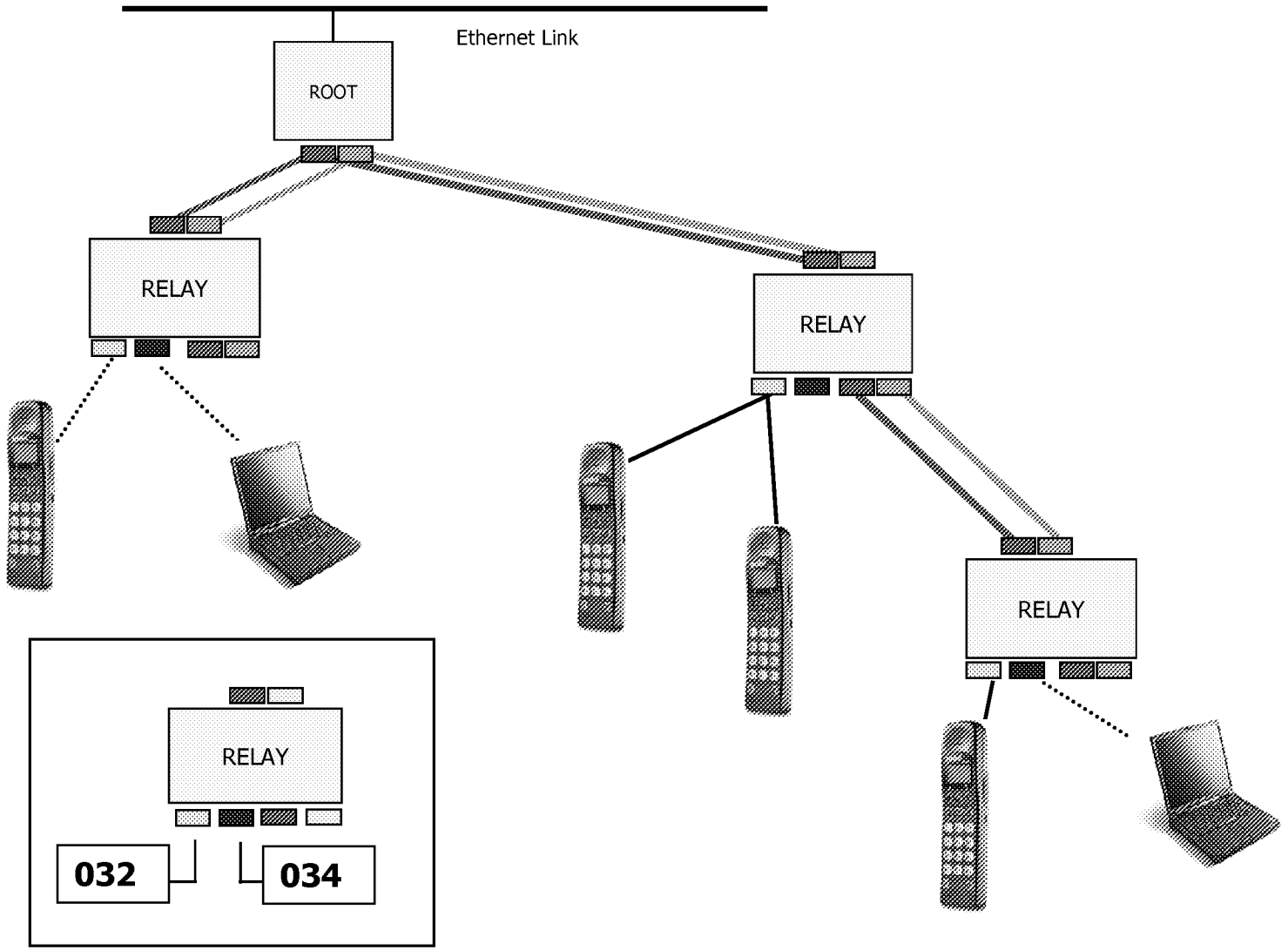


Figure 8

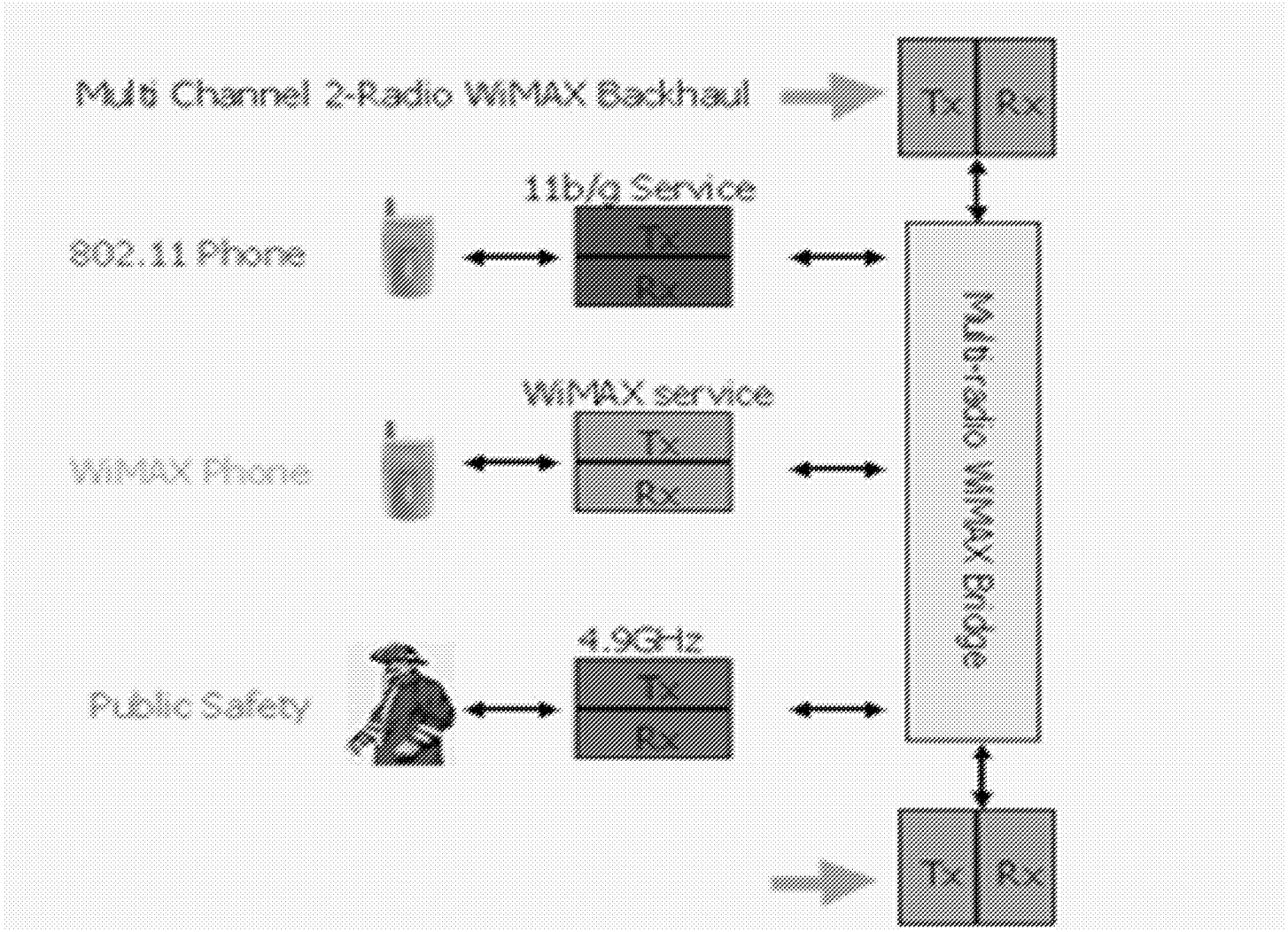

Multi Channel 2-Radio WiMAX Backhaul
Tx
Rx
11b/g Service
802.11 Phone
Tx
Rx
WiMAX service
WiMAX Phone
Tx
Rx
4.9GHz
Public Safety
Tx
Rx
Multi-radio WiMAX Bridge
Tx
Rx

Figure 9

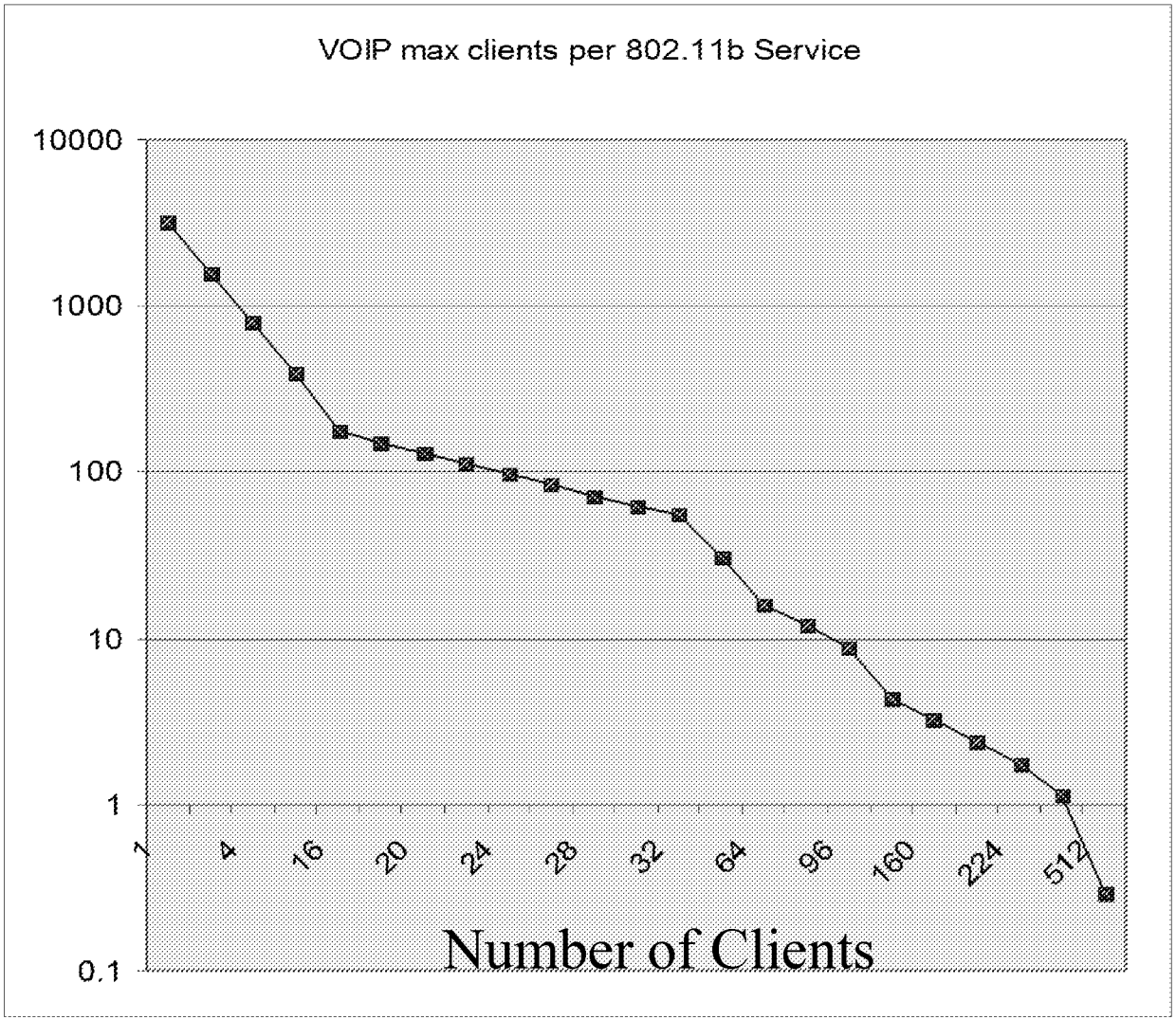


Figure 10

EX1018, Page 16

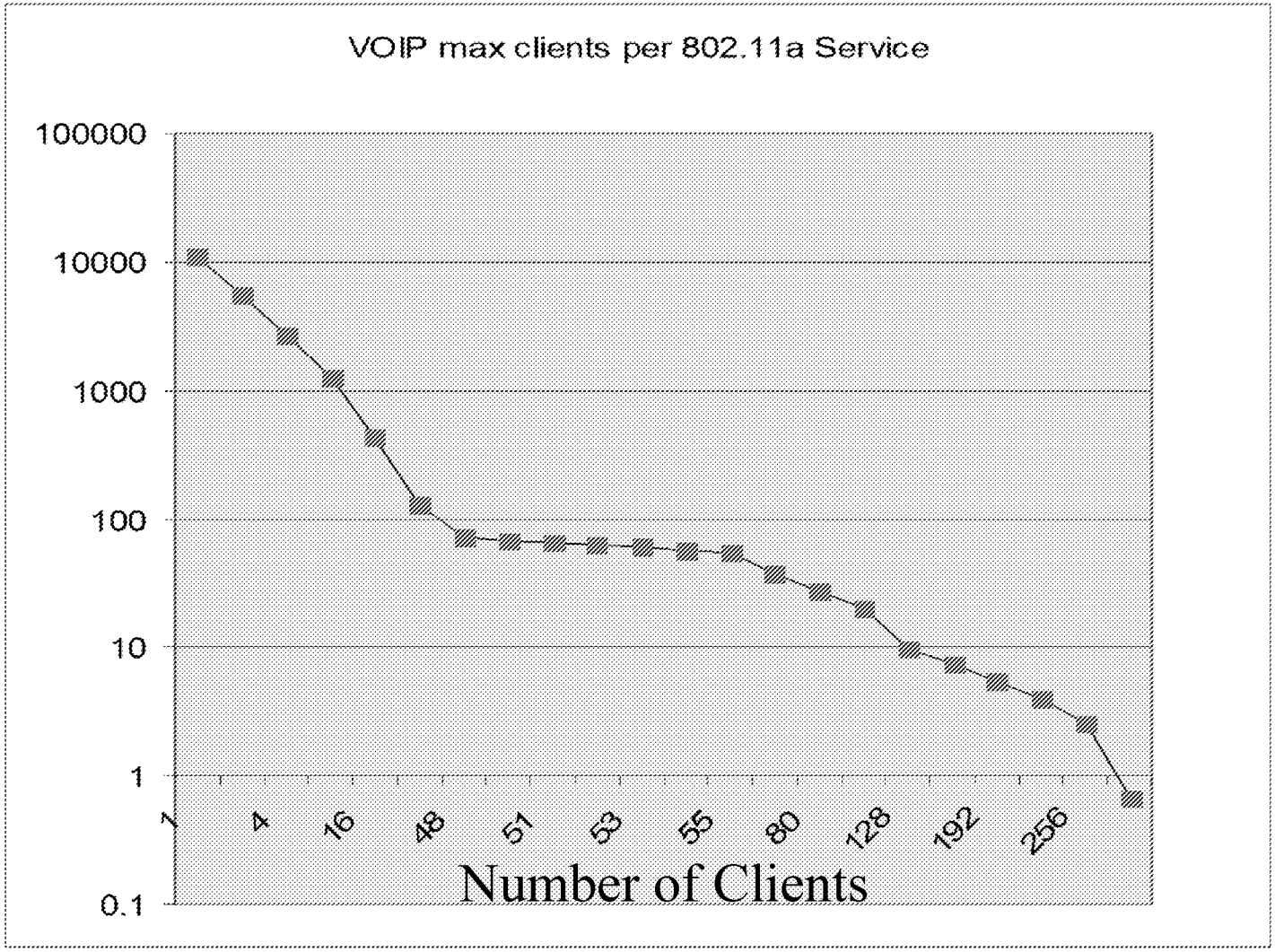


Figure 11

EX1018, Page 17

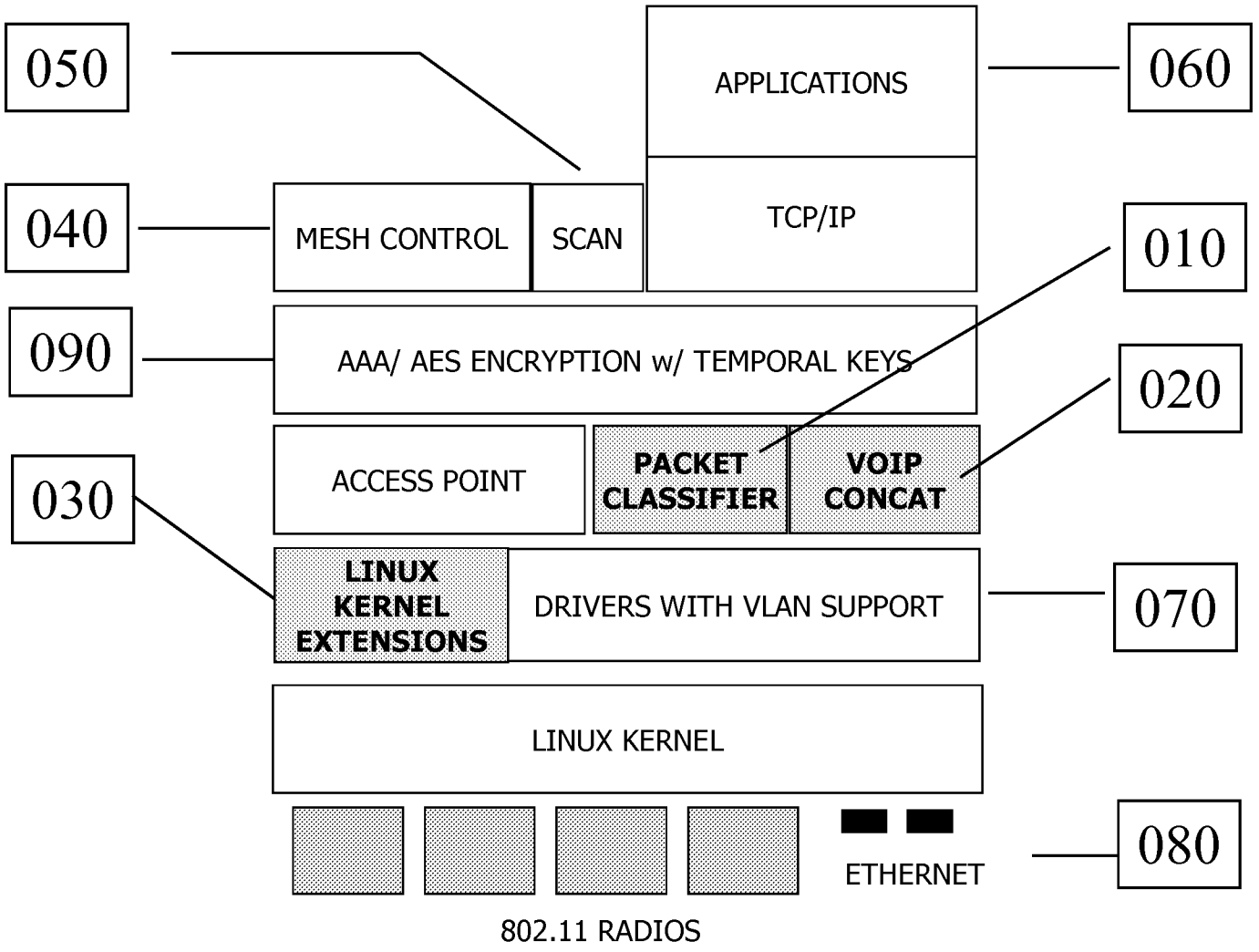


Figure 12

EX1018, Page 18

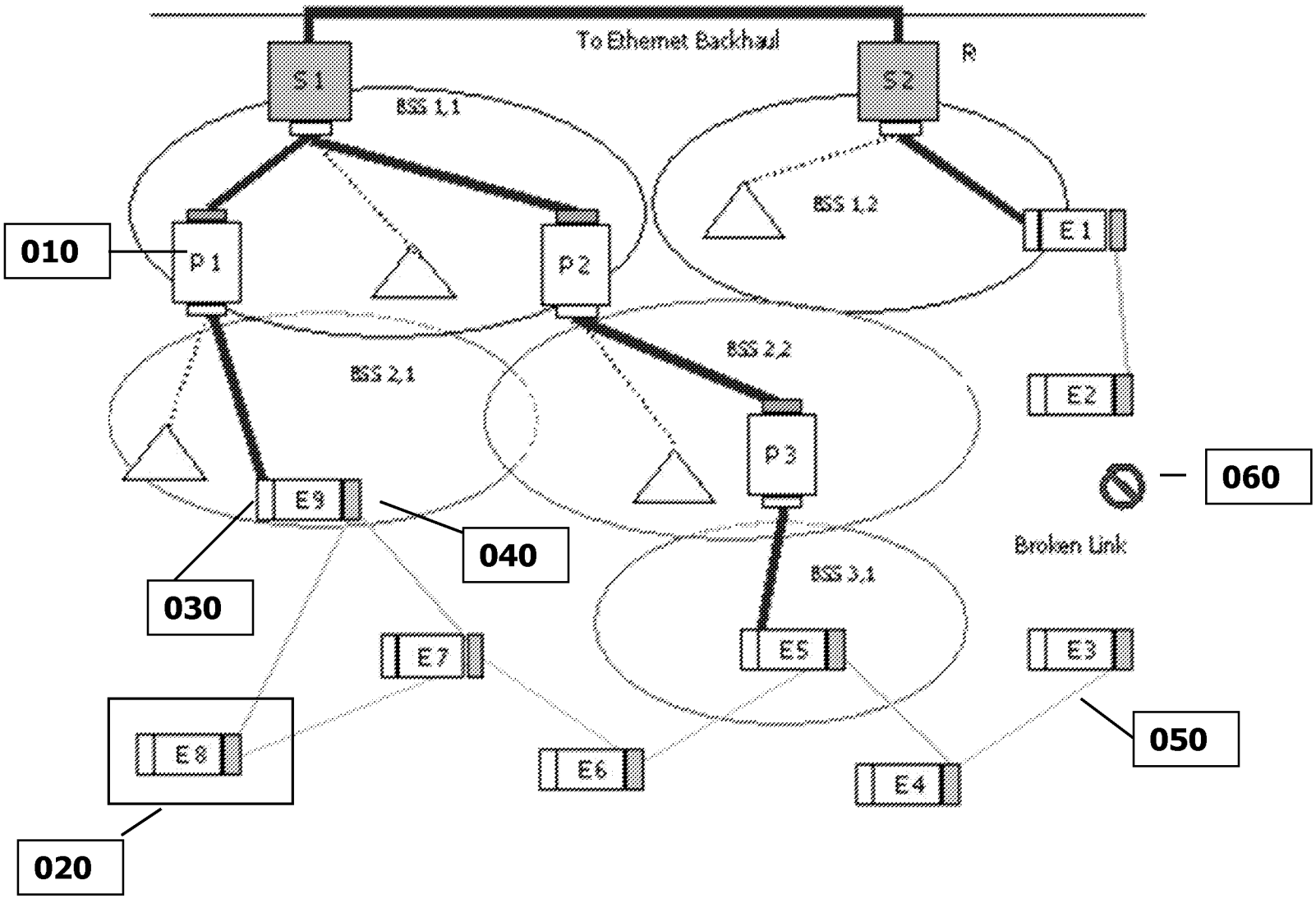


FIGURE 13

EX1018, Page 19

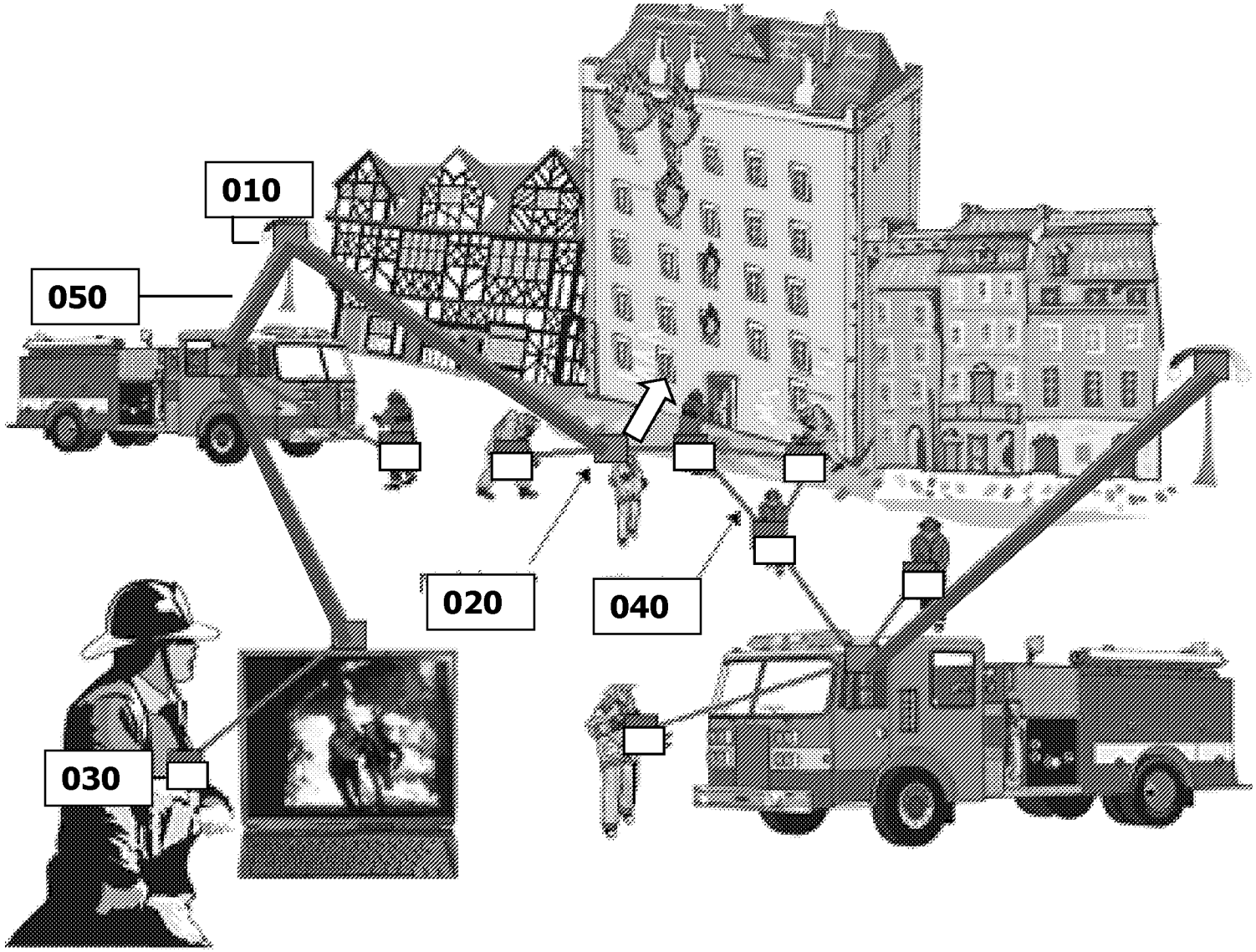


Figure 14

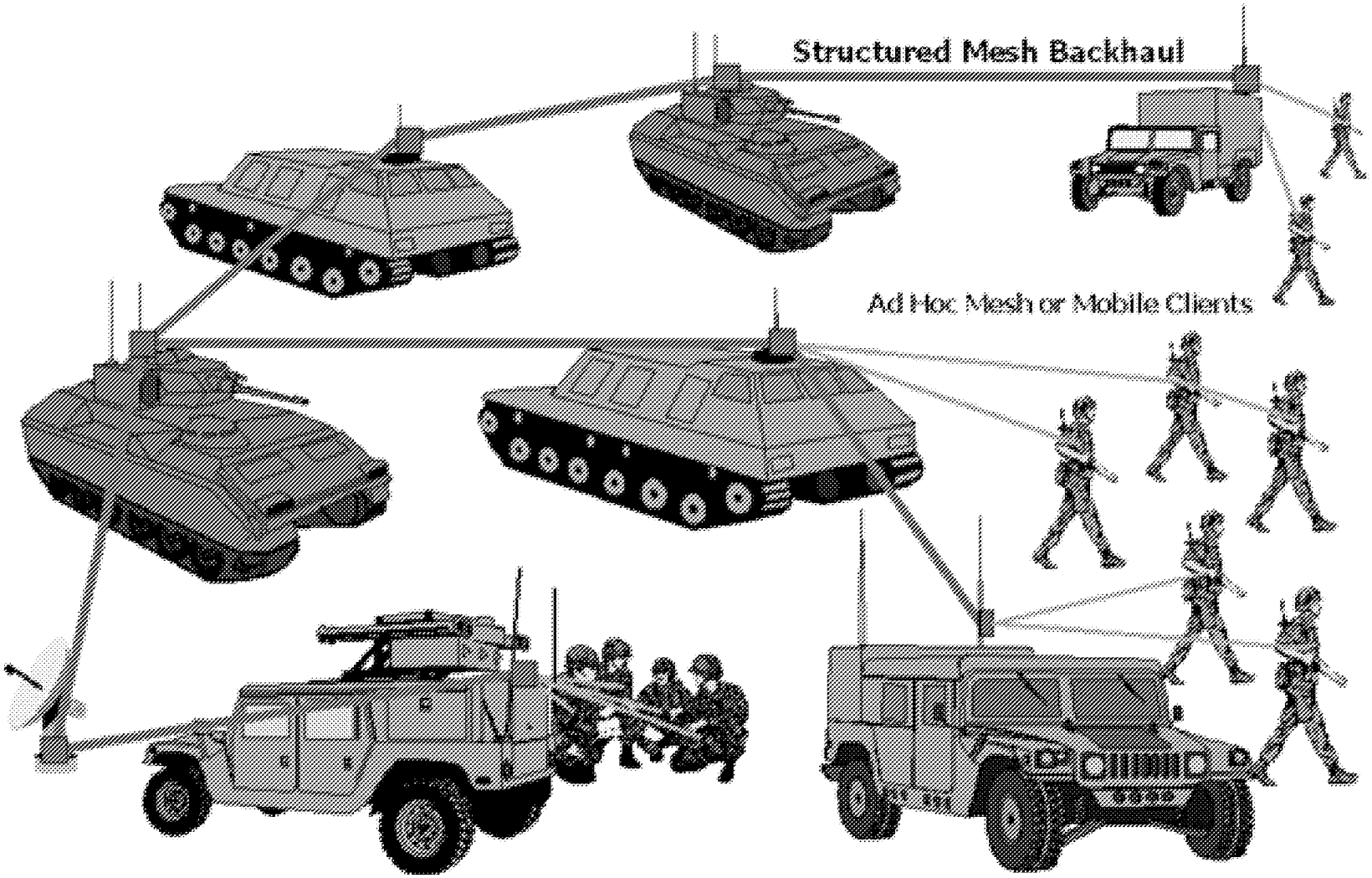


Figure 15

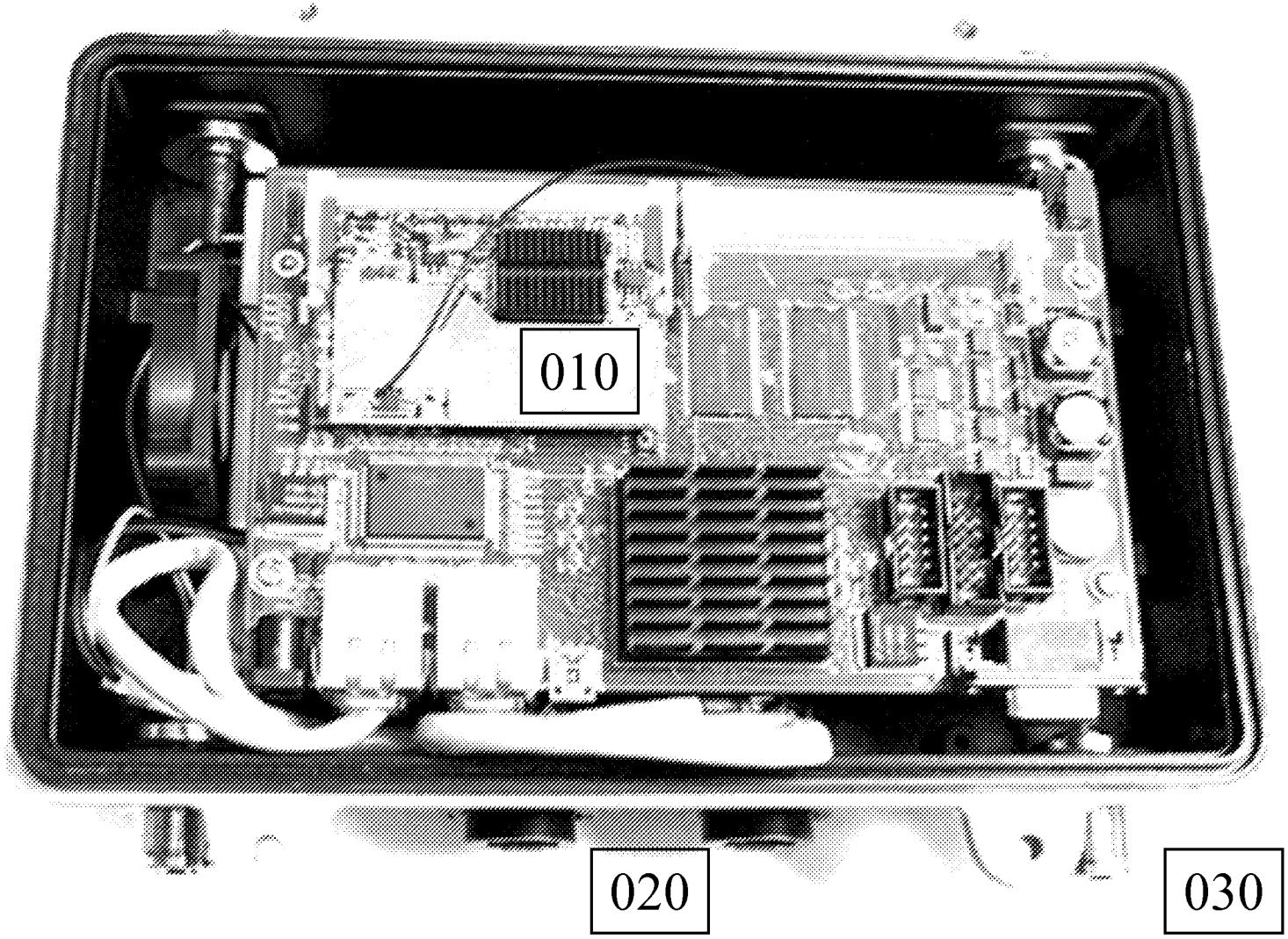


Figure 16

EX1018, Page 22

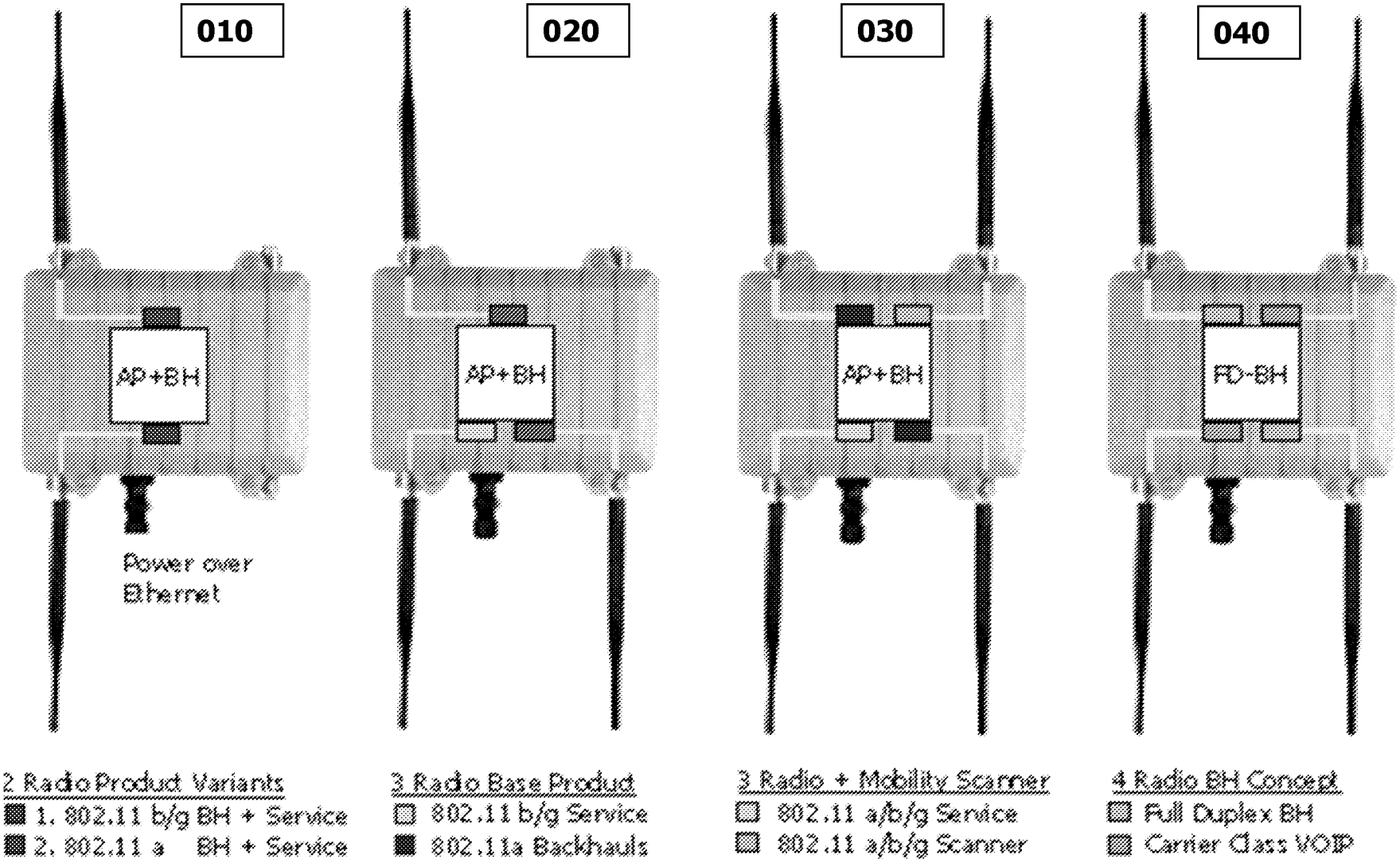

010
020
030
040
AP+BH
AP+BH
AP+BH
FD-BH
Power over
Ethernet
2 Radio Product Variants
1. 802.11 b/g BH + Service
2. 802.11 a BH + Service
3 Radio Base Product
802.11 b/g Service
802.11a Backhauls
3 Radio + Mobility Scanner
802.11 a/b/g Service
802.11 a/b/g Scanner
4 Radio BH Concept
Full Duplex BH
Carrier Class VOIP

Figure 17

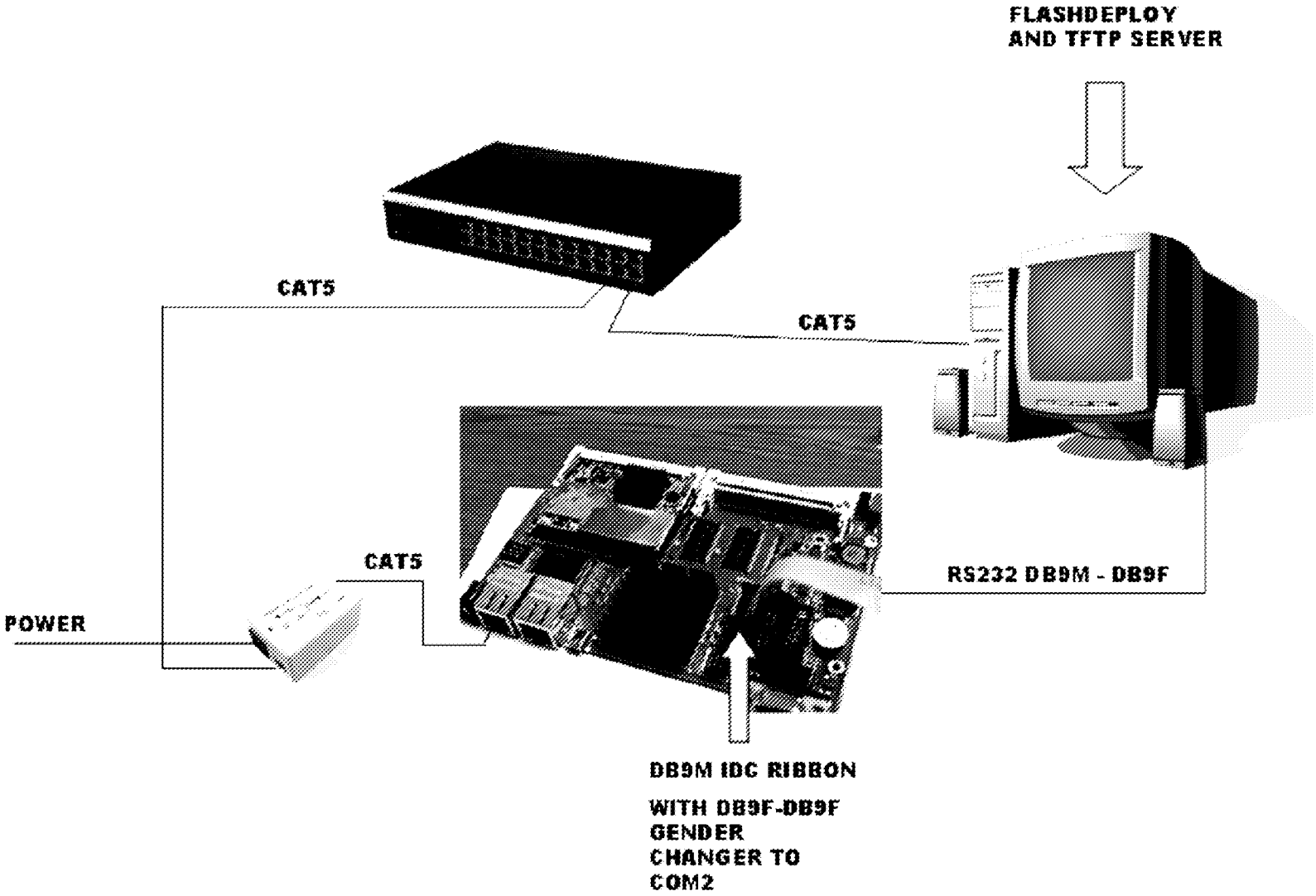

FLASHDEPLOY
AND TFTP SERVER
CAT5
CAT5
CAT5
POWER
RS232 DB9M - DB9F
DB9M IDC RIBBON
WITH DB9F-DB9F
GENDER
CHANGER TO
COM2

Figure 18

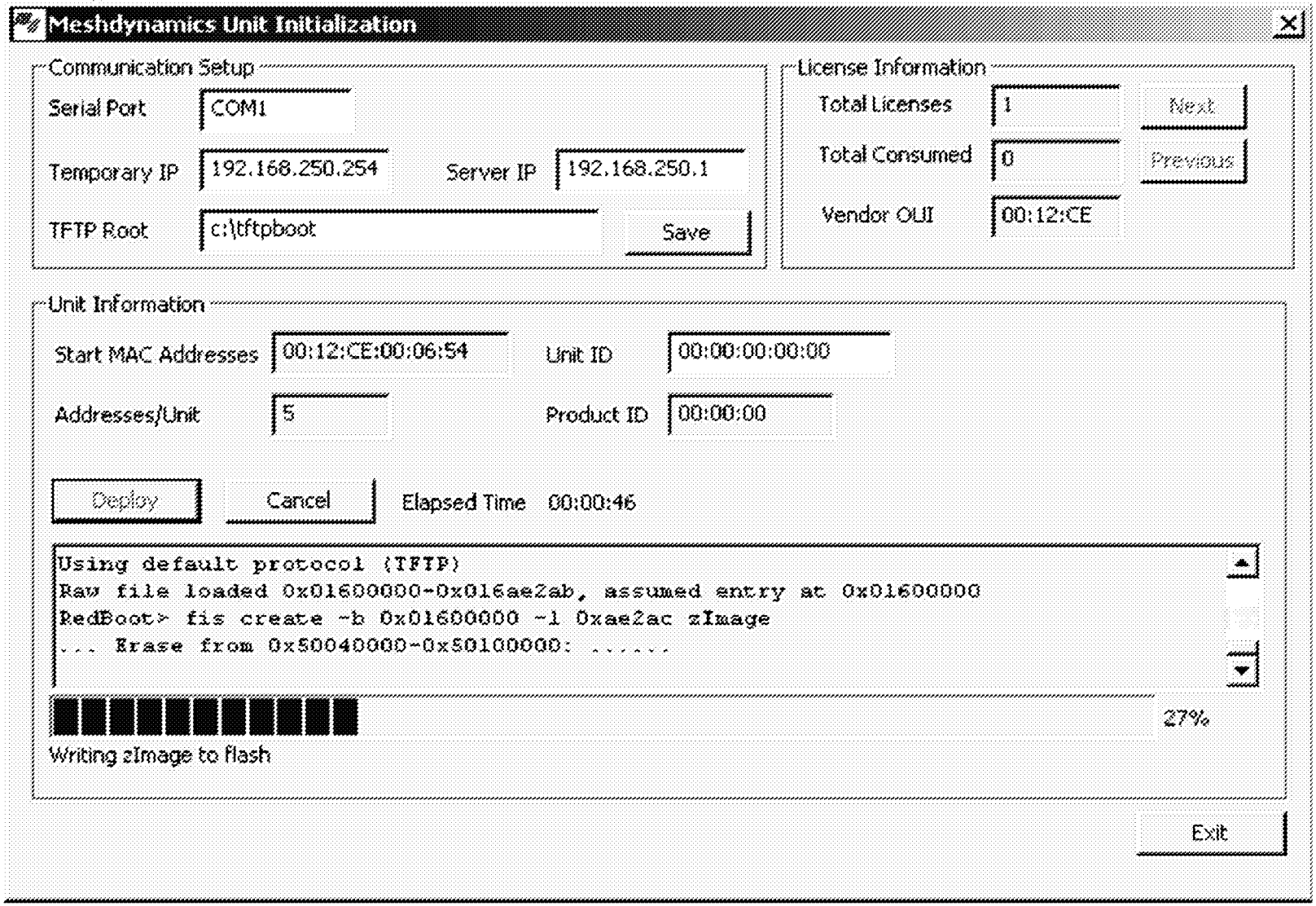

Meshdynamics Unit Initialization
Communication Setup
Serial Port
COM1
Temporary IP
192.168.250.254
Server IP
192.168.250.1
TFTP Root
c:\tftpboot
Save
License Information
Total Licenses
1
Next
Total Consumed
0
Previous
Vendor OUI
00:12:CE
Unit Information
Start MAC Addresses
00:12:CE:00:06:54
Unit ID
00:00:00:00:00:00
Addresses/Unit
5
Product ID
00:00:00
Deploy
Cancel
Elapsed Time
00:00:46
Using default protocol (TFTP)
Raw file loaded 0x01600000-0x016ae2ab, assumed entry at 0x01600000
RedBoot> fis create -b 0x01600000 -l 0xae2ac zImage
... Erase from 0x50040000-0x50100000: ......
27%
Writing zImage to flash
Exit

Figure 19

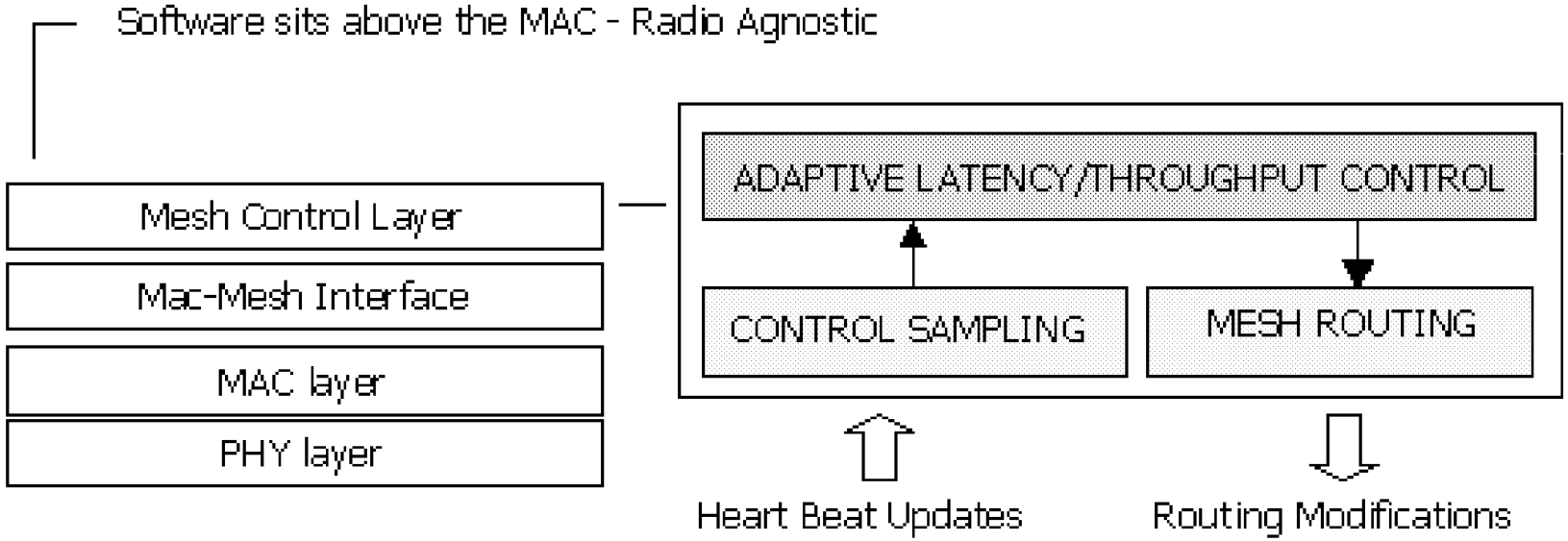


Figure 20

EX1018, Page 26

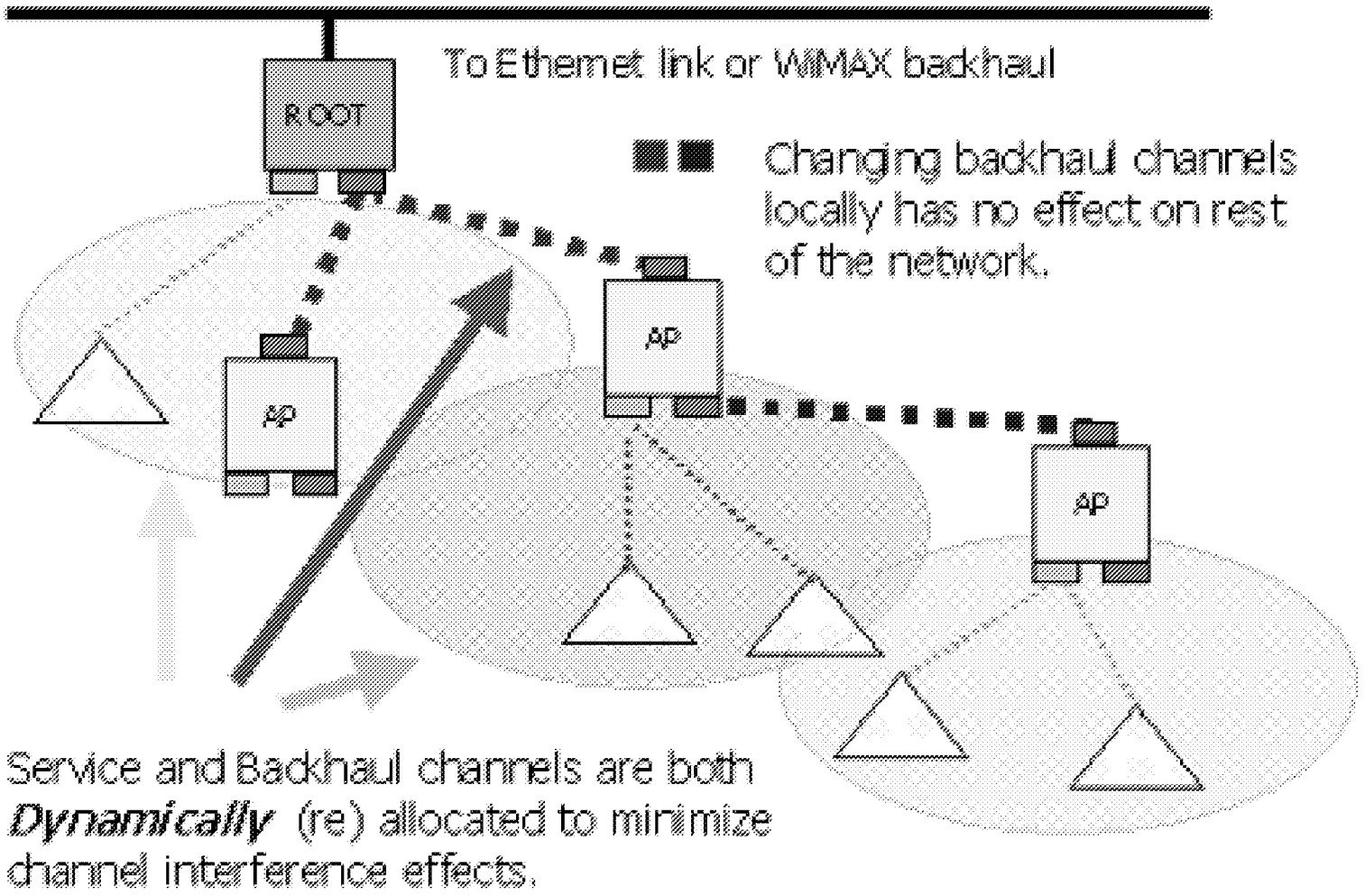

To Ethernet link or WiMAX backhaul
ROOT
Changing backhaul channels locally has no effect on rest of the network.
AP
AP
AP
Service and Backhaul channels are both *Dynamically* (re) allocated to minimize channel interference effects.

Figure 21

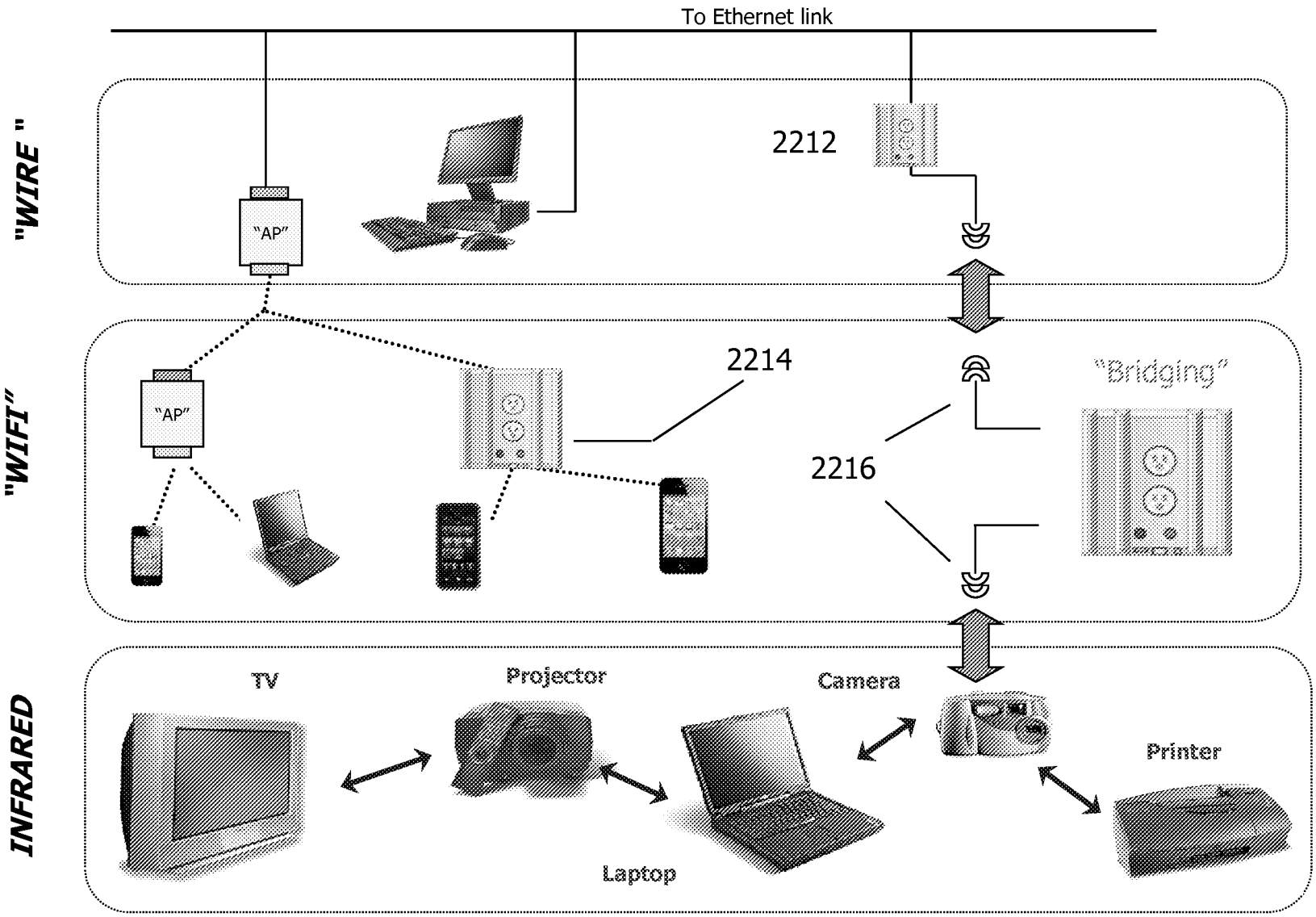
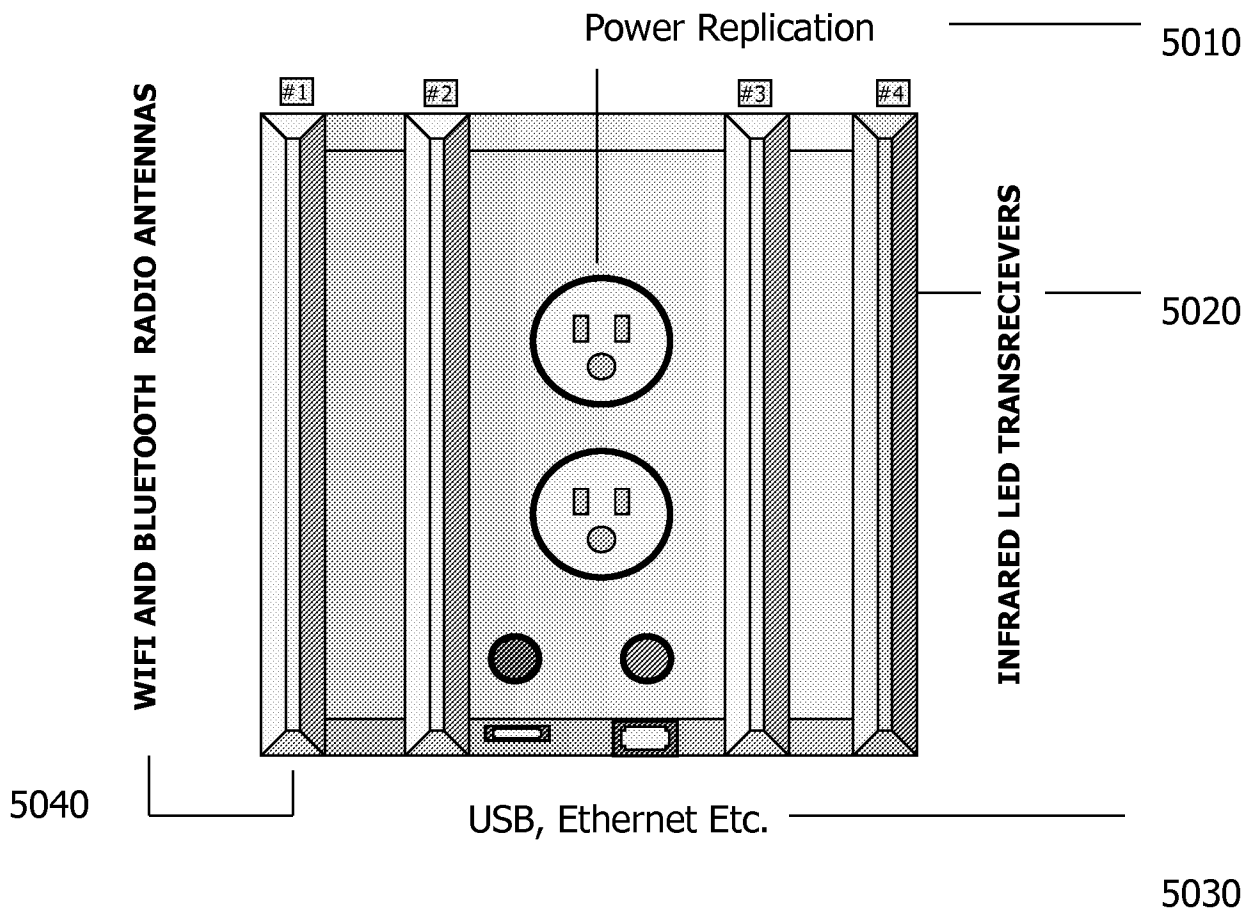

To Ethernet link
"WIRE"
"AP"
2212
"WIFI"
"AP"
2214
"Bridging"
2216
INFRARED
TV
Projector
Camera
Printer
Laptop

Figure 22

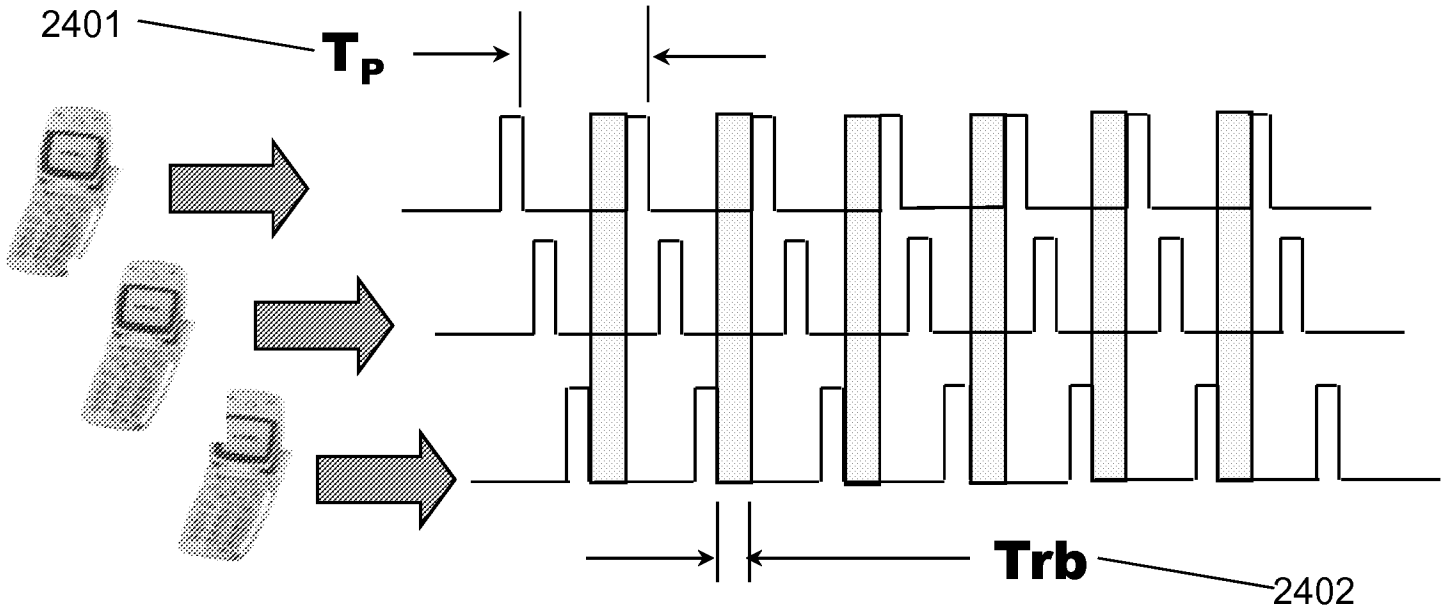


N- Logical "Radio" Modular Mesh aware Bridge

Figure 23

EX1018, Page 29

Receive Block: Time for Bulk VOIP Transmissions



BLOCK OF TIME RESERVED FOR RECEVE PACKETS

- T_P : PACKETIZATION TIME: 20 ms for G.711 and G.729 CODECS
- T_{rb} : RECEIVE BLOCK: For all receive packets (from Access Point to Devices)

Figure 24

Separate Voice and Data Service

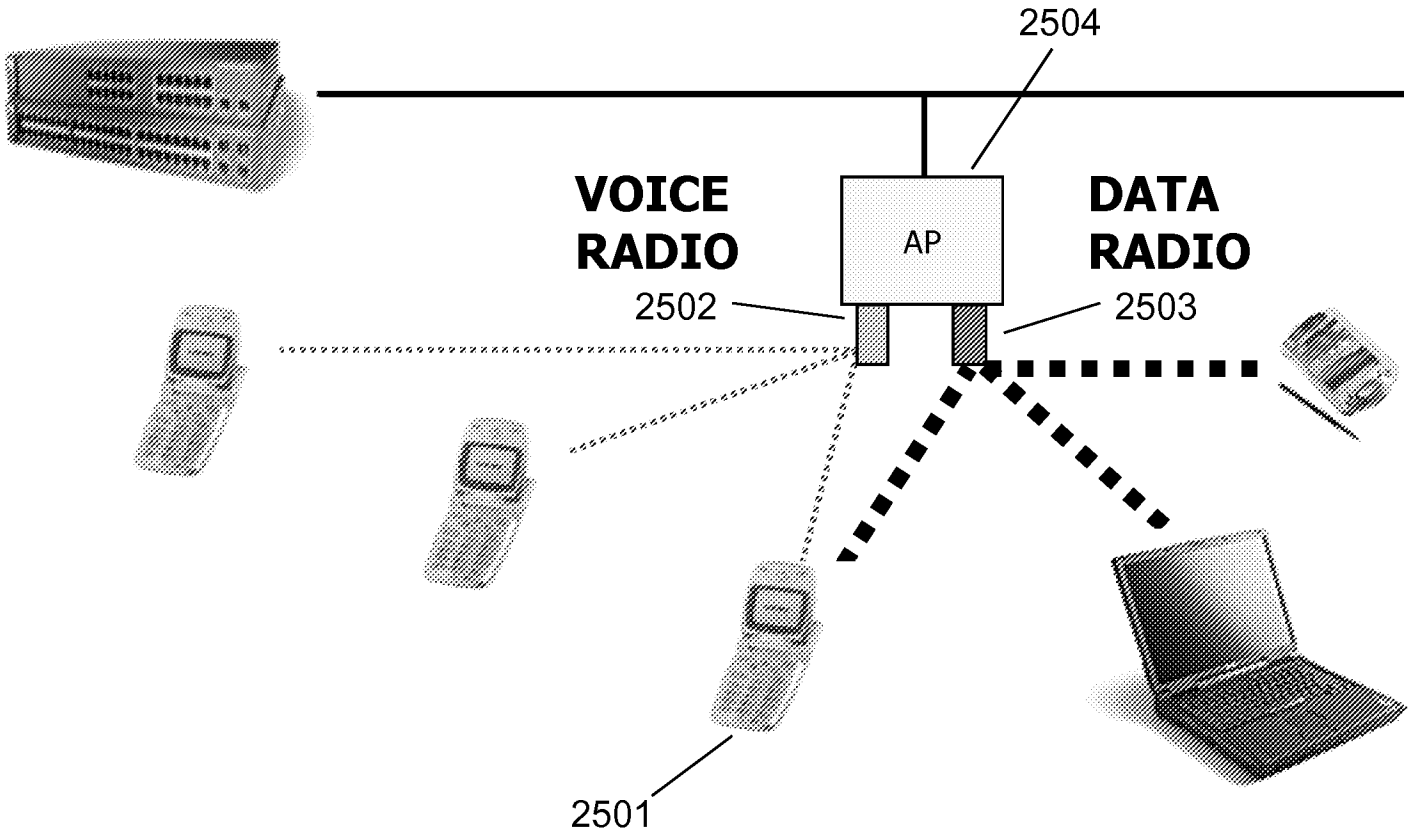


Figure 25

EX1018, Page 31

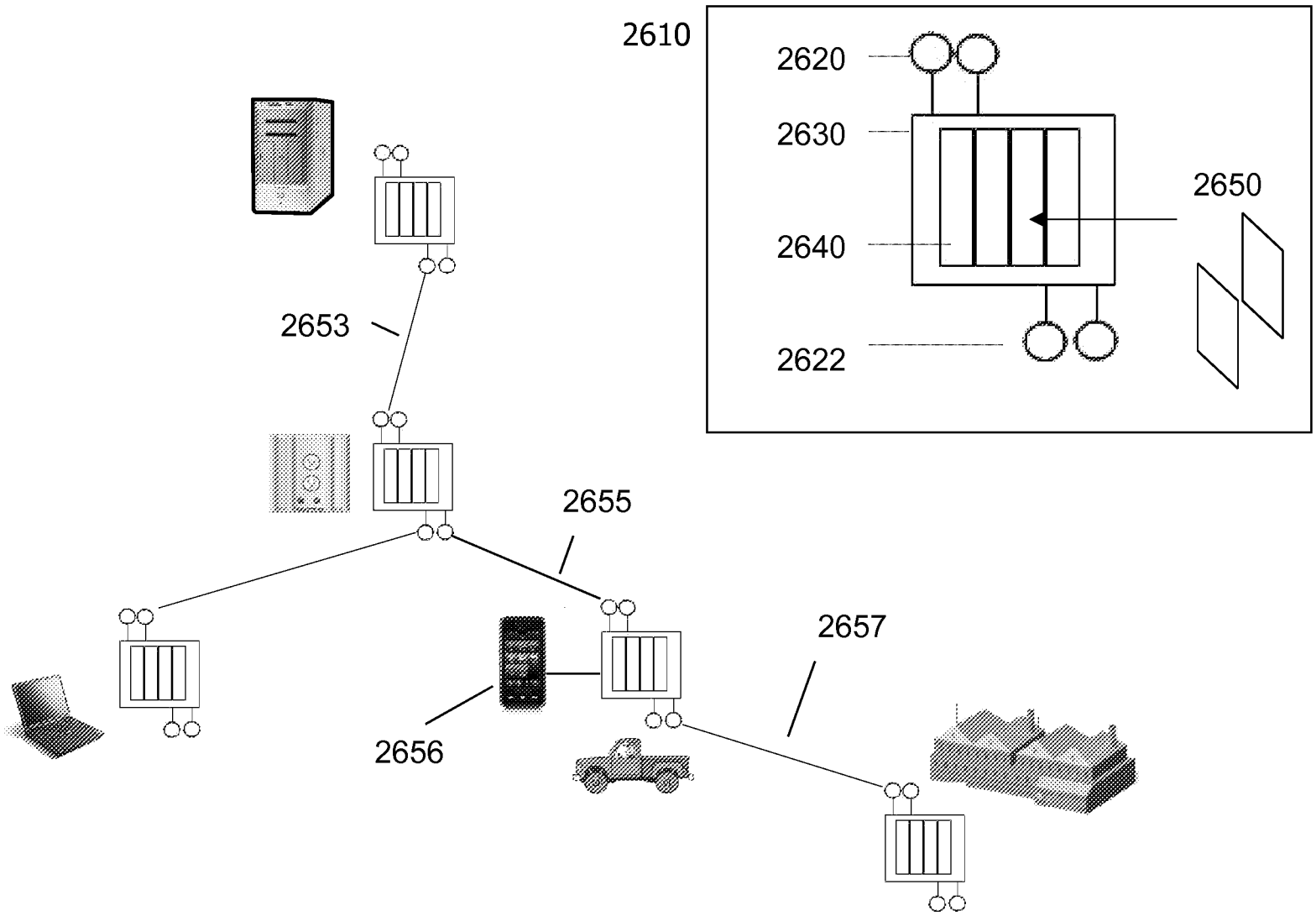


Figure 26

EX1018, Page 32

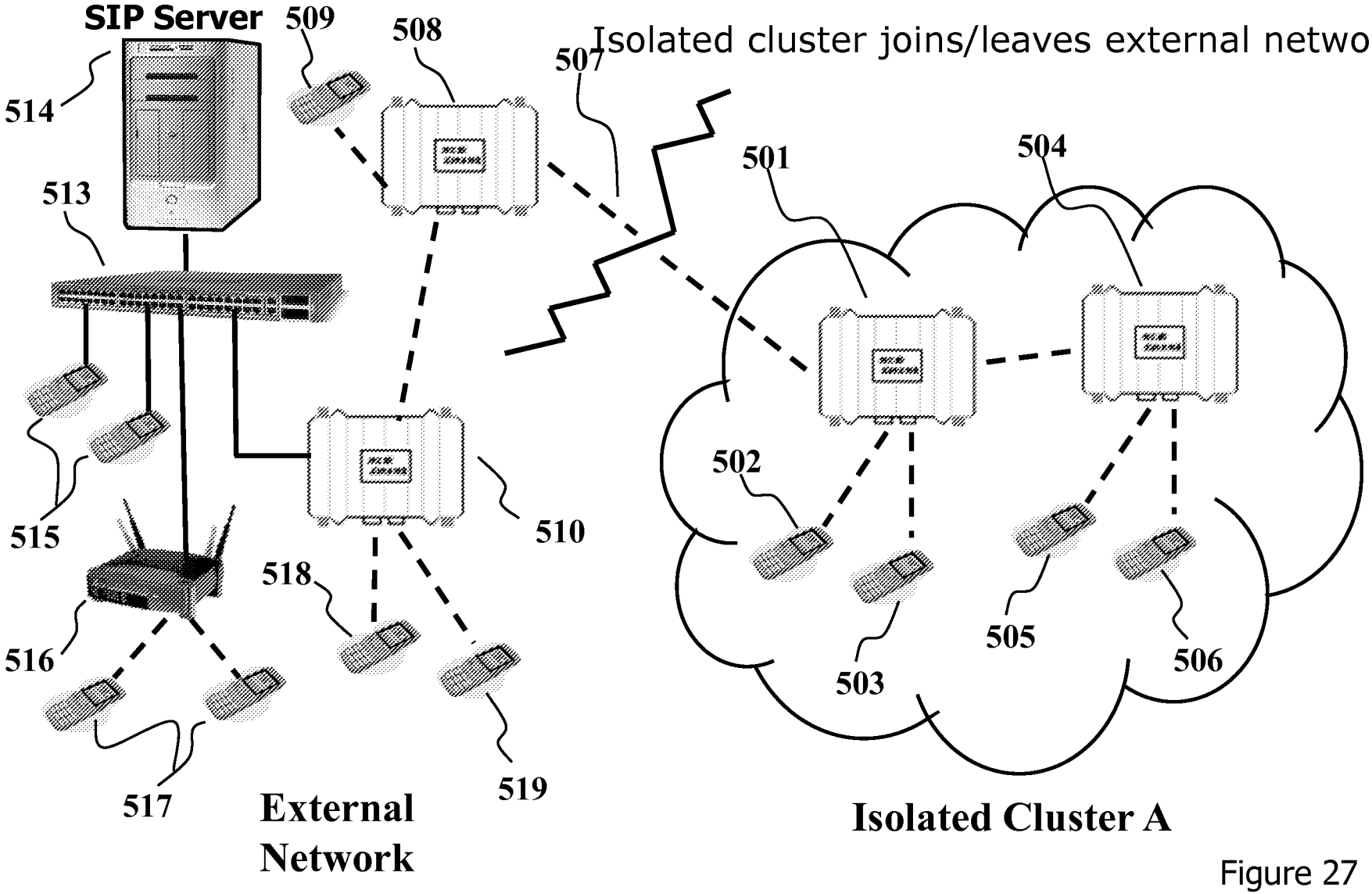
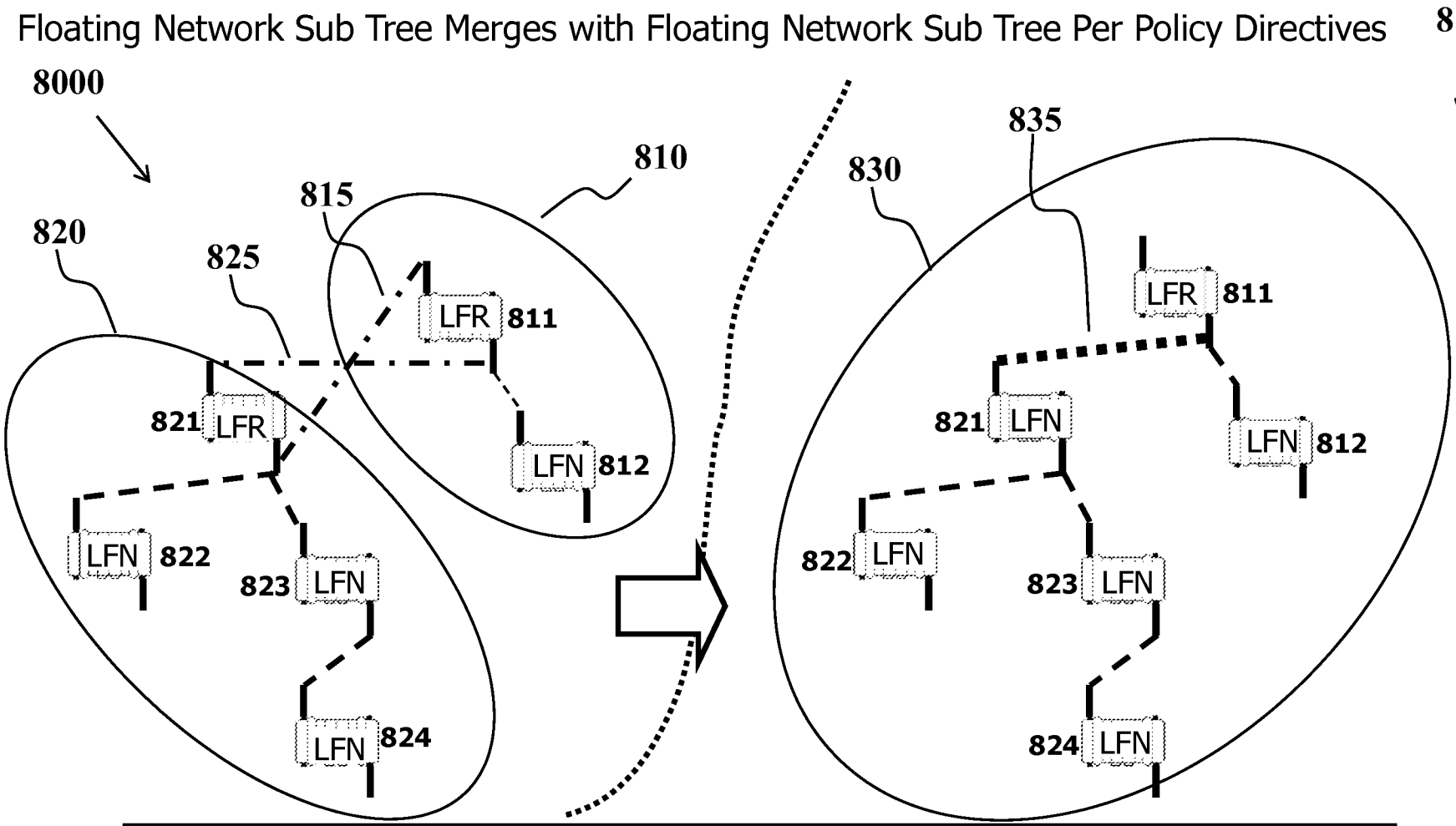


Figure 27

EX1018, Page 33

Floating Network Sub Tree Merges with Floating Network Sub Tree Per Policy Directives



- **When two LFRs see each other, one becomes LFN and joins the other**
- **A Tie Breaker Function (TBF) decides which one becomes an LFN**

Figure 28

EX1018, Page 34

DISTRIBUTED DHCP SERVICE WITH INHERENT CONFLICT RESOLUTION

ASSUME A FIXED SUBNET MASK OF *255.0.0.0* IS USED

- **IP ADDRESSES OF THE FORM A.*x.y.k* where**
- **A defines the *CUSTOMER-NETWORK-ID* 16 bit (0 -255)**
- **k is *CLIENT BASED ID* 16 bit (0-255)**
- **x, y are each 16 bit : 2^{32} unique networks each with up 255 clients possible**

POLICY DIRECTIVE: SPLIT UP ADDRESS SPACE BETWEEN STATIC and MOBILE networks

- **Assign 15 bits to distributed DHCP services for floating networks**
- **Let NODES CHOOSE A RANDOM 15-bit NUMBER '*R*' AT STARTUP and**
  1. **LET '*M*' BE THE DECIMAL EQUIVALENT OF THE 7-MSBs OF '*R*'**
  2. **LET '*N*' THE DECIMAL EQUIVALENT OF THE 8-LSBs OF '*R*'**

  THE DHCP ADDRESS SPACE OF THE NODE WOULD BE

  A.255-M.N.0 to A.255-M.N.254 where 0<=M<=127 and 0<=N<=255

Figure 29

Objective: Low foot print for low cost embedded system applications
Key Idea: Remove overhead of OS/Virtual Machine from the equation

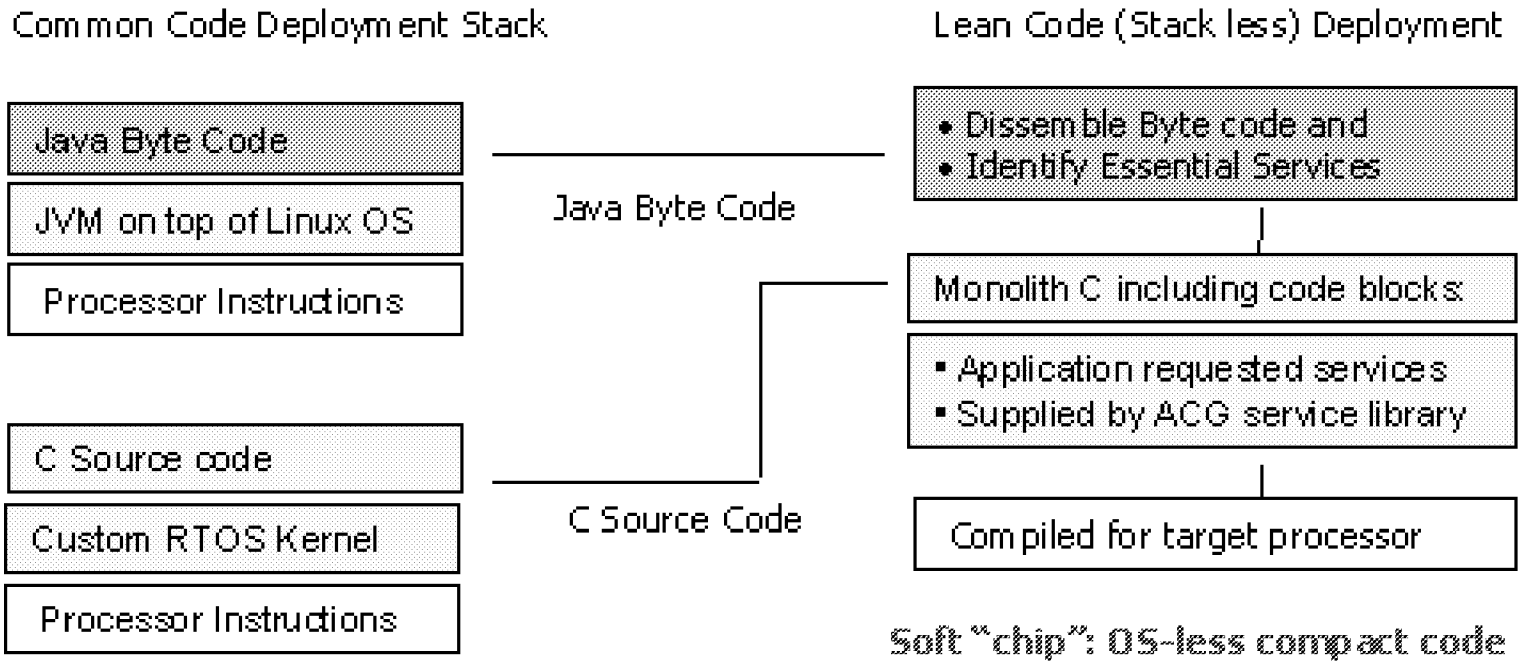


Figure 30

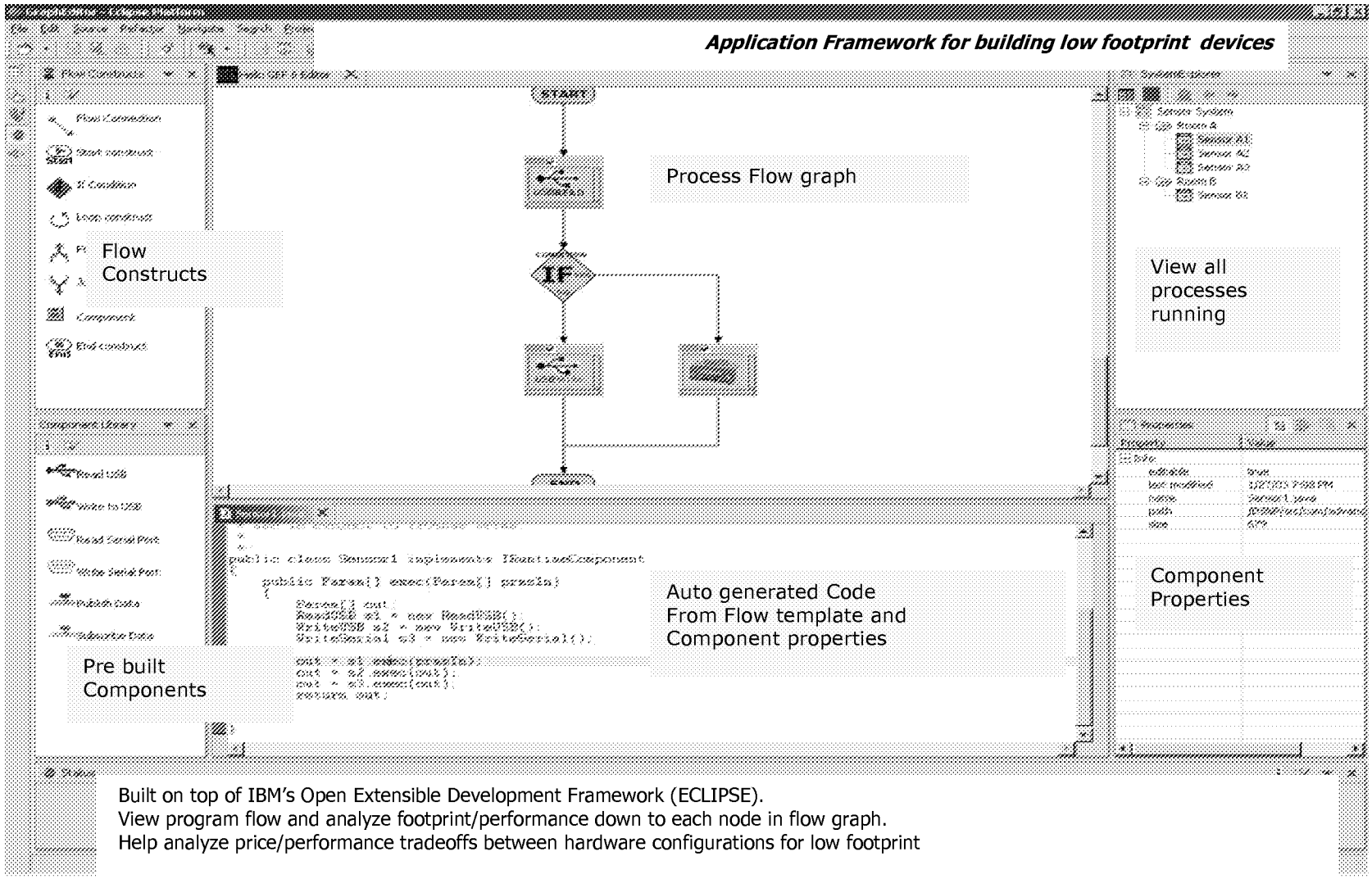

Application Framework for building low footprint devices
START
IF
Process Flow graph
Flow Constructs
View all processes running
Component Properties
Auto generated Code From Flow template and Component properties
Pre built Components
Built on top of IBM's Open Extensible Development Framework (ECLIPSE).
View program flow and analyze footprint/performance down to each node in flow graph.
Help analyze price/performance tradeoffs between hardware configurations for low footprint

Figure 31

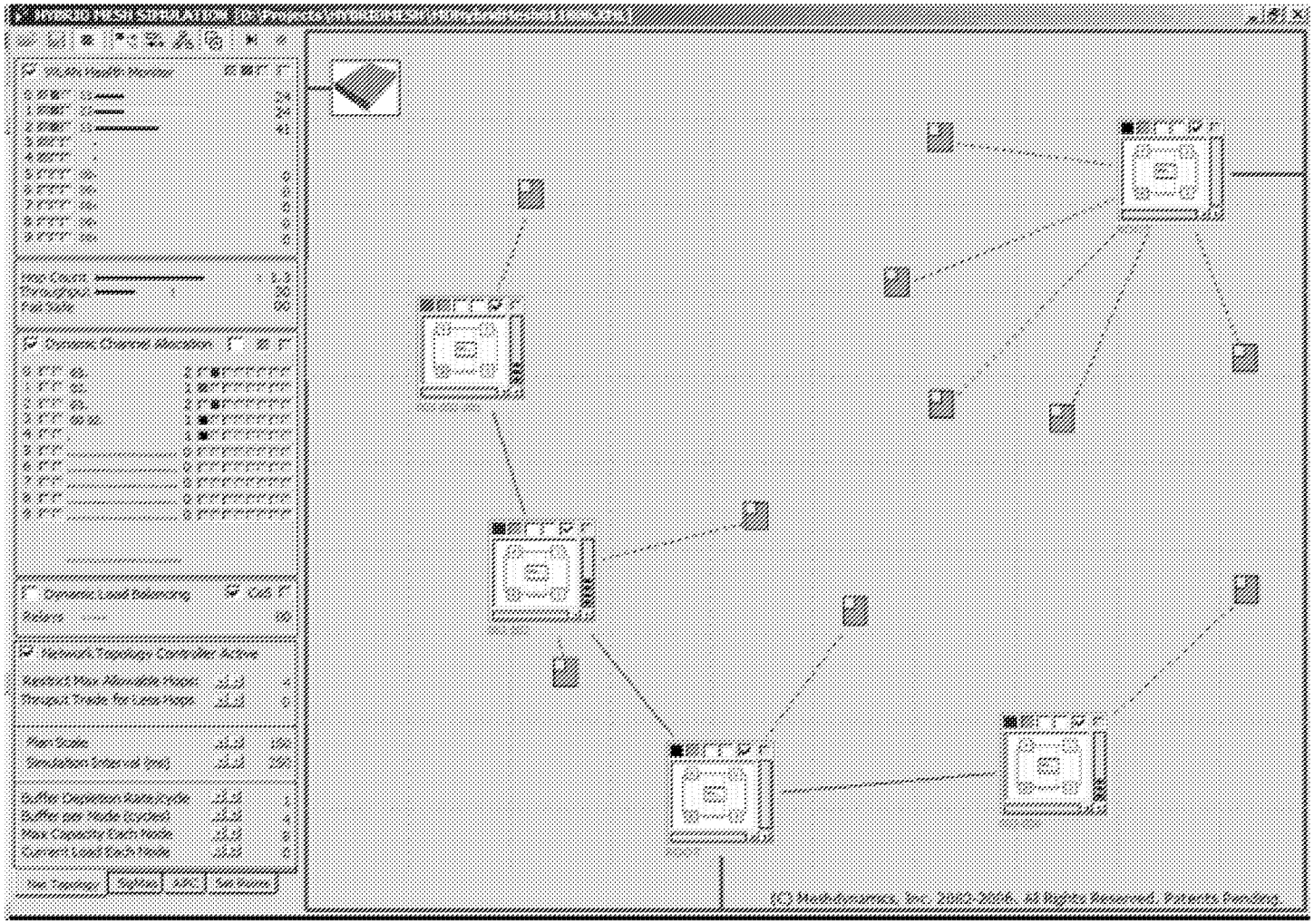


Figure 32

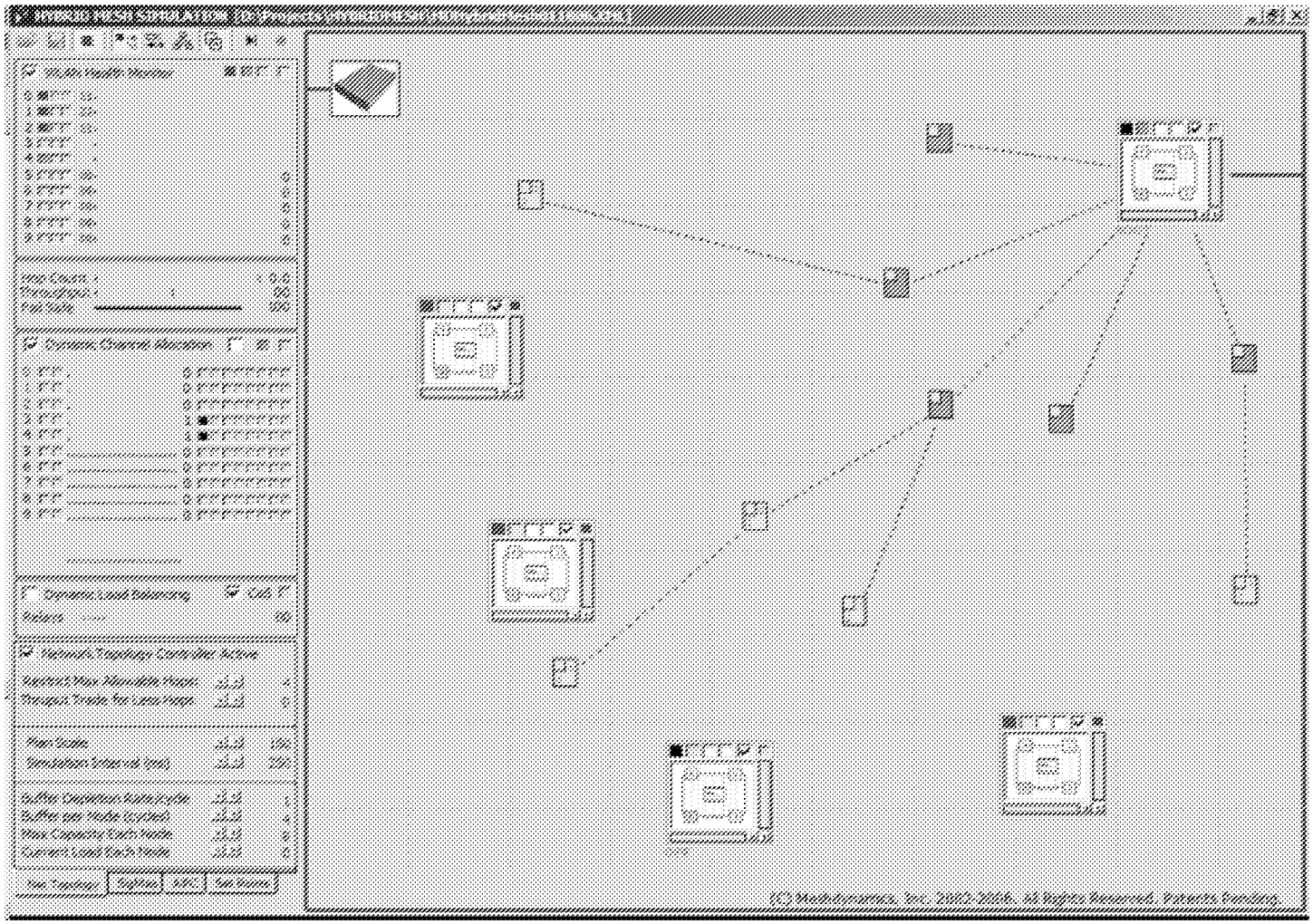


Figure 33

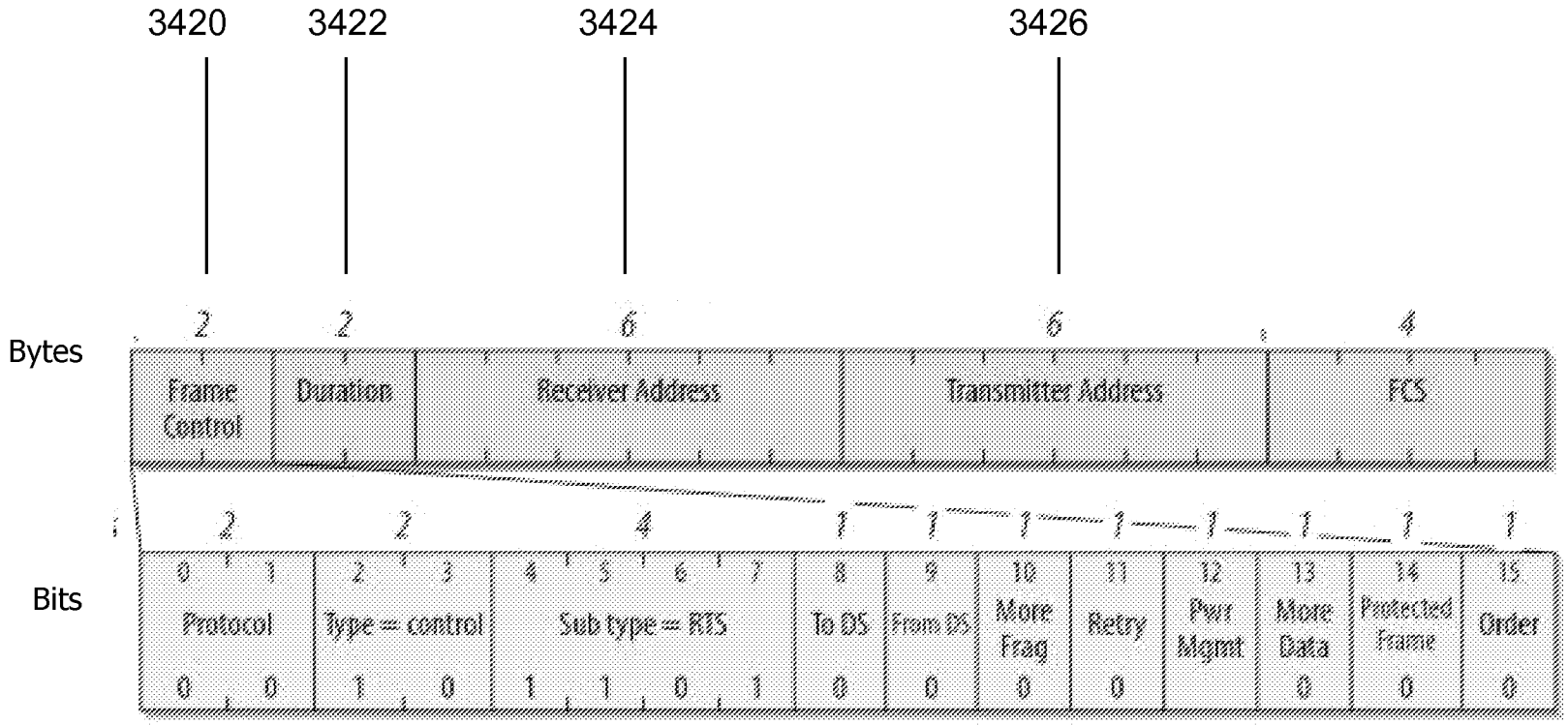


Figure 34

EX1018, Page 40

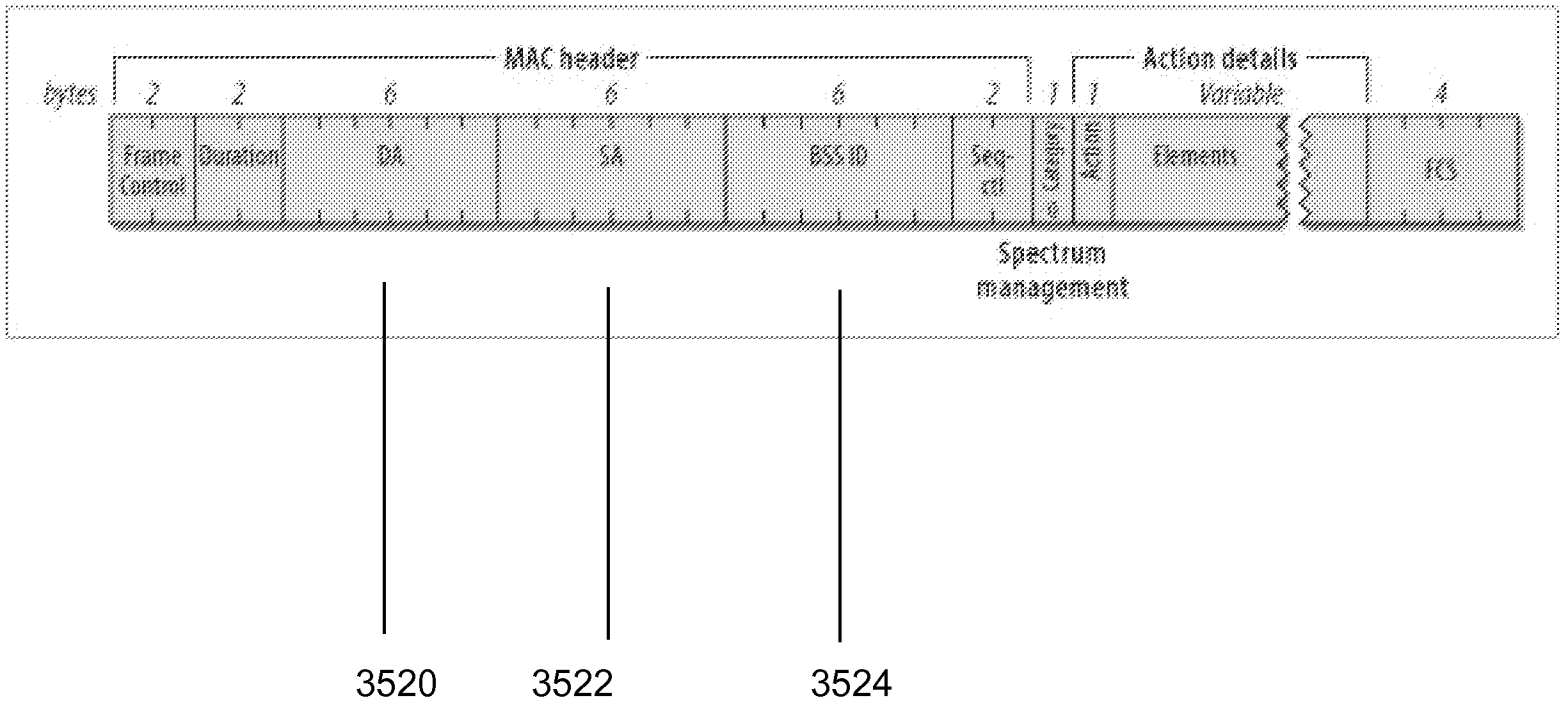

MAC header
Action details
bytes
2
2
6
6
6
2
1
1
Variable
4
Frame Control
Duration
DA
SA
BSS ID
Seq-ctl
HT Control
Action
Elements
FCS
Spectrum management
3520
3522
3524

Figure 35

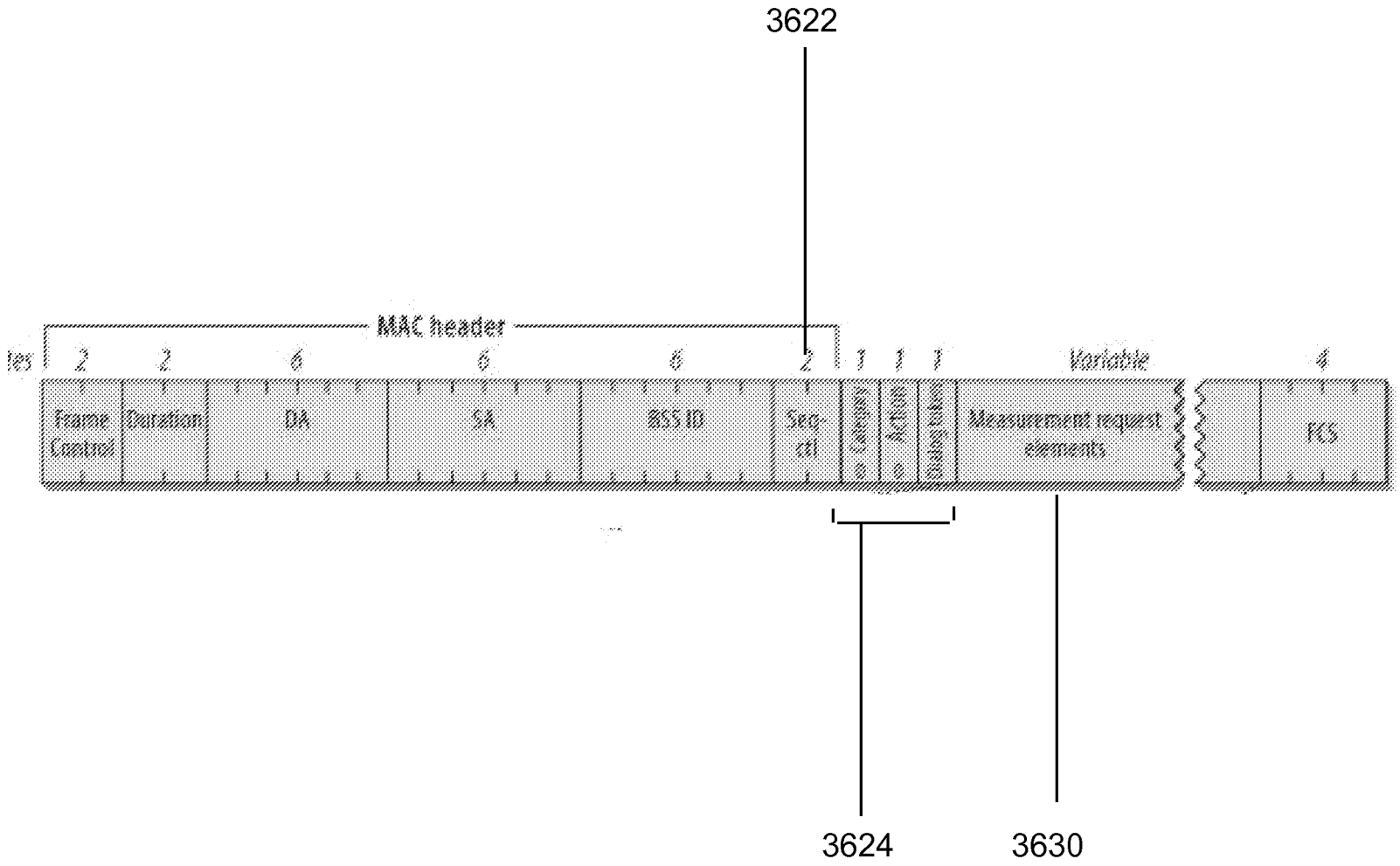

3622
MAC header
Bytes
2
2
6
6
6
2
1
1
1
Variable
4
Frame Control
Duration
DA
SA
BSS ID
Seq ctl
Category
Action
Dialog Token
Measurement request elements
FCS
3624
3630

Figure 36

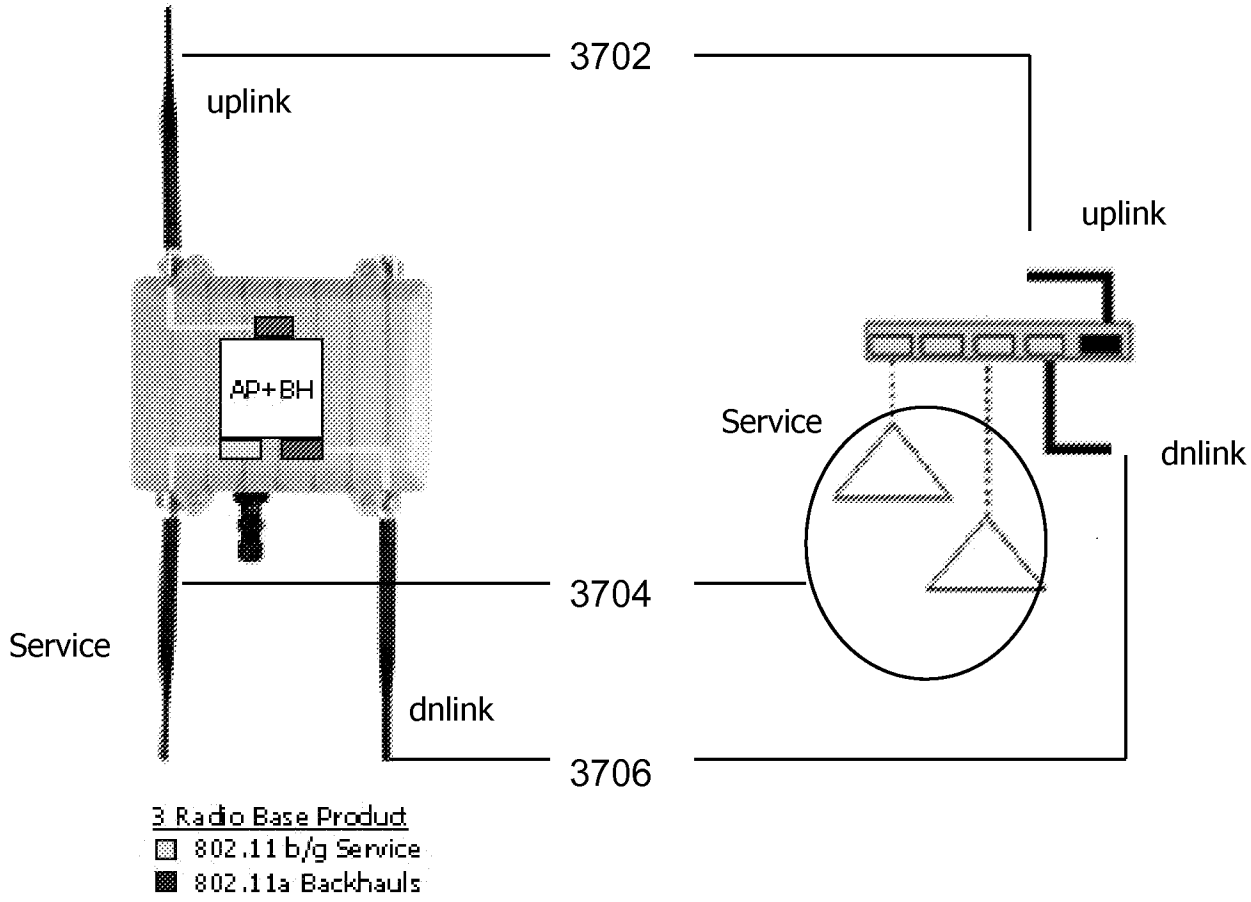
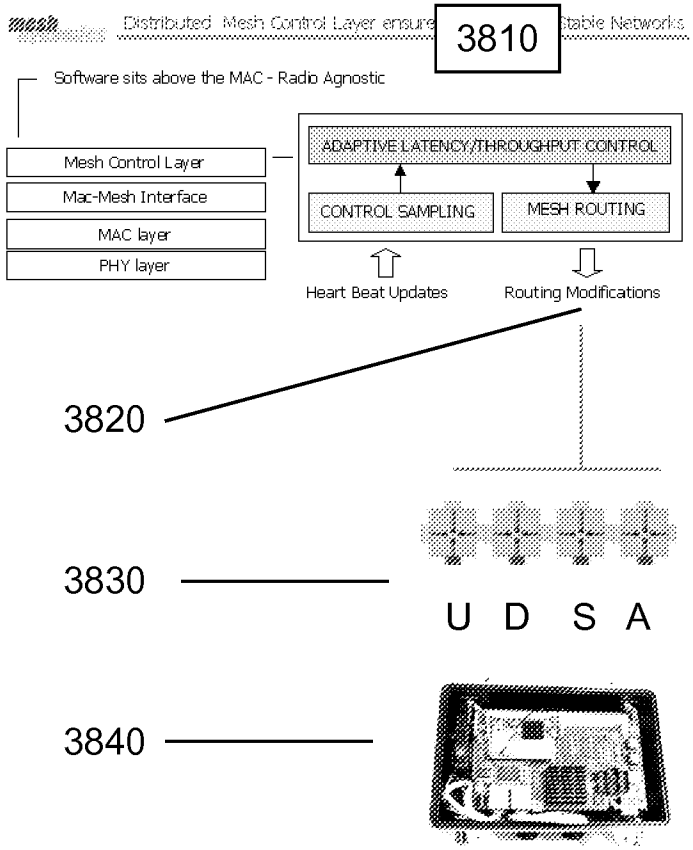

3702
uplink
uplink
AP+BH
Service
dnlink
3704
Service
dnlink
3706
3 Radio Base Product
802.11 b/g Service
802.11a Backhauls

Figure 37


Distributed Mesh Control Layer ensure
3810
Stable Networks
Software sits above the MAC - Radio Agnostic
Mesh Control Layer
Mac-Mesh Interface
MAC layer
PHY layer
ADAPTIVE LATENCY/THROUGHPUT CONTROL
CONTROL SAMPLING
MESH ROUTING
Heart Beat Updates
Routing Modifications
3820
3830
U D S A
3840

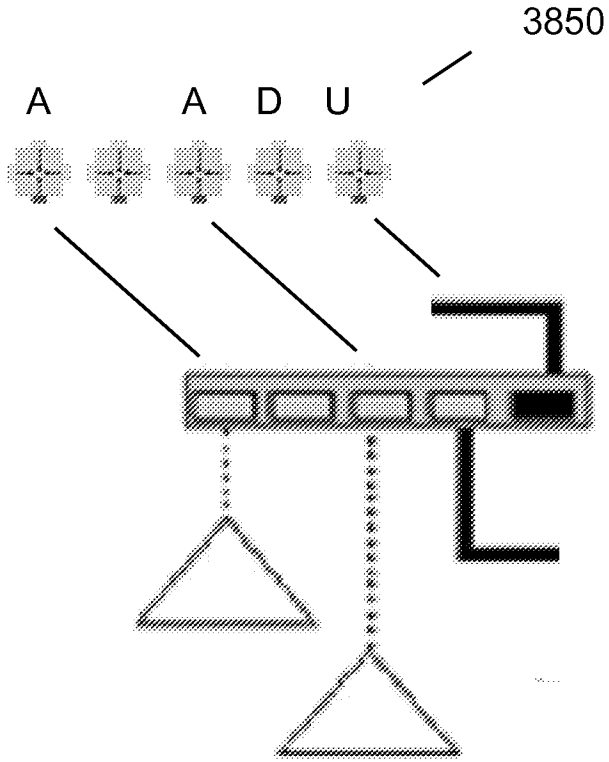

3850
A A D U

Figure 38

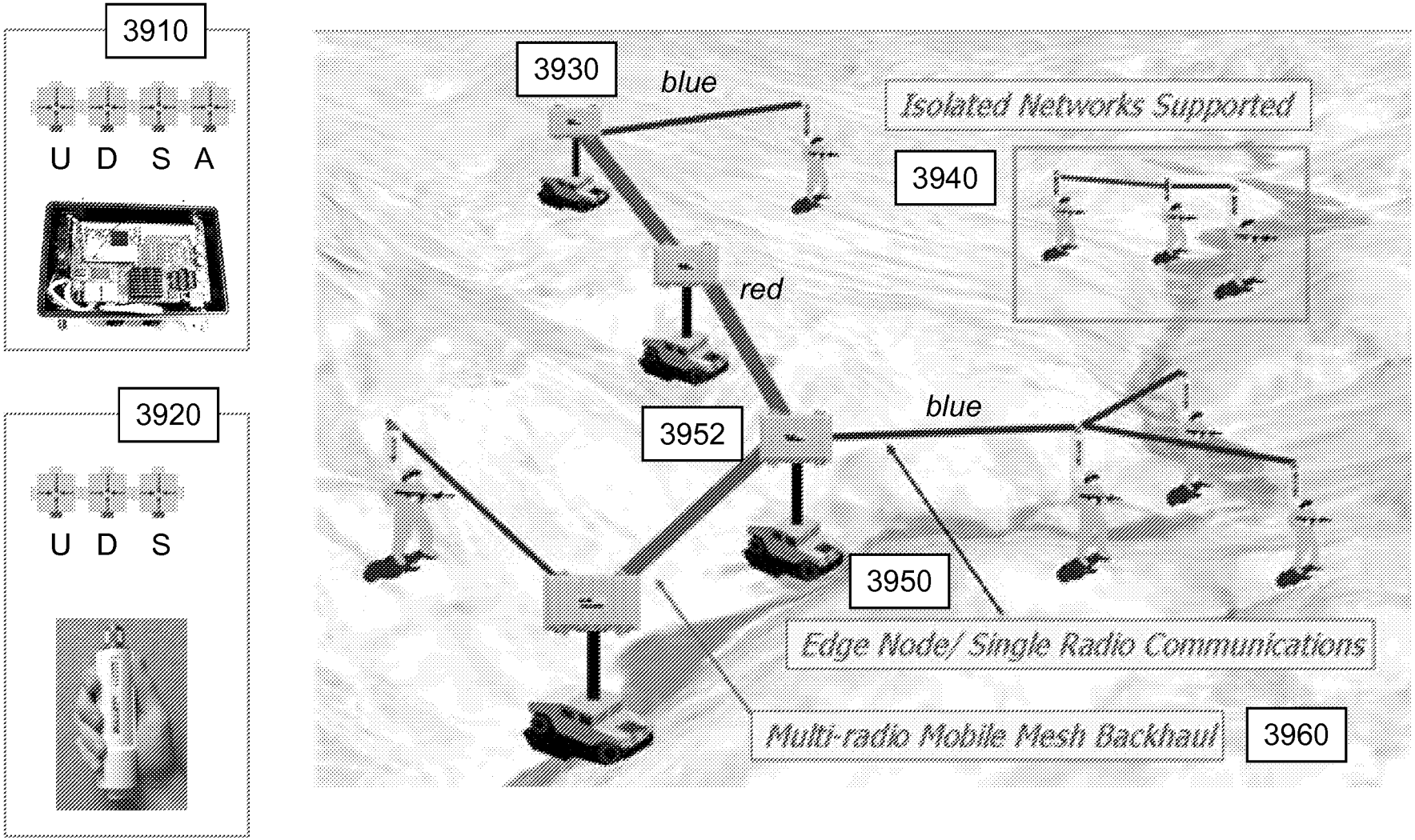


Figure 39

EX1018, Page 45

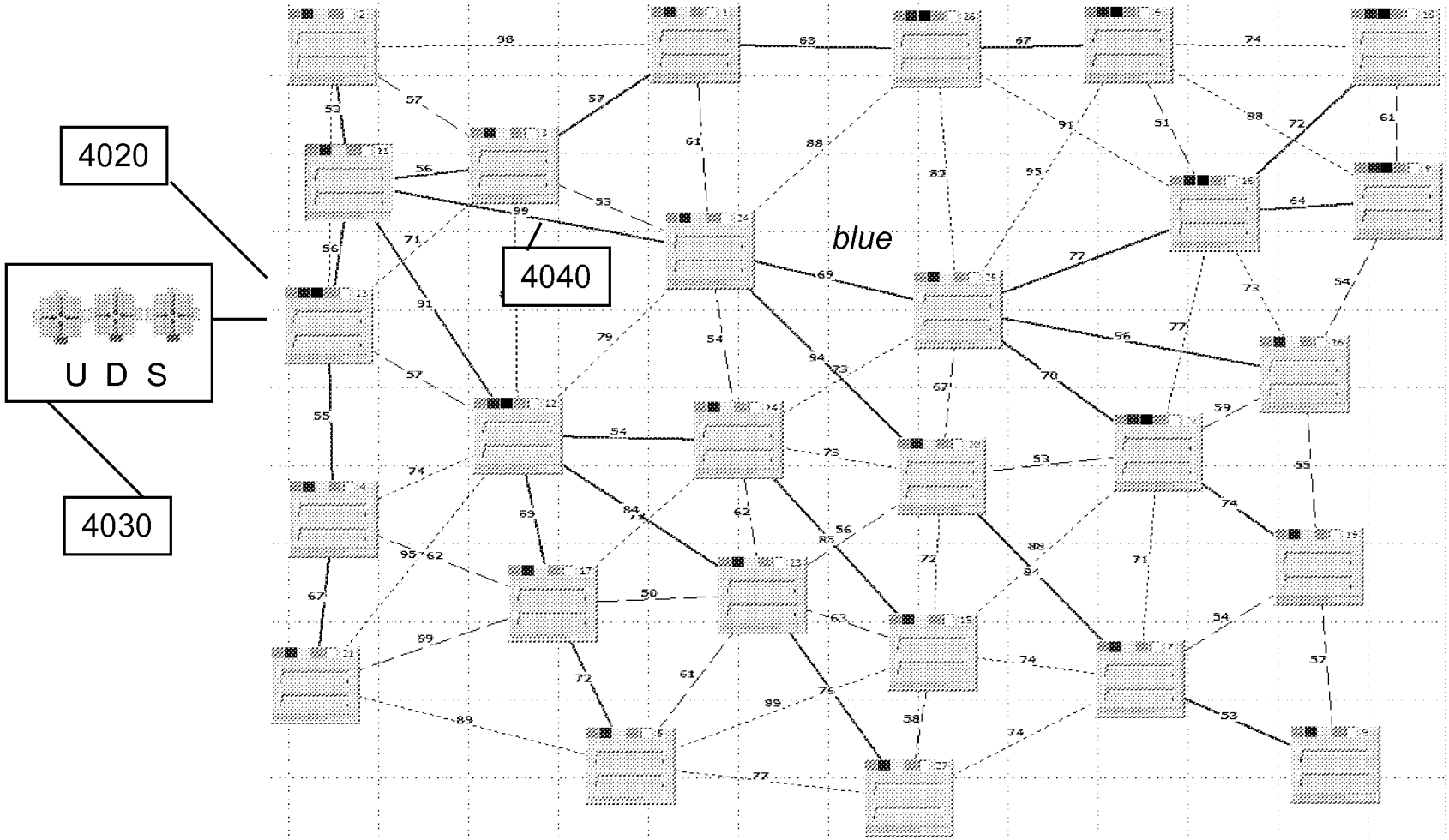


Figure 40

EX1018, Page 46

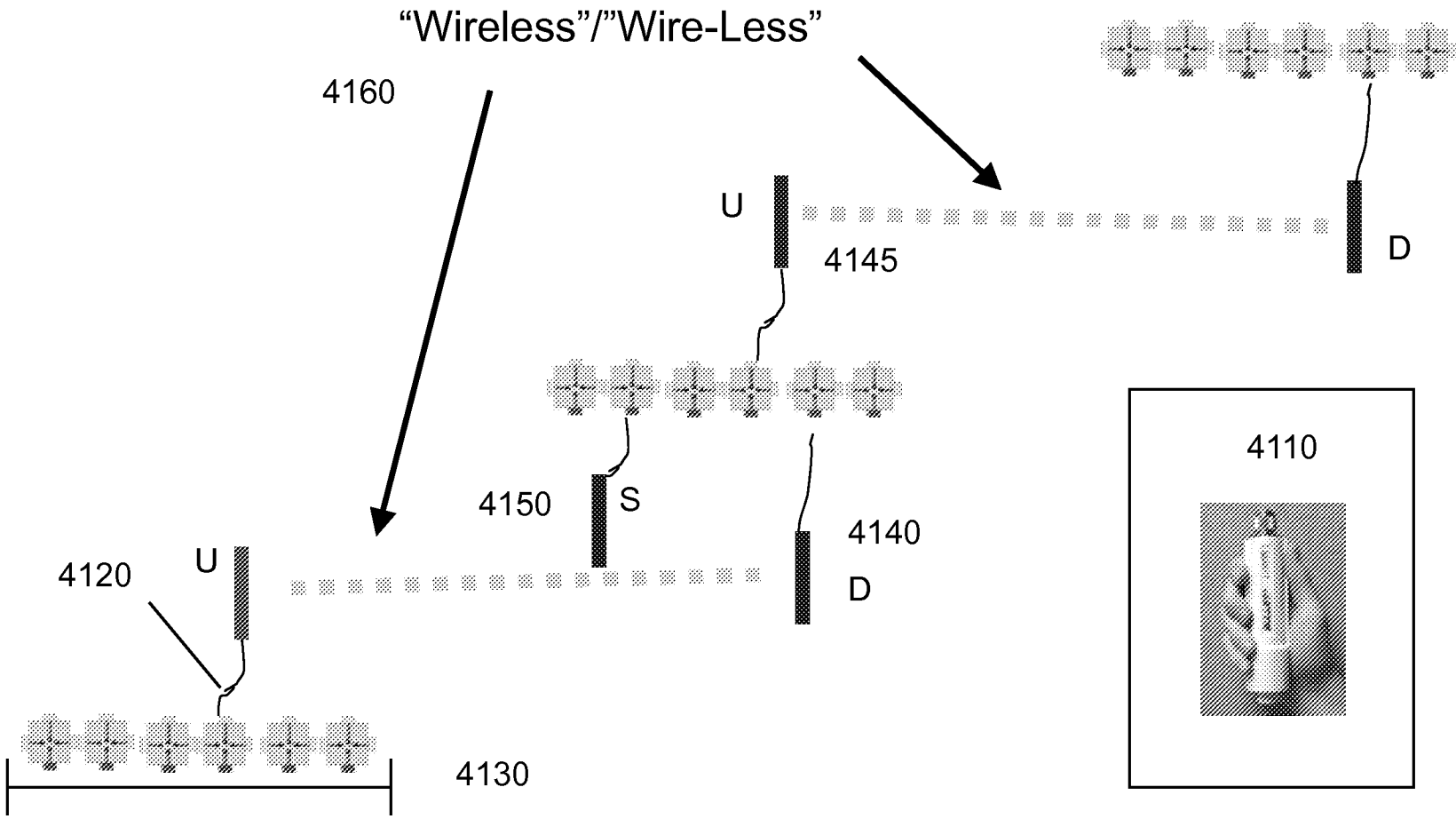


Figure 41

EX1018, Page 47

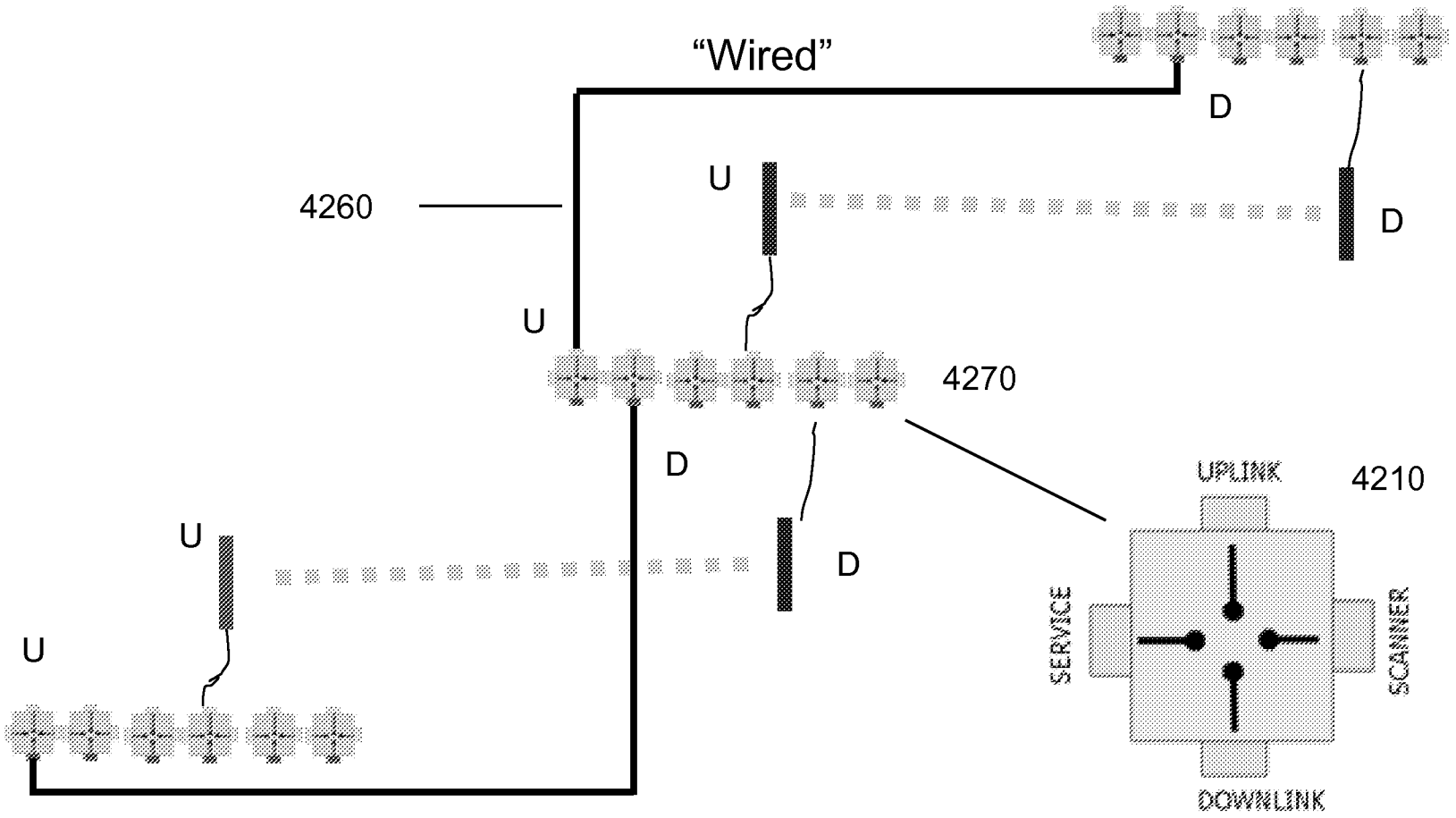


Figure 42

EX1018, Page 48

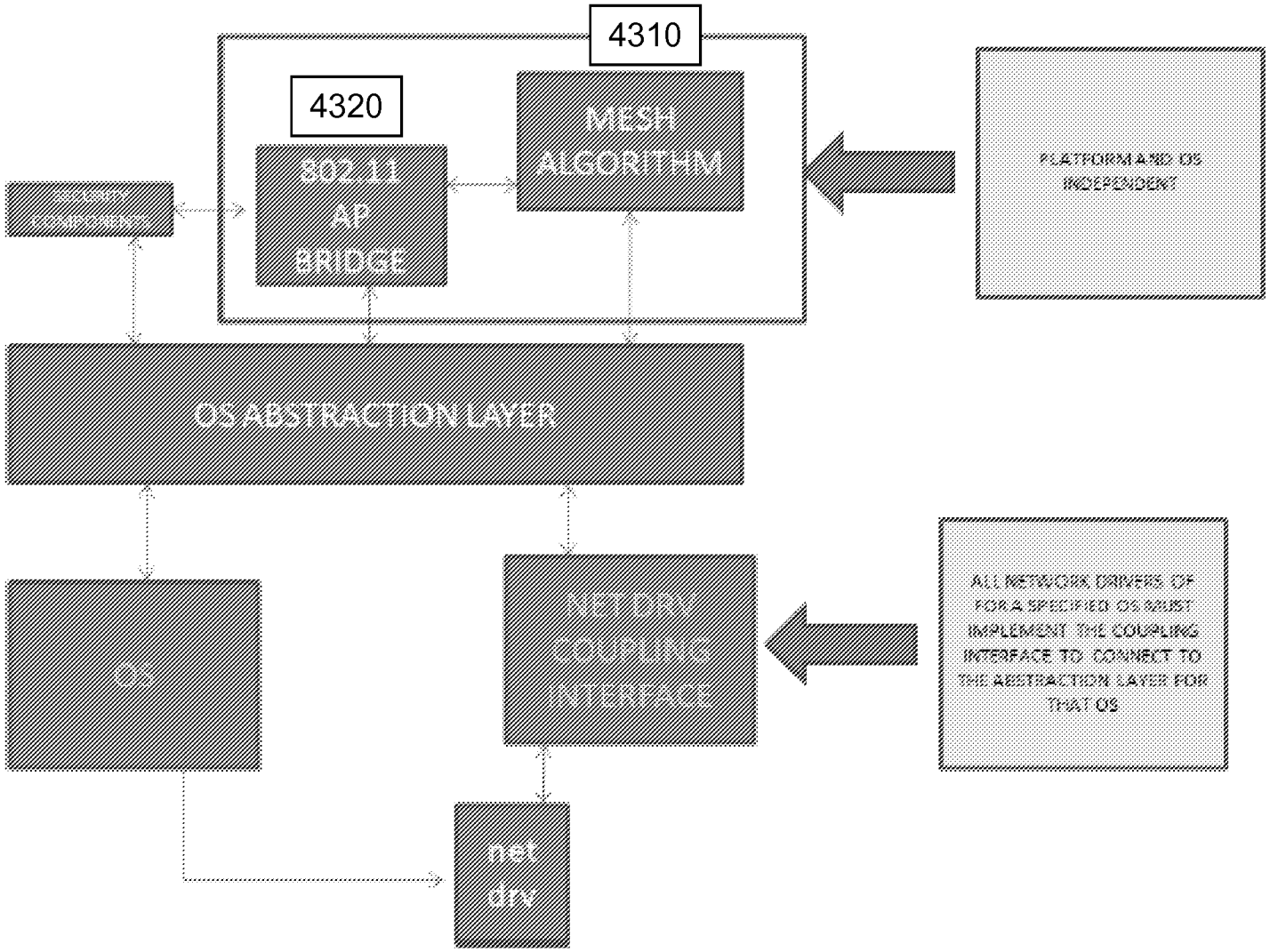
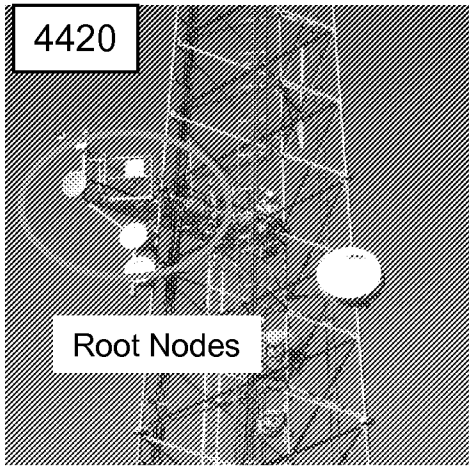
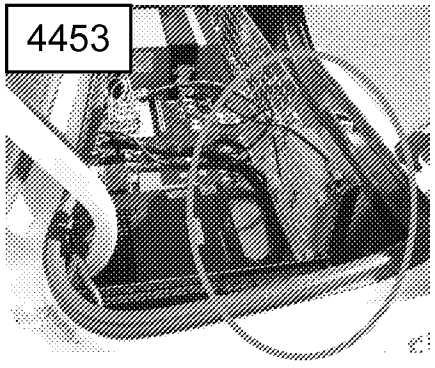


Figure 43

EX1018, Page 49





Mobile Node

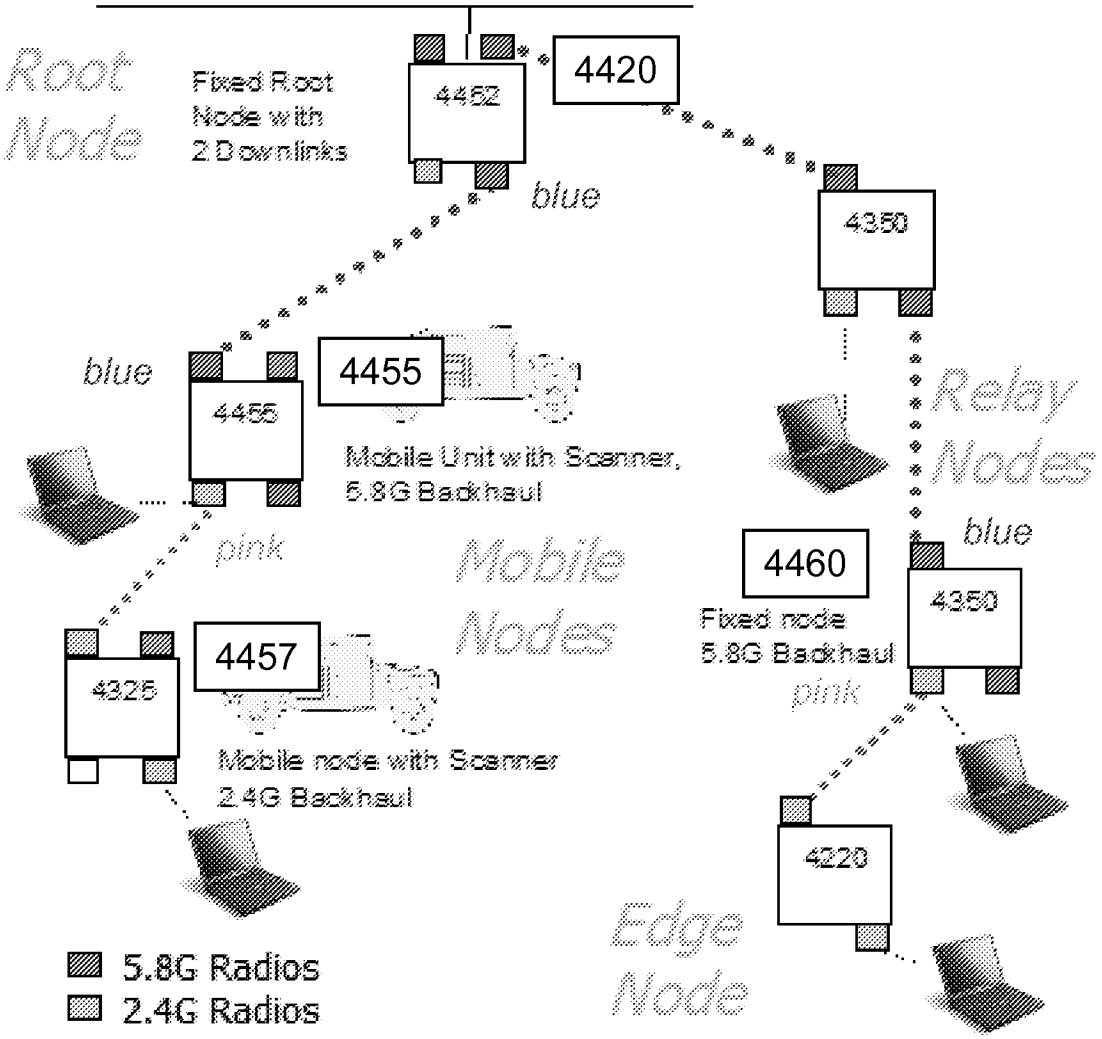


Figure 44

EX1018, Page 50

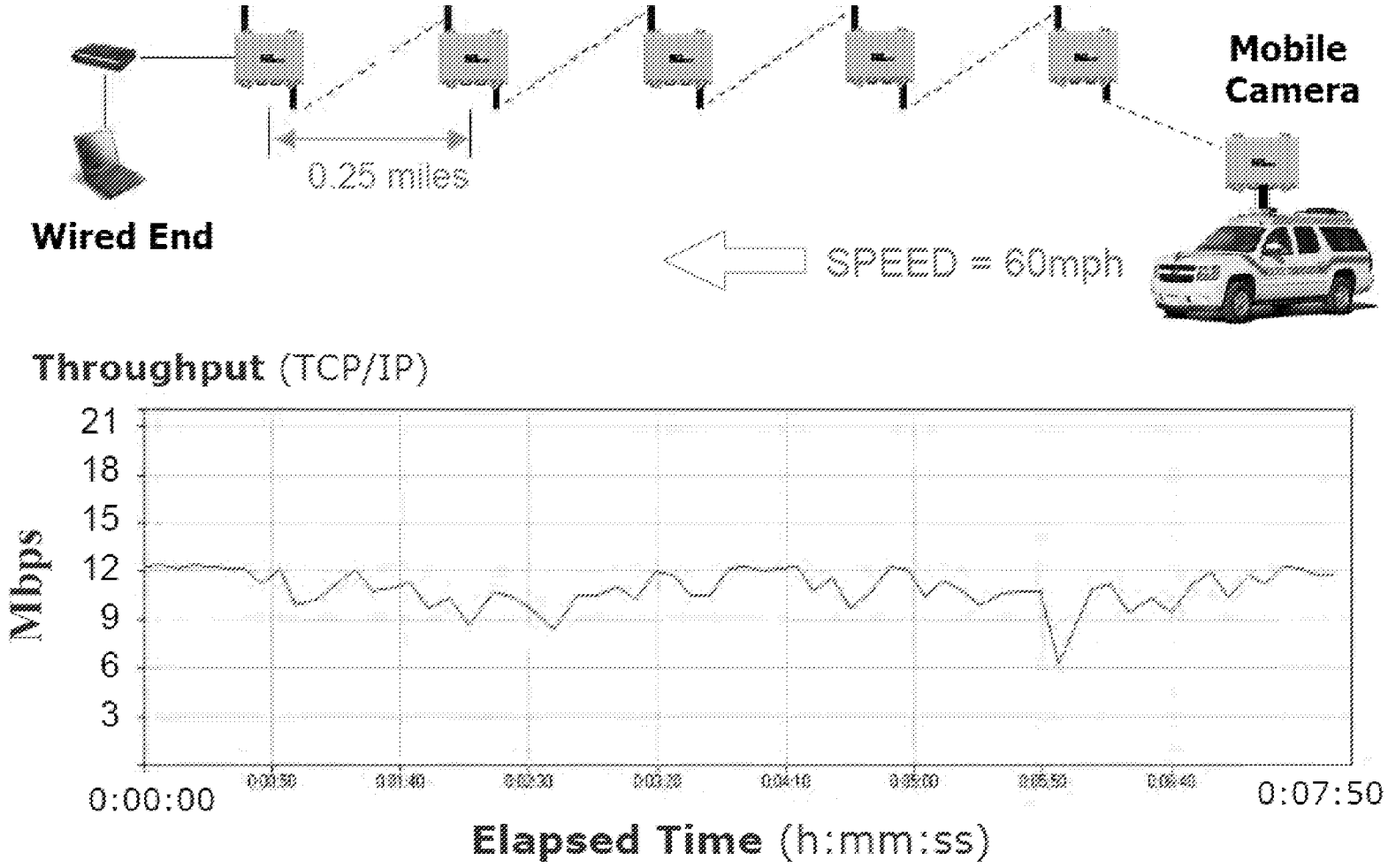

Mobile Camera
0.25 miles
Wired End
SPEED = 60mph
Throughput (TCP/IP)
21
18
15
12
9
6
3
Mbps
0:00:00
0:07:50
Elapsed Time (h:mm:ss)

Figure 45

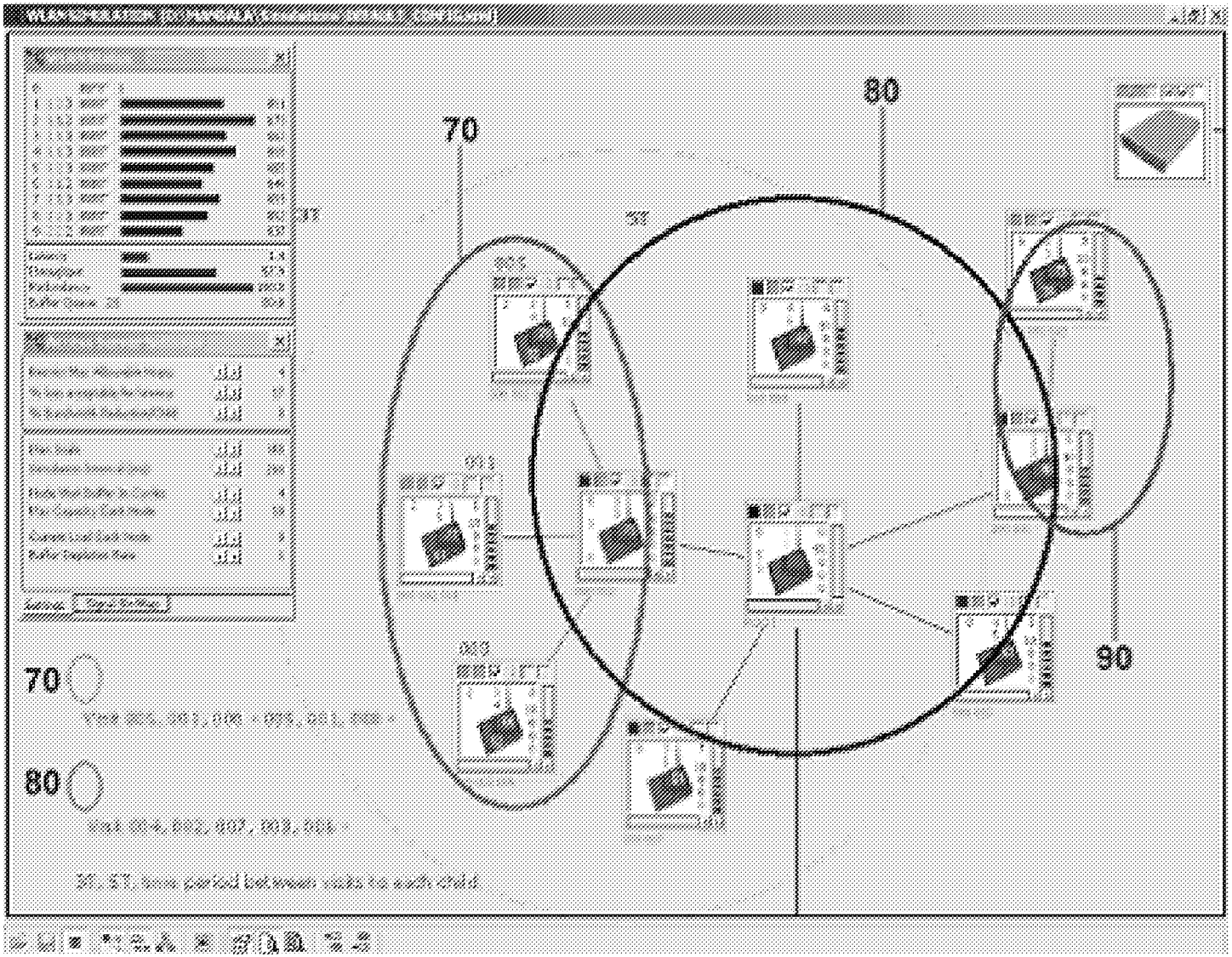
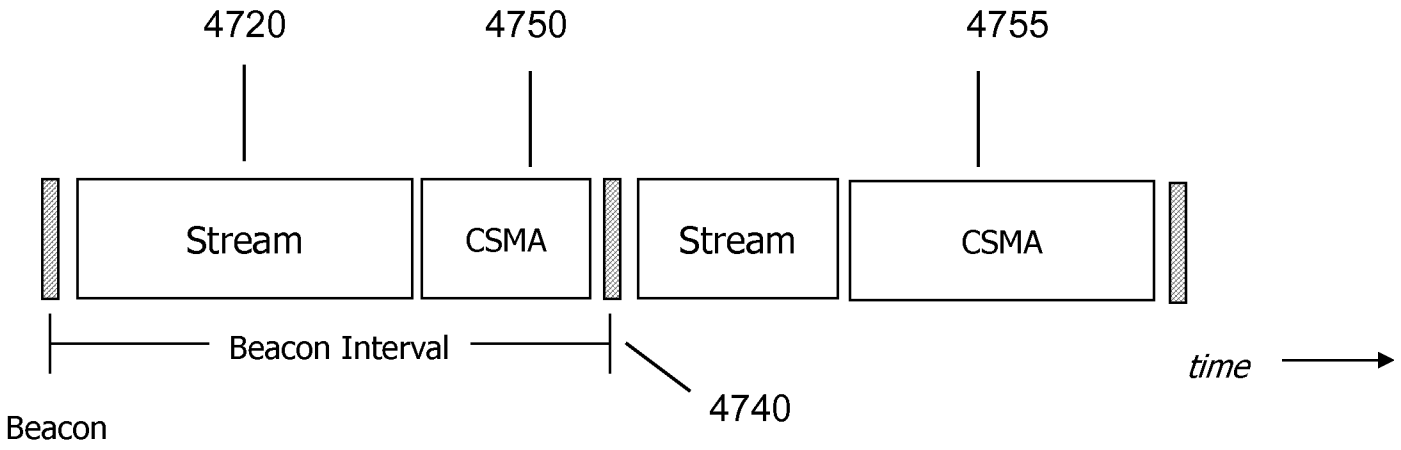


Figure 46

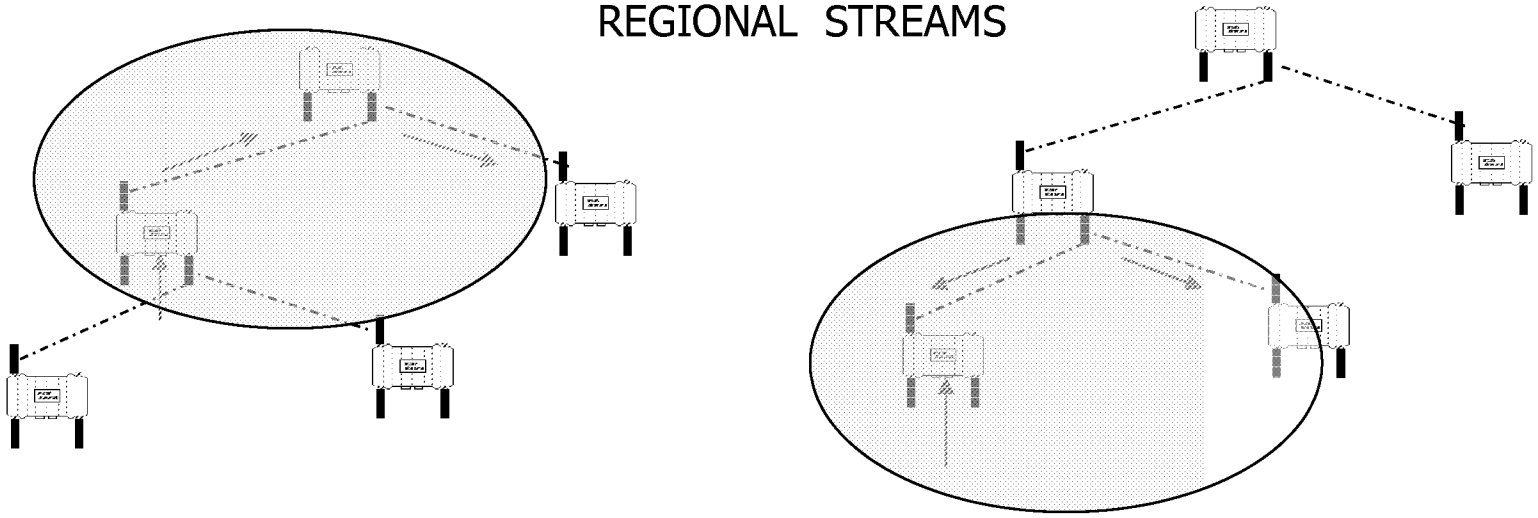


- CLIENTS SILENT IN ALLOCATED TIME SLOT FOR STREAMING.
- CSMA TIME SLOT IS ADJUSTABLE AFTER STREAM TIME SLOT ALLOCATIONN

Figure 47

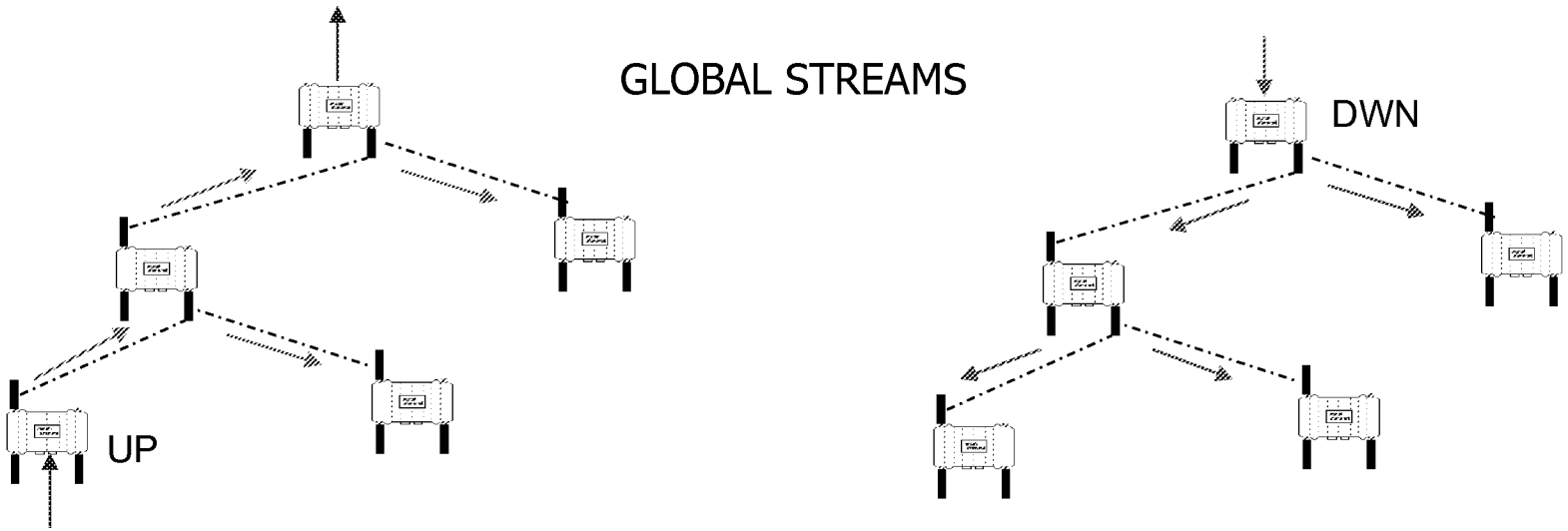
EX1018, Page 53

REGIONAL STREAMS



- REGIONAL STREAMS TRAVERSE ONLY THE SPECIFIED DIRECTIONS AND/OR REGION
  - REGIONS CAN BE GPS BOUNDARIES, OR NUMBER OF HOPS / SUBTREES
  - DIRECTIONS CAN BE a) UP OR DOWN OR b) TURN-BY-TURN etc.
  - RELEVANT FOR DATA IMPORTANT LOCALLY ONLY (e.g. Sibling Devices)
  - DOES NOT AFFECT BACKHAUL BANDWIDTH OUTSIDE SPECIFIED REGION

Figure 48



- GLOBALS STREAMS TRAVERSE THE ENTIRE NETWORK
  - AT THE MINIMUM GOES UP TO THE LOGICAL "ROOT"/PARENT/AGENT
  - THEY CAN ORIGINATE FROM ANY WHERE ON THE NETWORK
    - IF FROM ROOT: DOWNWARD ONLY (worst case).
    - IF FROM NODE : UPWARDS AND DOWNWARDS (worst case).
    - IF FROM CLIENT : UPWARDS AND DOWNWARDS, includes Siblings (worst case)

Figure 49

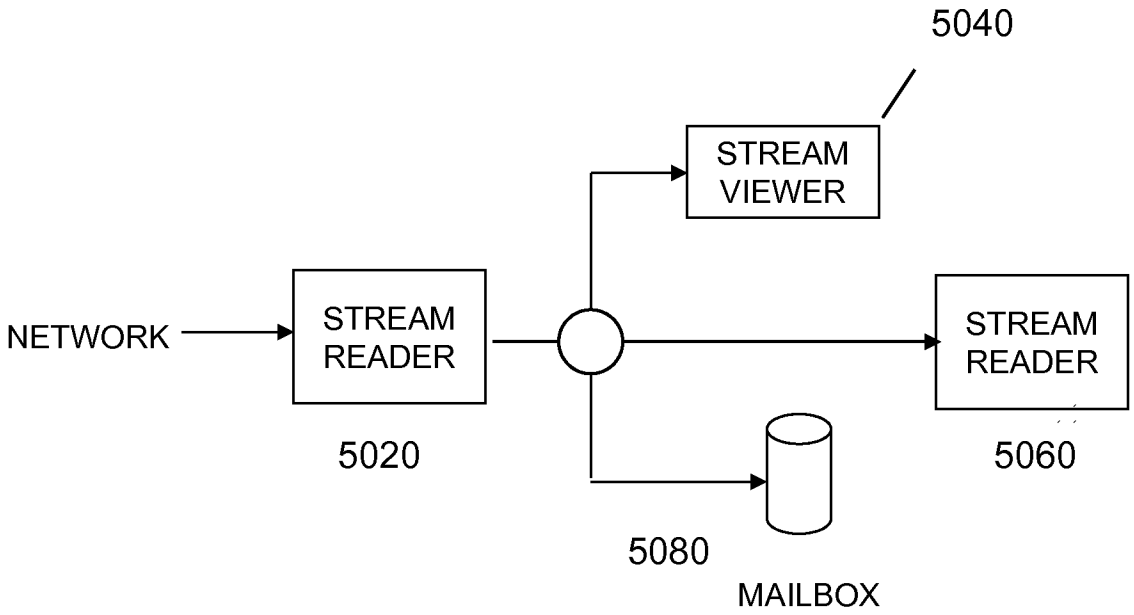


Figure 50

EX1018, Page 56

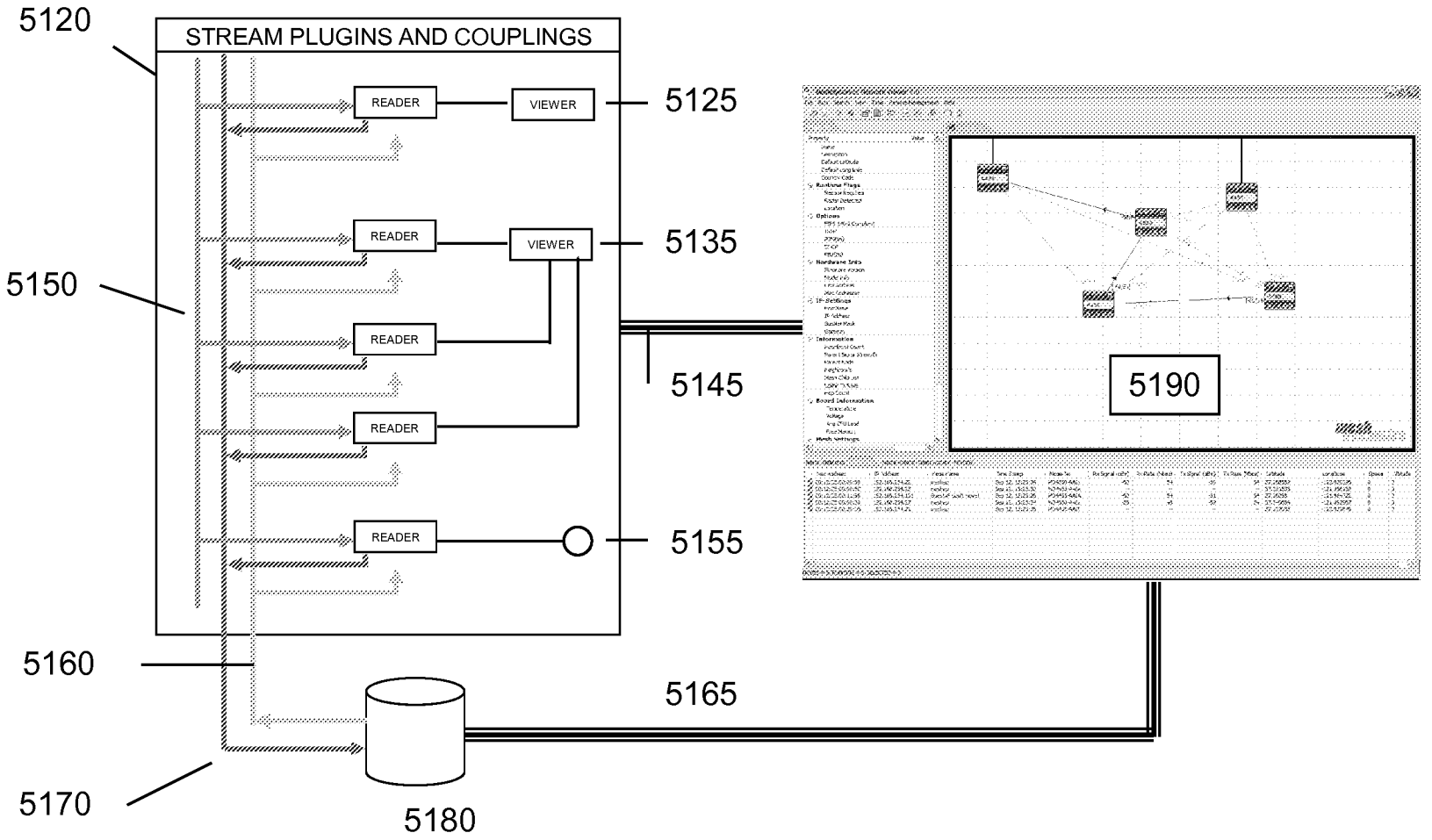


Figure 51

EX1018, Page 57

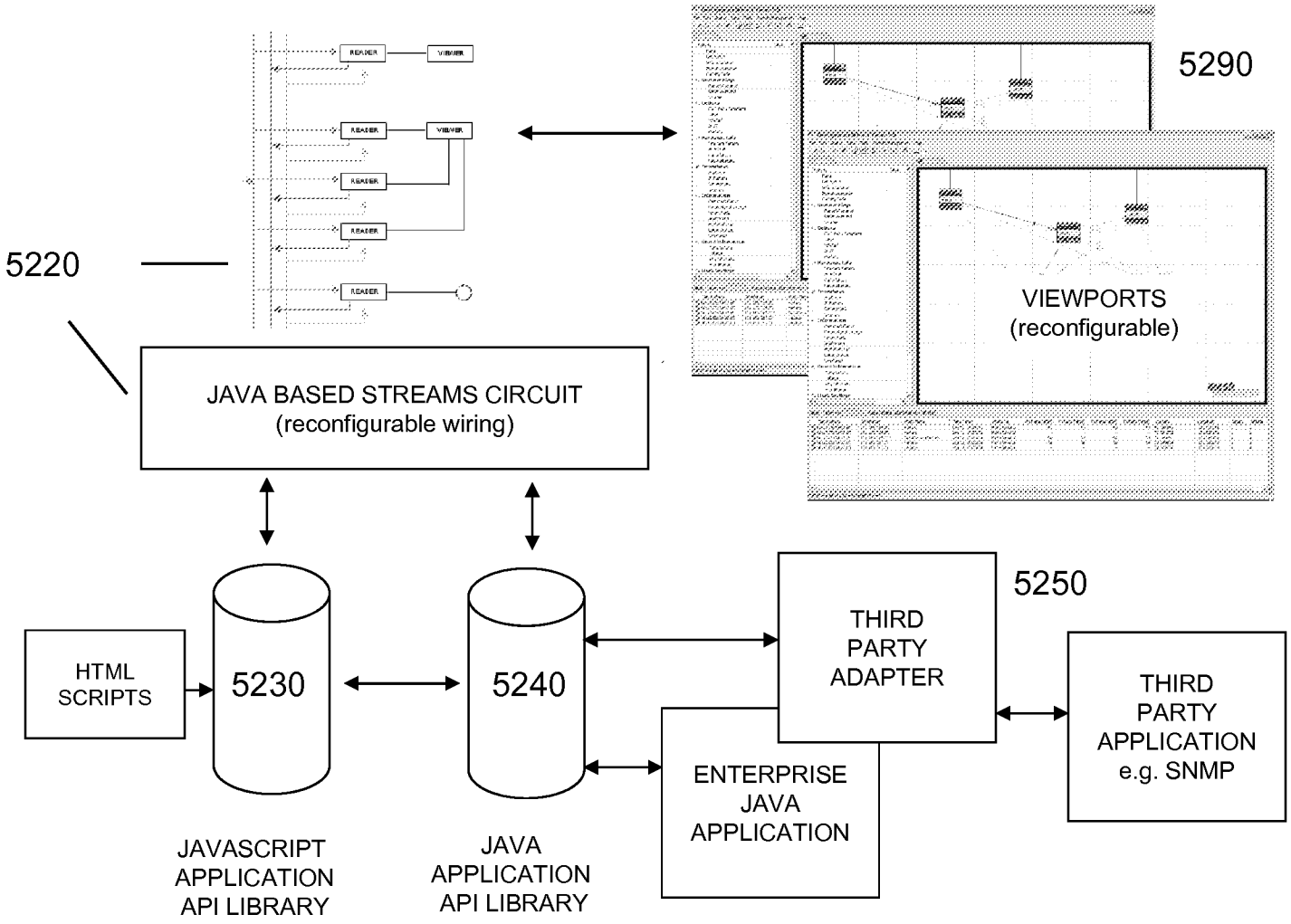
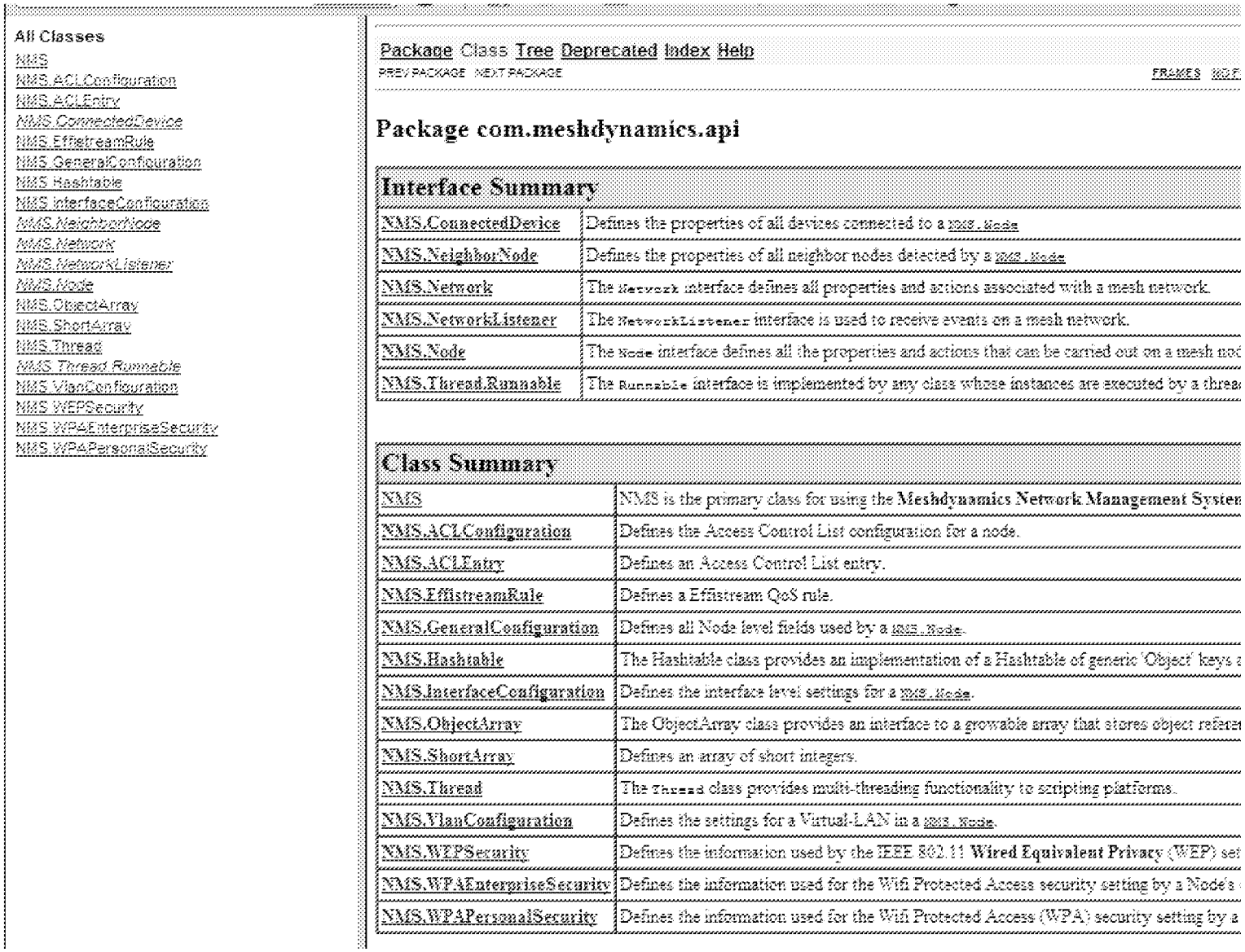


Figure 52

EX1018, Page 58



All Classes
NMS
NMS.ACLConfiguration
NMS.ACLEntry
NMS.ConnectedDevice
NMS.EffistreamRule
NMS.GeneralConfiguration
NMS.Hashtable
NMS.InterfaceConfiguration
NMS.NeighborNode
NMS.Network
NMS.NetworkListener
NMS.Node
NMS.ObjectArray
NMS.ShortArray
NMS.Thread
NMS.Thread.Runnable
NMS.VlanConfiguration
NMS.WEPSecurity
NMS.WPAEnterpriseSecurity
NMS.WPAPersonalSecurity

Package Class Tree Deprecated Index Help
PREV PACKAGE NEXT PACKAGE FRAMES NO F

Package com.meshdynamics.api

Interface Summary

NMS.ConnectedDevice	Defines the properties of all devices connected to a NMS.Node
NMS.NeighborNode	Defines the properties of all neighbor nodes detected by a NMS.Node
NMS.Network	The Network interface defines all properties and actions associated with a mesh network.
NMS.NetworkListener	The NetworkListener interface is used to receive events on a mesh network.
NMS.Node	The Node interface defines all the properties and actions that can be carried out on a mesh nod
NMS.Thread.Runnable	The Runnable interface is implemented by any class whose instances are executed by a threa

Class Summary

NMS	NMS is the primary class for using the Meshdynamics Network Management Systen
NMS.ACLConfiguration	Defines the Access Control List configuration for a node.
NMS.ACLEntry	Defines an Access Control List entry.
NMS.EffistreamRule	Defines a Effistream QoS rule.
NMS.GeneralConfiguration	Defines all Node level fields used by a NMS.Node.
NMS.Hashtable	The Hashtable class provides an implementation of a Hashtable of generic 'Object' keys a
NMS.InterfaceConfiguration	Defines the interface level settings for a NMS.Node.
NMS.ObjectArray	The ObjectArray class provides an interface to a growable array that stores object refere
NMS.ShortArray	Defines an array of short integers.
NMS.Thread	The Thread class provides multi-threading functionality to scripting platforms.
NMS.VlanConfiguration	Defines the settings for a Virtual-LAN in a NMS.Node.
NMS.WEPSecurity	Defines the information used by the IEEE 802.11 Wired Equivalent Privacy (WEP) set
NMS.WPAEnterpriseSecurity	Defines the information used for the Wifi Protected Access security setting by a Node's
NMS.WPAPersonalSecurity	Defines the information used for the Wifi Protected Access (WPA) security setting by a

Figure 53

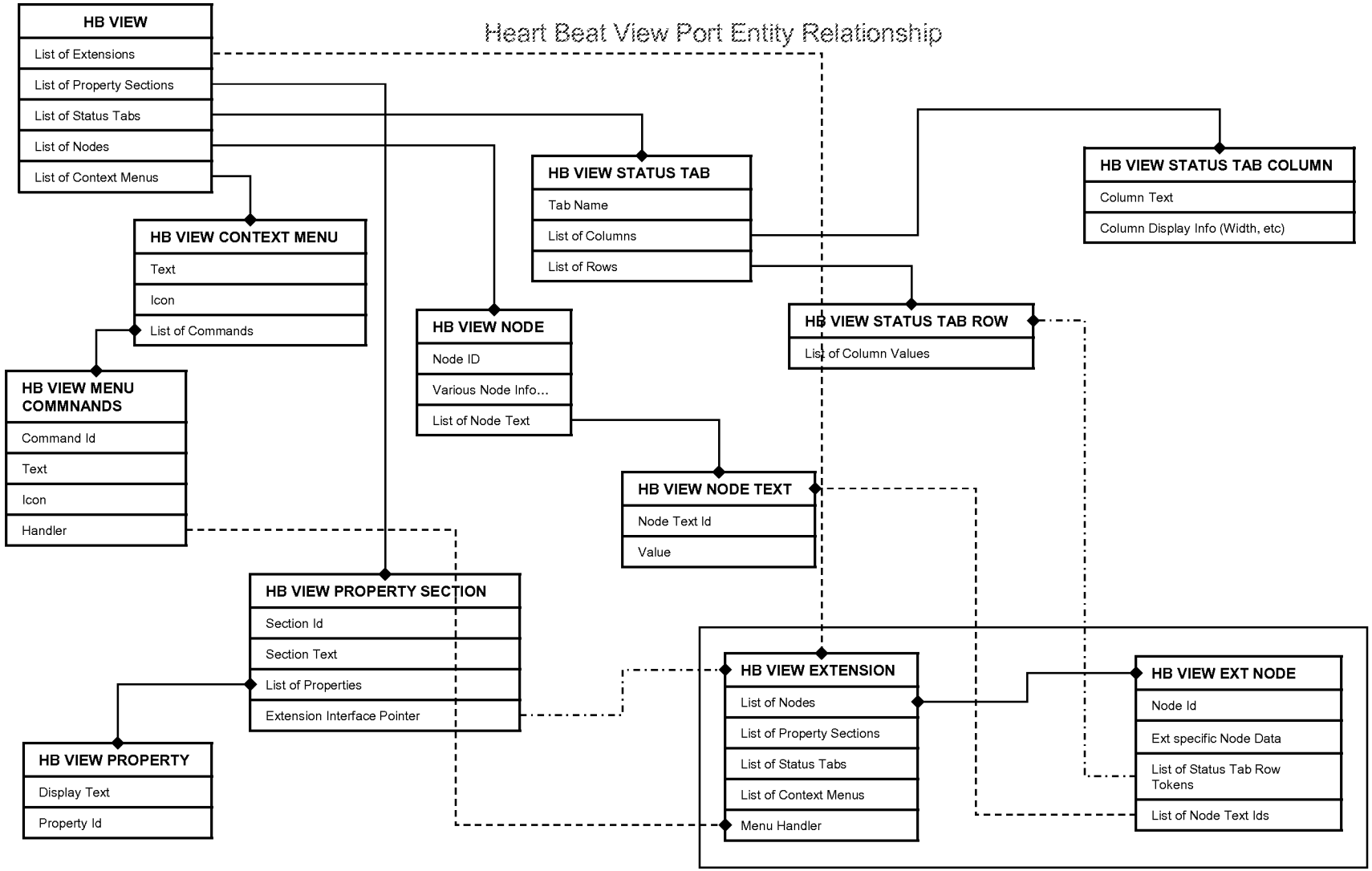

Heart Beat View Port Entity Relationship
HB VIEW
List of Extensions
List of Property Sections
List of Status Tabs
List of Nodes
List of Context Menus
HB VIEW CONTEXT MENU
Text
Icon
List of Commands
HB VIEW MENU COMMNANDS
Command Id
Text
Icon
Handler
HB VIEW STATUS TAB
Tab Name
List of Columns
List of Rows
HB VIEW STATUS TAB COLUMN
Column Text
Column Display Info (Width, etc)
HB VIEW NODE
Node ID
Various Node Info...
List of Node Text
HB VIEW STATUS TAB ROW
List of Column Values
HB VIEW NODE TEXT
Node Text Id
Value
HB VIEW PROPERTY SECTION
Section Id
Section Text
List of Properties
Extension Interface Pointer
HB VIEW PROPERTY
Display Text
Property Id
HB VIEW EXTENSION
List of Nodes
List of Property Sections
List of Status Tabs
List of Context Menus
Menu Handler
HB VIEW EXT NODE
Node Id
Ext specific Node Data
List of Status Tab Row Tokens
List of Node Text Ids

Figure 54

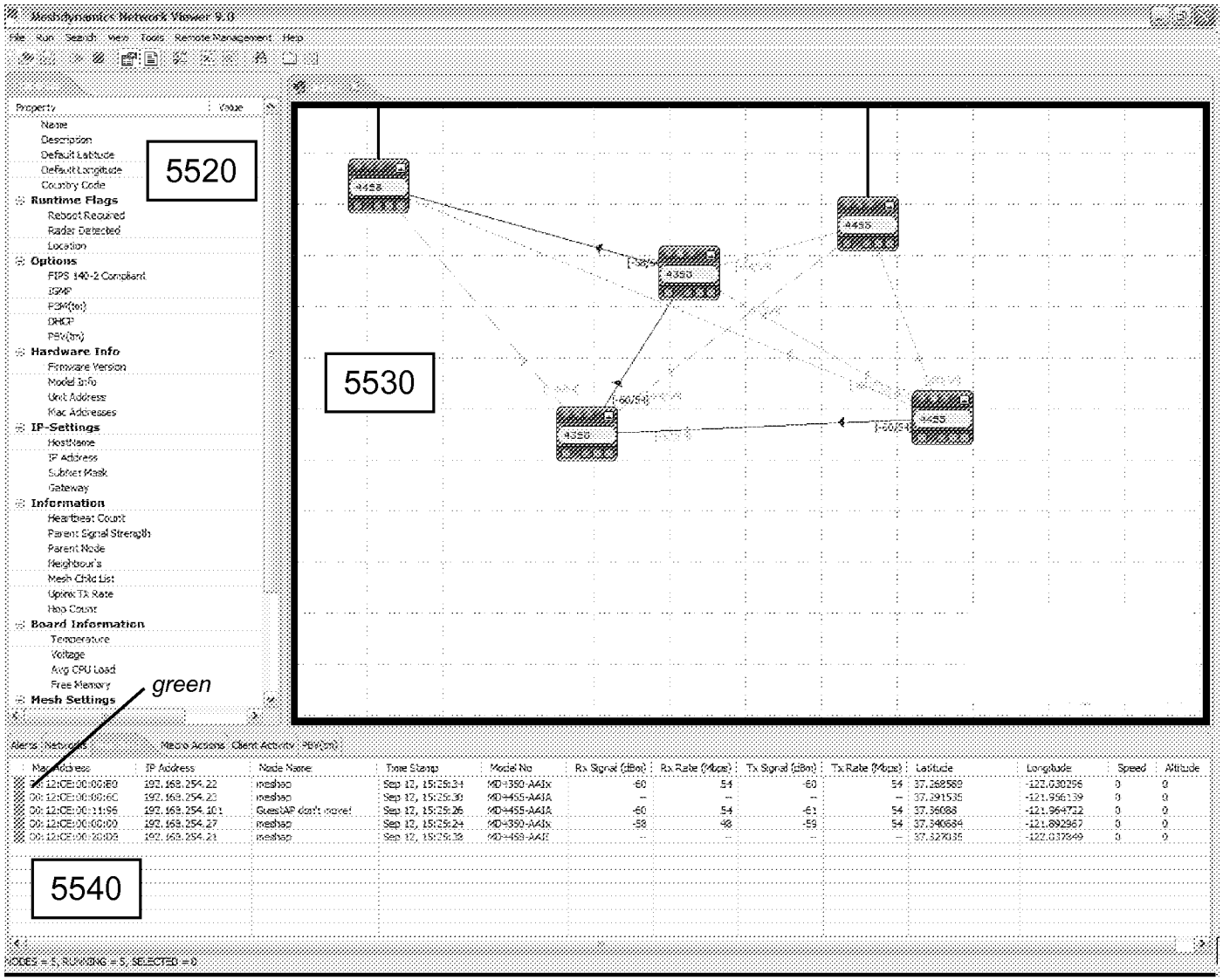
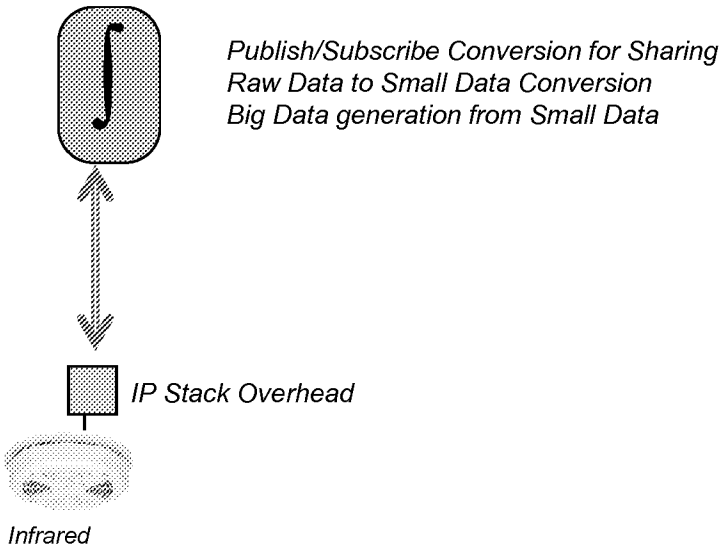


Figure 55

Single Control Loop



Dual Control Loop

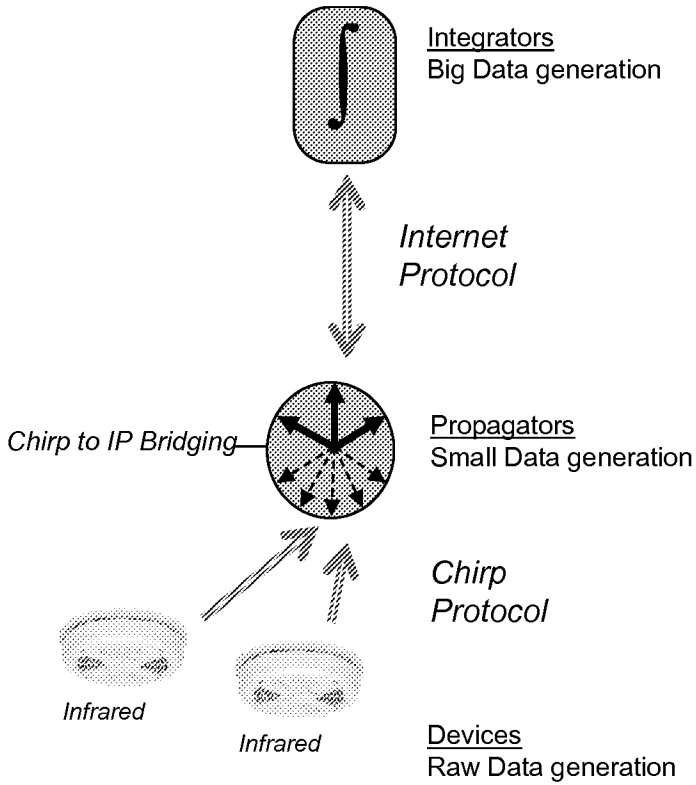


Figure 56

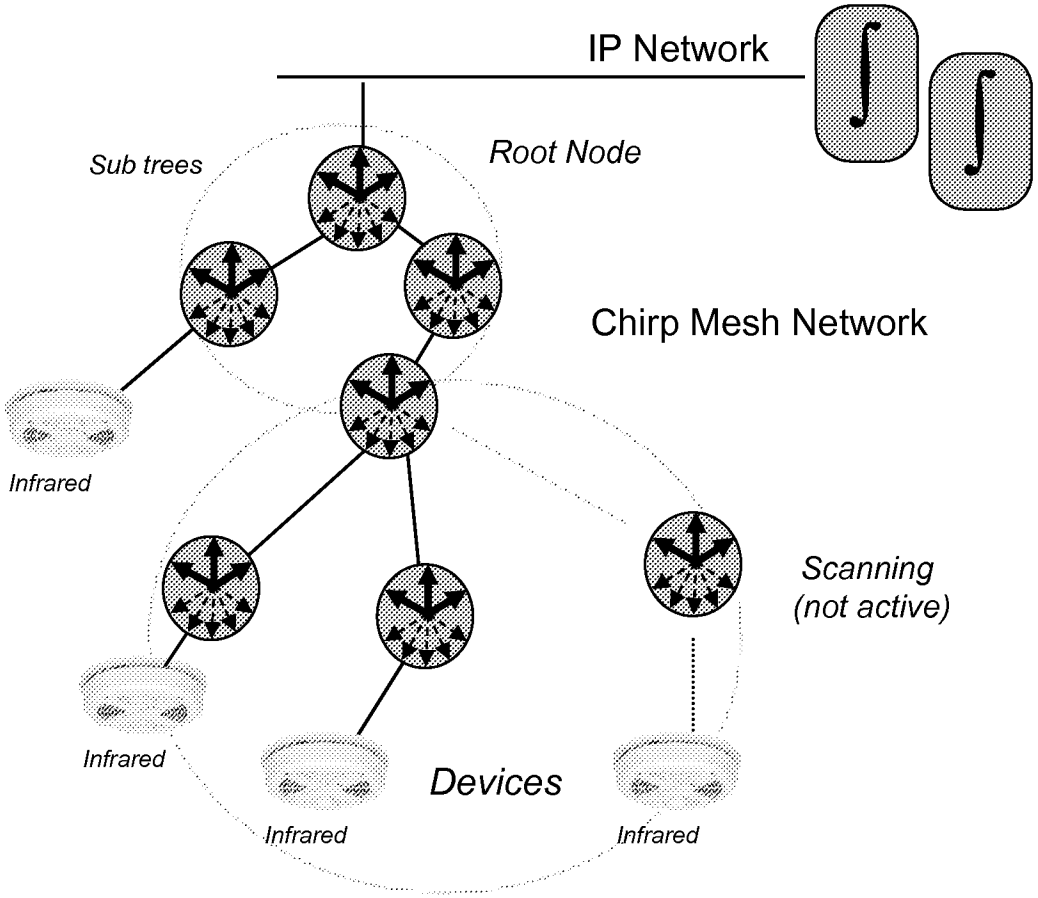

IP Network
Root Node
Sub trees
Chirp Mesh Network
Infrared
Scanning
(not active)
Infrared
Devices
Infrared
Infrared

Figure 57

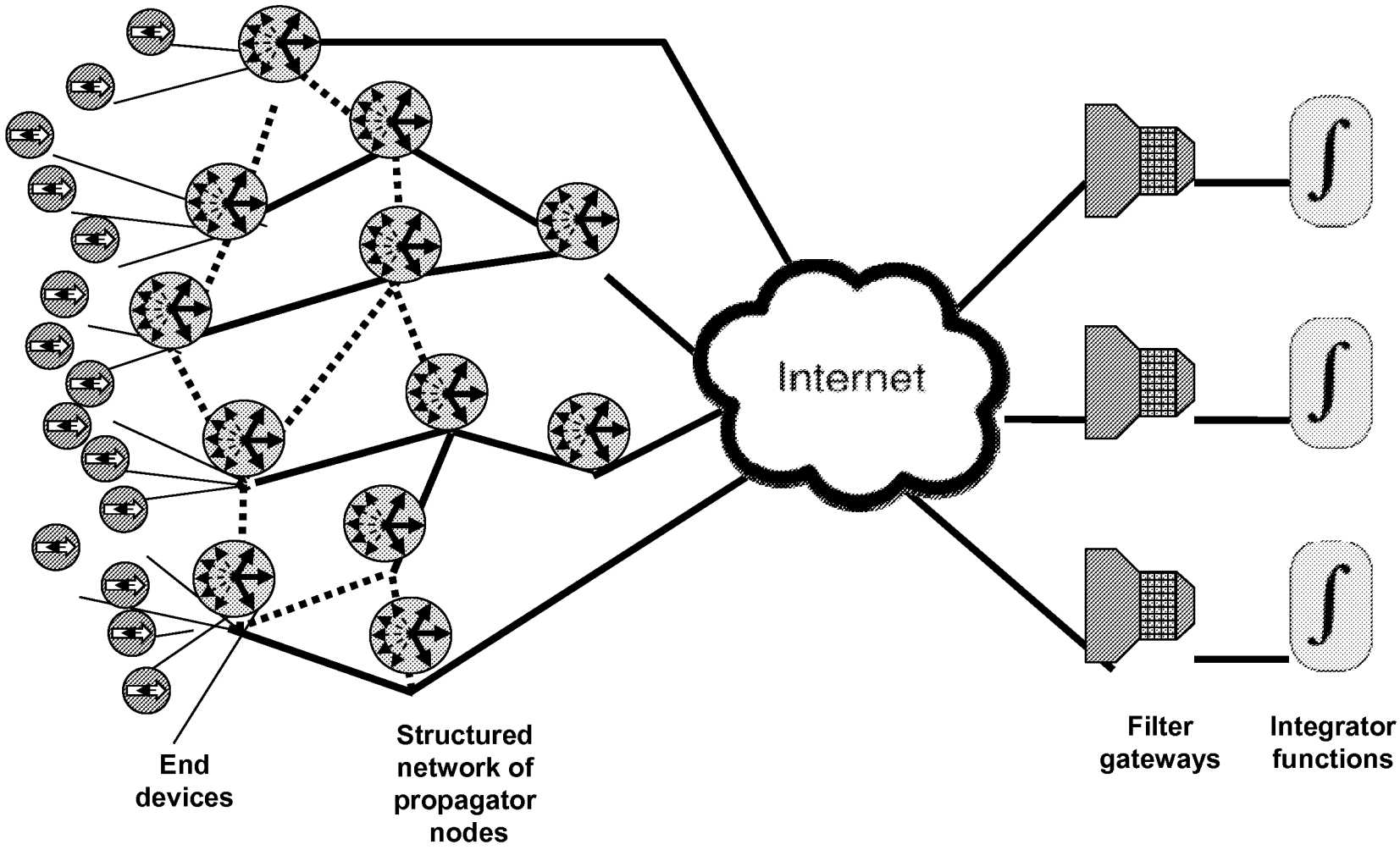

Internet
End devices
Structured network of propagator nodes
Filter gateways
Integrator functions

Figure 58

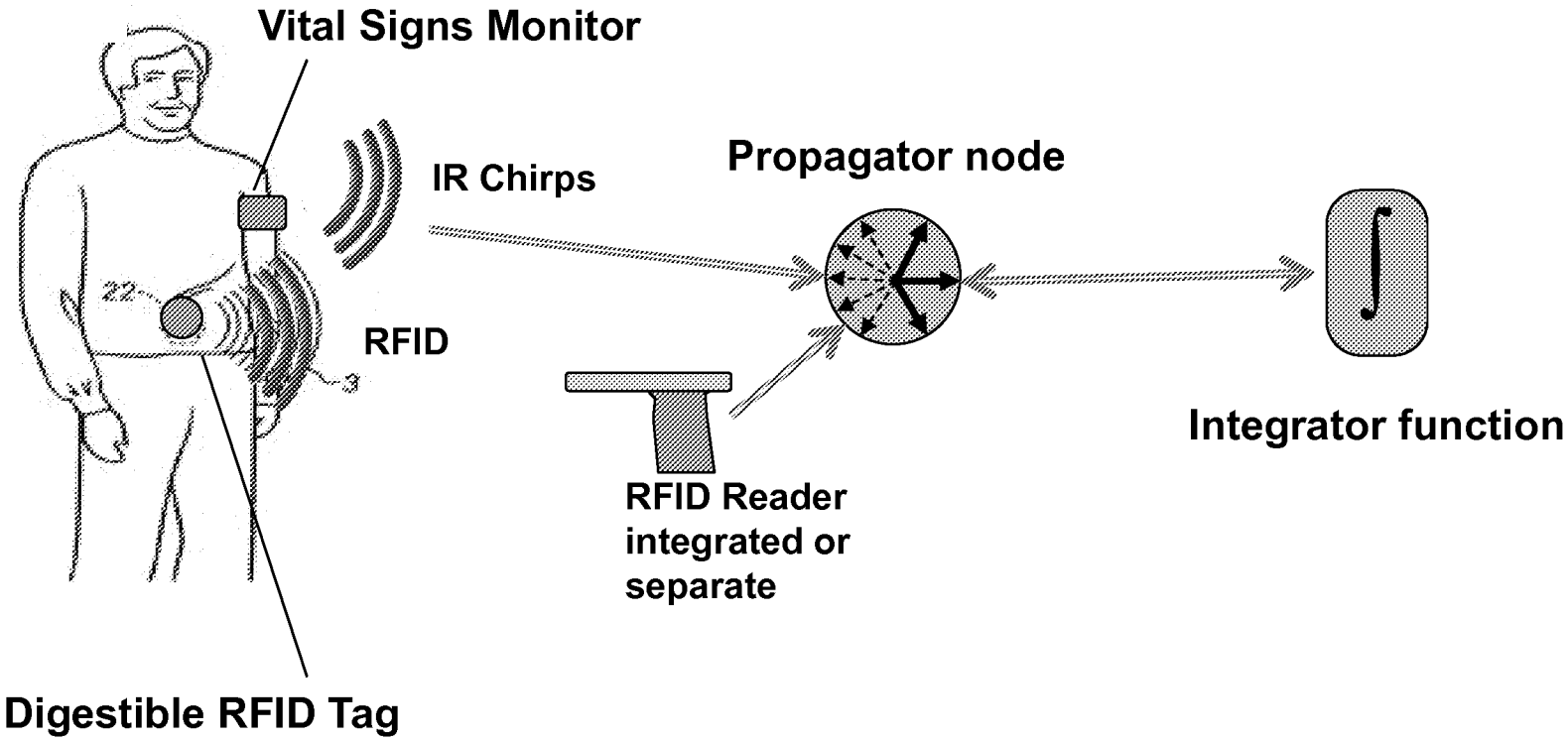

Vital Signs Monitor
IR Chirps
Propagator node
22
RFID
3
Integrator function
RFID Reader
integrated or
separate
Digestible RFID Tag

Figure 59

An Integrator function retrieves data from End Devices such as moisture sensors as well as external feeds and uses the information to control irrigation valves.

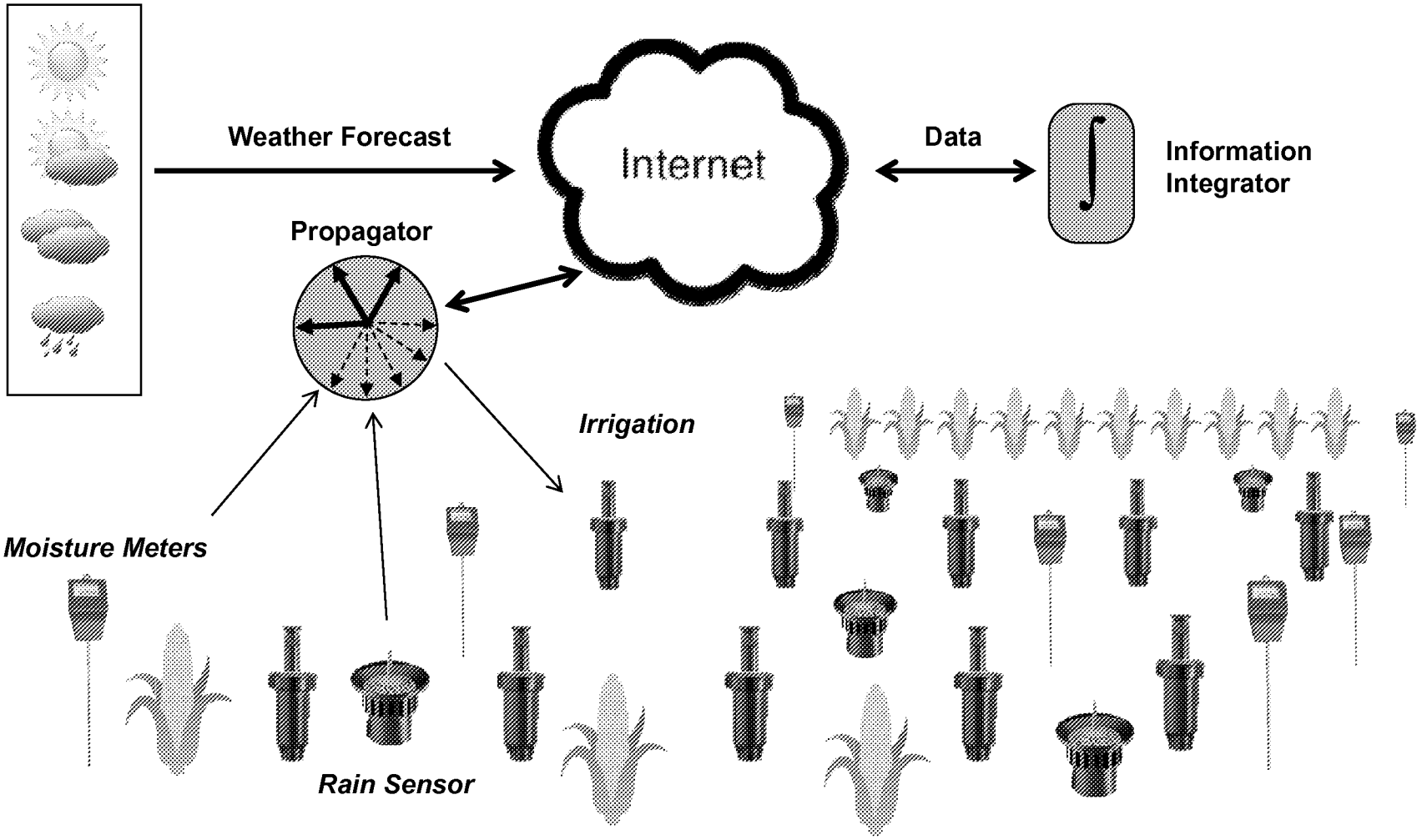
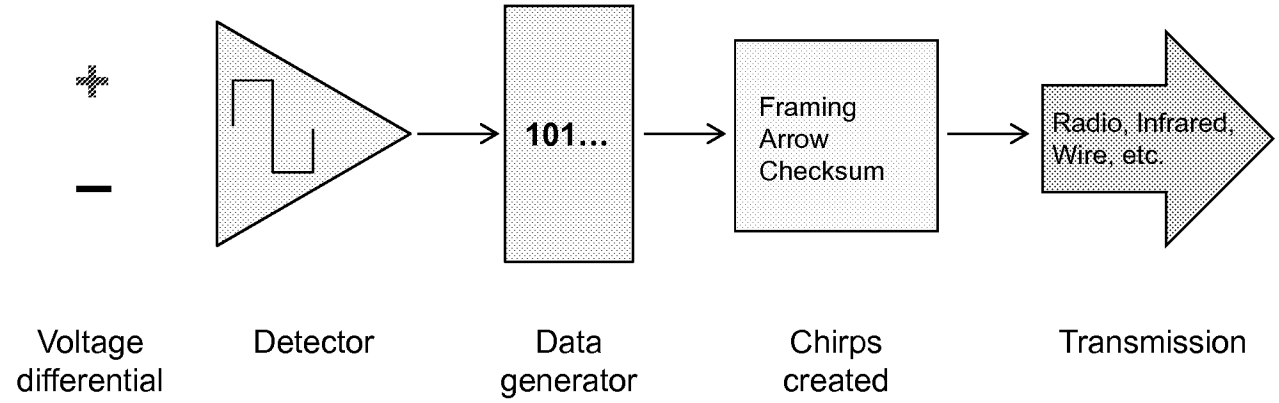
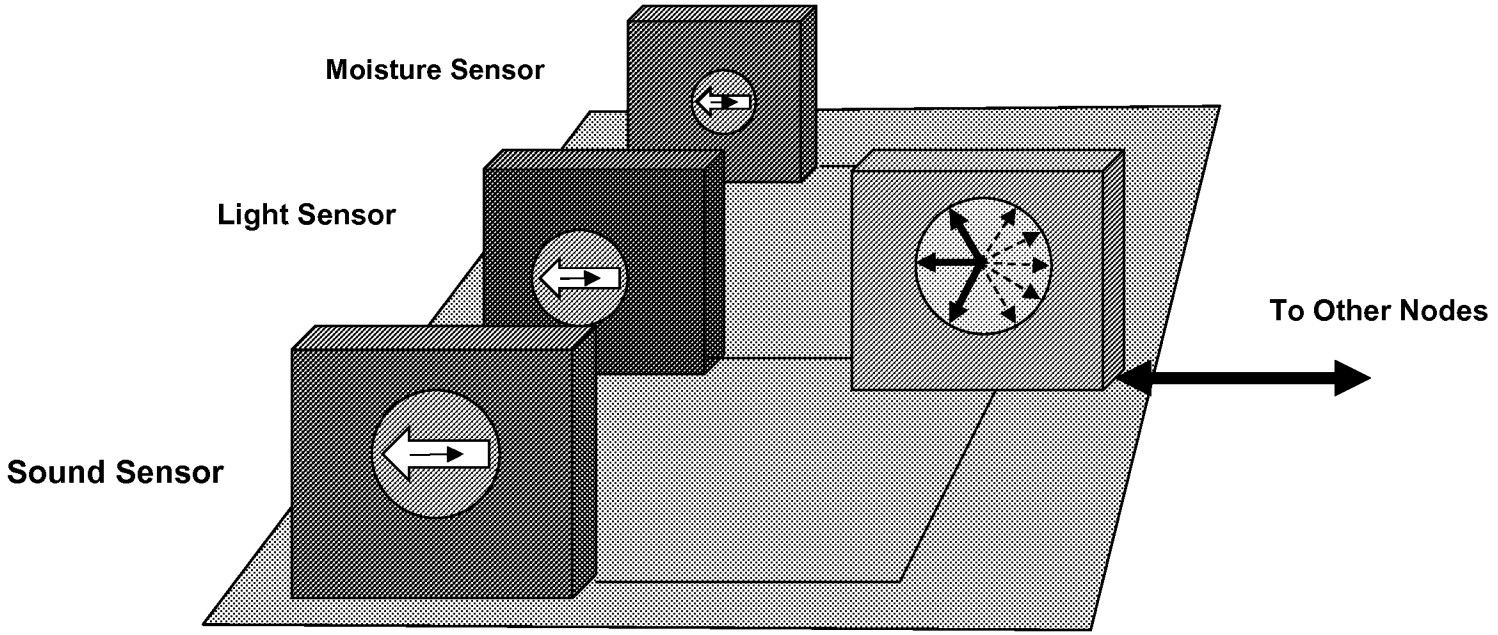


Figure 60



In millions of simple End Devices, basic physical states will be converted to Chirp payloads. An address, "arrow" of transmission, and checksum are added to this payload to form the complete Chirp packet.

Figure 61



Some devices will combine multiple IoT functions in a single package. Here an End Device includes a Propagator node that may provide networking services for additional nearby End Devices.

Figure 62

Tree Based Lineage Based Routing

P1: P0/1 → 1 (hence also one hop)
P2: P1/3 → 1-3 (two hop)
C1: P1/1 → 1-1
C2: P0/2 → 2
C3: P2/3 → 1-3-3
C4: P2/1 → 1-3-1 Hence C3/C4 Siblings

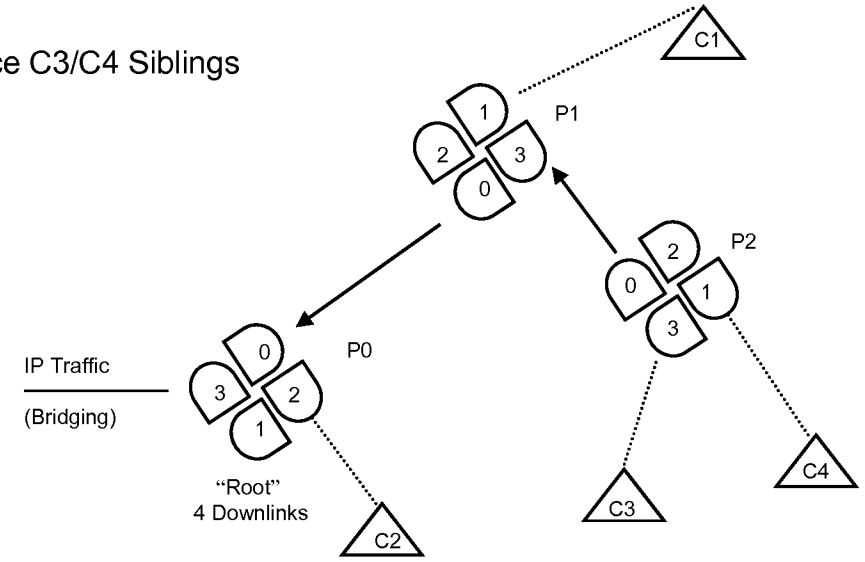


Figure 63

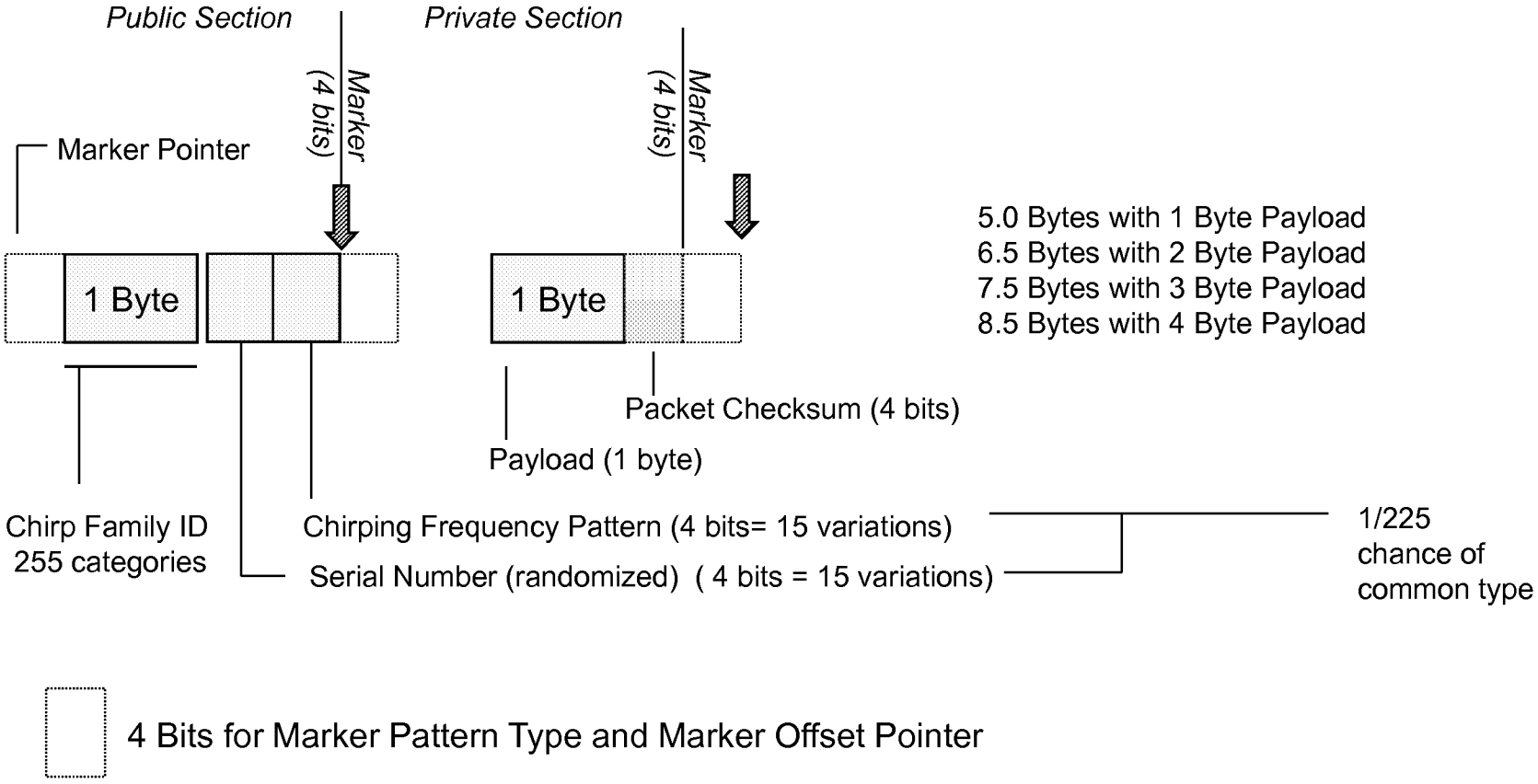

Public Section
Private Section
Marker (4 bits)
Marker (4 bits)
Marker Pointer
1 Byte
1 Byte
5.0 Bytes with 1 Byte Payload
6.5 Bytes with 2 Byte Payload
7.5 Bytes with 3 Byte Payload
8.5 Bytes with 4 Byte Payload
Packet Checksum (4 bits)
Payload (1 byte)
Chirp Family ID
255 categories
Chirping Frequency Pattern (4 bits= 15 variations)
Serial Number (randomized) (4 bits = 15 variations)
1/225
chance of
common type
4 Bits for Marker Pattern Type and Marker Offset Pointer

Figure 64

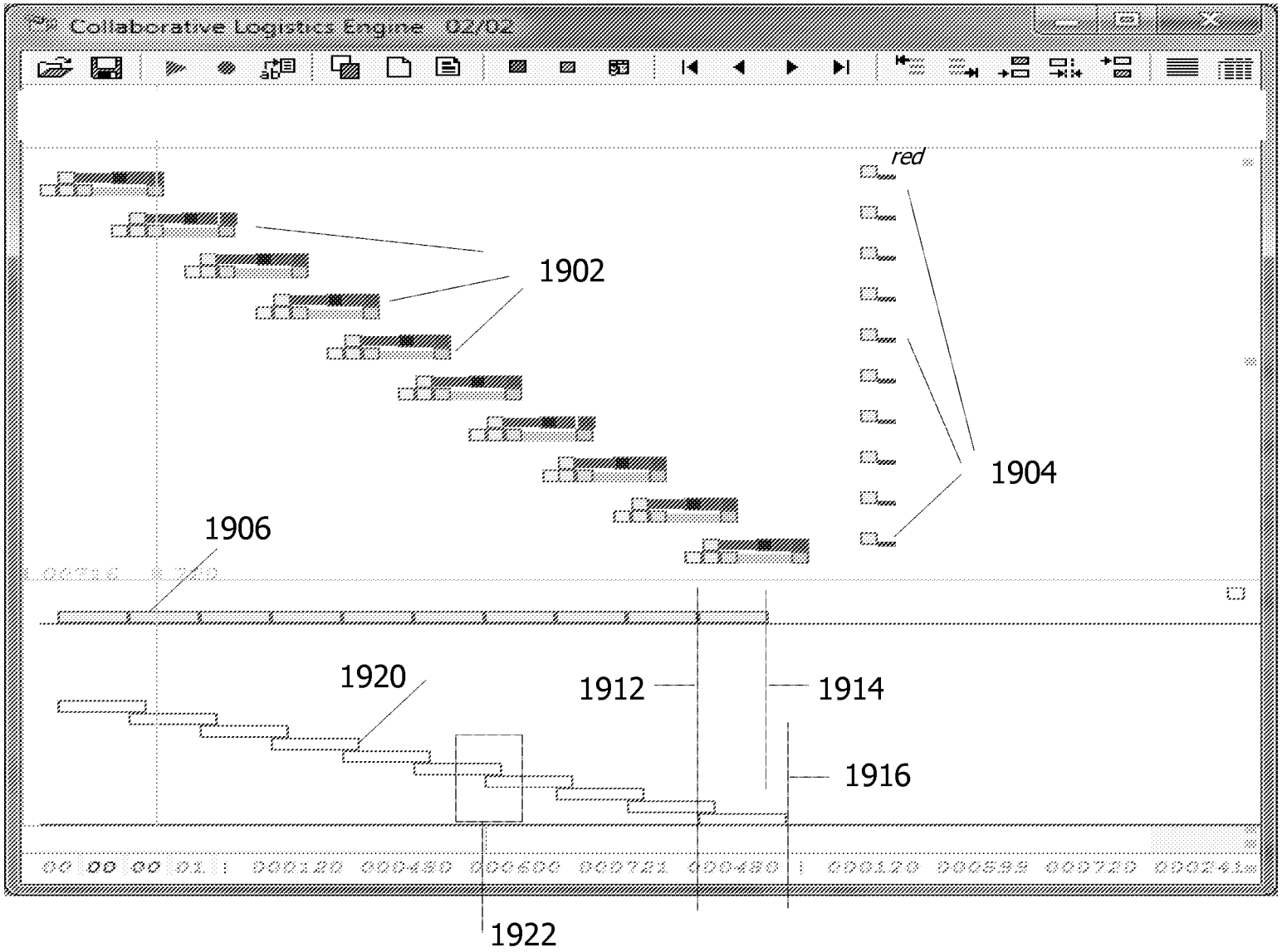


Figure 65

EX1018, Page 71

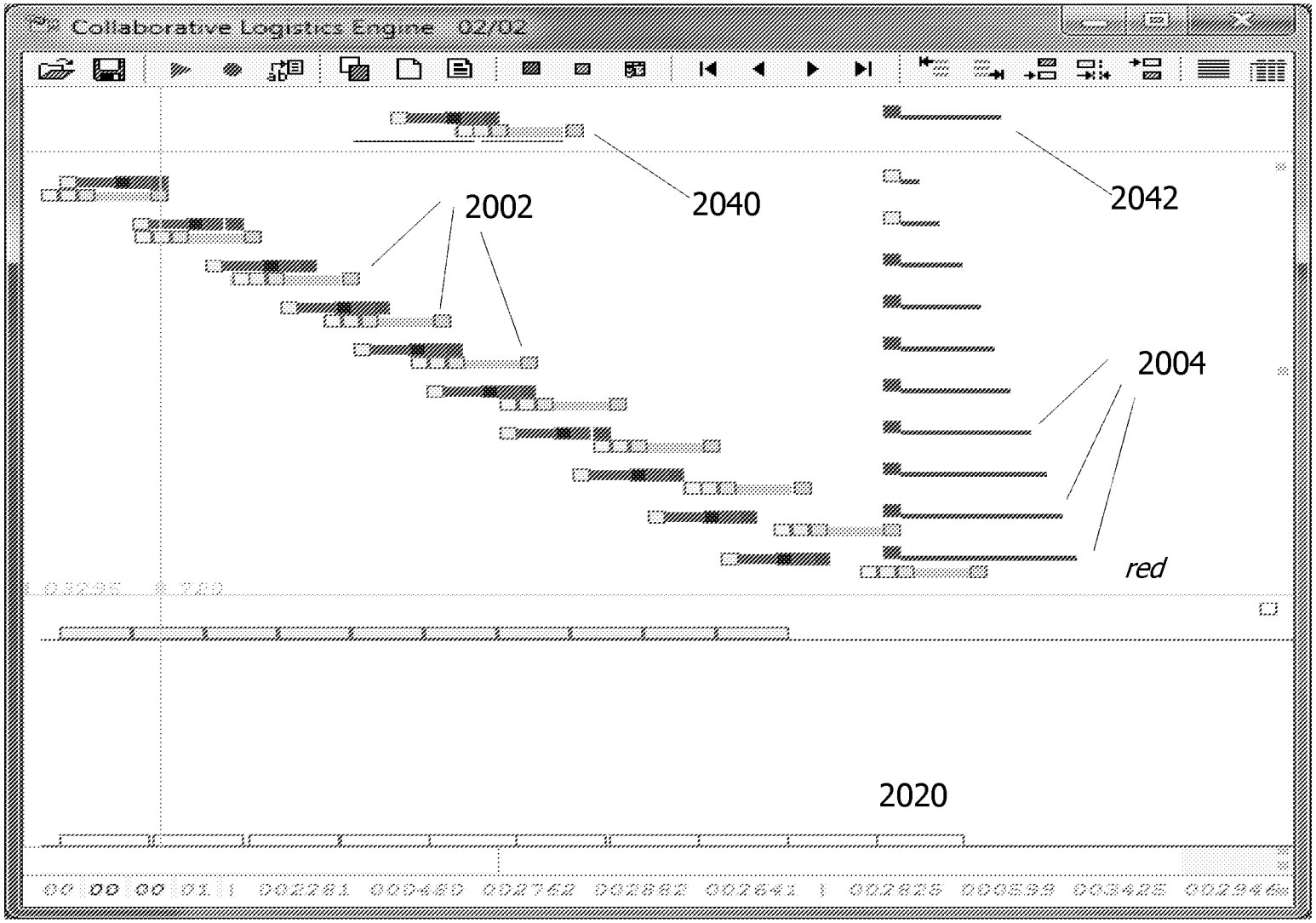


Figure 66

EX1018, Page 72

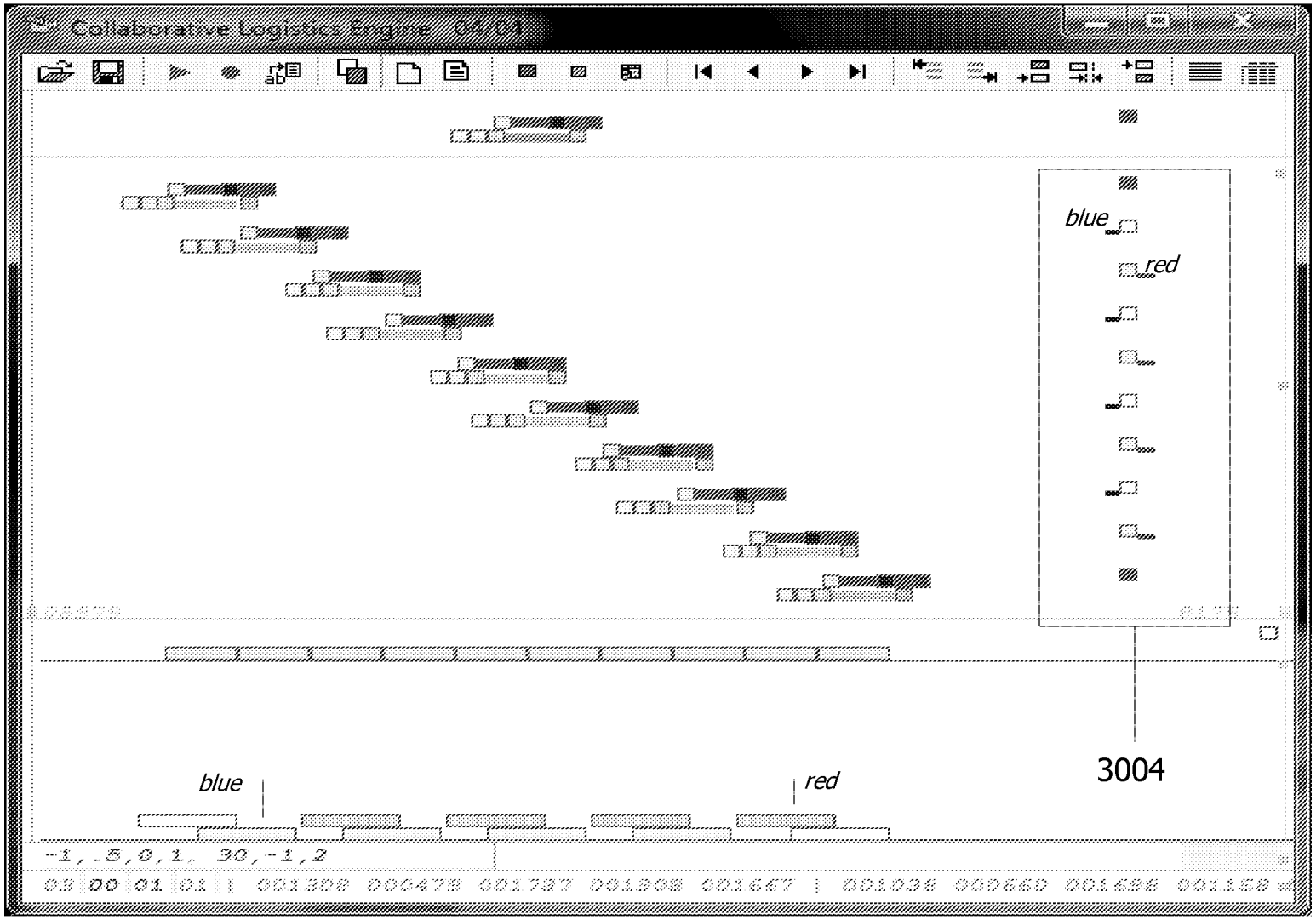


Figure 67

EX1018, Page 73

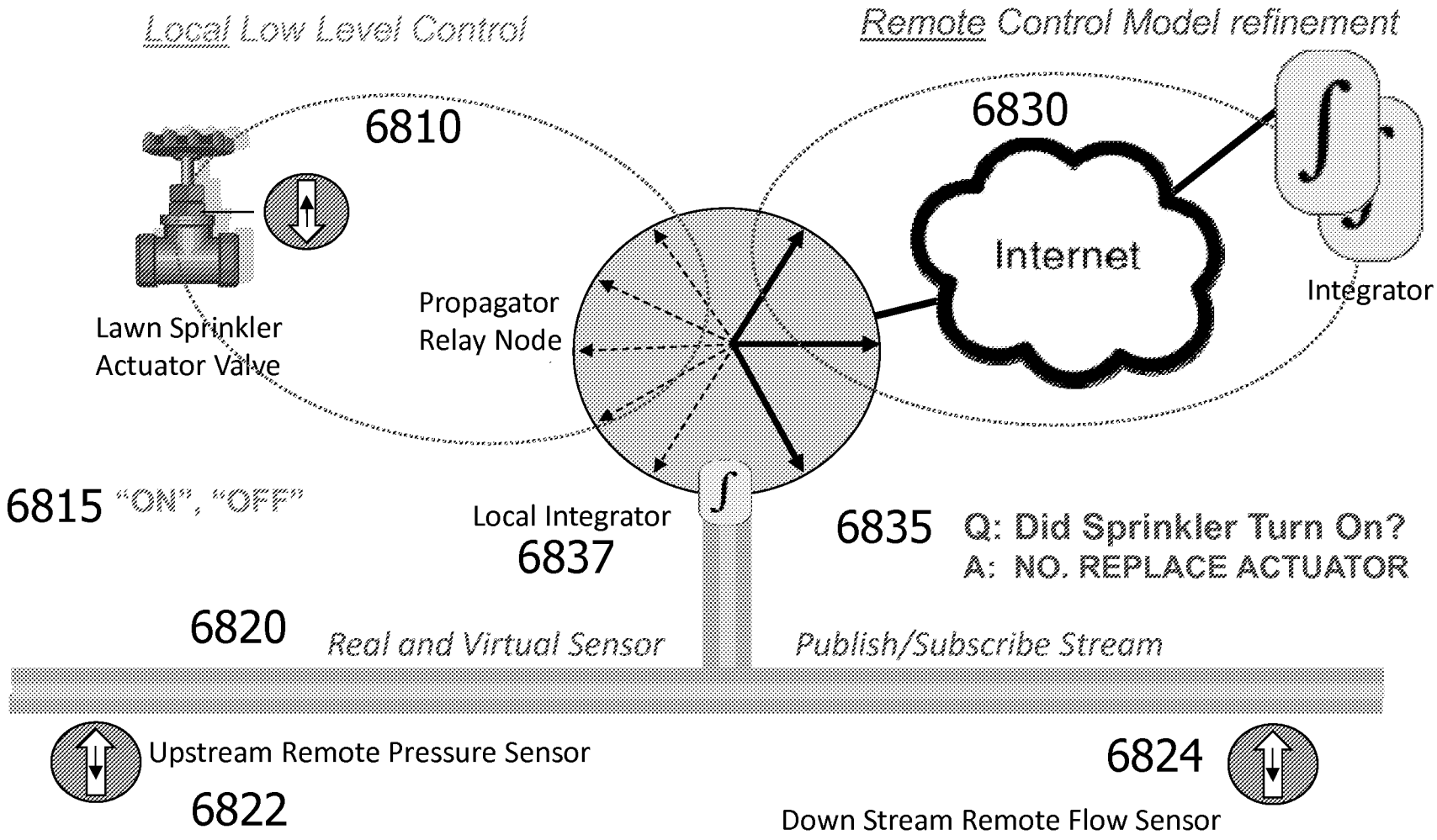


Figure 68

EX1018, Page 74

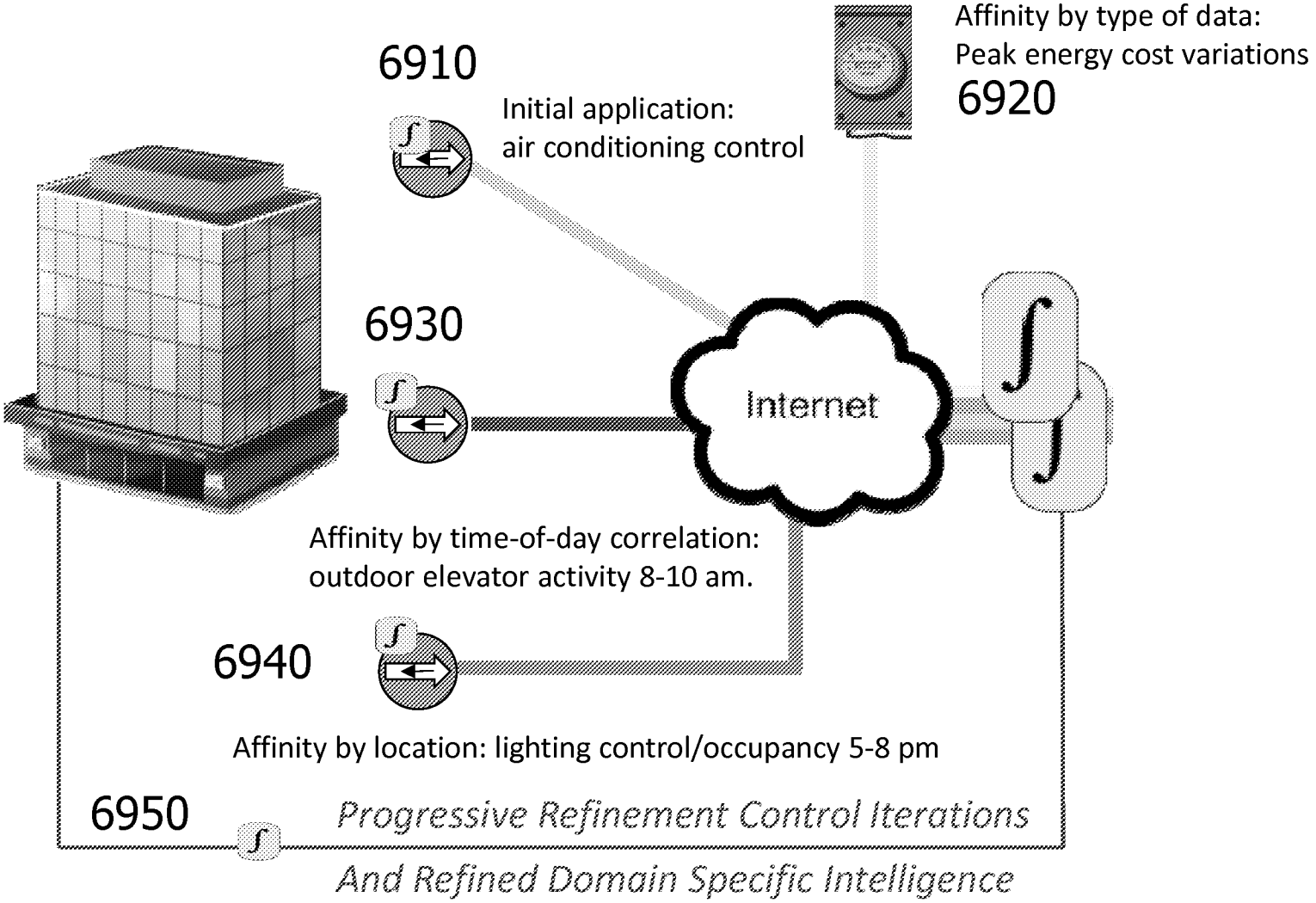
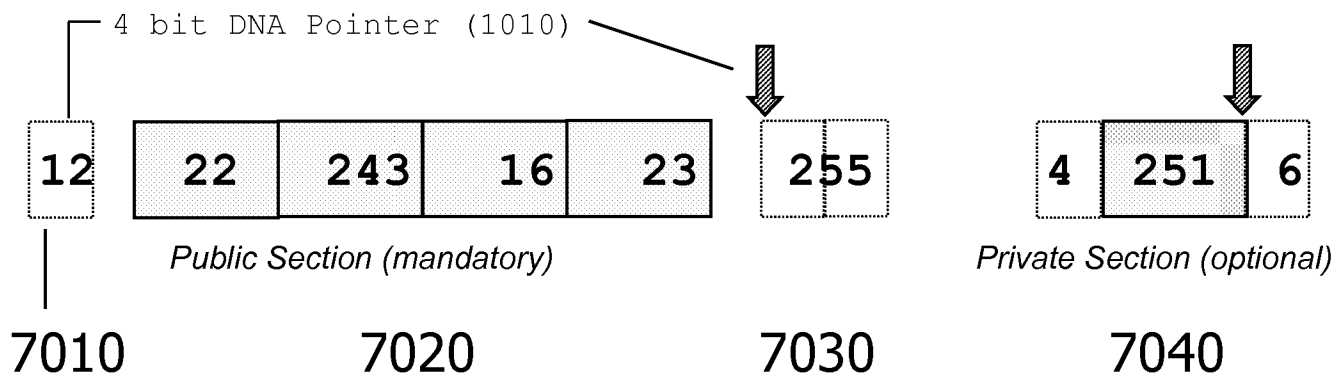


Figure 69

EX1018, Page 75



7050 **Public Agent ID: 4.8.255 (4 byte Public, 8 bit Marker, DNA 255**

7060 **Agent 4.8.255: Format is 8.8.8.8 (4 variables,1 byte each)**

7070 **Subscribed Chirp Classification: 4.8.255.22.243.16.23.**

7080 **Private Agent ID 1.4.6 decodes payload [251] for 4.8.255.22.243.16.23**

Figure 70

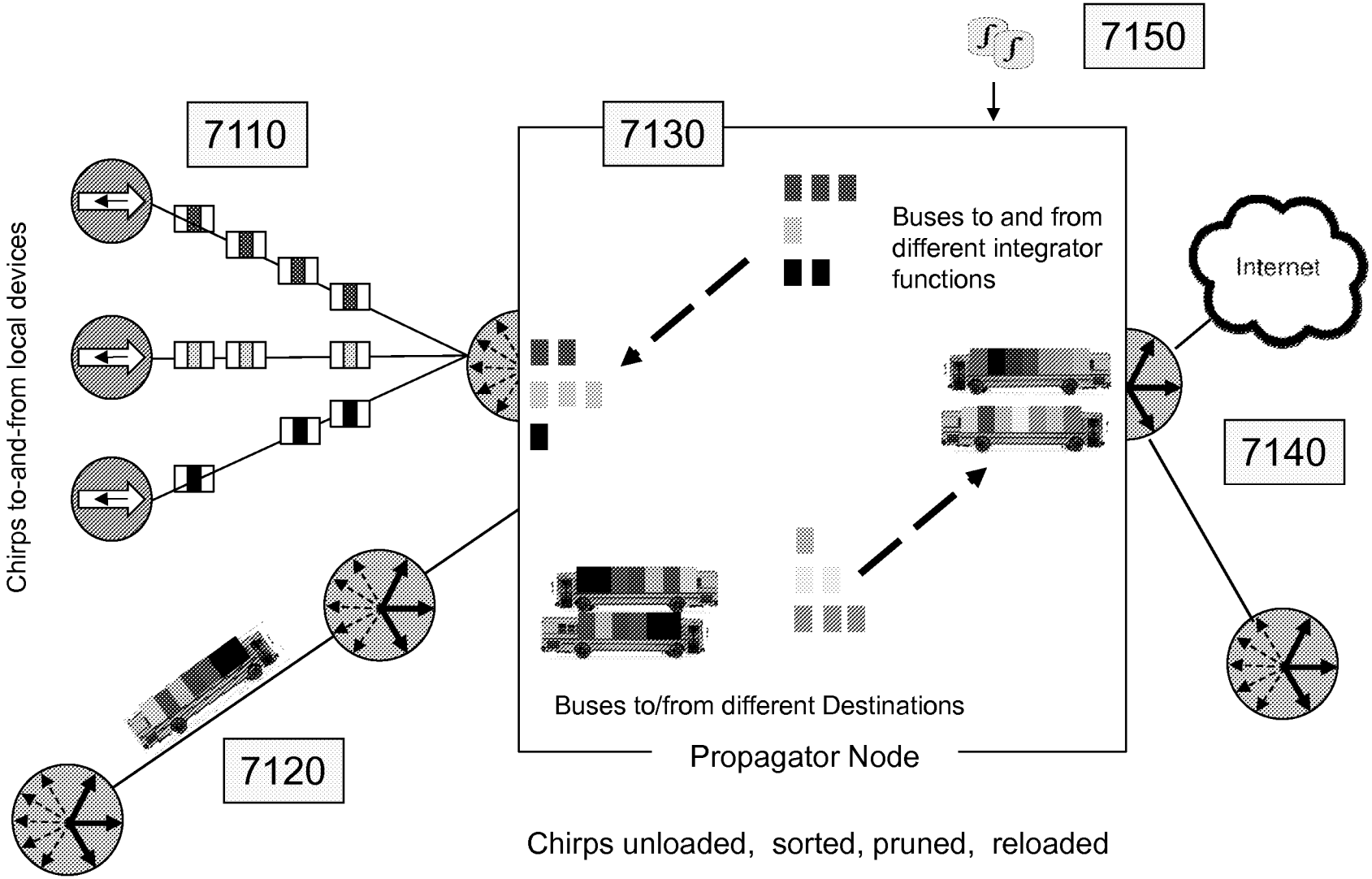


Figure 71

EX1018, Page 77

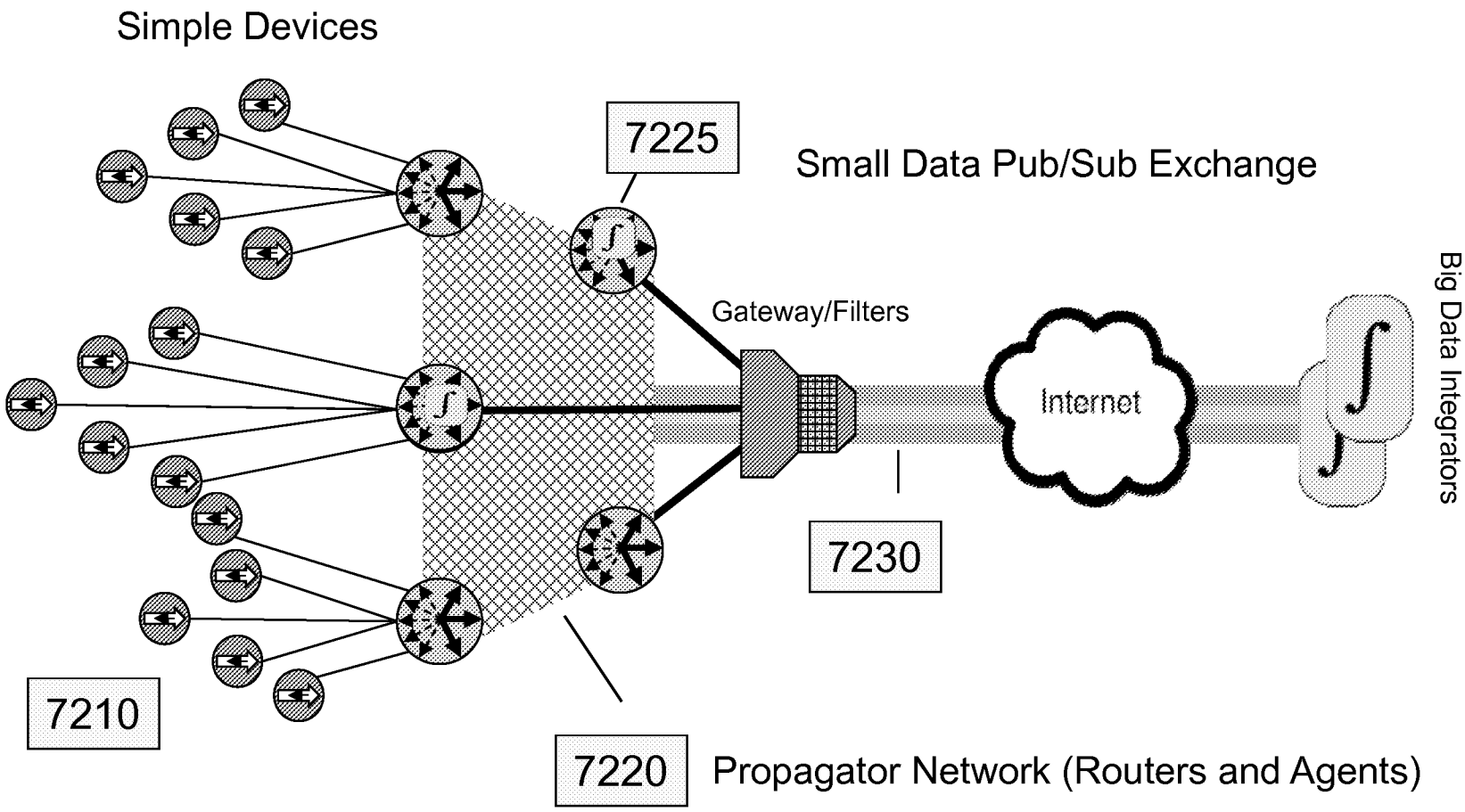


Figure 72

EX1018, Page 78

Title: Chirp Networks

Inventor: Francis daCosta

CROSS REFERENCES

The instant application claims priority as a non-provisional of U.S. Provisional Application Serial Number 62/012,196, filed on June 13, 2015, presently pending.

The instant application is a continuation in part of U.S. Utility Application Serial Number 13/764,008, filed on Feb. 11, 2013, which is pending, which in turn claimed priority as a continuation in part of U.S. Utility Application Serial Number 13/627,883, filed on September 26, 2012, and issued as U.S. Patent No. 8,923,186 on Dec. 30, 2014, which in turn claimed priority as a non-provisional utility application of Provisional U.S. Patent Application Serial Number 61/555,400 filed on November 3, 2011, currently expired, and Provisional U.S. Patent Application Serial Number 61/615,802, filed on March 26, 2012, presently expired, and Provisional U.S. Patent Application Serial Number 61/621,926, filed on April 9, 2012, presently expired, the contents of which are hereby incorporated by reference.

The instant application claims priority as a continuation in part of U.S. Patent Application Serial Number 13/571,294, filed on August 9, 2012, presently pending, which in turn claimed priority to U.S. Patent Application Serial Number 12/696,947, filed on January 29, 2010, issued as U.S. Patent 8,520,691 which issued on August 27, 2013, which in turn claimed priority as a non-provisional of U.S. application serial number 61/148,803, filed on January 30, 2009, presently expired, the contents of each prior application is hereby incorporated by reference. Application 13/571,294 also claimed priority as a continuation in part of U.S. Utility Application No. 12/352,457, filed on January 12, 2009, and issued as U.S. Patent 8,477,762 on June 2, 2013, the contents of each prior application is hereby incorporated by reference.

The instant application claims priority as a continuation in part of U.S. Application 13/541,446 filed on July 3, 2012, presently pending, the contents of which are hereby incorporated by reference.

The instant application further claims priority as a continuation in part of U.S. Utility Application 14/523,778, filed on February 12, 2015, presently pending, which in turn claims priority to U.S. Utility Application No. 12/625,365, filed on November 24, 2009, issued as U.S. Patent 8,514,852 on August 20, 2013, which in turn claimed priority to U.S. application 61/117,502, filed

on Nov. 24, 2008, presently expired, which are hereby incorporated by reference.

FIELD OF THE INVENTION

This invention relates to the field of computer networks and machine communications and, more particularly to a network system and method for facilitating large scale messaging emanating from devices on the edge of the network. These edge devices include, for example, sensors and actuators that interface with the dynamics of the physical world and each other through terse messages. In some embodiments these terse messages are referred to as chirps. Small data propagators near the edge of the network optimize the data based on dynamic subscriber interests.

BACKGROUND OF THE INVENTION

Increasing percentages of devices connected to the Internet or other global networks are not used by people in the familiar way that personal computers, tablets and smart phones are. Interconnected devices monitor the environment, structures, transportation systems, factories, farms, forests, utilities, soil and weather conditions, oceans and resources. Many of these sensors and actuators are networked into autonomous sets, with much of the information being exchanged machine-to-machine directly and without human involvement.

Machine-to-machine communications are typically brief and specialized. Most sensors and actuators will report or act upon small pieces of information. For purposes of the systems described in this application these terse messages are "chirps." Burdening these devices with prior art standard network protocol stacks is inefficient, unnecessary and unduly increases their cost of ownership.

Machine-to-machine communications dominate in several applications, including the field referred to as the "Internet of Things." As described in this application, the architecture optimized for the Internet of Things necessarily entails a widely distributed topology relying on simpler chirp protocols, especially at the edges of the network where the machine-to-machine communications predominate. Intermediate network elements perform information propagation, manage broadcasts, and provide protocol translation. Another class of devices house integrator functions providing higher-level analysis, for both near-edge analytics and broader-scope analysis. Small chirp data provides the necessary information for analytical systems.

The system as described in the application is described using certain analogies, such as the propagation of pollen, and interaction of social insects.

This application describes reasons why a different architecture is needed for the Internet of Things. The architectures described can coexist with existing incumbent networking protocols. In one embodiment, the architecture comprises integrator functions, propagator nodes, and end devices, and their interactions.

SUMMARY OF THE INVENTION

This invention addresses multiple embodiments. The methods taught address a variety of current networking challenges, specifically for mobile, temporal, or isolated networks, as can occur when a collection of wireless nodes is moving. These networks are mission critical, often requiring multiple connectivity media. Approaches for such networks are described in figures 9, 14, 15, 25, 39, 44, 45. As shown in those figures, the networks are often hybrids, involving both humans and machines. The machines may use IP or non IP (machine native) protocols. Such protocols are suitable for terse machine-to-machine (M2M) messaging and may use separate physical radios as shown in figures 22, 23, 25, 62, 63. Alternately, they may collaboratively share the same physical radio as shown in figures 32, 33, 39. Such a one-radio embodiment may use collaborative scheduling shown in figures 65-67. Lastly a Network Management System (NMS) framework must support clients which include humans, machines, routers and applications in the routers supporting terse M2M messaging, as hown in figure 12, element 060.

These diverse requirements are supported by a service delivery framework for network participants comprising mesh nodes (in one embodiment) wherein each mesh node supports wireless clients. The features implemented in the architecture include:

Logical Radio Routers Figures 1 through 8 depict one logical radio abstraction to support diverse client connectivity needs. Figures 9, 13, 14, 15, 25, 44, 45, 56 through 63 explain certain other embodiments. Figures 5, 6 depict the analogy to tree based wired switch stacks. The analogy to ports on the switches is made in Figures 9, 38 through 42. Figures 13, 14 ,15, 16, 44, 45 depict mission critical embodiments. Home or office application are shown in Figures 22, 23, 56 through 63, 68, 69.

Efficient Terse Messaging Transport Figures 10, 11 12, 24, teach concatenation for latency bound transmissions of terse M2M messaging, an embodiment of particular importance to VOIP packets.

Modular Nodes based on U/D/S/A Figures 17, 22, 23, 26, 38, 39 through 45, 63 are embodiments of modular frameworks supporting the logical radio abstractions of Uplink, Downlink, Scanner and Access Point. Failover and dynamic options from one uplink port to another is depicted in Figures 9, 21, 41, 42, 44, 45. Dynamic reconfigurable ports and sharing of U,D,S,A functions are depicted in Figures 9, 41, 42, 44, 45.

Isolated Network support: Figures 27 through 29 teach methods for Distributed DHCP address generation needed in mobile, temporal or isolated networks. Other applications are depicted in Figures 26, 39, 44, 45. Finally, Figure 27 depicts the SIP registry for M2M messaging, e.g. VOIP.

Remote Management Figures 18, 19 describe embodiments for remotely programming clients. Clients include mesh router applications, element 060 Figure 12. Programming applications or rule based directives is taught in Figures 30, 31. The NMS based application support framework is depicted in Figure 52. It extensively uses Local and Global Streams, Figures 48, 49. Intra router communications is implemented using terse UDP-based "heartbeats," Figure 54. It is open and customizable and used for other M2M messaging. Stream Readers are used to translate and communicate with native formats, Figures 50, 51, 52. A published NMS API, Figure 53, enables custom and domain specific NMS development, see Figure 55.

Application-Aware Mesh Control Figures 12, 20, 43 depict facets of the Mesh Control Layer that manages mesh topology first introduced in Figure 1. The control layer is radio and protocol abstracted. It supports both IP and non-IP client devices and applications.

Chirp Device Registration and Discovery Figures 64, 70 describe a topic-based addressing scheme that does not require IP based addressing schemes. Instead the nature of the device and its function, define its genus. Categories may be defined or created using the SIP/DHCP services depicted in Figures 27, 28. Figures 56 through 63 depict embodiments for such low-cost chirp devices. Category based information, e.g. "small data" is available within the M2M network for autonomous pattern discovery and machine control, see Figures 68, 69, 70.

Latency Sensitive Messaging Figures 56 through 63 depict embodiments of devices participating in a dynamic M2M publish subscribe exchange. Terse M2M messaging between devices includes latency sensitive traffic, see Figures 25, 56, 68, 69. Figure 71 shows chirp packets enter the propagator from both local and remote publishers (elements 7110 and 7120 respectively). The latter is containerized as a bus-load for efficient transport, 7120. Inside the propagator, port forwarding tables define the locations of interested subscribers. The bus containers may be reconstituted, in alignment with the current dynamics of the pub-sub exchange. Further processing includes removing chirp packets that are duplication or are no longer desired (such as for those packets that arrived out of order or contain information that is no longer current). In one embodiment, heart beat packet duplicates are discarded at each mesh node. The reconstituted bus containers are then sent out to both local and remote subscribers 7140. As shown in Figure 72, the top level view of the entire M2M service delivery framework consists of simple terse messaging devices 7210. Further included in the embodiment are propagator and bridging Mesh Network elements 7220 which incorporate agents. The agents are implemented within the nodes 7225. Agents act on behalf of big data subscriber requirements 7230.

BRIEF DESCRIPTION OF DRAWINGS

In order to more fully describe embodiments of the present invention, reference is made to the accompanying drawings. These drawings are not to be considered limitations in the scope of the invention, but are merely illustrative.

FIG. 1 illustrates how the network topology is changed by selecting a different backhaul in a two-radio system, with one link to the backhaul AP and the other link servicing the child AP. It depicts four network topologies. Each of the four network topologies provides a different set of performance in terms of latency and throughput. The mesh control software adjusts the latency and throughput parameters to meet voice/video or data performance requirements in terms of latency and bandwidth.

FIG. 2 contrasts the conventional "Dual Radio" mesh with the Logical Two-Radio Mesh. On the left of FIG 2, two radios labeled 010 and 020 provide client connectivity and ad hoc mesh backhaul functionality, respectively. All the mesh backhaul radios (020) are on the same channel depicted by the clouds of coverage of the same color (030). They are all part of the same sub-network. In

contrast, on the right of FIG 2, the same radio (025) provides service to clients and also backhaul functionality but operates in different sub domains depicted by different color clouds of coverage (035). The left hand resembles a network hub, the right side a high performance network switch. Hubs are not scalable.

FIG. 3 compares the two-step process of a single radio relay to a two-radio relay. On the left side, (010) a single radio relay is shown. Every packet received has to be re-transmitted on the same radio. Thus the bandwidth with every hop in a single radio mesh network is reduced by approximately 50%. After three hops, the Bandwidth would be an eighth of what is available at the Ethernet backhaul. On the right side of FIG. 3 (020) a two-radio backhaul is shown, where packets received on one radio are re-transmitted on another radio operating on a non-interfering channel. In this configuration, there is no bandwidth reduction with every hop and bandwidth is preserved with every hop. Two radio mesh backhauls are scalable while single radio backhauls are not.

FIG. 4 shows how the structure of two-radio multiple hop mesh network where each two radio unit services a Basic Service Set (BSS) by configuring one of the two radios to serve as an AP to its clients. Clients may include the second radio of another two radio system, with this radio configured to run in station mode, providing the backhaul path back to the Ethernet link. In the insert, the uplink radio (labeled 010) connects to the parent mesh node while the downlink radio (labeled 020) acts like an Access Point to client radios, including other mesh nodes that connect to it through their uplink radio. Note that all service radios (020) operate on different non-interfering channels, depicted by different color ovals.

FIG. 5 shows the similarities between FIG 4 and a wired switch stack with the same chain of connectivity 040-050-060. Both have the same tree-like structure and up link and down link connections. In both cases the units (040,050,060) operate on a distinct sub domain.

FIG. 6 illustrates one embodiment of the two logical-radio approach with three physical radios. Two radios constitute logically one radio of the two logical radio concept, while the third physical radio serves clients as the second radio of the two logical radio concept. By eliminating the sharing of physical radios for both backhaul and client services, the backhaul bandwidth is improved and also reduced the dependency to use the same type of radios for the backhaul and for clients. In the insert, the uplink radio (labeled 010) connects to the parent mesh node while the downlink radio (labeled

020) connects to the uplink radio of child mesh nodes. The service radio (labeled 030) act as Access Points to client radios shown as triangles. One such is labeled 040. Note that all service radios (030) operate on different non-interfering channels, depicted by different color ovals.

FIG. 7 illustrates another embodiment of the two logical radio approach but with five physical radios. The uplink and downlink radios (shown as one radio Fig. 6) are split into two radios, in this embodiment, with each responsible for one direction of traffic. Bandwidth is doubled and latency halved, since traffic in the opposing direction now has its own channel or logical "lane". Thus, the radio labeled 010 in Figure 6 is now radios 012 and 010. Similarly, the radio marked 020 in Figure 6 is now split into radios labeled 022 and 020. The radio pairs 012-010 and 022-020 provide the same functionality as the radios labeled 010 and 020 in Figure 6 but with twice the bandwidth and approximately half the latency.

FIG. 8 is an extension of the five-radio embodiment shown in Figure 7. In Figure 7, there is one service radio to service both voice and data clients. However voice and data traffic has different performance requirements. By having different Access Point radios service the voice and data clients, the contention between voice and data packets attempting to gain access to the same medium is reduced. Also, with different radios servicing the data and voice clients, the voice and data packets can now be treated differently. The Access Point radios servicing the voice clients could therefore be operating in TDMA (time division multiple access) mode while the AP radio servicing the data clients operates in CSMA (Collision Sense Multiple Access) mode. The two radios (032) and (034) thus provide different functionality. VoIP devices such as phones connect to the former, data devices such as laptops to the latter.

FIG 9 is a five-radio extension of the three-radio configuration shown in Figure 6 but with more dedicated service radios operating on different frequencies for different types of client radios.

FIG 10 shows the maximum VOIP bandwidth available per client, using 802.11 radios, as the number of clients increase, as measured by the size of the packet that each client can send every 20 ms. As the number of clients increase the size of the packet - and the associated voice quality - drops dramatically. In one embodiment, to achieve 64 Kbps voice quality, an 802.11b radio can support around 25 clients.

FIG 11 shows the maximum VOIP bandwidth available per client, using 802.11a radios, as the number of clients increase, using the same packet size metric sent every 20 ms. As the number of clients increase the size of the packet - and the associated voice quality - drops dramatically. In one embodiment, to maintain 64 Kbps voice quality, an 802.11a radio can support around 55 clients.

FIG. 12 shows extensions developed and implemented in the mesh network stack to provide an efficient backhaul for voice. The small voice packets are concatenated into larger packets and sent (as one packet) at regular intervals to the backhaul radios. At each mesh node voice packets intended for that destination are removed and the rest sent back (as one large packet).

As explained below, the embodiment includes a Packet classifier (labeled 010) that recognizes voice packets based on size and regularity of transmissions. A VOIP concatenation engine (labeled 020) "container-izes" small voice packets into a larger "container" packet for more efficient transportation. Real time extensions (labeled 030) to the Linux kernel enable the system to provide near real time performance for sending and receiving the latency sensitive VOIP container packets through the network - regardless of what the Operating System is doing at the time.

Application driven rules and Scripts are resident in device abstracted APPLICATION layer library 060, a supervisory control layer above three lower control layer modules: TCP/IP, MESHCONTROL 040 and SCAN 050. Direct Machine to Machine (M2M) communications are controlled by APPLICATION over the Software MAC layer. The Software MAC Layer is typically running at the Kernel level of the software platform, requiring LINUX KERNEL EXTENSION 030. These extensions enable low level, fast applications/algorithms, operating at close to port forwarding tables, operating at (Kernel level) Drivers for Ports 080. The APPLICATION layer is analogous to the Control Plane in the SDN paradigm. The control plane manages the buses, Fig. 72 needed for real time M2M messaging for industrial applications Figs. 56, 68, 69, down to port level routing. The TCP/IP layer supports AAA audit trails and AES encryption 090 so the Application Service Delivery and Deployment is securely managed.

FIG. 13 shows the concept of a "Hybrid Mesh network" where two-radio systems provide two types of service. In one case, they are part of an infrastructure mesh as shown by the two-radio mesh node labeled 010. In another embodiment, the same node may be dynamically reconfigured to support ad hoc peer-to-peer connectivity. The node labeled 020 (marked as E8) has two radios. One is intended

for client radio connection to infrastructure mesh nodes - see the radio labeled 030 on the unit marked E9. The other provides a peer-to-peer mesh capability, as shown by radio labeled 040. Depending on the needs of the network, the two-radio units are dynamically re-configured to support either need, infrastructure mesh (010) or backhaul support to ad hoc mesh (020). Labels 050 and 060 designate connected and broken ad hoc mesh links.

FIG. 14 is an application of the Hybrid Mesh concept to a Public Safety embodiment. The node labeled 010 is a Stationary node on top of a light pole, in this embodiment. A mobile embodiment shown as labeled 020 is entering the building (arrow) such as when carried by firefighters. These mobile units are also called "breadcrumb" routers. The Mobile Mesh nodes provide connectivity to two-radio portable units worn by the firefighters in this picture. All firefighters are thus connected to themselves through a peer-to-peer mesh network shown as a thin line. They are also connected to the Infrastructure mesh backhaul through one or more connect points. This ensures redundancy in network connectivity. The broken link (labeled 060, Figure 13) is avoided.

FIG. 15 is an application of the Hybrid Mesh concept related to a Battle Force Protection embodiment.

FIG 16 depicts an embodiment using mesh nodes which feature four radio slots used in the modular mesh framework of Fig. 17. There are two slots for radio cards on the front and back. Up to four radios 010 are thus supported on a single embedded systems board. The radio card antenna connections 030 are included for four radios. Two Ethernet ports 020 provide wired access to provision wired uplink and wired service access.

FIG 17 indicates the modular mesh framework, whereby a four slot board, as shown in Fig. 16, may be configured to provide different functionalities: Two radio Backhaul (BH) 010; three radios BH+AP 020; four Radio with BH AP and Scanner 030; four radio with Full Duplex (FD) using a coupled two radio BH 040. Further, since the modular mesh framework always forms a tree, these nodes are part of a switch hierarchy, as shown in Fig. 5.

FIG 18 depicts how the installation software is tagged to both the radios and board characteristics. It shows a serial line connected to load the boot loader program, after which the Ethernet port is used to complete the software installation and branding process. Compiling the install program on the

board it is intended to run on performs this function, thus creating a unique software image.

FIG. 19 is a view of the flash deployment software developed and implemented to ensure that software generated for the install of this board cannot be used by another mesh node. When the software installation process begins, the software is compiled on the board it is intended for and the compilation process is unique since it is based on a number of unique factors. The software is generated on the board that it is intended to run on - to ensure that the software image cannot be used to run on another board, thus preventing both software privacy and dissuading theft of the mesh nodes.

FIG. 20 shows that the Mesh Control Software sits above the Media Access Control (MAC) of the radio. As such it is radio and protocol agnostic, in one embodiment.

FIG. 21 shows how channel interference is dynamically managed in the logical two-radio system.

FIGS. 22 and 23 introduce an embodiment bridging across diverse wireless medium using the example of an N-Logical wireless medium bridge, referred to as the "nightlight." In one embodiment, the nightlight serves as both range extender and intermediary between device "chirps" and more conventional, IP based, communication devices and protocols.

FIG. 24 shows the synchronization of multiple voice devices accessing the same wireless medium with a focus on the time for bulk receipt of packets that are shared among the separate devices.

FIG. 25 shows a voice device talking to a dedicated voice radio and data devices taking to a data radio, with one phone 2501, capable of taking to both 2502 and 2503 in one embodiment. The night light embodiment 2504 manages both voice and data transceivers, in the depicted embodiment.

FIG. 26 depicts the dynamic collaboration tree for an exemplary supply chain application, where routers support modular U,D,S,A functionalities and messaging is driven by collaborative scheduling, as detailed in Figs. 65, 66, 67.

FIG. 27 shows an isolated mobile network cluster and communication within it using VOIP phones.

FIGS. 28 and 29 describe an embodiment wherein isolated network clusters may converge with distributed DHCP services and inherent conflict resolution using randomized sub net address ranges.

FIGS. 30 and 31 depict the process of generating an OS-independent image for secure small footprint devices and an exemplary graphical programming environment for simple sensory devices, in one embodiment.

FIGS. 32 and 33 depict device repeaters and range extenders. Conceptually these devices are similar to clients, such as the soldiers in the battle force embodiment shown in FIG. 15. The range extenders provide blind repeating and therefore range extension for remote devices. They also serve as a redundant path, similar to FIG. 13 but employing a single physical radio. Thus, in chirp language, they are birds that repeat and relay a bird song in string of pearl configurations.

FIGS. 34 through 36 depict representative IP based "light" or low payload packets that may be used to transport chirp data over an IP based network. 802.11 packets are used as examples. Chirp data is encapsulated in such packets for onward transmissions, in unicast, multicast or broadcast modes, in search of flower/agents/tunes/subscribers interested in the chirp/pollen. In one embodiment, chirp devices use such innocuous frames to transport payload - only chirp aware routers know how to recognize them as chirp packets and process their (secure) routing to appropriate agents accordingly.

FIGS. 37 through 38 map the equivalent slots/ports of wired and wireless switch equivalents as shown in Figs. 4 and 5.

FIG. 39 shows how logical radio modes, Uplink (U), Downlink (D), Scanner (S), Access Point for Service (A) map to physical transceivers in single radio and multi radio mesh node embodiments. The joining of tree branches 3950 to tree trunks 3960 is aided by common routers 3952.

FIG. 40 is a simulation of a representative prior art mesh routing algorithm and its comparison to tree based routing of Fig 4. The thicker blue lines in Fig 40, 4040 denote the minimal spanning tree. Note the dashed lines have to be additionally recomputed for each node in prior art mesh routing. Performance deteriorates exponentially as O (n^2) where n is the number of mesh members.

FIGS. 41 and 42 depict a switch equivalent of logical radios operating in both wired and wireless

mediums/channels, using Logical Radios Uplink (U), Downlink (D), Scanner (S) and O(n) routing. The logical radio switching module (as an insert in one embodiment) is introduced.

FIG. 43 is a schematic of how the abstraction layers for logical radios may themselves be combined to create more complex abstractions. Element 4320 refers to two abstractions AP (also in Figs. 12, 17). The "bridge" is a combined logical radio abstraction, similar to the Uplink and Downlink (U+D) backhaul, but bridging over disparate frequencies and protocols.

FIG. 44 shows the bridging function (as described in Fig. 43). Mobile node 4455 switches from "blue" 5.8G backhaul to a "pink" 2.4G backhaul. The sub tree beginning with mobile node 4457 is thus operating on a non-interfering channel/frequency/protocol. The static counterpart is 4460.

FIG. 45 depicts a "string of pearls" configuration of static mesh nodes. A mobile mesh node, traveling at 60 mph makes temporary connections with each node in the string. Switching from node to another is seamless and unbroken, as noted by the video output below. The process is repeated with single radios embodiments, using logical radios. Bandwidth degraded along the string of pearls, as expected, but video output was still jitter free and unbroken, due to proactive Scan Control, Fig. 12, Logical Radio abstractions and the benefits of O(n), tree based routing.

FIG. 46 depicts the dependency of latency sensitive traffic to the network tree topology, specifically, the number of siblings in sub trees along the route to the destination node/parent/root.

FIG. 47 depicts the use of a reserved time slot for transmitting bulked, latency sensitive data, whereby clients remain silent during transmission in this time slot. The time slot allocations may be fixed or variable. In one embodiment it is dynamically managed by Collaborative Scheduling.

FIG. 48 depicts broadcasts/streams restricted to a region. The region may be defined by geography, membership and mesh topology e.g. restrict the number of hops or sub trees. Further, the region may include directions: up/down or a set of turn by turn directions. An example of regional streams may include a section of the home, where only siblings of a sub tree require particular data stream. Note that backhaul bandwidth is not affected outside stipulated regions. Restricted broadcasting improves overall network health.

FIG. 49 is effectively the reverse of Fig 48 and is global: e,g. not restricted. Tree based topologies favor global broadcasts. Streams from the root are always downwards. While streams from nodes may be either, they are typically upwards. The majority of devices populate the edge of the network and their pollen is typically upward bound, necessitating bulking, exception handling and deterministic time mail delivery along the route.

FIG. 50 depicts the Stream Reader, an agent authorized to peer into network router transmission and receiving packet queues, prior to their onward transmission through the network. Like Post office sorters, they identify and sort packets for scheduled deliveries, prune dead letters, duplicate messages etc. They also provide decoded outputs for Stream viewers, a custom GUI for the data. Stream readers may also forward output to other readers, mail boxes or messaging systems.

FIG. 51 depicts a circuit diagram of Stream Readers and their associated Stream Viewers, wired together to provide a capability, in this case "feeding" a section of the composite view ports 5190. The composite view port is back drivable since its connection may be to real or historical data.

FIG. 52 depicts the adapters and API interface components that provide an extensible, open library of stream reader and viewers. This enables the rapid prototyping of custom circuits to provide specialized competencies. The view port additions enable human participation in managing the network health. This includes, through adaptor view ports, all assets of the network and their health.

FIGS. 53 and 54 depict the published interfaces for the Network Manager Streams API and the Heart Beat Entity relationships, respectively. Together, these facilitate speedy viewport development.

FIG. 55 depicts an embodiment of methods outlined in Figs. 47 through 54. 5530 depicts the current mesh topology in dark lines. The lighter lines are alternatives gleamed from mesh node heart beats, which in turn was gleamed from SCAN agents, Fig 12. Clicking on a mesh node brings up its machine status 5520. This includes applications resident on that router. Recent heart beat log shown in 5540. Green light 5540 indicates that heart beat based algorithms infer the node is healthy e.g. multiple alternate parents, strong signals.

FIG. 56 compares contemporary thin client, single control loop architecture to a dual control loop, with a membrane separating the two control loops but, through the chirp to IP bridge/membrane,

there is bidirectional, pruned and selective traffic, based on collaborative scheduling of bus schedules in both directions. Note that the two control loops are working on their own frequencies but neither is waiting on the other, see also Fig 46. This predicates the need for a "hub", e.g. Propagator. They also serve as bridges between the upper control loop, IP based and lower, tighter (low latency/isochronous) control loops preferably in more efficient chirp protocols. Note that the overhead of converting raw, machine specific raw data to a more palatable device abstracted format (e.g. small data) is performed within the cloud in the single control loop model, (left) and delegated to propagators in the other (right). Further, the lower control loop, between propagators and devices can be low latency/isochronous while the upper control loop focuses on more infrequent high level tasks: performance tracking, exception handling system updates (event based, low latency), routine hourly reports (large interval periodic).

FIGS. 57 and 58 depicts a burgeoning market place "exchange", where the confluence of multiple sources of terse but potentially rich content streams, often in organic protocols occurs at propagator trees. The root node serves as the Chirp to IP bridge/membrane. Small data is progressively refined and pruned, in proactive manner, as data moves upstream, like salmon upstream.

FIGS. 59 and 60 depict a publish/subscribe exchange/market supporting multiple devices and integrators each operating in their own private communities/ but also part of the same logical exchange.

FIG. 59 is an example of a small "exchange" of multiple data streams, operating on different, non-interfering wireless media. The "vital signs" Integrator is fed exception and periodic, non urgent pruned data from the propagator. The exchange between device and integrator is managed by having two segmented control loops, maintained by the propagator.

FIG. 60 is an example of a proactive control system, operating on the confluence of both local and external data publishers. The propagator, with appropriate transceivers, picks up multiple sensor streams, from a grid of diverse sensor types. Local Integrators/Agents residing in the propagator, can quick discern patterns and overall state of a large area- since small data is being generated and shared across a local mesh network, see Figs 57 through 58. Local data streams are consolidated to provide a composite view of the region of interest. This feeds a second control systems where big data publishers provide a more global perspective. Thus, weather forecasts predicting rain, can cause

the cloud server to direct the propagator network to direct which section of the corn field need additional local irrigation.

FIG. 61 depicts the simple circuitry needed to mass manufacture very low cost, low footprint, light chirp or "pollen" generators.

FIG. 62 depicts a first layer, rudimentary small data generator, where sensor fusion/consensus generates early warning signals with fewer false positives. The propagator and first layer integrator may be bundled as one device, servicing both single and multi-sensor subscribers in the local meshed network and beyond.

FIG. 63 depicts a modular four leaf clover like propagator, with 4 independent transceivers, 90 degrees rotated from each other. The 4 transceivers may be logically assigned uplink, downlink and scanner functionality, based on where the clients and relay node parents are located and the current network routing priorities. The transceivers may be dynamically and logically reassigned as the network topology changes or as clients migrate into and out of the network. Note that, as other 4 port devices depicted in this application, there is only one uplink per the 4 leaf clover design- it is scalable tree architecture. One layer is shown - overlays of such devices cover different wireless transmission media (e.g. Infrared LEDS for Chirp and Bluetooth for IP networking). A stack of such four leaf transceivers than thus service both Chirp and IP clients, including other propagators. Routing is shown as lineage based, so siblings are distinctively identified. In one embodiment the unit is autonomously rotated to better align Uplink and Downlink radios to see alternate parents, 5530.

FIG. 64 depicts one embodiment of category classification based approach to publishing M2M data. The Marker Pointer tells the router/propagator/agent where to look for the type of Pattern being used. Thus Marker patterns located at Byte 6, would be part of the 6.X… family. A 4 bit Marker pattern value of 15 would imply that data being published is part of the 6.4.15 family. This coarse granularity may be sufficient to route the published data in the general direction of interested subscribers. Further levels of finer granularity are available to agents aware of what Marker Pattern 15 signifies e.g. how the category data in the 6 bytes of (open but cryptic) finer classification data are expected to be read.

FIGS. 65 through 67, relate to the distributed collaborative scheduling engine. Fig 65 is the starting condition where each task is taking just a little longer than expected. The usual first in first out queue, see Fig. 66, results on excessive delays further out for entities at the tail of the queue. Fig 67 employs collaborative scheduling to balance out and maintain overall "customer satisfaction". Two tasks are "stacked", because they are contending for the same resource a portion of the time. Stacking implies more resources are needed. When the resources are limited must be shared, this is not an option. As an example, consider the case of chirp devices and IP devices sharing the same wireless channel. Collaborative scheduling shifts the two tasks in opposite directions in time, to remove the stacking. The shifts are based on shifting those task start/end times within "Customer Satisfaction" constraints defined by the blue/red ranges for the task. In one embodiment, schedulers runs at each mesh node, thereby providing dynamic scheduling services for all packets entering or leaving the mesh node.

FIG. 68 depicts application use cases that highlight the shared publish subscribe exchange through which small data reaches big data subscribers and their analysis/inference engines. A low cost lawn sprinkler actuator is controlled through a local control loop 6910, a remote control loop 6930, conversing through a shared publish-subscribe exchange, 6920. Upstream to the actuator valve a water pressure sensor is depicted, 6922 as is a down stream water flow sensor 6924. Both sensors reside within the local (and secure) M2M home community and their (subscribed) chirps are part of scheduled pub/sub exchange 6920. The lower control loop vocabulary is limited to actuator commands 6915, (e.g. ON, OFF). The system has no way of knowing whether the lawn sprinkler is functional, without accessing information from the larger M2M community. When chirp data is time tagged, then causal analysis indicates that if the upstream water pressure is "good" and the down stream flow is "bad", then the actuator is worn out and needs replacement, see 6835. A local integrator agent, 6837 may also, through access to the shared pub/sub stream, 6920, be directed to perform this check each time the valve is activated, thus reserving internet traffic for exception handling. Thus an intelligent valve actuator emerges, without additional hardware/sensors at the actuator. Dual control loops thus provide intelligence without adding to the cost of the device.

FIG. 69 depicts how discovery of related sensory streams can drive more refined control models for M2M Enterprise. The initial application is Air Conditioning control for a large building, 6910. The integrator agents, through the shared chirp classification streams, discovers other local subscribers to the energy usage/cost data 6920 active in the same building. Further analysis of their activities

indicates that the front door elevators are active the same time that the heating/cooling in that zone is "unstable", 6930. It also can correlate night time activity, when lights are turned on 6940 in zones that need to be activated, when the lights are on. Hence multiple, related subscriptions now drive a refined control model for air conditioning, 6950. Note that human "experience" would arrive at the same conclusions over time but machines, through their subscriptions and pattern analysis are able to close the loop semi-autonomously or autonomously. Further, the causal analyses/inferences gleamed from one building may be transportable across related domains.

FIG. 70 depicts how discovery is engendered through the chirp classification system in one embodiment, see also Figure 64. In Figure 70, the 4 bit marker pointer 7010 has a bit address of 1010, indicating an 8 bit marker pointer 7030, at the end of the packet with its agent ID of 255. This means that the public section 7020 is 4 bytes long. The coarse classification is thus 4.8.255, sufficient for pub/sub bus schedules to deliver the chirps to hubs and clearing houses, see 7050. Those who have subscribed to Agent 4.8.255 may then be able to decipher the container further. For example, Agent 48.255 states that each of the 4 bytes is a further classification, see 7060. The full chirp classification is thus 4.8.255.22.243.16.23. Note that without access to the agent, though a subscription, this level of detail is not possible, since how the data is internally formatted within the 4 bytes is not known a priori. 4 bit marker pointer may be used for common and free formats while 8 bit markers, 7030 are used for subscription based services, in one embodiment of this invention. The same process applies to the (private) payload 7040 and 7080, where additional agent subscriptions are needed. Thus the level of shared information may be incrementally controlled within an M2M social community operating at the edge. Note that a larger 8 byte chirp (e.g. 8.8.X.) may also choose to use multiple agents with one agent pointing to another within the same packet. The incremental control of information shared is thus implemented in multiple manners.

FIG. 71 shows chirp packets enter the propagator from both local and remote publishers 7110 and 7120 respectively. The latter is containerized as a busload for efficient transport, 7120. Inside the propagator, port forwarding tables define the locations of interested subscribers. The bus containers may be reconstituted, in alignment with the current dynamics of the pub-sub exchange. Chirp packets that are no longer desired or duplicates. For example, heart beat packet duplicates are discarded at each mesh node. The reconstituted bus containers are then sent out to both local and remote subscribers 7140. Subscriber interests are provided by both local and remote agents of integrator functions, 7050. Since chirps are category based, the protocol handlers (on both sides of

the Chirp/IP boundary) are logically part of the same publish subscribe bus system, with buses operating at different schedules in both networks. In one embodiment, bus schedules are managed by a distributed scheduler, such as the embodiment of figs. 65 through 67. An Analogy would be nation wide bus services involving both greyhound (IP) and county (chirp) bus services collaborating on bus schedules to minimize overall delay, based on current traffic supply/demand.

FIG. 72, a version of Fig. 58, depicts the top level view of the entire M2M service delivery framework consisting of simple terse messaging devices 7210. A propagator and bridging Mesh Network 7220. This includes agents resident on the nodes 7225, see also 7050 of Fig. 71. Agents act on behalf of big data subscriber interests 7230. The propagator and integrator functions are thus closely coupled, down to the network port forwarding tables. This engenders efficient, latency sensitive, "small data" flows.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

The description above and below and the drawings of the present document focus on one or more currently embodiments of the present invention and also describe some exemplary optional features and/or alternative embodiments. The description and drawings are for the purpose of illustration and not limitation. Those of ordinary skill in the art would recognize variations, modifications, and alternatives. Such variations, modifications, and alternatives are also within the scope of the present invention. Section titles are terse and are for convenience only.

The following concepts are applied in the embodiments described below:

1. Logical Radio Routers
2. Efficient Terse Messaging Transport
3. Modular Nodes based on U/D/S/A
4. Isolated Network support
5. Remote Management
6. Application Aware Mesh Control
7. Chirp Device Registration and Discovery
8. Latency Sensitive Terse Messaging

This section applies those methods to transport "chirp" broadcasts akin to VoIP packets from "chirp"

device networks to co-existent and incumbent IP based network devices and protocols.

Raison d'être for Chirp Protocols

Traditional networking protocols/techniques, specifically IP-based protocols, originated from s*ender-oriented* communications. They emulated legacy frameworks of human-human networks to support human-to-human correspondence. Thus the methods of routing postal mail resulted in email. Emails are sender oriented. Sender oriented communications are intended to be read by stated intended recipients only. It is not lightweight: it contains destination addresses and potential encryption so they are not tampered by hackers. They were historically point to point communications.

With all this overhead in place, on every packet basis, IP based routing protocols favor economies of scale in moving large packets, preferably with best effort only. When QoS is required (latency/jitter/assured delivery) IP protocols extract a premium. Small packets are also charged a premium because the "standard" minimum packet size was not designed with them in mind. Traveling inside the minimum size, they have to pay the same price in transmission time and bandwidth requirements as the "standard" minimum.

This adversely affects the delivery schedule of lightweight packets (e.g. VOIP, Figs 10, 11) that travel no faster than large packets, through no fault of theirs, other being smaller than the standard packet size. Hence container based transport for VOIP, Figs. 10-12 are discussed in referenced applications. Filling the packet container reduces the "price" per VOIP packet and also ensures reliable (assured latency/jitter) delivery. Without containerization, client capacity rapidly deteriorates, Figs 10-11. The IP highway is not suited for short chirp like devices, whether they are VOIP packets or other types of small-payload transmissions.

In addition to favoring larger packet sizes, retries (as in birds chirping repetitively) are frowned upon. Resending large packets increases traffic and TCP/IP overhead costs are based on a low number of retries. Further, retries are discouraged because they may flood the network e.g. broadcast storms. Retries are the exception, not the de facto modus operandi. Hence various forms of "virus" checks on email, file transports etc. are used. Since small packets are treated as one large packet, any device that begins to "chirp" like birds who chirp blindly and repetitively are costly especially when

these chirp-like packets are travelling solo, Figs 10-11 and hence the value of concatenation and scheduled transmissions of larger packets see 020 in Fig 12.

In contrast with legacy networks, communications that uses retries and over provisioning/broadcast storms are common in nature. For instance, pollen distribution by plants is not sender oriented. Instead, as many messages are sent as possible, in all directions. Note that these storms (e.g. pollen, monsoons) are seasonal, their time to live functions are encoded in their design. Parameters for these information containers do not have to be explicitly stated in each packet header. Pollen has its time-to-live function genetically encoded in it. Beyond that time it is ineffective. No network flooding can occur, despite over provisioning. Broadcasts are managed at a distributed systems level through the mesh control layer, Fig 20, not on a per packet basis. Now, flooding can be contained, as in nature.

Further, nature's "packets" are receiver oriented. Pollen is promiscuously propagated, witness the temporary broadcast storms called allergy season. It is the receiver that has the (genetically encoded) secret handshake to unlock the pollen packet data. Sender data need not be encrypted.

In nature, receiver oriented security enables pollen to be lightweight (terse) and carried far by even low power winds. Further, pollen is reasonably patient or latency indifferent. As long as winds appear within pollen season, spring will occur. Light weight chirps/pollen are thus secure and lower Total Cost of Ownership (TCO) based on their lightness and "patience."

In the world of Internet of Things (IoT), there is a need to be able to support lightweight chirp-like data without unduly taxing either the incumbent IP based networking protocols or the "chirp" device. This network protocol would support economical and effective transport of small, terse, repetitive chirps. In many cases the chirps are latency indifferent. Further, they would allow varieties of subscriber driven (receiver oriented) temporary broadcast storms without adverse effects.

DNA based Genus Classification

Routers/Propagators, need some pollen “genus” or category or description to enable the match making. What does this descriptor look like? Bird chirps serve as an analogy. Bird chirps are categorized, based on studying individual bird categories. We can identify the bird type from its

chirp/tune/melody. Hence those subscribers interested in melodies from doves, can now receive those recordings, based on bird category. The categories will have to support different levels of granularity - some bird enthusiasts are only interested in doves near their homes. Hence the category field, should be sufficiently flexible in design, to support further drill down.

In both melody/tunes and DNA structures, there exist "marker" strands of information that provide a common pattern across members of the category. These markers occur at specific locations and are of specific patterns. Thus, some categories may be described as those that have a 8 bit marker, always in the 4th byte of the bit stream. Thus the classification could be 4.8.XX.XX, where XX are more levels of granularity that may be gleaned from knowing a specific pattern type and what it entails, in terms of how to further classify the public (no security but not necessarily universally decipherable) category field.

Subscription based granularity Finer granularity is simply a matter of loading the appropriate agents who can recognize and sort based on information unlocked by the marker templates. Markers may be used in both public and private sections, Fig. 64. Agents unlock those patterns, based on access to Marker data formats to generate a finer granularity category/payload. In Fig. 70, the public category 4.8.255 7050 is sufficient to get the pollen to the **4.8.XX** "bus stop". Agent 7060 then provides the data format to identify pollen as **4.8.255.22.243.16.23** 7070. The publish subscribe exchange can thus support M2M flows shown in Figs. 68, 69 at varying levels of granularity. The payload is still secure, with its own agent 7080.

Low Overhead Routing is now possible: a quick bit mask on incoming chirp packets, Fig. 71 filters all publishers for **4.8.255**…. Further filtering may require addition agent subscriptions e.g.

4.8.255.22
4.8.255.22.243 …

In one embodiment, Public classifications provide at least 3 levels of addressing (e.g. 4.8.255) and potentially the complete DNA strand/signature, based on agent subscriptions.
The number of sub genus categories (e.g. 3 for 4.8.255) needed to more tightly define the zone of publisher interest is diverse. It is based on subscriber interests and mesh topologies see Figs. 13, 39, 59, 60, 63, 68, 69. The nature of sorting, aggregation, filtering chirp data favors hubs along the

router mesh tree. As described in referenced applications, natural "hubs" emerge, where it is more toll and hop cost effective to place agent for rerouting and reloading buses, Fig. 71, and agents will move to propagator nodes based on demand/supply and toll/hop costs, see Appendix A, 10/434,948.

Finer granularity costs requests follow the same toll hop costs and driven by the same economics: some applications/agents will work with "cheaper" but still relevant data some "hops" away. Other traffic may be more latency/jitter sensitive see Figs. 56, 68, and onwards. In one embodiment, packets are cloned at each junction of the mesh tree, to support multiple subscribers and routes. Pollen subscriber thus are dynamically driving the "wind" of bus loads, their contents and their frequency, at concurrent multiple levels of granularity, Fig. 71, 72.

Inherent Security of Chirp Protocols

Encapsulating Chirp Packets Chirp data transport involves traversing the IP network, in some embodiments, and are thus susceptible to snooping/hacking. But this is not your typical IP data packet since the data is based or Chirp/Pollen-ID and/or Flower/Agents-ID etc. These are not typical IP or MAC-ID type Sender/Receiver Address Frames, Figs. 34 through 36. The same format is also available for chirp devices:

a) The IP Destination Address (if applicable), and can include other addressing information depending on the type of transmission involved - e.g. unicast, multi-cast or broadcast, 3520,
b) Chirp-ID (in the Sender Address frame, SA, 3522),
c) Agent-ID being sought (in the BSSID Element, 3524)
d) Any other use of the IP frame formats, recognizable by an agent.

All options (and their variants) exist within the exemplary Action Frame format, suitable for transmission over standard WIFI networks.

In one embodiment, Fig. 36 shows a measurement request action frame, 3630. These management or action frames look like the innocuous request from stations requesting information from a specific AP (with BSSID). Only chirp aware routers are aware that these are actually chirp packets and that the data in the DA, SA and BSSID is to be interpreted differently based on their internally known data format (Marker template, Figs. 64, 70).

Chirp routers know just enough to decode the DA, SA and BSSID data sections, Figs. 35-36, to provide necessary routing. They cannot decipher the vendor specific information elements - only specific agents/tunes/flowers hold those private "keys." Routers simply engineer "winds" and "buses" to move pollen.

How does the Chirp aware router recognize a chirp packet masquerading as an IP packet? Multiple embodiments exist:

SIP-like Registries In one embodiment, the router knows which interface transports Chirp packets. It has a complete list of 802.11 stations associated with this AP. As part of the tree topology, it also has a list of all stations downstream - via the downlinks, Figs. 4 through 8. It may not have access to the routing tables up stream. However, it may use distributed SIP registries that contain both chirp device and agent ID locations. Some embodiment use dynamic SIP registries to continue to provide VOIP phone connectivity even within isolated clusters. The same principles may be used to define where agents/flowers are, or the reverse look up - where chirp devices are, of interest to a particular agent.

Local Port Identification Even without the aid of SIP-like registries, chirp routers are still cognizant of the special nature of the data packets being transmitted. Chirp routers are keeping track of which port interface was used to inject the IP packet into the mesh network. In the mesh nodes shown in Figs 17, 23, there are multiple interfaces generally provided - the uplink and down links of Backhauls (BH and FD) and the client Access Points (AP). If the chirp packet came in through on of the APs, then it is marked as a chirp, since the Chirp ID provided does not match an associated IP based client's IP address or MAC-ID in its routing table.

Exclusion Principle in one embodiment, the AP does not need to keep a list of chirp devices it services - it can surmise its identity based on the *exclusion principle*, namely, this device ID, if an IP based device, is not in its routing tables or those of it node neighbors. Chirp device port locations and identity do not have to be stored, if anonymity is desired. In one embodiment, the chirp will still be forwarded up and/or down through the up links and down links the mesh tree, marked as a chirp in search of the agent/tune/subscriber. The identity of both chirp and its interested agent/tune/flower is hidden and yet the pollen reaches the flower efficiently. Ability to provide this type of anonymity

extends existing prior art IP based routing security.

Incognito Pollen: Some pollen travel incognito. That is, they expect propagators to rebroadcast them, potentially in all directions, until an intended agent discovers them. In one embodiment, a "4.0" category pollen implies a marker at byte 4 but its length is not specified. Agents with bit mask filtering locate such semi-incognito pollen, they know what the marker is. Note the marker can be arbitrarily long or short. Short markers increase the occurrence of false positives with other marker types (e.g. 4 bit markers 1.0.1.1 sharing same 4 bits as 8 bit marker 1.0.1.1.0.0.1.1). Agents that have this level of information can also glean other data from the packet melody/strands, to filter them out.

Port based Zone Control In another embodiment, a "0.0" category pollen does not specify either the location or size of the marker. This is completely incognito and the propagator must continue to rebroadcast the pollen both up and down the tree till it reaches either roots or leaves of the tree. Chirp devices have no access to the IP network except through the bridging propagators Fig. 22. As in nature's broadcast storms, an agent at the chirp interfaces is either present or the pollen dies. Not that the tree networks in Fig 22 are all layer 2. Only routers and their routing applications (Fig. 12) can initiate a bridge from Chirp to IP. Hence IP spamming/flooding from a corrupted or malfunctioning chirp device is stopped at the router.

Audit Trails Enterprise Class messaging mandates full audit trails on the myriad forms of communication being supported with the network. Each mesh node keeps a time window log of all messages received from all ports 090, Fig. 12. Further, for security reasons, it needs to keep a log of all out going packets created by applications operating at both Kernel and Application levels of the Stack. In on embodiment, the mesh node routing tables treat applications as a special class of client devices, resident in their multi-tenant application deployment environment. The location of affected devices is known within the network tree. Heart beat based messages are sent to all "clean" nodes to avoid contact with "affected" nodes and a new "temporal Key" is issued. Akin to ant colonies, the nodes response to "danger" evolves over time as publish-subscribe demographics change within the hybrid social network of humans and their machines and their evolving machine Esperanto, Fig. 69, 70.

Lineage Based Secret Maps. In some situations, a 0.0 pollen may wish to specify a direction and nothing else - e.g. up or down the tree. Thus, in one embodiment 0.0.1 pollen are upwards, while

0.0.2 pollen are downwards. Since each category has its own vocabulary and language, 0.0 chirp families may choose to use the next two bits to define direction (0.0.0.1, 0.0.1.0, 0.1.1.0 ..), as opposed to marker size. If the device is removed from the network and its expected topology, the navigation fails. The device is therefore "imprinted", like migrating birds, with a navigation "Mother" pattern. This is relevant to imprinting devices in the field to become part of a network, for life. The directions encompass both the chirp network topology and it parent IP based network tree, in an hybrid mesh network comprising of both, Figs 22, 39 et al. Alternate navigation routing maps are also provided in one embodiment, for dynamic failover in healthy networks, Fig. 55.

Chording Channels An agent can convert the data flow to be IP based, with regular IP addresses. In one embodiment, private networks coexist and span both chirp and conventional transmissions using "pattern" hopping techniques known only to them and their agents on the network. Part of the data travels as IP Data frames while others via chirp protocols, analogous to musical chords or dual signatures needed on a check. Only agents know the (chorded) "tune" This further obfuscates the chirp data flow.

In some embodiments, chirp data comprises IP based transport packets whose format is regular and legitimate IP-based packet. It supports all the Frame Control feature sets, Fig 34, 3420, including multiple frames, power management and Distribution System (DS) flags. Thus, competent agents, running on chirp aware routers, may also convert IP data (including VOIP packets) into chirp packets, send them anonymously to another agent and then reconvert them back to IP traffic. This obfuscates IP based data flow. Thus both Chirp and IP payloads may be used interchangeably to obfuscate data flow within both chirp and legacy networks.

Conventional IP based devices may also use category patterns as part of their data classification schemes. IP based packet headers specify the sensor MAC_ID or serial number within the payload, in addition to the category classification for IP based applications using the pub-sub exchange. By the same token chirp devices, may, in their private payload or public category type, contain an IP address where they wish their pollen to be sent. At each junction of the mesh network, there is the potential to bridge between IP and non IP logical radio mesh networks, Fig. 22. At each junction there is the ability to reroute the packets or prune and reload them, Fig. 71, in alignment with current pub-sub demographics.

Chirp Bus Shuttle Scheduling

Several embodiments refer to scheduling of VOIP, to enable chirp like broadcasts from chirp like device networks to be efficiently repackaged to travel on existent and incumbent prior art IP based Network devices and protocols.

Chirps do not have destination addresses. Like school children boarding a school bus, they must be directed to get on the "yellow" bus/wind. In one embodiment, at each bus stop along the way, they need to be told which next bus to board, Fig. 71. The edge router Figs. 12, 23, 71 manages bus arrival and departure times and also getting the chirp/pollen bulk containerized and ready for each bus trip. Where containers go is driven by the "clients": it is directing pollen to interested parties only. The chirp routers manage pollen/chirps getting on the correct "yellow" buses and bus departure schedules, as depicted in Fig. 71.

Random Intervals, In one embodiment, simple devices chirp intervals are random, thereby providing a "white noise" effect that smarter devices can adjust for, using automatic gain control and other methods.

Regular Intervals In one embodiment, buses leave at regular intervals to help schedule when a container of chirps arrives and leaves at each bus station. They are a part of the mesh network support infrastructure for chirp travel. Their frequency of arrival is driven by the polling frequency (e.g. 20 ms for VOIP phones). It will vary depending on the chirp device nature and urgency per methods taught previously, Figs. 12, 24, 27, 28. Scanning and polling frequency is adaptive, per methods taught for mobile nodes.

Dynamic Intervals. Additionally, subscribers, in one embodiment, awaiting specific pollen delivery, may also request sooner or later delivery, thereby dynamically changing Quality of Service (QoS). Collaborative scheduling agents, in some embodiments, ensure global supply chain alignment of supply/demand using simple concepts like "avoid" and "cluster" to ensure appropriate use of bandwidth resources and prevent "stacking" Figs. 65 and also teaches hierarchical scheduling collaborative agents in control systems, Figs, 26, 39, 68, 69.

This is a departure from Prior Art, where sender oriented IP packets declare their Quality of Service

(QoS) requirements a priori, and QoS requirements are blindly enforced along the network path at significant added cost. QoS is *dynamically managed in a receiver oriented network*.

Bus Logistics Hubs In one embodiment, using the bus stations as decision points breaks up routing decision to *hops between logistics hubs*. The current active subscriber demographics and demand may be reevaluated at these hub points. Re-routing may be needed. For example, in one embodiment, routing policies may be specified. One "policy" is in place that all GE refrigerators provide a daily health status short "chirp" "color" (e.g. red, orange, blue, purple) forwarded to GE appliance service centers/subscribers. There are four such appliance region centers e.g. North, South, East and West. Based on the chirp signature and device location, directives running in edge routers "know" which bus load this pollen/chirp has to be part of. There may be multiple subscribers so it also needs to track and route multiple concurrent buses to multiple subscriber locations. Further, at each bus stop, at each mesh node, the routers must "know" enough to "sort" pollen, at varied levels of granularity for most effective onward directions, Fig. 71. If packets need to be cloned to support multiple subscribers, they are, at forks along the path, in this embodiment. VOIP-like chirp packet cloning is managed by the router on a need basis, where forks occur - e.g. the container was traveling north, now is split into eastward and westward "half" containers and combined with other fellow "half" eastward and westward bound containers to form a more efficient whole container.

Departures from Prior Art The hierarchical tree architecture is similar to a post office hierarchy (county, city, country are the hub levels), but unlike the post office, the direction or "default" address does not convert the communication into explicit addresses and sender-oriented transmissions. This type of routing circumvents the *static address schemes* used in traditional mail and email routing. In these embodiments, the destination of the bus is dynamic and so is its routing path. This is analogous to not just changing bus routing (e.g. an accident) but also end destination (e.g. hospital) based on the current situation and nature of containerized load. If the load is no longer needed, it is discarded mid journey. Round tripping, caused by static destination addresses, is avoided. Further packets are cloned and pruned at each junction of the route, in alignment with pub-sub demands.

Collaborative Coexistence

Chirp data transport to the cloud involves traversing the IP network. Collaborative Coexistence is

key since some chirp packets have subscribers reachable only through the incumbent IP network, e.g. VOIP chirp-like packets for an overseas subscriber. These networks and protocols must also conform to the existing frameworks and mediation layers e.g. Figs 12, 20. Chirp/pollen devices are simple- they do not know where the flower is. Hence IP destination addresses cannot be provided. Chirp aware routing supports these new receiver oriented packets.

Further, if chirp devices intend to operate in the same frequency spectrum as IP devices, then both dance partners need to share the dance floor without constantly stubbing each others toes (e.g. collision □ causing interference □ some causing retries □ possibly network flooding). Coexistence requires chirp devices not habitually create collisions or accidents on the IP based highways, like bad drivers. Methods taught with legacy chirp like devices (VOIP) see Figs. 10-12, 24-25 ensure both types of transmitters dance well together in the same RF space.

Scheduling Device Chirps In one embodiment the chirp transmission schedules feeds the inter-node chirp bus schedules. Collaborative Scheduling, Figs 65 though 67 is used by mesh nodes to thus drill down to generate the local bus schedules for the node-node transport system. This in turn, drives when chirps need to arrive. The schedule also directs when buses leave. Routers are monitoring the bus queues. Routers may also thus request smart chirp devices to chirp more (if missing buses) or less frequently (if often waiting in line). Chirps then occur with the timing constraints of the bus scheduling system so that chirp packets arrive in time to climb aboard the bus in time to meet the inter-bus schedules of the logistics hubs. Hence, smart chirp devices, have an advantage over their simpler chirp only devices.

Ideally, Chirp transmissions should occur sufficiently frequently for the level of granularity requested by the subscribers ("Customers") schedules.

Small blue/red shift directives are provided by the Access Point for chirp devices. The Access Point receiving the chirps, monitors them to determine the range of the transmission "task" start/end times and their blue/red regions. It can thus profile the task and its variants. The bus schedule for the subscribers are then examined to determine the optimal bus size and interval. This, in turn drives how often the chirps must be transmitted and at what time. Synchronization may be approximate, measured in terms of a non dimensional parameter e.g. the fraction of the current chirp interval. This ensures complicity since both parties understand what that means regardless of whether they

represent the time in nanoseconds or primitive register counters, Thus listen capable chirp devices may be controlled to adapt to the subscriber interests.

Closing Local Control Loops

Compare pollen based routing to conventional IP addressing. IP addressing is destination based. After the IP packet reaches its destination, the payload is deciphered. The typical thin client machine control loop, Fig. 56 is best efforts and assumes (remote) connectivity. It is difficult to provide local autonomous machine control for applications in Figs. 39, 56, 57, 68 , 69.

The Chirp Category classifications scheme enables usable small data to be both generated and consumer by and for the edge member devices. Data is processed closer to the source/cluster, where it has more impact in tight sensing-control-actuation loops Fig 56.

Topology Matters Fig 46, depicts why network latency and topology are inter-related and hence relevant to latency sensitive VOIP/Chirp bus delivery schedules. In one embodiment, a round robin approach where, the AP services each client in turn. In that example, 10 ms is the (equal) service duration for individual client services. Packets are buffered till a round robin cycle is complete. At the end of each cycle the container is sent, per up the tree, in one embodiment. The local latency upper bound would therefore be 30 ms for section 70. By the same token, the root node is servicing 5 clients and hence the upper bound to reach the root node is 50 ms for sections 70, 80. Further, the example pointed out that, had all the nodes been connected directly to the root node, the latency would be 90 ms. 1 hop networks - all clients connected to a root node - are not necessarily "better". A five-hop string-of-pearls, O(n) routing scheme, Fig 45, may provide better service, than the 1-hop 5-client star, Fig 46, Section 80.

In one embodiment, bus delivery schedules are driven by the round robin delay caused by servicing siblings, at each sub tree along a route. More siblings imply more latency and favor node/device migrations. Others may barter to get a bigger slice of the pie. Accordingly, network topology and routing is modified based on toll/hop costs.

In Fig 46, nodes operated independently and asynchronously but based on a common multiple of some service time interval e.g. 10 ms. Minimum Bus Intervals vary, based in the number of siblings.

During the process, the bus interval is set. Buses leave at preset intervals, regardless of whether the bus is full or not. In more efficient implementations, the departure time is flexible, and buses may wait till more passengers arrive, within a prescribed waiting limit. Thus the stream and CSMA allocations are based on "stacking", in dynamic alignment with "Customer Satisfaction" Figs. 65, 66, 67.

Periodic Silent Intervals In Fig 47, the bulk bus transport stream 4720 is first, during which all clients can listen but not talk, see Figss. 12, 24. The remainder time 4750 is used to transfer data back from IP based clients to nodes etc. Further, Fig. 25 shows separate "channels" for concurrent transmissions. Contention is reduced during the Stream section, 4720 and possibly more. SCAN agent, Fig 12, measures overall activity of disparate packet types (a form of "channel list"). Note that in Wi-Fi standard infrastructure mode, all communications are with the AP, hence tree based routing is inherent.

Stream Reader Circuits: Fig. 50 depicts the stream reader, in one embodiment. Special purpose Stream Readers are privy to data traffic queued for transmission at a node. Like post office sorters, they identify and sort the "mail" and therefore, help to collectively define bus schedules, reduce dead letter re-transmissions etc. Stream readers, resident at the node, feel the "pulse" and therefore provide early warning signals to the Mesh Control Layer. More "mail" from one node may increase toll cost for other child nodes to switch parents, using load balancing and adaptive power control methods, Fig 1.

Stream readers can feed multiple stream viewers, 5040, sequential readers/agents, 5060 or a logging database 5080 community mailbox etc. A circuit of collaborating stream readers and subscribers emulate complex logistic supply chains, see Fig. 51, 5120. Disparate traffic data is sent to knowledge repositories 5180. Secure Control lines from it, 5170, drive sub-circuit behaviors and their outputs, 5125, 5135, 5155. Repositories may also provide the secret handshakes needed by readers to correctly decode public network traffic 5150. Thus bulk network traffic, 5150 may employ little or no encryption and thus be lightweight, like pollen. Further, the Network Viewer 5190 may be connected to the real time stream plug in circuit 5145 or run it in playback mode, 5165 from knowledge repositories 5180. The same circuit based framework 5120 may also provide interleaved real time and historical trending, simulations and machine learning, Fig. 52, 5290. Note that 5155 is not connected - it is in "connectionless" broadcast/multicast mode. Thus both direct and indirect

subscription styles are supported within the same stream reader framework.

One embodiment of an open extensible Stream Reader Framework, Fig. 52, is implemented in Java. A subset, JavaScript API 5230, provides dynamic and customizable HTML based views. Custom Stream viewers define the GUI for different devices and form factors. More complex business logic applications use the Enterprise class Java API and Repository 5240. Third party adapters and applications, 5250, extend the network to consumers/providers of information and their viewers. Fig 53 and 54 depicts the published interfaces for the Network Manager Streams API and the Heart Beat Entity relationships, respectively. Together, they enable speedy development, for Hybrid Human-Machine networks Fig. 55.

Device Management and Control

Discovery and Registration: Several embodiments expand on the DHCP approach with the isolated distributed SIP registry functionality as described in that invention. Terse and periodic VOIP chirps are routed by the local SIP server. Further, when the VOIP network joins an external network, SIP registry information is exchanged. The Chirp registries may thus also exchange chirp device classifications and protocol specifics. Other (restricted) registries may contain location of agents dispersed at local nodes based on bus scheduling requirements. This enables discovery using the same approaches for devices, agents and logistics hubs. A comprehensive framework for discovery and routing for both Chirp and IP devices are thus supported by the DHCP and SIP registry modules, specifically designed for mobile, temporal wireless mesh networks.

When a new device is registered on the network, its agent/app is "loaded"- . This agent/app then provides the subscriber-based chirp-to-chirp translations and chirp-to-IP translations and filtered "small" data. Based on the direction of the chirp, agents may also direct propagators to provide intermediate translations see Figs. 22,23 through applets operating at the routing and "port" forwarding tables at each mesh node port/interface of the dynamic switch stack tree.

Learning through Correlations Figs. 68 through 69 depict application use cases that highlight the shared publish subscribe exchange through which small data reaches big data subscribers and their analysis/inference engines. In Fig 68, a low cost lawn sprinkler actuator is controlled through a local control loop, 6910 and a remote control loop 6930, conversing through a shared publish-subscribe

exchange, 6920, see also Fig. 56. Upstream to the actuator valve a water pressure sensor is depicted, 6922 as is a down stream water flow sensor 6924. Both sensors reside within the local (and secure) M2M home community and their (subscribed) chirps are part of scheduled pub/sub exchange 6920.

The lower control loop vocabulary is limited to actuator commands 6915, (e.g. "ON", "OFF"). The system has no way of knowing whether the lawn sprinkler is functional, without accessing information from the larger M2M community. When chirp data is time tagged, then causal analysis indicates that if the upstream water pressure is "good" and the down stream flow is "bad", then the actuator is worn out and needs replacement, see 6835. A local integrator agent, 6837 may also, through access to the shared pub/sub stream, 6920, be directed to perform this check each time the valve is activated, thus reserving internet traffic for exception handling. Thus an intelligent valve actuator emerges, without additional hardware/sensors at the actuator. Dual control loops thus provide intelligence without adding to the cost of the device.

Figure 69 depicts how discovery of related sensory streams can drive more refined control models for M2M Enterprise. The initial application is Air Conditioning control for a large building, 6910. The integrator agents, through the shared chirp classification streams, discovers other local subscribers to the energy usage/cost data 6920 active in the same building. Further analysis of their activities indicates that the front door elevators are active the same time that the heating/cooling in that zone is "unstable", 6930. It also can correlate night time activity, when lights are turned on 6940 in zones that need to be activated, when the lights are on. Hence multiple, related subscriptions now drive a refined control model for air conditioning, 6950. Note that human "experience" would arrive at the same conclusions over time but machines, through their subscriptions and pattern analysis are able to close the loop semi-autonomously or autonomously. Further, the causal analyses/inferences gleamed from one building may be transportable across related domains. Therein lies the power of a shared pub/sub exchange - the ability to glean useful data from hitherto unknown sources. See also

Classification Aided Discovery How does the local integrator or its big data supervisors "discover" water pressure correlations in Fig 68 or the local energy consumers in Fig 69 ?. This discovery is engendered through the chirp classification system, two embodiments shown in Figures 64 and 70. In Figure 70, the 4 bit marker pointer 7010 has a bit address of 1010, indicating an 8 bit marker pointer 7030, at the end of the packet with its agent ID of 255. This means that the public section 7020 is 4 bytes long. The coarse classification is thus 4.8.255, sufficient for pub/sub bus schedules to

deliver the chirps to hubs and clearing houses, see 7050. Those who have subscribed to Agent 4.8.255 may then be able to decipher the container further. For example, Agent 48.255 states that each of the 4 bytes is a further classification, see 7060. The full chirp classification is thus 4.8.255.22.243.16.23.

Network Management The resulting implementation within a network of wireless nodes is scalable with no loss of bandwidth over many hops. The resulting network logic is distributed with low level autonomy on routing, power and channel management. The network uses distributed intelligence in terms of applications and where they reside: the result is a network where both the network management and the applications within the network can be distributed. The embodiments serve as a new type of service delivery framework specifically to address more "smarts" at the edge where the simple devices are sending terse messages or chirps. The network is flexible in that it can be implemented with multi-purpose devices, with alternative embodiments relying on a router and other embodiments using a client device. The embodiments rely on mesh nodes or routers, with the benefit of the router versus Machine controller are that by relying on the router there is low latency communication and ability to prevent escalation. The embodiments also rely on the router as the application delivery platform. The result is that the SDN control plane extends to the edge of the network where the chirping devices broadcast. In one embodiment the heartbeat extension to include sensor feeds and the result is integration with the NMS.

In summary, a new type of device management system emerges where efficient M2M command and control is enabled at the edge and edge communities. Chirp category based packet identification provides the M2M version on nature's receiver based communication protocols. Timing pollen "winds" is explored in Figs 25, 26, 65, 71. Heart Beats and Streams are discussed in Figs 46 through 55. The streams support applications in closing real time M2M control loops, Figs. 56 through 63, 68 through 71. Figs 72 and 58, depict the top level view of devices, propagators and integrators, each essential to a sustainable Internet of Things.

CLAIMS

1. A system of transmitting of data packets within a network comprising:

at least one device transmitting at least one short communication message;

at least one network router comprising a chirp receiver for the at least one short communication message;

wherein said chirp receiver accepts said short communication message during an access function of said router without interrupting other communications; and

wherein said router further comprises an uplink function connecting said least one router to an external ip-based network using intermediary routers; a downlink function connecting said least one router to other routers within said network; and a scanning function.

2. The system of claim 1 wherein within the network router a single radio performs the uplink function, downlink function, scanning function, and access function.

3. The system of claim 1 wherein said router further comprises at least two dedicated radios within the router perform the uplink function, downlink function, scanning function, and access function.

4. The system of claim 1 wherein the updates to the routing information within the network follow O(n) complexity where n is a number of network participants.

5. The system of claim 3 wherein the dedicated radios employ at least two different physical mediums and wherein said router bridges said different physical mediums and wherein each medium supports distinct tree-based network topologies.

6. The system of claim 1 wherein said short communication message comprises a terse status update without a specific receiver.

7. The system of claim 1 wherein said short communication message comprises a series of terse status updates received by the router wherein said router containerizes said series of terse messages.

8. The system of claim 1 wherein said uplink function comprises a connection to a single parent forming a logical tree network.

9. The system of claim 1 wherein said downlink function comprises a connection to other routers wherein said downlink routers do not communicate with one another directly, forming a logical tree network.

10. The system of claim 1 wherein each router sends a regular heart beat status update.

ABSTRACT

A network combining wireless and wired elements is described, using a multi-slot modular mesh node to house diverse transceiver elements (e.g. IR, Wi-Fi, Powerline). A radio agnostic tree based mesh network is formed, based on what type of wireless links are formed on the uplink and downlink of the backhaul and what type of radios are used for the Access Points AP. In addition to servicing IP based clients (e.g. Wi-Fi, WiMax, Bluetooth), the modular mesh nodes APs may also serve as receivers/collectors for low cost chirp devices. The method of transport is standard IP based packets yet security is inherent in this chirp-based implementation: only mesh nodes are privy to the routing tables that indicate that packet addresses are not IP. Multiple methods to obfuscate packet flow are presented. An organic approach to providing category/class based form of data type identification is proposed, to support a (dynamic) M2M Social Network Applications in-device discovery, registration and control are presented.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	CHIRP NETWORKS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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LEGAL NAME OF INVENTOR

Inventor: Francis DACOSTA Date (Optional): _____

Signature: Francis Dacosta

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Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	CHIRP NETWORKS
First Named Inventor/Applicant Name:	Francis DACOSTA
Filer:	Szymon Maciej Gurda
Attorney Docket Number:	0357-02904

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	70	70
Utility Search Fee	2111	1	300	300
Utility Examination Fee	2311	1	360	360
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**730**

Electronic Acknowledgement Receipt

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Application Number:	14740062
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Title of Invention:	CHIRP NETWORKS
First Named Inventor/Applicant Name:	Francis DACOSTA
Customer Number:	27197
Filer:	Szymon Maciej Gurda
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	WebADS.pdf	136760 c16189a5d26c1281b87ff1d7dea9b7fadeda d39f	no	6
Warnings:					
Information:					
2	Drawings-only black and white line drawings	Drawings.pdf	7601487 990ee7afba68c7fc13def619d23e57b0f152 7322	no	72
Warnings:					
Information:					
3		SpecClaimsAbstract.pdf	319588 eb35312e3e93eb46314d5afed38587eb82b a2fd2	yes	36

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Specification	1	33
Claims	34	35
Abstract	36	36

Warnings:					
Information:					
4	Oath or Declaration filed	aia0001DEC.pdf	257345 05247376d50709ce01e439e54afd14f902cc 5029	no	1
Warnings:					
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5	Fee Worksheet (SB06)	fee-info.pdf	35102 e9469c9c636dece0a9d1f0be5073c5c9c0b5 b598	no	2
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Application Number: 14740062 Document Date: 06/15/2015

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14/740,062	06/15/2015	Francis DACOSTA	0357-02904

CONFIRMATION NO. 1794

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FORMALITIES LETTER

OC000000075935013

Date Mailed: 06/25/2015

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:
  - Numbers, letters, and reference characters on the drawings must measure at least 0.32 cm (1/8 inch) in height. See Figure(s) 40, 52, 54.
  - The drawings submitted to the Office are not electronically reproducible because portions of figures 38, 51, 52, 54 are missing and/or blurry.

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.

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/740,062

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	10 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x 210 =	0.00			
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).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL	

APPLICATION AS AMENDED - PART II

		(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($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	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))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(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($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	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))							OR		
						TOTAL ADD'L FEE		OR	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 found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/740,062	06/15/2015	2465	730	0357-02904	10	1

CONFIRMATION NO. 1794

27197
MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602

FILING RECEIPT

OC000000075935012

Date Mailed: 06/25/2015

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**

Inventor(s)

Francis DACOSTA, Santa Clara, CA;

Applicant(s)

MeshDynamics, Santa Clara, CA;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This appln claims benefit of 62/012,196 06/13/2014
and is a CIP of 13/764,008 02/11/2013
which is a CIP of 13/627,883 09/26/2012 PAT 8923186
which claims benefit of 61/615,802 03/26/2012
and claims benefit of 61/555,400 11/03/2011
and claims benefit of 61/621,926 04/09/2012
This application 14/740,062
is a CIP of 13/571,294 08/09/2012
which is a CIP of 12/696,947 01/29/2010 PAT 8520691
which claims benefit of 61/148,803 01/30/2009
and said 13/571,294 08/09/2012
is a CIP of 12/352,457 01/12/2009 PAT 8477762
This application 14/740,062
is a CIP of 13/541,446 07/03/2012
and is a CIP of 14/523,778 10/24/2014
which is a CON of 12/625,365 11/24/2009 PAT 8514852
which claims benefit of 61/117,502 11/24/2008

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 06/24/2015

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/740,062**

Projected Publication Date: To Be Determined - pending completion of Corrected Papers

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

CHIRP NETWORKS

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: Yes

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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.

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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 (1-866-999-4258).

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT

UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor:	Francis daCosta
Invention:	CHIRP NETWORKS
Serial No.:	14/740,062
Filing Date:	June 15, 2015
Confirmation No.:	1794
Art Unit:	2465
Examiner:	Not yet assigned
Atty Dkt No.:	0357-02904

Submitted via EFS-Web on July 2, 2015.

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Alexandria, VA 22313-1450

123 West Madison Street
Suite 400
Chicago, Illinois 60602
312-621-1330

RESPONSE TO MISSING PARTS

Dear Sir:

In Response to the Notice to File Corrected Application Papers dated June 25, 2015, Applicant hereby submits the following:

Amendments to the Specification can be seen on page two of this paper;

Amendments to the Drawings are discussed on page three of this paper; and

Applicant's Remarks can be found beginning on page four of this paper.

Amendments to Specification

Please amend the last paragraph (paragraph 5) on page 1 of the specification as filed accordingly:

The instant application further claims priority as a continuation in part of U.S. Utility Application 14/523,778, filed on ~~February 12, 2015~~ October 24, 2014, presently pending, which in turn claims priority to U.S. Utility Application No. 12/625,365, filed on November 24, 2009, issued as U.S. Patent 8,514,852 on August 20, 2013, which in turn claimed priority to U.S. application 61/117,502, filed on Nov. 24, 2008, presently expired, which are hereby incorporated by reference.

Amendments to the Drawings

Applicant has amended FIGS. 38, 40, 51, 52, and 54 in order to make the numbering and lettering appearing thereon bigger and less blurry. Attached hereto are the updated drawings, labeled as "Replacement Sheets." Applicant has also substituted a new set of figures, which the Office is directed to substitute these presently submitted figures for the previously filed figures.

Applicant's Remarks

In the Notice to File Corrected Application Papers, Applicant was directed to submit replacement drawings because some of the figures filed with the application were unacceptable. Specifically, in Figures 40, 52, and 54, the numbers and letters were too small. In Figures 38, 51, 52, and 54, some of the elements were blurry. In response, Applicant has increased the size of the lettering/numbering contained in the figures. Applicant has also increased the size of some of the elements in the figures to reduce the overall blurriness of the figure. No new matter has been introduced through these amendments.

These changes are reflected in the Replacement Sheets attached hereto. Applicant has also submitted complete set of Drawings to replace the previously submitted set of drawings.

Applicant also amended the specification to fix a priority claim contained therein. As detailed above, the filing date for one of the priority applications was incorrectly listed. Applicant has provided a substitute specification to effect this amendment. The Office is directed to substitute the presently submitted specification for the previously submitted specification. No new matter has been added by this amendment.

Applicant has made an earnest effort to respond to the Notice to File Corrected Application Papers. No new matter was entered by this amendment. Applicant believes that the application is in condition for examination, and the same is respectfully solicited. If a telephonic interview would aid in the consideration of this response, the Office is urged to contact the undersigned.

Respectfully submitted,
CHERSKOV FLAYNIK & GURDA, LLC
/John Paul Kale/
John Paul Kale (Reg. No. 70,805)

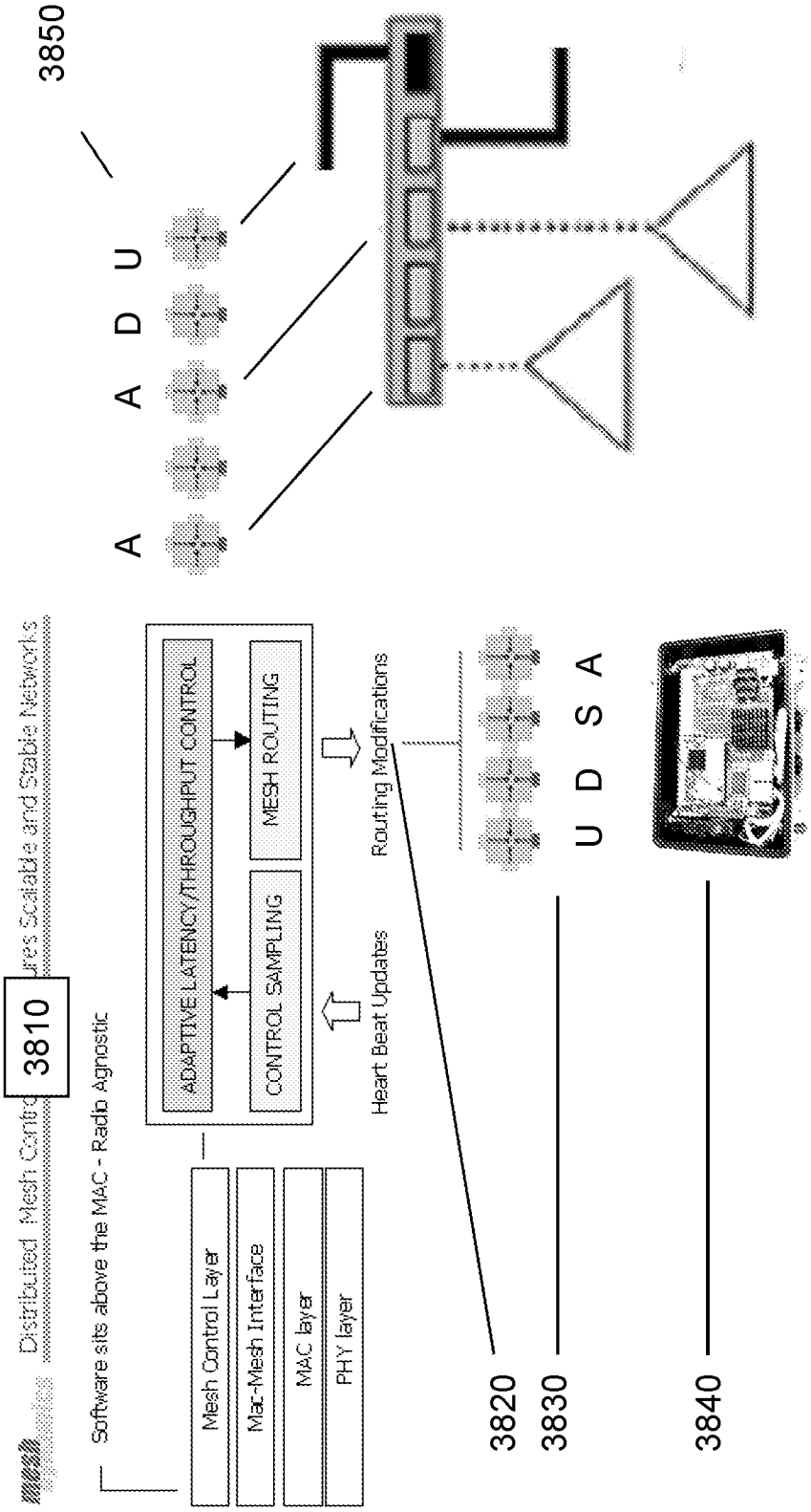

3850
A A D U
U D S A
3820
3830
3840
Distributed Mesh Contro
3810
ires Scalable and Stable Networks
Software sits above the MAC - Radio Agnostic
Mesh Control Layer
Mac-Mesh Interface
MAC layer
PHY layer
ADAPTIVE LATENCY/THROUGHPUT CONTROL
CONTROL SAMPLING
MESH ROUTING
Heart Beat Updates
Routing Modifications

Figure 38

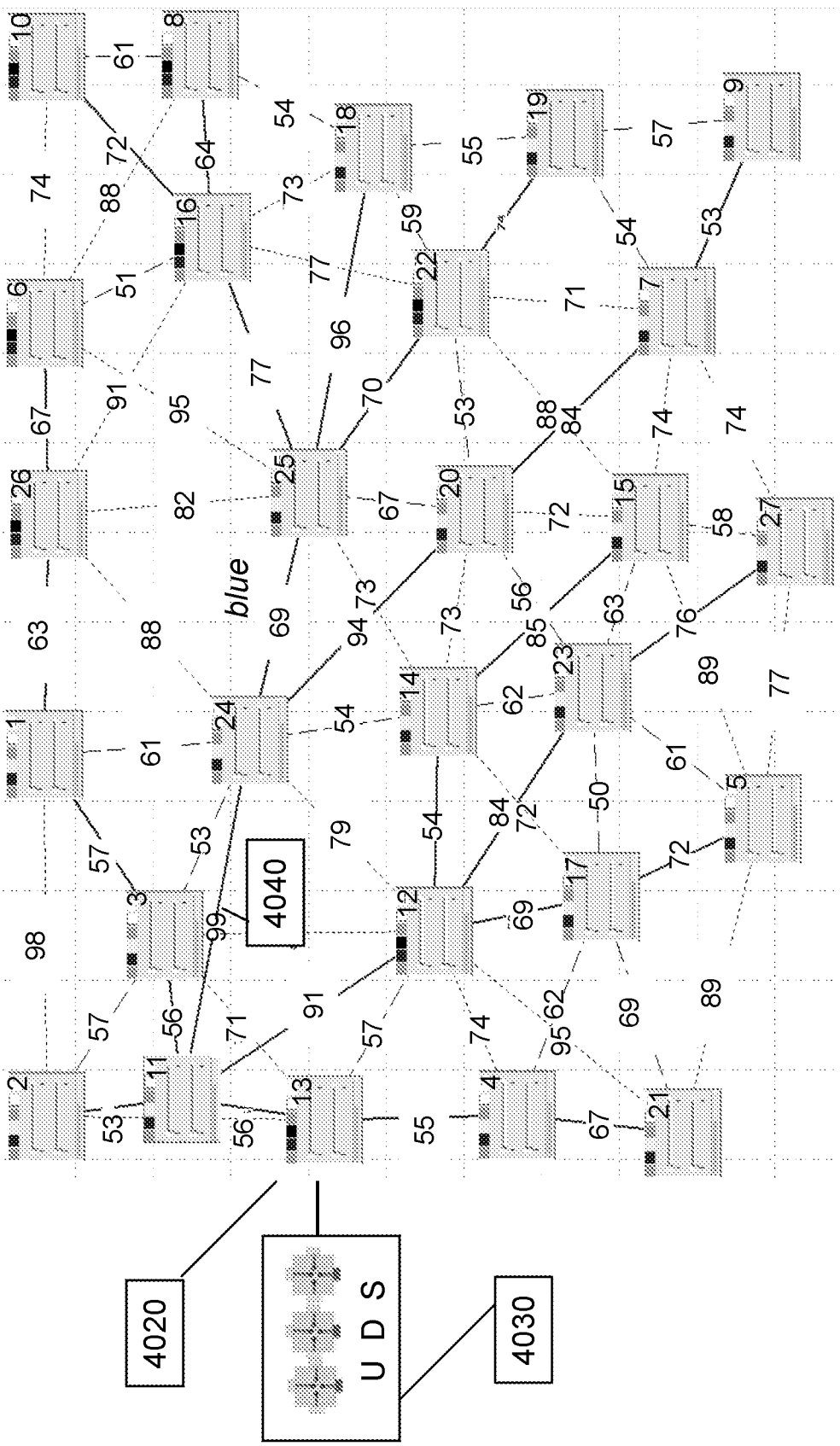


Figure 40

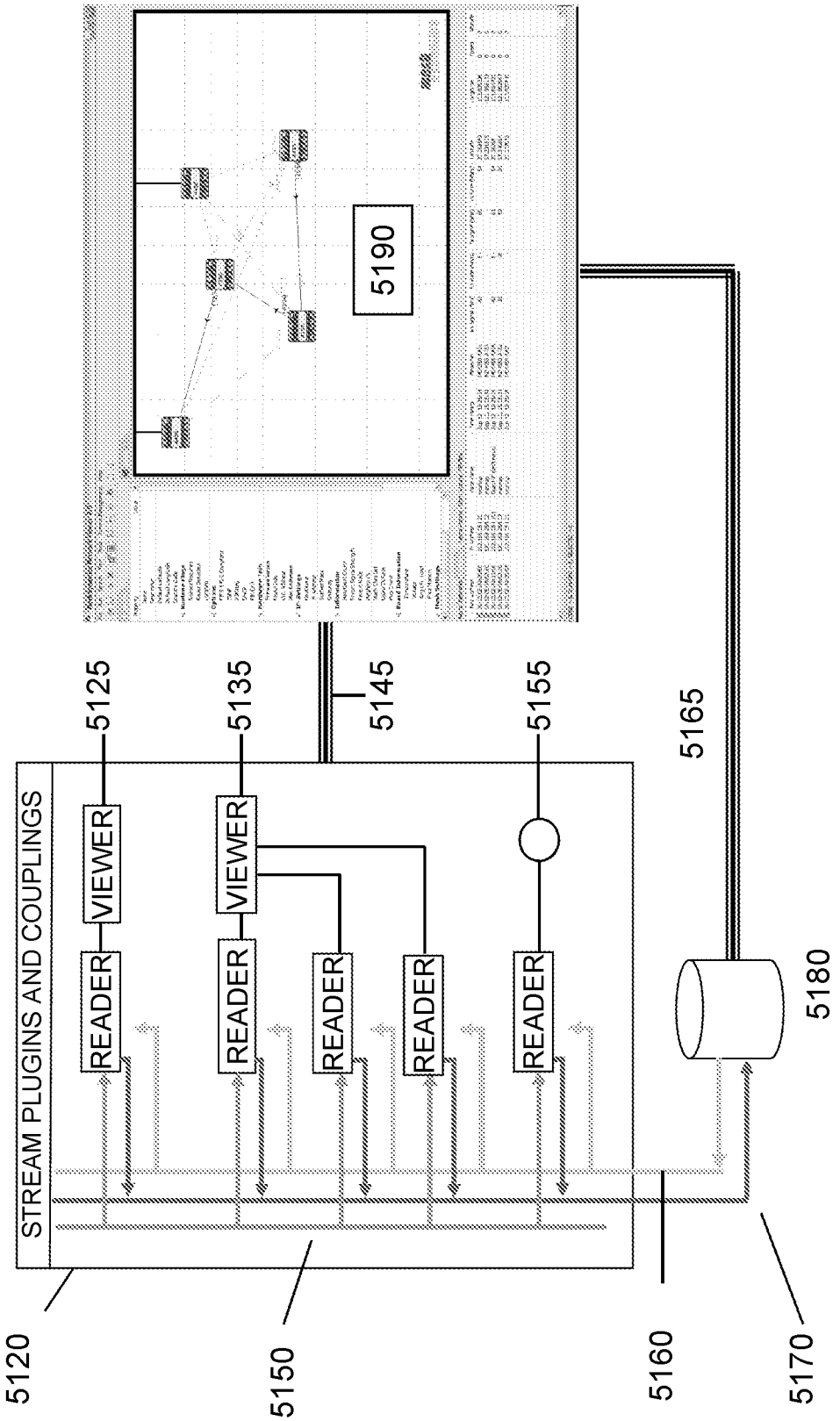

5190
5125
5135
5145
5155
5165
STREAM PLUGINS AND COUPLINGS
VIEWER
VIEWER
READER
READER
READER
READER
READER
5180
5120
5150
5160
5170

Figure 51

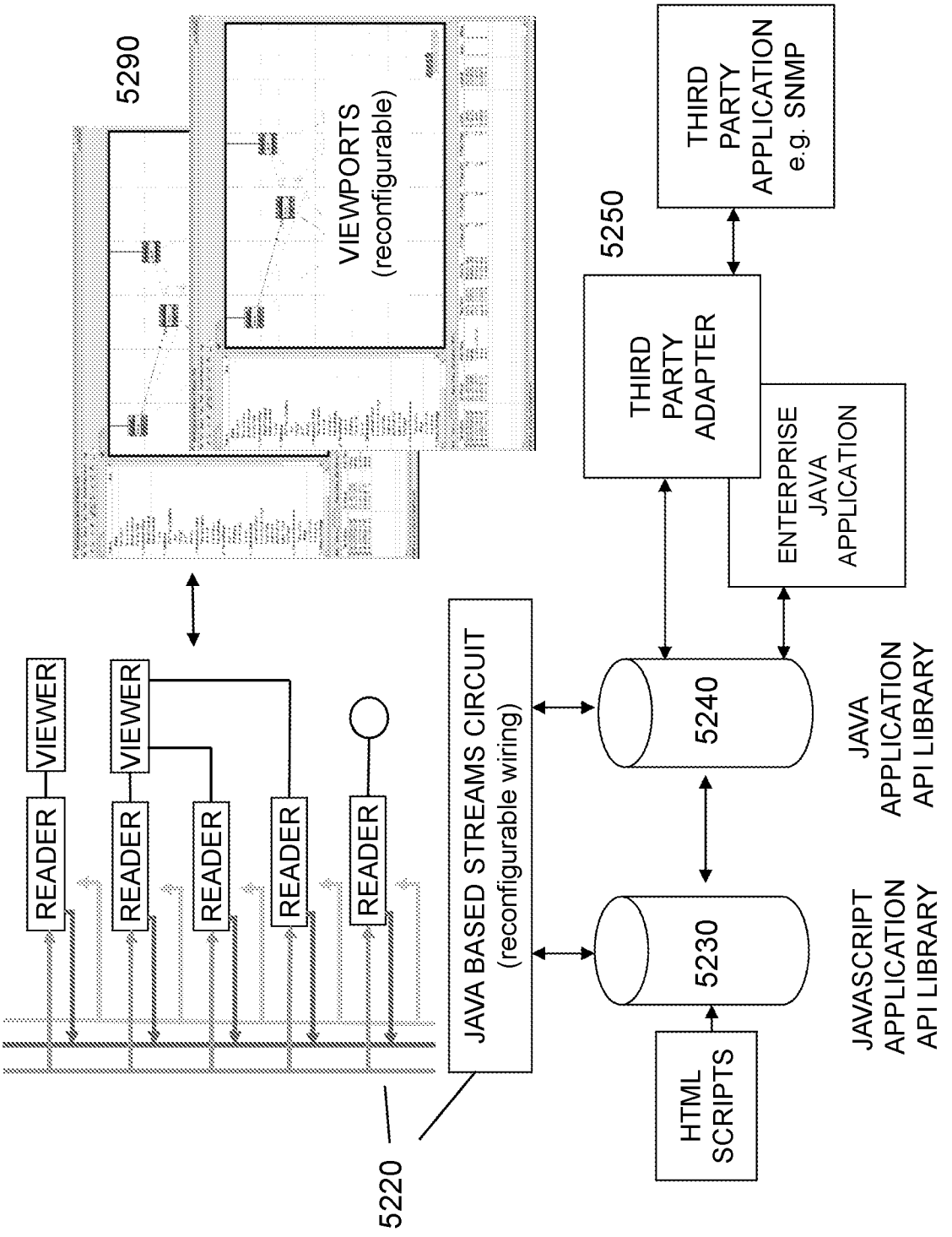

5290
VIEWPORTS
(reconfigurable)
VIEWER
VIEWER
READER
READER
READER
READER
READER
5220
JAVA BASED STREAMS CIRCUIT
(reconfigurable wiring)
5240
5230
HTML
SCRIPTS
5250
THIRD
PARTY
ADAPTER
ENTERPRISE
JAVA
APPLICATION
THIRD
PARTY
APPLICATION
e.g. SNMP
JAVA
APPLICATION
API LIBRARY
JAVASCRIPT
APPLICATION
API LIBRARY

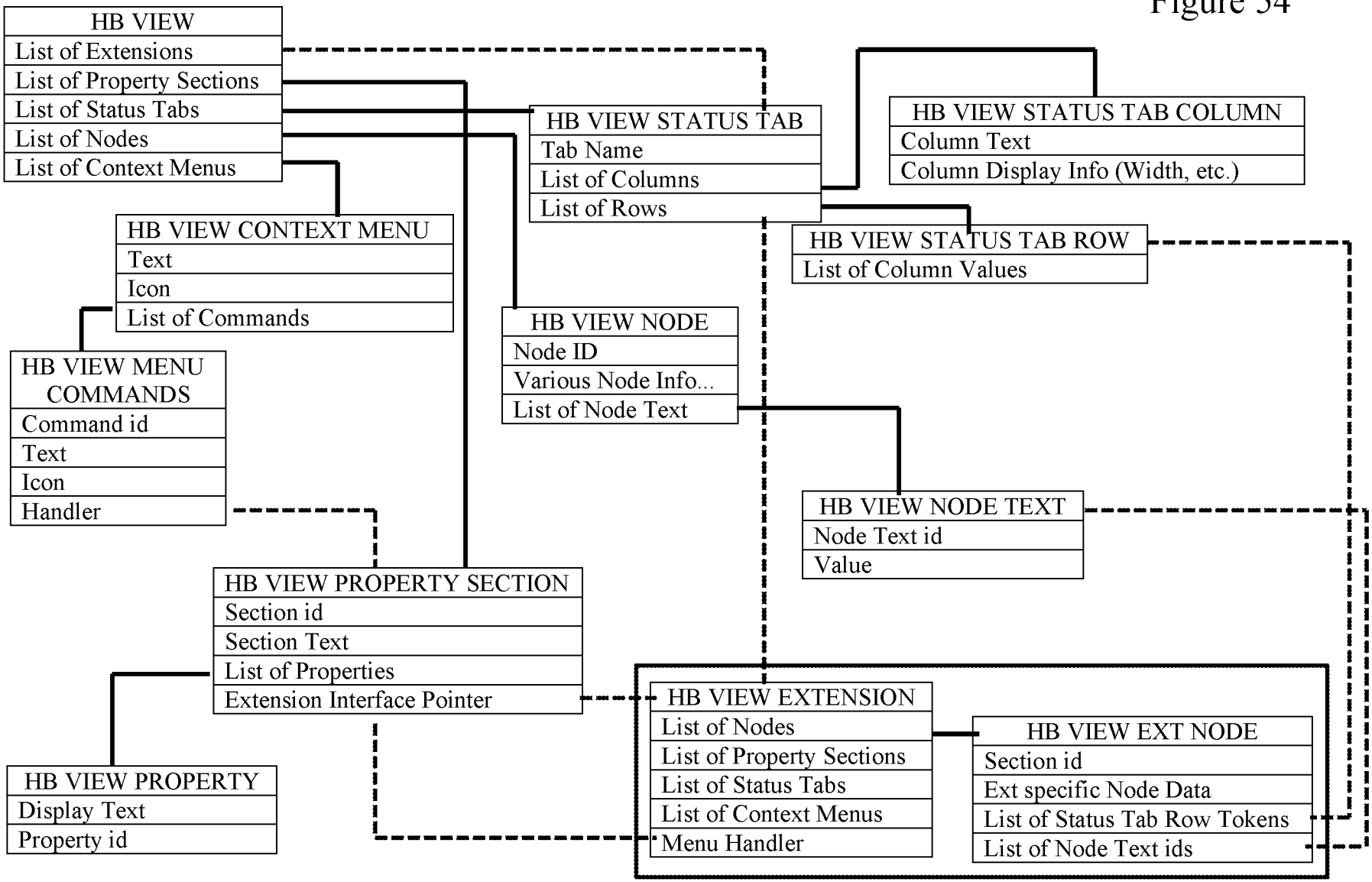
Figure 52

EX1018, Page 137

REPLACEMENT SHEET

HEART BEAT VIEW PORT ENTITY RELATIONSHIP

Figure 54



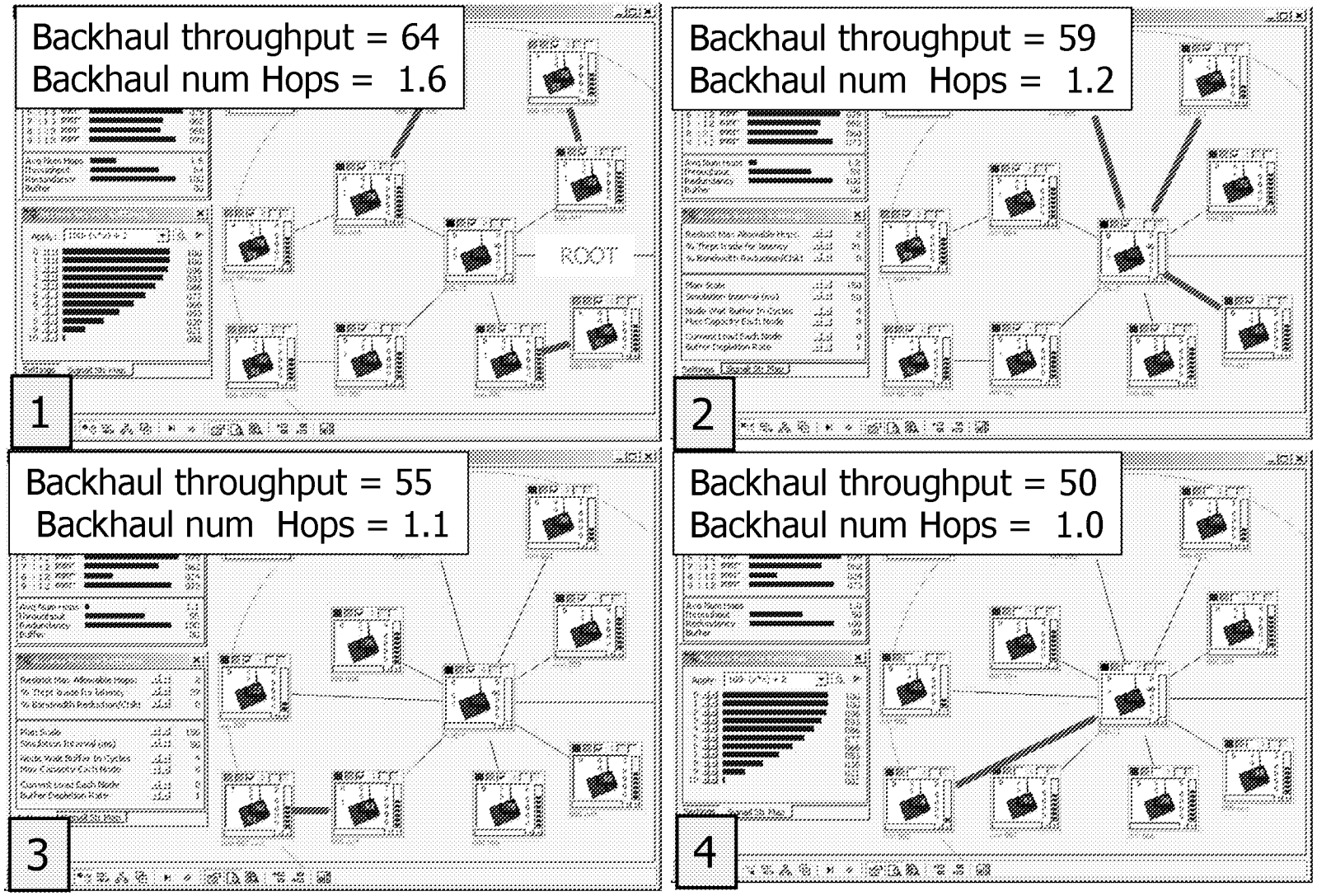


Figure 1

EX1018, Page 138

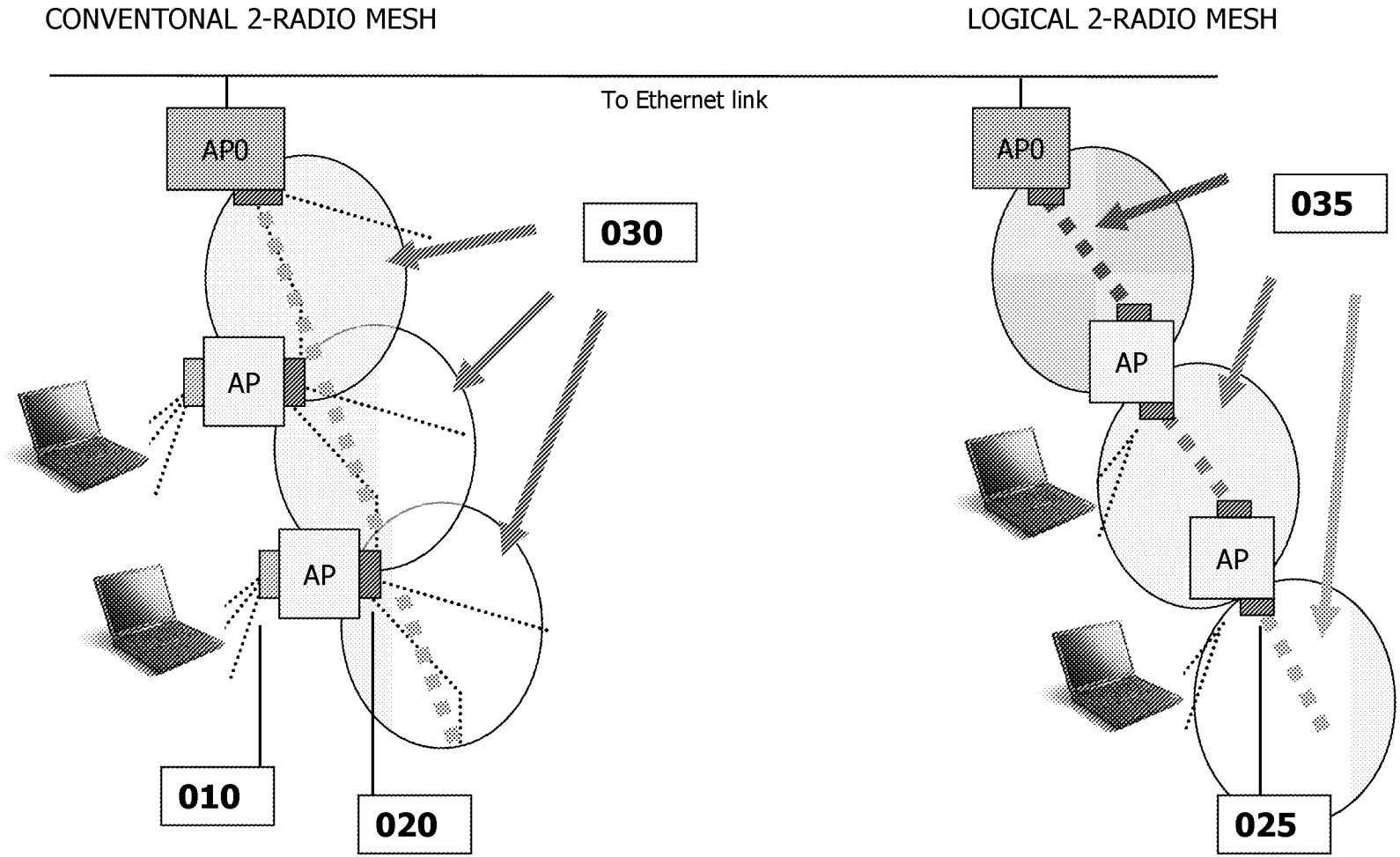
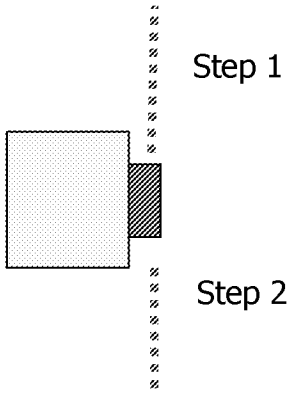


Figure 2

EX1018, Page 139

010 1-Radio Relay / Backhaul



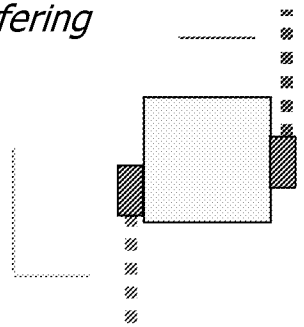
Step 1. Receive Packet
Step 2. Relay (on same channel)

Relay / Backhaul Radios

020 2-Radio Relay / Backhaul

Non-Interfering Channels

030



Simultaneous Receive/Send

Figure 3

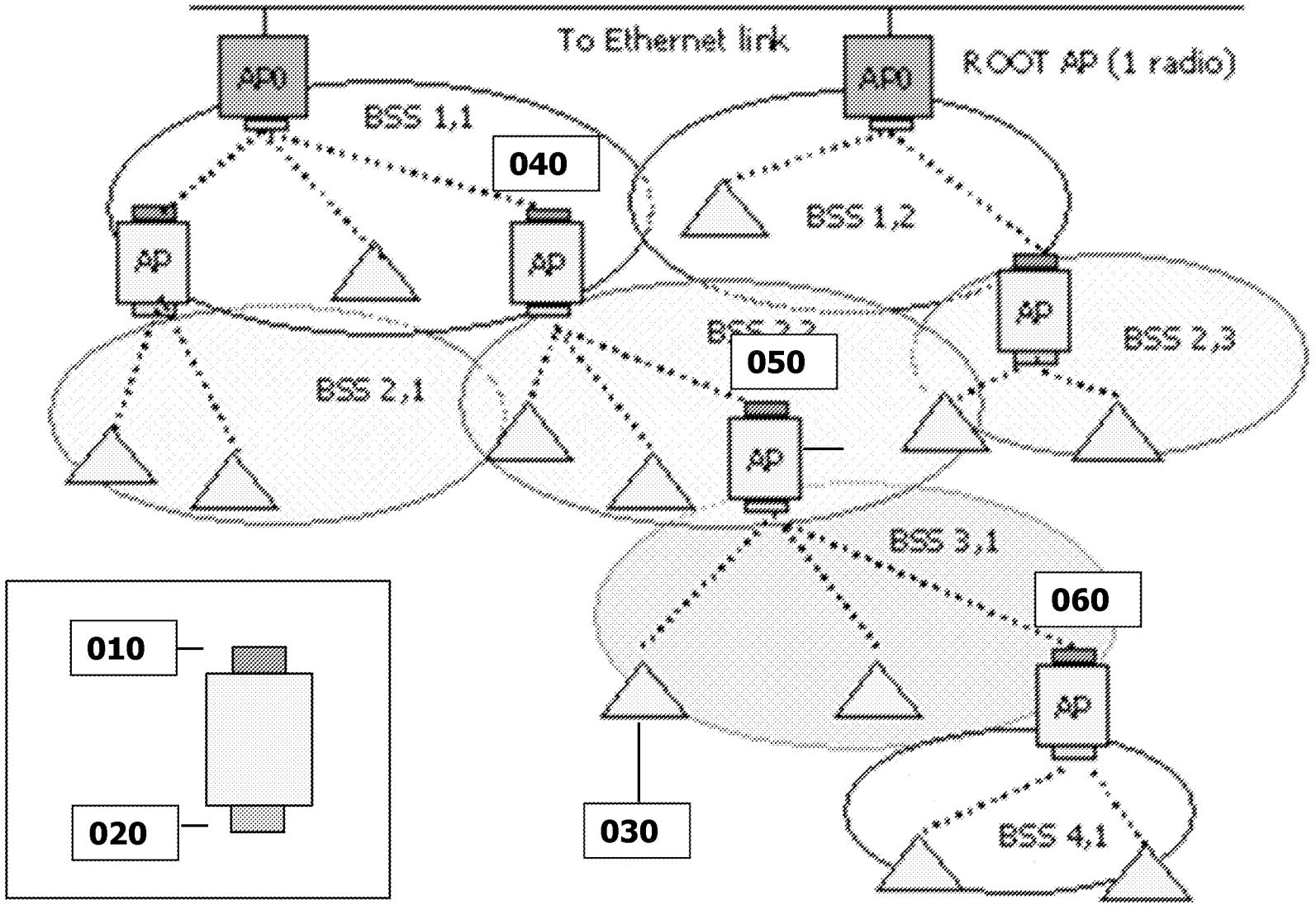


FIGURE 4

EX1018, Page 141

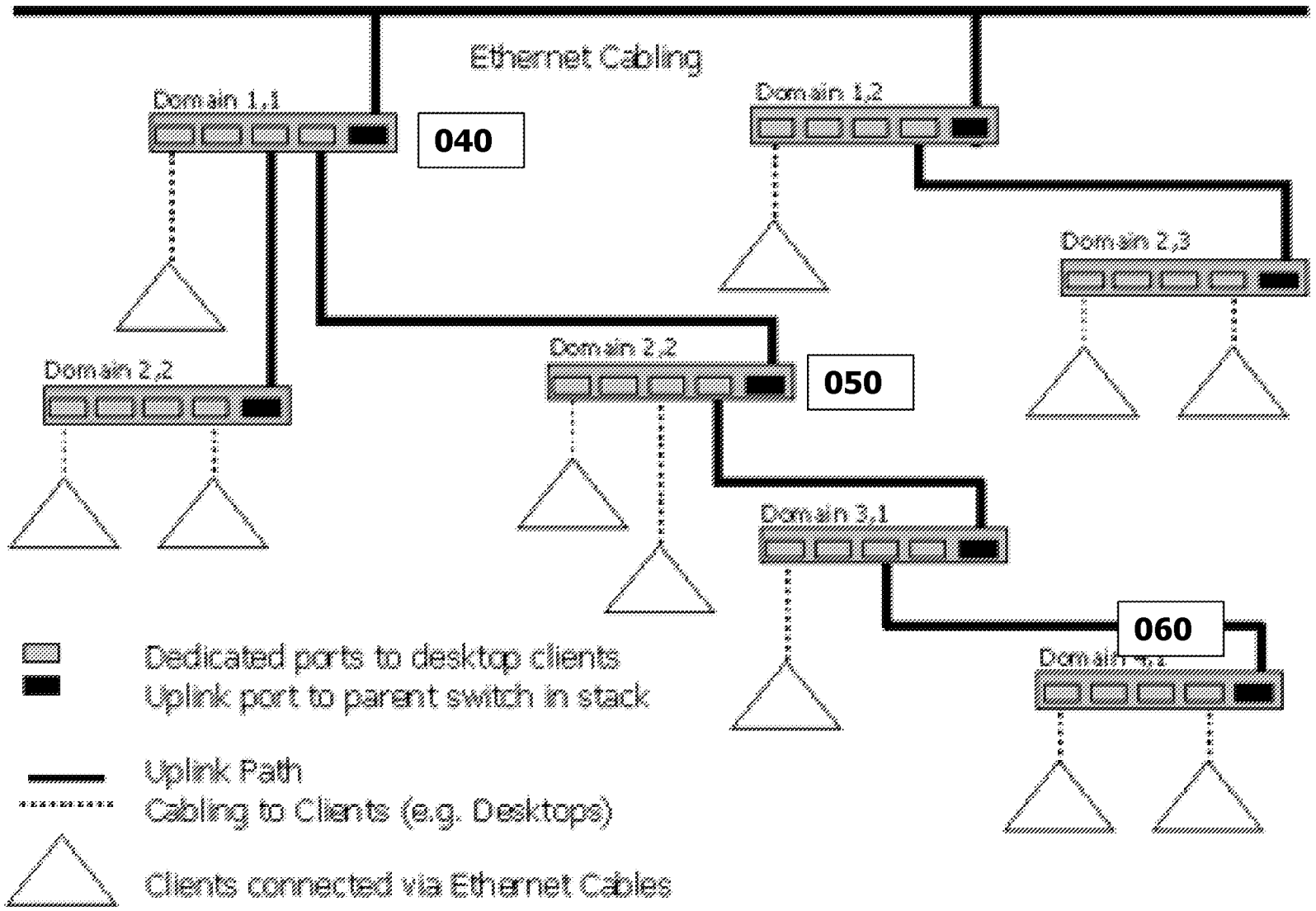

Ethernet Cabling
Domain 1,1
040
Domain 1,2
Domain 2,3
Domain 2,2
Domain 2,2
050
Domain 3,1
060
Dedicated ports to desktop clients
Uplink port to parent switch in stack
Uplink Path
Cabling to Clients (e.g. Desktops)
Clients connected via Ethernet Cables

Figure 5

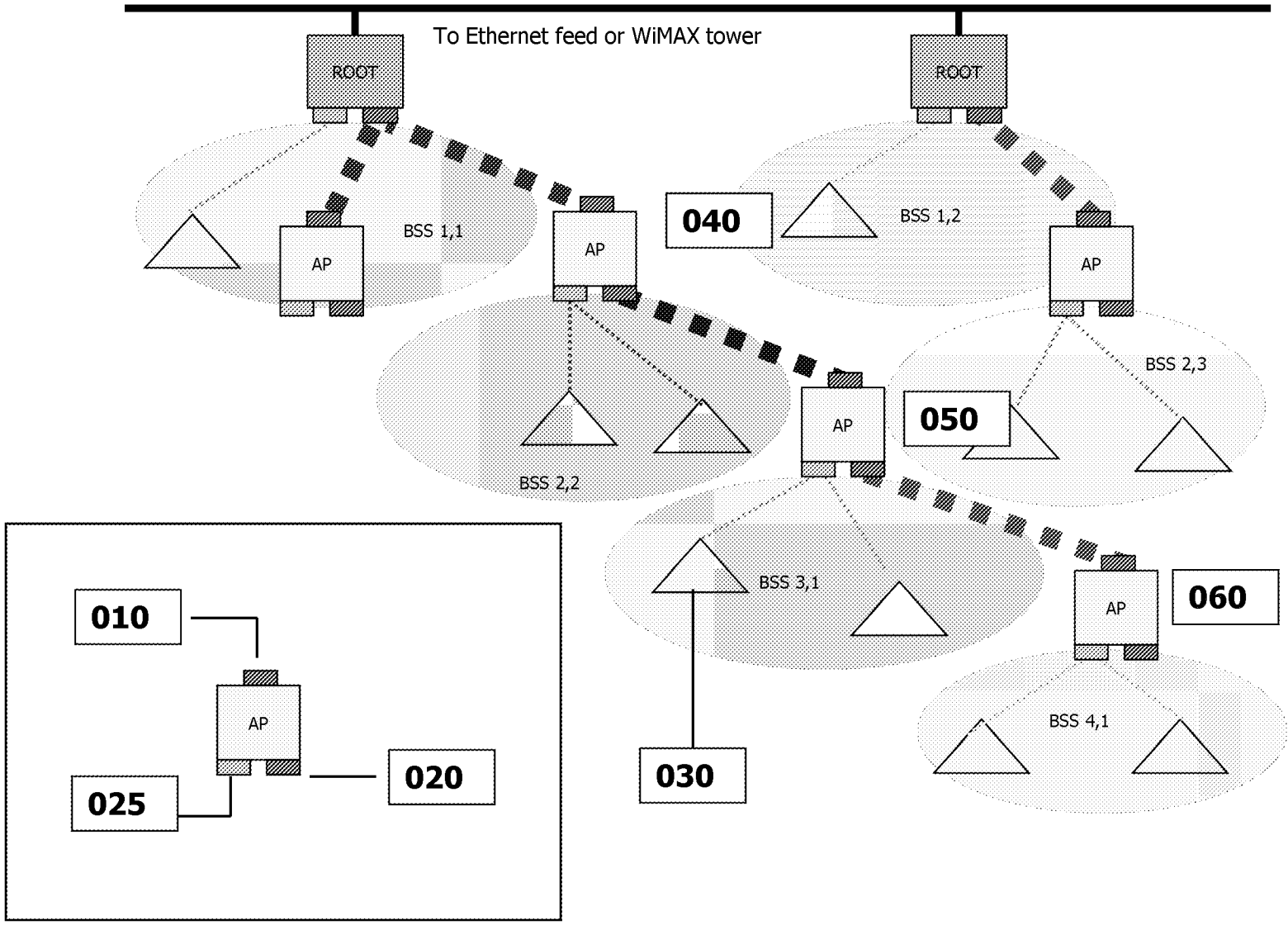

To Ethernet feed or WiMAX tower
ROOT
ROOT
BSS 1,1
AP
AP
040
BSS 1,2
AP
BSS 2,3
AP
050
BSS 2,2
BSS 3,1
AP
060
BSS 4,1
030
010
AP
020
025

Figure 6

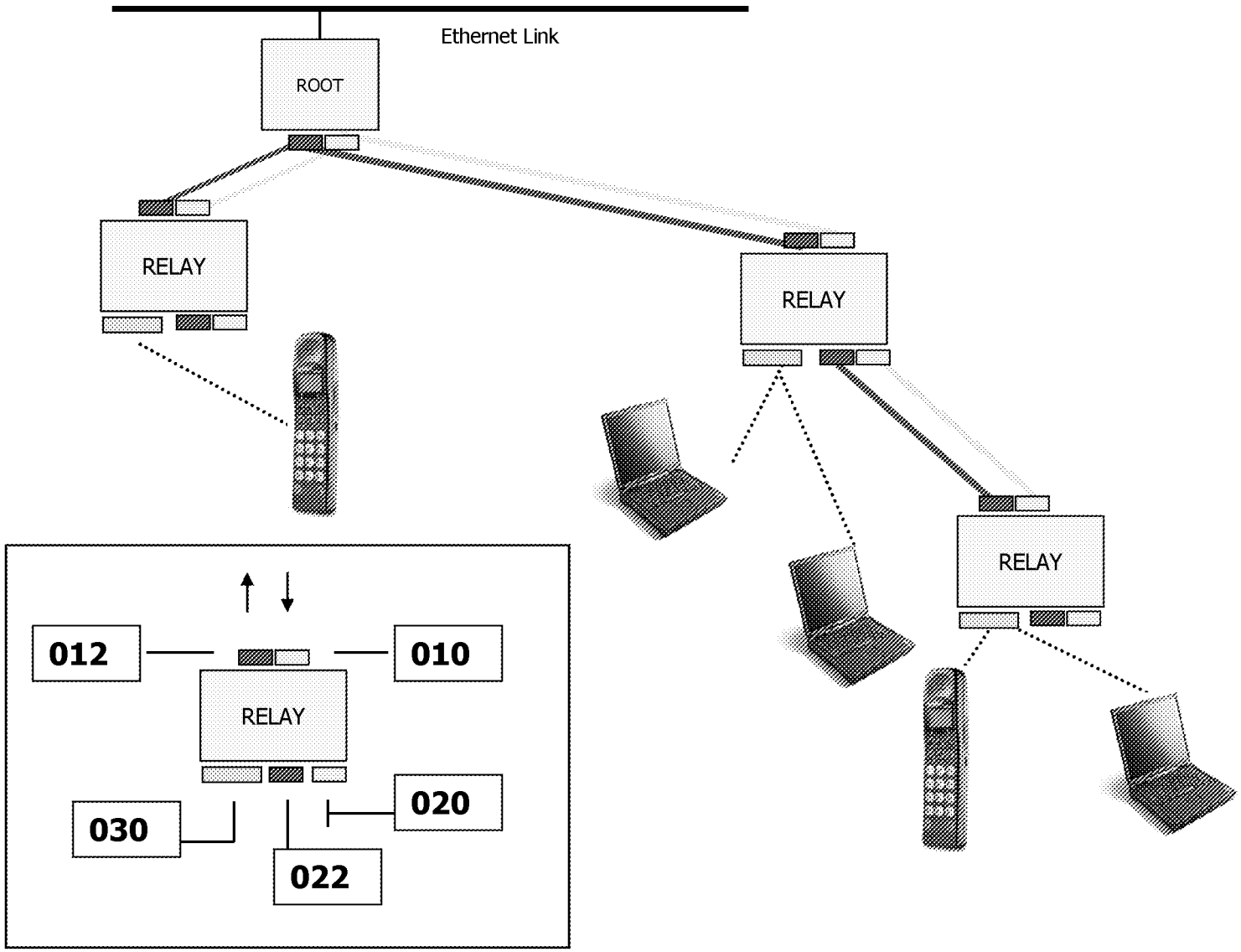


Figure 7

EX1018, Page 144

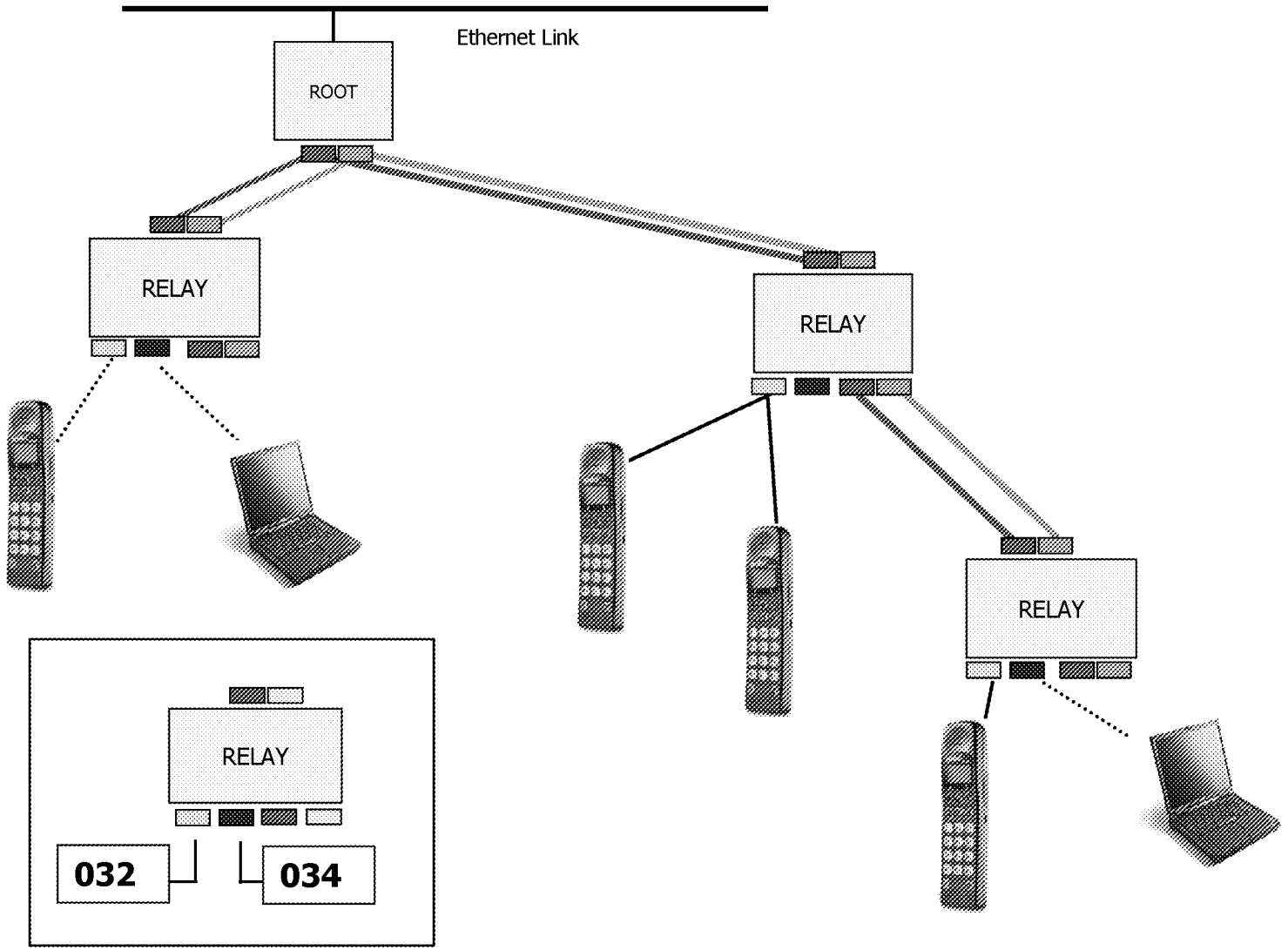


Figure 8

EX1018, Page 145

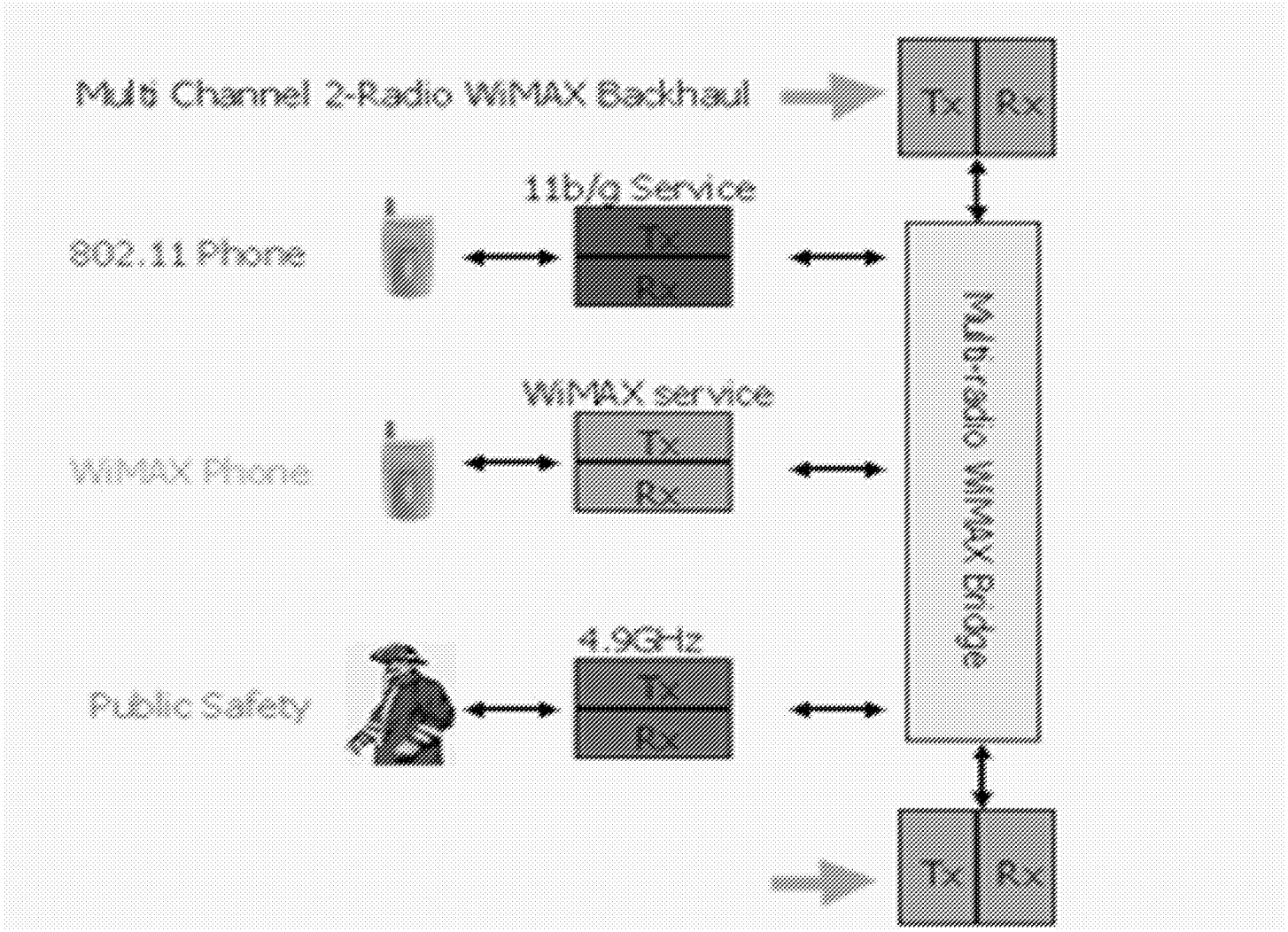

Multi Channel 2-Radio WiMAX Backhaul
Tx
Rx
11b/g Service
802.11 Phone
Tx
Rx
WiMAX service
WiMAX Phone
Tx
Rx
4.9GHz
Public Safety
Tx
Rx
Multi-Radio WiMAX Engine
Tx
Rx

Figure 9

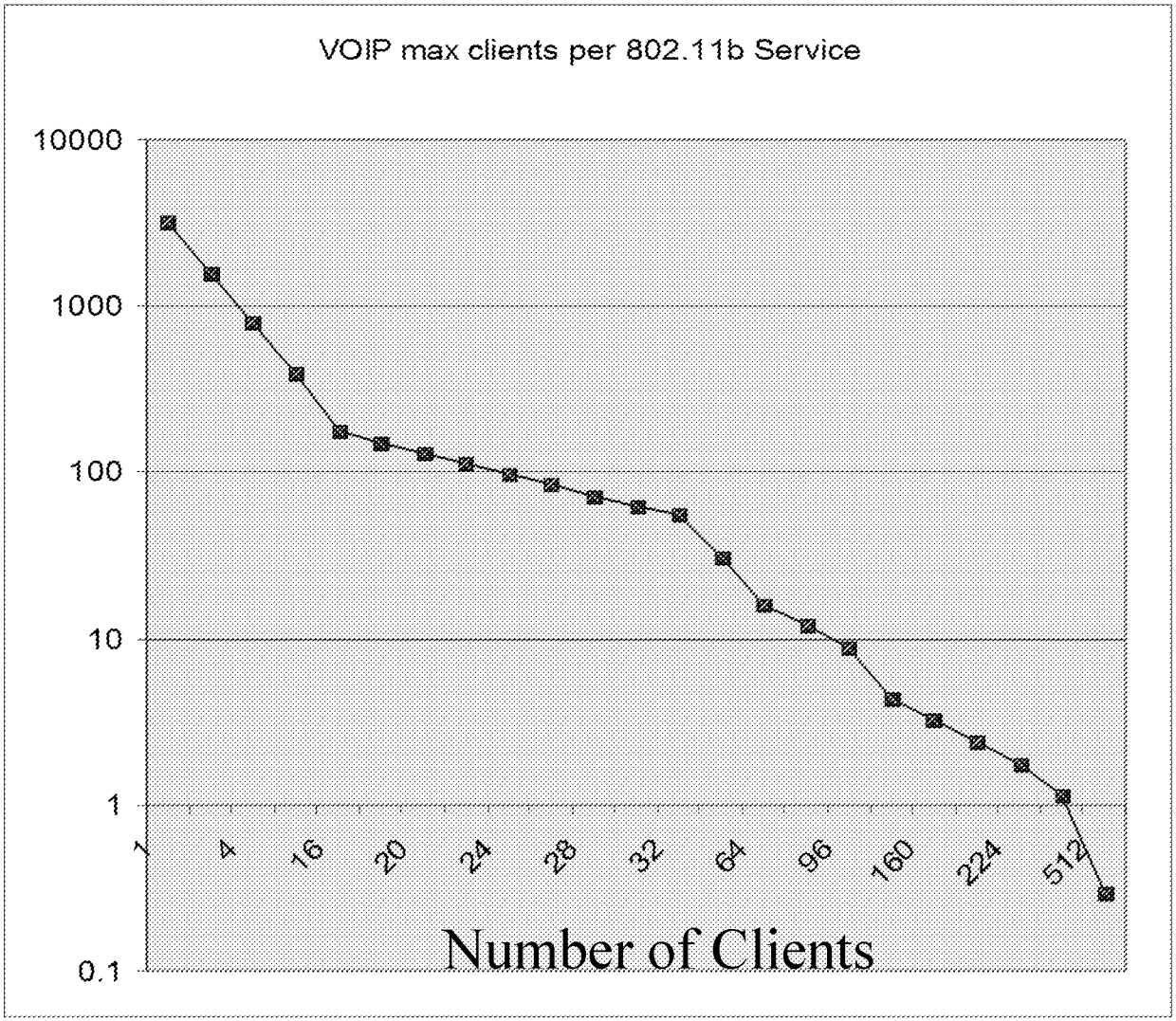


Figure 10

EX1018, Page 147

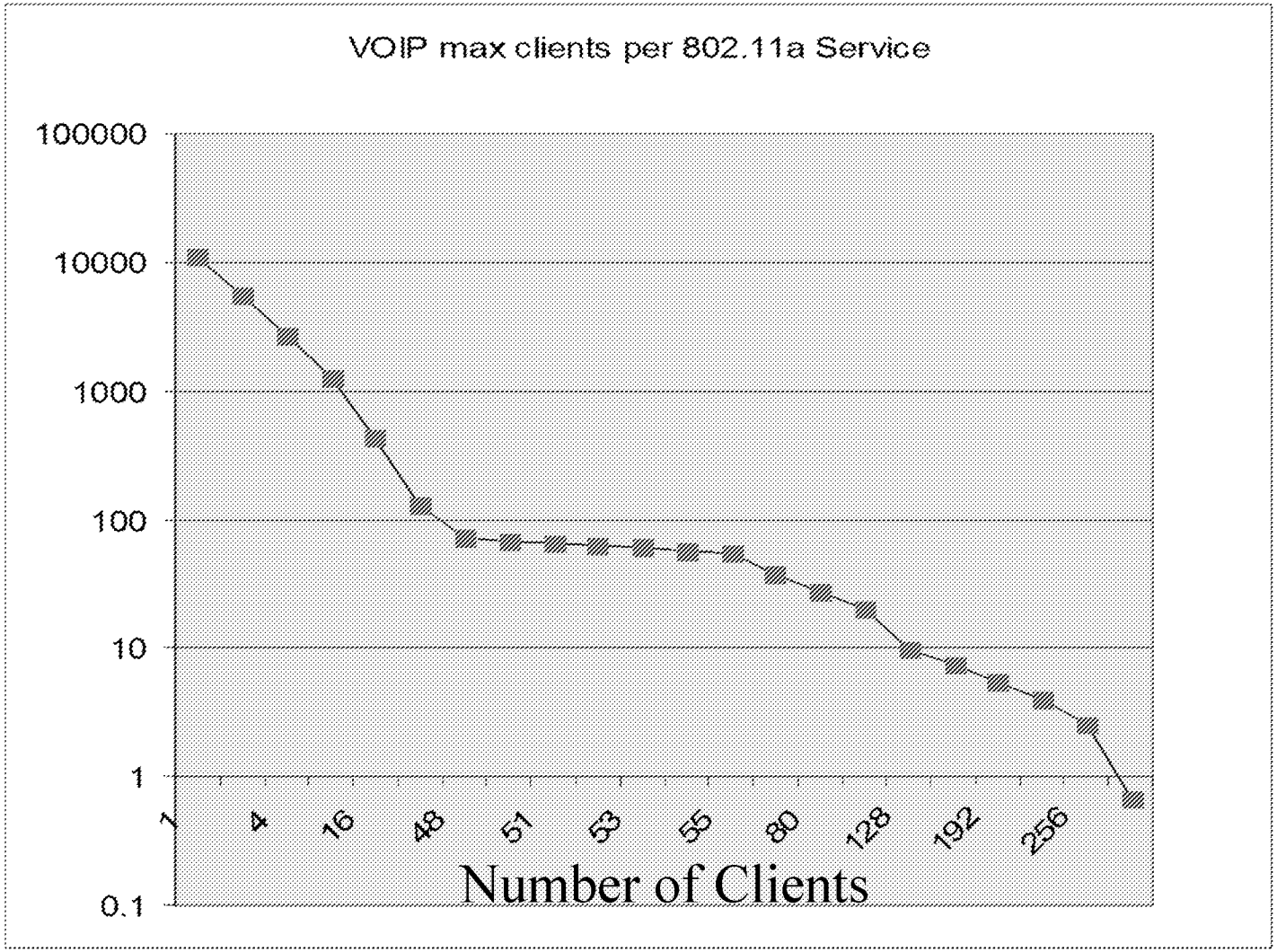


Figure 11

EX1018, Page 148

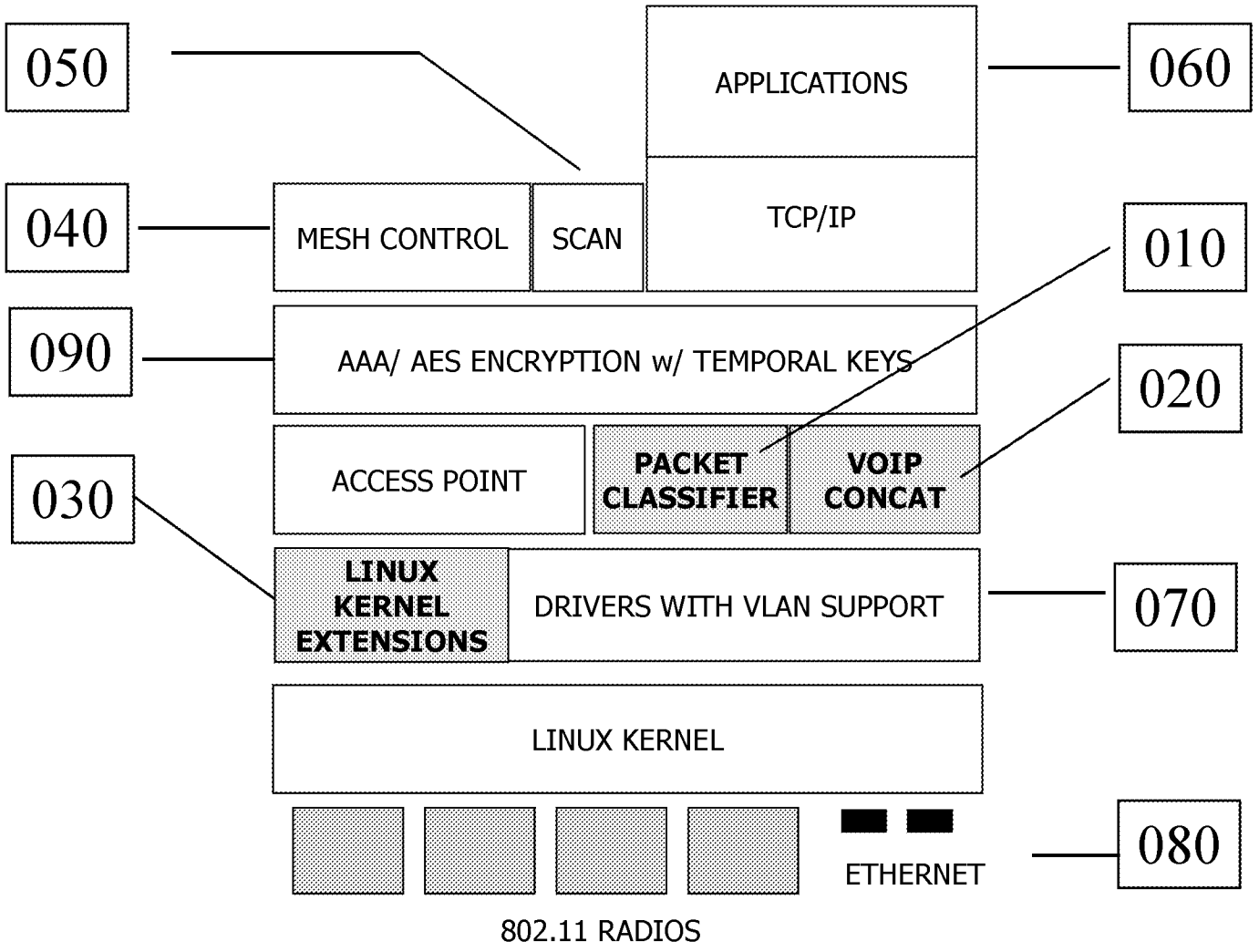


Figure 12

EX1018, Page 149

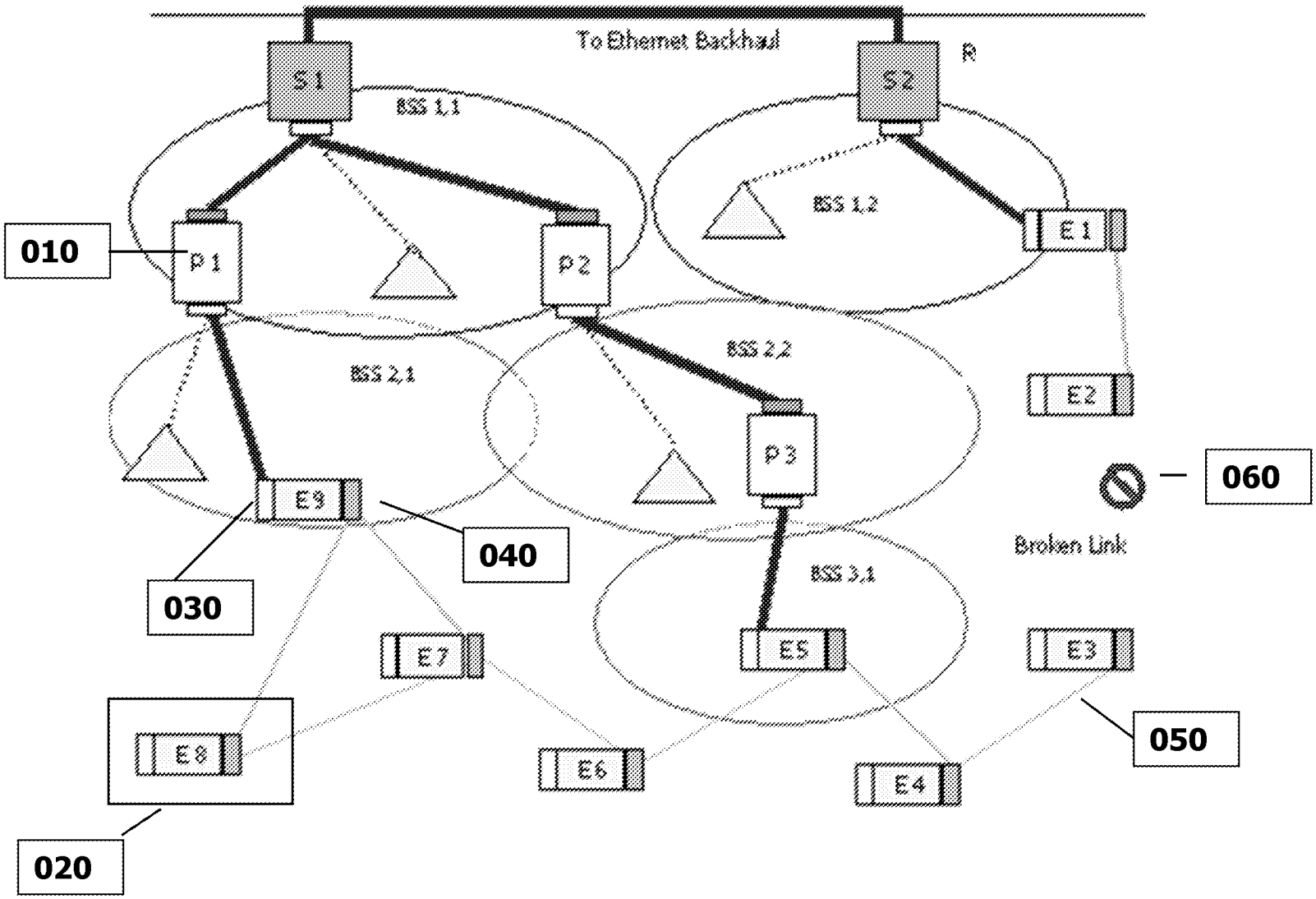


FIGURE 13

EX1018, Page 150

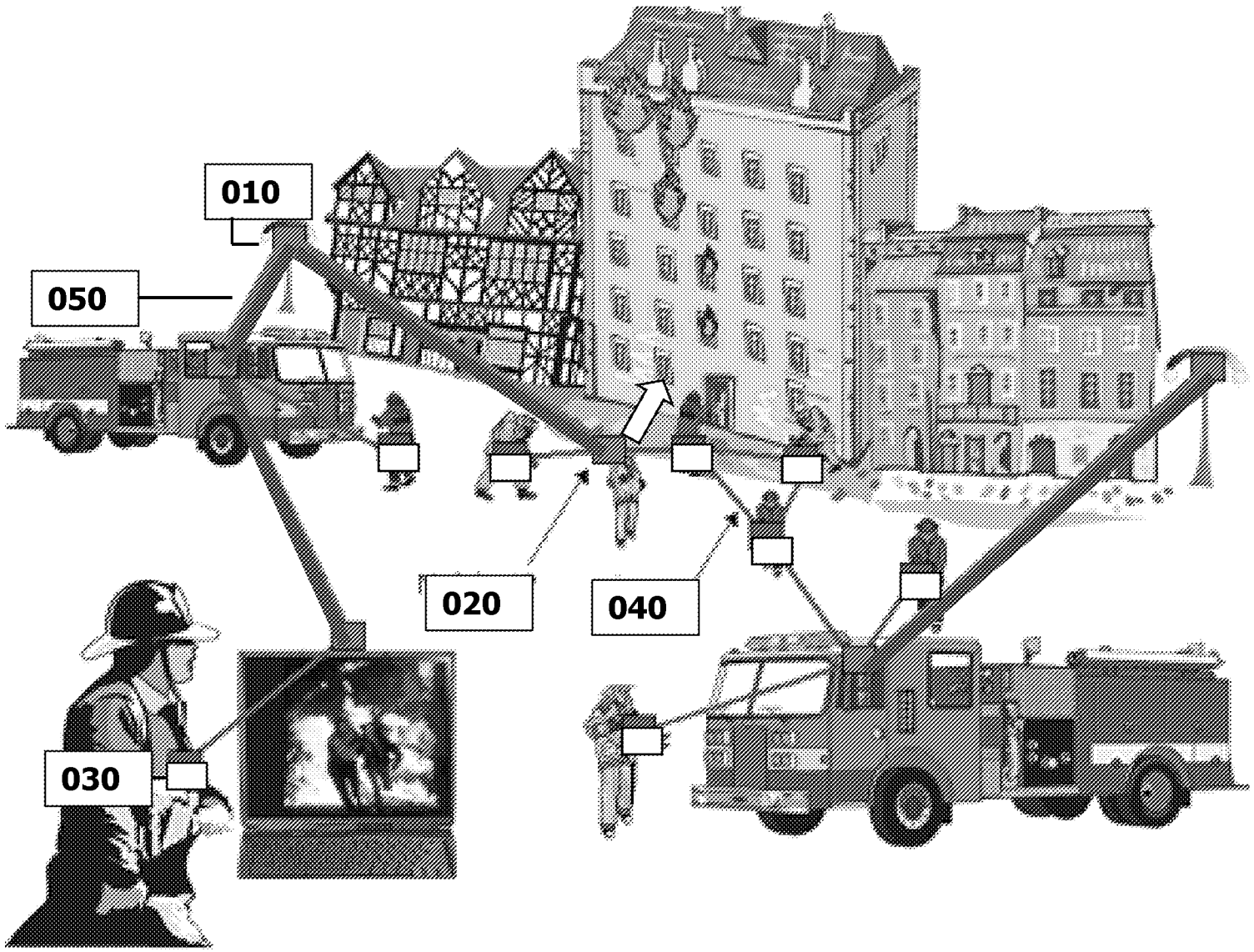


Figure 14

EX1018, Page 151

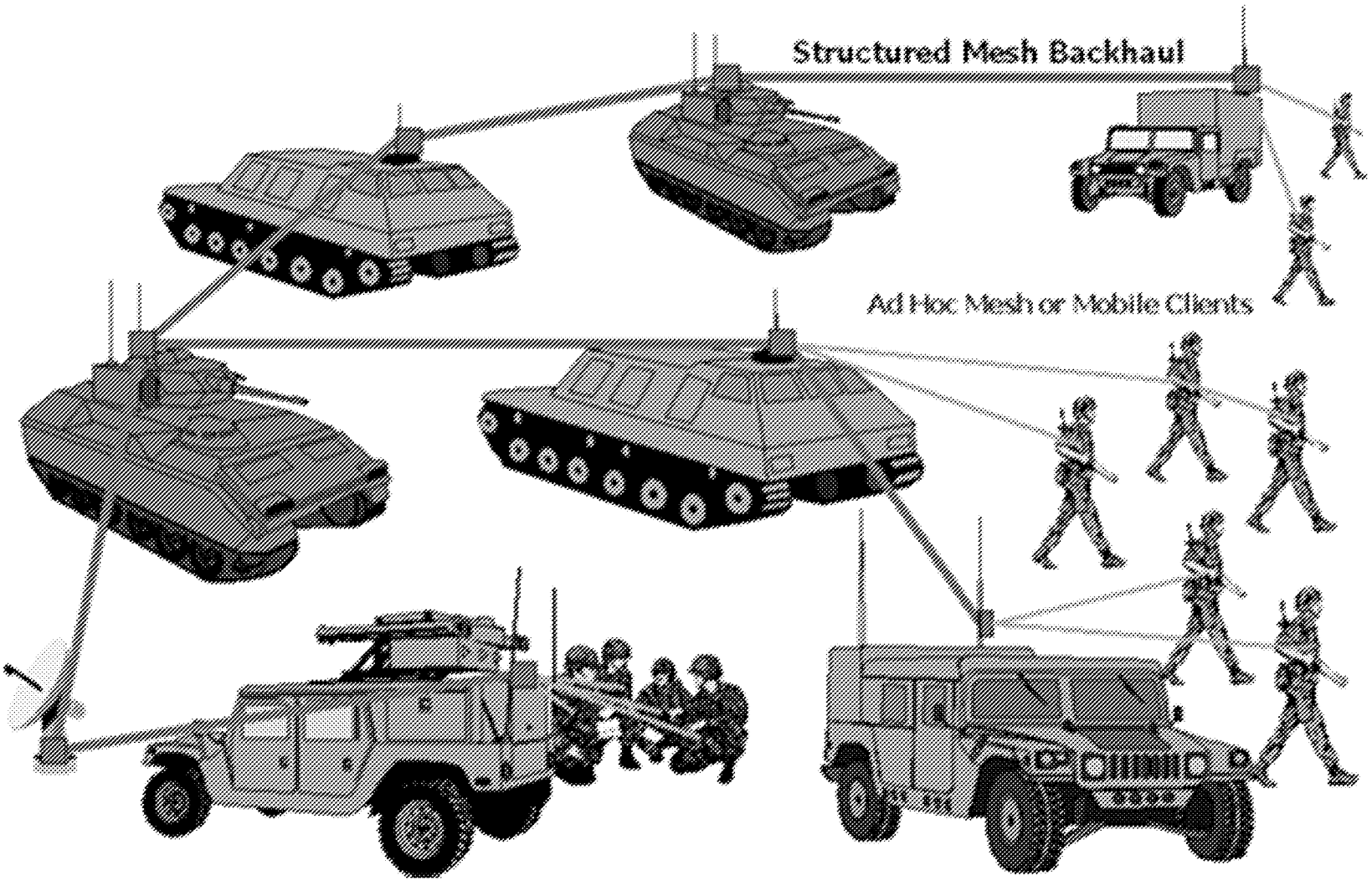


Figure 15

EX1018, Page 152

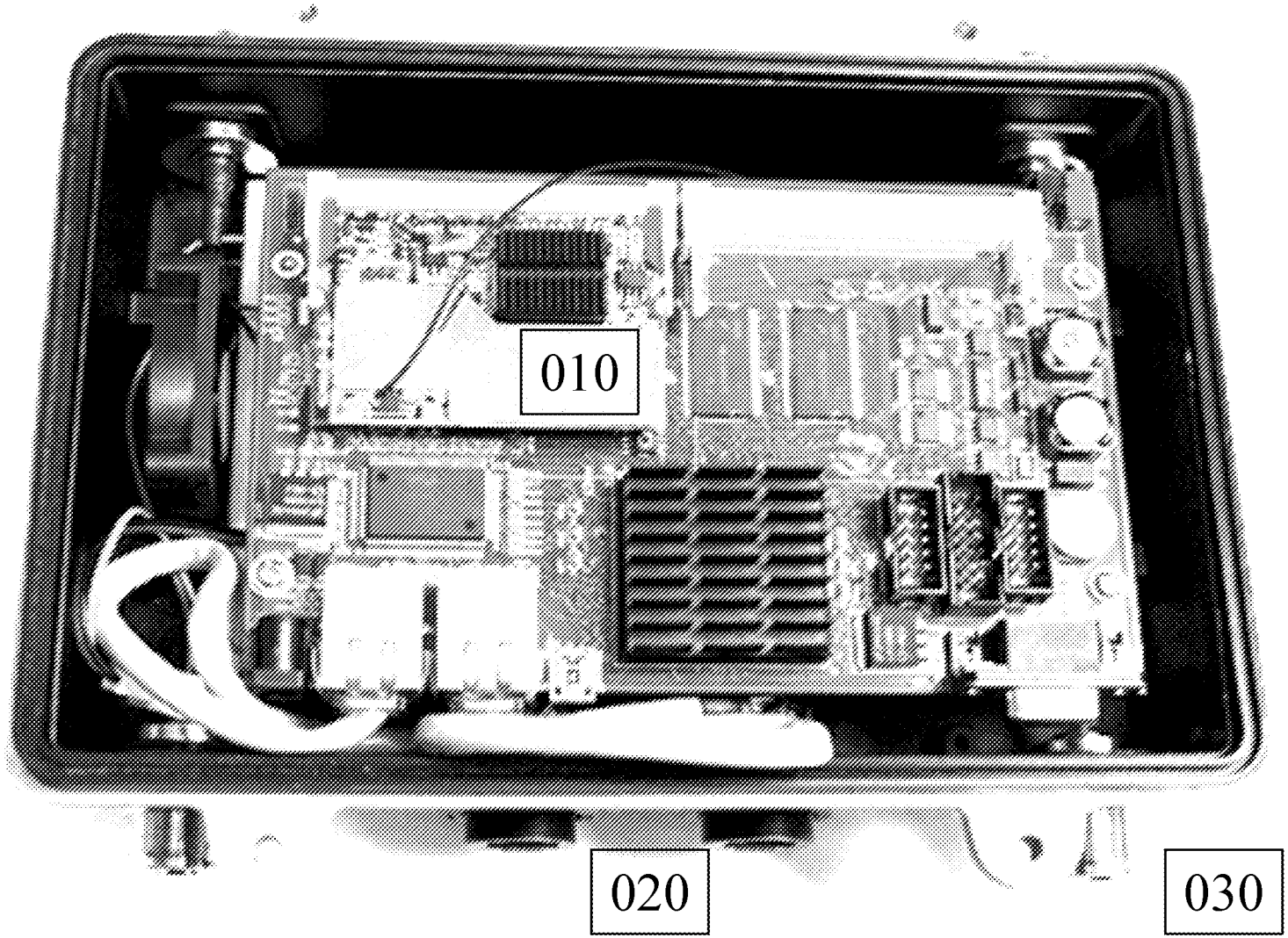


Figure 16

EX1018, Page 153

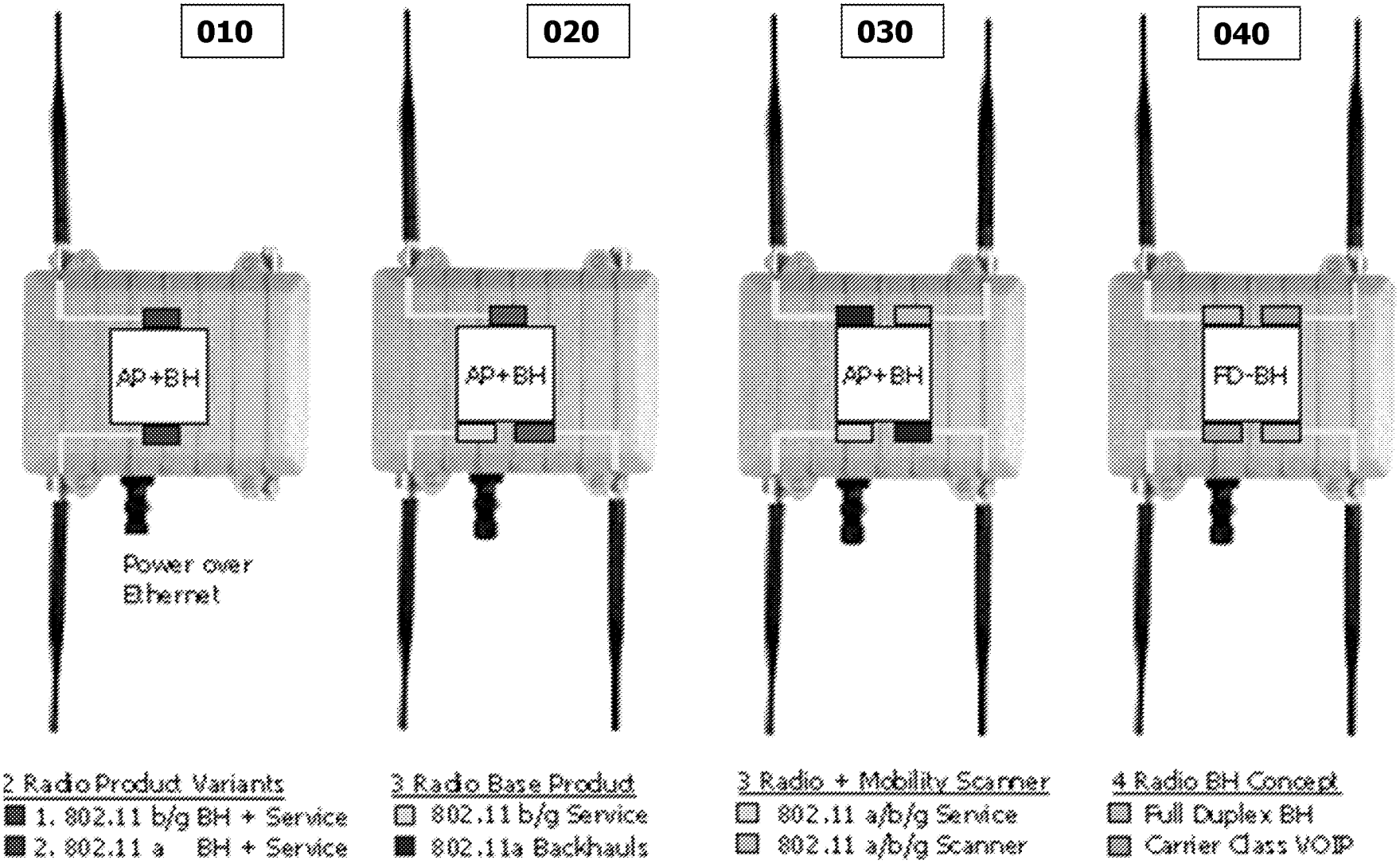

010
020
030
040
AP+BH
AP+BH
AP+BH
FD-BH
Power over
Ethernet
2 Radio Product Variants
1. 802.11 b/g BH + Service
2. 802.11 a BH + Service
3 Radio Base Product
802.11 b/g Service
802.11a Backhauls
3 Radio + Mobility Scanner
802.11 a/b/g Service
802.11 a/b/g Scanner
4 Radio BH Concept
Full Duplex BH
Carrier Class VOIP

Figure 17

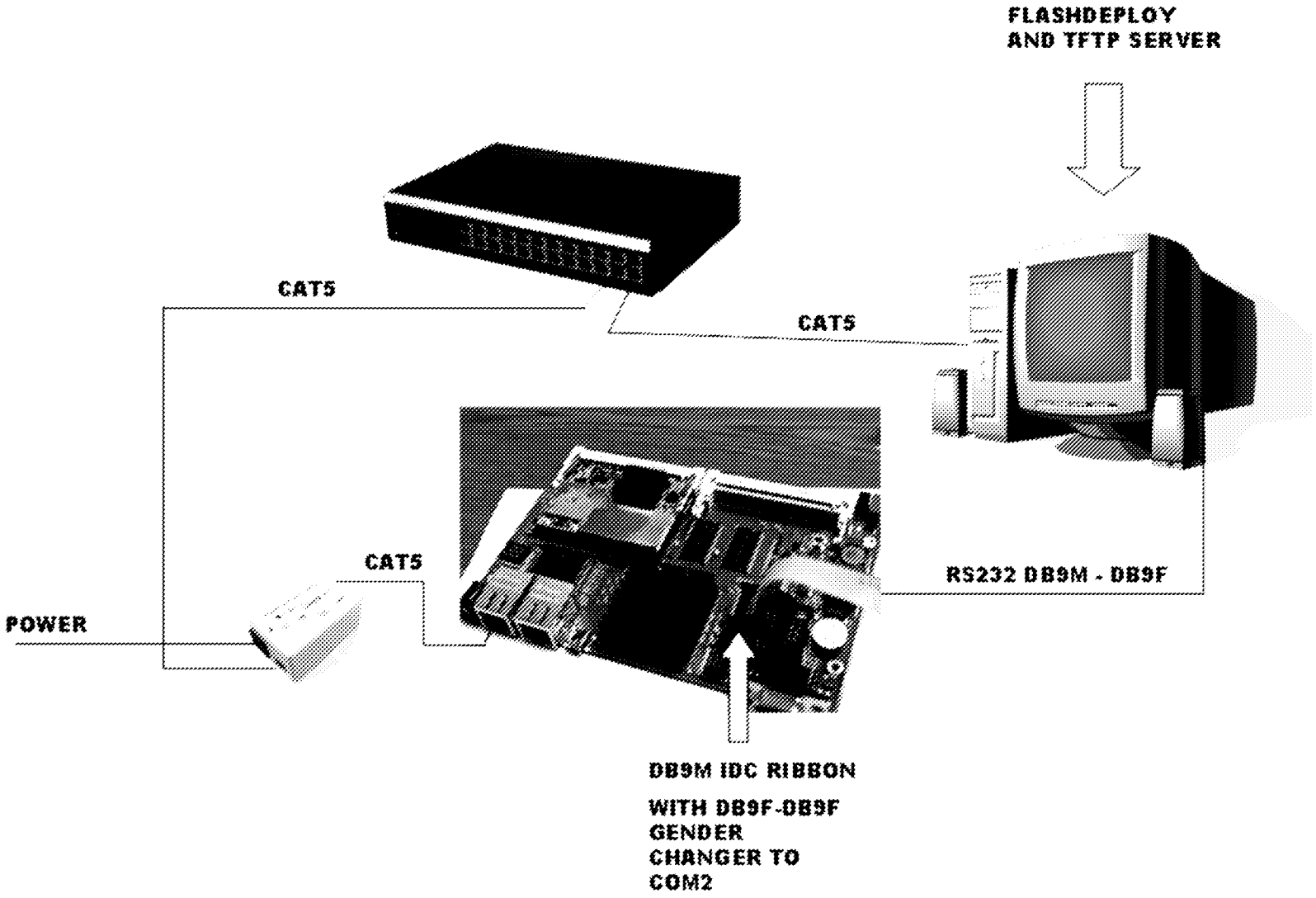

FLASHDEPLOY
AND TFTP SERVER
CAT5
CAT5
CAT5
POWER
RS232 DB9M - DB9F
DB9M IDC RIBBON
WITH DB9F-DB9F
GENDER
CHANGER TO
COM2

Figure 18

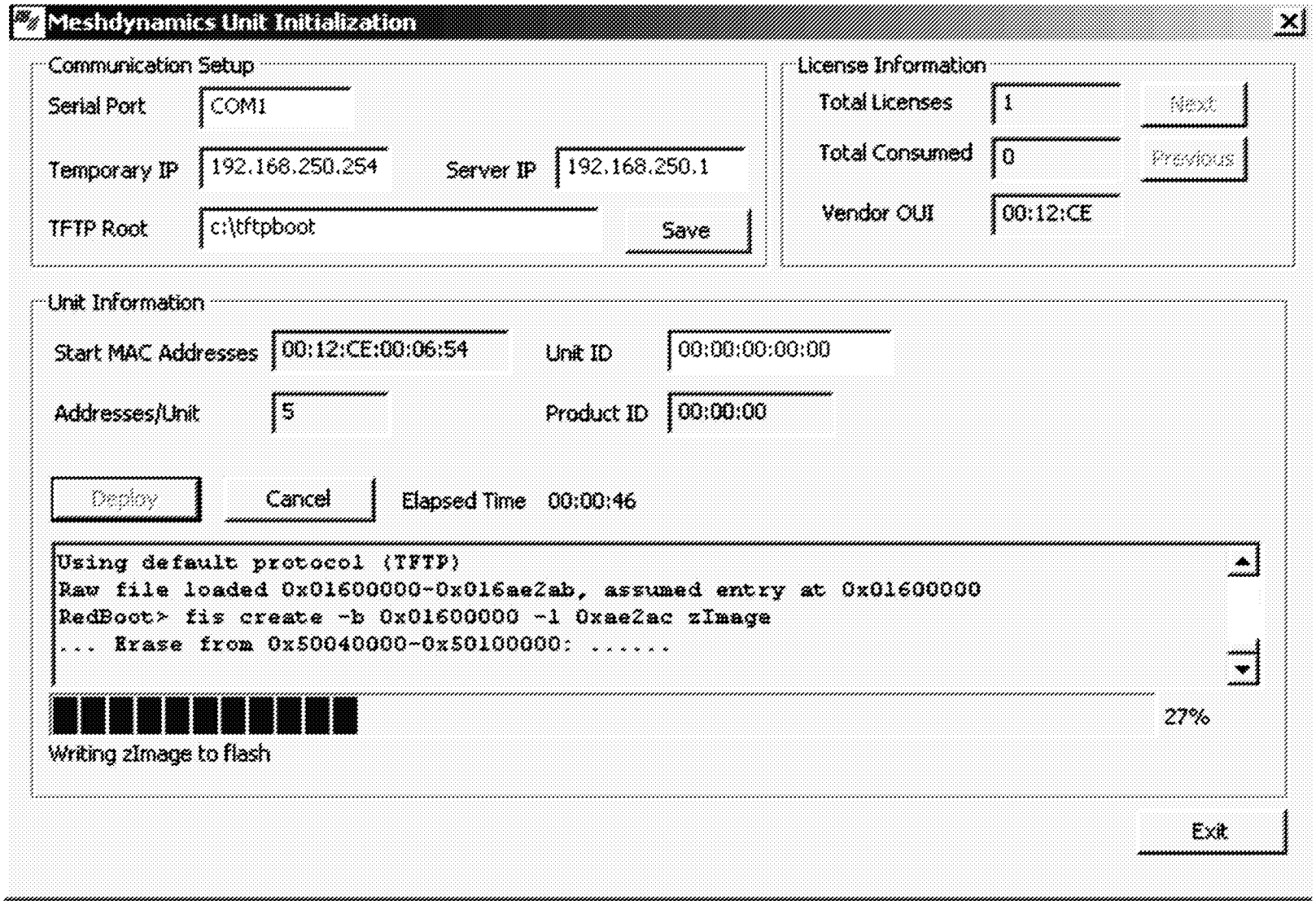

Meshdynamics Unit Initialization
Communication Setup
Serial Port
COM1
Temporary IP
192.168.250.254
Server IP
192.168.250.1
TFTP Root
c:\tftpboot
Save
License Information
Total Licenses
1
Next
Total Consumed
0
Previous
Vendor OUI
00:12:CE
Unit Information
Start MAC Addresses
00:12:CE:00:06:54
Unit ID
00:00:00:00:00:00
Addresses/Unit
5
Product ID
00:00:00
Deploy
Cancel
Elapsed Time 00:00:46
Using default protocol (TFTP)
Raw file loaded 0x01600000-0x016ae2ab, assumed entry at 0x01600000
RedBoot> fis create -b 0x01600000 -l 0xae2ac zImage
... Erase from 0x50040000-0x50100000: ......
27%
Writing zImage to flash
Exit

Figure 19

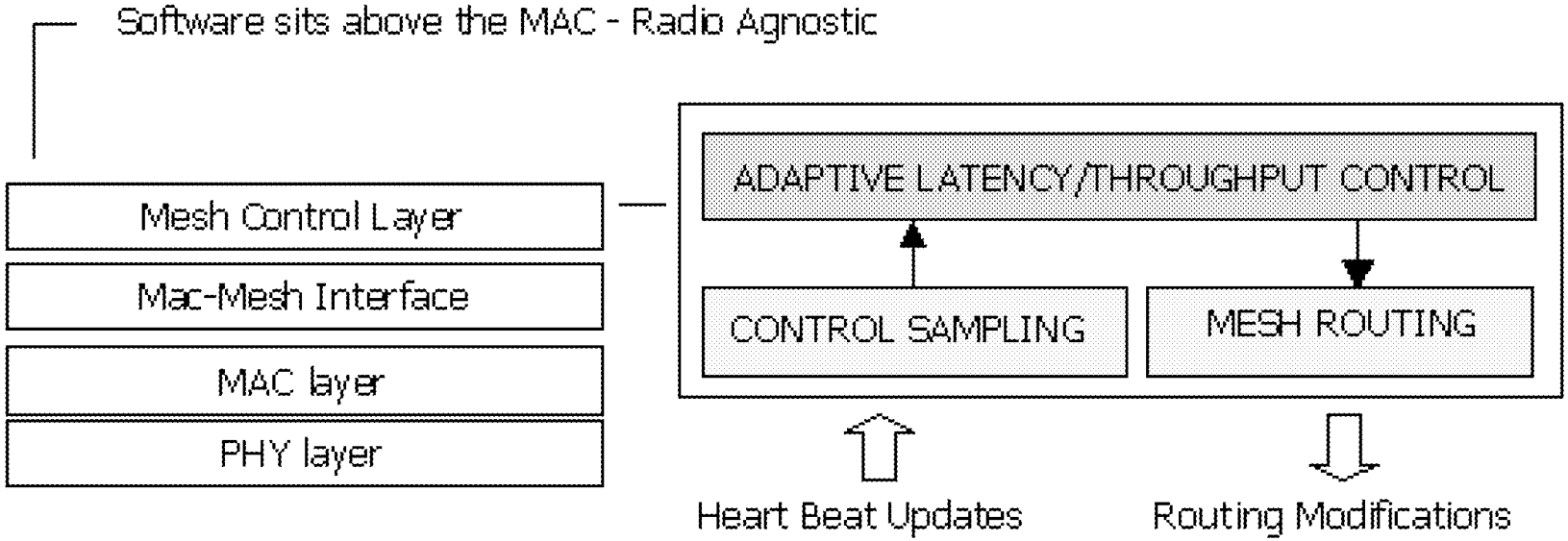


Figure 20

EX1018, Page 157

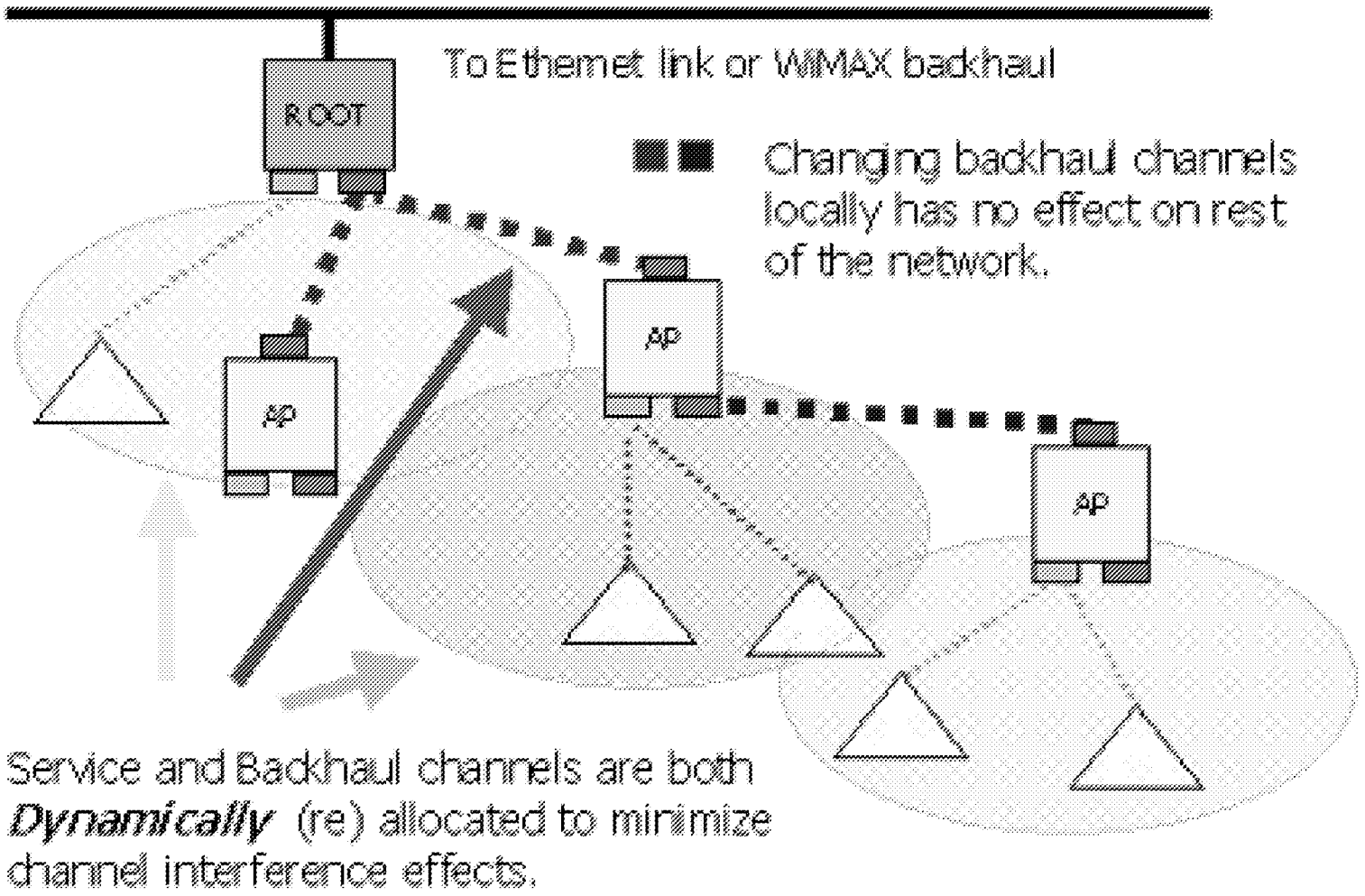


Figure 21

EX1018, Page 158

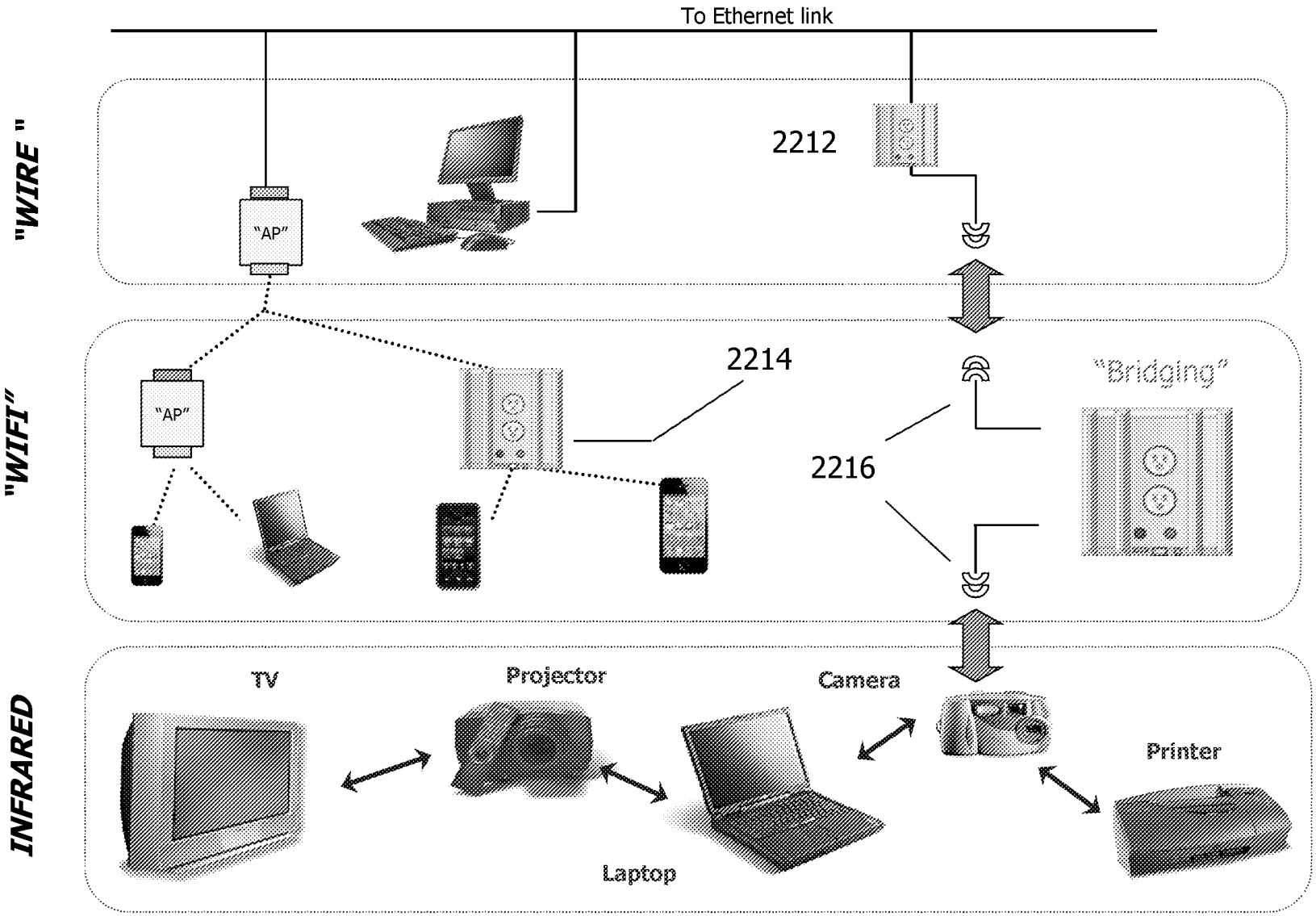
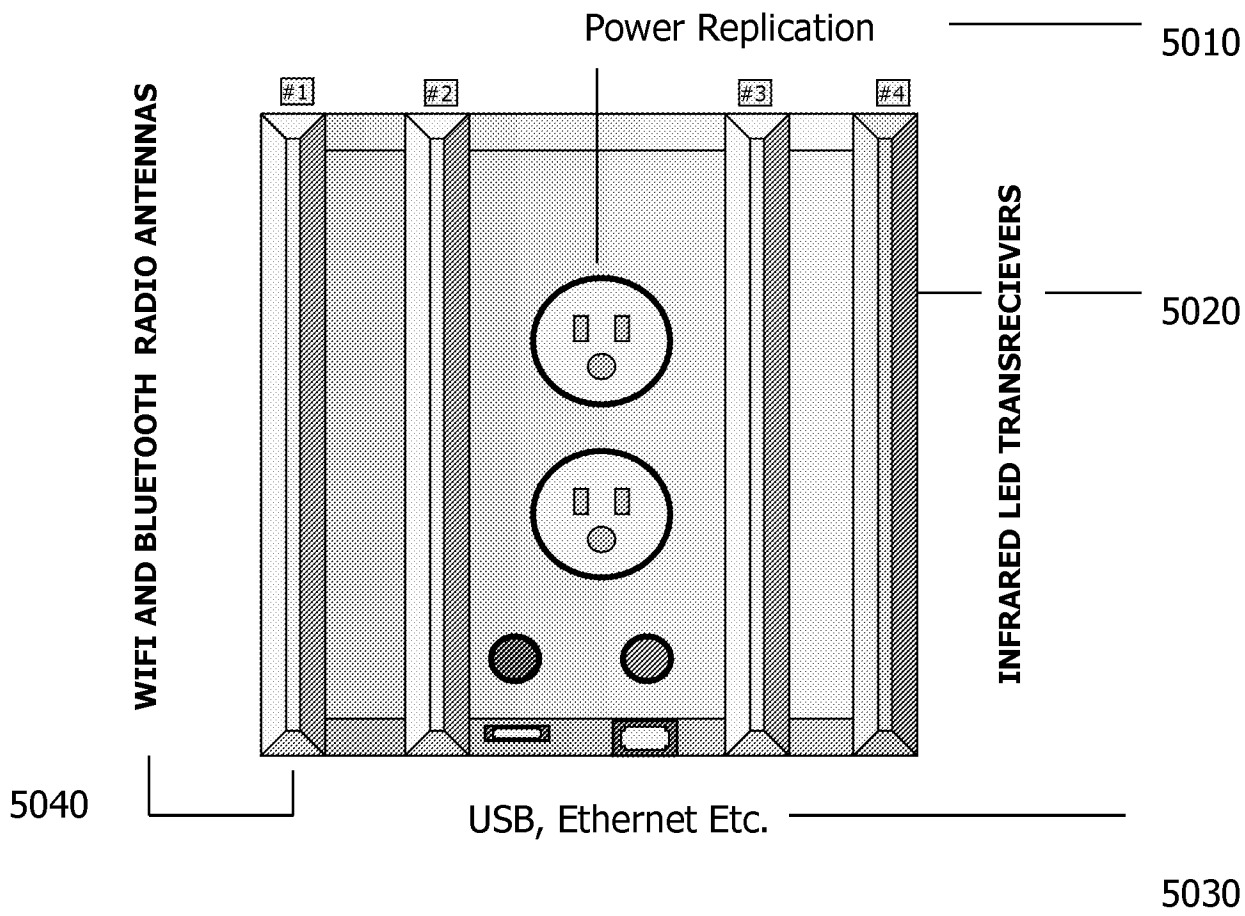


Figure 22

EX1018, Page 159

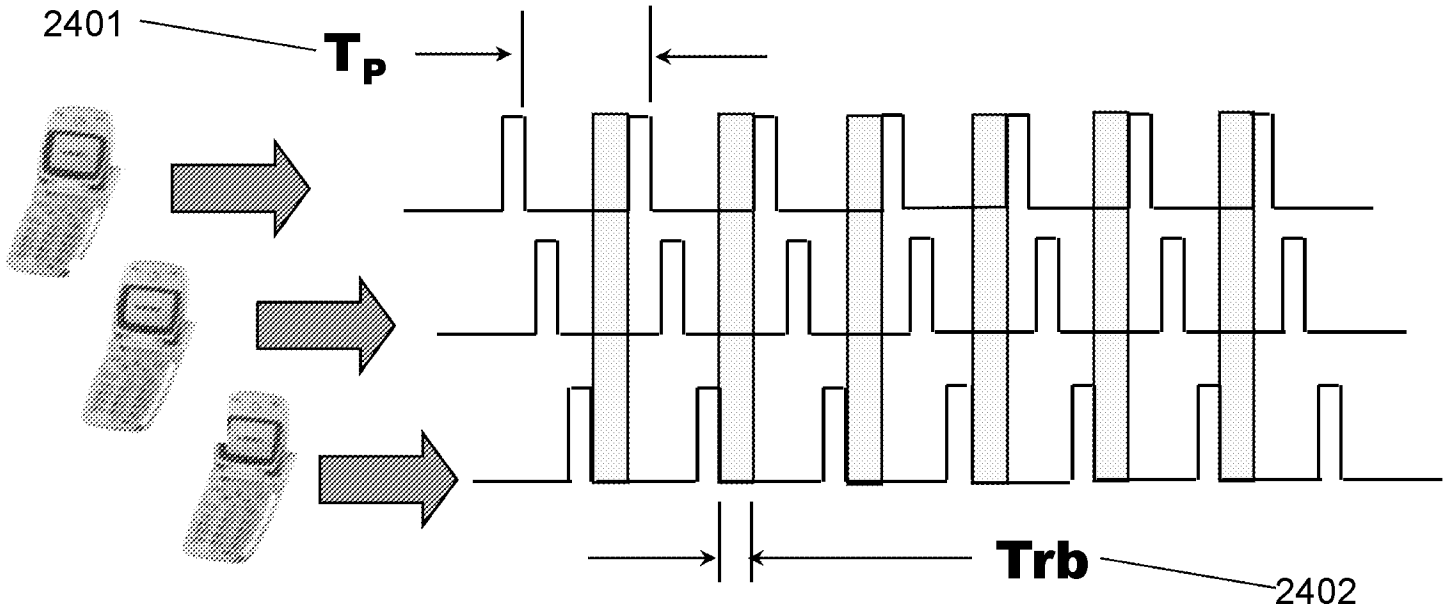


N- Logical "Radio" Modular Mesh aware Bridge

Figure 23

EX1018, Page 160

Receive Block: Time for Bulk VOIP Transmissions



BLOCK OF TIME RESERVED FOR RECEVE PACKETS

- T_P : PACKETIZATION TIME: 20 ms for G.711 and G.729 CODECS
- T_{rb} : RECEIVE BLOCK: For all receive packets (from Access Point to Devices)

Figure 24

Separate Voice and Data Service

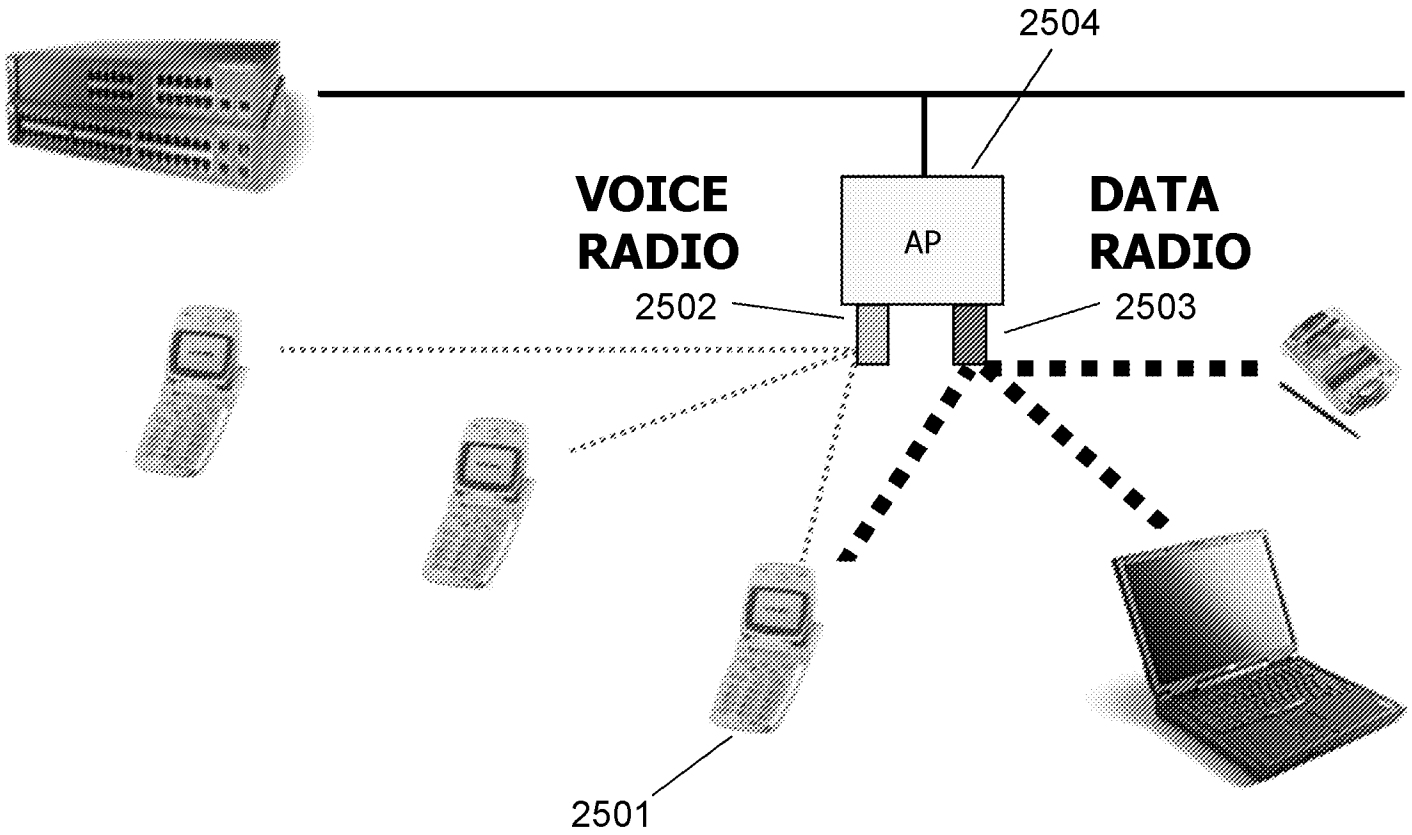


Figure 25

EX1018, Page 162

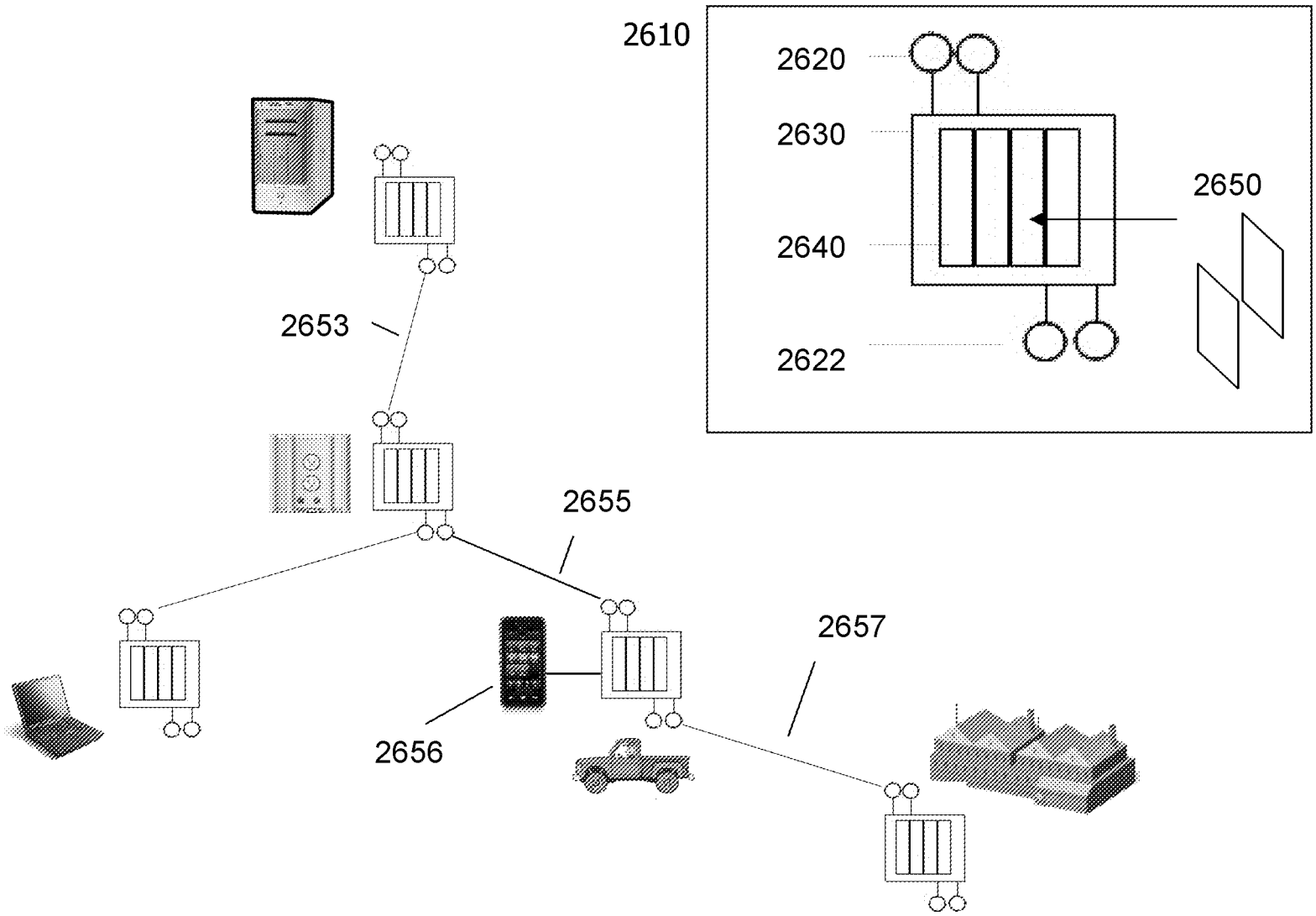


Figure 26

EX1018, Page 163

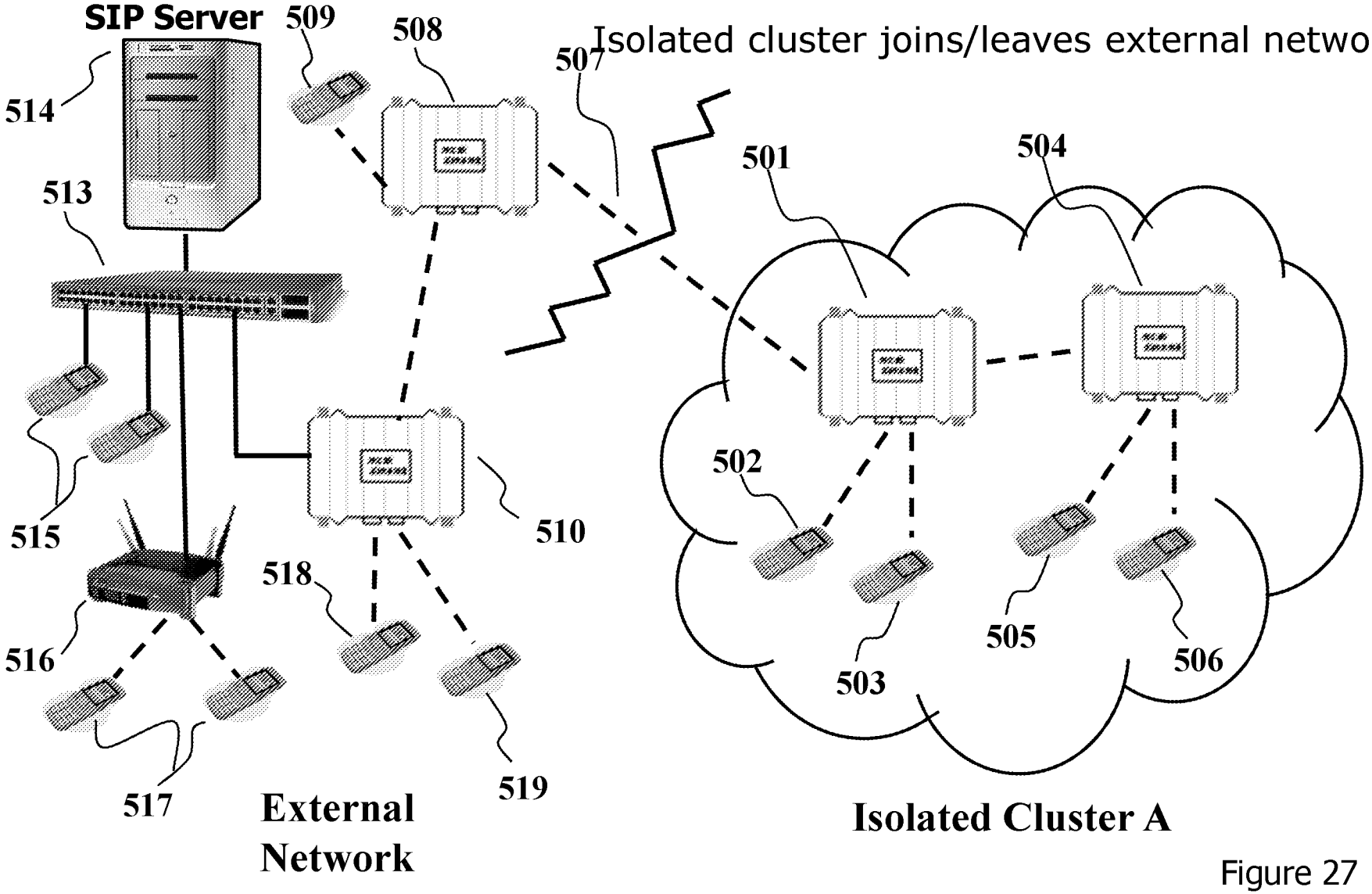
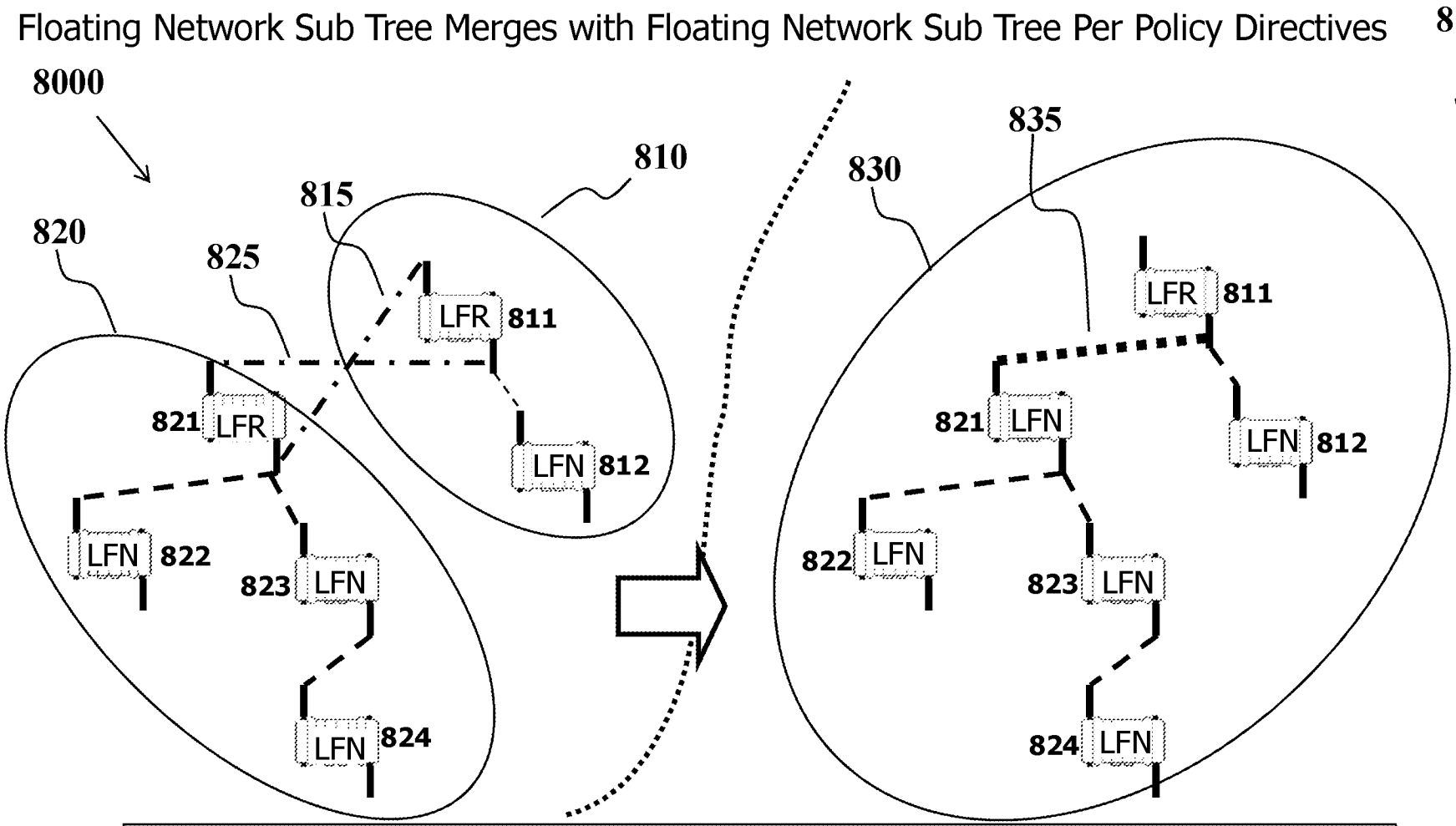


Figure 27

EX1018, Page 164

Floating Network Sub Tree Merges with Floating Network Sub Tree Per Policy Directives



- **When two LFRs see each other, one becomes LFN and joins the other**
- **A Tie Breaker Function (TBF) decides which one becomes an LFN**

Figure 28

EX1018, Page 165

DISTRIBUTED DHCP SERVICE WITH INHERENT CONFLICT RESOLUTION

ASSUME A FIXED SUBNET MASK OF *255.0.0.0* IS USED

- **IP ADDRESSES OF THE FORM A.*x.y.k* where**
- **A defines the *CUSTOMER-NETWORK-ID* 16 bit (0 -255)**
- **k is *CLIENT BASED ID* 16 bit (0-255)**
- **x, y are each 16 bit : 2^{32} unique networks each with up 255 clients possible**

POLICY DIRECTIVE: SPLIT UP ADDRESS SPACE BETWEEN STATIC and MOBILE networks

- **Assign 15 bits to distributed DHCP services for floating networks**
- **Let NODES CHOOSE A RANDOM 15-bit NUMBER '*R*' AT STARTUP and**
  1. **LET '*M*' BE THE DECIMAL EQUIVALENT OF THE 7-MSBs OF '*R*'**
  2. **LET '*N*' THE DECIMAL EQUIVALENT OF THE 8-LSBs OF '*R*'**

  THE DHCP ADDRESS SPACE OF THE NODE WOULD BE

  A.255-M.N.0 to A.255-M.N.254 where 0<=M<=127 and 0<=N<=255

Figure 29

Objective: Low foot print for low cost embedded system applications
Key Idea: Remove overhead of OS/Virtual Machine from the equation

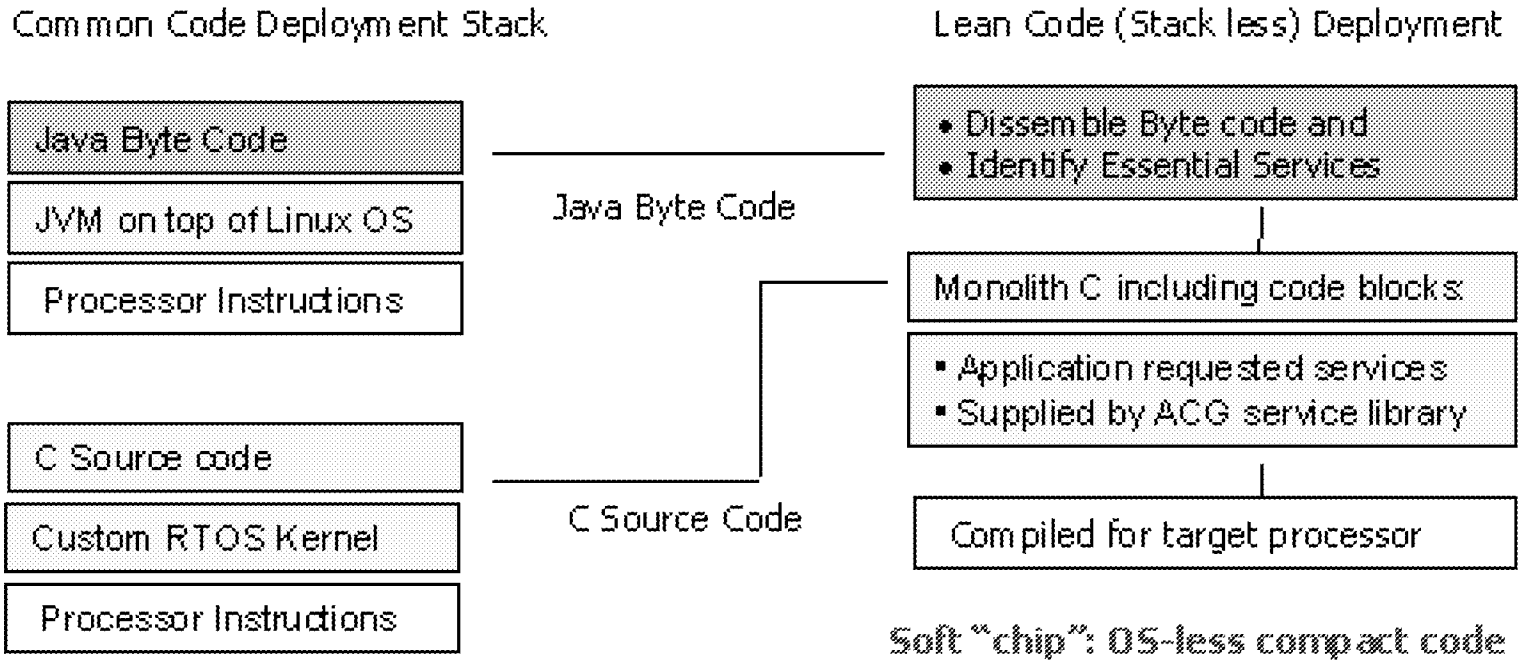


Figure 30

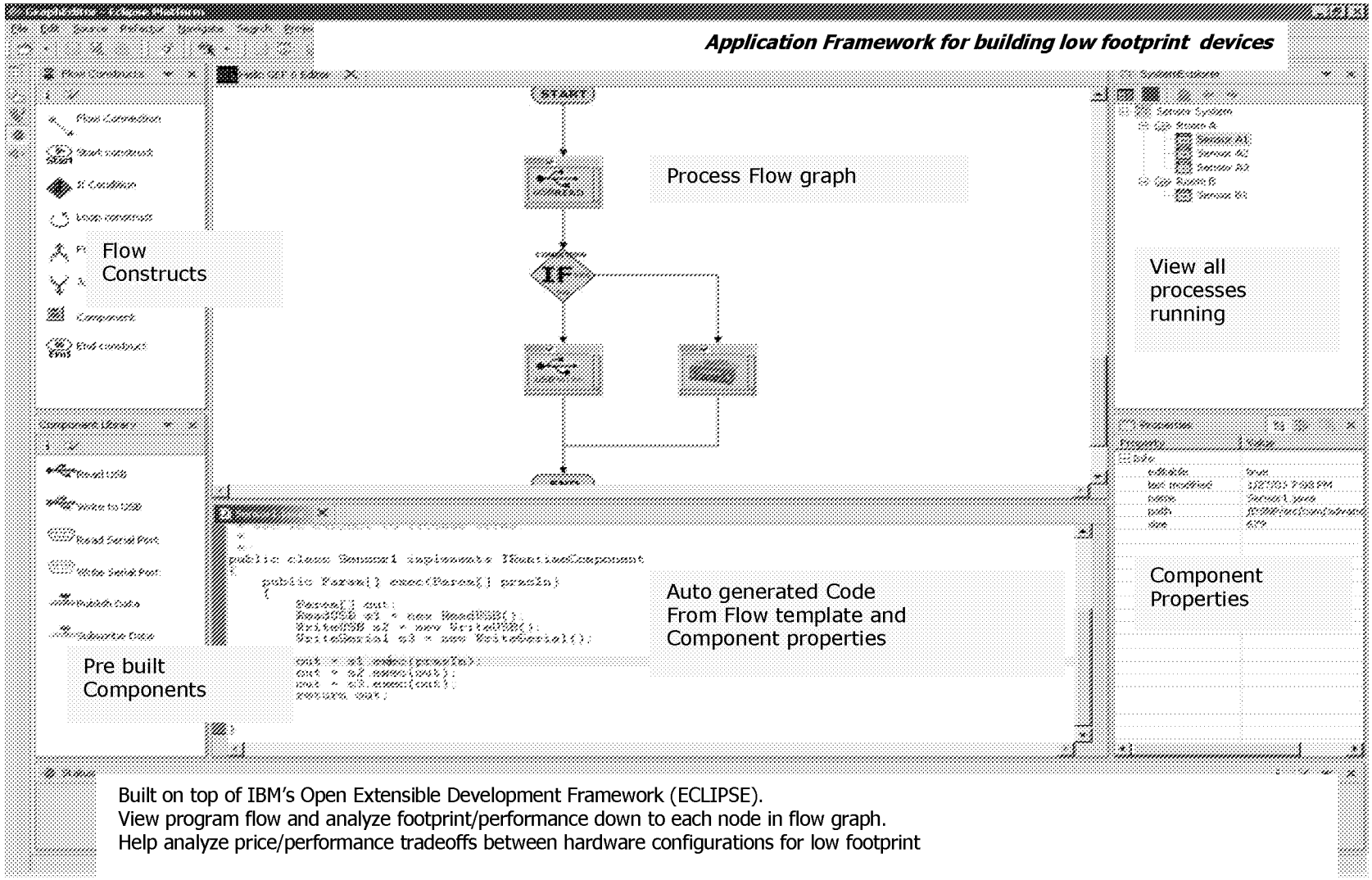

Application Framework for building low footprint devices
START
IF
Process Flow graph
Flow Constructs
View all processes running
Auto generated Code From Flow template and Component properties
Component Properties
Pre built Components
Built on top of IBM's Open Extensible Development Framework (ECLIPSE).
View program flow and analyze footprint/performance down to each node in flow graph.
Help analyze price/performance tradeoffs between hardware configurations for low footprint

Figure 31

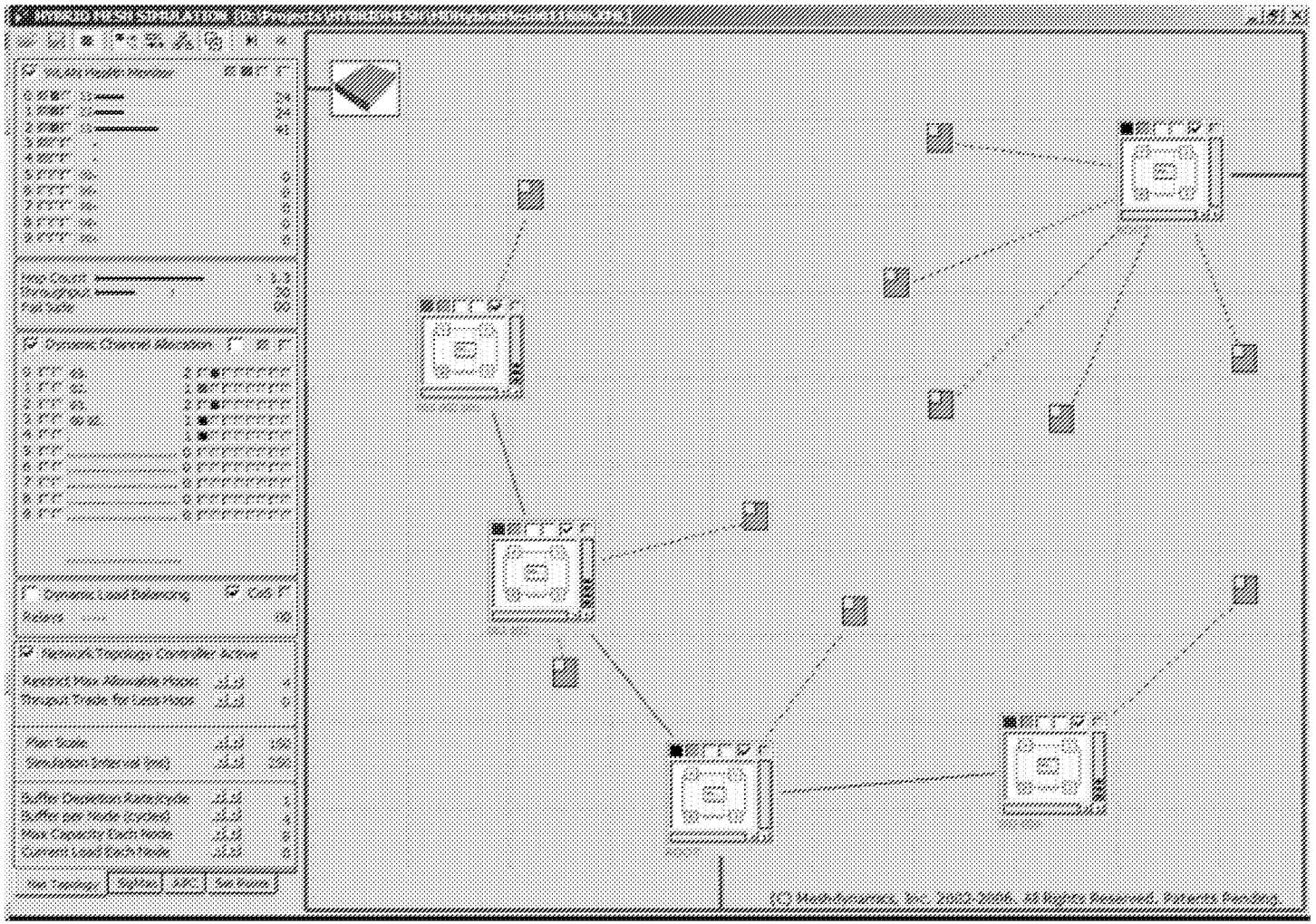


Figure 32

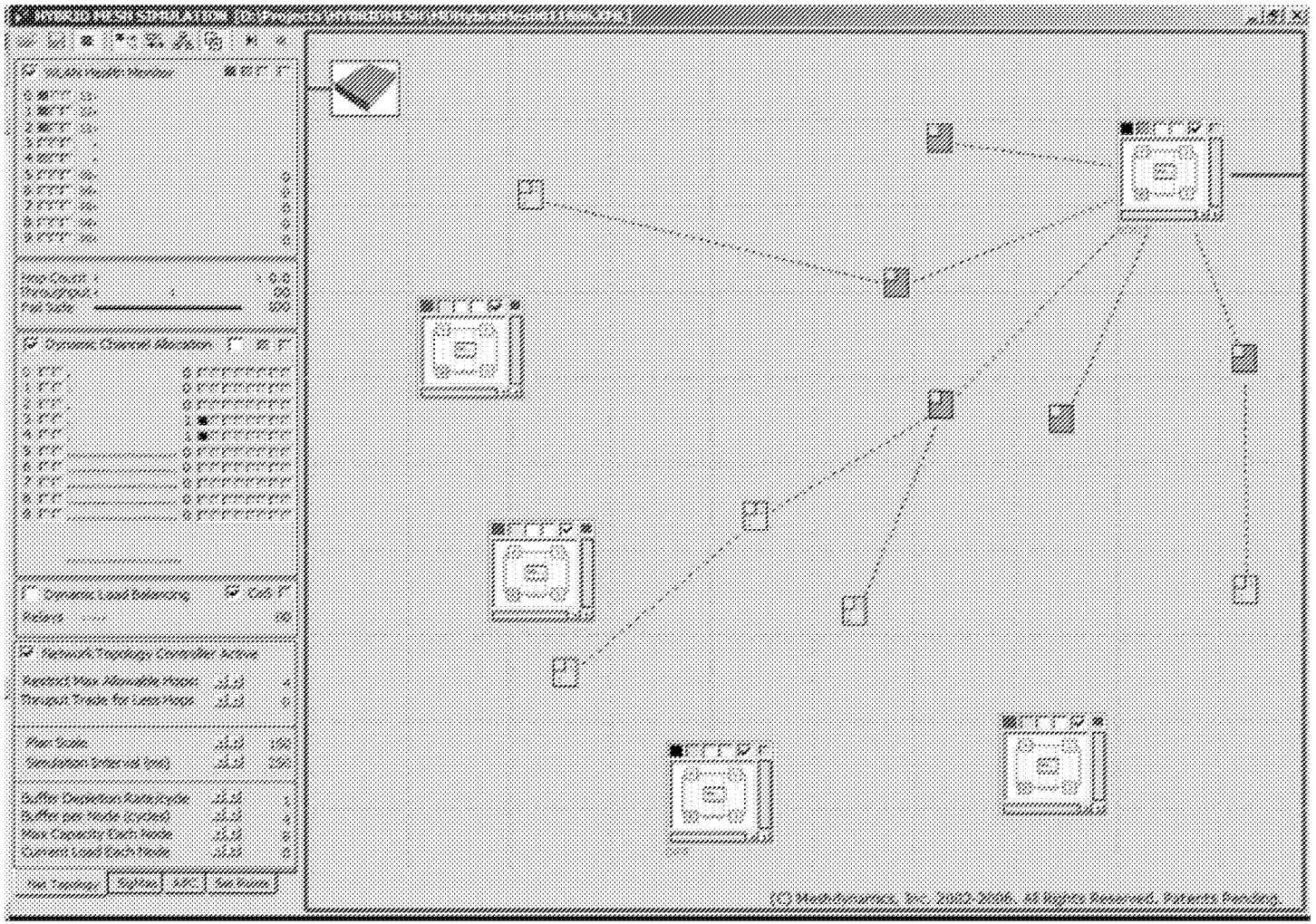


Figure 33

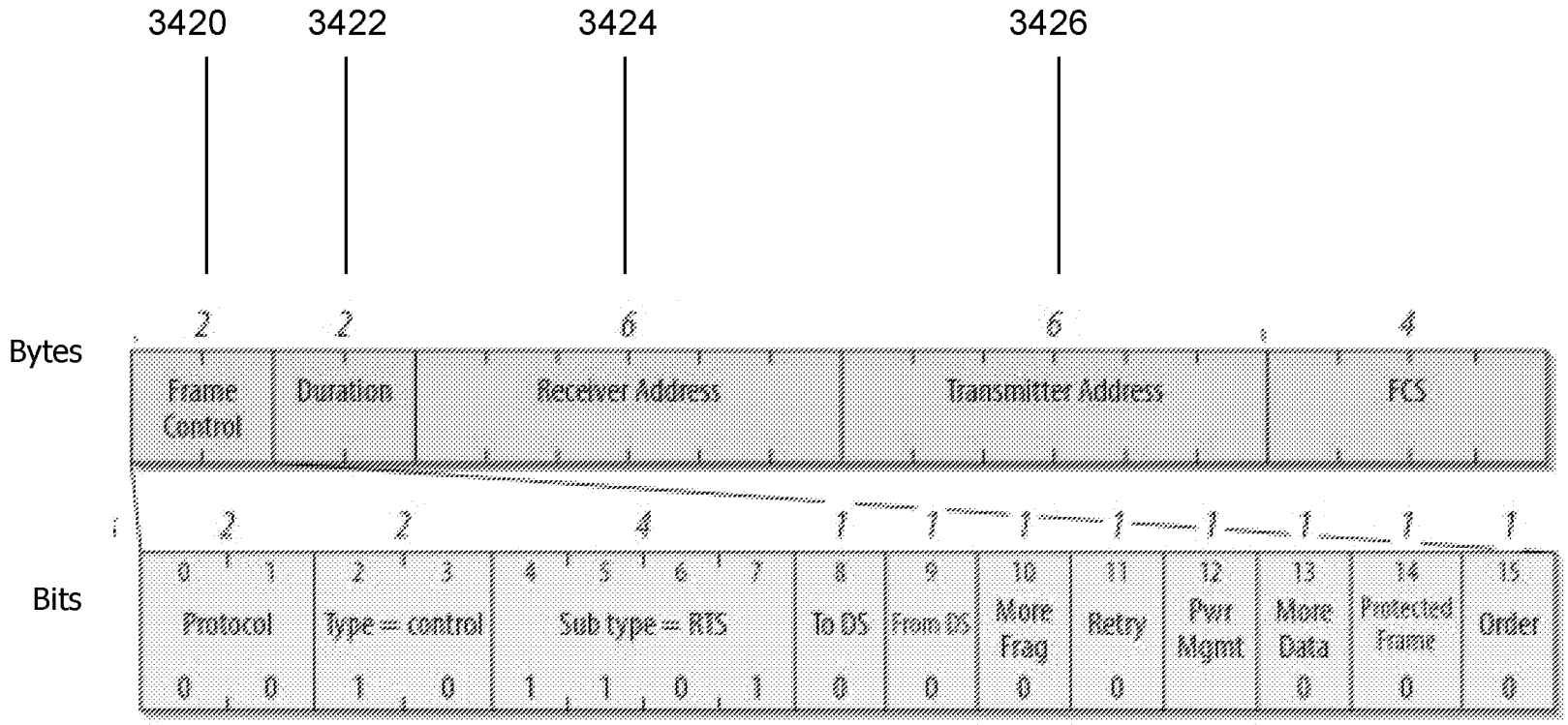

3420
3422
3424
3426
Bytes
2
2
6
6
4
Frame Control
Duration
Receiver Address
Transmitter Address
FCS
Bits
2
2
4
1
1
1
1
1
1
1
1
0 1
Protocol
0 0
2 3
Type = control
1 0
4 5 6 7
Sub type = RTS
1 1 0 1
8
To DS
0
9
From DS
0
10
More Frag
0
11
Retry
0
12
Pwr Mgmt
13
More Data
0
14
Protected Frame
0
15
Order
0

Figure 34

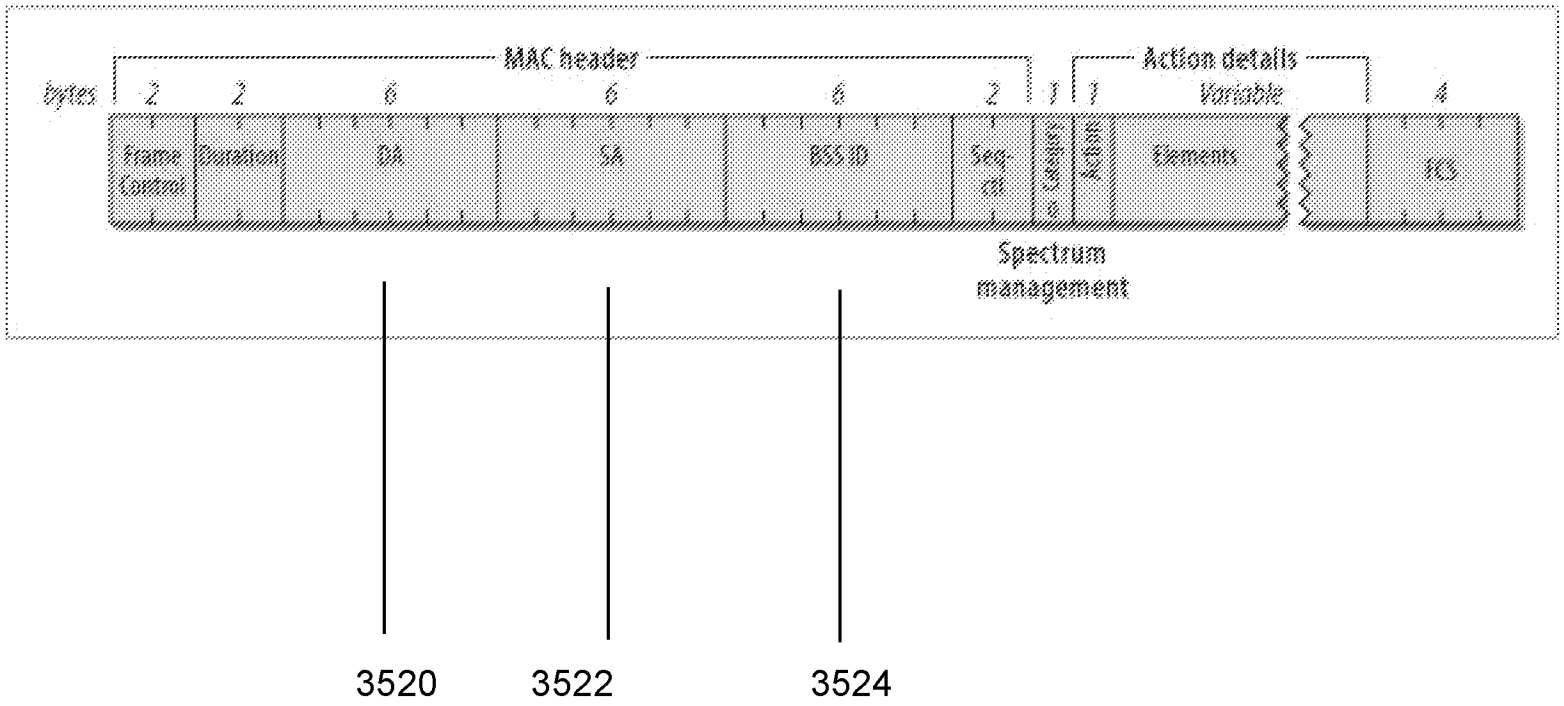

MAC header
Action details
bytes
2
2
6
6
6
2
1
1
Variable
4
Frame Control
Duration
DA
SA
BSS ID
Seq-ctl
HT Control
Action
Elements
FCS
Spectrum management
3520
3522
3524

Figure 35

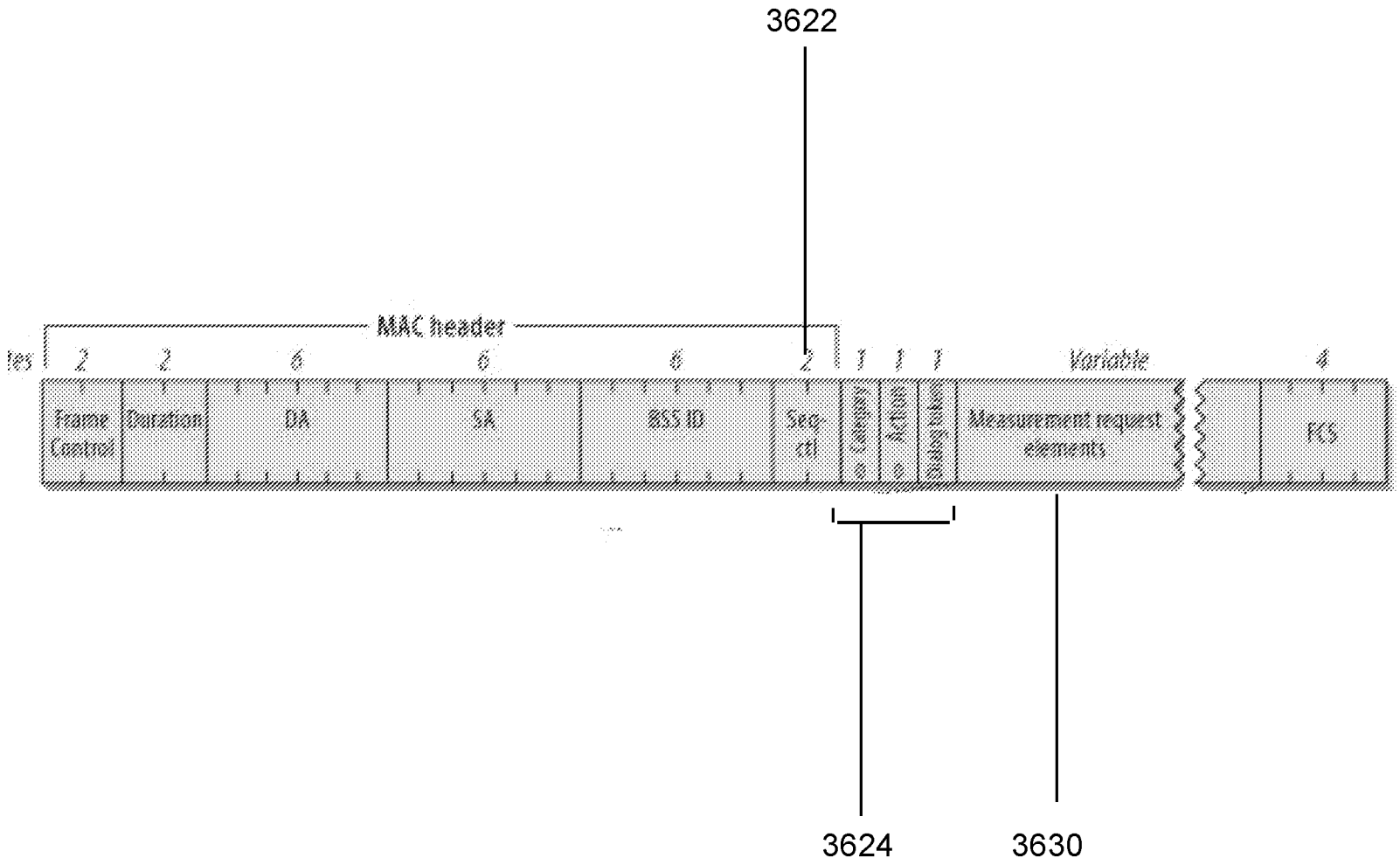


Figure 36

EX1018, Page 173

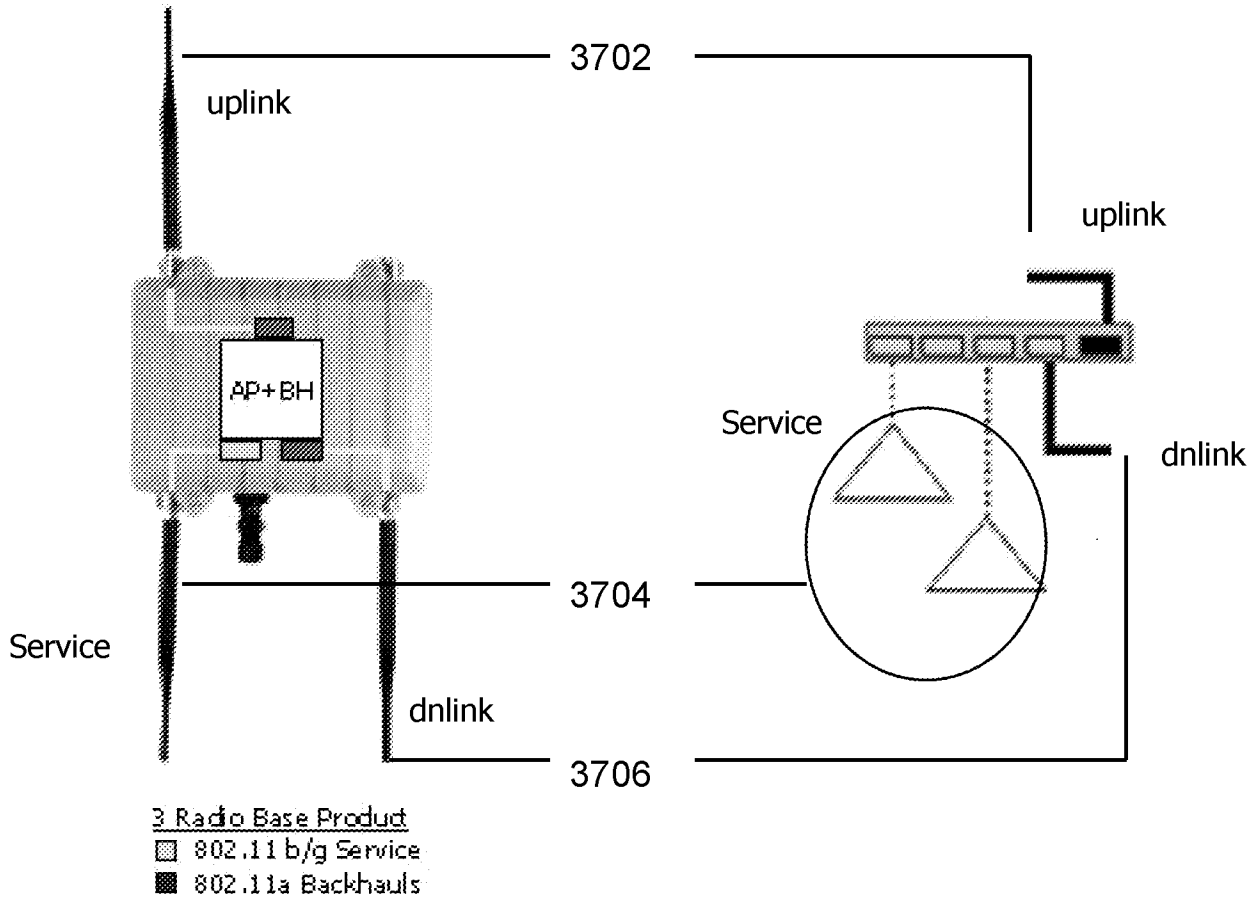

3702
uplink
uplink
AP+BH
Service
dnlink
3704
Service
dnlink
3706
3 Radio Base Product
802.11 b/g Service
802.11a Backhauls

Figure 37

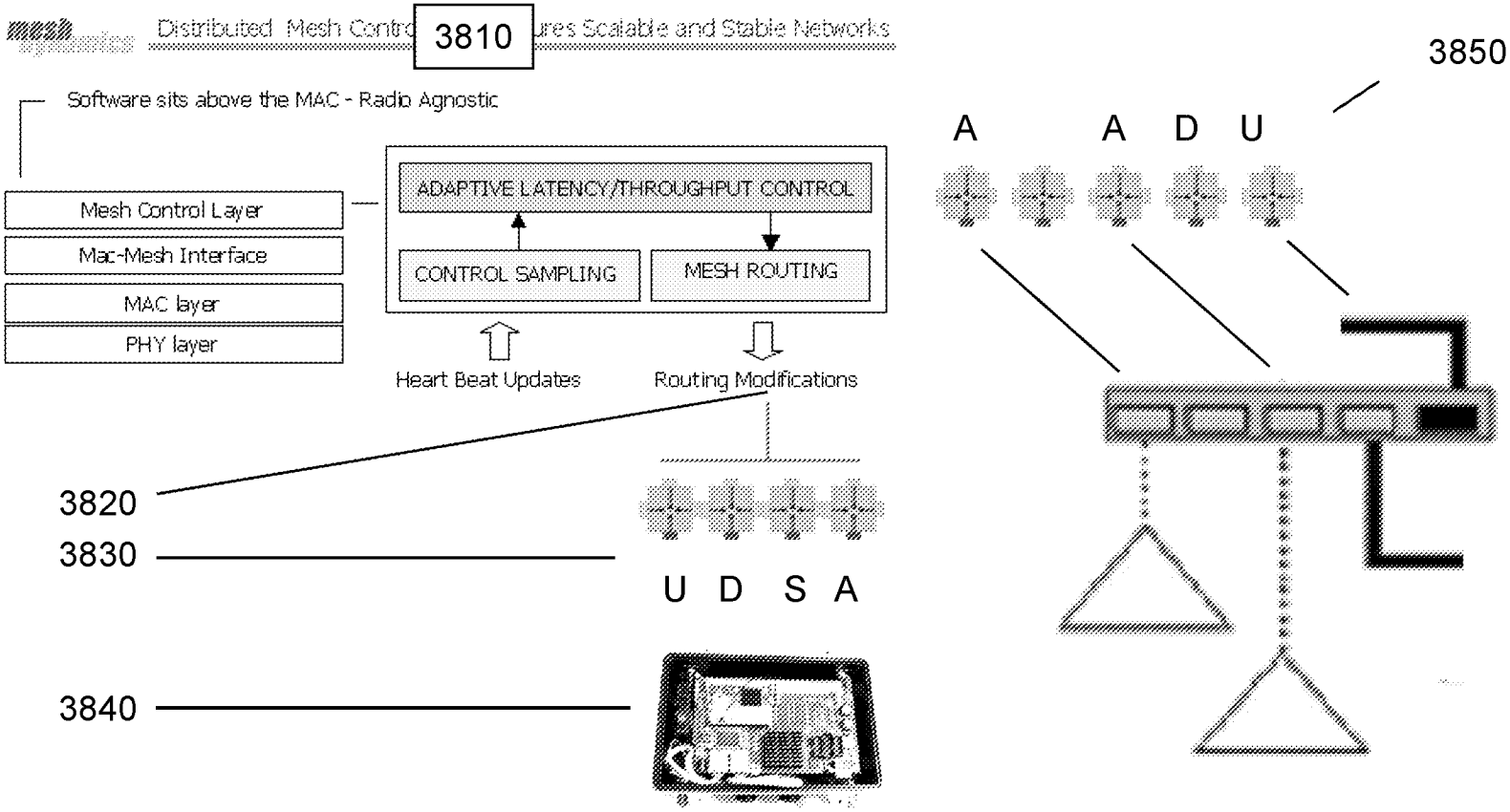


Figure 38

EX1018, Page 175

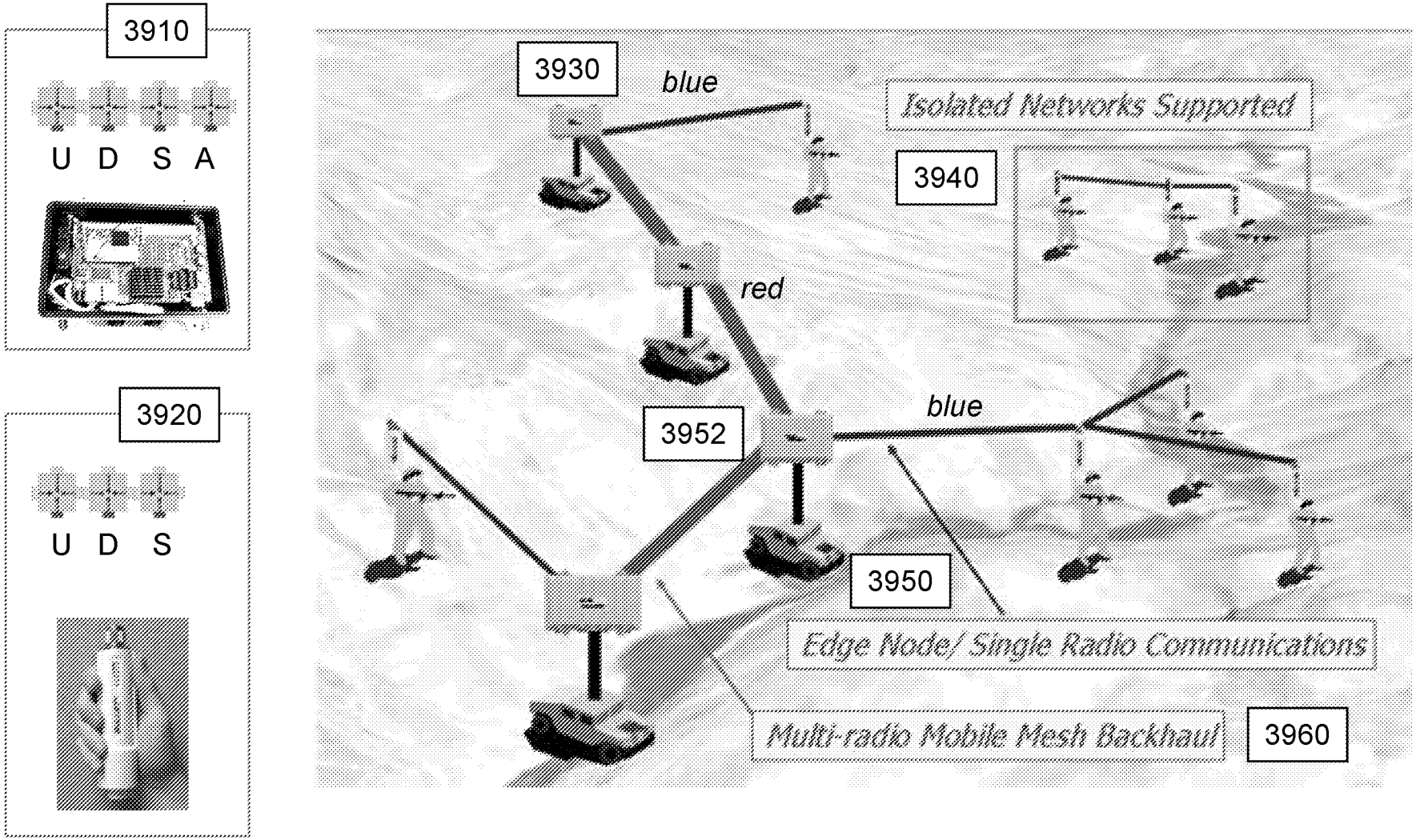


Figure 39

EX1018, Page 176

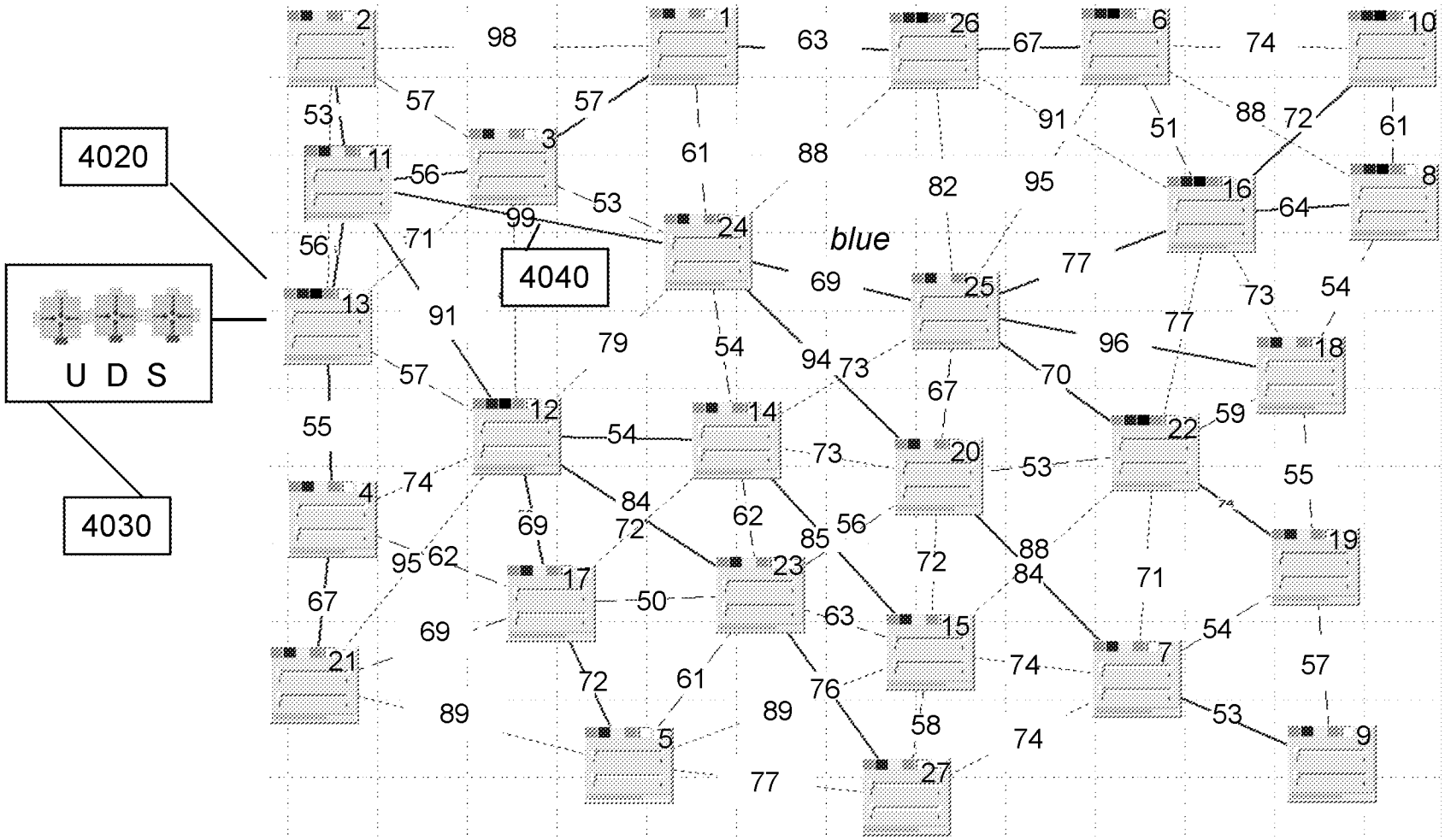


Figure 40

EX1018, Page 177

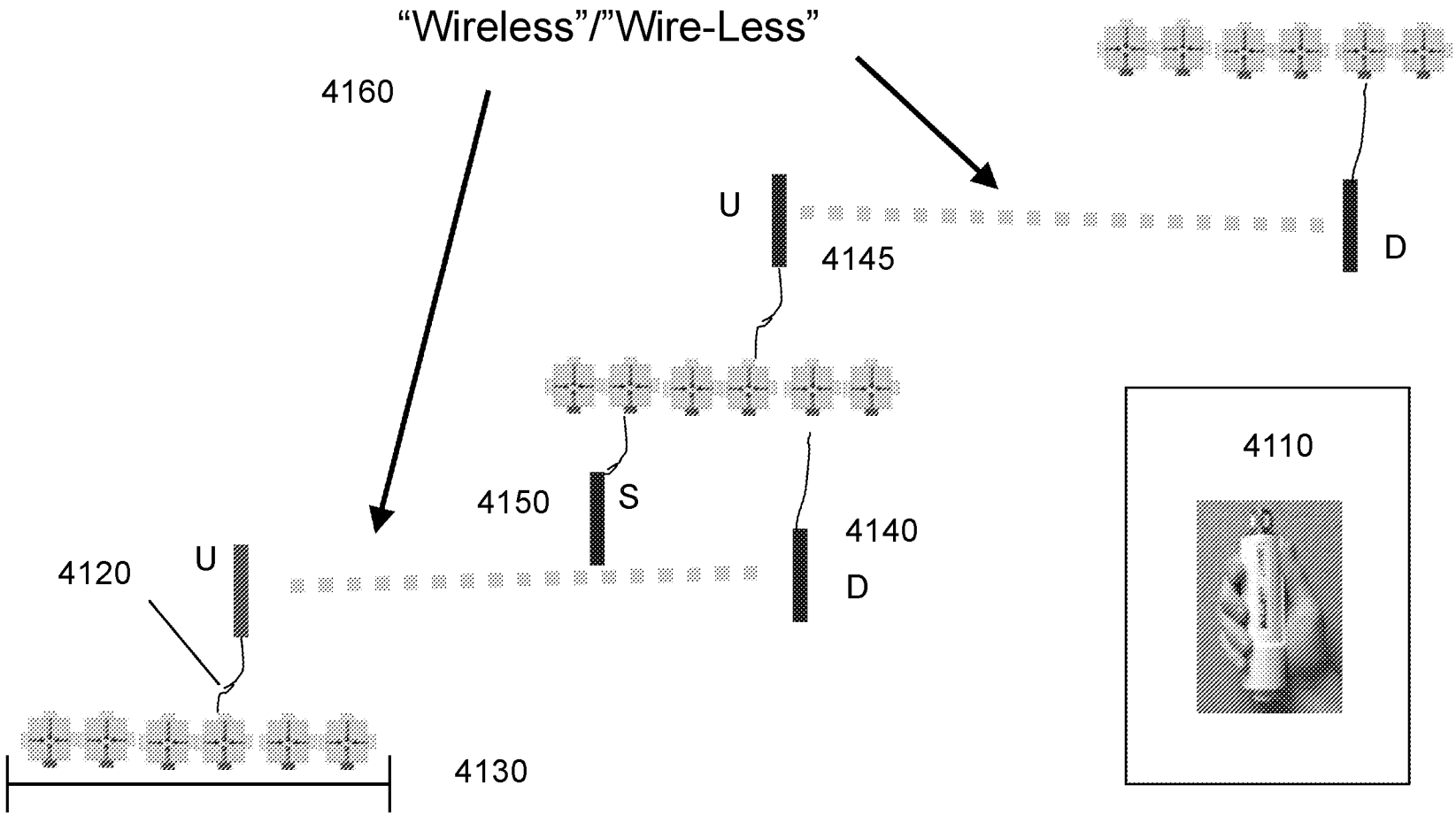


Figure 41

EX1018, Page 178

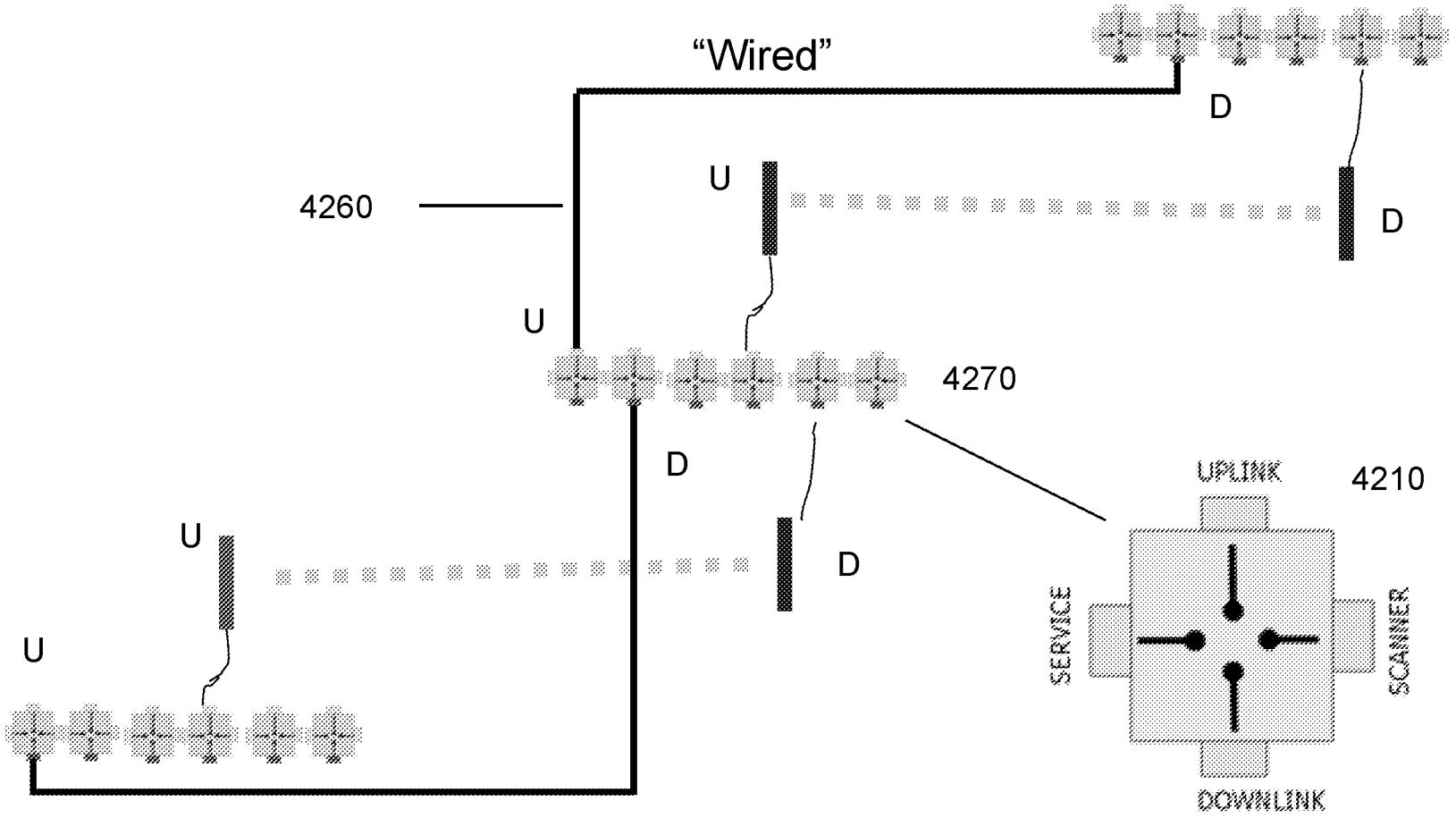


Figure 42

EX1018, Page 179

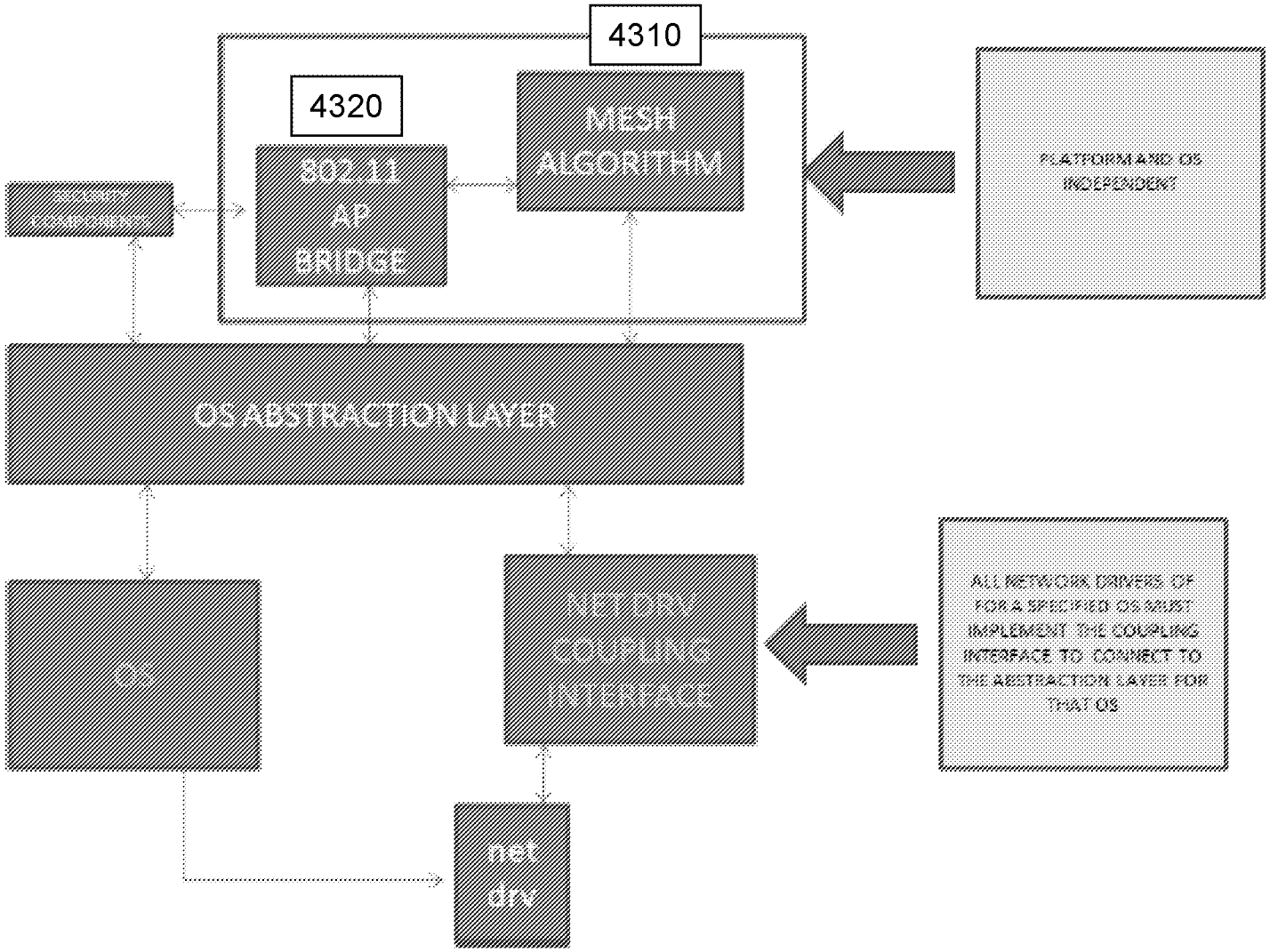
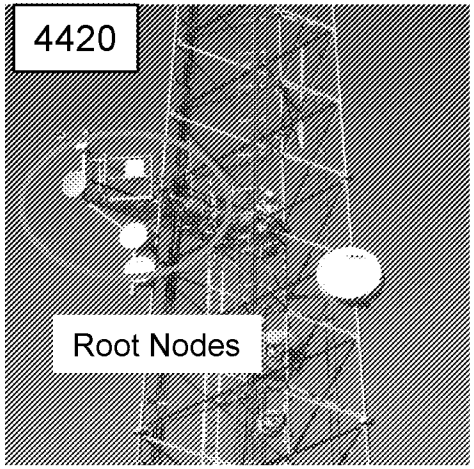
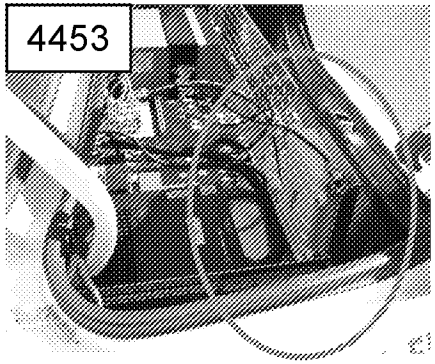


Figure 43

EX1018, Page 180





Mobile Node

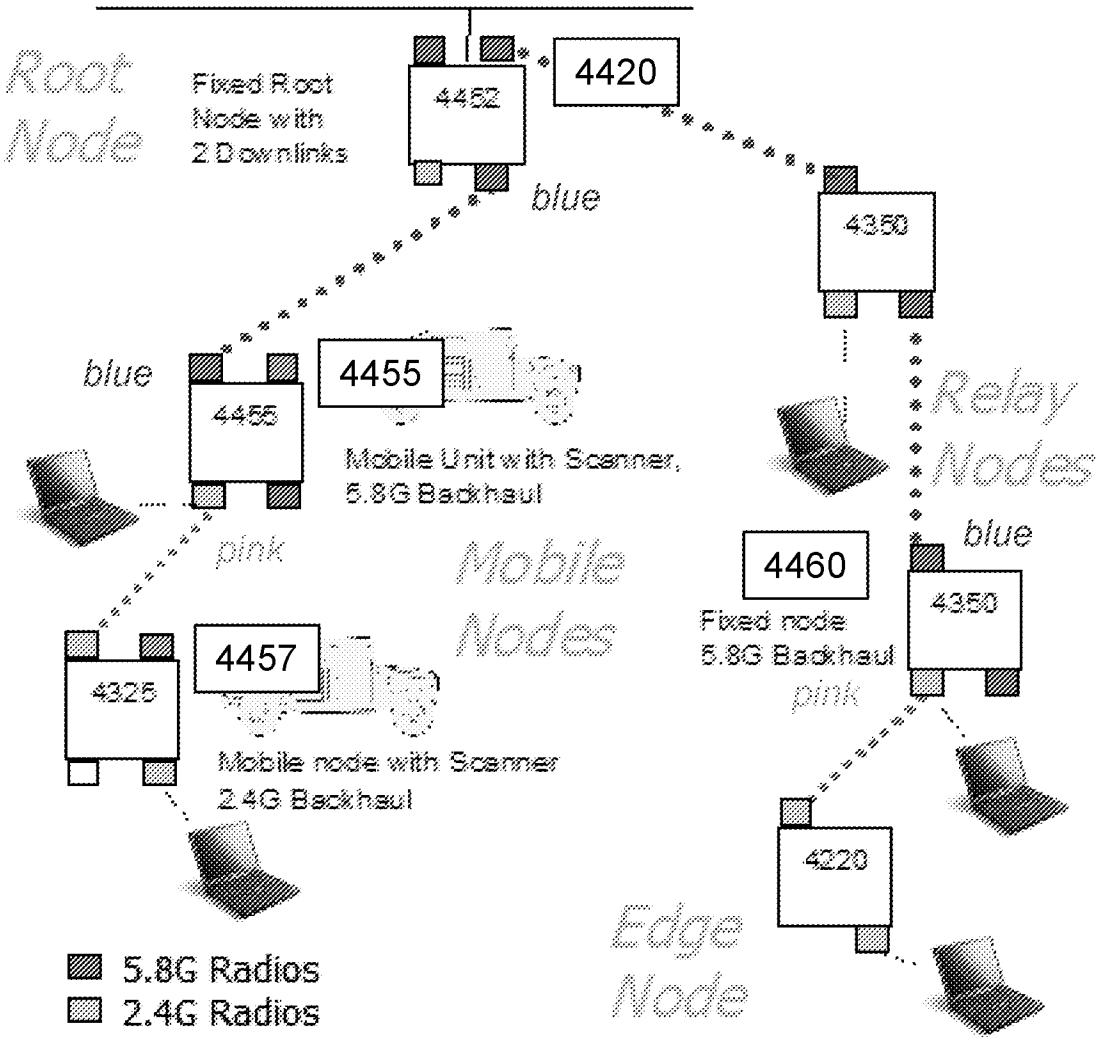


Figure 44

EX1018, Page 181

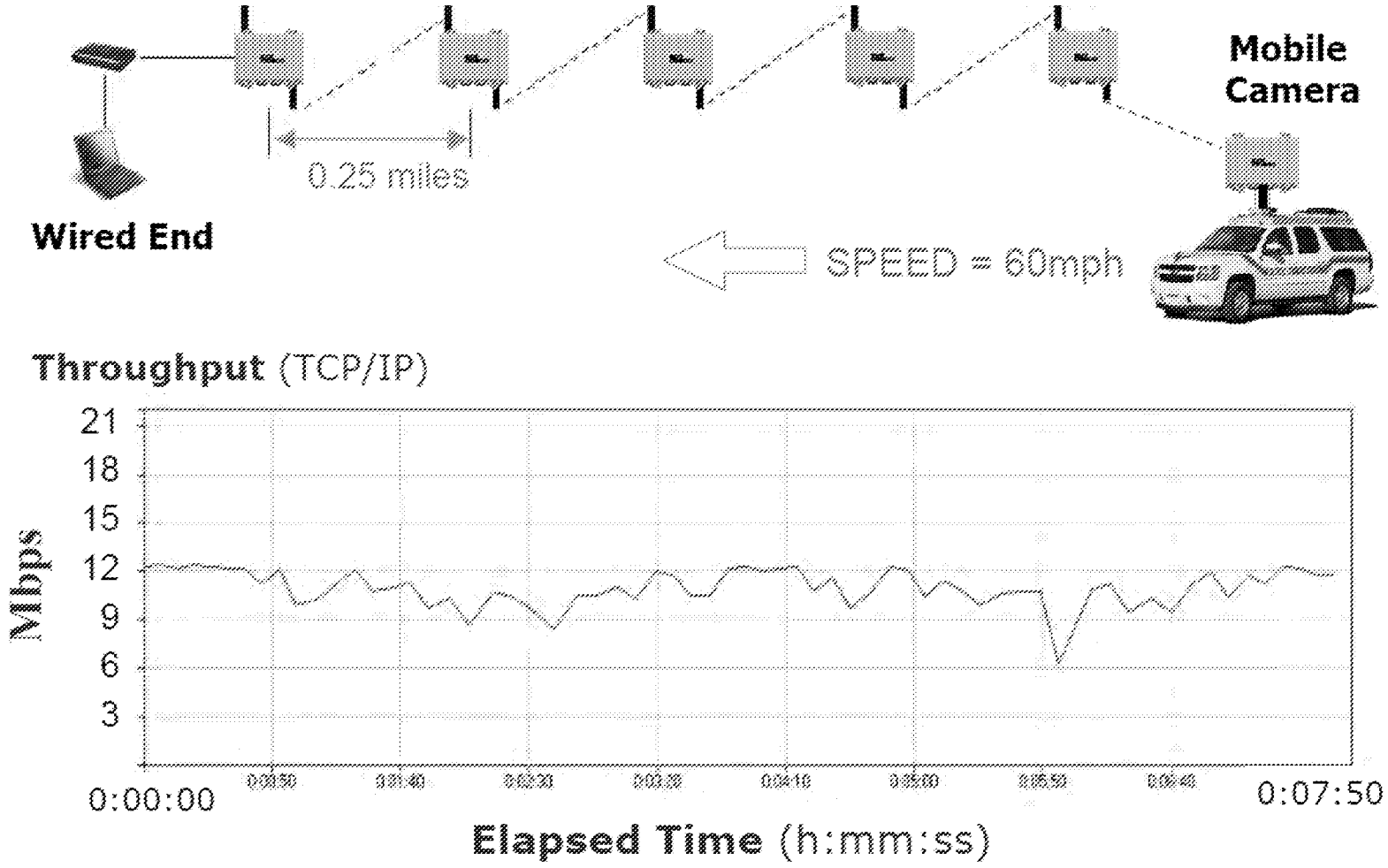


Figure 45

EX1018, Page 182

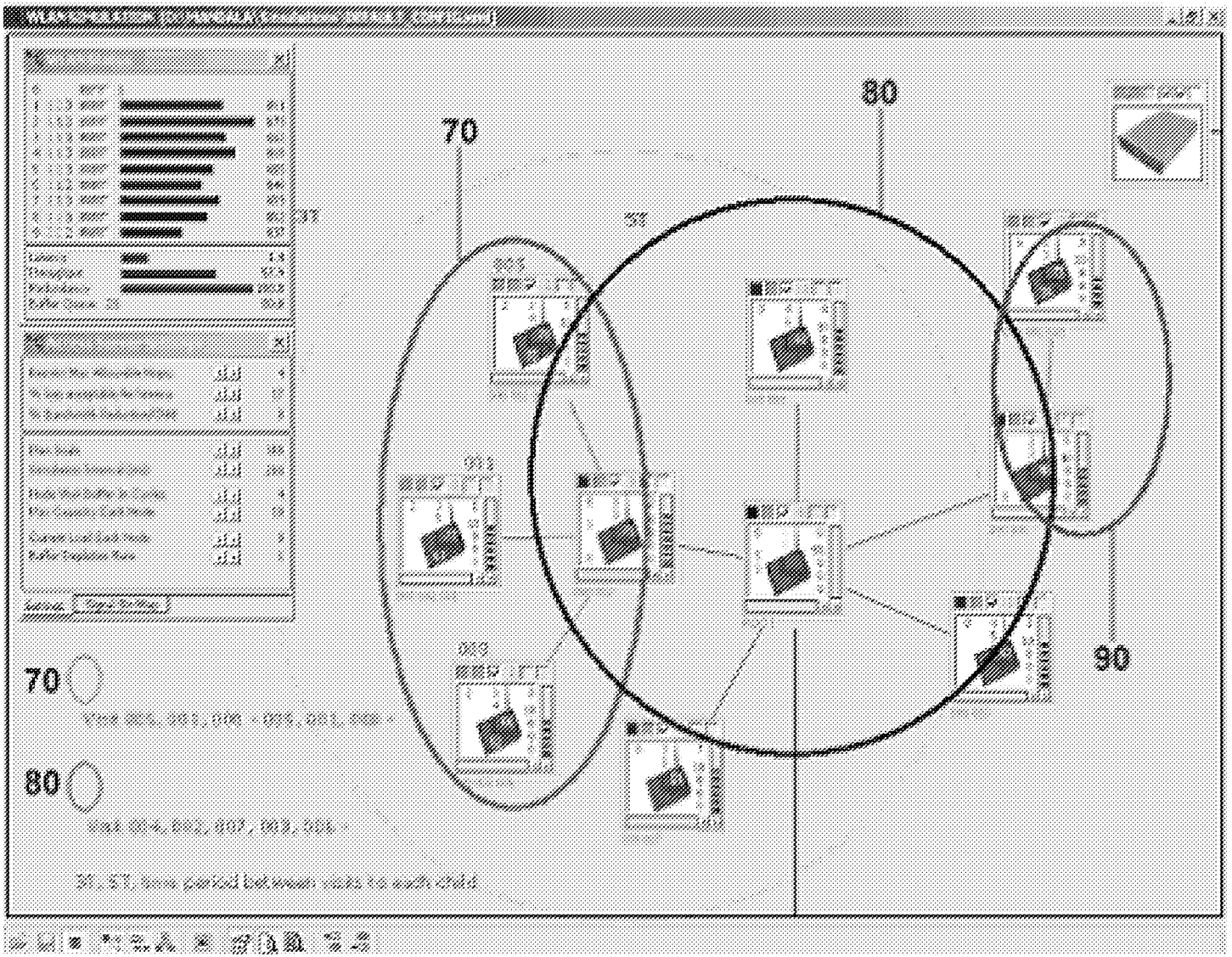
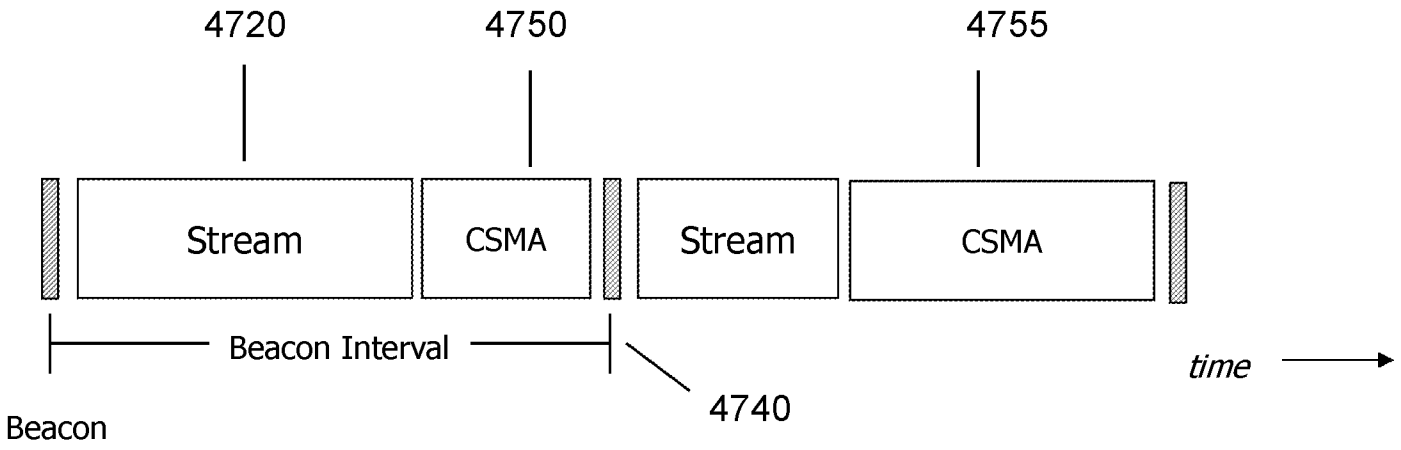


Figure 46

EX1018, Page 183

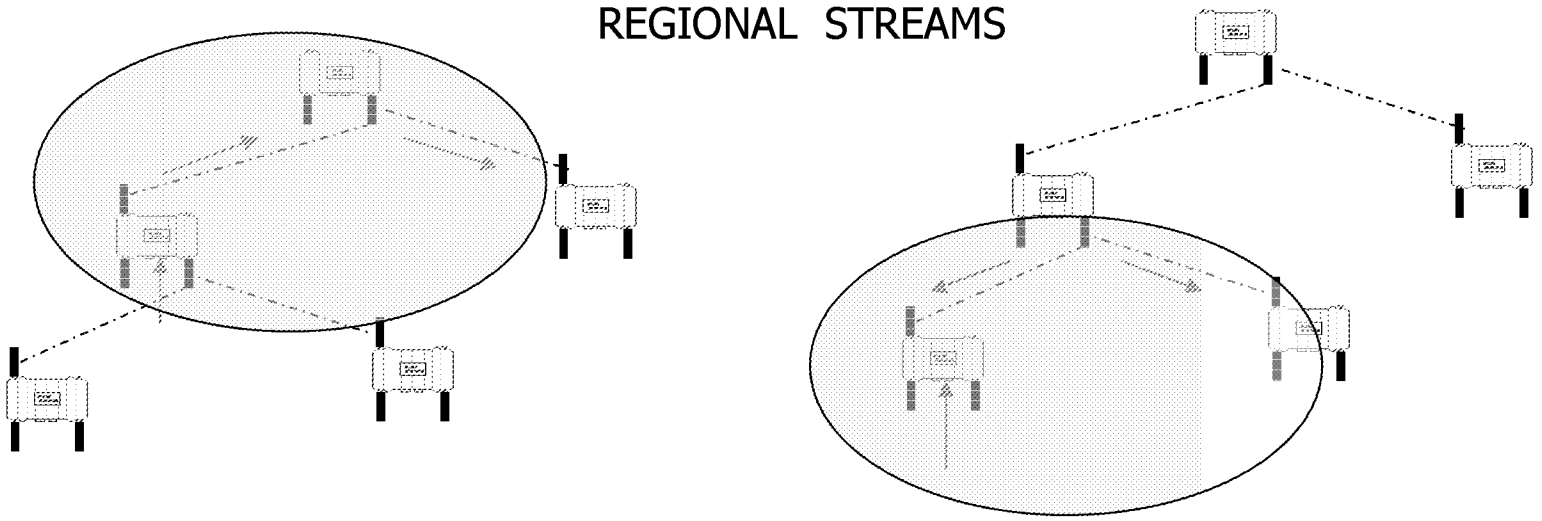


- CLIENTS SILENT IN ALLOCATED TIME SLOT FOR STREAMING.
- CSMA TIME SLOT IS ADJUSTABLE AFTER STREAM TIME SLOT ALLOCATIONN

Figure 47

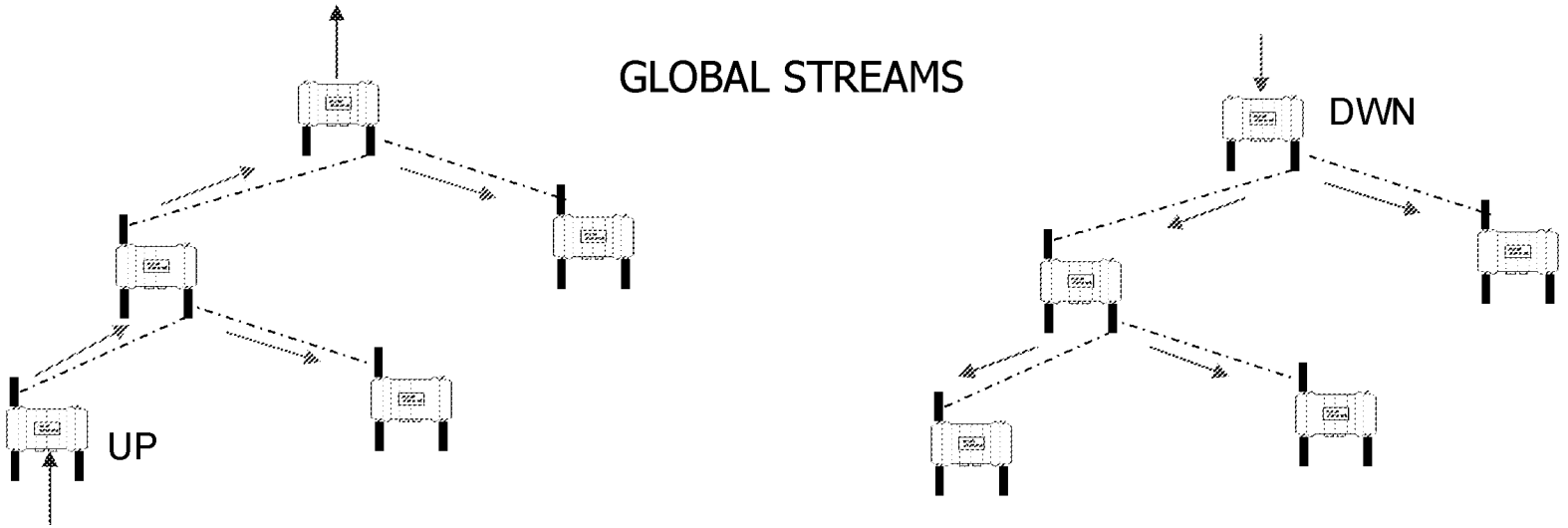
EX1018, Page 184

REGIONAL STREAMS



- REGIONAL STREAMS TRAVERSE ONLY THE SPECIFIED DIRECTIONS AND/OR REGION
  - REGIONS CAN BE GPS BOUNDARIES, OR NUMBER OF HOPS / SUBTREES
  - DIRECTIONS CAN BE a) UP OR DOWN OR b) TURN-BY-TURN etc.
  - RELEVANT FOR DATA IMPORTANT LOCALLY ONLY (e.g. Sibling Devices)
  - DOES NOT AFFECT BACKHAUL BANDWIDTH OUTSIDE SPECIFIED REGION

Figure 48



- GLOBALS STREAMS TRAVERSE THE ENTIRE NETWORK
  - AT THE MINIMUM GOES UP TO THE LOGICAL "ROOT"/PARENT/AGENT
  - THEY CAN ORIGINATE FROM ANY WHERE ON THE NETWORK
    - IF FROM ROOT: DOWNWARD ONLY (worst case).
    - IF FROM NODE : UPWARDS AND DOWNWARDS (worst case).
    - IF FROM CLIENT : UPWARDS AND DOWNWARDS, includes Siblings (worst case)

Figure 49

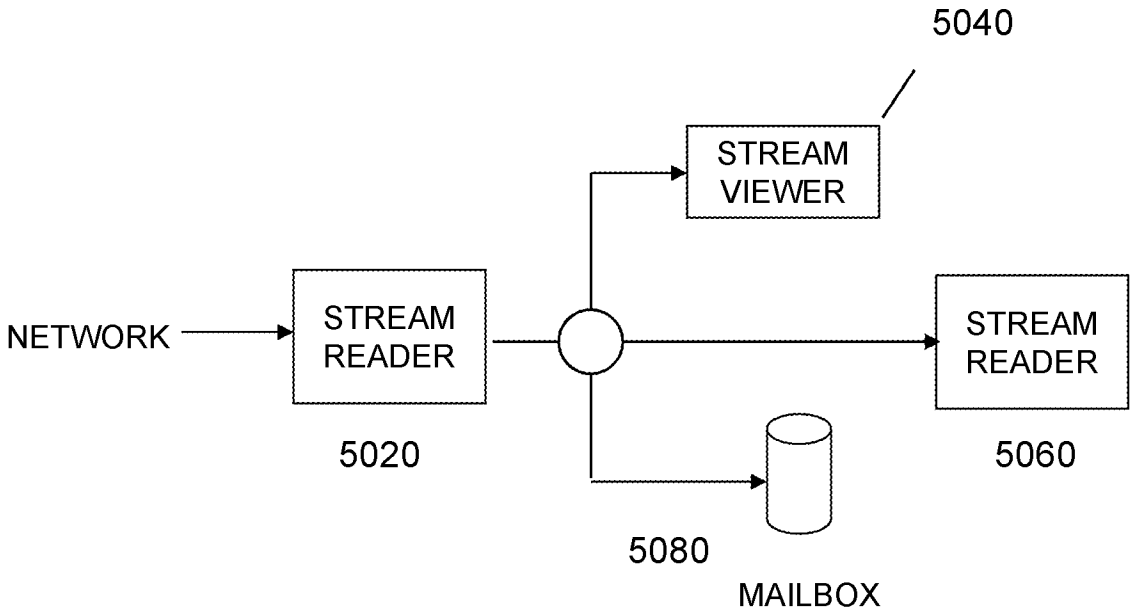


Figure 50

EX1018, Page 187

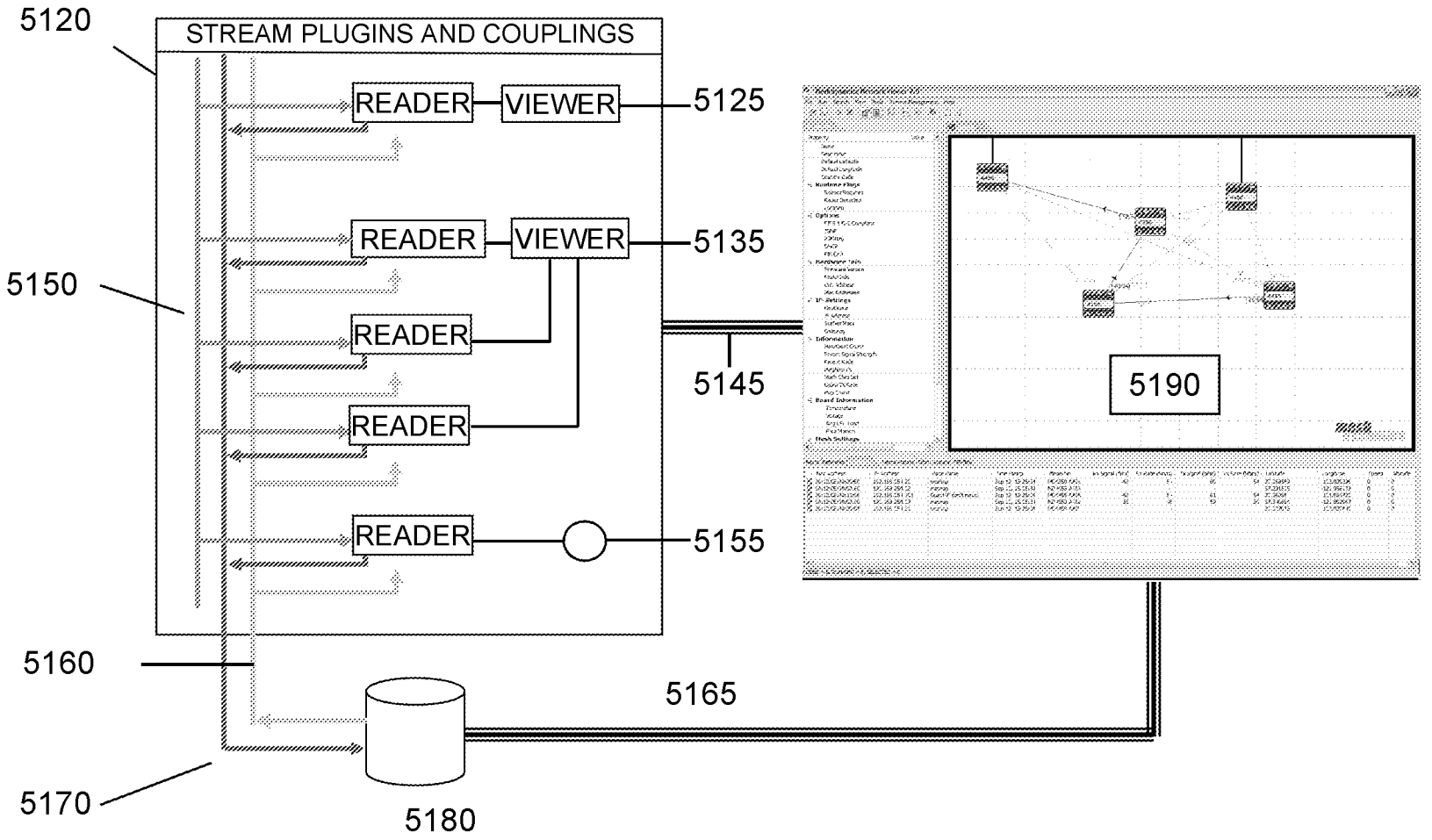


Figure 51

EX1018, Page 188

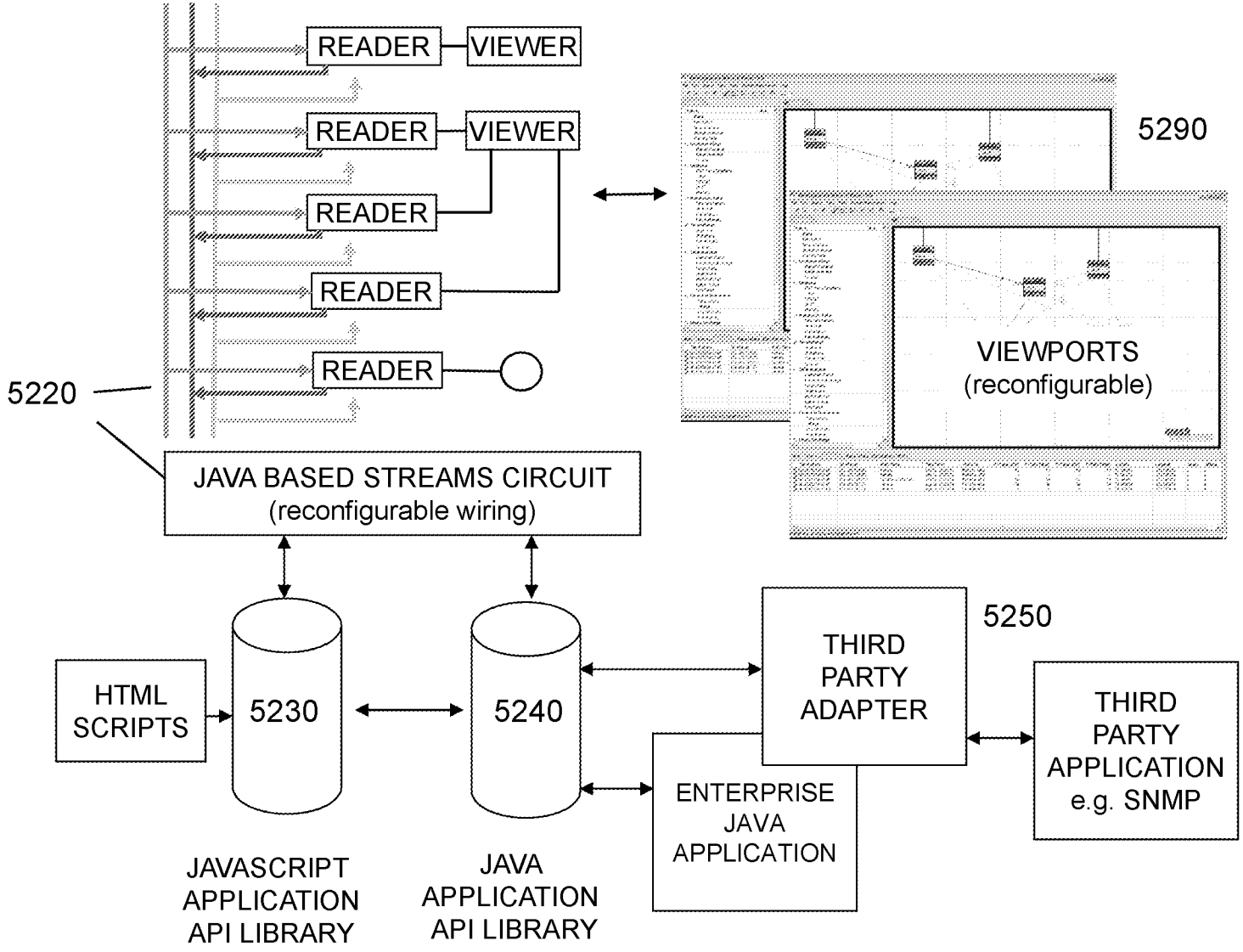
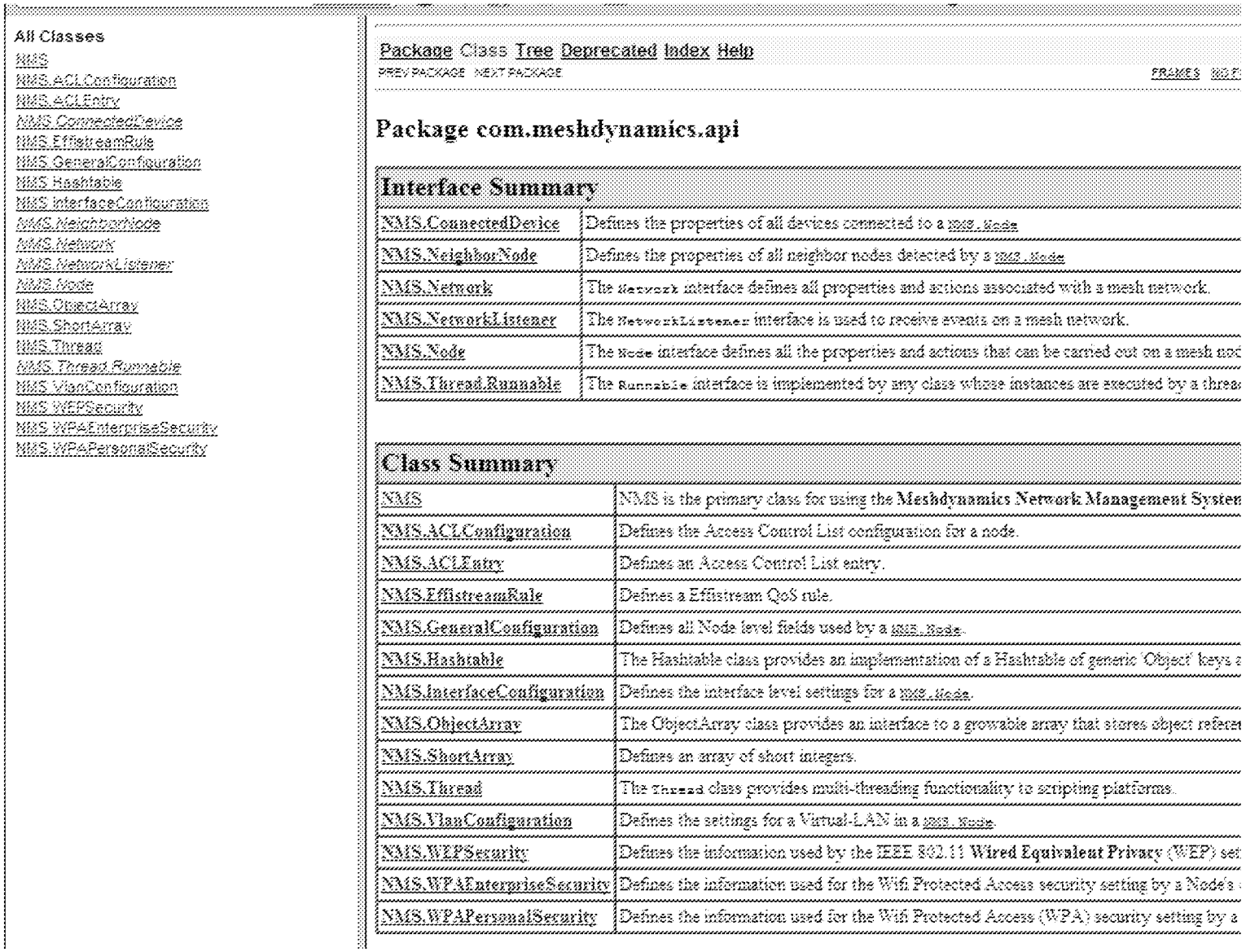


Figure 52

EX1018, Page 189



All Classes
NMS
NMS.ACLConfiguration
NMS.ACLEntry
NMS.ConnectedDevice
NMS.EffistreamRule
NMS.GeneralConfiguration
NMS.Hashtable
NMS.InterfaceConfiguration
NMS.NeighborNode
NMS.Network
NMS.NetworkListener
NMS.Node
NMS.ObjectArray
NMS.ShortArray
NMS.Thread
NMS.Thread.Runnable
NMS.VlanConfiguration
NMS.WEPSecurity
NMS.WPAEnterpriseSecurity
NMS.WPAPersonalSecurity

Package Class Tree Deprecated Index Help
PREV PACKAGE NEXT PACKAGE FRAMES NO F

Package com.meshdynamics.api

Interface Summary

NMS.ConnectedDevice	Defines the properties of all devices connected to a nms.Node
NMS.NeighborNode	Defines the properties of all neighbor nodes detected by a nms.Node
NMS.Network	The Network interface defines all properties and actions associated with a mesh network.
NMS.NetworkListener	The NetworkListener interface is used to receive events on a mesh network.
NMS.Node	The Node interface defines all the properties and actions that can be carried out on a mesh nod
NMS.Thread.Runnable	The Runnable interface is implemented by any class whose instances are executed by a threa

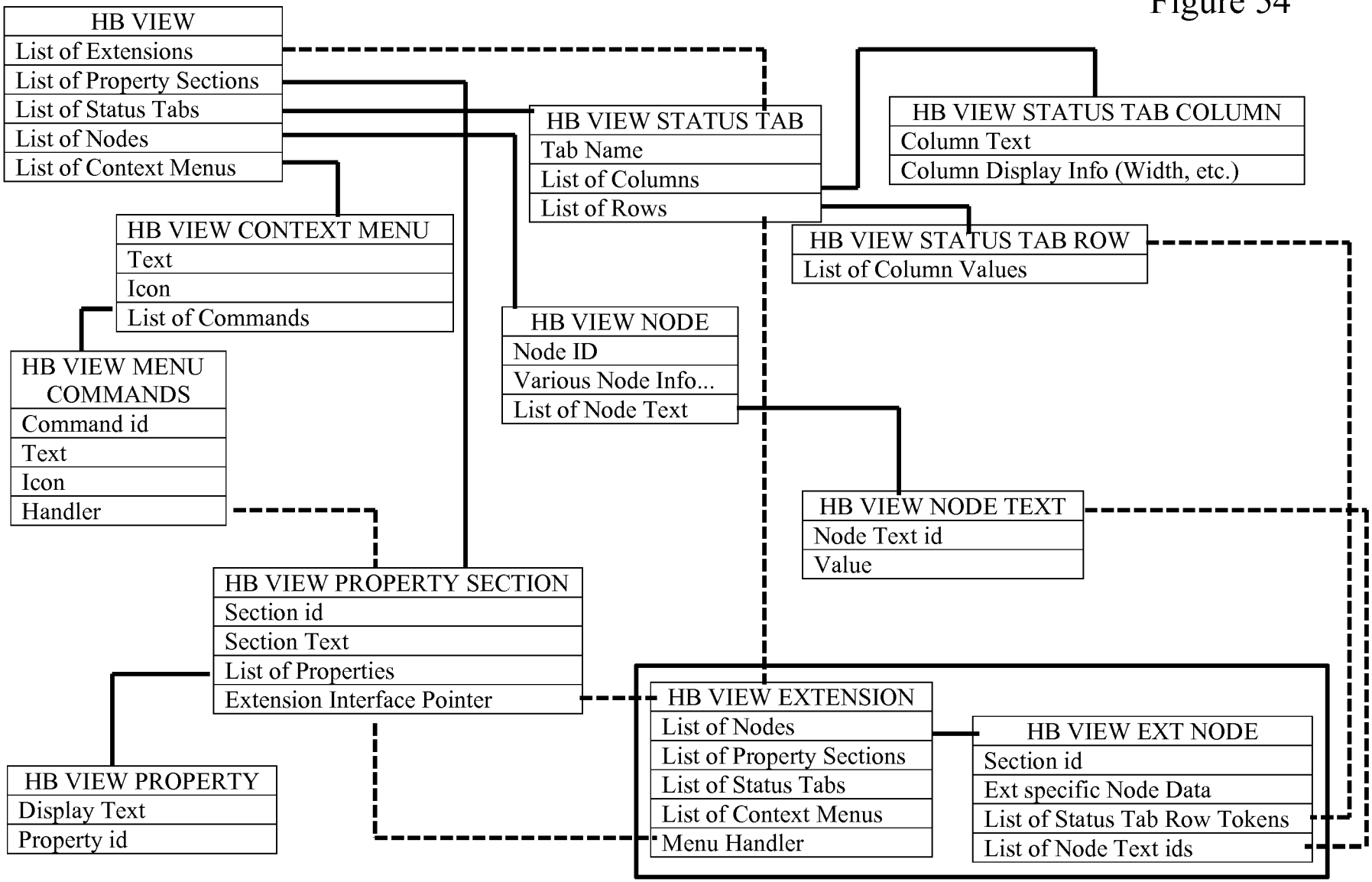
Class Summary

NMS	NMS is the primary class for using the Meshdynamics Network Management Systen
NMS.ACLConfiguration	Defines the Access Control List configuration for a node.
NMS.ACLEntry	Defines an Access Control List entry.
NMS.EffistreamRule	Defines a Effistream QoS rule.
NMS.GeneralConfiguration	Defines all Node level fields used by a nms.Node.
NMS.Hashtable	The Hashtable class provides an implementation of a Hashtable of generic 'Object' keys a
NMS.InterfaceConfiguration	Defines the interface level settings for a nms.Node.
NMS.ObjectArray	The ObjectArray class provides an interface to a growable array that stores object refere
NMS.ShortArray	Defines an array of short integers.
NMS.Thread	The Thread class provides multi-threading functionality to scripting platforms.
NMS.VlanConfiguration	Defines the settings for a Virtual-LAN in a nms.Node.
NMS.WEPSecurity	Defines the information used by the IEEE 802.11 Wired Equivalent Privacy (WEP) set
NMS.WPAEnterpriseSecurity	Defines the information used for the Wifi Protected Access security setting by a Node's
NMS.WPAPersonalSecurity	Defines the information used for the Wifi Protected Access (WPA) security setting by a

Figure 53

HEART BEAT VIEW PORT ENTITY RELATIONSHIP

Figure 54



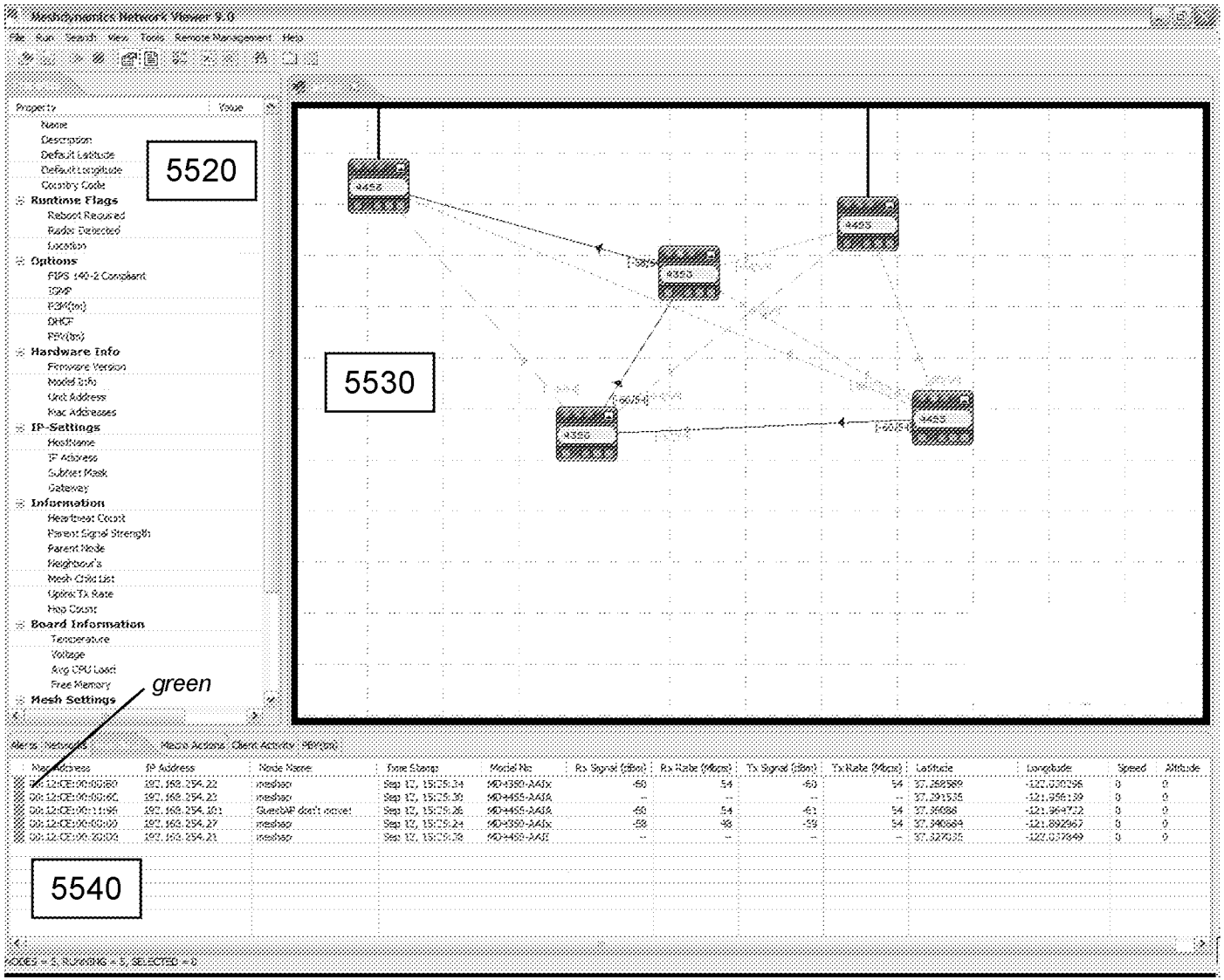


Figure 55

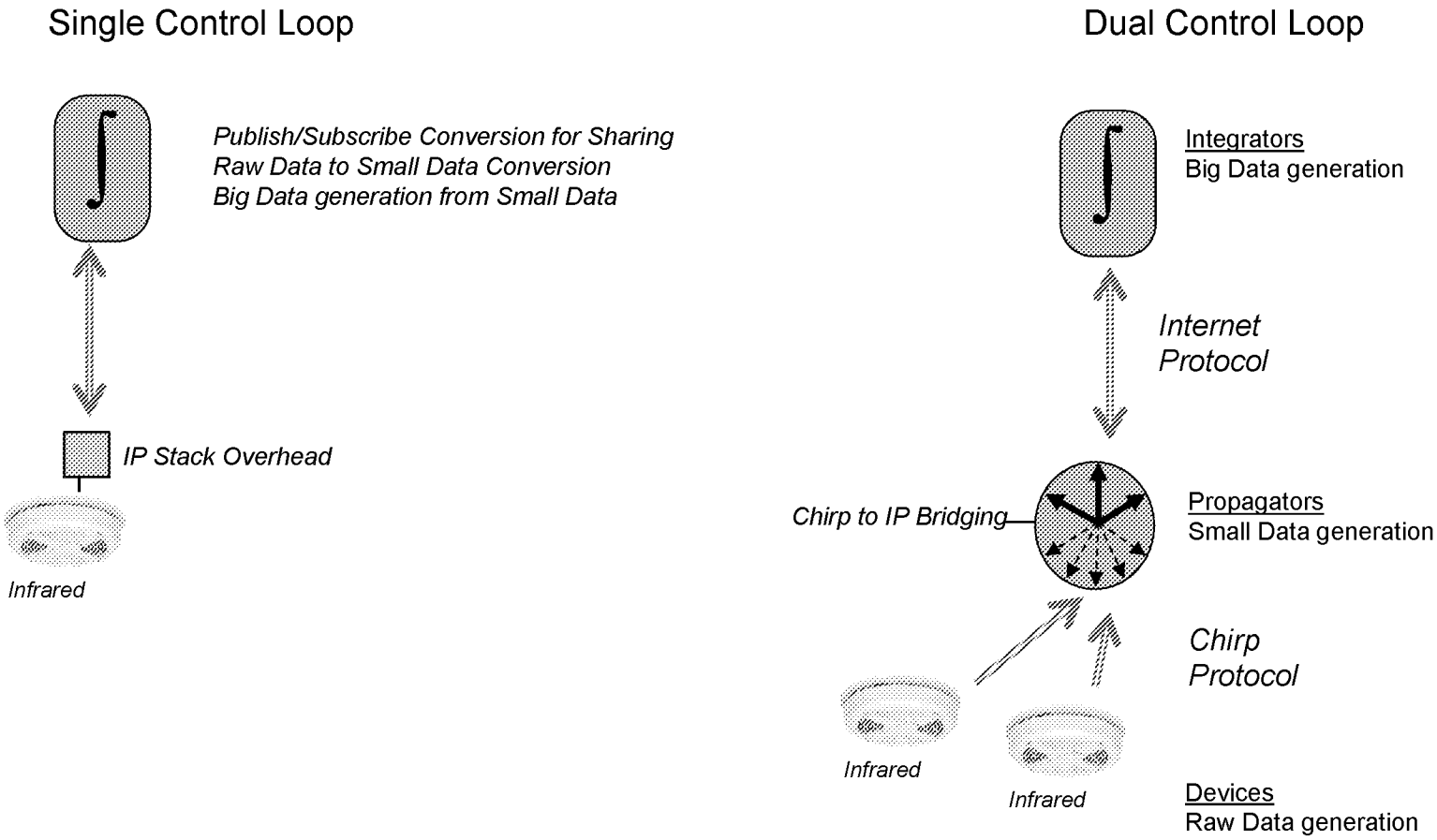

Single Control Loop
Publish/Subscribe Conversion for Sharing
Raw Data to Small Data Conversion
Big Data generation from Small Data
IP Stack Overhead
Infrared
Dual Control Loop
Integrators
Big Data generation
Internet
Protocol
Chirp to IP Bridging
Propagators
Small Data generation
Chirp
Protocol
Infrared
Infrared
Devices
Raw Data generation

Figure 56

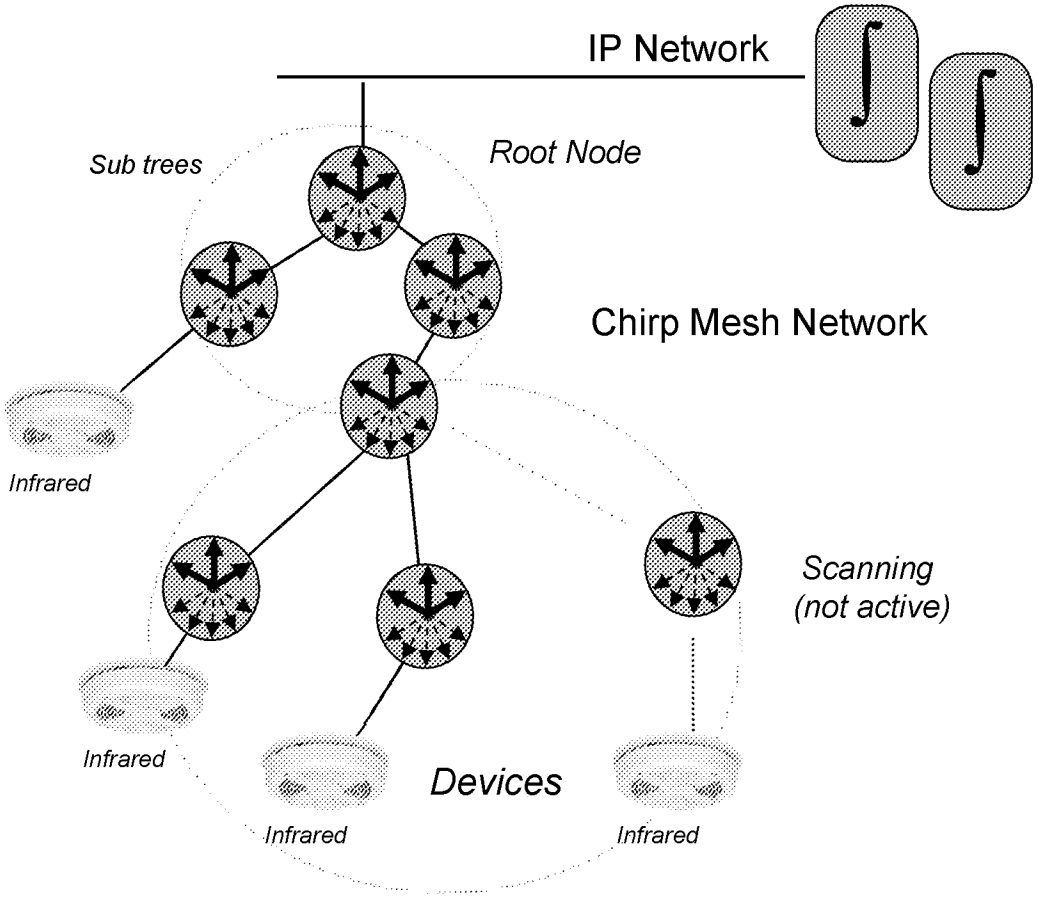

IP Network
Sub trees
Root Node
Chirp Mesh Network
Infrared
Scanning
(not active)
Infrared
Devices
Infrared
Infrared

Figure 57

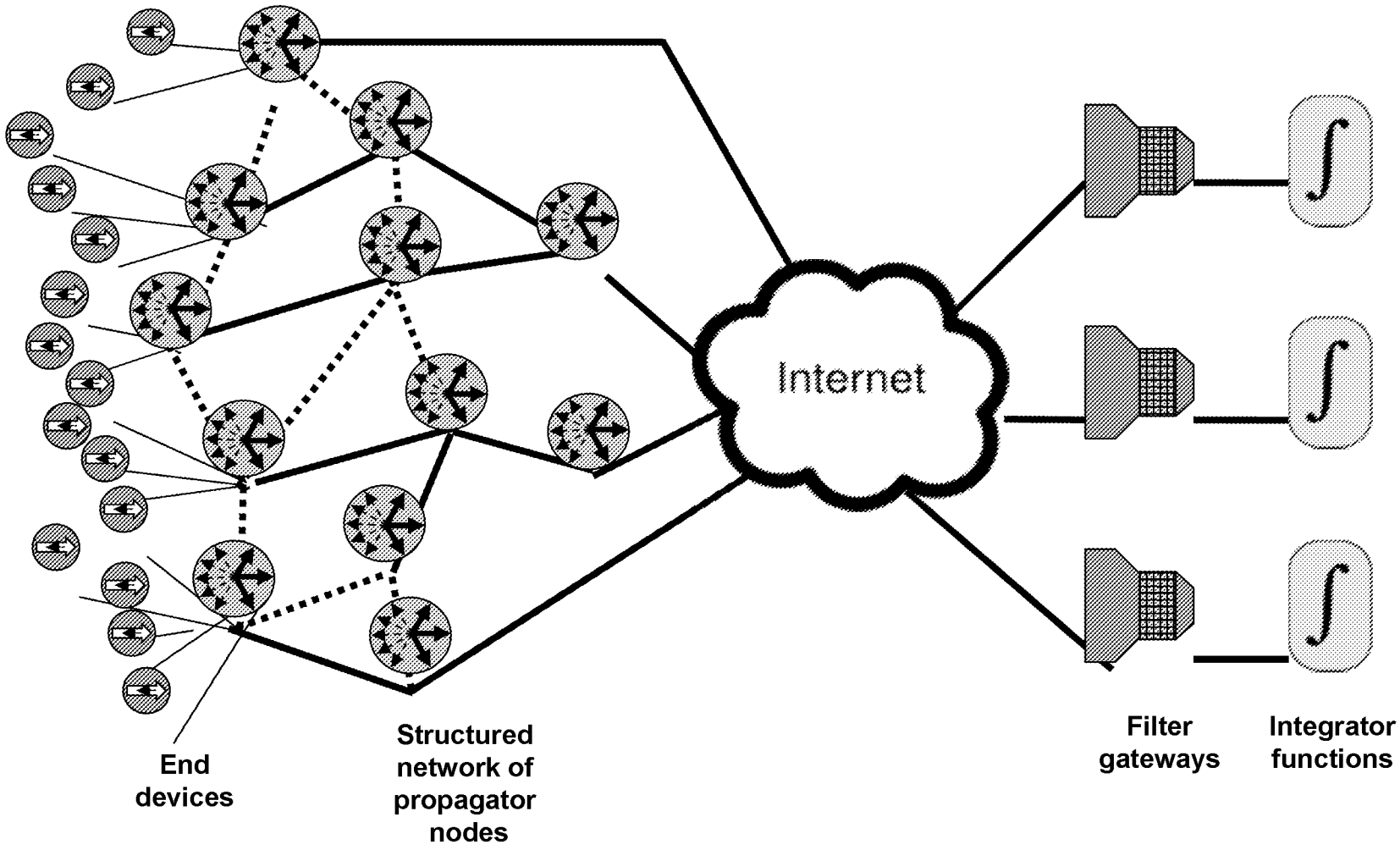

Internet
End devices
Structured network of propagator nodes
Filter gateways
Integrator functions

Figure 58

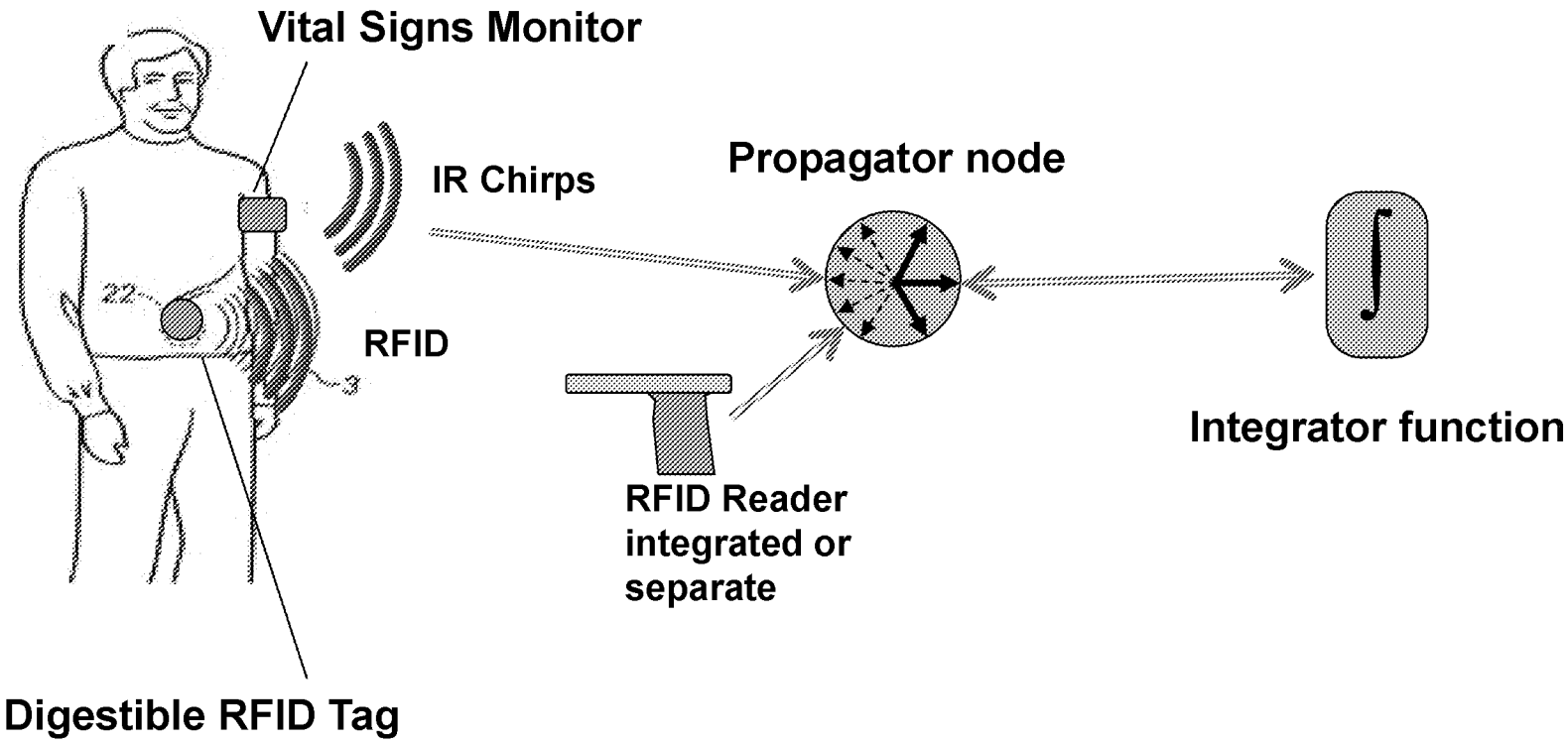

Vital Signs Monitor
IR Chirps
Propagator node
22
RFID
3
Integrator function
RFID Reader
integrated or
separate
Digestible RFID Tag

Figure 59

An Integrator function retrieves data from End Devices such as moisture sensors as well as external feeds and uses the information to control irrigation valves.

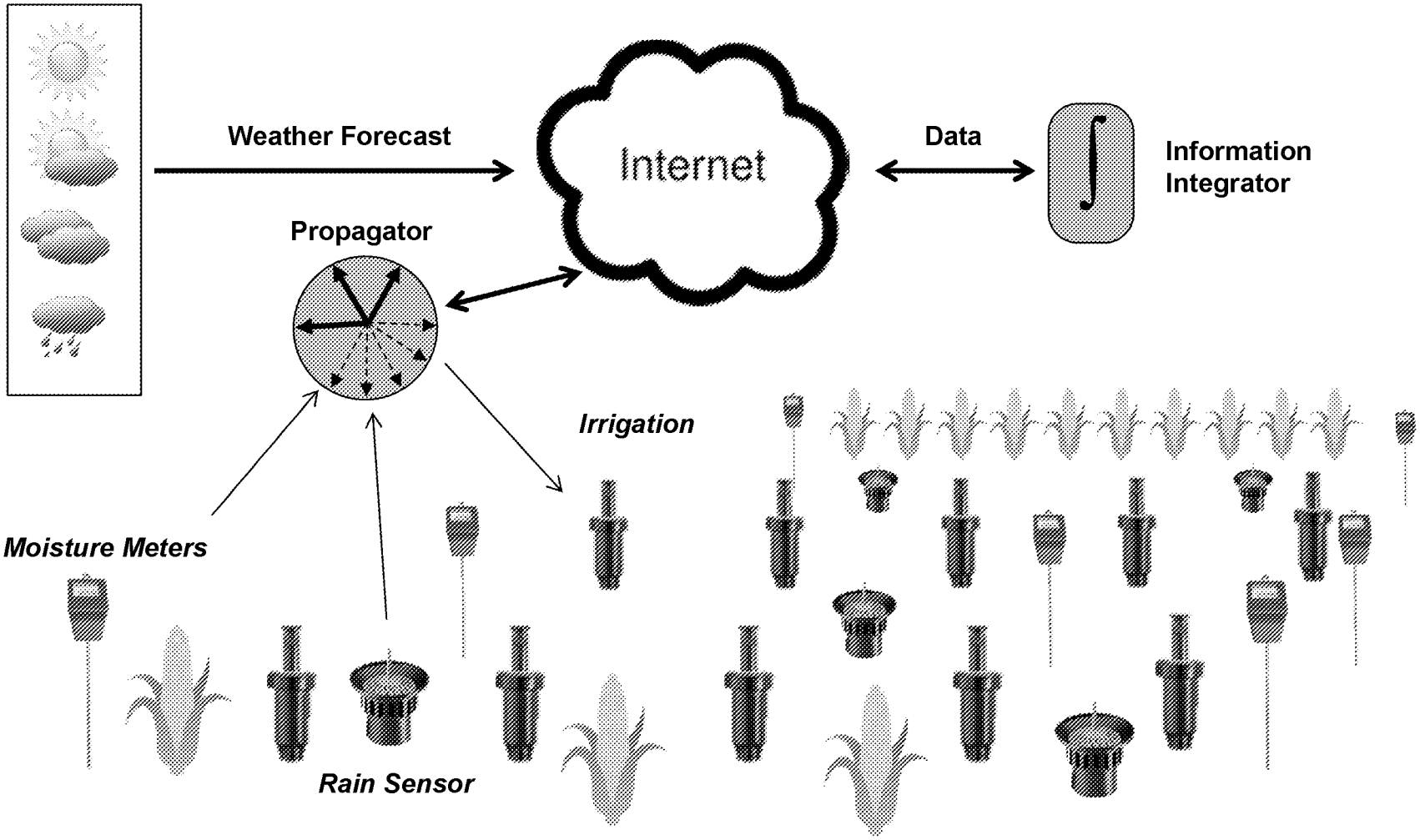
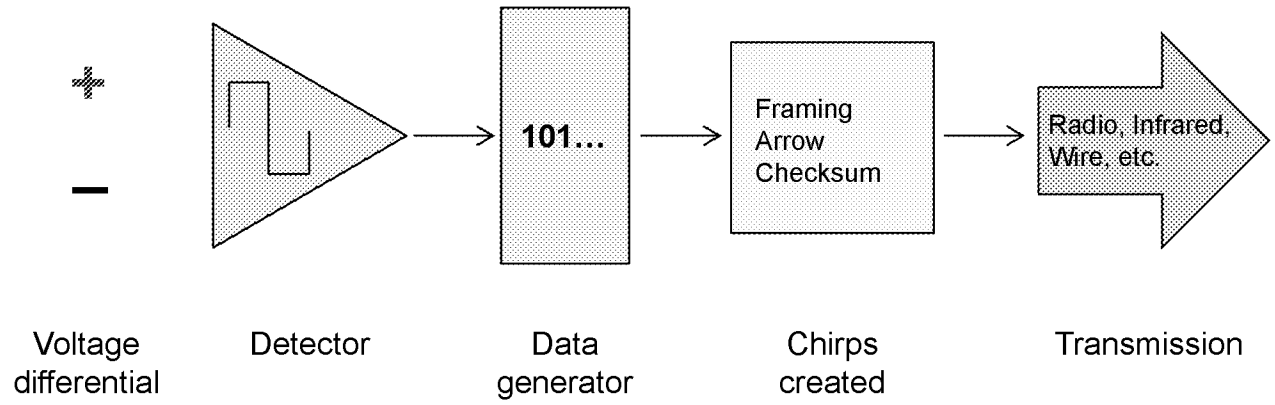


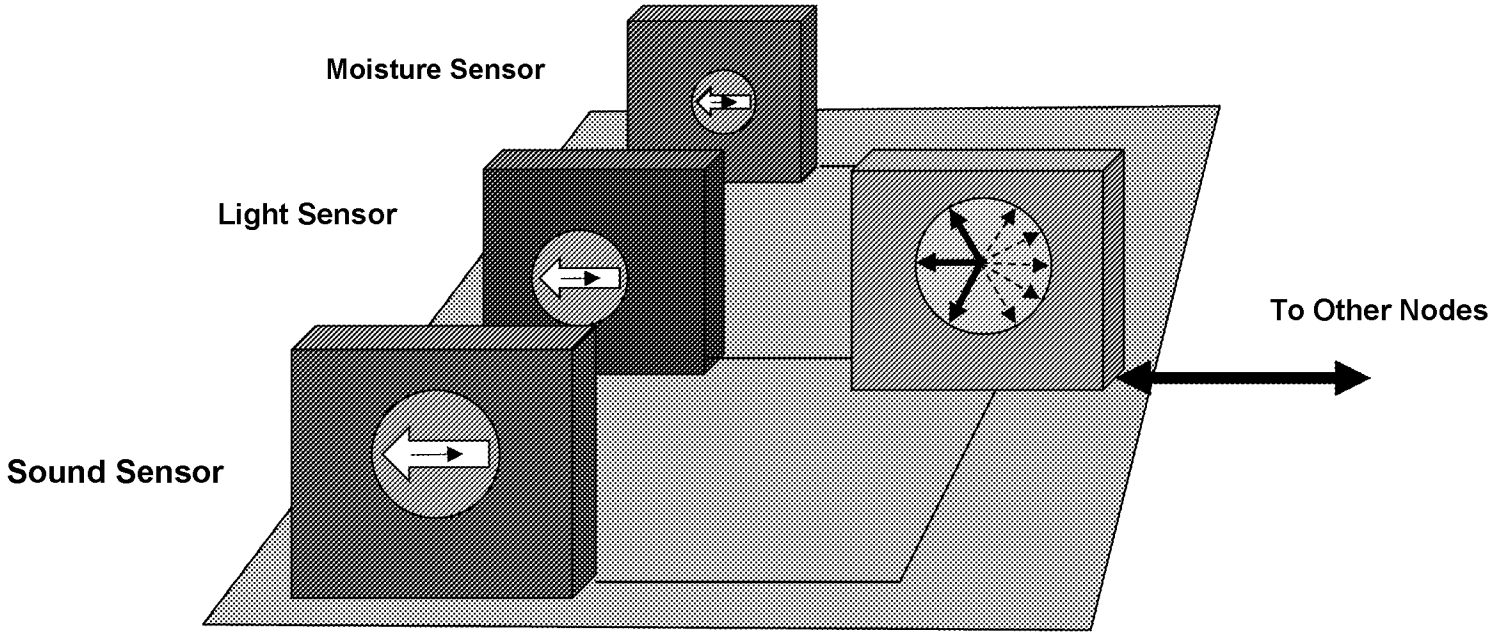
Figure 60



In millions of simple End Devices, basic physical states will be converted to Chirp payloads. An address, "arrow" of transmission, and checksum are added to this payload to form the complete Chirp packet.

Figure 61

EX1018, Page 198



Some devices will combine multiple IoT functions in a single package. Here an End Device includes a Propagator node that may provide networking services for additional nearby End Devices.

Figure 62

Tree Based Lineage Based Routing

P1: P0/1 → 1 (hence also one hop)
P2: P1/3 → 1-3 (two hop)
C1: P1/1 → 1-1
C2: P0/2 → 2
C3: P2/3 → 1-3-3
C4: P2/1 → 1-3-1 Hence C3/C4 Siblings

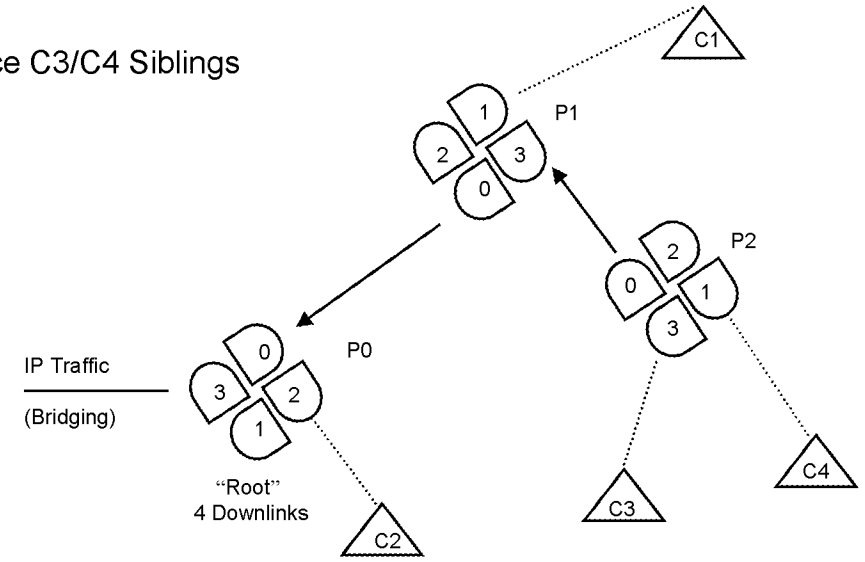


Figure 63

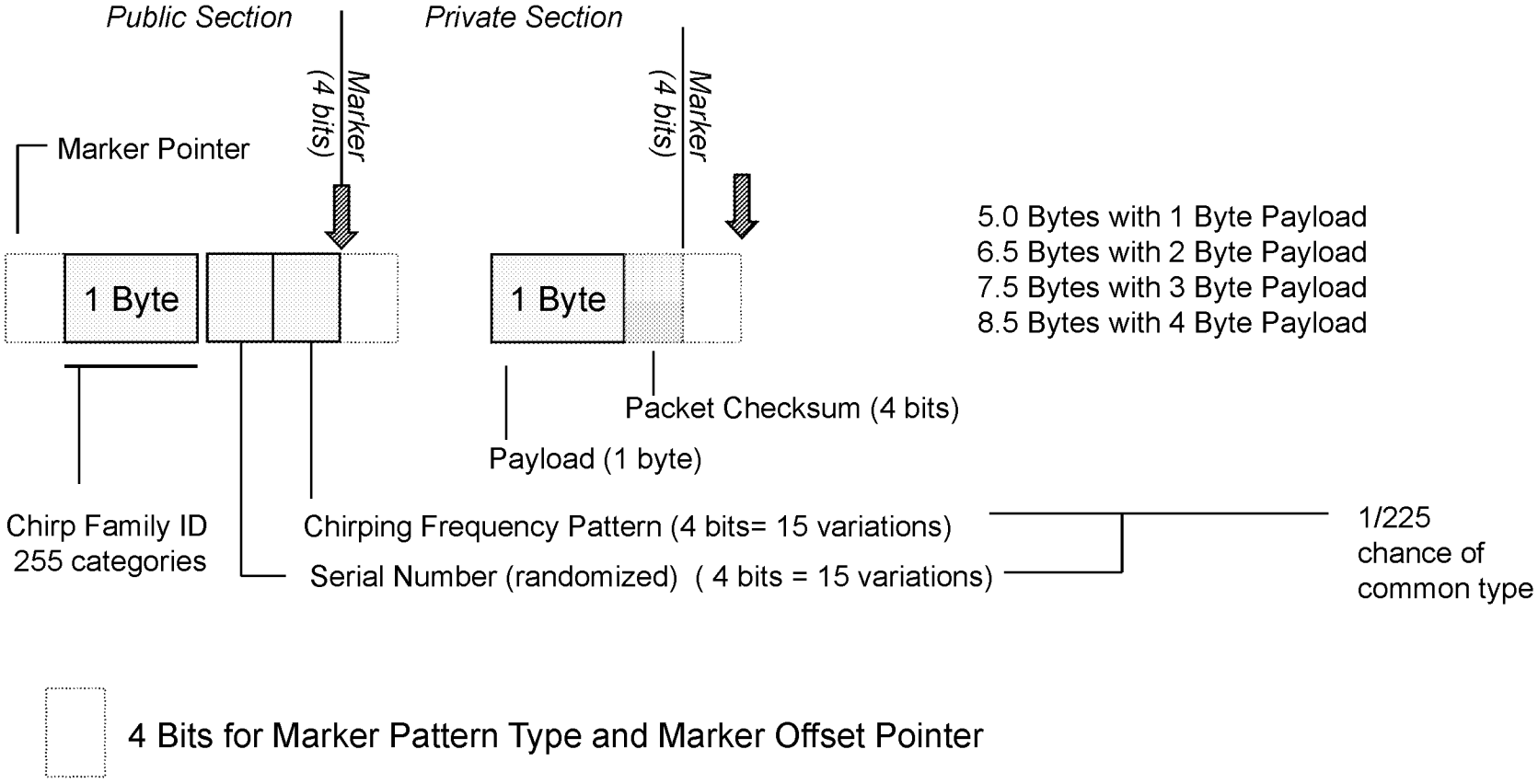


Figure 64

EX1018, Page 201

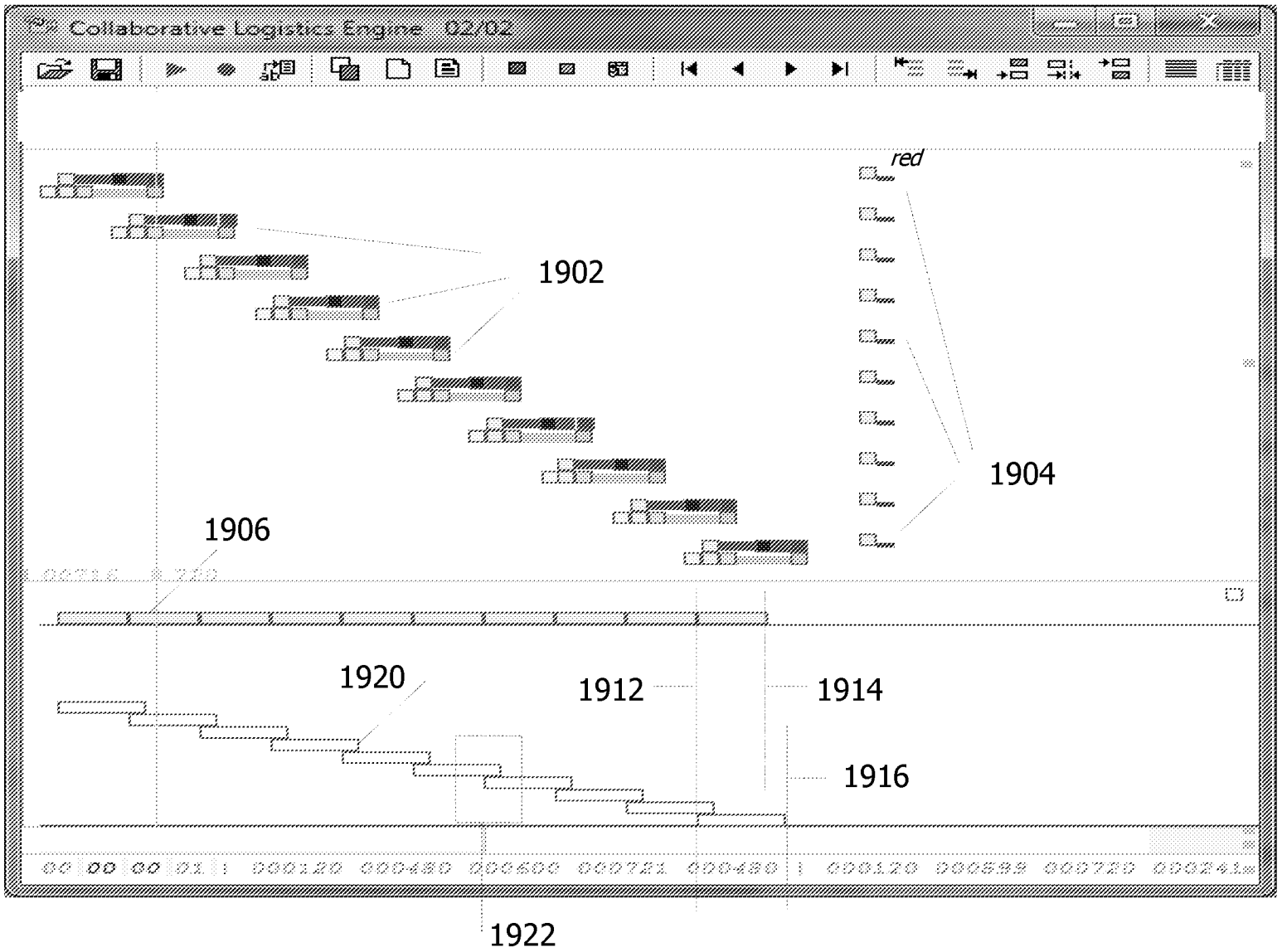


Figure 65

EX1018, Page 202

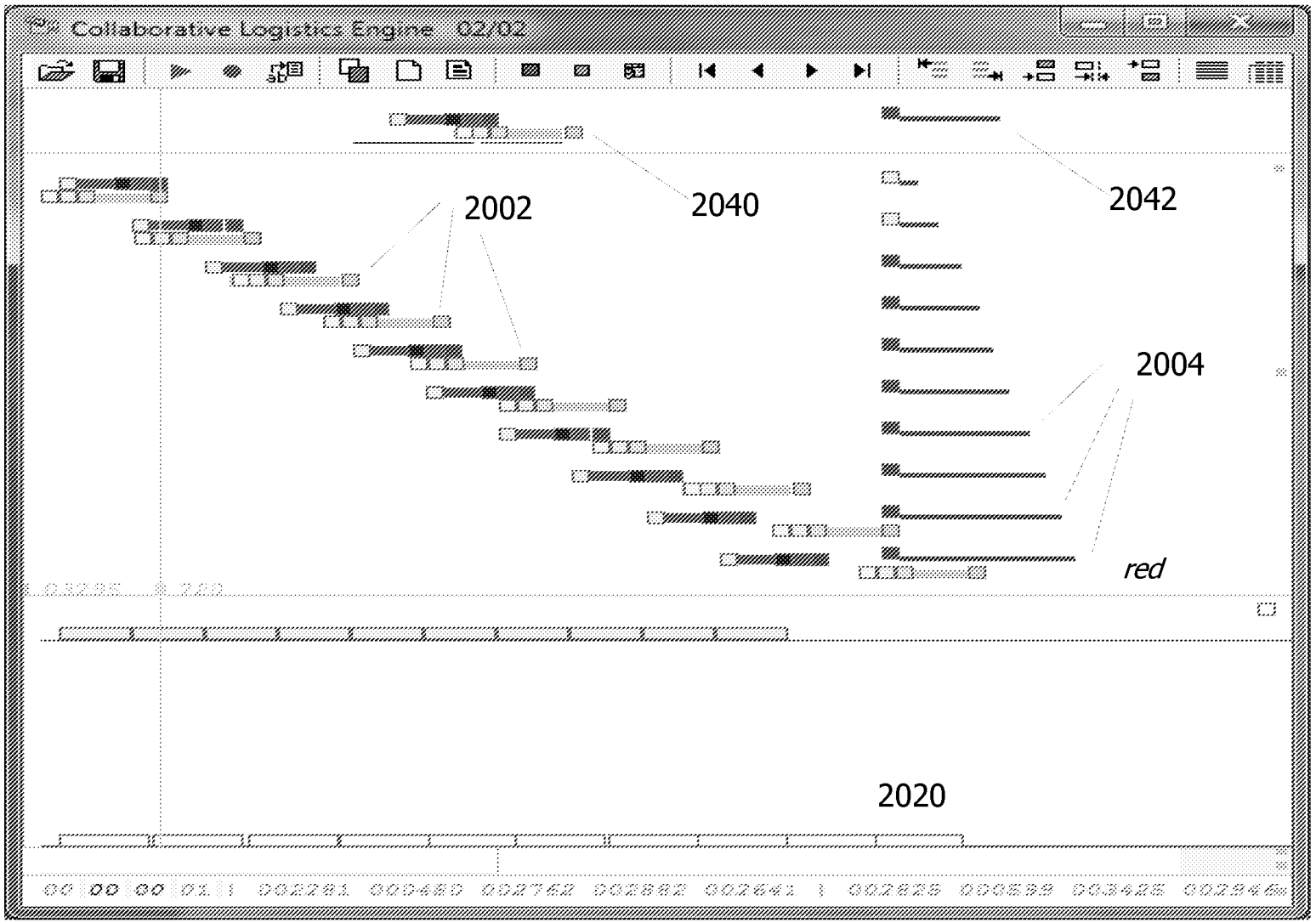


Figure 66

EX1018, Page 203

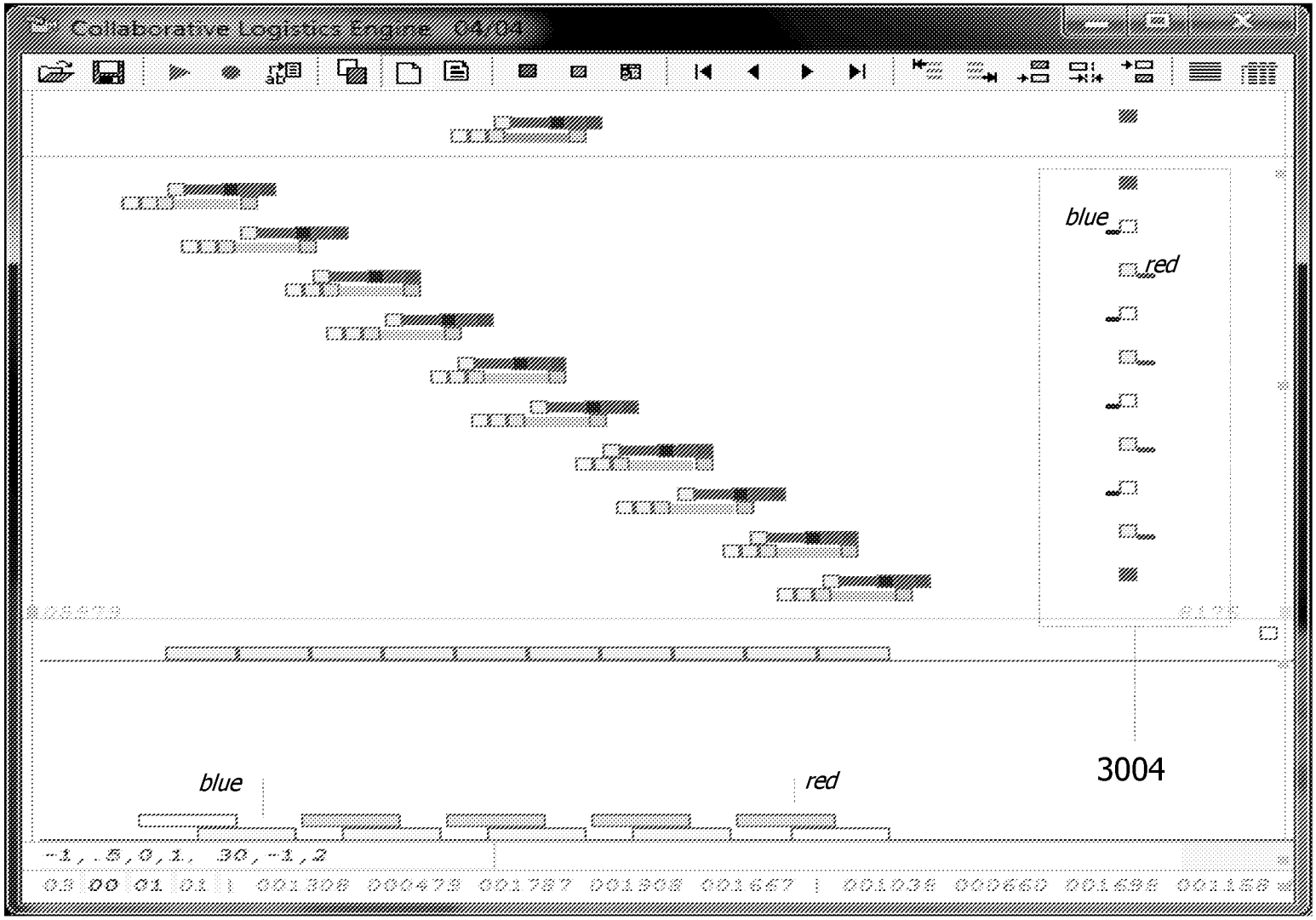


Figure 67

EX1018, Page 204

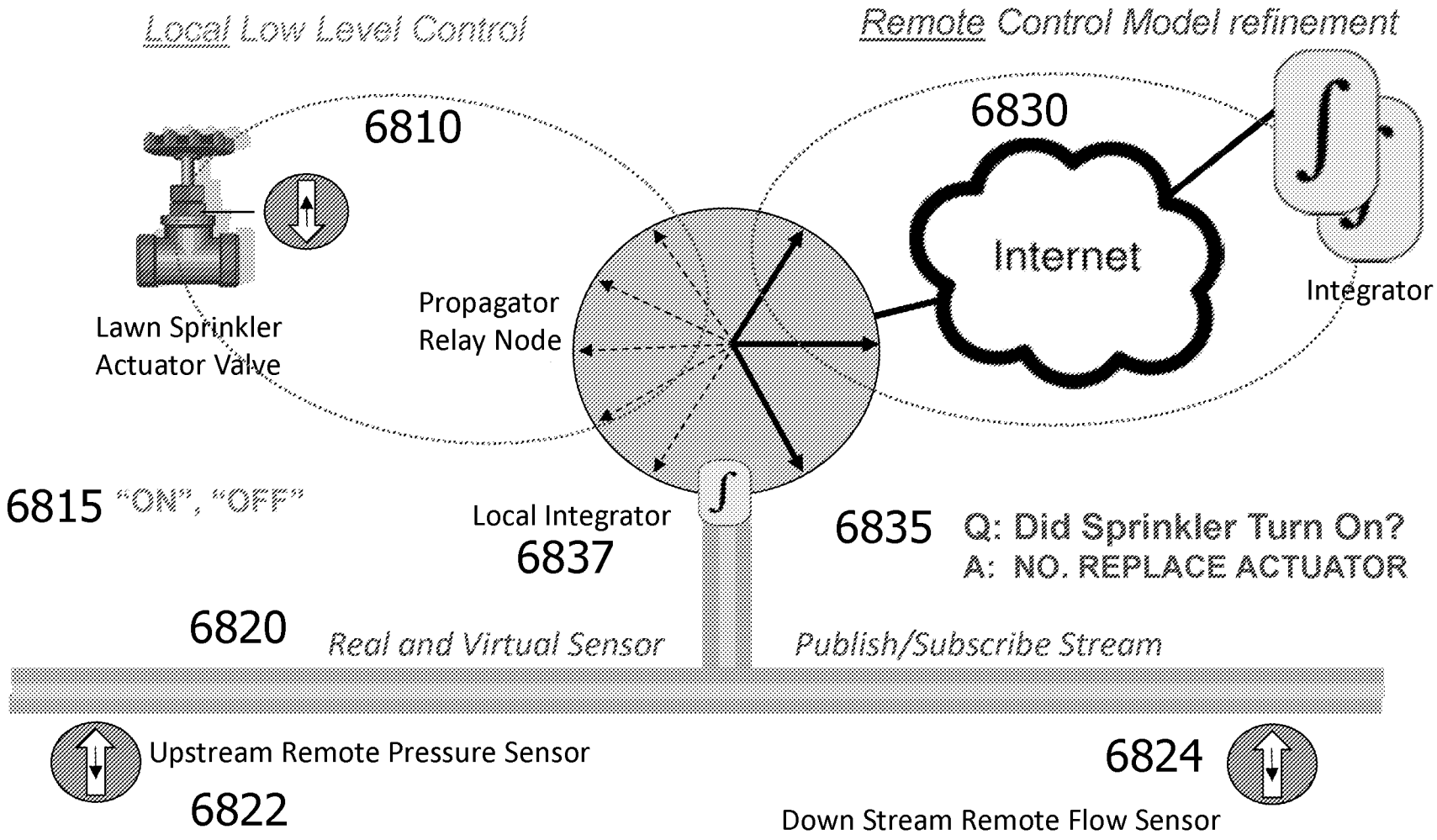


Figure 68

EX1018, Page 205

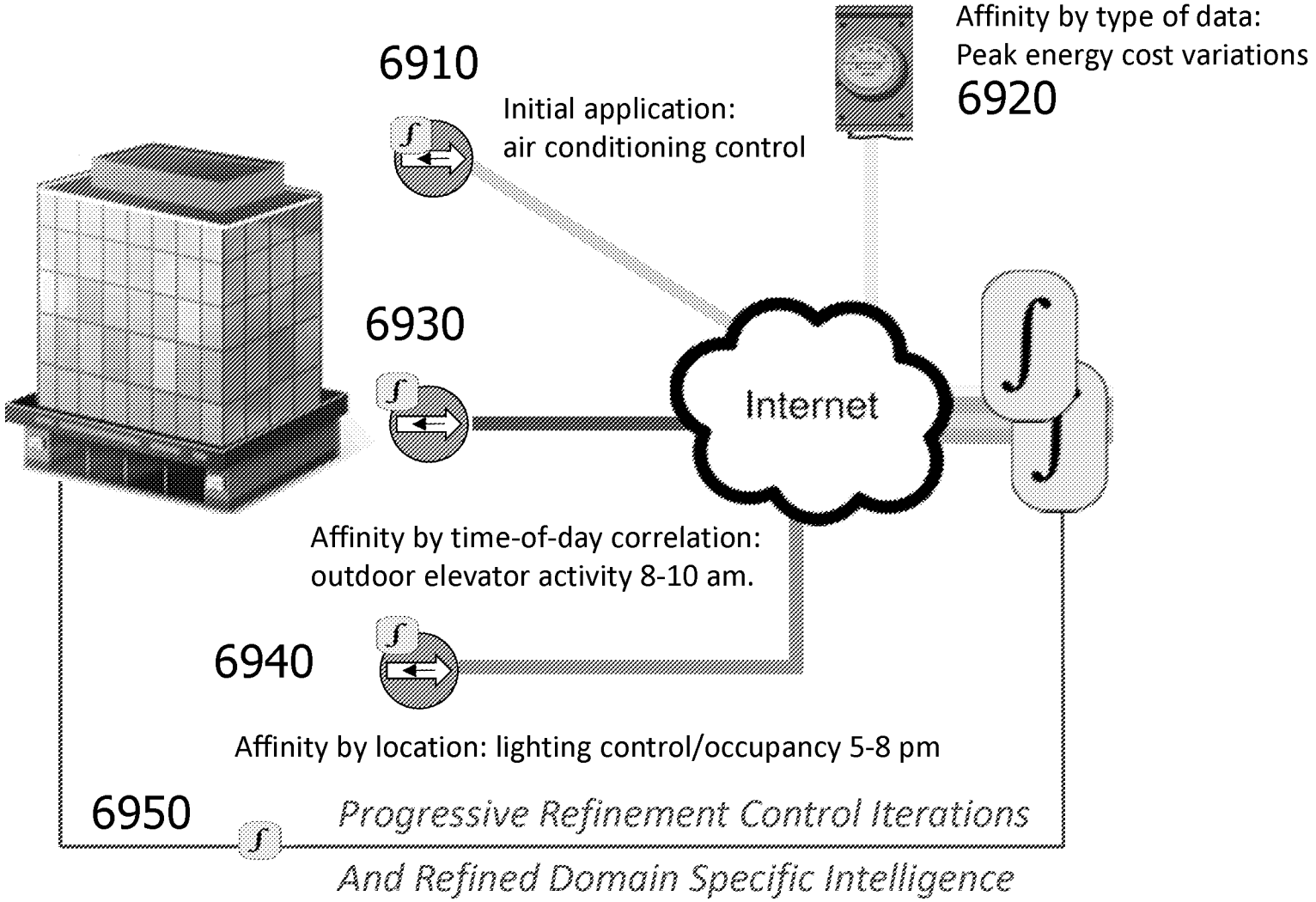
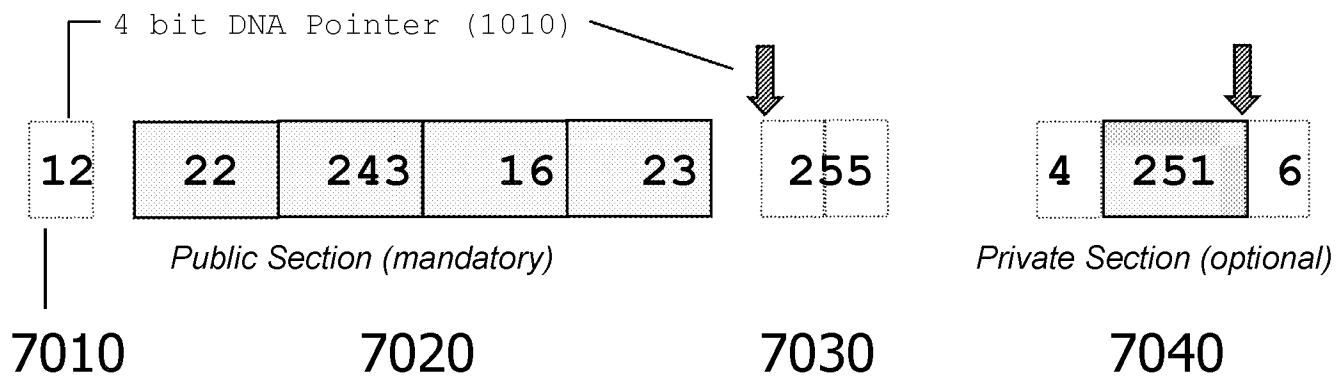


Figure 69

EX1018, Page 206



7050 Public Agent ID: 4.8.255 (4 byte Public, 8 bit Marker, DNA 255

7060 Agent 4.8.255: Format is 8.8.8.8 (4 variables,1 byte each)

7070 Subscribed Chirp Classification: 4.8.255.22.243.16.23.

7080 Private Agent ID 1.4.6 decodes payload [251] for 4.8.255.22.243.16.23

Figure 70

EX1018, Page 207

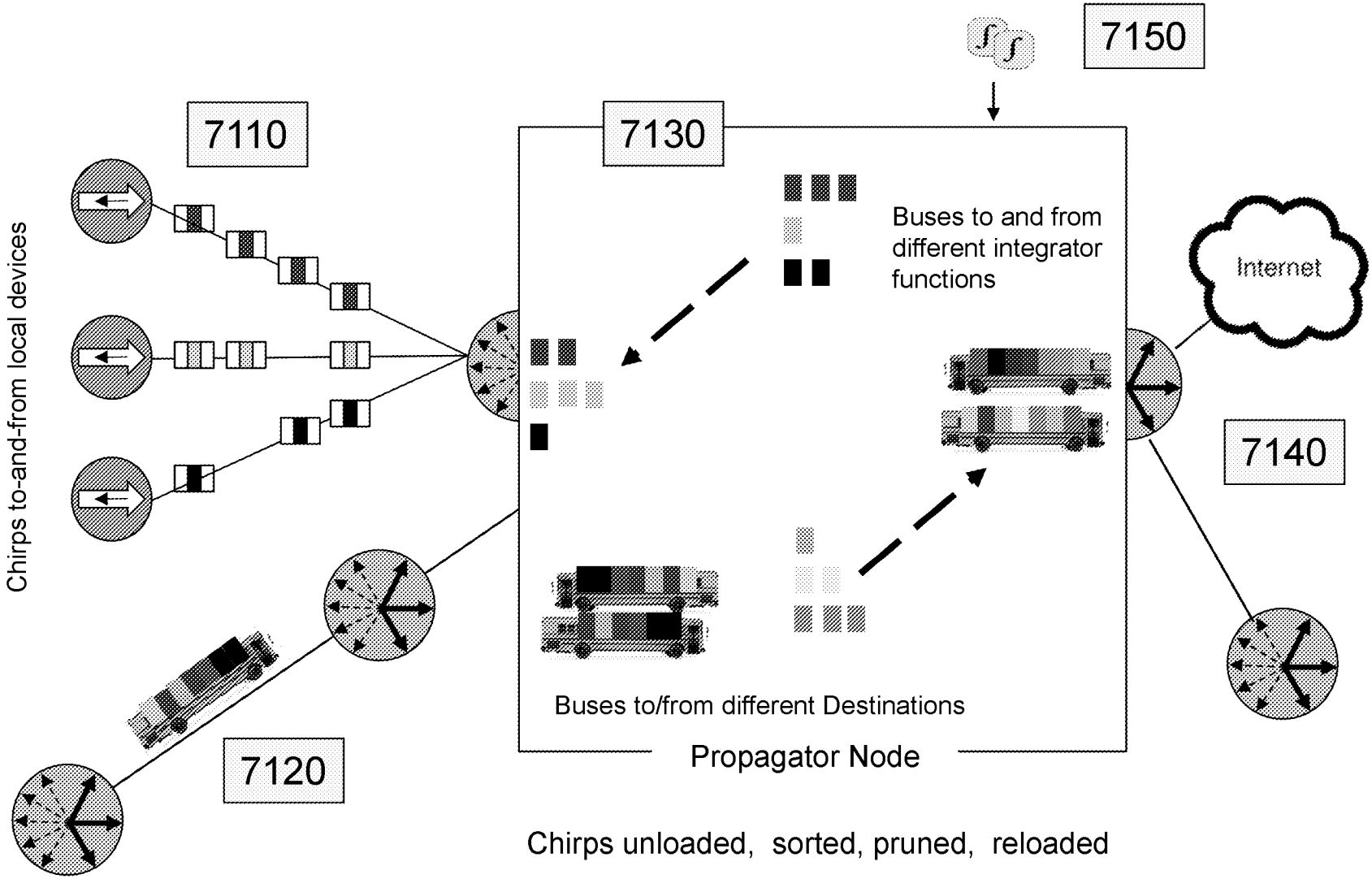


Figure 71

EX1018, Page 208

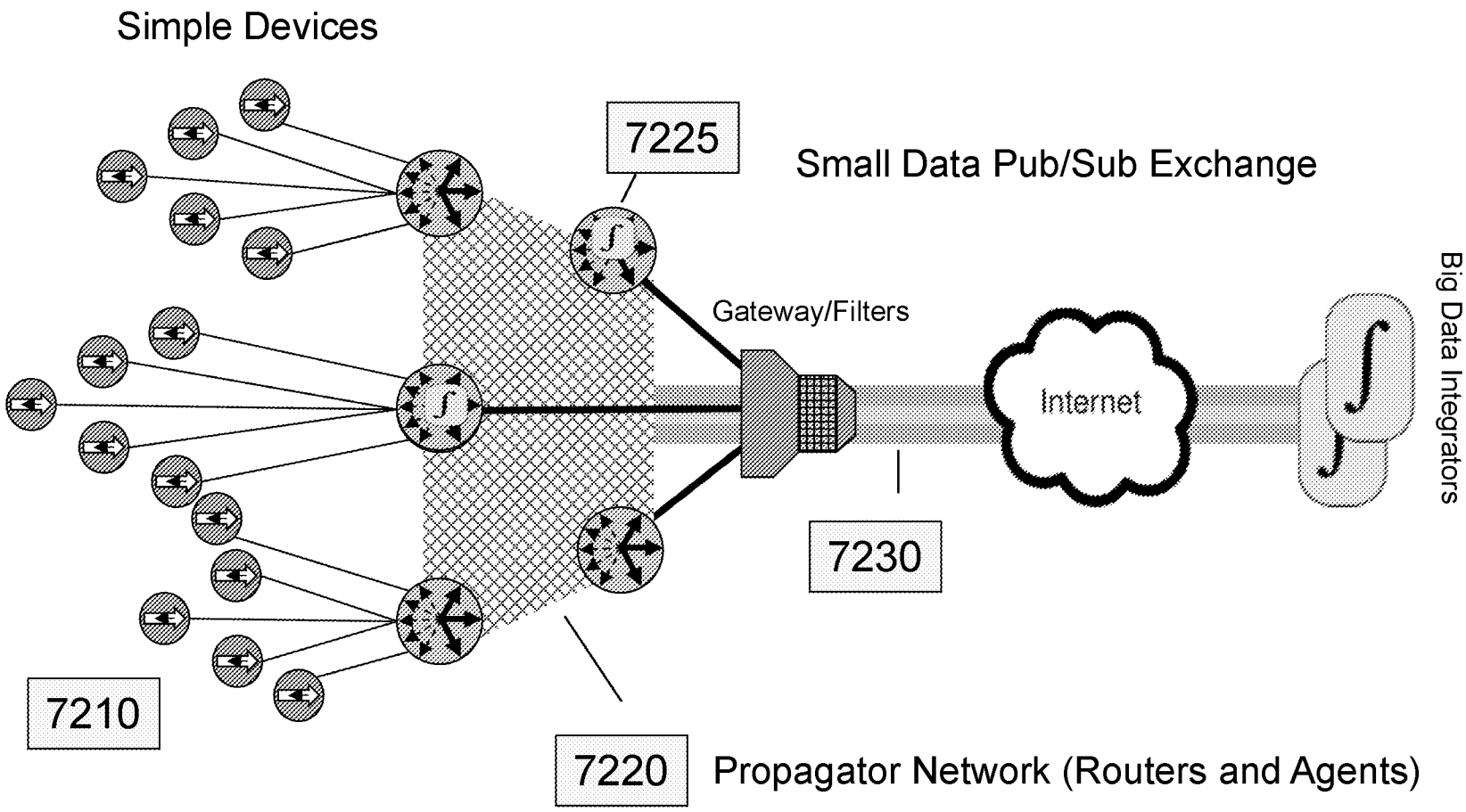


Figure 72

EX1018, Page 209

Title: Chirp Networks

Inventor: Francis daCosta

CROSS REFERENCES

The instant application claims priority as a non-provisional of U.S. Provisional Application Serial Number 62/012,196, filed on June 13, 2015, presently pending.

The instant application is a continuation in part of U.S. Utility Application Serial Number 13/764,008, filed on Feb. 11, 2013, which is pending, which in turn claimed priority as a continuation in part of U.S. Utility Application Serial Number 13/627,883, filed on September 26, 2012, and issued as U.S. Patent No. 8,923,186 on Dec. 30, 2014, which in turn claimed priority as a non-provisional utility application of Provisional U.S. Patent Application Serial Number 61/555,400 filed on November 3, 2011, currently expired, and Provisional U.S. Patent Application Serial Number 61/615,802, filed on March 26, 2012, presently expired, and Provisional U.S. Patent Application Serial Number 61/621,926, filed on April 9, 2012, presently expired, the contents of which are hereby incorporated by reference.

The instant application claims priority as a continuation in part of U.S. Patent Application Serial Number 13/571,294, filed on August 9, 2012, presently pending, which in turn claimed priority to U.S. Patent Application Serial Number 12/696,947, filed on January 29, 2010, issued as U.S. Patent 8,520,691 which issued on August 27, 2013, which in turn claimed priority as a non-provisional of U.S. application serial number 61/148,803, filed on January 30, 2009, presently expired, the contents of each prior application is hereby incorporated by reference. Application 13/571,294 also claimed priority as a continuation in part of U.S. Utility Application No. 12/352,457, filed on January 12, 2009, and issued as U.S. Patent 8,477,762 on June 2, 2013, the contents of each prior application is hereby incorporated by reference.

The instant application claims priority as a continuation in part of U.S. Application 13/541,446 filed on July 3, 2012, presently pending, the contents of which are hereby incorporated by reference.

The instant application further claims priority as a continuation in part of U.S. Utility Application 14/523,778, filed on October 24, 2014, presently pending, which in turn claims priority to U.S. Utility Application No. 12/625,365, filed on November 24, 2009, issued as U.S. Patent 8,514,852 on August 20, 2013, which in turn claimed priority to U.S. application 61/117,502, filed

on Nov. 24, 2008, presently expired, which are hereby incorporated by reference.

FIELD OF THE INVENTION

This invention relates to the field of computer networks and machine communications and, more particularly to a network system and method for facilitating large scale messaging emanating from devices on the edge of the network. These edge devices include, for example, sensors and actuators that interface with the dynamics of the physical world and each other through terse messages. In some embodiments these terse messages are referred to as chirps. Small data propagators near the edge of the network optimize the data based on dynamic subscriber interests.

BACKGROUND OF THE INVENTION

Increasing percentages of devices connected to the Internet or other global networks are not used by people in the familiar way that personal computers, tablets and smart phones are. Interconnected devices monitor the environment, structures, transportation systems, factories, farms, forests, utilities, soil and weather conditions, oceans and resources. Many of these sensors and actuators are networked into autonomous sets, with much of the information being exchanged machine-to-machine directly and without human involvement.

Machine-to-machine communications are typically brief and specialized. Most sensors and actuators will report or act upon small pieces of information. For purposes of the systems described in this application these terse messages are "chirps." Burdening these devices with prior art standard network protocol stacks is inefficient, unnecessary and unduly increases their cost of ownership.

Machine-to-machine communications dominate in several applications, including the field referred to as the "Internet of Things." As described in this application, the architecture optimized for the Internet of Things necessarily entails a widely distributed topology relying on simpler chirp protocols, especially at the edges of the network where the machine-to-machine communications predominate. Intermediate network elements perform information propagation, manage broadcasts, and provide protocol translation. Another class of devices house integrator functions providing higher-level analysis, for both near-edge analytics and broader-scope analysis. Small chirp data provides the necessary information for analytical systems.

The system as described in the application is described using certain analogies, such as the propagation of pollen, and interaction of social insects.

This application describes reasons why a different architecture is needed for the Internet of Things. The architectures described can coexist with existing incumbent networking protocols. In one embodiment, the architecture comprises integrator functions, propagator nodes, and end devices, and their interactions.

SUMMARY OF THE INVENTION

This invention addresses multiple embodiments. The methods taught address a variety of current networking challenges, specifically for mobile, temporal, or isolated networks, as can occur when a collection of wireless nodes is moving. These networks are mission critical, often requiring multiple connectivity media. Approaches for such networks are described in figures 9, 14, 15, 25, 39, 44, 45. As shown in those figures, the networks are often hybrids, involving both humans and machines. The machines may use IP or non IP (machine native) protocols. Such protocols are suitable for terse machine-to-machine (M2M) messaging and may use separate physical radios as shown in figures 22, 23, 25, 62, 63. Alternately, they may collaboratively share the same physical radio as shown in figures 32, 33, 39. Such a one-radio embodiment may use collaborative scheduling shown in figures 65-67. Lastly a Network Management System (NMS) framework must support clients which include humans, machines, routers and applications in the routers supporting terse M2M messaging, as hown in figure 12, element 060.

These diverse requirements are supported by a service delivery framework for network participants comprising mesh nodes (in one embodiment) wherein each mesh node supports wireless clients. The features implemented in the architecture include:

Logical Radio Routers Figures 1 through 8 depict one logical radio abstraction to support diverse client connectivity needs. Figures 9, 13, 14, 15, 25, 44, 45, 56 through 63 explain certain other embodiments. Figures 5, 6 depict the analogy to tree based wired switch stacks. The analogy to ports on the switches is made in Figures 9, 38 through 42. Figures 13, 14 ,15, 16, 44, 45 depict mission critical embodiments. Home or office application are shown in Figures 22, 23, 56 through 63, 68, 69.

Efficient Terse Messaging Transport Figures 10, 11 12, 24, teach concatenation for latency bound transmissions of terse M2M messaging, an embodiment of particular importance to VOIP packets.

Modular Nodes based on U/D/S/A Figures 17, 22, 23, 26, 38, 39 through 45, 63 are embodiments of modular frameworks supporting the logical radio abstractions of Uplink, Downlink, Scanner and Access Point. Failover and dynamic options from one uplink port to another is depicted in Figures 9, 21, 41, 42, 44, 45. Dynamic reconfigurable ports and sharing of U,D,S,A functions are depicted in Figures 9, 41, 42, 44, 45.

Isolated Network support: Figures 27 through 29 teach methods for Distributed DHCP address generation needed in mobile, temporal or isolated networks. Other applications are depicted in Figures 26, 39, 44, 45. Finally, Figure 27 depicts the SIP registry for M2M messaging, e.g. VOIP.

Remote Management Figures 18, 19 describe embodiments for remotely programming clients. Clients include mesh router applications, element 060 Figure 12. Programming applications or rule based directives is taught in Figures 30, 31. The NMS based application support framework is depicted in Figure 52. It extensively uses Local and Global Streams, Figures 48, 49. Intra router communications is implemented using terse UDP-based "heartbeats," Figure 54. It is open and customizable and used for other M2M messaging. Stream Readers are used to translate and communicate with native formats, Figures 50, 51, 52. A published NMS API, Figure 53, enables custom and domain specific NMS development, see Figure 55.

Application-Aware Mesh Control Figures 12, 20, 43 depict facets of the Mesh Control Layer that manages mesh topology first introduced in Figure 1. The control layer is radio and protocol abstracted. It supports both IP and non-IP client devices and applications.

Chirp Device Registration and Discovery Figures 64, 70 describe a topic-based addressing scheme that does not require IP based addressing schemes. Instead the nature of the device and its function, define its genus. Categories may be defined or created using the SIP/DHCP services depicted in Figures 27, 28. Figures 56 through 63 depict embodiments for such low-cost chirp devices. Category based information, e.g. "small data" is available within the M2M network for autonomous pattern discovery and machine control, see Figures 68, 69, 70.

Latency Sensitive Messaging Figures 56 through 63 depict embodiments of devices participating in a dynamic M2M publish subscribe exchange. Terse M2M messaging between devices includes latency sensitive traffic, see Figures 25, 56, 68, 69. Figure 71 shows chirp packets enter the propagator from both local and remote publishers (elements 7110 and 7120 respectively). The latter is containerized as a bus-load for efficient transport, 7120. Inside the propagator, port forwarding tables define the locations of interested subscribers. The bus containers may be reconstituted, in alignment with the current dynamics of the pub-sub exchange. Further processing includes removing chirp packets that are duplication or are no longer desired (such as for those packets that arrived out of order or contain information that is no longer current). In one embodiment, heart beat packet duplicates are discarded at each mesh node. The reconstituted bus containers are then sent out to both local and remote subscribers 7140. As shown in Figure 72, the top level view of the entire M2M service delivery framework consists of simple terse messaging devices 7210. Further included in the embodiment are propagator and bridging Mesh Network elements 7220 which incorporate agents. The agents are implemented within the nodes 7225. Agents act on behalf of big data subscriber requirements 7230.

BRIEF DESCRIPTION OF DRAWINGS

In order to more fully describe embodiments of the present invention, reference is made to the accompanying drawings. These drawings are not to be considered limitations in the scope of the invention, but are merely illustrative.

FIG. 1 illustrates how the network topology is changed by selecting a different backhaul in a two-radio system, with one link to the backhaul AP and the other link servicing the child AP. It depicts four network topologies. Each of the four network topologies provides a different set of performance in terms of latency and throughput. The mesh control software adjusts the latency and throughput parameters to meet voice/video or data performance requirements in terms of latency and bandwidth.

FIG. 2 contrasts the conventional "Dual Radio" mesh with the Logical Two-Radio Mesh. On the left of FIG 2, two radios labeled 010 and 020 provide client connectivity and ad hoc mesh backhaul functionality, respectively. All the mesh backhaul radios (020) are on the same channel depicted by the clouds of coverage of the same color (030). They are all part of the same sub-network. In

contrast, on the right of FIG 2, the same radio (025) provides service to clients and also backhaul functionality but operates in different sub domains depicted by different color clouds of coverage (035). The left hand resembles a network hub, the right side a high performance network switch. Hubs are not scalable.

FIG. 3 compares the two-step process of a single radio relay to a two-radio relay. On the left side, (010) a single radio relay is shown. Every packet received has to be re-transmitted on the same radio. Thus the bandwidth with every hop in a single radio mesh network is reduced by approximately 50%. After three hops, the Bandwidth would be an eighth of what is available at the Ethernet backhaul. On the right side of FIG. 3 (020) a two-radio backhaul is shown, where packets received on one radio are re-transmitted on another radio operating on a non-interfering channel. In this configuration, there is no bandwidth reduction with every hop and bandwidth is preserved with every hop. Two radio mesh backhauls are scalable while single radio backhauls are not.

FIG. 4 shows how the structure of two-radio multiple hop mesh network where each two radio unit services a Basic Service Set (BSS) by configuring one of the two radios to serve as an AP to its clients. Clients may include the second radio of another two radio system, with this radio configured to run in station mode, providing the backhaul path back to the Ethernet link. In the insert, the uplink radio (labeled 010) connects to the parent mesh node while the downlink radio (labeled 020) acts like an Access Point to client radios, including other mesh nodes that connect to it through their uplink radio. Note that all service radios (020) operate on different non-interfering channels, depicted by different color ovals.

FIG. 5 shows the similarities between FIG 4 and a wired switch stack with the same chain of connectivity 040-050-060. Both have the same tree-like structure and up link and down link connections. In both cases the units (040,050,060) operate on a distinct sub domain.

FIG. 6 illustrates one embodiment of the two logical-radio approach with three physical radios. Two radios constitute logically one radio of the two logical radio concept, while the third physical radio serves clients as the second radio of the two logical radio concept. By eliminating the sharing of physical radios for both backhaul and client services, the backhaul bandwidth is improved and also reduced the dependency to use the same type of radios for the backhaul and for clients. In the insert, the uplink radio (labeled 010) connects to the parent mesh node while the downlink radio (labeled

020) connects to the uplink radio of child mesh nodes. The service radio (labeled 030) act as Access Points to client radios shown as triangles. One such is labeled 040. Note that all service radios (030) operate on different non-interfering channels, depicted by different color ovals.

FIG. 7 illustrates another embodiment of the two logical radio approach but with five physical radios. The uplink and downlink radios (shown as one radio Fig. 6) are split into two radios, in this embodiment, with each responsible for one direction of traffic. Bandwidth is doubled and latency halved, since traffic in the opposing direction now has its own channel or logical "lane". Thus, the radio labeled 010 in Figure 6 is now radios 012 and 010. Similarly, the radio marked 020 in Figure 6 is now split into radios labeled 022 and 020. The radio pairs 012-010 and 022-020 provide the same functionality as the radios labeled 010 and 020 in Figure 6 but with twice the bandwidth and approximately half the latency.

FIG. 8 is an extension of the five-radio embodiment shown in Figure 7. In Figure 7, there is one service radio to service both voice and data clients. However voice and data traffic has different performance requirements. By having different Access Point radios service the voice and data clients, the contention between voice and data packets attempting to gain access to the same medium is reduced. Also, with different radios servicing the data and voice clients, the voice and data packets can now be treated differently. The Access Point radios servicing the voice clients could therefore be operating in TDMA (time division multiple access) mode while the AP radio servicing the data clients operates in CSMA (Collision Sense Multiple Access) mode. The two radios (032) and (034) thus provide different functionality. VoIP devices such as phones connect to the former, data devices such as laptops to the latter.

FIG 9 is a five-radio extension of the three-radio configuration shown in Figure 6 but with more dedicated service radios operating on different frequencies for different types of client radios.

FIG 10 shows the maximum VOIP bandwidth available per client, using 802.11 radios, as the number of clients increase, as measured by the size of the packet that each client can send every 20 ms. As the number of clients increase the size of the packet - and the associated voice quality - drops dramatically. In one embodiment, to achieve 64 Kbps voice quality, an 802.11b radio can support around 25 clients.

FIG 11 shows the maximum VOIP bandwidth available per client, using 802.11a radios, as the number of clients increase, using the same packet size metric sent every 20 ms. As the number of clients increase the size of the packet - and the associated voice quality - drops dramatically. In one embodiment, to maintain 64 Kbps voice quality, an 802.11a radio can support around 55 clients.

FIG. 12 shows extensions developed and implemented in the mesh network stack to provide an efficient backhaul for voice. The small voice packets are concatenated into larger packets and sent (as one packet) at regular intervals to the backhaul radios. At each mesh node voice packets intended for that destination are removed and the rest sent back (as one large packet).

As explained below, the embodiment includes a Packet classifier (labeled 010) that recognizes voice packets based on size and regularity of transmissions. A VOIP concatenation engine (labeled 020) "container-izes" small voice packets into a larger "container" packet for more efficient transportation. Real time extensions (labeled 030) to the Linux kernel enable the system to provide near real time performance for sending and receiving the latency sensitive VOIP container packets through the network - regardless of what the Operating System is doing at the time.

Application driven rules and Scripts are resident in device abstracted APPLICATION layer library 060, a supervisory control layer above three lower control layer modules: TCP/IP, MESHCONTROL 040 and SCAN 050. Direct Machine to Machine (M2M) communications are controlled by APPLICATION over the Software MAC layer. The Software MAC Layer is typically running at the Kernel level of the software platform, requiring LINUX KERNEL EXTENSION 030. These extensions enable low level, fast applications/algorithms, operating at close to port forwarding tables, operating at (Kernel level) Drivers for Ports 080. The APPLICATION layer is analogous to the Control Plane in the SDN paradigm. The control plane manages the buses, Fig. 72 needed for real time M2M messaging for industrial applications Figs. 56, 68, 69, down to port level routing. The TCP/IP layer supports AAA audit trails and AES encryption 090 so the Application Service Delivery and Deployment is securely managed.

FIG. 13 shows the concept of a "Hybrid Mesh network" where two-radio systems provide two types of service. In one case, they are part of an infrastructure mesh as shown by the two-radio mesh node labeled 010. In another embodiment, the same node may be dynamically reconfigured to support ad hoc peer-to-peer connectivity. The node labeled 020 (marked as E8) has two radios. One is intended

for client radio connection to infrastructure mesh nodes - see the radio labeled 030 on the unit marked E9. The other provides a peer-to-peer mesh capability, as shown by radio labeled 040. Depending on the needs of the network, the two-radio units are dynamically re-configured to support either need, infrastructure mesh (010) or backhaul support to ad hoc mesh (020). Labels 050 and 060 designate connected and broken ad hoc mesh links.

FIG. 14 is an application of the Hybrid Mesh concept to a Public Safety embodiment. The node labeled 010 is a Stationary node on top of a light pole, in this embodiment. A mobile embodiment shown as labeled 020 is entering the building (arrow) such as when carried by firefighters. These mobile units are also called "breadcrumb" routers. The Mobile Mesh nodes provide connectivity to two-radio portable units worn by the firefighters in this picture. All firefighters are thus connected to themselves through a peer-to-peer mesh network shown as a thin line. They are also connected to the Infrastructure mesh backhaul through one or more connect points. This ensures redundancy in network connectivity. The broken link (labeled 060, Figure 13) is avoided.

FIG. 15 is an application of the Hybrid Mesh concept related to a Battle Force Protection embodiment.

FIG 16 depicts an embodiment using mesh nodes which feature four radio slots used in the modular mesh framework of Fig. 17. There are two slots for radio cards on the front and back. Up to four radios 010 are thus supported on a single embedded systems board. The radio card antenna connections 030 are included for four radios. Two Ethernet ports 020 provide wired access to provision wired uplink and wired service access.

FIG 17 indicates the modular mesh framework, whereby a four slot board, as shown in Fig. 16, may be configured to provide different functionalities: Two radio Backhaul (BH) 010; three radios BH+AP 020; four Radio with BH AP and Scanner 030; four radio with Full Duplex (FD) using a coupled two radio BH 040. Further, since the modular mesh framework always forms a tree, these nodes are part of a switch hierarchy, as shown in Fig. 5.

FIG 18 depicts how the installation software is tagged to both the radios and board characteristics. It shows a serial line connected to load the boot loader program, after which the Ethernet port is used to complete the software installation and branding process. Compiling the install program on the

board it is intended to run on performs this function, thus creating a unique software image.

FIG. 19 is a view of the flash deployment software developed and implemented to ensure that software generated for the install of this board cannot be used by another mesh node. When the software installation process begins, the software is compiled on the board it is intended for and the compilation process is unique since it is based on a number of unique factors. The software is generated on the board that it is intended to run on - to ensure that the software image cannot be used to run on another board, thus preventing both software privacy and dissuading theft of the mesh nodes.

FIG. 20 shows that the Mesh Control Software sits above the Media Access Control (MAC) of the radio. As such it is radio and protocol agnostic, in one embodiment.

FIG. 21 shows how channel interference is dynamically managed in the logical two-radio system.

FIGS. 22 and 23 introduce an embodiment bridging across diverse wireless medium using the example of an N-Logical wireless medium bridge, referred to as the "nightlight." In one embodiment, the nightlight serves as both range extender and intermediary between device "chirps" and more conventional, IP based, communication devices and protocols.

FIG. 24 shows the synchronization of multiple voice devices accessing the same wireless medium with a focus on the time for bulk receipt of packets that are shared among the separate devices.

FIG. 25 shows a voice device talking to a dedicated voice radio and data devices taking to a data radio, with one phone 2501, capable of taking to both 2502 and 2503 in one embodiment. The night light embodiment 2504 manages both voice and data transceivers, in the depicted embodiment.

FIG. 26 depicts the dynamic collaboration tree for an exemplary supply chain application, where routers support modular U,D,S,A functionalities and messaging is driven by collaborative scheduling, as detailed in Figs. 65, 66, 67.

FIG. 27 shows an isolated mobile network cluster and communication within it using VOIP phones.

FIGS. 28 and 29 describe an embodiment wherein isolated network clusters may converge with distributed DHCP services and inherent conflict resolution using randomized sub net address ranges.

FIGS. 30 and 31 depict the process of generating an OS-independent image for secure small footprint devices and an exemplary graphical programming environment for simple sensory devices, in one embodiment.

FIGS. 32 and 33 depict device repeaters and range extenders. Conceptually these devices are similar to clients, such as the soldiers in the battle force embodiment shown in FIG. 15. The range extenders provide blind repeating and therefore range extension for remote devices. They also serve as a redundant path, similar to FIG. 13 but employing a single physical radio. Thus, in chirp language, they are birds that repeat and relay a bird song in string of pearl configurations.

FIGS. 34 through 36 depict representative IP based "light" or low payload packets that may be used to transport chirp data over an IP based network. 802.11 packets are used as examples. Chirp data is encapsulated in such packets for onward transmissions, in unicast, multicast or broadcast modes, in search of flower/agents/tunes/subscribers interested in the chirp/pollen. In one embodiment, chirp devices use such innocuous frames to transport payload - only chirp aware routers know how to recognize them as chirp packets and process their (secure) routing to appropriate agents accordingly.

FIGS. 37 through 38 map the equivalent slots/ports of wired and wireless switch equivalents as shown in Figs. 4 and 5.

FIG. 39 shows how logical radio modes, Uplink (U), Downlink (D), Scanner (S), Access Point for Service (A) map to physical transceivers in single radio and multi radio mesh node embodiments. The joining of tree branches 3950 to tree trunks 3960 is aided by common routers 3952.

FIG. 40 is a simulation of a representative prior art mesh routing algorithm and its comparison to tree based routing of Fig 4. The thicker blue lines in Fig 40, 4040 denote the minimal spanning tree. Note the dashed lines have to be additionally recomputed for each node in prior art mesh routing. Performance deteriorates exponentially as O (n^2) where n is the number of mesh members.

FIGS. 41 and 42 depict a switch equivalent of logical radios operating in both wired and wireless

mediums/channels, using Logical Radios Uplink (U), Downlink (D), Scanner (S) and O(n) routing. The logical radio switching module (as an insert in one embodiment) is introduced.

FIG. 43 is a schematic of how the abstraction layers for logical radios may themselves be combined to create more complex abstractions. Element 4320 refers to two abstractions AP (also in Figs. 12, 17). The "bridge" is a combined logical radio abstraction, similar to the Uplink and Downlink (U+D) backhaul, but bridging over disparate frequencies and protocols.

FIG. 44 shows the bridging function (as described in Fig. 43). Mobile node 4455 switches from "blue" 5.8G backhaul to a "pink" 2.4G backhaul. The sub tree beginning with mobile node 4457 is thus operating on a non-interfering channel/frequency/protocol. The static counterpart is 4460.

FIG. 45 depicts a "string of pearls" configuration of static mesh nodes. A mobile mesh node, traveling at 60 mph makes temporary connections with each node in the string. Switching from node to another is seamless and unbroken, as noted by the video output below. The process is repeated with single radios embodiments, using logical radios. Bandwidth degraded along the string of pearls, as expected, but video output was still jitter free and unbroken, due to proactive Scan Control, Fig. 12, Logical Radio abstractions and the benefits of O(n), tree based routing.

FIG. 46 depicts the dependency of latency sensitive traffic to the network tree topology, specifically, the number of siblings in sub trees along the route to the destination node/parent/root.

FIG. 47 depicts the use of a reserved time slot for transmitting bulked, latency sensitive data, whereby clients remain silent during transmission in this time slot. The time slot allocations may be fixed or variable. In one embodiment it is dynamically managed by Collaborative Scheduling.

FIG. 48 depicts broadcasts/streams restricted to a region. The region may be defined by geography, membership and mesh topology e.g. restrict the number of hops or sub trees. Further, the region may include directions: up/down or a set of turn by turn directions. An example of regional streams may include a section of the home, where only siblings of a sub tree require particular data stream. Note that backhaul bandwidth is not affected outside stipulated regions. Restricted broadcasting improves overall network health.

FIG. 49 is effectively the reverse of Fig 48 and is global: e,g. not restricted. Tree based topologies favor global broadcasts. Streams from the root are always downwards. While streams from nodes may be either, they are typically upwards. The majority of devices populate the edge of the network and their pollen is typically upward bound, necessitating bulking, exception handling and deterministic time mail delivery along the route.

FIG. 50 depicts the Stream Reader, an agent authorized to peer into network router transmission and receiving packet queues, prior to their onward transmission through the network. Like Post office sorters, they identify and sort packets for scheduled deliveries, prune dead letters, duplicate messages etc. They also provide decoded outputs for Stream viewers, a custom GUI for the data. Stream readers may also forward output to other readers, mail boxes or messaging systems.

FIG. 51 depicts a circuit diagram of Stream Readers and their associated Stream Viewers, wired together to provide a capability, in this case "feeding" a section of the composite view ports 5190. The composite view port is back drivable since its connection may be to real or historical data.

FIG. 52 depicts the adapters and API interface components that provide an extensible, open library of stream reader and viewers. This enables the rapid prototyping of custom circuits to provide specialized competencies. The view port additions enable human participation in managing the network health. This includes, through adaptor view ports, all assets of the network and their health.

FIGS. 53 and 54 depict the published interfaces for the Network Manager Streams API and the Heart Beat Entity relationships, respectively. Together, these facilitate speedy viewport development.

FIG. 55 depicts an embodiment of methods outlined in Figs. 47 through 54. 5530 depicts the current mesh topology in dark lines. The lighter lines are alternatives gleamed from mesh node heart beats, which in turn was gleamed from SCAN agents, Fig 12. Clicking on a mesh node brings up its machine status 5520. This includes applications resident on that router. Recent heart beat log shown in 5540. Green light 5540 indicates that heart beat based algorithms infer the node is healthy e.g. multiple alternate parents, strong signals.

FIG. 56 compares contemporary thin client, single control loop architecture to a dual control loop, with a membrane separating the two control loops but, through the chirp to IP bridge/membrane,

there is bidirectional, pruned and selective traffic, based on collaborative scheduling of bus schedules in both directions. Note that the two control loops are working on their own frequencies but neither is waiting on the other, see also Fig 46. This predicates the need for a "hub", e.g. Propagator. They also serve as bridges between the upper control loop, IP based and lower, tighter (low latency/isochronous) control loops preferably in more efficient chirp protocols. Note that the overhead of converting raw, machine specific raw data to a more palatable device abstracted format (e.g. small data) is performed within the cloud in the single control loop model, (left) and delegated to propagators in the other (right). Further, the lower control loop, between propagators and devices can be low latency/isochronous while the upper control loop focuses on more infrequent high level tasks: performance tracking, exception handling system updates (event based, low latency), routine hourly reports (large interval periodic).

FIGS. 57 and 58 depicts a burgeoning market place "exchange", where the confluence of multiple sources of terse but potentially rich content streams, often in organic protocols occurs at propagator trees. The root node serves as the Chirp to IP bridge/membrane. Small data is progressively refined and pruned, in proactive manner, as data moves upstream, like salmon upstream.

FIGS. 59 and 60 depict a publish/subscribe exchange/market supporting multiple devices and integrators each operating in their own private communities/ but also part of the same logical exchange.

FIG. 59 is an example of a small "exchange" of multiple data streams, operating on different, non-interfering wireless media. The "vital signs" Integrator is fed exception and periodic, non urgent pruned data from the propagator. The exchange between device and integrator is managed by having two segmented control loops, maintained by the propagator.

FIG. 60 is an example of a proactive control system, operating on the confluence of both local and external data publishers. The propagator, with appropriate transceivers, picks up multiple sensor streams, from a grid of diverse sensor types. Local Integrators/Agents residing in the propagator, can quick discern patterns and overall state of a large area- since small data is being generated and shared across a local mesh network, see Figs 57 through 58. Local data streams are consolidated to provide a composite view of the region of interest. This feeds a second control systems where big data publishers provide a more global perspective. Thus, weather forecasts predicting rain, can cause

the cloud server to direct the propagator network to direct which section of the corn field need additional local irrigation.

FIG. 61 depicts the simple circuitry needed to mass manufacture very low cost, low footprint, light chirp or "pollen" generators.

FIG. 62 depicts a first layer, rudimentary small data generator, where sensor fusion/consensus generates early warning signals with fewer false positives. The propagator and first layer integrator may be bundled as one device, servicing both single and multi-sensor subscribers in the local meshed network and beyond.

FIG. 63 depicts a modular four leaf clover like propagator, with 4 independent transceivers, 90 degrees rotated from each other. The 4 transceivers may be logically assigned uplink, downlink and scanner functionality, based on where the clients and relay node parents are located and the current network routing priorities. The transceivers may be dynamically and logically reassigned as the network topology changes or as clients migrate into and out of the network. Note that, as other 4 port devices depicted in this application, there is only one uplink per the 4 leaf clover design- it is scalable tree architecture. One layer is shown - overlays of such devices cover different wireless transmission media (e.g. Infrared LEDS for Chirp and Bluetooth for IP networking). A stack of such four leaf transceivers than thus service both Chirp and IP clients, including other propagators. Routing is shown as lineage based, so siblings are distinctively identified. In one embodiment the unit is autonomously rotated to better align Uplink and Downlink radios to see alternate parents, 5530.

FIG. 64 depicts one embodiment of category classification based approach to publishing M2M data. The Marker Pointer tells the router/propagator/agent where to look for the type of Pattern being used. Thus Marker patterns located at Byte 6, would be part of the 6.X… family. A 4 bit Marker pattern value of 15 would imply that data being published is part of the 6.4.15 family. This coarse granularity may be sufficient to route the published data in the general direction of interested subscribers. Further levels of finer granularity are available to agents aware of what Marker Pattern 15 signifies e.g. how the category data in the 6 bytes of (open but cryptic) finer classification data are expected to be read.

FIGS. 65 through 67, relate to the distributed collaborative scheduling engine. Fig 65 is the starting condition where each task is taking just a little longer than expected. The usual first in first out queue, see Fig. 66, results on excessive delays further out for entities at the tail of the queue. Fig 67 employs collaborative scheduling to balance out and maintain overall "customer satisfaction". Two tasks are "stacked", because they are contending for the same resource a portion of the time. Stacking implies more resources are needed. When the resources are limited must be shared, this is not an option. As an example, consider the case of chirp devices and IP devices sharing the same wireless channel. Collaborative scheduling shifts the two tasks in opposite directions in time, to remove the stacking. The shifts are based on shifting those task start/end times within "Customer Satisfaction" constraints defined by the blue/red ranges for the task. In one embodiment, schedulers runs at each mesh node, thereby providing dynamic scheduling services for all packets entering or leaving the mesh node.

FIG. 68 depicts application use cases that highlight the shared publish subscribe exchange through which small data reaches big data subscribers and their analysis/inference engines. A low cost lawn sprinkler actuator is controlled through a local control loop 6910, a remote control loop 6930, conversing through a shared publish-subscribe exchange, 6920. Upstream to the actuator valve a water pressure sensor is depicted, 6922 as is a down stream water flow sensor 6924. Both sensors reside within the local (and secure) M2M home community and their (subscribed) chirps are part of scheduled pub/sub exchange 6920. The lower control loop vocabulary is limited to actuator commands 6915, (e.g. ON, OFF). The system has no way of knowing whether the lawn sprinkler is functional, without accessing information from the larger M2M community. When chirp data is time tagged, then causal analysis indicates that if the upstream water pressure is "good" and the down stream flow is "bad", then the actuator is worn out and needs replacement, see 6835. A local integrator agent, 6837 may also, through access to the shared pub/sub stream, 6920, be directed to perform this check each time the valve is activated, thus reserving internet traffic for exception handling. Thus an intelligent valve actuator emerges, without additional hardware/sensors at the actuator. Dual control loops thus provide intelligence without adding to the cost of the device.

FIG. 69 depicts how discovery of related sensory streams can drive more refined control models for M2M Enterprise. The initial application is Air Conditioning control for a large building, 6910. The integrator agents, through the shared chirp classification streams, discovers other local subscribers to the energy usage/cost data 6920 active in the same building. Further analysis of their activities

indicates that the front door elevators are active the same time that the heating/cooling in that zone is "unstable", 6930. It also can correlate night time activity, when lights are turned on 6940 in zones that need to be activated, when the lights are on. Hence multiple, related subscriptions now drive a refined control model for air conditioning, 6950. Note that human "experience" would arrive at the same conclusions over time but machines, through their subscriptions and pattern analysis are able to close the loop semi-autonomously or autonomously. Further, the causal analyses/inferences gleamed from one building may be transportable across related domains.

FIG. 70 depicts how discovery is engendered through the chirp classification system in one embodiment, see also Figure 64. In Figure 70, the 4 bit marker pointer 7010 has a bit address of 1010, indicating an 8 bit marker pointer 7030, at the end of the packet with its agent ID of 255. This means that the public section 7020 is 4 bytes long. The coarse classification is thus 4.8.255, sufficient for pub/sub bus schedules to deliver the chirps to hubs and clearing houses, see 7050. Those who have subscribed to Agent 4.8.255 may then be able to decipher the container further. For example, Agent 48.255 states that each of the 4 bytes is a further classification, see 7060. The full chirp classification is thus 4.8.255.22.243.16.23. Note that without access to the agent, though a subscription, this level of detail is not possible, since how the data is internally formatted within the 4 bytes is not known a priori. 4 bit marker pointer may be used for common and free formats while 8 bit markers, 7030 are used for subscription based services, in one embodiment of this invention. The same process applies to the (private) payload 7040 and 7080, where additional agent subscriptions are needed. Thus the level of shared information may be incrementally controlled within an M2M social community operating at the edge. Note that a larger 8 byte chirp (e.g. 8.8.X.) may also choose to use multiple agents with one agent pointing to another within the same packet. The incremental control of information shared is thus implemented in multiple manners.

FIG. 71 shows chirp packets enter the propagator from both local and remote publishers 7110 and 7120 respectively. The latter is containerized as a busload for efficient transport, 7120. Inside the propagator, port forwarding tables define the locations of interested subscribers. The bus containers may be reconstituted, in alignment with the current dynamics of the pub-sub exchange. Chirp packets that are no longer desired or duplicates. For example, heart beat packet duplicates are discarded at each mesh node. The reconstituted bus containers are then sent out to both local and remote subscribers 7140. Subscriber interests are provided by both local and remote agents of integrator functions, 7050. Since chirps are category based, the protocol handlers (on both sides of

the Chirp/IP boundary) are logically part of the same publish subscribe bus system, with buses operating at different schedules in both networks. In one embodiment, bus schedules are managed by a distributed scheduler, such as the embodiment of figs. 65 through 67. An Analogy would be nation wide bus services involving both greyhound (IP) and county (chirp) bus services collaborating on bus schedules to minimize overall delay, based on current traffic supply/demand.

FIG. 72, a version of Fig. 58, depicts the top level view of the entire M2M service delivery framework consisting of simple terse messaging devices 7210. A propagator and bridging Mesh Network 7220. This includes agents resident on the nodes 7225, see also 7050 of Fig. 71. Agents act on behalf of big data subscriber interests 7230. The propagator and integrator functions are thus closely coupled, down to the network port forwarding tables. This engenders efficient, latency sensitive, "small data" flows.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

The description above and below and the drawings of the present document focus on one or more currently embodiments of the present invention and also describe some exemplary optional features and/or alternative embodiments. The description and drawings are for the purpose of illustration and not limitation. Those of ordinary skill in the art would recognize variations, modifications, and alternatives. Such variations, modifications, and alternatives are also within the scope of the present invention. Section titles are terse and are for convenience only.

The following concepts are applied in the embodiments described below:

1. Logical Radio Routers
2. Efficient Terse Messaging Transport
3. Modular Nodes based on U/D/S/A
4. Isolated Network support
5. Remote Management
6. Application Aware Mesh Control
7. Chirp Device Registration and Discovery
8. Latency Sensitive Terse Messaging

This section applies those methods to transport "chirp" broadcasts akin to VoIP packets from "chirp"

device networks to co-existent and incumbent IP based network devices and protocols.

Raison d'être for Chirp Protocols

Traditional networking protocols/techniques, specifically IP-based protocols, originated from s*ender-oriented* communications. They emulated legacy frameworks of human-human networks to support human-to-human correspondence. Thus the methods of routing postal mail resulted in email. Emails are sender oriented. Sender oriented communications are intended to be read by stated intended recipients only. It is not lightweight: it contains destination addresses and potential encryption so they are not tampered by hackers. They were historically point to point communications.

With all this overhead in place, on every packet basis, IP based routing protocols favor economies of scale in moving large packets, preferably with best effort only. When QoS is required (latency/jitter/assured delivery) IP protocols extract a premium. Small packets are also charged a premium because the "standard" minimum packet size was not designed with them in mind. Traveling inside the minimum size, they have to pay the same price in transmission time and bandwidth requirements as the "standard" minimum.

This adversely affects the delivery schedule of lightweight packets (e.g. VOIP, Figs 10, 11) that travel no faster than large packets, through no fault of theirs, other being smaller than the standard packet size. Hence container based transport for VOIP, Figs. 10-12 are discussed in referenced applications. Filling the packet container reduces the "price" per VOIP packet and also ensures reliable (assured latency/jitter) delivery. Without containerization, client capacity rapidly deteriorates, Figs 10-11. The IP highway is not suited for short chirp like devices, whether they are VOIP packets or other types of small-payload transmissions.

In addition to favoring larger packet sizes, retries (as in birds chirping repetitively) are frowned upon. Resending large packets increases traffic and TCP/IP overhead costs are based on a low number of retries. Further, retries are discouraged because they may flood the network e.g. broadcast storms. Retries are the exception, not the de facto modus operandi. Hence various forms of "virus" checks on email, file transports etc. are used. Since small packets are treated as one large packet, any device that begins to "chirp" like birds who chirp blindly and repetitively are costly especially when

these chirp-like packets are travelling solo, Figs 10-11 and hence the value of concatenation and scheduled transmissions of larger packets see 020 in Fig 12.

In contrast with legacy networks, communications that uses retries and over provisioning/broadcast storms are common in nature. For instance, pollen distribution by plants is not sender oriented. Instead, as many messages are sent as possible, in all directions. Note that these storms (e.g. pollen, monsoons) are seasonal, their time to live functions are encoded in their design. Parameters for these information containers do not have to be explicitly stated in each packet header. Pollen has its time-to-live function genetically encoded in it. Beyond that time it is ineffective. No network flooding can occur, despite over provisioning. Broadcasts are managed at a distributed systems level through the mesh control layer, Fig 20, not on a per packet basis. Now, flooding can be contained, as in nature.

Further, nature's "packets" are receiver oriented. Pollen is promiscuously propagated, witness the temporary broadcast storms called allergy season. It is the receiver that has the (genetically encoded) secret handshake to unlock the pollen packet data. Sender data need not be encrypted.

In nature, receiver oriented security enables pollen to be lightweight (terse) and carried far by even low power winds. Further, pollen is reasonably patient or latency indifferent. As long as winds appear within pollen season, spring will occur. Light weight chirps/pollen are thus secure and lower Total Cost of Ownership (TCO) based on their lightness and "patience."

In the world of Internet of Things (IoT), there is a need to be able to support lightweight chirp-like data without unduly taxing either the incumbent IP based networking protocols or the "chirp" device. This network protocol would support economical and effective transport of small, terse, repetitive chirps. In many cases the chirps are latency indifferent. Further, they would allow varieties of subscriber driven (receiver oriented) temporary broadcast storms without adverse effects.

DNA based Genus Classification

Routers/Propagators, need some pollen “genus” or category or description to enable the match making. What does this descriptor look like? Bird chirps serve as an analogy. Bird chirps are categorized, based on studying individual bird categories. We can identify the bird type from its

chirp/tune/melody. Hence those subscribers interested in melodies from doves, can now receive those recordings, based on bird category. The categories will have to support different levels of granularity - some bird enthusiasts are only interested in doves near their homes. Hence the category field, should be sufficiently flexible in design, to support further drill down.

In both melody/tunes and DNA structures, there exist "marker" strands of information that provide a common pattern across members of the category. These markers occur at specific locations and are of specific patterns. Thus, some categories may be described as those that have a 8 bit marker, always in the 4th byte of the bit stream. Thus the classification could be 4.8.XX.XX, where XX are more levels of granularity that may be gleaned from knowing a specific pattern type and what it entails, in terms of how to further classify the public (no security but not necessarily universally decipherable) category field.

Subscription based granularity Finer granularity is simply a matter of loading the appropriate agents who can recognize and sort based on information unlocked by the marker templates. Markers may be used in both public and private sections, Fig. 64. Agents unlock those patterns, based on access to Marker data formats to generate a finer granularity category/payload. In Fig. 70, the public category 4.8.255 7050 is sufficient to get the pollen to the **4.8.XX** "bus stop". Agent 7060 then provides the data format to identify pollen as **4.8.255.22.243.16.23** 7070. The publish subscribe exchange can thus support M2M flows shown in Figs. 68, 69 at varying levels of granularity. The payload is still secure, with its own agent 7080.

Low Overhead Routing is now possible: a quick bit mask on incoming chirp packets, Fig. 71 filters all publishers for **4.8.255**…. Further filtering may require addition agent subscriptions e.g.

4.8.255.22
4.8.255.22.243 …

In one embodiment, Public classifications provide at least 3 levels of addressing (e.g. 4.8.255) and potentially the complete DNA strand/signature, based on agent subscriptions.
The number of sub genus categories (e.g. 3 for 4.8.255) needed to more tightly define the zone of publisher interest is diverse. It is based on subscriber interests and mesh topologies see Figs. 13, 39, 59, 60, 63, 68, 69. The nature of sorting, aggregation, filtering chirp data favors hubs along the

router mesh tree. As described in referenced applications, natural "hubs" emerge, where it is more toll and hop cost effective to place agent for rerouting and reloading buses, Fig. 71, and agents will move to propagator nodes based on demand/supply and toll/hop costs, see Appendix A, 10/434,948.

Finer granularity costs requests follow the same toll hop costs and driven by the same economics: some applications/agents will work with "cheaper" but still relevant data some "hops" away. Other traffic may be more latency/jitter sensitive see Figs. 56, 68, and onwards. In one embodiment, packets are cloned at each junction of the mesh tree, to support multiple subscribers and routes. Pollen subscriber thus are dynamically driving the "wind" of bus loads, their contents and their frequency, at concurrent multiple levels of granularity, Fig. 71, 72.

Inherent Security of Chirp Protocols

Encapsulating Chirp Packets Chirp data transport involves traversing the IP network, in some embodiments, and are thus susceptible to snooping/hacking. But this is not your typical IP data packet since the data is based or Chirp/Pollen-ID and/or Flower/Agents-ID etc. These are not typical IP or MAC-ID type Sender/Receiver Address Frames, Figs. 34 through 36. The same format is also available for chirp devices:

a) The IP Destination Address (if applicable), and can include other addressing information depending on the type of transmission involved - e.g. unicast, multi-cast or broadcast, 3520,
b) Chirp-ID (in the Sender Address frame, SA, 3522),
c) Agent-ID being sought (in the BSSID Element, 3524)
d) Any other use of the IP frame formats, recognizable by an agent.

All options (and their variants) exist within the exemplary Action Frame format, suitable for transmission over standard WIFI networks.

In one embodiment, Fig. 36 shows a measurement request action frame, 3630. These management or action frames look like the innocuous request from stations requesting information from a specific AP (with BSSID). Only chirp aware routers are aware that these are actually chirp packets and that the data in the DA, SA and BSSID is to be interpreted differently based on their internally known data format (Marker template, Figs. 64, 70).

Chirp routers know just enough to decode the DA, SA and BSSID data sections, Figs. 35-36, to provide necessary routing. They cannot decipher the vendor specific information elements - only specific agents/tunes/flowers hold those private "keys." Routers simply engineer "winds" and "buses" to move pollen.

How does the Chirp aware router recognize a chirp packet masquerading as an IP packet? Multiple embodiments exist:

SIP-like Registries In one embodiment, the router knows which interface transports Chirp packets. It has a complete list of 802.11 stations associated with this AP. As part of the tree topology, it also has a list of all stations downstream - via the downlinks, Figs. 4 through 8. It may not have access to the routing tables up stream. However, it may use distributed SIP registries that contain both chirp device and agent ID locations. Some embodiment use dynamic SIP registries to continue to provide VOIP phone connectivity even within isolated clusters. The same principles may be used to define where agents/flowers are, or the reverse look up - where chirp devices are, of interest to a particular agent.

Local Port Identification Even without the aid of SIP-like registries, chirp routers are still cognizant of the special nature of the data packets being transmitted. Chirp routers are keeping track of which port interface was used to inject the IP packet into the mesh network. In the mesh nodes shown in Figs 17, 23, there are multiple interfaces generally provided - the uplink and down links of Backhauls (BH and FD) and the client Access Points (AP). If the chirp packet came in through on of the APs, then it is marked as a chirp, since the Chirp ID provided does not match an associated IP based client's IP address or MAC-ID in its routing table.

Exclusion Principle in one embodiment, the AP does not need to keep a list of chirp devices it services - it can surmise its identity based on the *exclusion principle*, namely, this device ID, if an IP based device, is not in its routing tables or those of it node neighbors. Chirp device port locations and identity do not have to be stored, if anonymity is desired. In one embodiment, the chirp will still be forwarded up and/or down through the up links and down links the mesh tree, marked as a chirp in search of the agent/tune/subscriber. The identity of both chirp and its interested agent/tune/flower is hidden and yet the pollen reaches the flower efficiently. Ability to provide this type of anonymity

extends existing prior art IP based routing security.

Incognito Pollen: Some pollen travel incognito. That is, they expect propagators to rebroadcast them, potentially in all directions, until an intended agent discovers them. In one embodiment, a "4.0" category pollen implies a marker at byte 4 but its length is not specified. Agents with bit mask filtering locate such semi-incognito pollen, they know what the marker is. Note the marker can be arbitrarily long or short. Short markers increase the occurrence of false positives with other marker types (e.g. 4 bit markers 1.0.1.1 sharing same 4 bits as 8 bit marker 1.0.1.1.0.0.1.1). Agents that have this level of information can also glean other data from the packet melody/strands, to filter them out.

Port based Zone Control In another embodiment, a "0.0" category pollen does not specify either the location or size of the marker. This is completely incognito and the propagator must continue to rebroadcast the pollen both up and down the tree till it reaches either roots or leaves of the tree. Chirp devices have no access to the IP network except through the bridging propagators Fig. 22. As in nature's broadcast storms, an agent at the chirp interfaces is either present or the pollen dies. Not that the tree networks in Fig 22 are all layer 2. Only routers and their routing applications (Fig. 12) can initiate a bridge from Chirp to IP. Hence IP spamming/flooding from a corrupted or malfunctioning chirp device is stopped at the router.

Audit Trails Enterprise Class messaging mandates full audit trails on the myriad forms of communication being supported with the network. Each mesh node keeps a time window log of all messages received from all ports 090, Fig. 12. Further, for security reasons, it needs to keep a log of all out going packets created by applications operating at both Kernel and Application levels of the Stack. In on embodiment, the mesh node routing tables treat applications as a special class of client devices, resident in their multi-tenant application deployment environment. The location of affected devices is known within the network tree. Heart beat based messages are sent to all "clean" nodes to avoid contact with "affected" nodes and a new "temporal Key" is issued. Akin to ant colonies, the nodes response to "danger" evolves over time as publish-subscribe demographics change within the hybrid social network of humans and their machines and their evolving machine Esperanto, Fig. 69, 70.

Lineage Based Secret Maps. In some situations, a 0.0 pollen may wish to specify a direction and nothing else - e.g. up or down the tree. Thus, in one embodiment 0.0.1 pollen are upwards, while

0.0.2 pollen are downwards. Since each category has its own vocabulary and language, 0.0 chirp families may choose to use the next two bits to define direction (0.0.0.1, 0.0.1.0, 0.1.1.0 ..), as opposed to marker size. If the device is removed from the network and its expected topology, the navigation fails. The device is therefore "imprinted", like migrating birds, with a navigation "Mother" pattern. This is relevant to imprinting devices in the field to become part of a network, for life. The directions encompass both the chirp network topology and it parent IP based network tree, in an hybrid mesh network comprising of both, Figs 22, 39 et al. Alternate navigation routing maps are also provided in one embodiment, for dynamic failover in healthy networks, Fig. 55.

Chording Channels An agent can convert the data flow to be IP based, with regular IP addresses. In one embodiment, private networks coexist and span both chirp and conventional transmissions using "pattern" hopping techniques known only to them and their agents on the network. Part of the data travels as IP Data frames while others via chirp protocols, analogous to musical chords or dual signatures needed on a check. Only agents know the (chorded) "tune" This further obfuscates the chirp data flow.

In some embodiments, chirp data comprises IP based transport packets whose format is regular and legitimate IP-based packet. It supports all the Frame Control feature sets, Fig 34, 3420, including multiple frames, power management and Distribution System (DS) flags. Thus, competent agents, running on chirp aware routers, may also convert IP data (including VOIP packets) into chirp packets, send them anonymously to another agent and then reconvert them back to IP traffic. This obfuscates IP based data flow. Thus both Chirp and IP payloads may be used interchangeably to obfuscate data flow within both chirp and legacy networks.

Conventional IP based devices may also use category patterns as part of their data classification schemes. IP based packet headers specify the sensor MAC_ID or serial number within the payload, in addition to the category classification for IP based applications using the pub-sub exchange. By the same token chirp devices, may, in their private payload or public category type, contain an IP address where they wish their pollen to be sent. At each junction of the mesh network, there is the potential to bridge between IP and non IP logical radio mesh networks, Fig. 22. At each junction there is the ability to reroute the packets or prune and reload them, Fig. 71, in alignment with current pub-sub demographics.

Chirp Bus Shuttle Scheduling

Several embodiments refer to scheduling of VOIP, to enable chirp like broadcasts from chirp like device networks to be efficiently repackaged to travel on existent and incumbent prior art IP based Network devices and protocols.

Chirps do not have destination addresses. Like school children boarding a school bus, they must be directed to get on the "yellow" bus/wind. In one embodiment, at each bus stop along the way, they need to be told which next bus to board, Fig. 71. The edge router Figs. 12, 23, 71 manages bus arrival and departure times and also getting the chirp/pollen bulk containerized and ready for each bus trip. Where containers go is driven by the "clients": it is directing pollen to interested parties only. The chirp routers manage pollen/chirps getting on the correct "yellow" buses and bus departure schedules, as depicted in Fig. 71.

Random Intervals, In one embodiment, simple devices chirp intervals are random, thereby providing a “white noise” effect that smarter devices can adjust for, using automatic gain control and other methods.

Regular Intervals In one embodiment, buses leave at regular intervals to help schedule when a container of chirps arrives and leaves at each bus station. They are a part of the mesh network support infrastructure for chirp travel. Their frequency of arrival is driven by the polling frequency (e.g. 20 ms for VOIP phones). It will vary depending on the chirp device nature and urgency per methods taught previously, Figs. 12, 24, 27, 28. Scanning and polling frequency is adaptive, per methods taught for mobile nodes.

Dynamic Intervals. Additionally, subscribers, in one embodiment, awaiting specific pollen delivery, may also request sooner or later delivery, thereby dynamically changing Quality of Service (QoS). Collaborative scheduling agents, in some embodiments, ensure global supply chain alignment of supply/demand using simple concepts like "avoid" and "cluster" to ensure appropriate use of bandwidth resources and prevent "stacking" Figs. 65 and also teaches hierarchical scheduling collaborative agents in control systems, Figs, 26, 39, 68, 69.

This is a departure from Prior Art, where sender oriented IP packets declare their Quality of Service

(QoS) requirements a priori, and QoS requirements are blindly enforced along the network path at significant added cost. QoS is *dynamically managed in a receiver oriented network*.

Bus Logistics Hubs In one embodiment, using the bus stations as decision points breaks up routing decision to *hops between logistics hubs*. The current active subscriber demographics and demand may be reevaluated at these hub points. Re-routing may be needed. For example, in one embodiment, routing policies may be specified. One "policy" is in place that all GE refrigerators provide a daily health status short "chirp" "color" (e.g. red, orange, blue, purple) forwarded to GE appliance service centers/subscribers. There are four such appliance region centers e.g. North, South, East and West. Based on the chirp signature and device location, directives running in edge routers "know" which bus load this pollen/chirp has to be part of. There may be multiple subscribers so it also needs to track and route multiple concurrent buses to multiple subscriber locations. Further, at each bus stop, at each mesh node, the routers must "know" enough to "sort" pollen, at varied levels of granularity for most effective onward directions, Fig. 71. If packets need to be cloned to support multiple subscribers, they are, at forks along the path, in this embodiment. VOIP-like chirp packet cloning is managed by the router on a need basis, where forks occur - e.g. the container was traveling north, now is split into eastward and westward "half" containers and combined with other fellow "half" eastward and westward bound containers to form a more efficient whole container.

Departures from Prior Art The hierarchical tree architecture is similar to a post office hierarchy (county, city, country are the hub levels), but unlike the post office, the direction or "default" address does not convert the communication into explicit addresses and sender-oriented transmissions. This type of routing circumvents the *static address schemes* used in traditional mail and email routing. In these embodiments, the destination of the bus is dynamic and so is its routing path. This is analogous to not just changing bus routing (e.g. an accident) but also end destination (e.g. hospital) based on the current situation and nature of containerized load. If the load is no longer needed, it is discarded mid journey. Round tripping, caused by static destination addresses, is avoided. Further packets are cloned and pruned at each junction of the route, in alignment with pub-sub demands.

Collaborative Coexistence

Chirp data transport to the cloud involves traversing the IP network. Collaborative Coexistence is

key since some chirp packets have subscribers reachable only through the incumbent IP network, e.g. VOIP chirp-like packets for an overseas subscriber. These networks and protocols must also conform to the existing frameworks and mediation layers e.g. Figs 12, 20. Chirp/pollen devices are simple- they do not know where the flower is. Hence IP destination addresses cannot be provided. Chirp aware routing supports these new receiver oriented packets.

Further, if chirp devices intend to operate in the same frequency spectrum as IP devices, then both dance partners need to share the dance floor without constantly stubbing each others toes (e.g. collision causing interference some causing retries possibly network flooding). Coexistence requires chirp devices not habitually create collisions or accidents on the IP based highways, like bad drivers. Methods taught with legacy chirp like devices (VOIP) see Figs. 10-12, 24-25 ensure both types of transmitters dance well together in the same RF space.

Scheduling Device Chirps In one embodiment the chirp transmission schedules feeds the inter-node chirp bus schedules. Collaborative Scheduling, Figs 65 though 67 is used by mesh nodes to thus drill down to generate the local bus schedules for the node-node transport system. This in turn, drives when chirps need to arrive. The schedule also directs when buses leave. Routers are monitoring the bus queues. Routers may also thus request smart chirp devices to chirp more (if missing buses) or less frequently (if often waiting in line). Chirps then occur with the timing constraints of the bus scheduling system so that chirp packets arrive in time to climb aboard the bus in time to meet the inter-bus schedules of the logistics hubs. Hence, smart chirp devices, have an advantage over their simpler chirp only devices.

Ideally, Chirp transmissions should occur sufficiently frequently for the level of granularity requested by the subscribers ("Customers") schedules.

Small blue/red shift directives are provided by the Access Point for chirp devices. The Access Point receiving the chirps, monitors them to determine the range of the transmission "task" start/end times and their blue/red regions. It can thus profile the task and its variants. The bus schedule for the subscribers are then examined to determine the optimal bus size and interval. This, in turn drives how often the chirps must be transmitted and at what time. Synchronization may be approximate, measured in terms of a non dimensional parameter e.g. the fraction of the current chirp interval. This ensures complicity since both parties understand what that means regardless of whether they

represent the time in nanoseconds or primitive register counters, Thus listen capable chirp devices may be controlled to adapt to the subscriber interests.

Closing Local Control Loops

Compare pollen based routing to conventional IP addressing. IP addressing is destination based. After the IP packet reaches its destination, the payload is deciphered. The typical thin client machine control loop, Fig. 56 is best efforts and assumes (remote) connectivity. It is difficult to provide local autonomous machine control for applications in Figs. 39, 56, 57, 68 , 69.

The Chirp Category classifications scheme enables usable small data to be both generated and consumer by and for the edge member devices. Data is processed closer to the source/cluster, where it has more impact in tight sensing-control-actuation loops Fig 56.

Topology Matters Fig 46, depicts why network latency and topology are inter-related and hence relevant to latency sensitive VOIP/Chirp bus delivery schedules. In one embodiment, a round robin approach where, the AP services each client in turn. In that example, 10 ms is the (equal) service duration for individual client services. Packets are buffered till a round robin cycle is complete. At the end of each cycle the container is sent, per up the tree, in one embodiment. The local latency upper bound would therefore be 30 ms for section 70. By the same token, the root node is servicing 5 clients and hence the upper bound to reach the root node is 50 ms for sections 70, 80. Further, the example pointed out that, had all the nodes been connected directly to the root node, the latency would be 90 ms. 1 hop networks - all clients connected to a root node - are not necessarily "better". A five-hop string-of-pearls, O(n) routing scheme, Fig 45, may provide better service, than the 1-hop 5-client star, Fig 46, Section 80.

In one embodiment, bus delivery schedules are driven by the round robin delay caused by servicing siblings, at each sub tree along a route. More siblings imply more latency and favor node/device migrations. Others may barter to get a bigger slice of the pie. Accordingly, network topology and routing is modified based on toll/hop costs.

In Fig 46, nodes operated independently and asynchronously but based on a common multiple of some service time interval e.g. 10 ms. Minimum Bus Intervals vary, based in the number of siblings.

During the process, the bus interval is set. Buses leave at preset intervals, regardless of whether the bus is full or not. In more efficient implementations, the departure time is flexible, and buses may wait till more passengers arrive, within a prescribed waiting limit. Thus the stream and CSMA allocations are based on "stacking", in dynamic alignment with "Customer Satisfaction" Figs. 65, 66, 67.

Periodic Silent Intervals In Fig 47, the bulk bus transport stream 4720 is first, during which all clients can listen but not talk, see Figss. 12, 24. The remainder time 4750 is used to transfer data back from IP based clients to nodes etc. Further, Fig. 25 shows separate "channels" for concurrent transmissions. Contention is reduced during the Stream section, 4720 and possibly more. SCAN agent, Fig 12, measures overall activity of disparate packet types (a form of "channel list"). Note that in Wi-Fi standard infrastructure mode, all communications are with the AP, hence tree based routing is inherent.

Stream Reader Circuits: Fig. 50 depicts the stream reader, in one embodiment. Special purpose Stream Readers are privy to data traffic queued for transmission at a node. Like post office sorters, they identify and sort the "mail" and therefore, help to collectively define bus schedules, reduce dead letter re-transmissions etc. Stream readers, resident at the node, feel the "pulse" and therefore provide early warning signals to the Mesh Control Layer. More "mail" from one node may increase toll cost for other child nodes to switch parents, using load balancing and adaptive power control methods, Fig 1.

Stream readers can feed multiple stream viewers, 5040, sequential readers/agents, 5060 or a logging database 5080 community mailbox etc. A circuit of collaborating stream readers and subscribers emulate complex logistic supply chains, see Fig. 51, 5120. Disparate traffic data is sent to knowledge repositories 5180. Secure Control lines from it, 5170, drive sub-circuit behaviors and their outputs, 5125, 5135, 5155. Repositories may also provide the secret handshakes needed by readers to correctly decode public network traffic 5150. Thus bulk network traffic, 5150 may employ little or no encryption and thus be lightweight, like pollen. Further, the Network Viewer 5190 may be connected to the real time stream plug in circuit 5145 or run it in playback mode, 5165 from knowledge repositories 5180. The same circuit based framework 5120 may also provide interleaved real time and historical trending, simulations and machine learning, Fig. 52, 5290. Note that 5155 is not connected - it is in "connectionless" broadcast/multicast mode. Thus both direct and indirect

subscription styles are supported within the same stream reader framework.

One embodiment of an open extensible Stream Reader Framework, Fig. 52, is implemented in Java. A subset, JavaScript API 5230, provides dynamic and customizable HTML based views. Custom Stream viewers define the GUI for different devices and form factors. More complex business logic applications use the Enterprise class Java API and Repository 5240. Third party adapters and applications, 5250, extend the network to consumers/providers of information and their viewers. Fig 53 and 54 depicts the published interfaces for the Network Manager Streams API and the Heart Beat Entity relationships, respectively. Together, they enable speedy development, for Hybrid Human-Machine networks Fig. 55.

Device Management and Control

Discovery and Registration: Several embodiments expand on the DHCP approach with the isolated distributed SIP registry functionality as described in that invention. Terse and periodic VOIP chirps are routed by the local SIP server. Further, when the VOIP network joins an external network, SIP registry information is exchanged. The Chirp registries may thus also exchange chirp device classifications and protocol specifics. Other (restricted) registries may contain location of agents dispersed at local nodes based on bus scheduling requirements. This enables discovery using the same approaches for devices, agents and logistics hubs. A comprehensive framework for discovery and routing for both Chirp and IP devices are thus supported by the DHCP and SIP registry modules, specifically designed for mobile, temporal wireless mesh networks.

When a new device is registered on the network, its agent/app is "loaded"- . This agent/app then provides the subscriber-based chirp-to-chirp translations and chirp-to-IP translations and filtered "small" data. Based on the direction of the chirp, agents may also direct propagators to provide intermediate translations see Figs. 22,23 through applets operating at the routing and "port" forwarding tables at each mesh node port/interface of the dynamic switch stack tree.

Learning through Correlations Figs. 68 through 69 depict application use cases that highlight the shared publish subscribe exchange through which small data reaches big data subscribers and their analysis/inference engines. In Fig 68, a low cost lawn sprinkler actuator is controlled through a local control loop, 6910 and a remote control loop 6930, conversing through a shared publish-subscribe

exchange, 6920, see also Fig. 56. Upstream to the actuator valve a water pressure sensor is depicted, 6922 as is a down stream water flow sensor 6924. Both sensors reside within the local (and secure) M2M home community and their (subscribed) chirps are part of scheduled pub/sub exchange 6920.

The lower control loop vocabulary is limited to actuator commands 6915, (e.g. "ON", "OFF"). The system has no way of knowing whether the lawn sprinkler is functional, without accessing information from the larger M2M community. When chirp data is time tagged, then causal analysis indicates that if the upstream water pressure is "good" and the down stream flow is "bad", then the actuator is worn out and needs replacement, see 6835. A local integrator agent, 6837 may also, through access to the shared pub/sub stream, 6920, be directed to perform this check each time the valve is activated, thus reserving internet traffic for exception handling. Thus an intelligent valve actuator emerges, without additional hardware/sensors at the actuator. Dual control loops thus provide intelligence without adding to the cost of the device.

Figure 69 depicts how discovery of related sensory streams can drive more refined control models for M2M Enterprise. The initial application is Air Conditioning control for a large building, 6910. The integrator agents, through the shared chirp classification streams, discovers other local subscribers to the energy usage/cost data 6920 active in the same building. Further analysis of their activities indicates that the front door elevators are active the same time that the heating/cooling in that zone is "unstable", 6930. It also can correlate night time activity, when lights are turned on 6940 in zones that need to be activated, when the lights are on. Hence multiple, related subscriptions now drive a refined control model for air conditioning, 6950. Note that human "experience" would arrive at the same conclusions over time but machines, through their subscriptions and pattern analysis are able to close the loop semi-autonomously or autonomously. Further, the causal analyses/inferences gleamed from one building may be transportable across related domains. Therein lies the power of a shared pub/sub exchange - the ability to glean useful data from hitherto unknown sources. See also

Classification Aided Discovery How does the local integrator or its big data supervisors "discover" water pressure correlations in Fig 68 or the local energy consumers in Fig 69 ?. This discovery is engendered through the chirp classification system, two embodiments shown in Figures 64 and 70. In Figure 70, the 4 bit marker pointer 7010 has a bit address of 1010, indicating an 8 bit marker pointer 7030, at the end of the packet with its agent ID of 255. This means that the public section 7020 is 4 bytes long. The coarse classification is thus 4.8.255, sufficient for pub/sub bus schedules to

deliver the chirps to hubs and clearing houses, see 7050. Those who have subscribed to Agent 4.8.255 may then be able to decipher the container further. For example, Agent 48.255 states that each of the 4 bytes is a further classification, see 7060. The full chirp classification is thus 4.8.255.22.243.16.23.

Network Management The resulting implementation within a network of wireless nodes is scalable with no loss of bandwidth over many hops. The resulting network logic is distributed with low level autonomy on routing, power and channel management. The network uses distributed intelligence in terms of applications and where they reside: the result is a network where both the network management and the applications within the network can be distributed. The embodiments serve as a new type of service delivery framework specifically to address more "smarts" at the edge where the simple devices are sending terse messages or chirps. The network is flexible in that it can be implemented with multi-purpose devices, with alternative embodiments relying on a router and other embodiments using a client device. The embodiments rely on mesh nodes or routers, with the benefit of the router versus Machine controller are that by relying on the router there is low latency communication and ability to prevent escalation. The embodiments also rely on the router as the application delivery platform. The result is that the SDN control plane extends to the edge of the network where the chirping devices broadcast. In one embodiment the heartbeat extension to include sensor feeds and the result is integration with the NMS.

In summary, a new type of device management system emerges where efficient M2M command and control is enabled at the edge and edge communities. Chirp category based packet identification provides the M2M version on nature's receiver based communication protocols. Timing pollen "winds" is explored in Figs 25, 26, 65, 71. Heart Beats and Streams are discussed in Figs 46 through 55. The streams support applications in closing real time M2M control loops, Figs. 56 through 63, 68 through 71. Figs 72 and 58, depict the top level view of devices, propagators and integrators, each essential to a sustainable Internet of Things.

Electronic Acknowledgement Receipt

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1		Response.pdf	76255 573edb239612129459aaf2c394034037fb4371d4	yes	4

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	Applicant Response to Pre-Exam Formalities Notice	1	1
	Specification	2	2
	Drawings-only black and white line drawings	3	3
	Applicant Arguments/Remarks Made in an Amendment	4	4

Warnings:					
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2	Drawings-only black and white line drawings	replacementFigures.pdf	1252459 53a17285cdbf789a3eef8ec884c905e83ab5175a	no	5
Warnings:					
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3	Drawings-only black and white line drawings	figures.pdf	19303861 f7569f0f4db0dae40951ebdb6da5b9fbf51d9435	no	72
Warnings:					
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Application Number: 14740062 Document Date: 07/02/2015

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CONFIRMATION NO. 1794

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27197
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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**

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Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

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Title

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APPLICATION AS FILED - PART I

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BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	10 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x 210 =	0.00			
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).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL	

APPLICATION AS AMENDED - PART II

		(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($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	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))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	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))							OR		
						TOTAL ADD'L FEE		OR	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 found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/740,062	06/15/2015	Francis DACOSTA	0357-02904

CONFIRMATION NO. 1794

27197
MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602

PUBLICATION NOTICE

OC000000078212896

Title:CHIRP NETWORKS

Publication No.US-2015-0304879-A1
Publication Date:10/22/2015

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.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/740,062	06/15/2015	Francis DACOSTA	0357-02904	1794

27197 7590 01/27/2017

MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602

EXAMINER
BAYARD, DJENANE M

ART UNIT	PAPER NUMBER
2444	

NOTIFICATION DATE	DELIVERY MODE
01/27/2017	ELECTRONIC

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 the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mail@cherskov.com
sgurda@cherskov.com

Office Action Summary	Application No. 14/740,062	Applicant(s) DACOSTA, FRANCIS	
	Examiner DJENANE BAYARD	Art Unit 2444	AIA (First Inventor to File) Status Yes

-- 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* MONTHS 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 *6/15/15*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ 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*

5)☒ Claim(s) *1-10* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-10* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *6/15/15* 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).

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).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

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) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

DETAILED ACTION

1. This is in response to communication filed on 6/15/15 in which claims 1-10 are pending.

Claim Rejections – 35 USC § 102

2. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

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 –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale or otherwise available to the public before the effective filing date of the claimed invention.

3. Claims 1-3, 5-7 and 9 are rejected under 35 U.S.C. 102 (a)(1) as being anticipated by U.S. Publication No. 2012/0202514 to Kadirkamathan et al.

a. As per claim 1, Kadirkamanathan et al teaches a system of transmitting of data packets within a network comprising: at least one device transmitting at least one short communication message (see paragraph [0016]); at least one network router comprising a chirp receiver for the at least one short communication message (see paragraph [0043 and 0114]); wherein said chirp

receiver accepts said short communication message during an access function of said router without interrupting other communications (See paragraph [0043]); and wherein said router further comprises an uplink function connecting said least one router to an external ip-based network using intermediary routers (see paragraph [0080-0083]); a downlink function connecting said least one router to other routers within said network (See paragraph [0080-0083]); and a scanning function (See paragraph [0058]).

b. As per claim 2, Kadirkamanathan et al teaches the claimed invention as described above. Furthermore, Kardirkamanathan et al clearly teaches wherein within the network router a single radio performs the uplink function, downlink function, scanning function, and access function (See paragraph [0058, 0080-0083]).

c. As per claim 3, Kadirkamanathan et al teaches the claimed invention as described above. Furthermore, Kardirkamanathan et al clearly teaches wherein said router further comprises at least two dedicated radios within the router perform the uplink function, downlink function, scanning function, and access function (See paragraph [0042 and 0080-0083]).

d. As per claim 5, Kadirkamanathan et al teaches the claimed invention as described above. Furthermore, Kardirkamanathan et al clearly teaches wherein the dedicated radios employ at least two different physical mediums and wherein said router bridges said different physical mediums and wherein each medium supports distinct tree-based network topologies (See figures

2 and 4]).

e. As per claim 6, Kadirkamanathan et al teaches the claimed invention as described above. Furthermore, Kardirkamanathan et al clearly teaches wherein said short communication message comprises a terse status update without a specific receiver (See paragraph [0016]).

f. As per claim 7, Kadirkamanathan et al teaches the claimed invention as described above. Furthermore, Kardirkamanathan et al clearly teaches wherein said short communication message comprises a series of terse status updates received by the router wherein said router containerizes said series of terse messages (See paragraph [0041, 0053 and 0080]).

g. As per claim 9, Kadirkamanathan et al teaches the claimed invention as described above. Furthermore, Kardirkamanathan et al clearly teaches wherein said downlink function comprises a connection to other routers wherein said downlink routers do not communicate with one another directly, forming a logical tree network (See paragraph [0080-0083]).

Claim Rejections – 35 USC § 103

4. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

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

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claim 4 is rejected under 35 U.S.C. 103 as being unpatentable over U.S. Publication No. 2012/0202514 to Kadirkamathan et al in view of U.S. Patent No. 7428300 to Drew et al.

a. As per claim 4, Kadirkamanathan et al teaches the claimed invention as described above. However, Kardirkamanathan et al fails to teach wherein the updates to the routing information within the network follow O(n) complexity where n is a number of network participants.

Drew et al teaches wherein the updates to the routing information within the network follow O(n) complexity where n is a number of network participants (See col. 1, lines 12-24).

It would have been obvious to incorporate the teaching of Drew et al in the claimed invention of Kadirkamanathan et al in order to provide high availability networks.

6. Claim 8 is rejected under 35 U.S.C. 103 as being unpatentable over U.S. Publication No. 2012/0202514 to Kadirkamathan et al U.S. Publication No. 2015/0036649 to Chen et al.

a. As per claim 8, Kadirkamanathan et al teaches the claimed invention as described above. However, Kardirkamanathan et al fails to teach wherein said uplink function comprises a connection to a single parent forming a logical tree network.

Chen et al teaches wherein said uplink function comprises a connection to a single parent forming a logical tree network (See paragraph [0008]).

It would have been obvious to one with ordinary skill in the art to incorporate the teaching of Kadirkamanathan et al in order to facilitate the transfer of uplink data.

7. Claim 7 is rejected under 35 U.S.C. 103 as being unpatentable over U.S. Publication No. 2012/0202514 to Kadirkamathan et al in view of U.S. Publication No. 2010/0150170 to Lee et al.

a. As per claim 10, Kadirkamanathan et al teaches the claimed invention as described above. However, Kardirkamanathan et al fails to teach wherein each router sends a regular heart beat status update.

Lee et al teaches wherein each router sends a regular heart beat status update (See paragraph [0022]).

It would have been obvious to one with ordinary skill in the art to incorporate the teaching of Lee et al in the claimed invention of Kardirkamanathan et al in order to provide status monitoring data.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

U.S. Publication No. 2013/0343430 to Bettendorff et al teaches methods and systems for distributing broadcast messages on various networks.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DJENANE BAYARD whose telephone number is (571)272-3878. The examiner can normally be reached on Monday- Friday 5:30 AM- 3:00 PM..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Peter-Anthony Pappas can be reached on (571) 272-7646. 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.

/DJENANE BAYARD/
Primary Examiner, Art Unit 2444

Notice of References Cited	Application/Control No. 14/740,062	Applicant(s)/Patent Under Reexamination DACOSTA, FRANCIS	
	Examiner DJENANE BAYARD	Art Unit 2444	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2010/0150170 A1	06-2010	Lee; Herman H.	H04L41/0213	370/466
*	B	US-2012/0202514 A1	08-2012	KADIRKAMANATHAN; MAHARATHY	H04W64/006	455/456.1
*	C	US-2015/0036649 A1	02-2015	CHEN; CHUN-YU	H04W72/0453	370/330
*	D	US-2013/0343430 A1	12-2013	Bettendorff; John	H04B1/713	375/133
*	E	US-7,428,300 B1	09-2008	Drew; James Howard	H04M3/2254	379/14.01
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	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.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14740062	DACOSTA, FRANCIS
	Examiner	Art Unit
	DJENANE BAYARD	2444

CPC- SEARCHED		
Symbol	Date	Examiner
H04L27/103 OR H04L1/0003 OR H04L25/0202 OR H04L2027/0093	1/23/17	db

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
East (text and classification search)	1/23/17	db
Double Patenting search	1/23/17	db
NPL (google scholar)	1/23/17	db

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

	/D.B./ Primary Examiner.Art Unit 2444

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L14	2	(router with (terse near3 messag$5))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:18
L15	306	(number near4 participant) same (complexity)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:26
L16	61	(number near4 participant) same (complexity) same network	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:26
L17	16	(number near4 participant)with (complexity) with network	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:26
L18	1	(ters$3 with status with updat$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:33
L19	0	"20120202514" and (tree)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:44
L20	24	(router with chirp)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:46
L21	182	(uplink same (tree near2 network))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:48
L22	91	(uplink with (tree near2 network))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:48
L23	5	(uplink with (tree near2 network) with parent)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:51

L24	7	(uplink with (tree near2 network) same parent)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:51
L25	9760705	(uplink with (tree near2 network) single)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:52
L26	8	(uplink with (tree near2 network) with single)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:52
L27	4	(uplink with (tree near2 network) with router)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:53
L28	3	(router with (heart with beat with status))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:57
L29	578	(Chirp near3 receiv$3).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 10:06
L30	55	29 AND ((H04L27/103 OR H04L1/0003 OR H04L25/0202 OR H04L2027/0093).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 10:13
S1	1	"14740062"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/11/25 12:59
S2	160	Chirp near3 network	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/27 12:25
S3	12	S2 same (router)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/27 12:25
S4	11	S2 same (router) and radio	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/27 12:26
S5	1856	Chirp near3 receiv$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:51

S6	8	S5 same router	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:51
S8	1	(Chirp near3 receiv$3).ab. and (router same (uplink near3 function))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:52
S9	1	(Chirp near3 receiv$3).ab. and (router same (uplink))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:53
S10	3	(Chirp near3 receiv$3).ab. and router	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:53
S11	6	(Chirp near3 receiv$3) and (router with (uplink upstream downlink downstream))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:24
S12	6	(Chirp near3 receiv$3) and (router with (uplink upstream downlink downstream))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:24
S13	7	(Chirp near3 receiv$3) and (router with (scan$5))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:25
S14	119	(Chirp near3 (recept$5 receiv$3)) and (router)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:26
S15	1	((Chirp near3 (recept$5 receiv$3)) and (router)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:27
S16	42	(Chirp near3 (recept$5 receiv$3)) and (router) and (uplink$3 downlink$3 upstream$3 downstream$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:27
S17	25	(Chirp near3 (recept$5 receiv$3)) and (router) and (mesh near3 network)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:30

EAST Search History (Interference)

<This search history is empty>

1/ 23/ 2017 10:28:31 AM
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Alexandria, Virginia 22313-1450
www.uspto.gov

BIB DATA SHEET

CONFIRMATION NO. 1794

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
14/740,062	06/15/2015	709	2444	0357-02904

APPLICANTS
MeshDynamics, Santa Clara, CA;

INVENTORS
Francis DACOSTA, Santa Clara, CA;

**** CONTINUING DATA ***************************
This appln claims benefit of 62/012,196 06/13/2014
and is a CIP of 13/764,008 02/11/2013 PAT 9363651
which is a CIP of 13/627,883 09/26/2012 PAT 8923186
which claims benefit of 61/615,802 03/26/2012
and claims benefit of 61/555,400 11/03/2011
and claims benefit of 61/621,926 04/09/2012
This application 14/740,062 06/15/2015
is a CIP of 13/571,294 08/09/2012 PAT 9172738
which is a CIP of 12/696,947 01/29/2010 PAT 8520691
which claims benefit of 61/148,803 01/30/2009
and said 13/571,294 08/09/2012
is a CIP of 12/352,457 01/12/2009 PAT 8477762
This application 14/740,062 06/15/2015
is a CIP of 13/541,446 07/03/2012 ABN
and is a CIP of 14/523,778 10/24/2014
which is a CON of 12/625,365 11/24/2009 PAT 8514852
which claims benefit of 61/117,502 11/24/2008

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

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
06/24/2015

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /DJENANE M BAYARD/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		CA	72	10	1

ADDRESS

MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602
UNITED STATES

TITLE

CHIRP NETWORKS

		☐ All Fees
		☐ 1.16 Fees (Filing)

BIB (Rev. 05/07).

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14740062	DACOSTA, FRANCIS
	Examiner	Art Unit
	DJENANE BAYARD	2444

✓	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	01/23/2017								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								

PATENT
CONFIRMATION NO. 1794

UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Francis daCosta
Title:	CHIRP NETWORKS
Serial No.:	14/740,062
Filing Date:	January 27, 2017
Examiner:	Djenane M. Bayard
Art Unit:	2444
Atty. Docket:	0363-02904

Sent via EFS-Web on April 27, 2017.

Mail Stop: AMENDMENT
COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, VA 22313-1450

Suite 400
123 West Madison Street
Chicago, Illinois 60602
(312) 621-1330

AMENDMENT AND RESPONSE TO OFFICE ACTION

Dear Sir:

In response to the January 27, 2017 Official Action, applicant submits the following amendments and remarks:

Amendments to the claims begin on page two of this paper.

Remarks begin on page four of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) A system of transmitting of data packets within a network comprising:

at least one device transmitting at least one short communication message;

at least one network router comprising a chirp receiver for the at least one short communication message;

wherein said chirp receiver accepts said short communication message during an access function of said router without interrupting other communications; and

wherein said router further comprises an uplink function connecting said least one router to an external ip-based network using intermediary routers; a downlink function connecting said least one router to other routers within said network; and a scanning function wherein said uplink function, downlink function, scanning, and access functions are performed using one physical radio acting as multiple logical radios wherein the uplink function logical radio and the downlink function logical radio connect the routers participating in the system in a tree-based virtual switch.

2. (Currently Amended) The system of claim 1 ~~wherein within the~~ further comprising at least one non-chirp enabled network router having a single physical radio which performs the uplink function, downlink function, scanning function, and access function.

3. (Cancelled)

4. (Original) The system of claim 1 wherein the updates to the routing information within the network follow O(n) complexity where n is a number of network participants.

5. (Cancelled)

6. (Original) The system of claim 1 wherein said short communication message comprises a terse status update without a specific receiver.

7. (Original) The system of claim 1 wherein said short communication message comprises a series of terse status updates received by the router wherein said router containerizes said series of terse messages.

8. (Original) The system of claim 1 wherein said uplink function comprises a connection to a single parent forming a logical tree network.

9. (Original) The system of claim 1 wherein said downlink function comprises a connection to other routers wherein said downlink routers do not communicate with one another directly, forming a logical tree network.

10. (Original) The system of claim 1 wherein each router sends a regular heart beat status update.

REMARKS

In an office action dated January 27, 2017, the Examiner rejected claims 1-3, 5-7 and 9 as being anticipated by U.S. Publication No. 2012/0202514 to Kadirkamathan et al. Claim 4 is rejected under 35 U.S.C. 103 as being unpatentable over U.S. Publication No. 2012/0202514 to Kadirkamathan et al in view of U.S. Patent No. 7428300 to Drew et al. Claim 8 is rejected under 35 U.S.C. 103 as being unpatentable over U.S. Publication No. 2012/0202514 to Kadirkamathan et al U.S. Publication No. 2015/0036649 to Chen et al. Claim 7 is rejected under 35 U.S.C. 103 as being unpatentable over U.S. Publication No. 2012/0202514 to Kadirkamathan et al in view of U.S. Publication No. 2010/0150170 to Lee et al.

Applicant's Invention

Applicant's system facilities a highly efficient wireless network that operates akin to a virtual switch. It does so by establishing a logical tree-based layout relationship between the nodes participating in the network. The tree-shaped network results in highly efficient routing of large numbers of packets, even for routers that include but a single physical radio. The single physical radio operates as multiple logical radios. The single physical radio maintains the tree-structure even as it switches modes of operation.

Prior Art Requires Multiple Modules

The current claims specify that each router participating in the network includes a single physical radio which operates as multiple logical radios which form a tree structure. Examiner cited the Chen application for its disclosure of a tree-based network. However, as disclosed in Chen, the network participants have multiple physical radios or modules.

Chen discloses an embodiment having three physical radios (such as the three modules shown in Fig. 12), but not one using a single physical radio as current independent claim requires. Otherwise, Chen discusses various frequency sharing approaches between downlink modems and the parent uplink modem, such as time slot assignments.

While Chen describes the communication modules switching roles, such as the communication module 1225 acting as an uplink or downlink module, Chen describes a system where each physical radio performs one task and at least two radios are required.

The primary reference, Kadirkamanathan, describes a system for geo-location of network participants. The system uses delays in receipt of signals to determine the relative physical locations of devices communicating directly. However, this requires communication between 'siblings' on the same level within the network hierarchy. As presently claimed, the wireless network used in the system is tree shaped. This choice is critical to the performance of the network and ensures that packet routing decisions, routing table updates, and other network tasks can occur in n log n time, instead of exhaustive searches, as would occur if ad hoc sibling-level direct communications were allowed.

Kadirkamanathan generally only shows an amorphous network 200, without specifying details of the network participants. This approach in Kadirkamanathan may work as it is designed to function with standard network participants. The instant invention is designed to handle large amounts of unstructured traffic without dropping packets and without creating overhead inherent in an ad hoc network. For this reason the independent claim requires a tree structure.

An earnest attempt has been made hereby to respond to the January 27, 2017 Official Action. The application is deemed in condition for allowance and same is respectfully requested. If the Examiner feels that a telephonic interview will expedite allowance, he is respectfully urged to contact the undersigned at the phone number provided above. Claims 1, 2, 4 and 6-10 are pending.

Respectfully submitted,

CHERSKOV, FLAYNIK & GURDA, LLC

By: /Szymon M. Gurda/
Szymon M. Gurda (Reg. No. 58,451)

Electronic Acknowledgement Receipt

EFS ID:	29055339
Application Number:	14740062
International Application Number:	
Confirmation Number:	1794
Title of Invention:	CHIRP NETWORKS
First Named Inventor/Applicant Name:	Francis DACOSTA
Customer Number:	27197
Filer:	Szymon Maciej Gurda
Filer Authorized By:	
Attorney Docket Number:	0357-02904
Receipt Date:	27-APR-2017
Filing Date:	15-JUN-2015
Time Stamp:	19:16:09
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		Response.pdf	92161 990e1cee5218e4b470caebdc072eb11e1a3b9c84	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	3
	Applicant Arguments/Remarks Made in an Amendment	4	6
Warnings:			
Information:			
	Total Files Size (in bytes):	92161	

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/06 (09-11)
Approved for use through 1/31/2014. 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 14/740,062	Filing Date 06/15/2015	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ 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))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	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	

APPLICATION AS AMENDED – PART II

AMENDMENT **04/27/2017**

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 8	Minus	** 20	= 0	X $40 =	0
Independent (37 CFR 1.16(h))	* 1	Minus	***3	= 0	X $210 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) 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.

LIE
DANTE SMITH

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
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NOTICE OF ALLOWANCE AND FEE(S) DUE

27197 7590 07/05/2017

MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602

EXAMINER
BAYARD, DJENANE M

ART UNIT	PAPER NUMBER
2444	

DATE MAILED: 07/05/2017

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/740,062	06/15/2015	Francis DACOSTA	0357-02904	1794

TITLE OF INVENTION: CHIRP NETWORKS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	10/05/2017

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

27197 7590 07/05/2017
MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/740,062	06/15/2015	Francis DACOSTA	0357-02904	1794

TITLE OF INVENTION: CHIRP NETWORKS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	10/05/2017

EXAMINER	ART UNIT	CLASS-SUBCLASS
BAYARD, DJENANE M	2444	709-230000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

EX1018, Page 279

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
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/740,062	06/15/2015	Francis DACOSTA	0357-02904	1794

27197 7590 07/05/2017

MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602

EXAMINER	
BAYARD, DJENANE M	
ART UNIT	**PAPER NUMBER**
2444	

DATE MAILED: 07/05/2017

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. 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.

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.

Notice of Allowability	Application No. 14/740,062	Applicant(s) DACOSTA, FRANCIS	
	Examiner DJENANE BAYARD	Art Unit 2444	AIA (First Inventor to File) Status Yes

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

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *4/27/17*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1-2, 4, 6-10*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   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)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/DJENANE BAYARD/
Primary Examiner, Art Unit 2444

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

REASONS FOR ALLOWANCE

Claims 1-2, 4, 6-10 are allowed.

The following is an examiner's statement of reasons for allowance: As per claim 1, the prior art on record fails at least one device transmitting at least one short communication message; at least one network router comprising a chirp receiver for the at least one short communication message, wherein said chirp receiver accepts said short communication message during an access function of said router without interrupting other communications; and wherein said router further comprises an uplink function connecting said least one router to an external IP-based network using intermediary routers; a downlink function connecting said least one router to other routers within said network; and a scanning function wherein said uplink function, downlink function, scanning, and access functions are performed using one physical radio acting as multiple logical radios wherein the uplink function logical radio and the downlink function logical radio connect the routers participating in the system in a tree-based virtual switch in combination with all the element in the claim.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DJENANE BAYARD whose telephone number is (571)272-3878. The examiner can normally be reached on Monday- Friday 5:30 AM- 3:00 PM..

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Peter-Anthony Pappas can be reached on (571) 272-7646. 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.

/DJENANE BAYARD/
Primary Examiner, Art Unit 2444

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14740062	DACOSTA, FRANCIS
	Examiner	Art Unit
	DJENANE BAYARD	2444

CPC- SEARCHED		
Symbol	Date	Examiner
H04L27/103 OR H04L1/0003 OR H04L25/0202 OR H04L2027/0093	1/23/17	db
H04L45/04 OR H04L45/02 OR H04L45/48 OR H04L45/28 OR H04L41/12 OR H04L12/462 OR H04L47/10 OR H04L49/15 OR H04L47/781	6/23/17	db

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
East (text and classification search)	1/23/17	db
Double Patenting search	1/23/17	db
NPL (google scholar)	1/23/17	db
Updated East (text and classification search)	6/23/17	db
Double Patenting search	6/23/17	db
NPL google scholar	6/23/17	db

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
H04L	12/4625, 45/02; 67/145	6/23/17	db

	/D.B./ Primary Examiner.Art Unit 2444

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14740062	DACOSTA, FRANCIS
	Examiner	Art Unit
	DJENANE BAYARD	2444

✓	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	01/23/2017	06/26/2017							
1	1	✓	=							
2	2	✓	=							
	3	✓	-							
3	4	✓	=							
	5	✓	-							
4	6	✓	=							
5	7	✓	=							
6	8	✓	=							
7	9	✓	=							
8	10	✓	=							

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	189	(uplink same (tree near2 network))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/06/26 11:51
L2	83	1 AND ((H04L45/04 OR H04L45/02 OR H04L45/48 OR H04L45/28 OR H04L41/12 OR H04L12/462 OR H04L47/10 OR H04L49/15 OR H04L47/781).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/06/26 11:53
L3	598	(Chirp near3 receiv$3).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/06/26 12:09
L4	59	L3 AND ((H04L27/103 OR H04L1/0003 OR H04L25/0202 OR H04L2027/0093).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/06/26 12:09
L5	1	((chirp near3 receiv$3) same (Uplink near3 function)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/06/26 12:10
S1	1	"14740062"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/11/25 12:59
S2	160	Chirp near3 network	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/27 12:25
S3	12	S2 same (router)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/27 12:25
S4	11	S2 same (router) and radio	US-PGPUB; USPAT; USOCR;	OR	ON	2016/12/27 12:26

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S5	1856	Chirp near3 receiv$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:51
S6	8	S5 same router	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:51
S8	1	(Chirp near3 receiv$3).ab. and (router same (uplink near3 function))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:52
S9	1	(Chirp near3 receiv$3).ab. and (router same (uplink))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:53
S10	3	(Chirp near3 receiv$3).ab. and router	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 00:53
S11	6	(Chirp near3 receiv$3) and (router with (uplink upstream downlink downstream))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:24
S12	6	(Chirp near3 receiv$3) and (router with (uplink upstream downlink downstream))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:24
S13	7	(Chirp near3 receiv$3) and (router with (scan$5))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:25
S14	119	(Chirp near3 (recept$5 receiv$3)) and (router)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:26
S15	1	((Chirp near3 (recept$5 receiv$3)) and (router)).ab.	US-PGPUB; USPAT; USOCR;	OR	ON	2017/01/23 08:27

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S16	42	(Chirp near3 (recept$5 receiv$3)) and (router) and (uplink$3 downlink$3 upstream$3 downstream$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:27
S17	25	(Chirp near3 (recept$5 receiv$3)) and (router) and (mesh near3 network)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 08:30
S27	2	(router with (terse near3 messag$5))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:18
S28	306	(number near4 participant) same (complexity)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:26
S29	61	(number near4 participant) same (complexity) same network	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:26
S30	16	(number near4 participant)with (complexity) with network	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:26
S31	1	(ters$3 with status with updat$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:33
S32	0	"20120202514" and (tree)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:44
S33	24	(router with chirp)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:46
S34	182	(uplink same (tree near2 network))	US-PGPUB; USPAT; USOCR;	OR	ON	2017/01/23 09:48

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S35	91	(uplink with (tree near2 network))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:48
S36	5	(uplink with (tree near2 network) with parent)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:51
S37	7	(uplink with (tree near2 network) same parent)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:51
S38	9760705	(uplink with (tree near2 network) single)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:52
S39	8	(uplink with (tree near2 network) with single)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:52
S40	4	(uplink with (tree near2 network) with router)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:53
S41	3	(router with (heart with beat with status))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 09:57
S42	578	(Chirp near3 receiv$3).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 10:06
S43	55	S42 AND ((H04L27/103 OR H04L1/0003 OR H04L25/0202 OR H04L2027/0093).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/01/23 10:13

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L6	1	((chirp near3 receiv$3) same (Uplink near3 function)).clm.	US-PGPUB; USPAT	OR	ON	2017/06/26 12:10
L7	1	((router same receiver) same (Uplink near3 function)).clm.	US-PGPUB; USPAT	OR	ON	2017/06/26 12:11

6/26/2017 12:16:16 PM
C:\Users\dbayard\Documents\EAST\Workspaces\14740062.wsp

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14740062	DACOSTA, FRANCIS
	Examiner	**Art Unit**
	DJENANE BAYARD	2444

CPC						
Symbol					**Type**	**Version**
H04L		67	/	145	F	2013-01-01
H04W		4	/	14	I	2013-01-01
H04W		84	/	18	A	2013-01-01
H04W		40	/	248	I	2013-01-01
H04L		45	/	02	I	2013-01-01
H04L		45	/	48	I	2013-01-01
H04L		12	/	4625	I	2013-01-01
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CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	8	
/DJENANE BAYARD/ Primary Examiner.Art Unit 2444	06/26/2017	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	71

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14740062	DACOSTA, FRANCIS
	Examiner	**Art Unit**
	DJENANE BAYARD	2444

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
		G	0	6	F	15 / 16 (2006.01.01)						
CROSS REFERENCE(S)												
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)											

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	8	
/DJENANE BAYARD/ Primary Examiner.Art Unit 2444	06/26/2017	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	71

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14740062	DACOSTA, FRANCIS
	Examiner	**Art Unit**
	DJENANE BAYARD	2444

☐ 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
1	1														
2	2														
	3														
3	4														
	5														
4	6														
5	7														
6	8														
7	9														
8	10														

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 8	
/DJENANE BAYARD/ Primary Examiner.Art Unit 2444 (Primary Examiner)	06/26/2017 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 71

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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/740,062	06/15/2015	Francis DACOSTA	0357-02904	1794

27197 7590 07/25/2017

MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602

EXAMINER
BAYARD, DJENANE M

ART UNIT	PAPER NUMBER
2444	

NOTIFICATION DATE	DELIVERY MODE
07/25/2017	ELECTRONIC

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 the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mail@cherskov.com
sgurda@cherskov.com
akeith@cherskov.com

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

Application No. : 14740062
Applicant : Dacosta
Filing Date : 06/15/2015
Date Mailed : 07/25/2017

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Kam Sin/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 14740062 **Drawings filed: 07/02/2015**

IDENTIFICATION OF DRAWING DEFICIENCIES

- [ ] There is a hole or the image thereof within the illustration. FIG(s)
- [ ] The illustration is penetrated or traversed by a solid or broken line that is not intended to be part of the drawing, such as a dark line caused by a flaw in the copying process. FIG(s)
- [ ] An ink stamp or the image thereof obscures part of the illustration. FIG(s)
- [ ] The drawing is marred by black smudges, obliterations, or fax/copier marks (for example, speckles or dots in a substantial portion of the drawing). FIG(s)
- [ ] Figure numbers are duplicated or missing. FIG(s)
- [ ] Drawing sheet or figure is missing. FIG(s)
- [ ] Numbers, letters, or reference characters in the drawing have been crossed out or are illegibly handwritten. FIG(s)
- [ ] The character of the lines, numbers, and letters is poor. FIG(s)
- [ ] The drawing's background shows that the original drawing was made on graph paper or other paper with a pattern or decoration. FIG(s)
- [ ] The FIG. number label is placed in a location that causes the drawing to be read upside down. FIG(s)
- [ ] Data, a reference number, or part of the drawing is truncated or missing, or a lead line has no reference number. FIG(s)
- [ ] The drawing and/or the FIG. label contain(s) foreign language. FIG(s)
- [X] This utility application contains a photograph of a view that is capable of being illustrated as a line drawing. FIG(s) see other
- [ ] A petition under 37 CFR 1.84(a)(2) to accept color drawings has been granted, but the brief description of the drawings in the specification does not contain (or has not been amended to contain) the paragraph required by 37 CFR 1.84(a)(2)(iii).
- [ ] This reissue application contains added and/or amended drawings that are not labeled as "New" or "Amended" or "Canceled" as required by 37 CFR 1.173(b)(3). FIG(s)
- [ ] This Design reissue application contains a drawing that is labeled as "Canceled" but is not surrounded by brackets, or a drawing that is surrounded by brackets but is not labeled as "Canceled." See 37 CFR 1.173(b)(3). FIG(s)
- [X] OTHER: 2, 7-8, 16-18, 22, 25-27, 37-39, 41, 44-45, 56-57, 60
- [ ] COMMENTS:

PATENT
CONFIRMATION NO. 1794

UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Francis daCosta
Title:	CHIRP NETWORKS
Serial No.:	14/740,062
Filing Date:	January 27, 2017
Examiner:	Djenane M. Bayard
Art Unit:	2444
Atty. Docket:	0363-02904

Sent via EFS-Web on August 28, 2017.

Mail Stop: AMENDMENT
COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, VA 22313-1450

Suite 400
123 West Madison Street
Chicago, Illinois 60602
(312) 621-1330

RESPONSE TO NOTICE

Dear Sir:

In response to the July 25, 2017 Notice to File Corrected Papers, attached please find nineteen (19) sheets of formal drawings for the above-identified patent application. Please substitute the enclosed drawings for the previously submitted Fig. 2, 7-8, 16-18, 22, 25-27, 37-39, 41, 44-45, 56-57, and 60.

No new matter has been added to the drawings.

An earnest attempt has been made hereby to respond to the July 25, 2017 Official Action. The application is deemed in condition for allowance and same is

respectfully requested. If the Examiner feels that a telephonic interview will expedite allowance, he is respectfully urged to contact the undersigned at the phone number provided above.

Respectfully submitted,

CHERSKOV, FLAYNIK & GURDA, LLC

By: /Szymon M. Gurda/
Szymon M. Gurda (Reg. No. 58,451)

Electronic Acknowledgement Receipt

EFS ID:	30204169
Application Number:	14740062
International Application Number:	
Confirmation Number:	1794
Title of Invention:	CHIRP NETWORKS
First Named Inventor/Applicant Name:	Francis DACOSTA
Customer Number:	27197
Filer:	Szymon Maciej Gurda
Filer Authorized By:	
Attorney Docket Number:	0357-02904
Receipt Date:	28-AUG-2017
Filing Date:	15-JUN-2015
Time Stamp:	17:47:12
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	Drawings-only black and white line drawings	Replacement.pdf	1587853 2b85e3ba6a40ad6775f3ed880e4cfcb5a86ba235	no	19

Warnings:

Information:					
2	Supplemental Response or Supplemental Amendment	Response.pdf	63321 83ea80a775354d108d60156d33d3db3b61376ce7	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	1651174	

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.

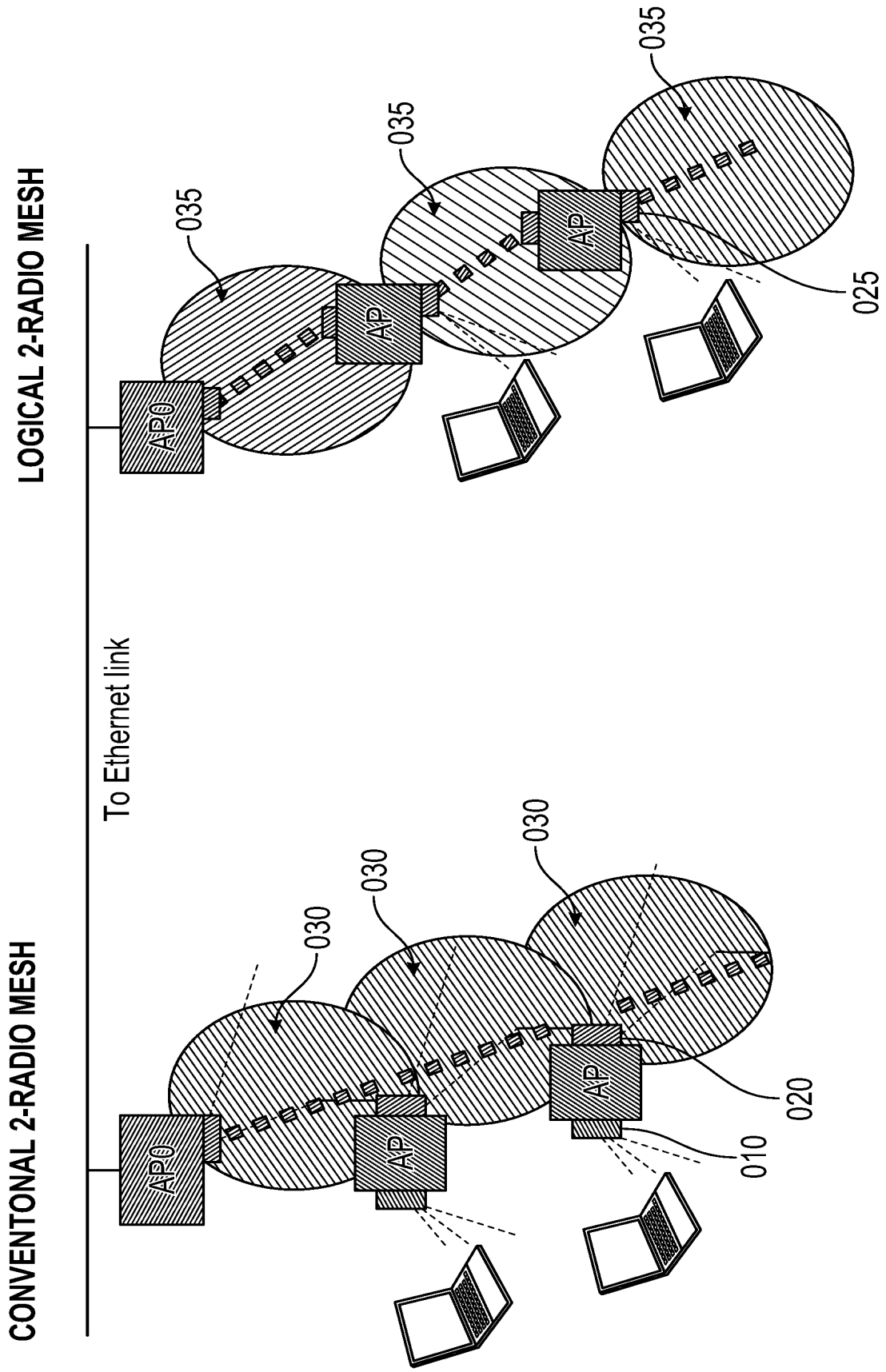

LOGICAL 2-RADIO MESH
CONVENTONAL 2-RADIO MESH
To Ethernet link
AP0
AP
AP
AP
035
035
035
025
030
030
030
020
010

FIG. 2

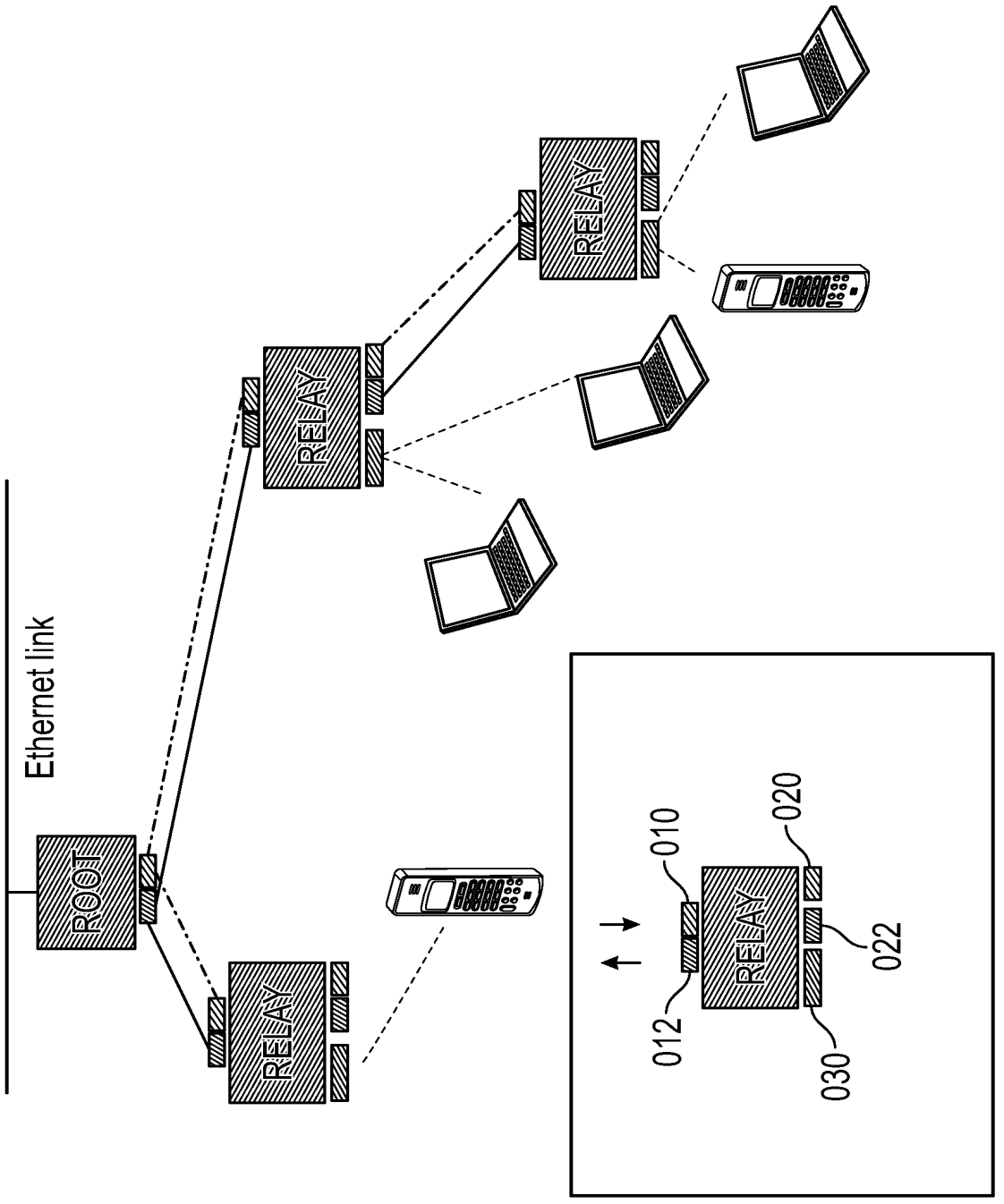


FIG. 7

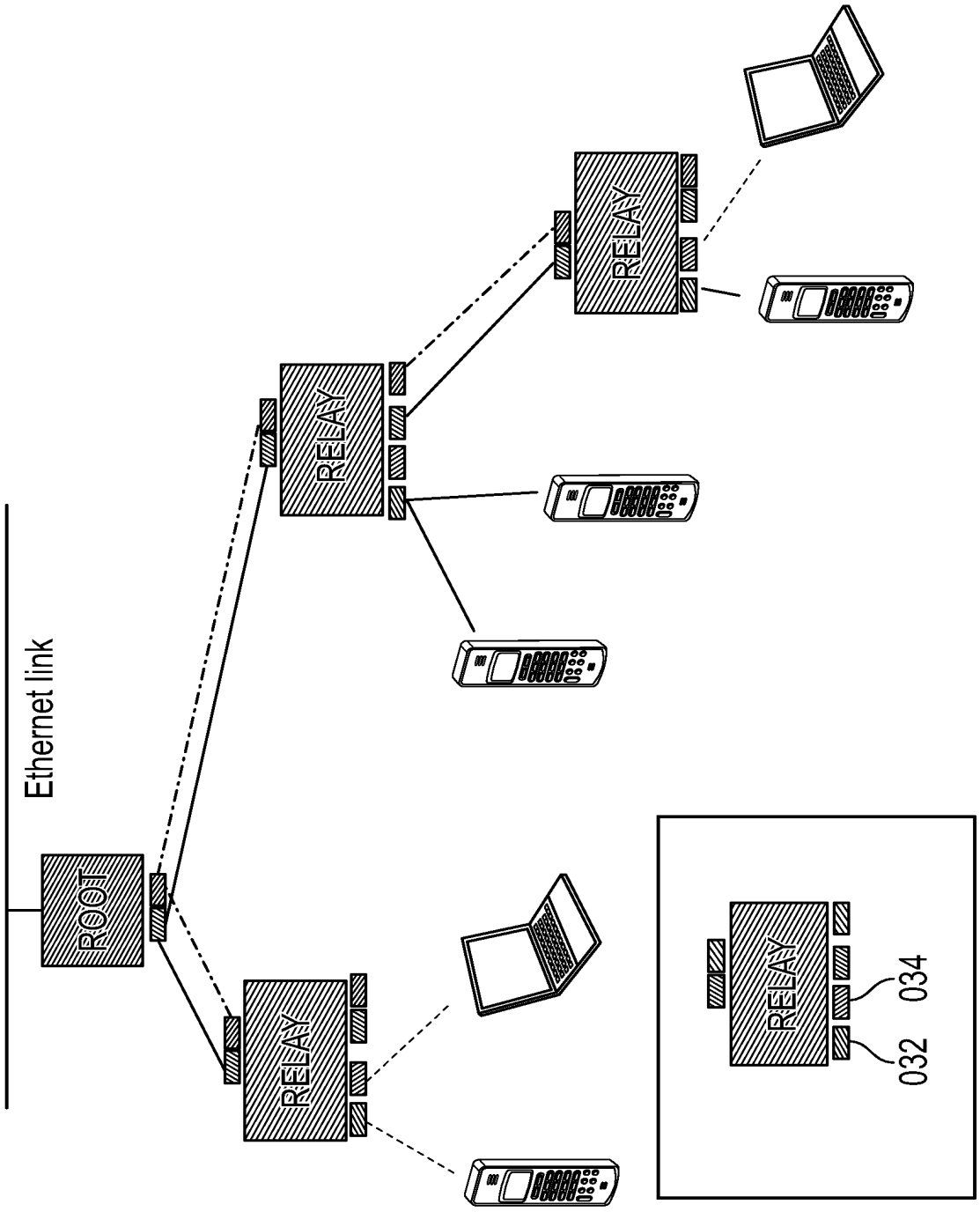


FIG. 8

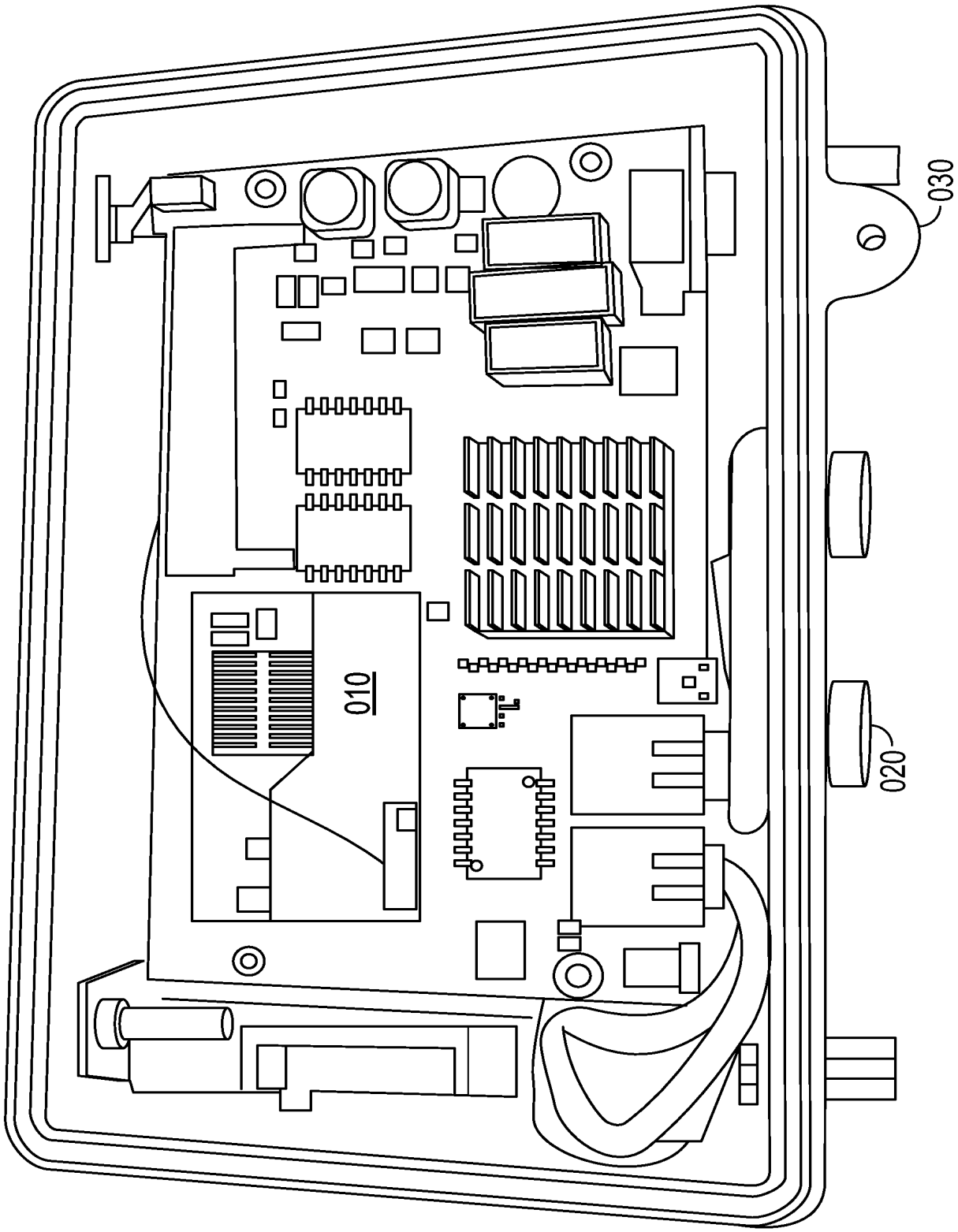


FIG. 16

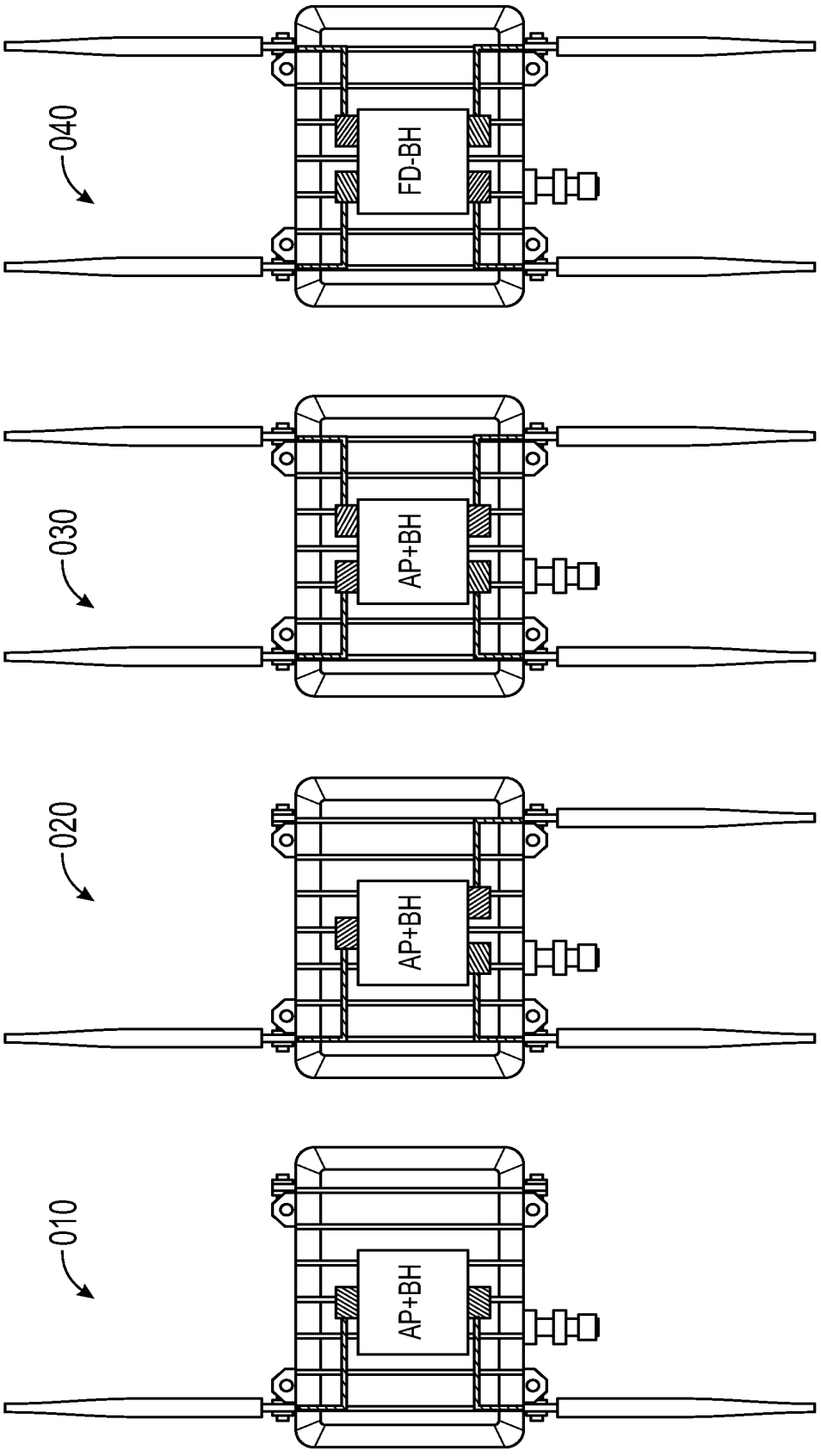

010
AP+BH
020
AP+BH
030
AP+BH
040
FD-BH
2 Radio Product Variants
1. 802.11 b/g BH + Service
2. 802.11 a BH + Service
3 Radio Base Product
802.11 b/g Service
802.11 a Backhauls
3 Radio+Mobility Scanner
802.11 a/b/g Service
802.11 a/b/g Scanner
4 Radio BH Concept
Full Duplex BH
Carrier Class VOIP

FIG. 17

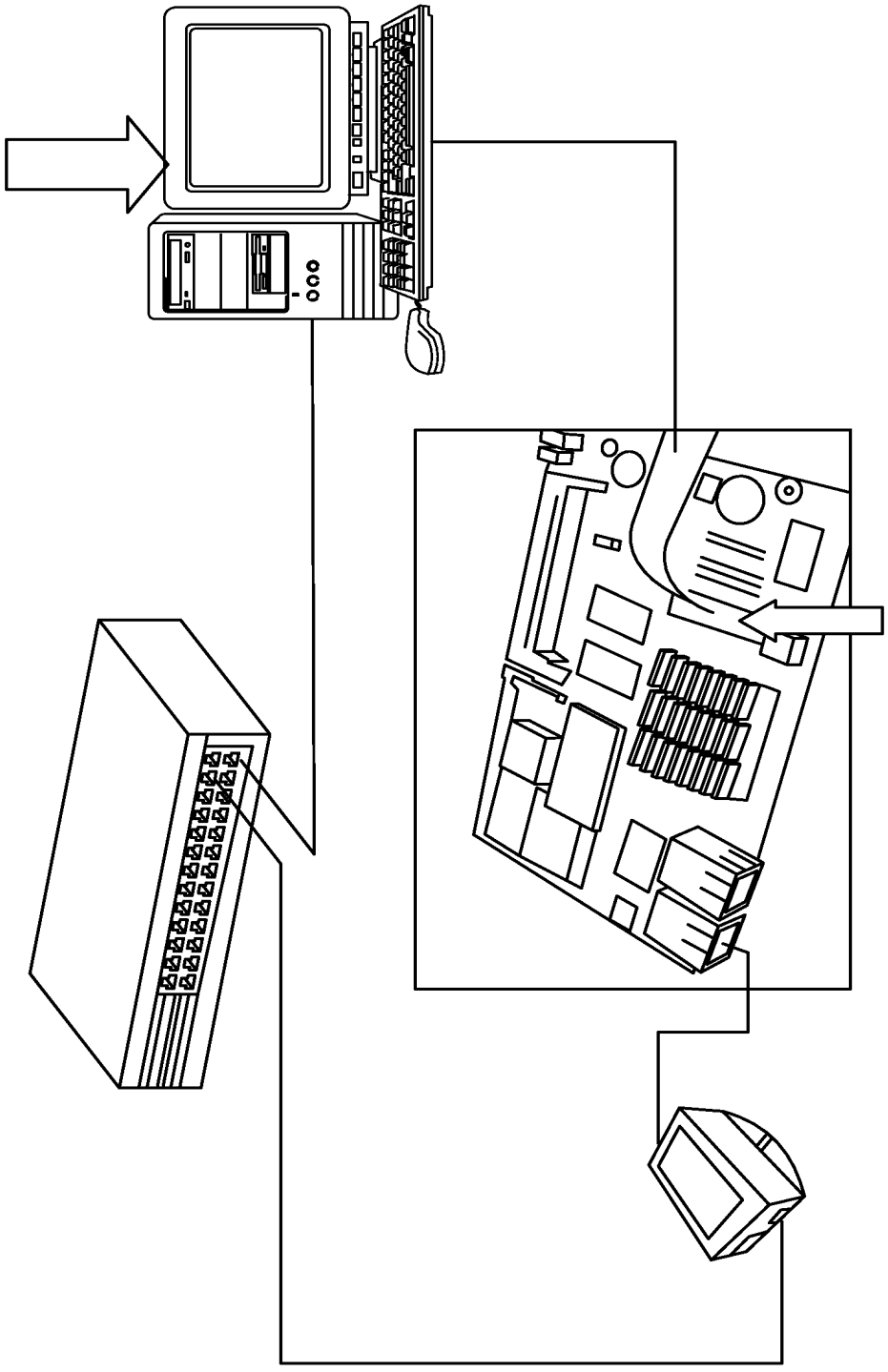


FIG. 18

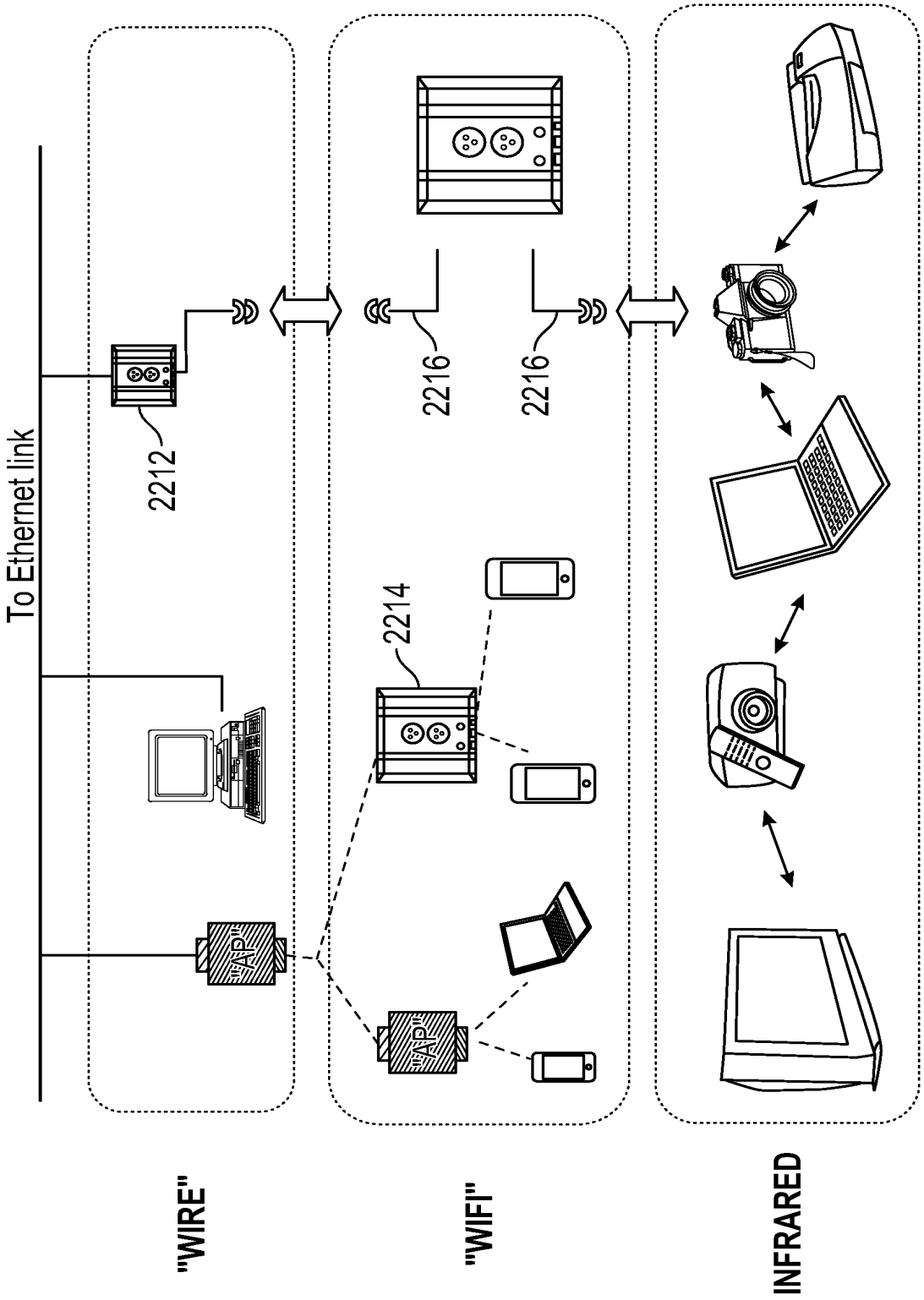

To Ethernet link
2212
2216
2216
2214
"AP"
"AP"
"WIRE"
"WIFI"
INFRARED

FIG. 22

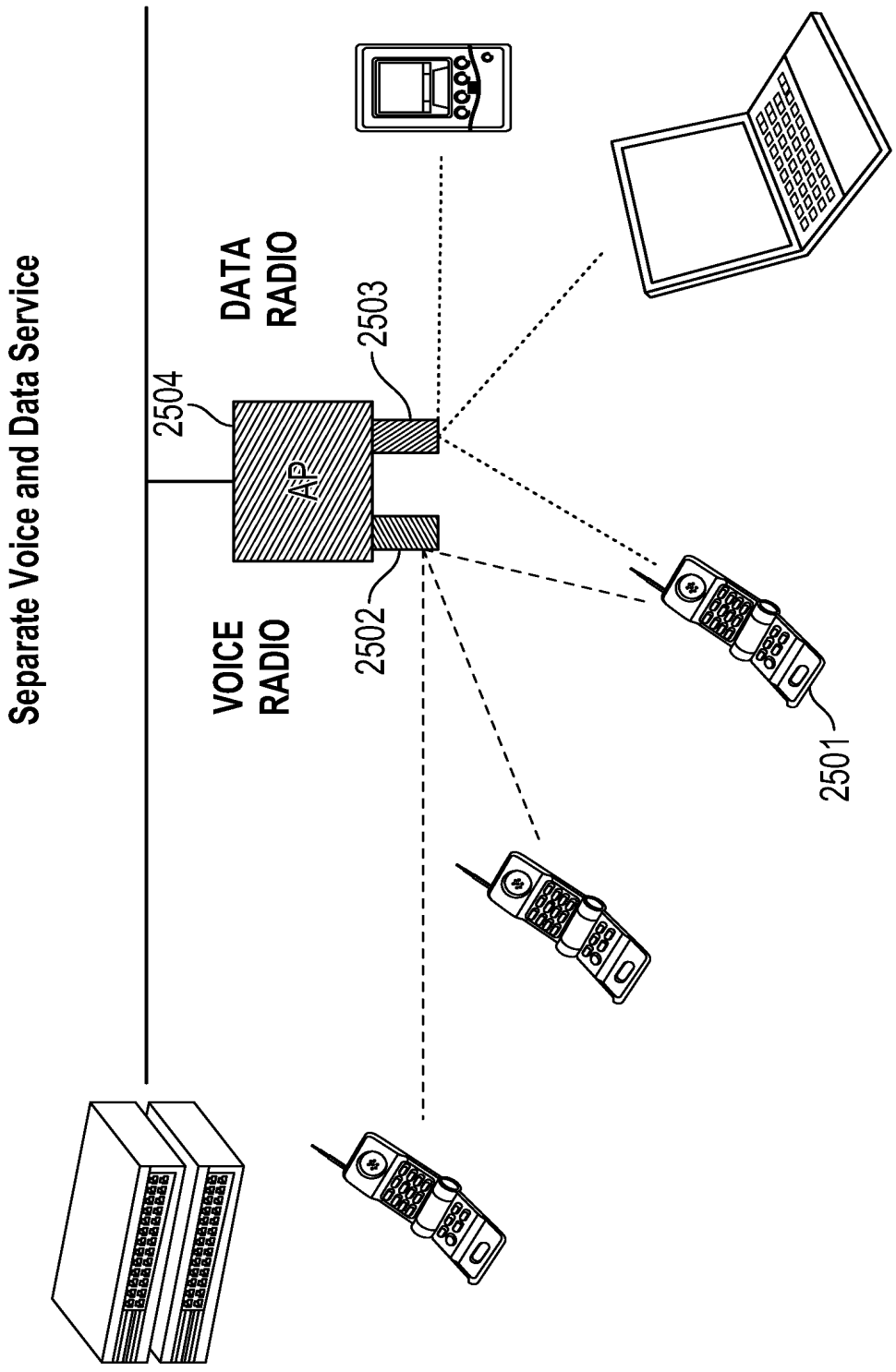

Separate Voice and Data Service
DATA RADIO
VOICE RADIO
AP
2504
2503
2502
2501

FIG. 25

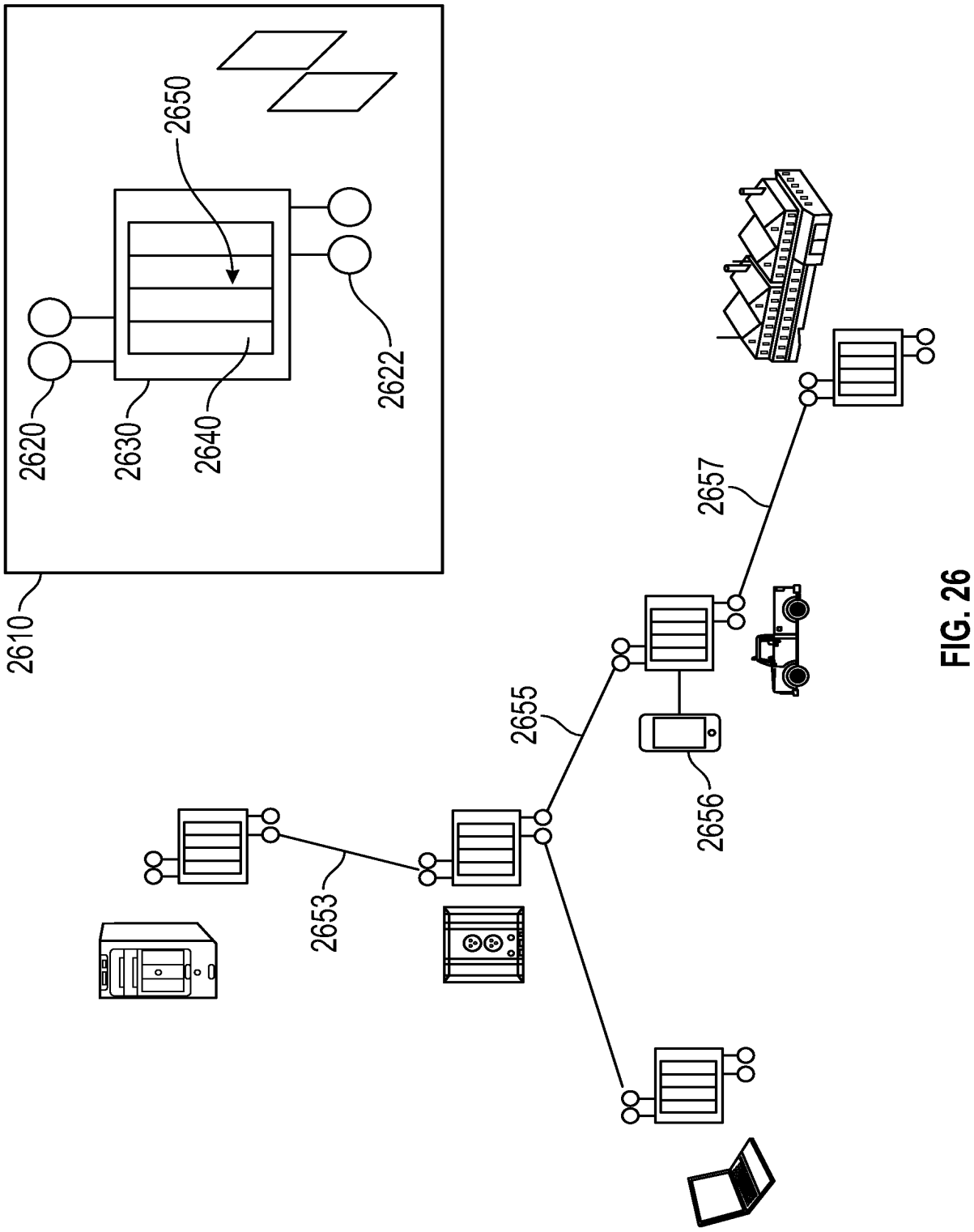


FIG. 26

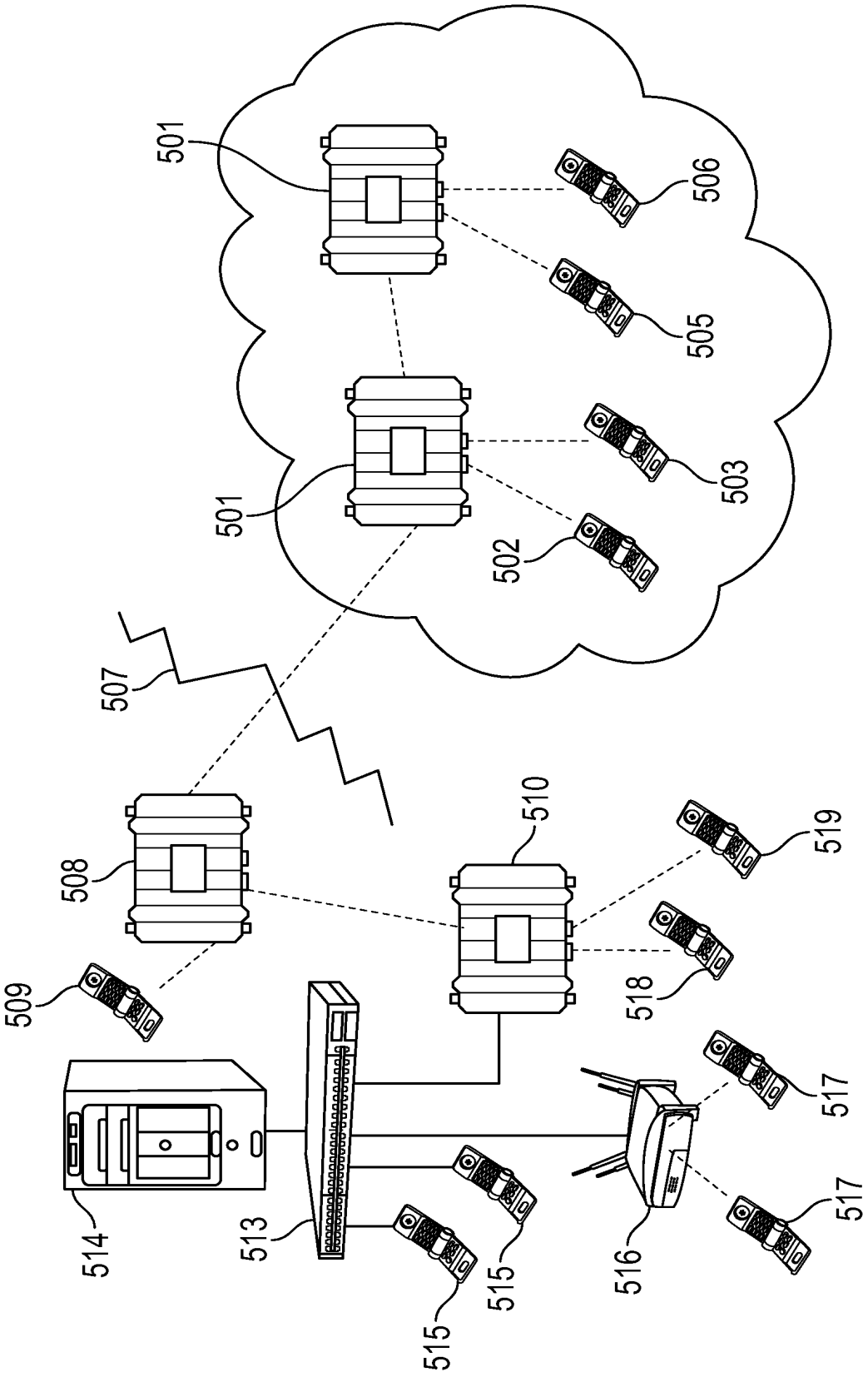

501
506
505
501
503
502
507
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510
519
509
518
517
514
513
515
516
517
515

FIG. 27

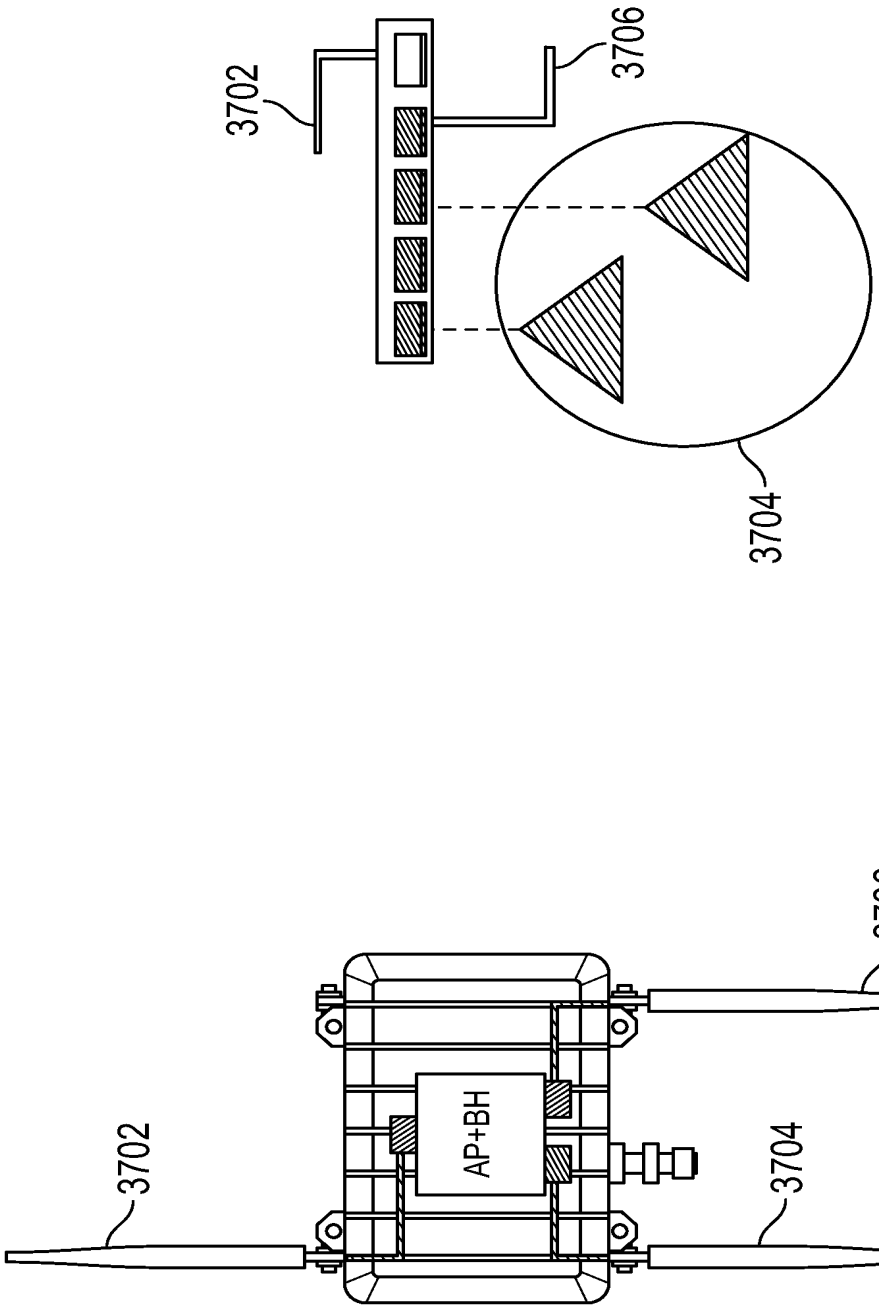

3702
3706
3704
3706
AP+BH
3702
3704
3 Radio Base Product
802.11 b/g Service
802.11 a Backhauls

FIG. 37

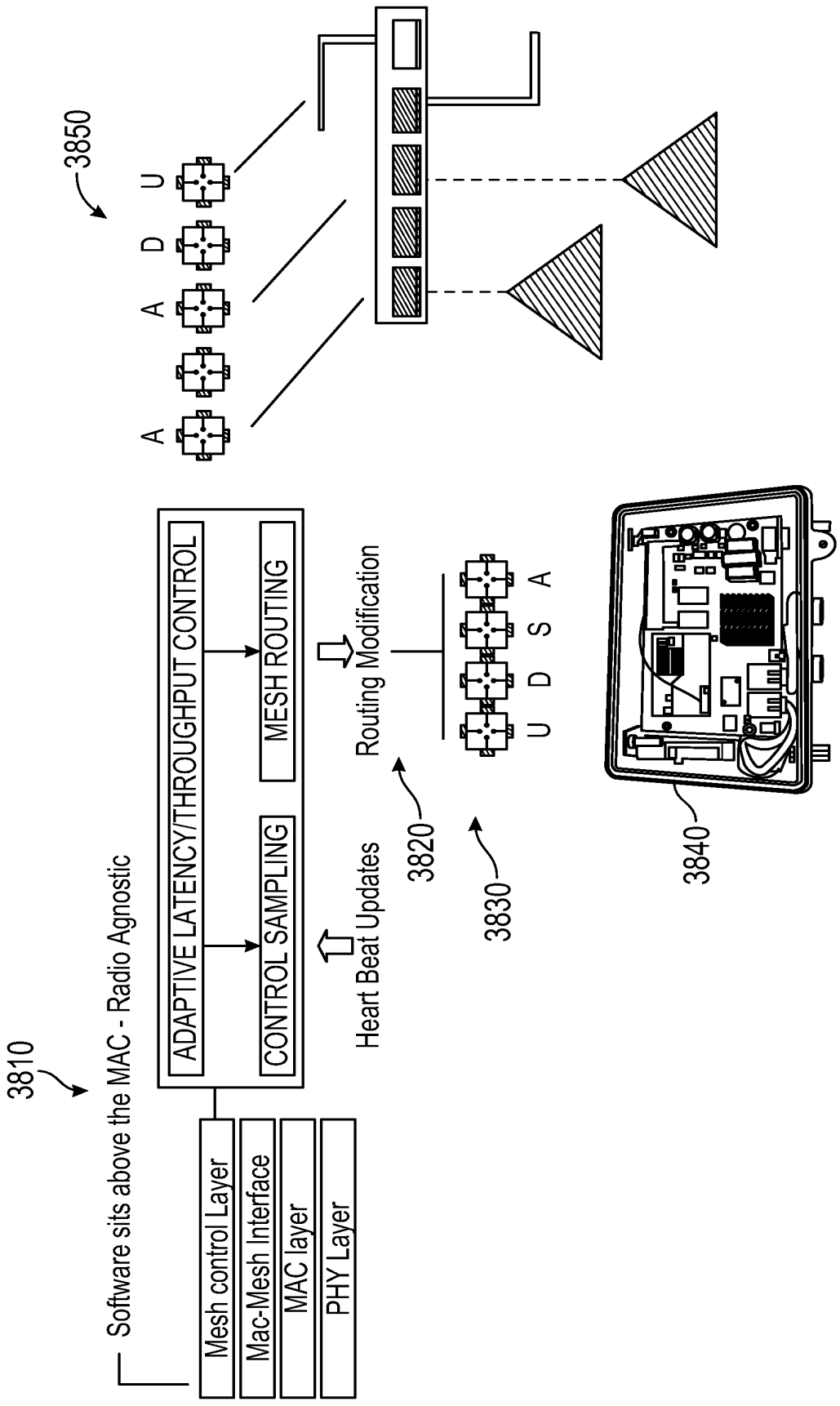

3850
A D U
A
3810
Software sits above the MAC - Radio Agnostic
Mesh control Layer
Mac-Mesh Interface
MAC layer
PHY Layer
ADAPTIVE LATENCY/THROUGHPUT CONTROL
CONTROL SAMPLING
MESH ROUTING
Heart Beat Updates
Routing Modification
3820
3830
U D S A
3840

FIG. 38

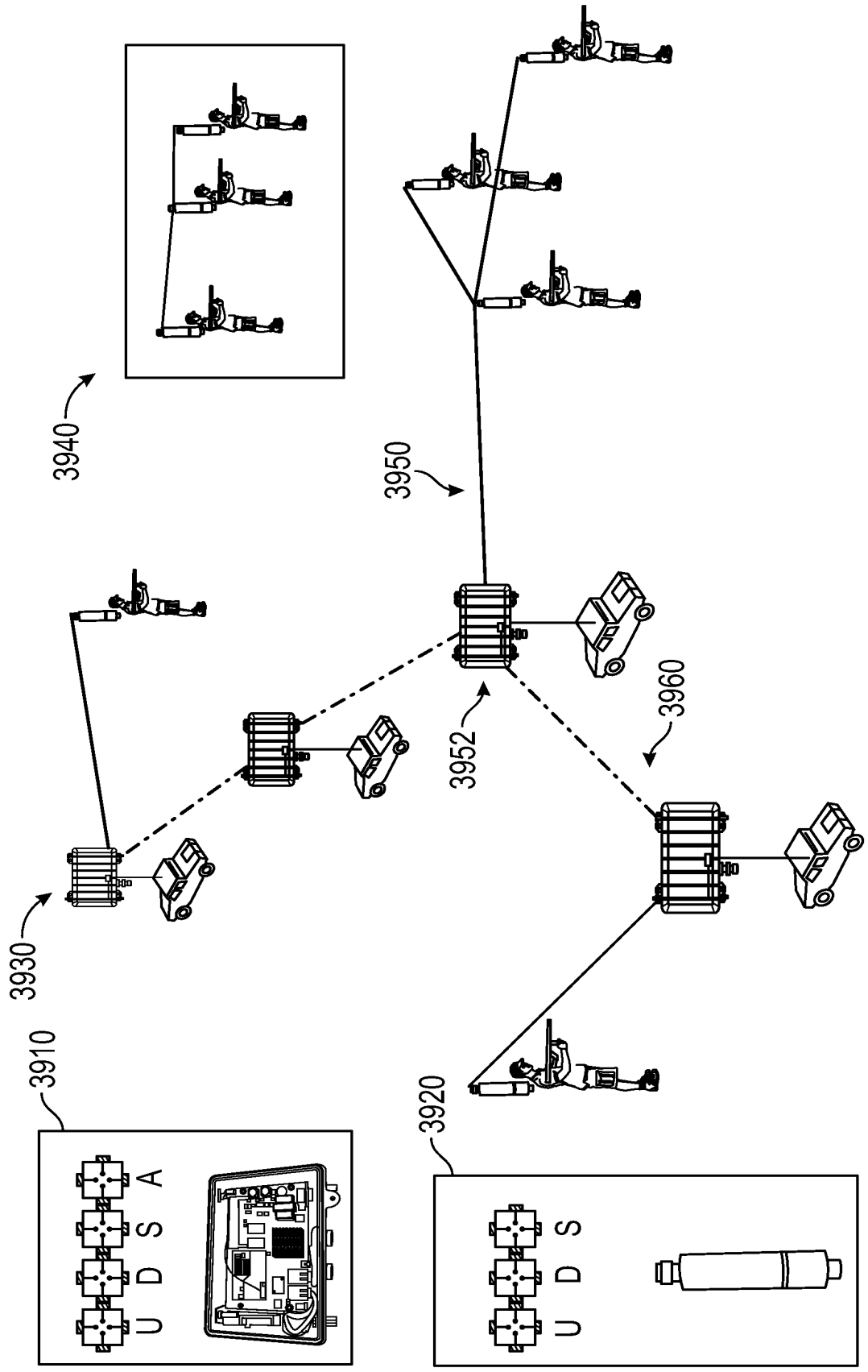


FIG. 39

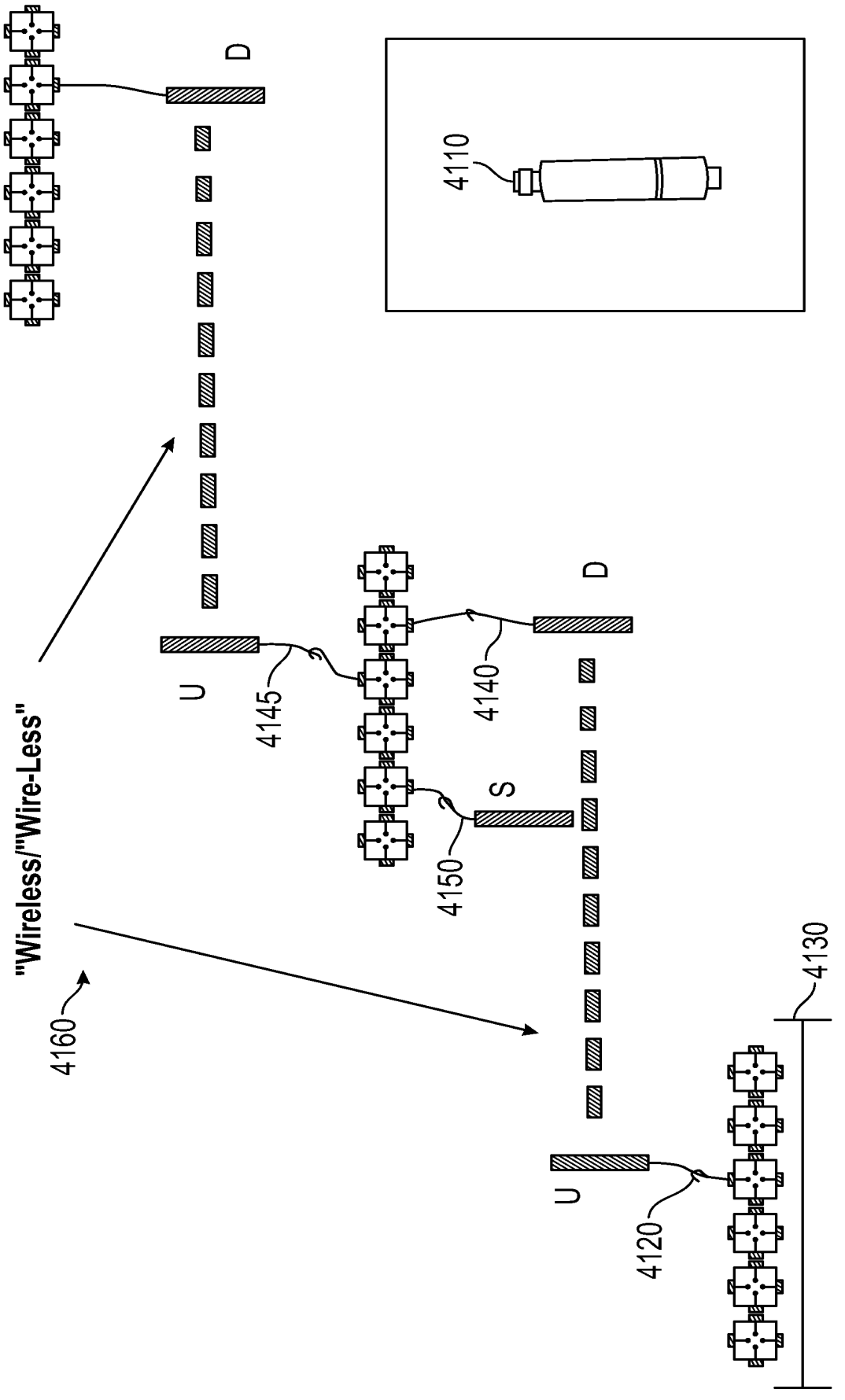


FIG. 41

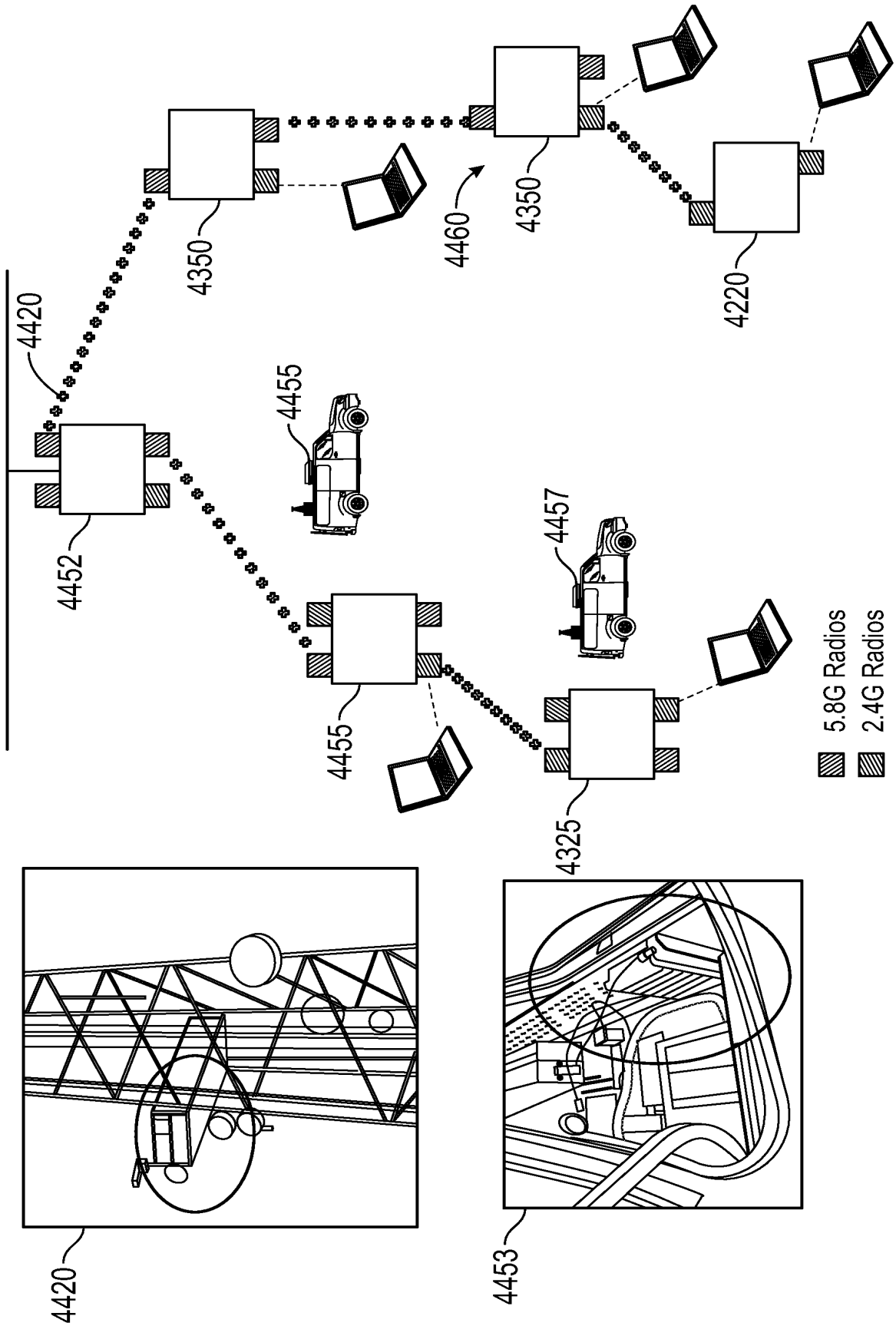

4420
4350
4460
4350
4220
4455
4452
4457
4455
4325
5.8G Radios
2.4G Radios
4420
4453

FIG. 44

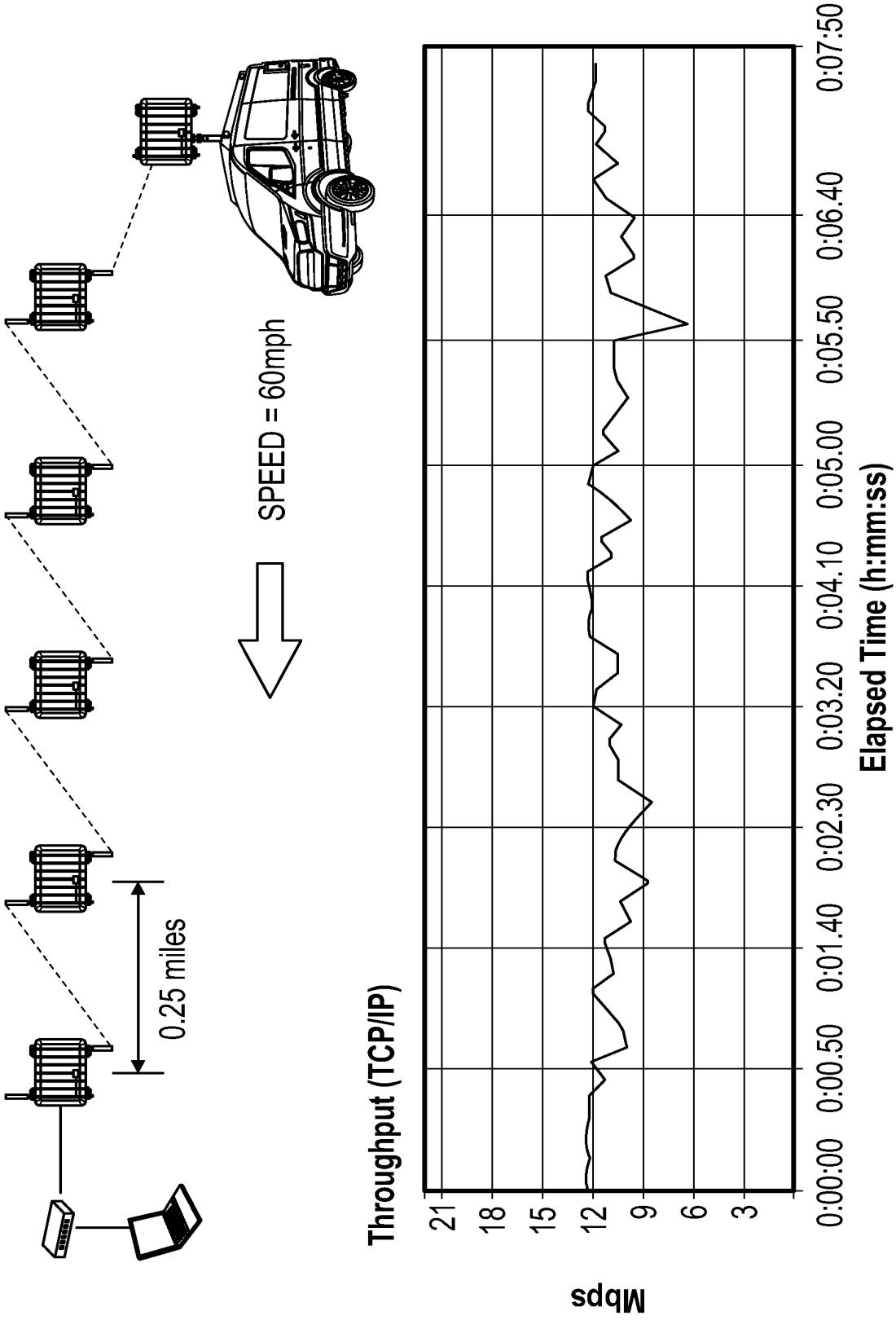

0.25 miles
SPEED = 60mph
Throughput (TCP/IP)
Mbps
21
18
15
12
9
6
3
0:00:00
0:00:50
0:01.40
0:02.30
0:03.20
0:04.10
0:05.00
0:05.50
0:06.40
0:07:50
Elapsed Time (h:mm:ss)

FIG. 45

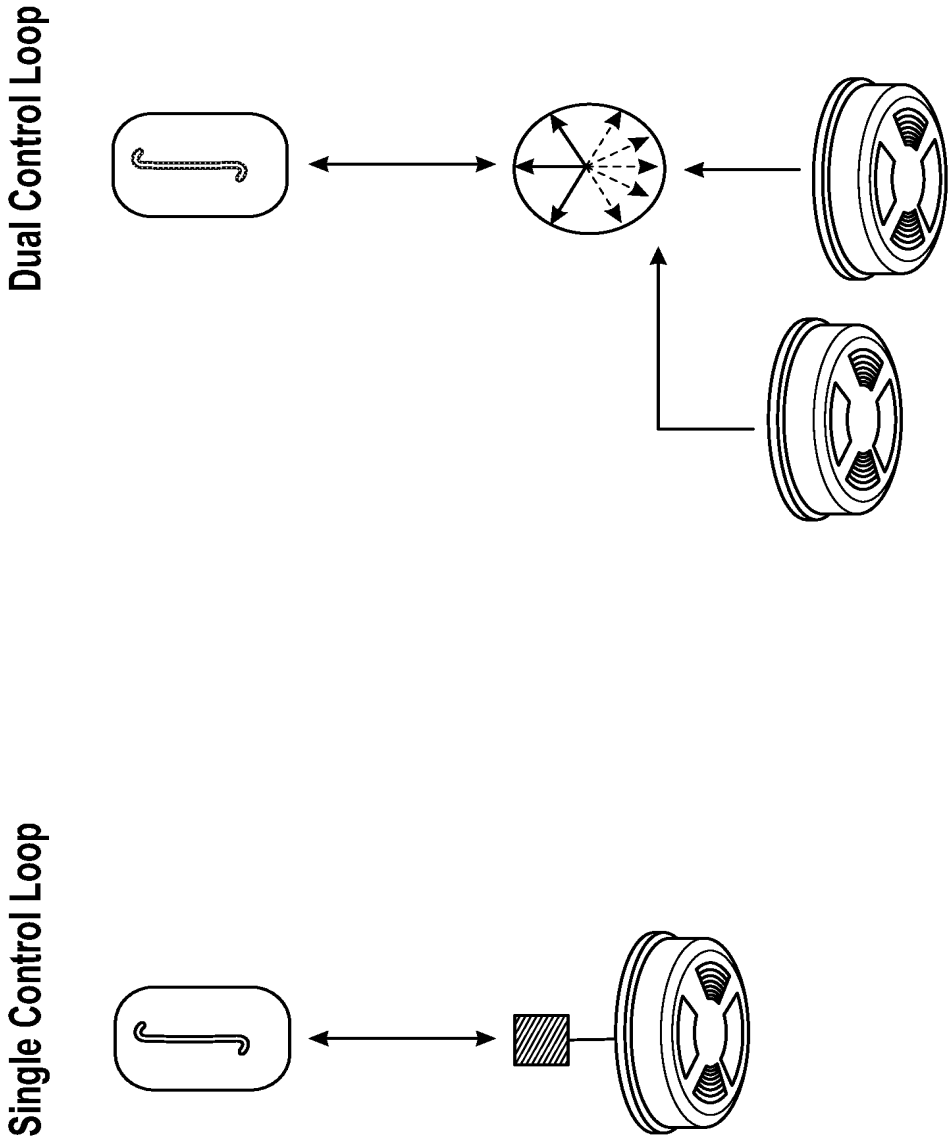


FIG. 56

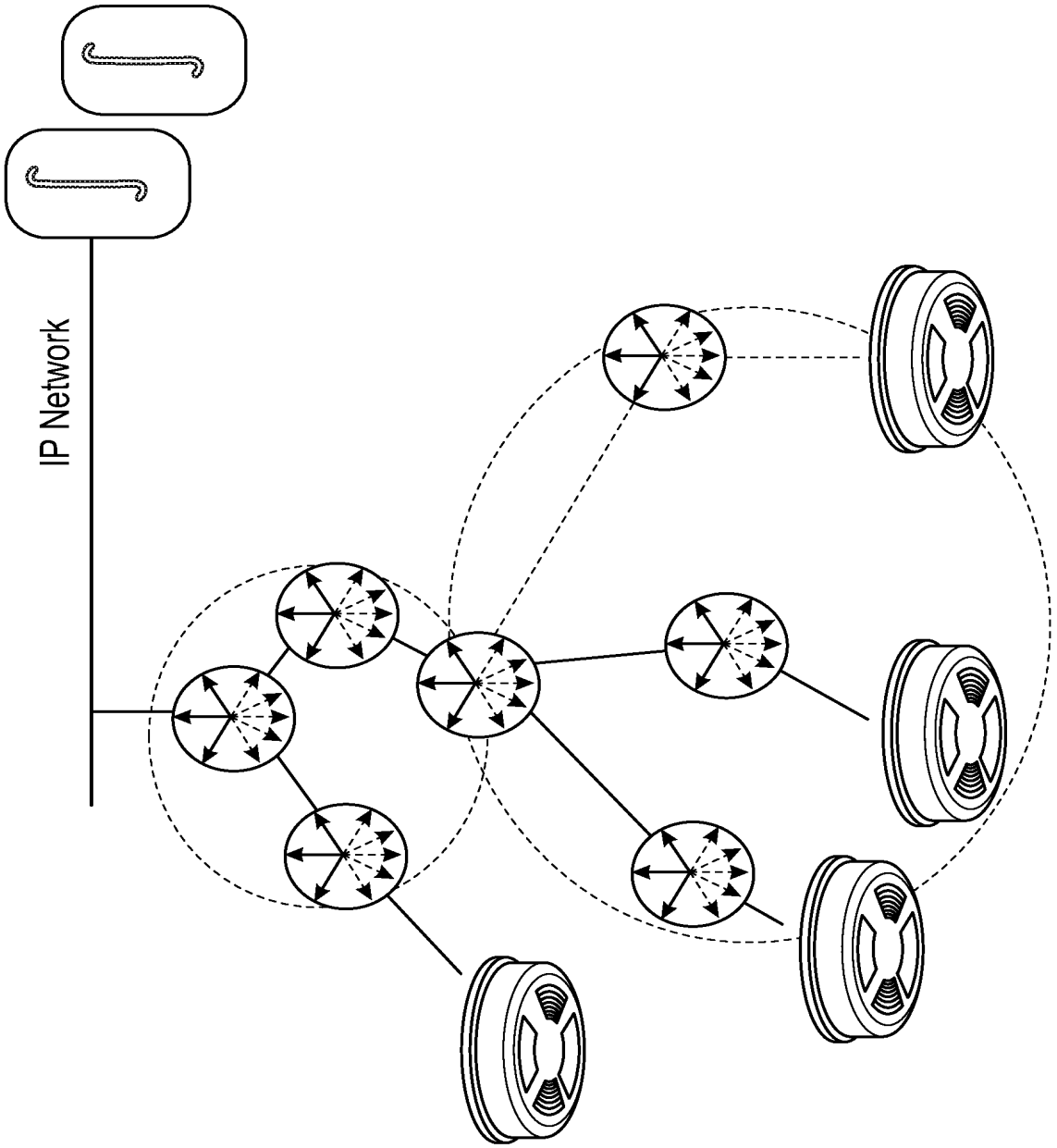


FIG. 57

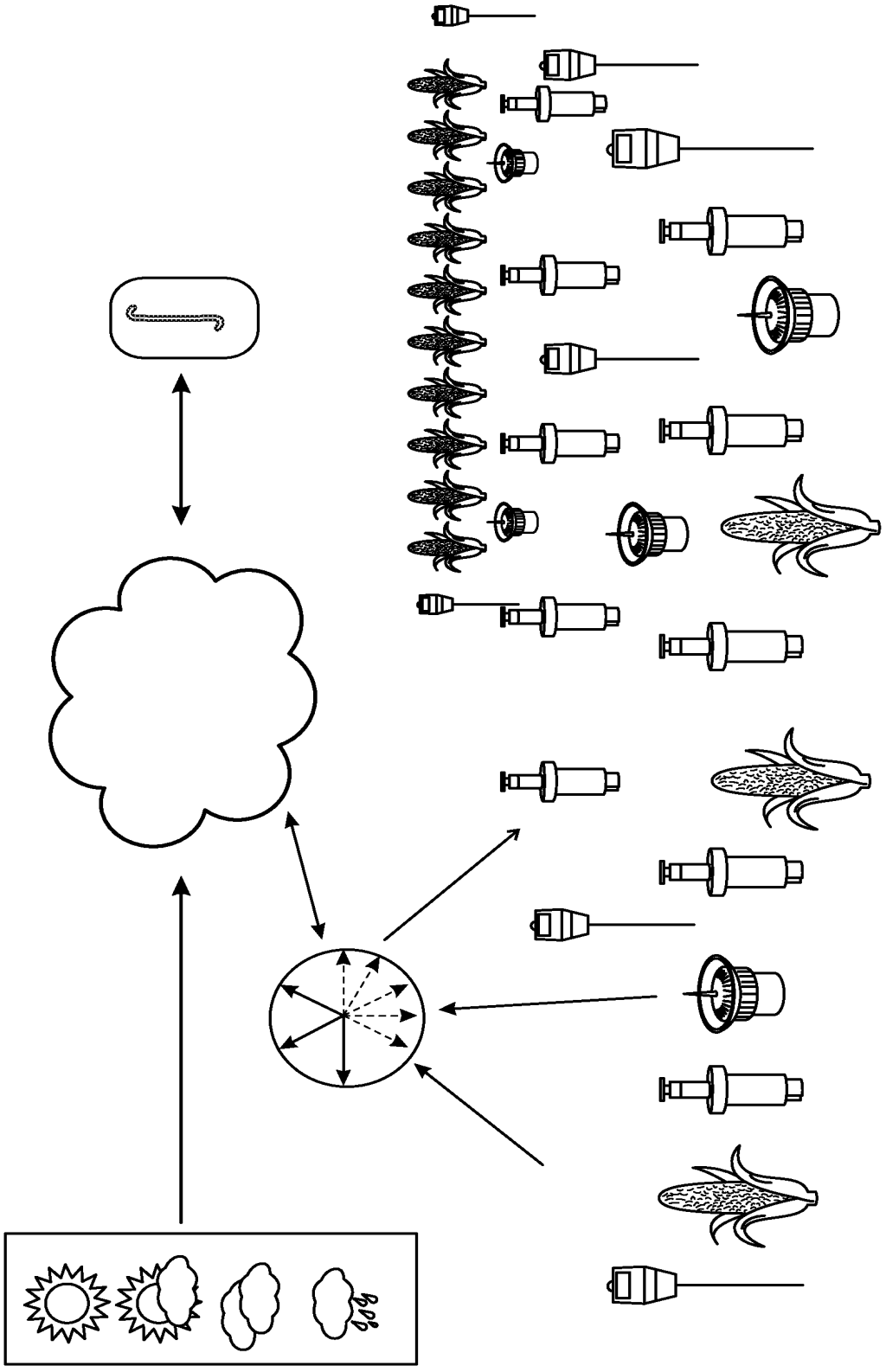


FIG. 60

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

27197 7590 07/05/2017
MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Szymon M. Gurda	(Depositor's name)
/Szymon M. Gurda/	(Signature)
via EFS-Web on Oct. 5, 2017	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/740,062	06/15/2015	Francis DACOSTA	0357-02904	1794

TITLE OF INVENTION: CHIRP NETWORKS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	10/05/2017

EXAMINER	ART UNIT	CLASS-SUBCLASS
BAYARD, DJENANE M	2444	709-230000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Cherskov Flaynik &
2 Gurda, LLC
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: MeshDynamics

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Santa Clara, CA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☐ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
☒ Payment by credit card. Form PTO-2038 is attached.
☒ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 501709 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
☐ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
☐ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Szymon M. Gurda/ Date Oct. 5, 2017
Typed or printed name Szymon M. Gurda Registration No. 58,451

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Electronic Patent Application Fee Transmittal

Application Number:	14740062
Filing Date:	15-Jun-2015
Title of Invention:	CHIRP NETWORKS
First Named Inventor/Applicant Name:	Francis DACOSTA
Filer:	Szymon Maciej Gurda
Attorney Docket Number:	0357-02904

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	2501	1	480	480

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**480**

Electronic Acknowledgement Receipt

EFS ID:	30579244
Application Number:	14740062
International Application Number:	
Confirmation Number:	1794
Title of Invention:	CHIRP NETWORKS
First Named Inventor/Applicant Name:	Francis DACOSTA
Customer Number:	27197
Filer:	Szymon Maciej Gurda
Filer Authorized By:	
Attorney Docket Number:	0357-02904
Receipt Date:	05-OCT-2017
Filing Date:	15-JUN-2015
Time Stamp:	16:31:00
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$480
RAM confirmation Number	100617INTEFSW16313700
Deposit Account	501709
Authorized User	Michael Cherskov

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	Issue Fee Payment (PTO-85B)	IssueFee.pdf	1571117 3581a743af768835f3d914099ba89282c222c65b	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30525 e6345f1d64184e6c878f07751e60df6e54444057	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1601642		

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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.

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.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/740,062	11/14/2017	9819747	0357-02904	1794

27197 7590 10/25/2017

MICHAEL J. CHERSKOV
123 WEST MADISON STREET
SUITE 400
CHICAGO, IL 60602

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 86 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Francis DACOSTA, Santa Clara, CA;
MeshDynamics, Santa Clara, CA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

PETITION TO ACCEPT UNINTENTIONALLY DELAYED PAYMENT OF MAINTENANCE FEE IN AN EXPIRED PATENT (37 CFR 1.378(b))

Patent Number	Issue Date	Application Number	Filing Date	Docket Number (if applicable)
9819747	14-Nov-2017	14740062	15-Jun-2015	

CAUTION: Maintenance fee (and surcharge, if any) payment must correctly identify: (1) the patent number and (2) the application number of the actual U.S. application leading to issuance of that patent to ensure the fee(s) is/are associated with the correct patent. 37 CFR 1.366(c) and (d).

Applicants claims the following fee status:

(◉) Small Entity

(◯) Micro Entity

(◯) Regular Undiscounted

Applicants selects the following :

(◉) 3 1/2	(◯) 7 1/2	(◯) 11 1/2

PETITION FEE
The petition fee required by 37 CFR 1.17(m) (Fee Code 1558/2558) must be paid as a condition of accepting unintentionally delayed payment of the maintenance fee.

MAINTENANCE FEE (37 CFR 1.20(e)-(g))
The appropriate maintenance fee must be submitted with this petition.

STATEMENT

The delay in payment of the maintenance fee for this patent was unintentional.

Petitioner is reminded that a delay resulting from a deliberately chosen course of action or a change in circumstance is not an unintentional delay.

Petitioner is further reminded that a person seeking reinstatement of an expired patent should not make a statement that the delay in payment of the maintenance fee was unintentional unless the entire delay was unintentional, including the period from discovery that the maintenance fee was not timely paid until payment of the maintenance fee. For example, a statement that the delay in payment of the maintenance fee was unintentional would not be proper when the patentee becomes aware of an unintentional failure to timely pay the maintenance fee and then intentionally delays filing a petition for reinstatement of the patent under 37 CFR 1.378. See MPEP 2590.

NOTE: Where the petition under 37 CFR 1.378 is filed more than two years after the date the patent expired for nonpayment of the maintenance fee, the United States Patent and Trademark Office requires an additional explanation of the circumstances surrounding the delay that establishes the entire delay was unintentional. This requirement is in addition to the requirement to provide a statement that the entire delay was unintentional. See *Clarification of the Practice for Requiring Additional Information in Petitions Filed in Patent Applications and Patents Based on Unintentional Delay*, 85 FR 12222 (March 2, 2020). See MPEP 711.03(c)(II)(C)-(F) for additional guidance on the information required to establish that the entire delay was unintentional.

PETITIONER(S) REQUEST THAT THE DELAYED PAYMENT OF THE MAINTENANCE FEE BE ACCEPTED AND THE PATENT REINSTATED

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

37 CFR 1.378(c) states: "Any petition under this section must be signed in compliance with 37 CFR 1.33(b) ."

I certify, in accordance with 37 CFR 1.4(d)(4) that I am

○	An attorney or agent registered to practice before the Patent and Trademark Office who has been given power of attorney in this application.
◉	An attorney or agent registered to practice before the Patent and Trademark Office
○	A sole patentee
○	A joint patentee; I certify that I am authorized to sign this submission on behalf of all the other patentees as evidenced by the power of attorney in the application
○	A joint patentee; all of whom are signing this e-petition
○	The assignee of record of the entire interest that qualifies as an authorized party under 37 CFR 1.33(b)

Patent Practitioner			
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	/Szymon M. Gurda/		
Name	Szymon Gurda	Registration Number	58451

Electronic Patent Application Fee Transmittal

Application Number:	14740062
Filing Date:	15-Jun-2015
Title of Invention:	CHIRP NETWORKS
First Named Inventor/Applicant Name:	Francis DACOSTA
Filer:	Szymon Maciej Gurda
Attorney Docket Number:	0357-02904

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
MAINTENANCE FEE DUE AT 3.5 YEARS	2551	1	1000	1000
PET. DELAY PYMT MAINTAIN PATENT IN FORCE	2558	1	1050	1050
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**2050**

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

In re Patent No. 9819747
Issue Date: November 14,2017
Application No. 14740062
Filed: June 15,2015
Attorney Docket No. 0357-02904

:
:DECISION GRANTING PETITION
:UNDER 37 CFR 1.378(b)
:

This is a decision on the electronic petition, filed April 18,2022 ,under 37 CFR 1.378(b) to accept the unintentionally delayed payment of the 3.5 year maintenance fee for the above-identified patent.

The petition is **GRANTED**.

The maintenance fee is accepted, and the above-identified patent reinstated as of April 18,2022 . This decision also constitutes notice that the fee has been accepted. An electronic copy of the petition and this decision has been created as an entry in the Image File Wrapper. Nevertheless, petitioner should print and retain an independent copy.

Telephone inquiries related to this electronic decision should be directed to the Electronic Business Center at 1-866-217-9197.

Electronic Acknowledgement Receipt

EFS ID:	45500401
Application Number:	14740062
Patent Number:	9819747
Confirmation Number:	1794
Petition Issued Date:	April 18,2022
Title of Invention:	CHIRP NETWORKS
First Named Inventor/Applicant Name:	Francis DACOSTA
Customer Number:	27197
Filer:	Szymon Maciej Gurda
Filer Authorized By:	
Attorney Docket Number:	0357-02904
Receipt Date:	18-APR-2022
Filing Date:	15-JUN-2015
Time Stamp:	18:43:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2050
RAM confirmation Number	E20224HI43182401
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	ePetition Request Form	petition-request.pdf	47989 aef14db98997f8541f90a3ff0545f8b20536cbba	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	40122 f2da1eb3893fa6f5294ddd4d7668f30e7183909d	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	88111		

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.