

24. (Currently amended) The method network system-recited in claim 1, ~~wherein the one or more network elements are~~ further comprising configured to:

detecting a service usage indication associated with the end-user device;[[,]]

~~determine that the device credential is intended to be associated with the service processor on the end-user device,~~

detecting a specified condition;[[,]] and

declaring[[e]] a service processor integrity violation based on detecting the specified condition.

25. (Currently amended) The method network system-recited in claim 24, wherein the specified condition comprises that the ~~one or more network system is elements are~~ unable to complete the end-user device service processor authentication procedure.

26. (Currently amended) The method network system-recited in claim 24, wherein the service usage indication is a first service usage indication, and one or more network elements are further comprising configured to-receiving[[e]] a second device-originated-service usage indication from the service processor, and wherein the specified condition comprises that the second service usage indication ~~and is inconsistent with the first device-originated~~-service usage indication are inconsistent.

27. (Currently amended) The method network system-recited in claim 24, wherein the service usage indication is a first service usage indication, and one or more network elements are further comprising configured to-receiving[[e]] a second device-originated-service usage indication from the service processor, and wherein the specified condition comprises that either the first service usage indication or the second device-originated-service usage indication is inconsistent with the service policy.

28-29. (Canceled)

30. (Currently amended) The method network system-recited in claim 24, wherein the service usage indication ~~associated with the end-user device~~ comprises a start accounting message, a

stop accounting message, a charging data record, a flow data record, a service usage measure, or a combination of these.

31. (Currently amended) The method ~~network system~~-recited in claim 24, wherein the specified condition comprises that the service processor does not communicate with the ~~one or more~~ network system elements-within a predetermined amount of time after the ~~one or more~~ network system elements-detects the service usage indication-~~associated with the end-user device~~.

32. (Currently amended) The method ~~network system~~-recited in claim 1, wherein the service processor comprises a client configured to implement a portion of the service policy.

33. (Currently amended) The method ~~network system~~-recited in claim 1, wherein the service policy comprises a control policy, a service usage limit, an accounting policy, a billing policy, a notification policy, or a combination of these.

34. (Currently amended) The method ~~network system~~-recited in claim 5, wherein ~~cause a first portion of the service policy to be~~ executing[[ed]] the first portion of the service policy when the end-user device service processor authentication procedure is successful-comprises sending the first portion of the service policy to the service processor-~~when the end-user device service processor authentication procedure is successful~~.

35. (Currently amended) The method ~~network system~~-recited in claim 6, wherein the second portion of the service policy differs from the first portion of the service policy in a network access privilege, an allowable network destination, a service usage accounting or billing policy, a service usage rate, a service speed or quality, an allowed access network, a user notification, a roaming policy or permission, an effect on a device operation, or a combination of these.

36. (Currently amended) The method ~~network system~~-recited in claim 16, wherein the device data usage report indicates usage associated with a classification, the classification being one or more device applications, one or more network destinations, one or more network types, one or

more sponsored services, one or more background activities, one or more operating system (OS) programs, one or more OS libraries, one or more OS functions, or a combination of these.

37. (Currently amended) The ~~**method network system**~~-recited in claim 16, wherein the trusted data usage report indicates usage associated with a classification, the classification being one or more device applications, one or more network destinations, one or more network types, one or more sponsored services, one or more background activities, one or more operating system (OS) programs, one or more OS libraries, one or more OS functions, or a combination of these.

38. (Currently amended) The ~~**method network system**~~-recited in claim 16, wherein the device data usage report comprises information identifying an application, an operating system (OS) function, an OS program, an OS library, a network resource, a web site, a network source, a network destination, a domain, a uniform resource locator (URL), an IP address, a port, a protocol, a socket tuple, a server, a network route, an access point name (APN), a gateway, a proxy, a content source, a sub-network, a quality-of-service (QoS) level, a content type, a background activity, or a combination of these.

39. (Currently amended) The ~~**method network system**~~-recited in claim 16, wherein the trusted data usage report comprises information identifying an application, an operating system (OS) function, an OS program, an OS library, a network resource, a web site, a network source, a network destination, a domain, a uniform resource locator (URL), an IP address, a port, a protocol, a socket tuple, a server, a network route, an access point name (APN), a gateway, a proxy, a content source, a sub-network, a quality-of-service (QoS) level, a content type, a background activity, or a combination of these.

40. (Currently amended) The ~~**method network system**~~-recited in claim 18, wherein the ~~**end-user device**~~-software or firmware agent is part of the service processor.

REMARKS

Claims 1-9, 12, 16-27, and 30-40 are pending and stand rejected by the Office Action dated December 31, 2013. Claims 10, 11, 13-15, 28, and 29 were previously cancelled.

In section 2, the Office Action rejects claims 1-9, 12, 16-27, and 30-40 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 8,185,127 to Cai *et al.* (hereinafter, “Cai”). The Office Action also states that Applicant’s claim language contains “intended use” claim language that is not given patentable weight, and that Applicant should provide the full meanings of acronyms appearing in the claims.

Applicant is amending claims 1-9, 12, 16-27, and 30-40 to convert the claims to method claims, thereby eliminating what the Office Action characterized as “intended use” claim language. Applicant has also spelled out all acronyms appearing in claims 3 and 7. No new matter is being added by these amendments.

Applicant respectfully requests reconsideration.

Claim Rejections – 35 U.S.C. § 103

In section 2, the Office Action rejects claims 1-9, 12, 16-27, and 30-40 under 35 U.S.C. § 103(a) as being unpatentable over Cai.

Overview of Cai

Cai discloses a method and system for allocating usage of network resources in a communication network. Cai at col. 1, ll. 44-45; Abstract. A quality-of-service (QoS) profile is established for a user account. *Id.* at col. 4, ll. 32-33. The user account includes subscriber information, such as identity information, the type of subscription plan or contract, credit information, and other information that would typically be associated with a wireless subscription with a network operator. *Id.* at col. 4, ll. 33-39. The QoS profile comprises permissions and restrictions for use of the communication system or network for the user to utilize services on the network, and it may contain a database of a user’s devices associated with the user’s account. *Id.* at col. 4, ll. 41-43; col. 5, ll. 20-21. The QoS profile may provide a

priority factor for a particular device or a device identifier such as a phone number or device id. *Id.* at col. 5, ll. 21-24. If a particular device has a priority flag, then when that device requests access to the network, it is given priority over other devices assigned to the user and is allocated network resources accordingly. *Id.* at col. 5, ll. 24-27. Alternatively, a device may be assigned a fixed bandwidth allocation or a dynamic bandwidth allocation that can fluctuate depending on use by the wireless device. *Id.* at col. 5, ll. 27-28, 31-34.

When a usage request is received and registered from a first wireless device, use of the communication network is allocated to the first wireless device based on the QoS profile. *Id.* at col. 4, ll. 52-53, 61-62. When a usage request is received and registered from a second wireless device, use of the communication network is allocated to the second wireless device based on the QoS profile and the use of the communication network by the first wireless device. *Id.* at col. 5, ll. 4-5, 11-13. If the first wireless device is utilizing all of the network resources permitted by the user's QoS profile, the second wireless device may be denied access to the communication network. *Id.* at col. 5, ll. 14-17. If resources remain, the second wireless device is allocated the remaining resources as indicated in the QoS profile. *Id.* at col. 5, ll. 17-19. If the second wireless device has priority over the first wireless device, the resources are allocated accordingly. *Id.* at col. 8, ll. 44-56; col. 8, l. 58 – col. 9, l. 11.

Claim 1

In rejecting claim 1, the Office Action states that Cai discloses, *e.g.*, FIGS. 1-7 and related text, a network system (*e.g.*, 103, 306) comprising billing, authentication, and other network management functions; wireless devices (*e.g.*, 101, 102); a gateway (*e.g.*, 301); a server; a communication interface (*e.g.*, 701); a user interface (*e.g.*, 703); a user profile (*e.g.*, 201, 202); a storage system (*e.g.*, 704); a control node (*e.g.*, 104, 700) that is distributed among devices (*e.g.*, elements 700-705); and a quality-of-service (QoS) profile for a user account (*e.g.*, 200). Office Action at 2. The Office Action states that it would have been obvious for Cai to have the communication interface to have enabled the network system and the network elements configured to perform the intended use claim language as recited and the other network functions to comprise the language recited by Applicant's claims. *Id.* at 3.

Applicant is amending claim 1 to recite:

A method performed by a network system, the method comprising:

receiving a device credential from an end-user device communicatively coupled to the network system over a wireless access network;

obtaining a service policy based at least in part on the device credential, the service policy being applicable to the end-user device;

obtaining service processor authentication information associated with a service processor on the end-user device; and

using the service processor authentication information, facilitating execution of an end-user device service processor authentication procedure.

Applicant respectfully submits that claim 1, as amended, is patentable over Cai at least because Cai does not disclose or render obvious at least the limitations of “obtaining service processor authentication information associated with a service processor on the end-user device” or “using the service processor authentication information, facilitating execution of an end-user device service processor authentication procedure.”

“obtaining service processor authentication information associated with a service processor on the end-user device”

Applicant respectfully submits that claim 1 is nonobvious in view of Cai at least because Cai does not disclose or suggest (a) a service processor on an end-user device, or (b) obtaining service processor authentication information associated with such service processor.

First, Cai does not disclose or suggest a service processor on an end-user device. Although Cai discloses wireless devices (*see, e.g.*, Cai at FIGS. 1, 3, 4a, 4b, 4c, 5, 6), Cai does not disclose or suggest that such wireless devices include service processors. Cai discloses that the wireless device may be any device that has a wireless communication connectivity, such as a telephone, smart pone, mobile phone, cellular phone, personal digital assistant, personal communicator, handheld game console, personal computer, ultra-mobile personal computer, handheld television, or any other consumer appliance with wireless communication capabilities. *Id.* at col. 3, ll. 3-10; col. 5, ll. 58-64. Cai also discloses that the mobile stations may be any device that has wireless communication connectivity utilizing any high-speed data protocol, such

as UMTS, HSPA, EV-DO, 3GPP LTE, or WiMAX. *Id.* at col. 5, ll. 50-58. But Cai does not disclose that any of the wireless devices or mobile devices includes a service processor as disclosed in the instant application, nor does Cai suggest the presence of a service processor on any of the mobile devices. And Applicant respectfully submits that inclusion of a service processor, as disclosed in the instant application, on the mobile devices of Cai would not be obvious to a person having ordinary skill in the art.

Because Cai does not disclose or suggest a service processor on an end-user device, it follows that Cai cannot disclose or suggest obtaining service processor authentication information associated with such service processor. Although Cai discloses that the mobile station sends “registration information” that may include the user, device, and other relevant data to an AAA that provides the necessary authentication, authorization, and accounting functions for the service provider’s network, *id.* at col. 6, l. 62 – col. 7, l. 2; col. 6, ll. 32-34, Cai does disclose or suggest that such registration information comprises service processor authentication information. Likewise, although Cai discloses that the registration messages used by mobile stations could be any message utilized by a particular wireless protocol to allow subscribers to use a communication system, such as network acquisition messages, device authentication messages, and user authentication messages, *id.* at col. 7, ll. 32-37, Cai does not disclose or suggest that such network acquisition messages, device authentication messages, or user authentication messages comprise service processor authentication information associated with a service processor on a mobile device.

Finally, although Cai discloses that the QoS server uses the QoS profile to determine the appropriate bandwidth allocation for a mobile device, *id.* at col. 7, ll. 49-51, Cai does not disclose that the QoS profile includes service processor authentication information associated with a service processor on the mobile device. Instead, Cai discloses that the QoS profile comprises permissions and restrictions for use of the communication system or network for the user to utilize services on the network, that the QoS profile may contain a database of a user’s devices associated with the user’s account, and that the QoS profile may provide a priority factor for a particular device or a device identifier such as a phone number or device id. *Id.* at col. 4, ll. 41-43; col. 5, ll. 20-24. None of these items is service processor authentication information associated with a service processor on the mobile device.

For at least these reasons, Applicant respectfully submits that claim 1 is nonobvious over Cai.

“using the service processor authentication information, facilitating execution of an end-user device service processor authentication procedure”

Applicant respectfully submits that claim 1 is nonobvious over Cai at least because Cai does not disclose or suggest facilitating execution of an end-user device service processor authentication procedure using the service processor authentication information. As explained above, Cai does not disclose obtaining service processor authentication information associated with a service processor on an end-user device. Therefore, it follows that Cai cannot disclose facilitating execution of an end-user device service processor authentication procedure using such service processor authentication information. Moreover, as explained above, Applicant respectfully submits that inclusion of a service processor on the mobile device of Cai would not have been obvious to a person having ordinary skill in the art. Therefore, it would not have been obvious, in view of Cai, for a network system to facilitate execution of an end-user device service processor authentication procedure.

For at least these reasons, Applicant respectfully submits that claim 1 is patentable over Cai.

Claims 2-9, 12, 16-27, and 30-40

Claims 2-9, 12, 16-27, and 30-40 have been amended to reflect the amendments to claim 1. In addition, where applicable, Applicant has provided the meanings of acronyms in the claims.

Claims 2-9, 12, 16-27, and 30-40 depend, directly or indirectly, from claim 1 and are therefore patentable over Cai for at least the same reasons that claim 1 is patentable over Cai.

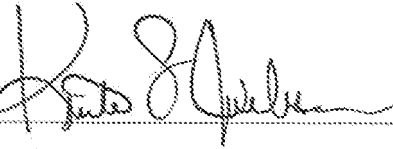
CONCLUSION

Applicant respectfully requests entry of these amendments as provided herein. The application is believed to be in condition for allowance, and a Notice of Allowance is hereby respectfully requested. If the Examiner has any questions or needs any additional information, the Examiner is invited to contact the undersigned.

The Commissioner is authorized to charge any fee deficiency or credit any overpayment to Deposit Account 50-5876.

Respectfully submitted,

Date: March 28, 2014

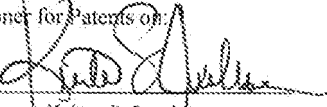
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Electronic Acknowledgement Receipt

EFS ID:	18618074
Application Number:	13237827
International Application Number:	
Confirmation Number:	1814
Title of Invention:	Adapting Network Policies Based on Device Service Processor Configuration
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	107265
Filer:	Krista Susan Jacobsen
Filer Authorized By:	
Attorney Docket Number:	RALEP034 [26WV-160511]
Receipt Date:	28-MAR-2014
Filing Date:	20-SEP-2011
Time Stamp:	17:59:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	P034_OAR_2014-03-28.pdf	321385 a9a6281465475e5fb16177136794ad63471f8cdf	no	14

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/237,827	Filing Date 09/20/2011	☐ To be Mailed
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ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO**APPLICATION AS FILED – PART I**

(Column 1)

(Column 2)

FOR	NUMBER FILED	NUMBER EXTRA	RATE (\$)	FEE (\$)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (l), 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

(Column 1)

(Column 2)

(Column 3)

AMENDMENT	03/28/2014	CLAIMS REMAINING AFTER AMENDMENT	MINUS	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	* 33	Minus	** 33	= 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

(Column 1)

(Column 2)

(Column 3)

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

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

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

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

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LIE
/KIMBERLY PANNELL/

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NOTICE OF ALLOWANCE AND FEE(S) DUE

107265 7590 05/09/2014
Headwater Partners I LLC - Outside Firm 1
350 Marine Parkway, Suite 300
Redwood Shores, CA 94065

EXAMINER

RUDY, ANDREW J

ART UNIT

PAPER NUMBER

3687

DATE MAILED: 05/09/2014

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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13/237,827

09/20/2011

Gregory G. Raleigh

RALEP034

1814

TITLE OF INVENTION: ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION [26WV-160511]

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	08/11/2014

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)".

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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

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107265 7590 05/09/2014
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/237,827	09/20/2011	Gregory G. Raleigh	RALEP034 [26WV-160511]	1814

TITLE OF INVENTION: ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION

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	08/11/2014

EXAMINER	ART UNIT	CLASS-SUBCLASS
RUDY, ANDREW J	3687	726-001000

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.**

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

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(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
☐ Applicant asserting small entity status. See 37 CFR 1.27
☐ Applicant changing to regular undiscounted fee status.

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.

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.

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. _____



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/237,827	09/20/2011	Gregory G. Raleigh	RALEP034 [26WV-160511]	1814
107265 7590 05/09/2014 Headwater Partners I LLC - Outside Firm 1 350 Marine Parkway, Suite 300 Redwood Shores, CA 94065			EXAMINER RUDY, ANDREW J	
			ART UNIT	PAPER NUMBER
			3687	
DATE MAILED: 05/09/2014				

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. 13/237,827	Applicant(s) RALEIGH ET AL.	
	Examiner ANDREW JOSEPH RUDY	Art Unit 3687	AIA (First Inventor to File) Status No

-- 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 28 March 2018 amendment.
☐ 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 1-9,12,16-27 and 30-40. 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) | 5. ☒ Examiner's Amendment/Comment |
| 2. ☒ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date ____ | 6. ☒ Examiner's Statement of Reasons for Allowance |
| 3. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 7. ☐ Other ____. |
| 4. ☐ Interview Summary (PTO-413),
Paper No./Mail Date ____. | |

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.
2. Applicant cancelled claims 10, 11, 13-15, 28 and 29.
3. Pertinent references of interest are noted on the attached PTO-892.
4. Applicant's Information Disclosure Statements (IDS's) submitted January 31, 2014 and March 19, 2014 have been reviewed. Note the attached IDS's.

EXAMINER'S AMENDMENT

5. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Krista Jacobsen (Reg. No. 59,374).

The application claims 1 and 32 have been amended as follows:

1. A method performed by a network system, the method comprising:
receiving a device credential from an end-user device communicatively coupled to the network system over a wireless access network;
obtaining a service policy based at least in part on the device credential, the service policy being applicable to the end-user device;
obtaining service processor authentication information associated with a service processor on the end-user device, **the service processor comprising one or more device agents at least assisting to implement the service policy**; and
using the service processor authentication information, facilitating execution of an end-user device service processor authentication procedure.

32. The method recited in claim 1, wherein the service processor comprises a client configured to implement **at least** a portion of the service policy.

Allowable Subject Matter

6. Pursuant to Applicant's March 28, 2014 AMENDMENT and REMARKS, claims 1-9, 12, 16-27 and 30-40 are allowed.

The following is an examiner's statement of reasons for allowance: The prior art of record, either alone or in combination, does not disclose, or suggest, Applicant's claim language.

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."

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANDREW JOSEPH RUDY whose telephone number is (571)272-6789. The examiner can normally be reached on Monday thru Friday. 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.

/ANDREW JOSEPH RUDY/
Primary Examiner
Art Unit 3687

Notice of References Cited	Application/Control No. 13/237,827		Applicant(s)/Patent Under Reexamination RALEIGH ET AL.	
	Examiner ANDREW JOSEPH RUDY		Art Unit 3687	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-8,554,876	10-2013	Winsor, Gerald W.	709/219
*	B	US-8,527,410	09-2013	Markki et al.	705/40
*	C	US-8,375,128	02-2013	Tofighbakhsh et al.	709/226
*	D	US-8,347,378	01-2013	Merkin et al.	726/18
*	E	US-8,191,124	05-2012	Wynn et al.	726/6
*	F	US-8,175,574	05-2012	Panda et al.	455/406
*	G	US-7,805,606	09-2010	Birger et al.	713/168
	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	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.

Doc code: IDS

PTO/SB/08a (01-10)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13237827
	Filing Date		2011-09-20
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	3687	
	Examiner Name	Andrew J RUDY	
	Attorney Docket Number	RALEP034 [26WV-160511]	

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6885997	B1	2005-04-26	Roberts, David T.	
	2	7720464	B2	2010-05-18	Batta, Puneet	
	3	7797060	B2	2010-09-14	Grgic et al.	
	4	7853255	B2	2010-12-14	Karaoguz et al.	
	5	7930327	B2	2011-04-19	Craft David et al.	
	6	8046449	B2	2011-10-25	Yoshiuchi, Hideya	
	7	8095124	B2	2012-01-10	Balia, Hinal K.	
	8	8229394	B2	2012-07-24	Karlberg, Johan	

**INFORMATION DISCLOSURE
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Examiner Name	Andrew J RUDY	
Attorney Docket Number		RALEP034 [26WV-160511]

9	8264965	B2	2012-09-11	Dolganow et al.	
10	8442015	B2	2013-05-14	Behzad et al.	
11	8495700	B2	2013-07-23	Shahbazi, Majid	
12	8528068	B1	2013-09-03	Weglein et al.	
13	8548427	B2	2013-10-01	Chow et al.	
14	8566236	B2	2013-10-22	Busch, James David	
15	8572117	B2	2013-10-29	Rappaport, Theodore S.	
16	8589955	B2	2013-11-19	Roundtree et al.	
17	8601125	B2	2013-12-03	Huang et al.	
18	8626115	B2	2014-01-07	Raleigh et al.	
19	8635164	B2	2014-01-21	Rosenhaft et al.	

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	20	8660853	B2	2014-02-25	Robb et al.	
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U.S.PATENT APPLICATION PUBLICATIONS

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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20030188006	A	2003-10-02	Bard, Steven R.	
	2	20030188117	A	2003-10-02	Yoshino et al.	
	3	20040255145	A	2004-12-16	Chow, Jerry	
	4	20050055595	A	2005-03-10	Frazer et al.	
	5	20060160536	A	2006-07-20	Chou, Joey	
	6	20060168128	A	2006-07-27	Sistla et al.	
	7	20070259656	A	2007-11-08	Jeong, Jong Woo	
	8	20080263348	A	2008-10-23	Zaltsman et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)

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Examiner Name	Andrew J RUDY
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9	20080313315	A	2008-12-18	Karaoguz et al.	
10	20090282127	A	2009-11-12	Leblanc et al.	
11	20100167696	A	2010-07-01	Smith, Christopher David et al.	
12	20110019574	A	2011-01-27	Malomsoky et al.	

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	1	101123553A	CN		2007-09-11	Southeast University		☐
	2	1937511A	CN		2007-03-28	ZTE		☐

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
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Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

EXAMINER SIGNATURE

Examiner Signature	/Andrew Joseph Rudy/	Date Considered	05/05/2014
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

Search Notes

Application/Control No.

13/237,827

Examiner

ANDREW JOSEPH RUDY

Applicant(s)/Patent under
Reexamination

RALEIGH ET AL.

Art Unit

3687

SEARCHED

Class	Subclass	Date	Examiner
709	203,217, 219,223, 224	5/1/2014	AJR
455	405,406	5/1/2014	AJR
455	414.1	5/1/2014	AJR
455	456.1	5/1/2014	AJR
726	1,2,5,6	5/1/2014	AJR

INTERFERENCE SEARCHED

Class	Subclass	Date	Examiner
726	1,5,6	5/1/2014	AJR
709	224	5/1/2014	AJR
455	406	5/1/2014	AJR

**SEARCH NOTES
(INCLUDING SEARCH STRATEGY)**

	DATE	EXMR
Continuity data reviewed.	5/1/2014	AJR

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)

Approved for use through 07/31/2012. OMB 0651-0031

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U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	5774532	A	1998-06-30	Gottlieb et al.	

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	1	20040225898	A	2004-11-11	Frost, D. et al.	
	2	20100284327	A	2010-11-11	Miklos, Gyorgy	
	3	20060114832	A	2006-06-01	Hamilton et al.	
	4	20060156398	A	2006-07-13	Ross et al.	
	5	20060173959	A	2006-08-03	Mckelvie et al.	

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	Examiner Name	Andrew J RUDY
	Attorney Docket Number	RALEP034 [26WV-160511]

	6	20070033194	A	2007-02-08	Srinivas et al.	
	7	20080070550	A	2008-03-20	Hose, David Alan	
	8	20080201266	A	2008-08-21	Chua et al.	

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	1							☐

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	1	"Communication Concepts for Mobile Agent Systems," by Joachim Baumann et al.; Inst. Of Parallel and Distributed High-Performance Systems, Univ. of Stuttgart, Germany, pp. 123-135, 1997	☐

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Examiner Signature	/Andrew Joseph Rudy/	Date Considered	05/05/2014
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U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6185576	B1	2001-02-06	Mcintosh, Lowrie	
	2	7320029	B2	2008-01-15	Rinne et al.	
	3	7539132	B2	2009-05-26	Werner et al.	
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Filing Date	2011-09-20
First Named Inventor	Gregory G. Raleigh
Art Unit	3687
Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

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(54) **Methods, systems and devices for pipeline processing**

(57) Methods, servers and systems for communicating signaling information in a telecommunications signaling network implement methods that include receiving a first message encoding signaling information from a source component and processing the message using a fixed pipeline having a plurality of modules, each module

having at least one procedure for performing a specific set of tasks. Application level routing operations may be performed to identify a suitable destination component. Information contained in the first message may be used to generate a second message encoding signaling information, which is sent to the identified destination component.

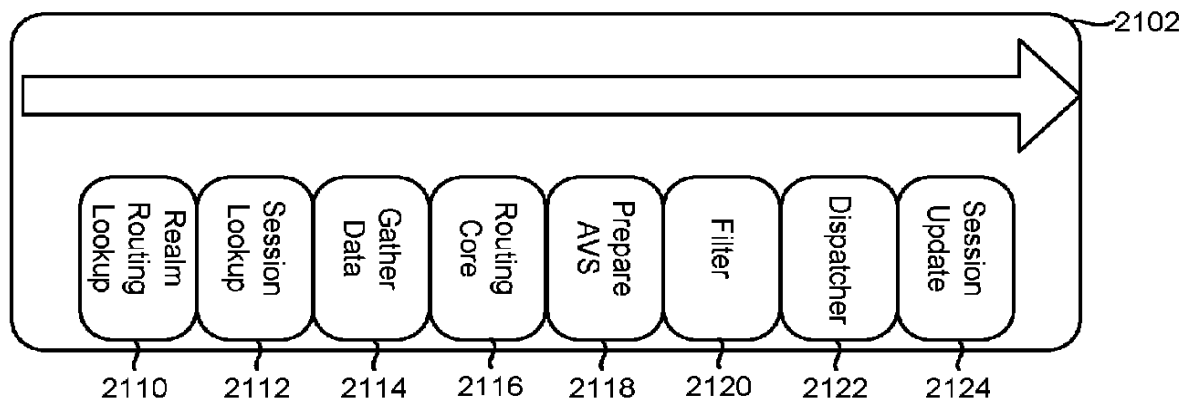


FIG. 21

Description

BACKGROUND

[0001] Wireless and cellular communication technologies have seen dramatic improvements over the past few years. Cellular service providers now offer users a wide array of services, higher usage limits and attractive subscription plans. Wireless dongles and embedded wireless modem cards allow users to use tablet computers, netbooks and laptops to access wireless Internet protocol (IP) and data services through the cellular networks. Internet-enabled smart phones, tablets and gaming consoles have become essential personal accessories, connecting users to friends, work, leisure activities and entertainment. Users now have more choices and expect to have access to content, data and communications at any time, in any place. As more users utilize these services, telecommunication system operator networks must expand to meet the increase in user demand, support the array of new services and provide fast, reliable communications. This expansion has greatly increased the complexity of wireless and cellular networks, and the efficient routing and management of signalling traffic is becoming an ever more challenging task.

SUMMARY

[0002] The various embodiments provide methods, devices and systems for enabling communications between multiple instances of components in a telecommunication network. The various embodiments provide protocol agnostic interfaces that allow communications between source and destination nodes in a telecommunication system operator network. Routing and load-balancing decisions may be made dynamically based on a context and content of the information being communicated. Messages being communicated may be opened and the information contained therein used to make intelligent connection management and control/rules routing decisions. Calls may be made to external systems requesting additional information for a specific message being communicated. Information from external systems may be used to modify the contents of the information being communicated or to aid in routing and/or load balancing operations within the operator's network. Information specific to a particular network node, protocol, application, message or message type may be stored in an internal memory and referenced for future routing and/or load balancing operations. Routing and load balancing algorithms may be updated as internal/external data changes.

[0003] The various embodiments include methods of communicating signaling information in a telecommunication signaling network that may include receiving, in a first processor, a first message encoding signaling information from a source component, decoding the received first message into an internal representation of

the message, processing the internal representation of the message via a pipeline having a plurality of stages, in which each stage may contain one or more procedures for performing a specific set of tasks, performing application level routing operations using contextual information derived from the internal representation to identify a destination component, encoding the signaling information contained in the internal representation into a second message, and sending the second message encoding the signaling information to the identified destination component. In an embodiment, performing application level routing operations using contextual information derived from the internal representation to identify a destination component includes using at least one pipeline stage to make a routing decision using a discrete number of configurable procedures. In a further embodiment, the pipeline type is one of a request handler pipeline, a response handler pipeline, a failover handler pipeline, or a redirect handler pipeline. In a further embodiment, the pipeline type and instance is selected on a per message type or on a per application basis. In a further embodiment, the pipeline may have a plurality of stages that include at least one stage from the group consisting of a realm routing lookup stage, a session lookup stage, a gather data stage, a routing core stage, a prepare AVS stage, a filter stage, a dispatcher stage, a session update stage, and a redirect stage.

[0004] Further embodiments include a server configured with server-executable instructions to perform operations that may include receiving a first message encoding signaling information from a source component, decoding the received first message into an internal representation of the message, processing the internal representation of the message via a pipeline having a plurality of stages, in which each stage may contain one or more procedures for performing a specific set of tasks, performing application level routing operations using contextual information derived from the internal representation to identify a destination component, encoding the signaling information contained in the internal representation into a second message, and sending the second message encoding the signaling information to the identified destination component. In an embodiment, the processor may be configured with processor-executable instructions to perform operations such that performing application level routing operations using contextual information derived from the internal representation to identify a destination component includes using at least one pipeline stage to make a routing decision using a discrete number of configurable procedures. In a further embodiment, the processor may be configured with processor-executable instructions to perform operations such that the pipeline type is one of a request handler pipeline, a response handler pipeline, a failover handler pipeline, or a redirect handler pipeline. In a further embodiment, the processor may be configured with processor-executable instructions to perform operations such that the pipeline type and instance is selected on a per message type

or on a per application basis. In a further embodiment, the pipeline may feature a plurality of stages that include at least one stage from the group consisting of a realm routing lookup stage, a session lookup stage, a gather data stage, a routing core stage, a prepare AVS stage, a filter stage, a dispatcher stage, a session update stage, and a redirect stage.

[0005] Further embodiments include a non-transitory server-readable storage medium having stored thereon server-executable instructions configured to cause a server to perform operations that may include receiving a first message encoding signaling information from a source component, decoding the received first message into an internal representation of the message, processing the internal representation of the message via a pipeline having a plurality of stages, in which each stage may contain one or more procedures for performing a specific set of tasks, performing application level routing operations using contextual information derived from the internal representation to identify a destination component, encoding the signaling information contained in the internal representation into a second message, and sending the second message encoding the signaling information to the identified destination component. In an embodiment, the stored server-executable instructions may be configured to cause a server to perform operations such that performing application level routing operations using contextual information derived from the internal representation to identify a destination component includes using at least one pipeline stage to make a routing decision using a discrete number of configurable procedures. In a further embodiment, the stored server-executable instructions may be configured to cause a server to perform operations such that the pipeline type is one of a request handler pipeline, a response handler pipeline, a failover handler pipeline, or a redirect handler pipeline. In a further embodiment, the stored server-executable instructions may be configured to cause a server to perform operations such that the pipeline type and instance is selected on a per message type or on a per application basis. In a further embodiment, the stored server-executable instructions may be configured to cause a server to perform operations such that the pipeline has a plurality of stages that include at least one stage from the group consisting of a realm routing lookup stage, a session lookup stage, a gather data stage, a routing core stage, a prepare AVS stage, a filter stage, a dispatcher stage, a session update stage, and a redirect stage.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate exemplary aspects of the invention, and, together with the general description given above and the detailed description given below, serve to explain features of the invention.

[0007] FIG. 1 is a communication system block diagram illustrating network components of a communication system having an evolved packet core (EPC) architecture suitable for use in the various embodiments.

[0008] FIG. 2 is a communication system block diagram illustrating network components of an example communication-system having a policy and charging control (PCC) network in accordance with the various embodiments.

[0009] FIG. 3 is a network architectural diagram illustrating logical components and information flows in an example policy and charging control network.

[0010] FIG. 4 is a network architectural diagram illustrating logical components and communication protocols in an example policy and charging control network.

[0011] FIG. 5 is an illustration of an example message structure for communicating signaling information suitable for use with an embodiment.

[0012] FIG. 6 is a network architectural diagram illustrating an expanded policy and charging control network having multiple instances of the same logical components.

[0013] FIG. 7A is a network architectural diagram illustrating an expanded policy and charging control network that includes a Diameter routing agent (DRA).

[0014] FIG. 7B is an architectural diagram illustrating an expanded policy and charging control network that includes a dynamic context router (DCR) in accordance with various embodiments.

[0015] FIG. 8 is a component block diagram illustrating the logical components and communication links of an example dynamic context router system in accordance with various embodiments.

[0016] FIG. 9 is an architectural diagram illustrating example signaling and message flows in a network that includes a dynamic context router system in accordance with the various embodiments.

[0017] FIG. 10A is a process flow diagram illustrating an embodiment dynamic context router method for receiving, processing and transmitting signaling messages in accordance with various embodiments.

[0018] FIG. 10B is a process flow diagram illustrating an embodiment dynamic context router method for determining if a specific instance of a destination node is required to perform load balancing and context routing operations in accordance with various embodiments.

[0019] FIG. 11 is an architectural diagram illustrating example logical components and information flows of an example dynamic context router system in accordance with an embodiment.

[0020] FIG. 12 is an illustration of an example dynamic context router topology tree that may be used for performing routing and load balancing operations by hierarchy in accordance with various embodiments.

[0021] FIG. 13 is a process flow diagram illustrating an embodiment dynamic context router method for processing Diameter messages in accordance with various embodiments.

[0022] FIG. 14 is a process flow diagram illustrating an embodiment dynamic context router method for performing hunting operations in accordance with various embodiments.

[0023] FIGs. 15A-17C are network architectural diagrams illustrating logical components and information flows of example dynamic context router systems configured to perform failover operations in accordance with various embodiments.

[0024] FIG. 18 is a network architectural diagram illustrating example logical components and information flows of an example dynamic context router system configured to perform fork routing operations.

[0025] FIG. 19 is a process flow diagram illustrating an embodiment dynamic context router method for performing fork routing operations in accordance with various embodiments.

[0026] FIG. 20 is a component block diagram illustrating the logical components and interfaces of an example dynamic context router system in accordance with the various embodiments.

[0027] FIG. 21 is an illustration of an example request message processing pipeline in a dynamic context router system.

[0028] FIG. 22 is an illustration of an example response message processing pipeline in a dynamic context router system.

[0029] FIG. 23 is an illustration of an example failover message processing pipeline in a dynamic context router system.

[0030] FIG. 24 is an illustration of an example message redirect processing pipeline in a dynamic context router system.

[0031] FIG. 25 is a component block diagram of a server suitable for use with an embodiment.

DETAILED DESCRIPTION

[0032] The various embodiments will be described in detail with reference to the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. References made to particular examples and implementations are for illustrative purposes, and are not intended to limit the scope of the invention or the claims.

[0033] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any implementation described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other implementations.

[0034] The terms "mobile device," "wireless device" and "user equipment (UE)" may be used interchangeably and refer to any one of various cellular telephones, smartphones (e.g., iPhone®), personal data assistants (PDA's), palm-top computers, tablet computers, laptop computers, wireless electronic mail receivers (e.g., Blackberry®), VoIP phones, wire-line devices, devices implementing Machine-to-Machine (M2M) technologies,

multimedia/Internet enabled cellular telephones, and similar electronic devices capable of sending and receiving wireless communication signals. A wireless device may include a programmable processor and memory. In a preferred embodiment, the wireless device is a cellular handheld device (e.g., a mobile device), which can communicate via a cellular telephone communications network.

[0035] The phrases "Diameter reference points," "Diameter applications," and "Diameter interfaces" may be used interchangeably and refer to specific implementations of the Diameter protocol. However, when possible, the phrase "Diameter application" is used to describe an extension of the Diameter base protocol (which is built on top of the Diameter base protocol) and the phrase "Diameter reference point" is used to describe an interface between network components that employ the Diameter protocol to realize communications (i.e., network components realize communications over a reference point). Diameter applications may use the same name as Diameter reference points (e.g., Gx reference point and Gx Diameter application), the distinction being that at each end of the reference point there may be a client node and a server node.

[0036] As used herein, the word "domain" refers to a logical entity configured entirely within the DCR system that can be used to represent any routing destination based on a scenario. It should be understood that the domains discussed herein differ from, and provide functionality over and above those provided by, the domain-like concepts present in the Diameter protocol standard. Examples include the "Destination-Realm" and "Destination-Host" attribute-value-pairs (AVPs).

[0037] The term "attribute value stream" and its acronym "AVS" are used herein to refer to a message structure that stores information corresponding to information carried by a telecommunications network message (e.g., a Diameter message). Each AVS may include one or more structured fields (e.g., a session identification field, a policy and charging rules function identification field, a domain field, an origin-host field, a subscriber identification field, an address field, etc.), and may be used by a dynamic context router (DCR) system as internal representation of a telecommunications network message (e.g., a Diameter message).

[0038] A number of different cellular and mobile communication services and standards are available or contemplated in the future, all of which may implement and benefit from the various embodiments. Such services and standards include, e.g., third generation partnership project (3GPP), long term evolution (LTE) systems, third generation wireless mobile communication technology (3G), fourth generation wireless mobile communication technology (4G), global system for mobile communications (GSM), universal mobile telecommunications system (UMTS), 3GSM, general packet radio service (GPRS), code division multiple access (CDMA) systems (e.g., cdmaOne, CDMA2000TM), enhanced data rates

for GSM evolution (EDGE), advanced mobile phone system (AMPS), digital AMPS (IS-136/TDMA), evolution-data optimized (EV-DO), digital enhanced cordless telecommunications (DECT), Worldwide Interoperability for Microwave Access (WiMAX), wireless local area network (WLAN), Wi-Fi Protected Access I & II (WPA, WPA2), and integrated digital enhanced network (iden). Each of these technologies involves, for example, the transmission and reception of signaling and content messages. It should be understood that any references to terminology and/or technical details related to an individual standard or technology are for illustrative purposes only, and are not intended to limit the scope of the claims to a particular communication system or technology unless specifically recited in the claim language.

[0039] The various embodiments provide methods, devices and systems for managing communications in a network. The various embodiments provide a dynamic context router (DCR) that operates as a flexible, protocol agnostic, application-level router and load balancer. The dynamic context router may perform message routing, relay, and redirect operations. The dynamic context router may identify communication partners and/or determine resource availability. The dynamic context router may make routing and load-balancing decisions dynamically based on the context and content of the information being communicated. The dynamic context router may look inside the messages being communicated and make intelligent decisions based on the content of the messages. The dynamic context router may make calls to external systems requesting additional information for a specific message being communicated. The dynamic context router may request information from external systems and use the information to modify the contents of the information being communicated or to aid in the routing and/or load balancing operations. The dynamic context router may store information specific to a particular network node, protocol, application, message or message type in an internal memory and reference the internal memories when processing future communications related to that node, protocol, application, message or message type. The dynamic context router may update its routing and load balancing algorithms as internal/external data changes.

[0040] In an embodiment, the dynamic context router may provide pipelining, topology hunting, and/or message forking operations.

[0041] In an embodiment, the dynamic context router may access subscriber information stored in subscriber profile repositories (SPRs) and use the subscriber information to aid its routing and load balancing operations. In an embodiment, the dynamic context router may modify the contents of the messages being communicated with subscriber information retrieved from a subscriber profile repository. In an embodiment, the dynamic context router may access online charging systems (OCSs) or off-line charging systems (OFCSs), and use charging and/or billing information from those systems to aid its

routing and load balancing operations and/or to modify the contents of the messages being communicated. In an embodiment, the dynamic context router may access additional business support systems (BSS)/operations support systems (OSS) to aid its routing and load balancing operations and/or to modify the contents of the messages being communicated.

[0042] In an embodiment, the dynamic context router (DCR) may generate, procure and/or use a topology tree, referred to herein as a "DCR topology tree." The DCR topology tree may be used to efficiently identify and locate nodes in the network. In an embodiment, the dynamic context router may use the DCR topology tree to perform routing and load balancing operations by hierarchy.

[0043] In an embodiment, the dynamic context router may perform message destination hunting operations to identify a correct instance of a destination node that cannot otherwise be ascertained from information included within the message or otherwise available. In an embodiment, the dynamic context router may use the DCR topology tree to performing hunting operations by hierarchy.

[0044] In an embodiment, the dynamic context router may communicate with a dictionary to receive decoding rules that can be used for decoding message types with which the dynamic context router is unfamiliar. In an aspect, the dictionaries may be implemented as databases, and the dictionary databases may be internal to the dynamic context router or external to the dynamic context router (e.g., may exist on dictionary servers). In an embodiment, the external dictionaries may be hosted "in the cloud" as part of a cloud computing implementation. In an embodiment, external dictionary servers may be used to centralize the configuration of the protocol capabilities. In an embodiment, the dynamic context router may access partial dictionaries to receive only the minimum amount of a rule or rules required to successfully decode messages, reducing latency and improving processing speeds.

[0045] In an embodiment, the dynamic context router may decode messages in multiple phases. For example, the dynamic context router may decode only a small portion of a message in a first phase and, if necessary, perform more extensive decoding operations in a second phase. In an embodiment, the need for the second phase of decoding may be determined based on the first phase decoding results and/or any combination of contextual and static information.

[0046] In an embodiment, the dynamic context router may incrementally decode messages. In this embodiment, incremental decoding may begin with decoding an initial portion of the message, and determining if the decoded portion identifies a destination component or if the destination component can be derived from the decoded portion. When it is determined that the previously decoded portions do not identify the destination component and/or that the destination component cannot be derived using the previously decoded portions, the dynamic con-

text router may then recursively decode subsequent portions of the message. The need for the continued decoding of additional portions of the message may be based on whether or not information extracted from the decoded portions may be used by the dynamic context router to identify a destination component.

[0047] In an embodiment, the dynamic context router may perform opaque proxy operations. In this embodiment, if the dynamic context router receives a message that is either partially syntactically or semantically invalid (and thus "opaque"), instead of sending an error message, the dynamic context router may decode only a portion of the message, leaving the rest of the message in the original format (e.g., binary wire format), package the message into a network transparent container, and send the container including the message to the destination node. In this manner, the dynamic context router may operate in a loose, tolerant mode that improves processing speeds, while supporting network nodes that do not fully comply with a particular standard.

[0048] In an embodiment, the dynamic context router may perform protocol translation operations. In an embodiment, the dynamic context router may include a flexible protocol translator module which converts received messages from a first protocol into a second protocol. In various embodiments, the first protocol may be the same as the second protocol, a subset of the second protocol, a superset of the second protocol, compatible with the second protocol, or completely independent of the second protocol.

[0049] In an embodiment, the dynamic context router may perform protocol translation operations even when the first and second protocols are the same.

[0050] Often, network nodes vary in their implementation of the same set of standards. This often occurs when the nodes are manufactured by different vendors or are operating different versions of software. For example, a vendor's implementation of a standard may not fully comply with the standards, the standards may have changed since the nodes were deployed, or there may be differences in implementations due to non-standard extensions. In such cases, messages originating from a source node may not be accepted by a destination node, even though the source node and the destination node implement the same protocol. In such cases, the dynamic context router may identify the differences in the implementations and change the structure and/or the content of the messages to ensure that the messages will be accepted by the destination node. This embodiment improves network efficiency by providing a protocol agnostic interface between source and destination nodes in a network. Source nodes may communicate with the dynamic context router using any protocol supported by the dynamic context router, and do not need to be informed of the protocols supported by the destination nodes. New instances of any destination node may be added to the network without informing the source nodes of the existence of the new destination node or of the protocols as-

sociated with the new node. Likewise, new instances of the source nodes may be added to the network without requiring the new source nodes to be informed of the other nodes in the network, their protocols, or the other intimate details of the network.

[0051] In an embodiment, the dynamic context router may perform protocol translation operations when the first protocol is completely independent of the second protocol. For example, the dynamic context router may receive hypertext transfer protocol (HTTP) messages and convert the messages into Diameter messages.

[0052] The dynamic context router may provide a protocol agnostic interface between source and destination nodes in a network which may serve to provide topology hiding and allow inter-protocol communication within a network. In an embodiment, the dynamic context router may operate as both a server and a client to further facilitate topology hiding. As mentioned above, the dynamic context router may receive messages from source nodes in a first protocol and send messages to a destination node in a second protocol. In an embodiment, the dynamic context router may remove all network specific information for each of the messages that it relays such that the source and destination nodes cannot determine the network topology through which the messages were routed. In an embodiment, the dynamic context router may perform physical topology hiding operations by removing all addressing information that may identify the location of the source nodes to the destination nodes, and the destination nodes to the source nodes.

[0053] The various embodiments provide scalable, distributed, highly available dynamic context router (DCR) systems capable of fast and efficient expansion. As discussed above, operator networks are expanding at an unprecedented rate. As these operator networks expand, so will the amount of signaling traffic that must be processed by each dynamic context router. To support this anticipated increase in workload, the various embodiments provide highly-available, highly-scalable dynamic context router systems that can support the addition of resources (e.g., additional cores, memories, servers, etc.), while maintaining high-availability.

[0054] The various embodiments provide dynamic context router systems configured to manage component failures. The dynamic context router may manage component failures by performing failover operations that automatically switch over to a redundant component (e.g., blade, server, DCR core, memory, network node, etc.) upon the failure or abnormal termination of a component. As new resources are introduced into the network and the dynamic context router systems, the probability of one or more components (e.g., server, processor, hard drive, DCR core, memory, etc.) failing increases. Various embodiments provide dynamic context router systems configured to perform multi-level and multi-tier failover operations that ensure continued dynamic context router operations in the event of multiple component failures. In an embodiment, the dynamic context router system

may be deployed in redundant pairs configured in a distributed array architecture with work load balancing schemes which, in combination, ensure continued dynamic context router operations in the event of failures.

[0055] As mentioned above, for reasons of availability and scalability it is common for multiple instances of particular network elements to be deployed within the same operator network. The deployment of multiple instances of the same component within a single network gives rise to both functionality and configuration overhead. Further, in cases where peer relationships traverse administrative boundaries, the network topology may be exposed across that boundary. Telecommunication system operator networks are particularly exposed in this regard, especially with the emergence of inter-operator Diameter applications, such as S9 and S6a. To meet these and other concerns, the various embodiments provide an extensive and flexible routing logic engine that may be configured to act as a network edge termination point or landing zone for roaming partners wishing to participate in these types of (e.g., Diameter) relationships.

[0056] In an embodiment, the dynamic context router (DCR) may perform application-level topology hiding operations. Certain protocols (e.g., Diameter) have application-level addresses. For example, each Diameter message includes a Diameter address (e.g., Origin-Host address) built into the structure of the messages that cannot be removed. In various embodiments, the dynamic context router may receive messages from source nodes, decode the message contents and store them in a memory, terminate the message, and create a new message that includes all of the stored contents, but not the address information of the source node.

[0057] In an embodiment, the dynamic context router may operate as a software appliance (i.e., may run on commodity hardware) that is capable of routing and load balancing network traffic using both static and context based routing rules.

[0058] The various embodiments may be implemented within a variety of communication systems, an example of which is illustrated in FIG. 1. Wireless devices 102 may be configured to send and receive voice, data and control signals to and from a service network 36 (and ultimately the Internet) using a variety of communication systems/technologies (e.g., GPRS, UMTS, LTE, cdmaOne, CDMA2000TM). For example, general packet radio service (GPRS) data transmitted from a wireless device 102 is received by a base transceiver station (BTS) 12 and sent to a base station controller (BSC) and/or packet control unit (PCU) component (BSC/PCU) 18. Code division multiple access (CDMA) data transmitted from a wireless device 102 is received by a base transceiver station 12 and sent to a base station controller (BSC) and/or point coordination function (PCF) component (BSC/PCF) 22. Universal mobile telecommunications system (UMTS) data transmitted from a wireless device 102 is received by a NodeB 14 and sent to a radio network controller (RNC) 20. Long term evolution (LTE) data transmitted

from a wireless device 102 is received by an eNodeB 16 and sent directly to a serving gateway (SGW) 28 located within the EPC 40.

[0059] The BSC/PCU 18, RNC 20 and BSC/PCF 22 components process the GPRS, UMTS and CDMS data, respectively, and send the processed data to a node within the EPC 40. More specifically, the BSC/PCU 18 and RNC 20 units send the processed data to a serving GPRS support node (SGSN) 24 and the BSC/PCF 22 sends the processed data to a packet data serving node (PDSN) and/or high rate packet data serving gateway (HSGW) component (PDSN/HSGW) 30. The PDSN/HSGW 30 may act as a connection point between the radio access network and the IP based PCEF/PGW 32. The SGSN 24 is responsible for routing the data within a particular geographical service area and may send signaling (control plane) information (e.g., information pertaining to call set-up, security, authentication, etc.) to a mobility management entity (MME) 26. The MME may request user and subscription information from a home subscriber server (HSS) 42, perform various administrative tasks (e.g., user authentication, enforcement of roaming restrictions, etc.), select a SGW 28, and send administrative and/or authorization information to the SGSN 24.

[0060] Upon receiving the authorization information from the MME 26 (e.g., an authentication complete indication, an identifier of a selected SGW, etc.), the SGSN 24 sends the GPRS/UMTS data to a selected SGW 28. The SGW 28 stores information about the data (e.g., parameters of the IP bearer service, network internal routing information, etc.) and forwards user data packets to a policy control enforcement function (PCEF) and/or packet data network gateway (PGW) 32. The PCEF/PGW 32 sends signaling information (control plane) to a policy control rules function (PCRF) 34. The PCRF 34 accesses subscriber databases, creates a set of policy rules and performs other specialized functions (e.g., interacts with online/offline charging systems, application functions, etc.) and sends the intelligent policy rules to the PCEF/PGW 32 for enforcement. The PCEF/PGW 32 implements the policy rules to control the bandwidth, the quality of service (QoS), and the characteristics of the data, and services being communicated between the service network 36 and the end users.

[0061] FIG. 2 illustrates various logical components in an example communication system 100 suitable for implementing the various embodiments. Wireless devices 102 may be configured to communicate via a cellular telephone network, a radio access network (e.g., UTRAN, RAN, etc.), WiFi network, WiMAX network, and/or other well known technologies (e.g., GPRS, UMTS, LTE, cdmaOne, CDMA2000TM). FIG. 2 illustrates that wireless devices 102 may be configured to transmit and receive voice, data, and control signals to and from a base station (e.g., base transceiver station, NodeB, eNodeB, etc.) 104. The base station may be coupled to a controller (e.g., cellular base station, radio network controller, service gateway, etc.) operable to com-

municate the voice, data, and control signals between mobile devices and to other network destinations. In the illustrated example of FIG. 2, the base station 104 communicates with an access gateway 110, which serves as the primary point of entry and exit of wireless device traffic and connects the wireless devices 102 to their immediate service provider and/or packet data networks (PDNs). The access gateway 110 may include one or more of a controller, a gateway, a serving gateway (SGW), a packet data network gateway (PGW), an evolved packet data gateway (ePDG), a packet data serving node (PDSN), a serving general packet radio service support node (SGSN), or any combination of the features/functions provided thereof. Since these structures are well known, certain details have been omitted in order to focus the descriptions on the most relevant features.

[0062] The access gateway 110 forwards the voice, data, and control signals to other network components as user data packets, provides connectivity to external packet data networks, manages and stores contexts (e.g. network internal routing information, etc.), and acts as an anchor between different technologies (e.g., 3GPP and non-3GPP systems). The access gateway 110 may coordinate the transmission and reception of data to and from the Internet 107, as well as the transmission and reception of voice, data and control information to and from an external service network 120 connected to the Internet 107, to other base stations 104 and to wireless devices 102. The access gateway 110 may also route control information to a policy and charging control (PCC) network 112, which may be a part of an implementation of an evolved packet core (EPC)/long term evolution (LTE) architecture. In the various embodiments, the access gateway 110 may be a part of the policy and charging control network 112, and the functions described may be implemented in a single computing device or in many computing devices coupled in a local area network or wide area network using any of the above mentioned telecommunication technologies (e.g., 3G, 4G, GPRS, UMTS, LTE, etc.).

[0063] Returning to FIG. 2, as mentioned above, the access gateway 110 routes control/signaling information (e.g., call setup, security, authentication, charging, enforcement of policy rules, etc.) to the policy and charging control (PCC) network 112, which is an example of a telecommunications signaling network. The PCC network 112 provides policy and service control rules, controls charging functionalities, and provides quality of service (QoS) authorizations, as discussed in further detail below. The PCC network 112 may include one or more components for a policy and charging enforcement function (PCEF) 114, a policy charging rules function (PCRF) 116, an off-line charging system (OFCS) 118, an on-line charging system (OCS) 120, a subscriber profile repository (SPR) 122, and an application function (AF) 124. Components in the PCC network 112 (e.g., PCEF, PCRF, OFCS, OCS, SPR, AF) may communicate using a standardized protocol, such as the Diameter protocol,

remote authentication dial in user service (RADIUS) protocol, session initiation protocol (SIP), or any other protocol.

[0064] To focus the discussion on the relevant features and functionalities, the various embodiments are described with reference to the Diameter protocol. However, it is to be understood that the various embodiments are protocol agnostic and should not be limited to the Diameter protocol unless expressly recited in the claims.

[0065] FIG. 3 is an architectural diagram illustrating communications between the various logical components in a PCC network 112. The PCC network 112 may include a policy and charging enforcement function (PCEF) component 114 that serves as the primary enforcement point, gateway and a routing mechanism between the Internet and the radio infrastructure/radio access network. As discussed above, the PCEF component 114 may be a part of, or perform operations typically associated with, a gateway GPRS support node (GGSN), a packet data network gateway (PGW), or other similar components. Detailed information about policy and charging enforcement function operations may be found in "3rd Generation Partnership Project Technical Specification Group Services and System Aspects, Policy and Charging Control Architecture," TS 23.203 (updated June 12, 2011), the entire contents of which are incorporated herein by reference.

[0066] The PCEF 114 may receive signaling messages from a gateway (e.g., Access Gateway 110 illustrated in FIG. 2) and use information contained within the signaling messages to select an optimal route and a quality of service (QoS) for a particular type of services, as well as to enforce various policies on those services. The enforcement of policies may include querying, coordinating, removing, revoking and/or adjusting various resources (e.g., network resources, subscriber resources, etc.) based on a set of policy rules.

[0067] The PCEF 114 enforces policies by implementing a set of policy rules. Each policy rule may govern the services, QoS, and/or bandwidth that are to be made available to a particular subscriber. The policy rules may also govern the times when certain services are made accessible to the subscriber (e.g. weekdays from 9AM to 5PM, etc.) and how long the subscriber may access those services (e.g., 15 minutes at a time, a total of two hours, etc.)

[0068] The PCRF 116 is responsible for identifying the appropriate policy rules for a given communication session of a given subscriber or terminal device, and sending the identified policy rules to the PCEF 114 for enforcement. Specifically, the PCRF 116 is responsible for generating, compiling, and selecting a set of business and technology rules that define the policies that are to be enforced for particular call sessions. The PCRF 116 may make rule decisions on a per-subscriber, per-session and/or per-service basis. For example, the PCRF 116 may use subscriber information (e.g., subscriber's city of residence), the current usage parameters (e.g., day of

week, time of day, peak hours, etc.), the subscriber's service level (e.g., Gold, Bronze, etc.), and other information related to the subscriber, session, or service to generate and/or select one or more rules or a rule group. The selected rules or rule group may be communicated to the PCEF 116 (e.g., via the Gx interface) as a profile that defines the policies to be enforced. The PCRF 116 may include one or more databases for storing default rules, maintaining generated rules and keeping track of session information.

[0069] The PCRF 116 may request subscriber profile information from the subscriber profile repository (SPR) 122, which maintains subscriber profiles (e.g., customer IDs, preferences, subscription levels, balances, etc.) in one or more data stores.

[0070] An application function (AF) 124 represents a node involved in the delivery of an application or service (e.g., voice-over-IP, voice and video call, video-on-demand, etc.) that may be used by a subscriber or that may have dealings with the subscriber. The AF 124 may communicate with the PCRF 116 to ensure that the generated rules are sufficient to provide subscribers with a quality of service (QoS) commensurate with the requirements of their requested services/flows. For example, if a current policy is being enforced based on rules for receiving a particular service (e.g., a voice-over-IP call) and the subscriber requests an additional amount of a given service, or another service (e.g., a voice and video call), the application function 124 component may push a new set of rules to the PCRF 116 reflecting the service changes (e.g., QoS, etc.) required for the additional services. The application function may also store information unique to each subscriber, service, session, and/or application.

[0071] In addition to receiving rules from the PCRF 116, the PCEF 114 component may also communicate with an on-line charging system (OCS) 120 and an offline charging system (OFCS) 118 to identify the policies that are to be enforced and/or to ensure proper charging. For example, the PCEF 114 may periodically inform the OFCS 118 of the amount of wireless data that is being used by a subscriber. The OFCS 118 may use this information to monitor the aggregate amount of data/service used by each subscriber, and to generate a record that may be collected, processed, formatted, correlated, aggregated, filtered, and/or sent to an external billing system for processing into a billing statement. In order to monitor the data/service usage of each subscriber, the OFCS 118 may store information related to each subscriber, session, and/or service.

[0072] The PCEF 114 may also periodically inform the OCS 120 of services requested by a subscriber. The OCS 120 is generally responsible for determining if the subscriber has sufficient funds/credits/access units to receive a requested service. In various embodiments, the OCS 120 may also perform other operations related to charging, balance management and real time rating. The OCS 120 may grant or deny access based on the amount of fund/credits/access units available. In an embodiment,

the OCS 120 may manage pre-pay services. In an embodiment, the OCS 120 may manage a combination of pre-pay and post-pay services in which some (or a portion) of the services require a pre-paid balance and some (or a portion) of the services may be billed to the client. In any case, the PCEF 114 may issue requests for service authorization to the OCS 120, and the OCS 120 may respond with a message granting or denying authorization. As part of its operations, the OCS 120 may store information unique to each subscriber, session, and/or service.

[0073] FIG. 4 is an architectural diagram illustrating the use of Diameter applications for communications between the various logical components in an example policy and charging control (PCC) network 400. As mentioned above, the logical components may communicate using a protocol, such as RADIUS, SIP or Diameter. Diameter is a protocol standardized by the Internet Engineering Task Force (IETF) and adopted by the Third Generation Partnership Project (3GPP). Diameter is an extensible protocol that provides a general mechanism for two or more nodes in a network to communicate signaling information (e.g., communications involving call setup, security, authentication, charging, enforcement of policy rules). Diameter also includes numerous access control features that make it highly useful in authentication, authorization, and accounting (AAA) systems as well as in the policy and charging control network 112. Detailed information about the Diameter protocol may be found in "Network Working Group Request for Comments: 3588; Diameter Base Protocol," the entire contents of which are hereby incorporated by reference for purposes of disclosing the protocol details.

[0074] The Diameter protocol provides a base protocol (i.e., "Diameter base protocol") and a framework for defining custom extensions (i.e., "Diameter applications") to the base protocol. The base protocol defines a set of generic messages useful for low-level operations (e.g., establishing connectivity, hand-shaking, etc.) and the framework allows application-developers to develop Diameter applications (i.e., extensions of the Diameter base protocol) that define custom messages for more specialized operations. By extending the Diameter base protocol, Diameter applications may use all of the features provided by the Diameter base protocol, as well as any custom protocol extensions they define. For example, a Diameter application may use Diameter base protocol components to define exactly how messages are to be communicated and define custom extensions that describe the content of the messages being communicated.

[0075] As mentioned above, logical components (e.g., PCEF 114, PCRF 116, AF 124, SPR 122, OCS 120, OFCS 118) in the PCC network 400 may use the Diameter protocol to communicate with each other. Components that use the Diameter protocol may support various standardized Diameter applications (e.g., Gx, Gy, Gz, Rx, Sy, etc.) that are especially well suited for their spe-

cialized operations.

[0076] The logical components (e.g., PCEF 114, PCRF 116, AF 124, SPR 122, OCS 120, OFCS 118) in the PCC network 400 may also communicate with resources outside of the provider network. For example, the PCRF 116 in a home provider network may need to communicate with a PCRF 410 in another provider network, such as while a subscriber's cell phone roams in the other provider's network. The external PCRF 410 may communicate with the appropriate logical components (e.g., PCRF 116, OCS 1201, etc.) in the home provider network to ensure proper charging, QoS, charging, etc. In the illustrated example, the external PCRF 410 communicates with PCRF 116 through the S9 interface.

[0077] To focus the discussion on the relevant features, various logical components (e.g., PCEF, PCRF, AF, SPR, OFCS, OCS, etc.) are described as using specific Diameter protocols. However, it should be understood that any protocol may be used (e.g., RADIUS, SIP, etc.) and nothing in the claims should be limited to a particular interface, protocol or application, unless expressly recited in the claims.

[0078] FIG. 5 illustrates the message structure of an example Diameter message 502 suitable for encoding signaling information. Diameter messages 502 have a fixed structure that includes a message header portion 504 and a message payload/body portion 506. The message header 504 contains general information about the message, such as version information 512, bit flags 514, message length 516, a command code 518, an application ID 520, a hop-by-hop identifier 522, and an end-to-end identifier 524. The version information 512 field identifies a Diameter protocol version. The bit flags 514 provide administrative information that may be used to process the message. For example, the first bit ("R") may indicate if the message is a request or an answer, the second bit ("P") may indicate if the messages must be processed locally or is proxiable (e.g., may be proxied, relayed, or redirected), the third bit ("E") may indicate if the message is a standard message or an error message, the fourth bit ("T") may indicate if the messaging is being sent for the first time or if there is a probability that the message is being re-transmitted, etc. The application ID 520 identifies a type of application (authentication, accounting, vendor specific, etc.) to which the message is related. The hop-by-hop identifier 522 is a unique ID that may be used to match requests to answers and send answer messages back to the requesting component. The end-to-end identifier 524 is a time-limited ID generated by the originator of a request message that should not be changed by intermediate network nodes or by the responder to the message. It is used for correlating responses with requests and for detecting duplicate messages.

[0079] The command code 518 identifies a message type of the Diameter message 502. There are several standard Diameter message types (e.g., Accounting-Request, Device-Watchdog-Answer, etc.) defined by the Di-

ameter base protocol. Network components may quickly identify the type of information carried by a particular Diameter message 502 by examining the command code message header 504. For example, a node receiving an "Accounting-Request" message needs only examine the command code (e.g., "271") in the message header 504 to identify the message as an accounting message.

[0080] The Diameter message body 506 contains the actual data/signaling information that is being communicated. The signaling information may be stored in one or more attribute-value-pairs (AVPs) 508, which may nest other attribute value pairs (nested AVPs) 510. Attribute-value-pairs 508, 510 are extendable data-structures that include a header portion 526 and a data portion 528. The header portion 526 may include general information about the attribute-value-pair, such as an AVP code 530, message length 532, an optional vendor ID 534, and various bit flags 536. The data portion 528 may store simple data (e.g., integer, unsigned, float, etc.) or complex data (e.g., other AVPs), in an encoded format. The data portion 528 may encapsulate protocol-specific data (e.g., routing information) as well as authentication, authorization, or accounting information.

[0081] The AVP code 530 field may identify an AVP type. The Diameter base protocol defines a number of standard AVP types (i.e., attributes). Diameter applications extending the base protocol inherit all of the AVP types defined by the base protocol and may define new AVP types unique to each application. AVP codes may be combined with the optional vendor-ID 534 field to uniquely identify an attribute.

[0082] FIG. 6 illustrates an expanded policy and charging control (PCC) network 600 having more than one instances of each of the PCEF (114a-c), PCRF (116a-c), AF (124a-c), OCS (120a-c) and/or OFCS (118a-c) components, as well as a connection to an external PCRF 410. As operator networks expand to meet increased traffic and user demands, multiple instances of the same component may be implemented within a single policy and charging control network 600. Each instance may be uniquely addressable and store information relevant to a particular service, application, session or subscriber in a local memory or database. For example, the first time a destination component (e.g., PCRF 116a) receives a Diameter message from a source component (e.g., PCEF 114a) for a particular subscriber, the destination component (PCRF 116a) may store session information related to that subscriber in a local session database. Subsequent Diameter messages may require access to the session information stored by that particular instance of the destination component (e.g., PCRF 116a). Before the introduction of the DRA there was no method for identifying the desired instances of components within the policy and charging control network 600, and each component was required to discover the correct instance by trial and error. As the operator networks continue to grow, managing communications between the various instances of the various components in a PCC network in a se-

cure and efficient manner is becoming ever more important.

[0083] FIG. 7A illustrates the role of a Diameter routing agent (DRA) 702 in an expanded policy and charging control (PCC) network 700. A Diameter routing agent is a concept introduced by 3GPP in its specifications for facilitating Gx, Gxx, S9, and Rx communications with a particular instance of a PCRF (e.g., 116) when multiple and separately addressable PCRFs (e.g., 116a-c) are deployed in the same Diameter realm. Source components can send messages to a Diameter routing agent (as opposed to the destination node) and rely on the Diameter routing agent to forward the message to the appropriate node. This allows the routing logic required to identify and locate a destination node to be decoupled from the source nodes and included in a specialized component (i.e., the Diameter routing agent).

[0084] However, the 3GPP specifications only identify the general role of a Diameter routing agent (DRA) in a Diameter network, which is to provide a proxy, relay or redirect services in networks having multiple PCRFs. For example, in a PCC network 700, the role of a Diameter routing agent (e.g., DRA 702) may be to manage PCEF 114a communications (e.g., Gx-1, Gx-2) with various instances of the PCRF (116a, 116b) by receiving Gx messages and relaying the Gx messages to the correct instance of the PCRF 116. The Diameter routing agent (e.g., DRA 702) may also manage communications (e.g., Rx-1, Rx-2) between the various instances of the PCRF 116 and AF 124 by performing simple proxy, relay or redirect operations.

[0085] While the Diameter routing agents (e.g., DRA 702) may simplify routing operations in a policy and charging control (PCC) network, they are primarily focused on routing messages involving policy control rules functions (PCRFs). In particular, Diameter routing agents only support specific interfaces (e.g., Gx, Gxx, S9 and Rx); do not perform intelligent routing operations, are unaware of the context of the messages; cannot augment messages; do not support dynamic operations; do not have built-in support for future protocols/ Diameter applications; cannot hide the network topology; cannot perform true translation operations; cannot covert messages into different protocols, and are not resilient in the event of failover.

[0086] FIG. 7B illustrates an expanded policy and charging control (PCC) network 700 that includes a dynamic context router (DCR) 706 in accordance with the various embodiments. A dynamic context router 706 is flexible, protocol agnostic, application-level router and load balancer that may be used to manage communications between the various instances of the various components in a network to ensure that the correct messages are sent to the correct instances. Some of the application layer functions performed by the dynamic context router 706 may include identifying communication partners, and determining resource availability. The identification of communication partners may include determining the

identity and availability of communication partners for an application requesting a communication session to transmit data.

[0087] The dynamic context router 706 allows the routing logic required to identify and locate a destination node to be decoupled from the source nodes. Source nodes may communicate with the dynamic context router 706 using any Diameter application (e.g., Gx, Gy, Gz, Rx, Sy, etc.) and do not need to know the protocol requirements and Diameter applications of the destination nodes. In this manner, new instances of any destination node may be added without having to inform the source nodes of the existence of the new destination node or of the protocols associated with the new node. Likewise, new instances of the source nodes may be added to the PCC network 700 without informing the new nodes of the other nodes (and vice versa), their protocols, or other intimate details of the PCC network 700.

[0088] The dynamic context router 706 may make routing and load-balancing decisions dynamically for each instance of an application/message based on the context and content of the data being communicated. The dynamic context router 706 may look inside the messages being communicated and make intelligent decisions based on the content of the messages. The dynamic context router 706 may make calls (e.g., function calls, etc.) to external systems to request additional information for a specific message being communicated. The dynamic context router 706 may receive additional information from external systems and use the information to augment the message, to aid in message routing, and/or to accomplish load balancing operations. The dynamic context router 706 may store information specific to a particular network node, protocol, application, message or message type in an internal memory, and reference the internal memories for message processing. As internal/external data changes, the dynamic context router 706 may update the routing and load balancing decision-making logic to reflect the changes in internal/external data.

[0089] In an embodiment, the dynamic context router may enable node upgrades without interrupting service. For example, a first PCEF in communication with a single PCRF (e.g., using Gx) may require upgrades or may need to be replaced without interrupting the service. The dynamic context router allows a second PCRF to be introduced into the network without any interruption of service by routing old messages (e.g., all existing Gx session messages) to the first PCRF, and all new message (e.g., new Gx session messages) to the second PCRF. The dynamic context router may indicate when all of the old sessions have terminated, identifying when the old PCRF can be safely removed. In an embodiment, a dynamic context router may be removed from the network after the new PCRF is introduced without interrupting operations. In an embodiment, a dynamic context router may be introduced into the network along with, or immediately prior to, the second PCRF and removed from the network after the new PCRF is introduced.

[0090] In an embodiment, the dynamic context router may use contextual information obtained from response messages to influence future routing decisions. This contextual information may be either intentionally placed within the response message for use by the dynamic context router, or it may normally be there. For example, a dynamic context router that is load balancing between five equal PCRFs may initially use a round-robin algorithm. However, some requests may require more processing than others, and the PCRF loads may differ. In an embodiment, each PCRF may include an additional proprietary parameter in the response messages indicating its current work load, which may be used as contextual information by the dynamic context router when making future load balancing routing decisions.

[0091] In an embodiment, the dynamic context router may utilize a PCRF that is highly optimized for a very limited set of functionality (e.g., a "Voice over LTE" optimized PCRF). For example, when the dynamic context router is routing a message to a PCRF it may use contextual information to choose the right type of DCR. As another example, the dynamic context router may be configured to host simple application logic such that if a certain type of service is not permitted in the network (regardless of all other criteria such as user details) the DCR can respond to the request message directly without needing to send the request message to a PCRF. Thus, in an embodiment, the dynamic context router may shield the PCRFs from additional and unnecessary communications and work.

[0092] FIG. 8 illustrates logical components and communication links of an example dynamic context router system 800. The dynamic context router system 800 may include a dynamic context router core (DCR core) 814 module, a plurality of internal resources 816, and communication links 832, 834. The communication links 832, 834 may link the dynamic context router system 800 to various external resources, such as a dictionary server 840, an Oracle™ server 808, a lightweight directory access protocol (LDAP) server 810, as well as other external resources 812 (e.g., a subscriber profile repository, an online charging system, etc.). The internal resources 816 may include in-memory database technologies such as a reference database 802, as well as a plurality of session stores 804 and a cache memory 806. The internal resources 816 may be on the same chip, on the same computing device, within the same realm, or in the same network as the DCR core 814. The session stores database 804 may include a DCR-specific session store, a general session store and a session store for each message/session/node/Diameter application serviced by the dynamic context router.

[0093] The reference database 802 may store any type of information that will aid DCR core 814 operations, such as message formats, message processing rules, validation rules, node IDs, etc. The reference database 802 may be populated by data from external sources 830. In such cases the data may either be pulled by the reference

database 802 from the external sources 830, or pushed to the reference database 802 by the external sources 830. As discussed below, the session stores 804 may store session information, which may be used to establish "session stickiness" and/or maintain session states. The cache memory 806 may be populated by the DCR core 814, which may periodically cache data in response to on-going dynamic context router operations. For example, the DCR core 814 may cache information received from external sources useful for processing future messages. In an embodiment, the DCR core 814 may perform cache-optimizing operations to identify the most expensive information requests (e.g., requests made to external systems having slow response times) and store information associated with the most expensive information requests in the cache memory 806. In an embodiment, the DCR core 814 may first seek information from the cache memory 806 before attempting to access external resources. In an embodiment, the dynamic context router may periodically expire or remove information from the cache memory 806. In an embodiment, the dynamic context router may perform cache-optimization operations to determine an optimal cache-expiration rate and expire/remove information at the optimal rate.

[0094] The dynamic context router (DCR) may use the communication links 834 to access one or more dictionary servers 840, which may include one or more dictionaries. Each dictionary may define information specific to a particular protocol, application, node or message type. For example, a dictionary may include file definitions, a list of available commands (e.g., "deduct balance," "refund balance," etc.), a list of mandatory message types, a list of optional message types, a list of unsupported message types, field/message descriptions, and message decoding rules. The list of available commands may include a list of specific message types, each of which may be associated with a specific validation rule. A dictionary may also define message requirements, such as rules for storing certain message fields (e.g., session ID must be at the end of the message, session ID cannot be in the middle of the message, etc.) for a given node, protocol, or application.

[0095] The dictionary servers 840 enable the dynamic context router to support any current or future Diameter applications and/or message formats through dictionary updates. For example, if a vendor develops a new Diameter application "Z", the vendor may add a new Diameter dictionary (dictionary entries) that defines the rules/requirements of the new application. In an embodiment, the DCR core 814 may dynamically generate and/or update the dictionary definitions, without requiring any of the dictionaries to be taken offline.

[0096] FIG. 9 illustrates example signaling flows in a network 900 in which a dynamic context router 920 has been deployed. The network 900 may include a plurality of nodes (902a-c, 904a-b, 906a-d) that provide specific functions and/or implement specific protocols (A, C, E). Multiple nodes in the network 900 may provide the same

function and/or implement the same protocol. Nodes that provide the same functions/implement the same protocol may be different instances of the same node (e.g., Node A, Node C, Node E). In an embodiment, the network 900 may be a policy and charging control network, each of A, C and E may be any of the logical components described above (e.g., PCEF, PCRF, OFCS, OCS, SPR, and/or AF) and each of nodes 902a-c, 904a-b and 906a-d may be an instance of one of the logical components.

[0097] Returning to FIG. 9, a source node (e.g., 902a-c, 904a-b) may send a request message (e.g., a connection request) to the dynamic context router 920, which receives the request message and establishes a connection (e.g., 910a-c, 912a-b) with the requesting source node. In an embodiment, the connection may be a physical link layer communication line. Source nodes (902a-c, 904a-b) may send signaling messages that encode signaling data to the dynamic context router 920 over the established connections 910a-c, 912a-b. The signaling messages may encode the signaling data in one or more Diameter messages. Each Diameter message may include a base Diameter message portion and an application specific Diameter message portion. The dynamic context router 920 may receive the signaling messages and examine the base Diameter message portion of the message to determine if the message may be processed by performing realm-based routing table look-up operations. If so, the dynamic context router DCR 920 may perform proxy, relay, or redirect operations, which may include performing load balancing operations.

[0098] If the message cannot be processed by performing message-based routing (e.g., realm-based routing) table look-up operations, the dynamic context router 920 may perform application-level routing and load balancing operations to identify a suitable destination node (e.g., 906a-d) to which a corresponding signaling message is to be sent. The dynamic context router 920 may determine if a message may be sent to any destination node offering a particular service (e.g., any "E" node) or if the message requires a particular instance (e.g., 906c) of the destination node. If the message may be sent to any destination node offering the service (906a-d), the dynamic context router 920 may perform load-balancing operations to identify a suitable instance (e.g., 906c), establish a connection/association (e.g., connection 916c) to the identified instance (e.g., 906c), encode the signaling information into a message, and transmit the signaling message to the identified instance.

[0099] If the dynamic context router 920 determines that the messages should be sent to a particular instance of the destination node (e.g., 906a), the dynamic context router 920 may decode the message, examine the contents of the message, perform application-level routing operations to identify the correct instance (e.g., 906a), establish a connection/association (e.g., connection 916a) to the identified instance (e.g., 906a), re-encode the decoded contents into a new message, encode the signaling information into a message, and transmit the

signaling message to the identified instance (e.g., 906a).

[0100] FIG. 10A illustrates an example dynamic context router method (DCR method) 1000 for receiving signaling messages from a source node and sending corresponding signaling messages to a destination node. As mentioned above, the dynamic context router may receive a connection/association request from a source node and establish a connection with the requesting source node. In step 1006, the dynamic context router may receive one or more Diameter messages over such connection. In step 1008, dynamic context router may decode a base portion of the Diameter message. In determination step 1010, dynamic context router may perform message-based (e.g., realm-based) routing table look-up operations to determine if an entry corresponding to the Diameter message exists in the routing table (i.e., the Diameter message matches a routing table entry). If the dynamic context router determines the Diameter message matches a routing table entry (i.e., determination step 1010 = "Yes"), in determination step 1012, the dynamic context router may determine if a "realm routing action" is a proxy operation. If it is determined that the realm routing action is a proxy operation (i.e., determination step 1012 = "Yes"), in step 1016, the dynamic context router may perform operations to fully decode the message, and in step 1018, begin routing operations. If the realm routing action is not a proxy operation (i.e., determination step 1012 = "No"), in step 1018, the dynamic context router may begin routing operations.

[0101] If in determination step 1010 the dynamic context router determines the Diameter message does not match a routing table entry (i.e., determination step 1010 = "No"), in determination step 1014, the dynamic context router may determine if a Diameter application associated with the Diameter message is supported. If the Diameter application associated with the Diameter message is supported (i.e., determination step 1014 = "Yes"), in step 1016, the dynamic context router may perform operations to fully decode the message. If the Diameter application is not supported (i.e., determination step 1014 = "No"), in step 1018, the dynamic context router may begin routing operations.

[0102] In determination step 1020, the dynamic context router determines if the destination-host is specified in the Diameter message. If the destination-host is specified in the Diameter message (i.e., determination step 1020 = "Yes"), in step 1026, the dynamic context router performs operations to modify the contents of the message (e.g., augments the message) and sends the modified message to the destination node. If the destination-host is not specified in the Diameter message (i.e., determination step 1020 = "No"), in step 1022 the dynamic context router performs context routing operations to select a destination domain. In step 1024, the dynamic context router performs load balancing operations to choose a specific instance of the selected destination domain. In an embodiment, the dynamic context router may match message parameters against internal or external refer-

ence data to identify a suitable instance of the destination node. In various embodiments, the dynamic context router may identify and select the first available instance of the destination node, the most available instance of the destination node, or the most under-utilized instance of the destination node, all of which may be performed with the assistance of dynamic information obtained in real-time from external systems (e.g., external resources 812 illustrated in FIG. 8). In an embodiment, the dynamic context router may identify and select an instance of the destination node, such that the processing workload is distributed across the nodes, the communication traffic is minimized, the network resources are optimally utilized, network throughput is maximized, and/or response time is minimized.

[0103] As mentioned above, in step 1026, the dynamic context router performs message modification operations (e.g., augments the message) and sends the modified message to the selected instance of the destination node.

[0104] FIG. 10B illustrates an example dynamic context router method 1050 for determining if a specific instance of a destination node is required. In step 1052, the dynamic context router may determine if session stickiness has been configured for a particular Diameter message. The dynamic context router may determine if a session exists by, for example, comparing message information to a session identifier stored in a session store. If session stickiness has not been configured (i.e., determination step 1052 = "No"), in step 1054, the dynamic context router may perform routing and load balancing operations to choose a destination node.

[0105] By establishing session stickiness the DCR may select the instance of the destination node to which a previous message related to that session was sent and send all future signaling messages associated with that session to the same instance of the destination node. In this manner, signaling messages belonging to the same session, but originating in different source nodes (e.g., Nodes A and C illustrated in FIG. 9), may be directed to the same instance of the destination node (e.g., 906a-d illustrated in FIG. 9). If the dynamic context router determines that session stickiness has been configured (i.e., determination step 1052 = "Yes"), in step 1056, the dynamic context router may perform a session look up. In determination step 1058, the dynamic context router may determine if the session exists by, for example, comparing session information extracted from the Diameter message to session identifier information stored in a session store. If the session is found (i.e., determination step 1058 = "Yes"), the dynamic context router may, in step 1064, route the message to a specific destination associated with the identified session. If the session is not found (i.e., determination step 1058 = "No"), in step 1060, the dynamic context router may perform routing and load balancing operation to choose a destination node. In step 1062, the dynamic context router may update the session store with the chosen destination node.

[0106] As mentioned above, in the various embodiments, as part of the application-level routing operations, the dynamic context router may determine that a specific instance of a destination node is required. For example, the dynamic context router may determine that a Diameter message must always be sent to a specific node due to a context based routing operation requiring all mobile subscriber integrated services digital network numbers (MSISDNs) matching a certain pattern go to a specific node, or due to a context based routing operation requiring that all messages in the session go to the same destination node.

[0107] FIG. 11 illustrates logical components and information flows 1100 of an example dynamic context router system (DCR system) 1150 configured to receive messages from multiple instances (e.g., 902a-904b) of multiple source nodes (e.g., Nodes A, C) and send corresponding signaling messages to destination nodes (e.g., Node E, 906a-d). The DCR system 1150 may include a dynamic context router core (DCR Core) 1114 module, a plurality of internal resources 1116 and communication links to various external resources, such as a dictionary server 1140a, an Oracle database 1108, a Lightweight Directory Access Protocol (LDAP) database 1110, etc. The internal resources 1116 may include a reference database 1102, session stores 1104 and a cache memory 1106.

[0108] FIG. 11 illustrates that the DCR core 1114 may receive signaling messages from one or more source nodes (902a-904b). Each signaling message may encapsulate signaling information (e.g., charging rules, authentication information, enforcement of policy rules, etc.). Signaling messages, such as Diameter messages, may be sent to the DCR core 1114 using interface 1120. Each Diameter message may have encoded base protocol portions and encoded application-specific portions. The base protocol portions may be decoded by any Diameter application/node and/or relayed or proxied accordingly. The application-specific portions may only be decoded if all of the application-specific decoding rules are known by the receiving node.

[0109] Thus, in an embodiment, the dynamic context router may receive a Diameter message, decode the base Diameter portions of the Diameter message into base parameters/AVPs, decode the application-specific portions of the Diameter message into application parameters/AVPs, use the decoded parameters/AVPs to identify a proper destination node, re-encode the base and application parameters/AVPs into a new Diameter message, and send the Diameter message to the identified destination node.

[0110] As mentioned above, the network nodes generally can only decode the application-specific portions of Diameter messages if all of the application-specific decoding rules are known to the network node. FIG. 11 illustrates that the dynamic context router communicates with a dictionary database 1140a, and may request these application-specific decoding rules from the dictionary

database 1140a. For example, the DCR core 1114 may send a request message identifying a protocol, node, or message to a dictionary server (not illustrated), which receives the request, queries the dictionary database 1140a for the correct set of rules and sends the rules to the DCR core 1114. The DCR core 1114 may then use these rules to decode the application-specific portions of the messages. However, access to the external resources, such as the dictionary database 1140a, is generally an expensive and time consuming process. In addition, once the DCR core 1114 receives the decoding rules, it must spend considerable processing resources to perform the actual decoding operations.

[0111] To improve efficiency and reduce latency, in an embodiment, the DCR core 1114 may access partial dictionaries 1140b and/or perform the decoding operations in two phases. Partial dictionaries 1140b are dictionaries that do not contain a complete set of rules for a particular protocol, message, node or application. In an embodiment, partial dictionaries 1140b may be created out of necessity when the information stored in the complete dictionary cannot fully describe both a newer and an older standard, both of which may exist simultaneously in the network. In an embodiment, partial dictionaries 1140b may contain only the minimum amount of rules required to successfully communicate with a given protocol. Since partial dictionaries may contain less information than complete dictionaries, in an embodiment, the DCR core 1114 may utilize partial dictionaries to receive and process the messages much faster when a partial dictionary is available.

[0112] In an embodiment, the DCR core 1114 may perform decoding operations in two or more phases. This multi-phase decoding allows the dynamic context router to decode a small portion of the message and, if necessary, perform additional decoding operations in small targeted increments until a suitable destination node is identified or it is determined that a suitable destination node cannot be determined from additional decoding operations. For example, the DCR core 1114 may incrementally decode additional portions of the base and/or message body until: a suitable destination node can be identified; the entire message is decoded; or the DCR core otherwise determines that a suitable destination node cannot be determined from further decoding of the message.

[0113] In an embodiment, the DCR core 1114 may perform protocol translation operations. Protocol translations may be performed at several different levels, and multiple translations may be performed together. For example, FIG. 11 illustrates that the DCR core 1114 may receive a Diameter message 1134 from a particular instance of a source node (e.g., 902a). The message 1134 may be implemented in a first protocol (e.g., SOAP) and require transmission to a destination node (e.g., 906a) that requires a second protocol (e.g., Diameter). Since the first and second protocols differ, the destination node will not be able to receive the message. In an embodi-

ment, the DCR core 1114 converts the message from the first protocol into the second protocol. For example, the DCR core 1114 may receive the SOAP message 1134, decode the message, perform operations to identify the destination node, perform operations to identify the protocol supported by the destination node (e.g., Diameter), access the dictionary databases 1140a-b for the message requirements of the second protocol (e.g., Diameter), re-encode the decoded message to implement the second protocol and send the re-encoded message to the destination node.

[0114] In various embodiments, the first protocol may be the same as the second protocol, a subset of the second protocol, a superset of the second protocol, compatible with the second protocol, or completely independent of the second protocol.

[0115] In an embodiment, the DCR core 1114 may perform protocol translation operations even when the first and second protocols are compatible or the same. Often, nodes/logical components (e.g., 902a-906d) vary in their implementation of the same set of standards, especially when the nodes/logical components (e.g., 902a-906d) are manufactured by different vendors. For example, a vendor's implementation of a standard may be less than compliant to the standards, outdated, contain proprietary extensions to the standard, or the standards may have changed since the nodes were deployed. In such cases, messages originating from a source node may not be accepted by a destination node, even though both the source node and the destination node implement the same protocol. In an embodiment, the DCR core 1114 changes the values of the Diameter message. In doing so, the DCR core 1114 may perform operations of: receiving and decoding a Diameter message; decoding the AVPs contained therein; examining the contents of the AVPs; identifying a destination node; identifying the values/fields that need to be added, removed, and/or changed in order for the message to be accepted by the identified destination node; requesting information from the internal and/or external resources; augmenting the message by adding, removing, or changing the identified values/fields; re-encoding the AVPs into a Diameter message that conforms to the standards; and sending the message to the destination node.

[0116] As mentioned above, the dynamic context router may perform routing operations, e.g. proxy, relay, and redirect operations. In order to perform these routing operations, the DCR core 1114 may determine if the message to be routed contains information identifying a specific destination host. If the message identifies a specific destination host, then the DCR core 1114 may forward the message to the specified destination host (e.g., 906a). If the message does not identify a specific destination host, then the DCR core 1114 may analyze the message to determine if the message contains information identifying a specific destination realm to which the message is to be sent. If the message identifies a specific destination realm, the DCR core 1114 may perform one

or more routing/load balancing operations to identify a suitable destination host, supplement the message with additional information (e.g., augment the message), and send the message to the identified destination host.

[0117] As part of the context routing operations, the DCR core 1114 may communicate with external resources (e.g., 1108, 1110, etc.) to receive the additional information that may be used to augment the messages and/or aid the context routing decisions. For example, the DCR core 1114 may generate one or more keys based on values/fields of the decoded messages and send the generated keys to the external resources (e.g., 1108, 1110, etc.). The external resources (e.g., 1108, 1110, etc.) may use the keys to locate (e.g., lookup, pull, etc.) supplementary information that may be used to aid the routing/load balancing operations and send the supplementary data to the DCR core 1114. The DCR core 1114 may receive the supplementary information, identify the proper destination host, add the information to the message, and send the augmented message to the proper destination host.

[0118] As mentioned above, the DCR may send and receive messages to and from any Diameter application, as well as other similar protocols (e.g., SOAP, RADIUS, HTTP, etc.). Also as mentioned above, the DCR may send and receive messages from network nodes (e.g., a subscriber profile repository, an online charging system, etc.) and may route messages to and from such nodes. In an embodiment, the DCR core 1114 communicates with a subscriber profile repository (e.g., SPR 122 discussed above with reference to FIG. 7B) and uses the information contained therein (e.g., subscriber information) to augment the messages and/or identify a destination node. In an embodiment, the DCR core 1114 communicates with an online charging system (e.g., OCS 120a-c discussed above with reference to FIG. 7B) and uses the information contained therein (e.g., charging information) to augment the messages and/or identify a destination node. In an embodiment, the DCR core 1114 accesses an off-line charging system (e.g., OFCS 118a-c discussed above with reference to FIG. 7B) and uses subscriber billing/charging information to augment the messages and/or identify a destination node.

[0119] As previously discussed, nodes/logical components (e.g., 902a-906d) may vary in their implementation of the same set of standards, especially when they are manufactured by a number of different vendors. In some cases, different instances of the same component may vary in their implementation of the same standard even when manufactured by the same vendor. For example, vendors typically upgrade their components piecemeal, as opposed to all-at-once, and it may take the vendors a number of years to fully upgrade all of their components. During this time, the upgraded components may use a newer, updated, or modified version of the standards (e.g., updated message structure, rules, etc.) compared to the yet-to-be upgraded components (i.e., the unimproved components). Since the newer/upgraded compo-

nents use a different version of the standards than the older/unimproved components, during the upgrade period, the vendor may reduce complete dictionaries to partial dictionaries. In such cases, the partial dictionary is created out of necessity because the information stored in the complete dictionary cannot fully describe both the newer standards and the older standards, both of which exist simultaneously in the network. The various embodiments may address such situations by performing protocol translation operations to cause the different versions to interoperate, by utilizing peer specific dictionaries, by performing partial decoding operations and/or by performing tolerant decoding operations. The partial decoding operations may include using a partial dictionary and/or only decoding parts of the message, as discussed in more detail above.

[0120] In an embodiment, the dynamic context router may operate in an opaque proxy mode that supports piecemeal upgrades. The opaque proxy mode may be logically situated between the relay and proxy modes. The dynamic context router may operate in an opaque proxy mode when the dictionary information is insufficient and/or when the dynamic context router system seeks to improve performance (e.g., intentional partial dictionary).

[0121] The dynamic context router may perform tolerant decoding operations, which may be performed as part of the opaque proxy operations. The tolerant decoding operations may include decoding the complete message while allowing errors to exist (e.g., tolerating errors). For example, the rules specified in the complete dictionary may be relaxed to allow messages with missing mandatory AVPs (or messages with AVPs in the wrong position) to be processed as if they do not include errors.

[0122] As discussed above, the dynamic context router may decode only a portion of the Diameter messages. When dynamic context router operates in the opaque proxy mode (i.e., as an opaque proxy agent), the dynamic context router may access a partial Diameter dictionary and decode only those fields available to it (e.g., inadvertent partial dictionary) or only those fields required by the destination node (e.g., intentional partial dictionary). For example, if a partial dictionary provides only five (5) out of ten (10) total definitions, instead of sending an error message to the source node, the dynamic context router may decode the message using the available definitions and leave the rest of the message in the original format (e.g., binary wire format). The dynamic context router may then re-encode the decoded portions, couple them to the un-encoded portions to create an opaque message, and send the opaque message to a destination node. If, in response to sending the opaque message, the dynamic context router receives an error message from the destination node, the dynamic context router may re-process the message by accessing a complete dictionary and perform a full decoding operation (e.g., in the case of intentional partial dictionary), or send an error message to the source (e.g., in the case of an inadvertent

partial dictionary).

[0123] In an embodiment, the dynamic context router system may perform routing/load balancing operations by hierarchy. For example, the dynamic context router system may organize the network topology into a logical structure that facilitates load balancing and high availability. The logical structure may define the nodes/resources available to the dynamic context router system and enable the dynamic context router system to quickly and efficiently locate nodes/resources. The logical structure may also identify available alternatives to each node/resource for fail-over operations, support the intelligent placing of new assets in peer groups, allow for dynamic addition/removal of nodes/resources to the dynamic context router network, and support intelligent routing between dynamic peers. In an embodiment, the logical structure may be a topology tree stored in memory.

[0124] FIG. 12 illustrates an example DCR topology tree 1200 that may be used by the dynamic context router for performing routing/load balancing operations by hierarchy. FIG. 12 also illustrates example DCR logical components 1250 for performing operations on the DCR topology tree 1200. The DCR logical components 1250 may include a business logic module 1202, a peer group-level module 1204 and a peer module 1206.

[0125] It should be noted that the DCR topology tree 1200 may be implemented using a wide variety of data structures, including arrays, trees, linked-lists, maps, vectors, and graphs. The DCR topology tree 1200 may be configured to support root nodes, internal nodes and terminal nodes. The DCR topology tree 1200 may be configured to allow each node to have more than one parent. The DCR topology tree 1200 may be configured to allow multiple root nodes. Thus, in various embodiments, the DCR topology tree 1200 may be implemented using a wide variety of data structures (e.g., arrays, trees, graphs, etc.) and is not limited to a tree structure.

[0126] In an embodiment, the DCR topology tree 1200 may include domains as root nodes, at least one peer-group as an internal node for each of the one or more domains, and at least one peer as a terminal node for the at least one peer-group. In an embodiment, the dynamic context router may perform application level routing operations to identify a root node in the topology tree and identify a terminal node destination component using the identified root node and hierarchical groups of the topology tree. In an embodiment, identifying a terminal node destination component using the identified root node and the hierarchical groups of the topology tree includes identifying and selecting the root node by performing business rule operations, identifying and selecting internal nodes by performing at least one of partitioning operations and availability operations and identifying and selecting the terminal node based on load balancing requirements.

[0127] Returning to FIG. 12, the DCR topology tree 1200 may be arranged such that peer nodes (e.g., peers 1-8) are grouped into peer groups (e.g., peer groups 1-4),

and peer groups are grouped into domains (e.g., domain 1, domain 2) 1208, 1210. The peer nodes may be grouped such that each peer node belonging to a particular peer group is capable of performing the same functions as every other peer node belonging to the same peer group. Since all of the nodes may be equivalent, this grouping enables the performance of efficient load balancing operations. Domains within the DCR topology tree may be defined according to business rules, e.g. domains can represent geographical areas, datacenters, subscriber ranges, and/or other any other logical group. Each peer may represent a destination node 1208-1222 and/or contain a reference to a destination node 1208-1222. In an embodiment, each peer group may belong to more than one domain, and each peer may belong to more than one peer group. In an embodiment, peer groups may belong to other peer groups, which may facilitate embodiments having multiple layers of internal nodes.

[0128] Each peer group may advertise itself as being in either an available state or in a not-available state. Each peer group may define the number peer nodes that need to be available before the peer group changes its state from not-available to available. Thus, Peer groups may be defined up front; pre-configured peers may be added up front; and non pre-configured peers may be added to peer-groups at run time via regular expression matching.

[0129] The business logic module 1202 may select a domain 1208, 1210 by performing business-level operations by defining a set of rules, regular expressions and/or patterns. In an embodiment, the peer group-level module 1204 may select a peer group by availability (e.g., first available in a chosen domain). Within the selected peer group, a specific peer node may be chosen according to a configured load balancing algorithm.

[0130] In an embodiment, the topology tree may be created such that peers are explicitly configured to belong to peer groups when the peers are added. In an embodiment, the topology tree may be created such that peers may be assigned to peer groups based on the regular expression method. In an embodiment, the rules, regular expressions and/or patterns for the intelligent placing of new assets in peer groups may be defined in a configuration file accessible to the operator network.

[0131] Peer nodes may be pre-configured such that the nodes are placed into a particular peer group as they are added to the topology tree. For example, a peer node may define a specific host and realm, which may be used by the dynamic context router to place the node within a particular peer group in the topology tree. Peer nodes that connect to the dynamic context router system without having been pre-configured to be placed explicitly in a specific peer group may be inserted into the topology tree by matching their host and realm information to a peer group using a regular expression template. The dynamic context router may add each type of peer node (e.g., pre-configured, dynamically defined, etc.) in a manner that allows both types of peer nodes to exist within

in the topology tree.

[0132] In certain situations, a Diameter message may be routed to a peer node that fails before a response is received by the dynamic context router. In such situations, the dynamic context router may coordinate failover operations by re-traversing the topology tree to find an appropriate alternative peer to which to resend the message. For example, if a selected peer node fails, the dynamic context router may traverse up the DCR topology tree 1200 to identify the peer group to which the failing peer node belongs, identify another available peer node within that peer group. If no peers are available in the peer group, the dynamic context router may traverse another level of the hierarchy tree to identify the first available peer group within the same domain, and traverse down the tree to a peer node within the identified peer group.

[0133] In an embodiment, the DCR topology tree 1200 may be generated or updated as part of the dynamic context router performing general processing and routing operations. For example, the dynamic context router may annotate peer destinations as they are processed to create one or more logical overlay networks, which may be represented by the DCR topology tree 1200. The logical overlay networks may lend themselves to simpler routing configurations by allowing routing logic to refer to an entire logical network, instead of having to refer to each constituent destination. For example, if it is determined that a certain geographical area is under heavy load, the dynamic context router may change one or more global context settings for that geographical area to allow multiple applications and routes to be updated in the DCR topology tree 1200, thereby avoiding the congested area (i.e., the geographical area under heavy load).

[0134] In an embodiment, the dynamic context router may prioritize the peers within a peer group. In an embodiment, the dynamic context router may give each of the peers within a peer group equal priority, while in other embodiments peers may be prioritized in a flexible manner. In an embodiment, the dynamic context router may create logical sub groupings of the peer nodes. For example, the dynamic context router may group peer nodes at various locations around the topology by annotating them as belonging to a group (e.g., "New York," "Data Center X," etc.). In this manner, the dynamic context router can control a large number of independent peers and control the execution of many different routing rules through a single command (e.g., "avoid New York").

[0135] As discussed above, the business logic module 1202 may select a domain 1208, 1210 by performing business-level operations, which may be defined by configuration. Allowing the business-level operations to be based on the configuration provides a flexible method of grouping destinations so that the routing operations may select a suitable destination node based on a number of factors. For example, the DCR system may be configured to define the domains 1208, 1210 to represent a subscriber range (e.g., subscriber range A, subscriber range

B), in which case, geography only comes into play at the peer group-level module 1204. In this manner, the DCR system may be configured to provide geo-redundancy, load balancing and/or failover capabilities within a single datacenter, as required.

[0136] In an embodiment, the dynamic context router may perform message destination address hunting operations within a network when that information is not ascertainable from the message itself. As discussed above with reference to FIG. 9, every instance of a node (e.g., destination nodes 906a-d) may maintain data that is unique to each node/subscriber/session, and some messages must be routed to a specific instance to access this data. However, on some occasions, the correct instance of the destination node cannot be ascertained from the information included within the message or otherwise available to the dynamic context router. If the decoded message does not include information identifying a specific realm or destination node, and information retrieved from the external and internal resources (e.g., reference databases, session stores, etc.) is not sufficient to identify a proper destination node, the dynamic context router may perform one or more hunting operations to locate the proper instance of the destination node.

[0137] FIG. 13 illustrates a dynamic context router (DCR method 1300 for receiving and sending Diameter messages in accordance with an embodiment. In step 1302, the dynamic context router may receive and decode a Diameter message. In determination step 1304, the dynamic context router may determine if the decoded message identifies a destination realm. If the decoded message does not identify a destination realm (i.e., determination step 1304 = "No"), in step 1340, the dynamic context router may send an error response message to the network node from which the message was received. If, on the other hand, the decoded message does identify a destination realm (i.e., determination step 1304 = "Yes"), in determination step 1306, the dynamic context router may determine if the decoded message identifies a destination host. If the decoded message identifies a destination host (i.e., determination step 1306 = "Yes"), in step 1320 the dynamic context router may re-encode the message into a proper format and/or send the re-encoded message to the identified destination host. If the decoded message does not identify a suitable destination host (i.e., determination step 1306 = "No"), in step 1308, the dynamic context router may request/receive information from internal resources if needed. In step 1310 the dynamic context router may request/receive information from external resources if needed. In step 1312, the dynamic context router may use all of the information available (e.g., information from the message, internal memories, external resources, etc.) to perform application-level routing operations as discussed above.

[0138] In determination step 1314, the dynamic context router may determine if the above-mentioned routing operations identify a suitable destination domain. If the routing operations identify a suitable destination domain

(i.e., determination step 1314 = "Yes"), in step 1316, the dynamic context router may perform load balancing operations to choose a destination host (e.g., a specific instance of a network node). If the routing operation does not identify a suitable destination domain (i.e., determination step 1314 = "No"), in step 1318, the dynamic context router may perform message destination hunting operations to identify a destination host (if configured to do so), and in step 1320, re-encode and send the message to the destination node identified from such hunting operations.

[0139] The node-selection operations may include selecting a node from the hierarchy tree, selecting a node based on heuristics, selecting the first available node, selecting a random node, performing a routing operation, performing a randomization operation, and/or performing a learning operation. Using one of these methods, the dynamic context router may select a node, encode the message into a suitable format/protocol, send the message to the selected destination node, and wait for a response from the destination node. In determination step 1322, the dynamic context router may determine whether it a negative response from the selected destination node, such as the selected destination node rejects the message. If the dynamic context router receives a message acknowledgement or otherwise does not receive a negative response from the selected destination node (i.e., determination step 1322 = "No"), which indicates that the correct destination node has been identified, the dynamic context router may store information correlating the subscriber and/or session to the correct destination node in a cache memory (e.g., cache memory 1016) in step 1324 so that all future messages associated with that subscriber and/or session may be sent to that same node.

[0140] However, if the dynamic context router receives a negative response from the selected destination node (i.e., determination step 1322 = "Yes"), the dynamic context router may add the selected node to a "do-not-use" list in memory, and update the node-selection algorithm in step 1326. In an embodiment, the "do-not-use" list may be a list of destination nodes known not to be correlated to certain subscribers/sessions, which the dynamic context router may reference to exclude certain nodes for future consideration. In an embodiment, adding the selected node to a "do-not-use" list in memory may include performing operations for updating a topology tree stored in memory to include or exclude the selected node. After receiving a negative response and updating the memory/algorithms in step 1326, the dynamic context router may un-select the node and repeat the above-mentioned process with the updated memory/algorithms by returning to determination step 1314 or step 1318. This process may continue until a correct destination node has been identified, as indicated by the message being accepted (i.e., determination step 1322 = "No"). Again, the dynamic context router may store information correlating the subscriber and/or session to the correct destination node in

a cache memory (e.g., cache memory 806) in step 1324 so that all future messages associated with that subscriber and/or session may be sent to that same node.

[0141] Message destination hunting operations may include checking (e.g., via customer routing logic) a user defined cache (e.g., user defined caches 2024 illustrated in FIG. 20) to determine if a destination for a particular subscriber being routed is already known. FIG. 14 illustrates in more detail a dynamic context router (DCR) method 1400 for performing message destination hunting operations. In step 1402, the dynamic context router may select a destination node. In step 1404, the dynamic context router may encode the Diameter message into the correct format/protocol and send the message to the selected node. In determination step 1406, the dynamic context router may determine if a reply has been received from the selected node. If a positive reply has been received from the selected node (i.e., determination step 1406 = "No"), in step 1414, the dynamic context router may store (e.g., in an internal memory or resource) information correlating subscriber and/or session information to the selected destination node, and terminate further destination hunting operations for the received message. If, on the other hand, either a negative reply has been received or no reply has been received from the selected node (i.e., determination step 1406 = "Yes"), in step 1408, the DCR may remove the selected node from a list of available nodes, which may be stored in an internal memory. In step 1410, the dynamic context router may unselect the selected node. In step 1412, the dynamic context router may update its node selection algorithms and parameters and re-initiate the node-selection operations (step 1402).

[0142] In an embodiment of message destination hunting operations, the dynamic context router may generate a list of possible destinations and route the message to the first destination on the list in steps 1402 and 1404. In this embodiment, the dynamic context router may issue a request to the Diameter library to store the rest of the list in an outstanding transactions queue. In determination step 1406, the dynamic context router system may examine (e.g., via custom logic in the response handling module/pipeline described below) response messages received in response to routing the message to the first destination. If a response message indicates "success" (i.e., determination step = "No"), the dynamic context router system may terminate further hunting operations and update the user defined cache in step 1414. If, on the other hand, the responses indicate that the message was not successfully transmitted to an appropriate destination node (i.e., determination step = "Yes"), the dynamic context router system may determine if there are more destinations in the generated list, select the next destination from the list, and send the message to the selected destination as part of re-performing step 1402. This process of steps 1402 through 1412 may be repeated until a "successful" response message is received (i.e., an appropriate destination node is discovered) or

until all of the destinations in the list have been attempted (e.g., list is empty). If there are no more destinations, then the dynamic context router system may deem the hunting operations as unsuccessful and send an error to the originating node.

[0143] In an embodiment, as part of performing the message destination hunting operations, the dynamic context router may perform operations that implement a randomization algorithm. The randomization algorithm may use parameters (e.g., uniformly random parameters, concentration parameters, etc.) to guide the dynamic context router's node-selection behavior. The randomization parameters may be selected/updated such that the average-case node-selection performance is greater than selecting the nodes at random.

[0144] In an embodiment, the hunting operations may include identifying and selecting nodes based on network latency, node performance, speed, capacity, workload and/or availability. In this manner, if the selected node is not the correct destination, the dynamic context router may quickly receive the rejection response and update the memories/algorithms accordingly.

[0145] In an embodiment, the hunting operations may continue for a predetermined amount of time or until the correct instance is identified. In an embodiment, the message destination hunting operations may implement one or more learning algorithms. In an embodiment, the hunting operations may be based on heuristics.

[0146] In various embodiments, the message destination hunting operations may be performed to locate information for a particular subscriber or a session. For example, if subscriber related information is partitioned across multiple data nodes and messages need to be routed to a particular node based on the location of the subscriber information, subscriber-based hunting algorithms may be applied to avoid provisioning all nodes with information about the employed partitioning scheme. Likewise, if an ephemeral session state is maintained in a particular network node and other network nodes need to either query or update that session state, the node location may be unpredictable (e.g., due to a non-deterministic routing during session set-up). In such cases, session hunting algorithms may be performed to locate a node storing the pertinent session information.

[0147] In an embodiment, the caching operations may be integrated with message destination hunting operations.

[0148] As discussed above, telecommunications operator networks are expanding. As these networks expand and new resources are introduced, it is more likely that a component (server, processor, hard drive, DCR core, memory, etc.) in the system will fail. The various embodiments enable management of component failure by configuring dynamic context routers to perform failover operations that automatically switch over to a redundant component (e.g., blade, server, DCR core, memory, network node, etc.) upon the failure or abnormal termination of a component. The dynamic context router

may be configured to perform multi-level and multi-tier failover operations to ensure continued operations in the event of multiple component failures. Moreover, the various embodiments provide scalable, distributed, highly available dynamic context router systems capable of fast and efficient expansion by supporting the addition of resources (e.g., additional cores, memories), while maintaining high-availability.

[0149] FIGs. 15A-17C illustrate example logical components and information flows in embodiment DCR systems that perform failover operations and maintain session state information in the event of a component failover. FIG. 15A illustrates example logical components in a DCR system 1500 configured to maintain session state information in the event of a failover. The DCR system 1500 may include one or more pairs of servers/DCRs, each pair including a first DCR 1502 having a first DCR core 1504 and a first memory 1506 and a second DCR 1508 having a second DCR core 1510 and a second memory 1512. The first and second memories 1506, 1512 may be any internal resource (e.g., reference database 1102, session stores 1104, cache 1106 discussed above with reference to FIG. 11) for storing information.

[0150] The DCR system 1500 may also include a communication link 1514 connecting the first and second DCRs 1502, 1508. The second memory 1512 may store a replica of the information stored by the first memory 1506, which may be initiated by the DCR system. In an embodiment, the communication link 1514 may connect the first and second memories 1506, 1512 on the first and second DCRs 1502, 1508 such that any information added to the first memory 1506 is automatically added to the second memory 1512. Likewise, any information removed/expired from the first memory 1506 may be automatically removed/expired from the second memory 1512.

[0151] Session information may be stored in the first and second memories 1506, 1512 using a structure (e.g., associative array, hashtable, tree, etc.) that allows the sessions to be quickly located and retrieved from the memories. In an embodiment, the first and second memories 1506, 1512 may store information so that the same decision logic locates the stored information in each physical memory. In this manner, the logic used to locate the session states in memory is the same for both memories, despite the session state information being physically stored in separate memories (e.g., first and second memories 1506, 1512).

[0152] FIG. 15B illustrates example information flows in an example DCR system 1550 configured to maintain session state information in the event of a failover. Specifically, FIG. 15B illustrates that a source node 902a may send a signaling message to the first DCR core 1504 over a primary communications link 1530 and maintain a reference to a secondary communication link 1532 to the second DCR core 1510. The first DCR core 1504 may receive the message, identify a proper destination node (e.g., 906a) and/or perform other DCR operations

on the message. The first DCR core 1504 may also establish session stickiness by storing session information (e.g., session 1) in the first memory 1506, which is automatically replicated in the second memory 1512 via the communication link 1514.

[0153] If the first DCR core 1504 fails or does not respond to the source node 902a in a predetermined amount of time, the source node 902a may fail over to the second DCR core 1510 by sending the signaling message over the secondary communication link 1532. Since the second memory is a replicate of the first memory 1506, the second DCR core 1510 may retrieve the session information from the second memory 1512 and perform any and all operations originally requested from the first DCR core 1504, including sending the message to the destination node 906a. In this manner, session state is maintained and the DCR system is resilient to the failure event.

[0154] It should be understood that the DCR systems discussed herein may operate in both an active-hot standby configuration, as well as in an active-active configuration, and that each of the DCR cores may simultaneously serve as both a primary DCR core and a secondary DCR core.

[0155] FIG. 15C illustrates example information flows in an embodiment DCR system 1570 configured to provide failover support on two layers. Similar to the system described above, the source node 902a sends a signaling message to the first DCR core 1504 over the primary communications link 1530 and maintains a reference to the secondary communication link 1532 to the second DCR core 1510. The first DCR core 1504 receives the message and performs DCR operations, which may include identifying suitable destination nodes and storing session information (e.g., session 1) in the first memory 1506, which is automatically replicated in the second memory 1512 via communication link 1514. The first and second memories 1506, 1512 and the primary and secondary communication links 1530, 1532 provide a first layer of failover support.

[0156] In the illustrated example of FIG. 15C, the DCR core sends messages to destination node 906a using DCR-1 Primary. When destination node 906a becomes unresponsive, the DCR may select destination node 906z (using the topology tree) and start sending future messages to it using DCR-1 Secondary. In other words, destination node 906z may not be chosen before destination node 906a fails.

[0157] In the various embodiments, dynamic context routers may be grouped into pairs (DCR Pairs) such that each dynamic context router system includes an even number of DCR cores. This allows the session stores to be deployed in an active-hot standby configuration while the DCR cores operate in an active-active configuration. That is, each DCR core within the DCR Pair may remain active (i.e., may receive and process network traffic) while one session store within the DCR pair remains active and a second session store within the DCR pair re-

mains on active standby.

[0158] FIG. 16 illustrates logical components and informational flows in another example DCR system 1600 configured to maintain session state information in the event of a failover. The DCR system 1600 may include a DCR pair 1602 having a first DCR 1604 and a second DCR 1606. Similar to the DCR system 1500 described above, the first DCR 1604 may include a first DCR core 1608 and a first memory 1610, the second DCR 1606 includes a second DCR core 1612 and a second memory 1614, and a communication link 1616 connects the first DCR 1604 to the second DCR 1606, and information may be transferred such that the second memory 1614 contains a replica of the session information stored by the first memory 1610. The DCR system 1600 also includes primary communications links (DCR-1 Primary) 1618, (DCR-2 Primary) 1620 connecting the first and second DCR cores 1608, 1612 to the first memory 1610. Likewise, secondary communications links (DCR-1 Secondary) 1622, (DCR-2 Secondary) 1624 connect the first and second DCR cores 1608, 1612 to the second memory 1614. Each of the first and second DCR cores 1608, 1612 may remain active (e.g., receives and processes Diameter messages), while one of the first and second memories 1610, 1614 remains active. The non-active memory (e.g., 1610 or 1614) may remain in a standby mode.

[0159] A source node 902a may send a signaling message to the first DCR core 1608 over a primary communication link and maintain a secondary communication link to the second DCR core 1612. If the first DCR core 1608 fails or does not respond to the source node in a predetermined amount of time, the source node 902a may fail over to the second DCR core 1612 and send the signaling message using the secondary communication link. Likewise, both the first and second DCR cores 1608, 1612 may read and write information to the first memory 1610 (e.g., via the primary communications links 1618, 1620). If the first memory fails, both the first and second DCR cores 1608, 1612 may fail over to the second memory 1614 to access the replicated data. In this manner, DCR system 1600 is resilient to the database/memories 1610, 1614 failing, the DCR cores 1608, 1612 failing, and the DCRs 1604, 1606 failing. In addition, the failure of any one component does not affect the availability of the other components.

[0160] FIGs. 17A-17C illustrate example information flows and logical components in an example DCR system 1700 configured to provide failover support and maintain session state information across partitions (e.g., partitions 1730 and 1732). As discussed above, operator networks must expand to meet the increase in user demand, support the array of new services and provide fast, reliable communications. As the operator networks grow, more DCR components must be deployed in each DCR system. To support scalability, the various embodiments provide scalable DCR systems capable of partitioning resources (e.g., logically grouping resources physically located on different DCRs and/or included in different

DCR pairs) and storing information across the network. In an embodiment, the partitioning of resources may include performing partitioning or domaining operations.

[0161] FIG. 17A illustrates example logical components that may be included in a scalable DCR system 1700 configured to maintain session state information across partitions. The DCR system 1700 may include a first DCR pair 1702 and a second DCR pair 1704. Each DCR pair 1702, 1704 may be similar to the DCR pair 1602 described above with reference to FIG. 16. For example, each DCR pair 1702, 1704 may include two DCRs (e.g., DCRs 1-2, 3-4) 1706, 1708, 1710, 1712, each DCR having a DCR core 1714, 1716, 1718, 1720 and a memory 1722, 1724, 1726, 1728. Each of the DCRs 1706, 1708, 1710, 1712 within the first and second DCR pairs 1702, 1704 may also be connected to each other by a communications link 1721, 1725 and the DCR cores 1714, 1716, 1718, 1720 may be configured to replicate the information stored in the primary memory (e.g., first memory 1722, third memory 1726) to the secondary memory (e.g., second memory 1724, fourth memory 1728). The first DCR pair 1702 may be connected to the second DCR pair 1704 via a communications link 1750. The first and second memories 1722, 1724 may be logically grouped together into a first memory group (i.e., the first partition 1730), and the third and fourth memories 1726, 1728 may be grouped together into a second memory group (i.e., the second partition 1732).

[0162] This architecture enables a greater level of redundancy and enables graceful failover operations in the event of failure of any one component. This is revealed by the information flows illustrated in FIGs. 17B and 17C.

[0163] FIG. 17B illustrates example DCR information flows in the DCR system 1700 in receiving messages from a source node 902a. Source node 902a may be configured to communicate with a particular DCR core as the primary DCR, and configured with a backup address to a secondary DCR core. Under normal circumstances, each source node will communicate with its primary DCR core. However, in the event that the primary DCR core is unavailable or does not respond to messages, the source node may begin communicating with its secondary DCR core. This is illustrated in FIG. 17 B by the source node 902a sending a signaling message to the first DCR core (DCR-1 Core) 1714 (illustrated with the solid arrow) while maintaining an address for a secondary DCR core (DCR-2 Core) 1716 (illustrated with the dotted arrow). While FIG. 17 B shows the secondary DCR core being positioned within the same DCR pair 1702, the primary and secondary DCR cores for any particular source node need not be within the same DCR pair, and may be located in other pairs (e.g., the secondary DCR core could be located in DCR pair 2 1704). Provisioning source nodes with primary and secondary DCR addresses is similar to the configurations discussed above with reference to FIGs. 15B, 15C and 16. In processing messages received from the source node 902a and performing DCR operations, the first DCR core

1714 storing session information within a primary memory, which may not be in the same DCR pair. Further, each DCR core may store session data in any one of the primary or secondary memories within the server. This may be implemented in a manner that spreads session data from all of the DCR cores among all of the primary memories in a semi-random manner. By distributing DCR core assignment and primary and secondary memory correlations across several DCR pairs within a given server installation may improve reliability and guard against systematic failures.

[0164] In an embodiment, the first DCR core 1714 may determine the particular primary memory or memory group for saving session data associated with a particular source node or even for a particular session by performing an address assignment operation. Thus, in the illustrated example of messages being received from source node 902a, the primary DCR core 1714 may perform an assignment operation on an address or session identifier portion of the received message to determine that associated session data should be stored in the second memory partition 1732. Using this addressing information, the primary DCR core 1714 stores the session information in the primary memory 1726 of the second memory partition 1732. As discussed above, the session data may be stored within the memory partition in the primary memory 1726, which may then be replicated in the secondary memory 1728. While not shown in this figure, when the primary DCR core 1714 receives messages associated with a different session, performing the address assignment operation may result in the session data being stored in memory partition 1 1730.

[0165] The address assignment function implemented on the primary DCR core 1714 may also be implemented on the secondary DCR core 1716, or on all the DCR cores within the network. This enables another DCR core (e.g., the secondary core 1716) to access session data (e.g., data stored in memory 1726) in the event that the source node 902a begins sending it messages related to a session originally managed by the primary DCR core 1714. This also enables another DCR core (e.g., the secondary core 1716) to access session data (e.g., data stored in memory 1726) in the event that a different source node references the same session as source node 902a begins sending it messages. Thus, by applying the same function to information contained in a portion of messages received from the source node 902a, the secondary DCR core 1716 may obtain the memory partition storing the associated session data without requiring any communication of memory addressing from the primary DCR core beforehand. This functionality enables the DCR core to resolve the Rx-Gx correlation problem that can arise when the source nodes are the AF and the PCEF, for example.

[0166] FIG. 17C illustrates a message flow that may occur in the event that the primary memory 1726 within the second partition 1732 fails. As discussed above, the memory contents of the primary memory 1726 may be

replicated to the secondary memory 1728 of the same partition. Thus, in an embodiment, memory accesses and storage communications from the primary DCR core 1714 directed to the memory partition 1732 may be serviced by the secondary memory 1728.

[0167] It should be appreciated that secondary DCR core assignments need not be fully redundant. Instead, each DCR core may serve as a primary DCR for a number of source nodes and as the secondary DCR for another group of source nodes. By distributing session data among memory partitions based upon an addressing function which uses information from received messages as the input, load-balancing and memory allocation can be accomplished autonomously in a manner which can avoid systematic failure while eliminating the need to share addressing information among the various DCR cores.

[0168] In the various embodiments, the DCR may be configured to divide (or "fork") a single request message (e.g., create a full or partial duplicate of the message, create child messages, etc.) that is destined for a single destination into multiple messages addressed to multiple destinations. As part of this message forking process, the dynamic context router may generate one or more child messages from the original message being forked (i.e., the parent message). Each resulting message (i.e., child message) may be equal to the original message, a subset of the original message, or contain additional information not contained by the original message.

[0169] FIG. 18 illustrates example logical components and data flows in a dynamic context router system 1800 configured to enable a single "request" message, as well as a corresponding "response" message, to be forked at the application level and distributed to one or more additional nodes in accordance with an embodiment. In the illustrated example, the dynamic context router 1804 communicates with a source peer 1802, a destination peer 1806, a first network node (Node 1) 1808, and a second network node (Node 2) 1810, each of which may be any of logical network components described above (e.g., PCEF, PCRF, OFCS, OCS, SPR, AF, etc.). The dynamic context router 1804 may receive (e.g., via data flow 1812) a request message from the source peer 1802 and perform operations to identify an appropriate destination peer 1806 to which the message is to be sent. The dynamic context router 1804 may send the request message (e.g., via data flow 1814a) to the identified destination peer 1806, send a duplicate of the request message (e.g., via data flow 1814b) to the first network node 1808, and send (e.g., via data flow 1814c) a new message containing values from the request message to the second network node 1810. The dynamic context router 1804 may receive (e.g., via data flow 1816) a response message from the destination peer 1806 and determine the appropriate source node to which the response message is to be sent (e.g., source peer 1802). The dynamic context router may send the response message (e.g., via data flow 1818a) to the identified source node (i.e.,

source peer 1802) and send a duplicate of the response message (e.g., via data flow 1818b) to the first network node 1808.

[0170] In an embodiment, the dynamic context router may be configured to discard responses to forked messages. For example, in such configurations, if the first network node (Node 1) 1808 generates a response to a request message sent via data flow 1814b, the dynamic context router may choose to not to send this message back to the source peer. In an embodiment, the dynamic context router may use information from the message (e.g., to update a cache that may be later utilized to make future routing decisions) before the message is discarded. In this manner, the first network node 1808 may be an existing network node that does not need to be informed that it has received a forked message (as opposed to a standard message). In an embodiment, such configurations may be used to perform operations for "hunting in parallel," in which a request may be sent to three candidate nodes, for example, and the first node to respond is used for further requests, while the two slower responses may be discarded.

[0171] When a parent message is forked into one or more child messages, each child message may be generated via any protocol/application/format supported by the dynamic context router. Each child message may be in the same format/protocol as the parent message, or in a different format/protocol than the parent. Multiple child messages may be generated from each parent. Each message may be sent to multiple destinations independent of the destinations of the other child or parent messages. Application level information from within received messages and/or contextual information (which may be obtained from one or more of the methods described above) may be used to determine which messages should be forked and which destination the forked messages are to be sent.

[0172] By forking request messages (as well as corresponding response messages) at the application level for distribution to additional nodes, the dynamic context router functions not only as an application-level router, but also as a source node capable of generating messages based on the content of the messages being routed. The forked messages (i.e., child messages) may be used, for example, by other network components to collect information about the type and content of messages being communicated. The dynamic context router's ability to generate new messages (via forking) in addition performing application-level routing operations allows the DCR system to provide operator networks with a level of functionality not typically provided by, or expected from, intermediate network nodes (e.g., application-level routers).

[0173] FIG. 19 illustrates a fork-routing method 1900 that may be performed by the dynamic context router in accordance with an embodiment. In step 1902, the dynamic context router may receive a first message from the source component. In step 1904, the dynamic context

router may use application-level information obtained from the message to determine which messages should be forked, and to which destination network components each of the messages are to be sent. In step 1906, the dynamic context router may use contextual information to further determine which messages should be forked and to further identify destination network components to which the messages are to be sent. In step 1908, the dynamic context router may fork or duplicate a single message destined for a single destination into multiple forked messages based on the application level and/or contextual information. In step 1910, the dynamic context router may send the original message to the appropriate identified destination. In step 1912, the dynamic context router may send each of the forked messages to their respective identified destinations.

[0174] In an embodiment, the dynamic context router may support the communication of messages between network components implementing different flavors of the same application/protocol/message format by adding extra attribute-value pairs (AVPs) into received messages, dropping AVPs from received messages, or both. In an embodiment, the dynamic context router may maintain references to specific dictionary databases for applications supported by each of the network components with which the dynamic context router communicates. The dynamic context router may communicate with the referenced dictionaries to determine which AVPs are to be added into the message and/or which AVP are to be removed from the message. In this manner, the dynamic context router may support multiple flavors of the same application/protocol/message format even when the specific flavors cannot be ascertained from the type or contents of the message being communicated (e.g., the message being communicated is a Diameter message, which does not include such information).

[0175] In an embodiment, the dynamic context router may modify messages such that they can be received and processed by the receiving network component and/or without causing the receiving network component to send an error message. In an embodiment, the dynamic context router may convert the messages into the specific flavors required by network components with which it communicates.

[0176] FIG. 20 illustrates logical components and interfaces in an example dynamic context router system (DCR system) 2000 configured to facilitate the communication of signaling messages between Diameter peers 2004. The DCR system 2000 may include a DCR core 2002 having a Diameter protocol library module 2006, a dynamic context router dispatcher module 2008 and a message handler module 2010. The message handler module 2010 may include a request handler module 2012, a response module 2014, and a failover handler module 2016, each of which may be a pipeline, which are discussed in more detail further below.

[0177] In the illustrated example of FIG. 20, the DCR core 2002 includes a number of interfaces 1-11 that fa-

cilitate communications between the modules (e.g., library module 2006, dispatcher module 2008, message handler module 2010, etc.) and with external resources, such as session stores 2020, external lookup databases 2022, user defined caches 2024, routing configuration data-stores 2026, databases storing peer topology, realm routing and application information 2028, and peer configuration data-stores 2030. For example, the DCR core 2002 may receive DCR Diameter configuration information over interface 8, initialize a Diameter protocol library by specifying application support over interface 5, and register any call-backs required for the Diameter protocol library to DCR notification interface (i.e., interface 2). Each of the interfaces 1-11 are discussed in more detail below.

[0178] The DCR core 2002 interacts with the Diameter Peers 2004 over interface 1, which may be used to perform base protocol interactions (e.g., performing capabilities exchanges, watchdog exchanges, etc.); maintain state information for each configured peer; send and receive Diameter application messages to and from each peer; maintain a transaction queue of unanswered messages sent to each peer; match responses received with entries in the transaction queues; handle redirect responses received from peers; maintain redirect caches; and perform other similar operations.

[0179] The Diameter protocol library module 2006 may communicate with the DCR dispatcher module 2008 and the message handler module 2010 over interface 2, which may be used to pass Diameter messages (requests or responses) to the DCR message handler module 2010 for processing; pass notifications of any peer transport failures to the DCR dispatcher module 2008; pass all outstanding messages for a failed peer to the DCR dispatcher module 2008 in Diameter failover situations (so that an alternative destination can be chosen); periodically pass information on the sizes of peer transaction queues to the DCR dispatcher module 2008 to enable it to make informed load balancing decisions; and perform other similar operations. In an embodiment, the DCR dispatcher module 2008 may receive notifications about the state of the Diameter peers 2004 from the Diameter protocol library module 2006 over interface 2, and manage such notifications accordingly. In an embodiment, the management of notifications may include storing state information in a local peer topology configuration data-store.

[0180] The DCR dispatcher module 2008 may send communications to message handling modules/pipelines (e.g., request handler pipeline 2012, etc.) over interface 3. For example, the DCR dispatcher module 2008 may dispatch messages (both requests and responses) received from the Diameter library module 2006 to the request handler pipeline module 2012 over interface 3.

[0181] The DCR dispatcher module 2008 may receive messages from the message handler module 2010 over interface 4 and perform operations that assist in the identification of a suitable Diameter peer destination for the

received messages. These operations may include: converting non-specific domain destinations populated by routing logic into specific destination hosts using the DCR dispatcher's 2008 knowledge of the peer topology (which may be loaded from interface 8) and each peer's availability; and selecting a specific destination based on failover and load balancing configuration information embedded in the peer topology definition.

[0182] The DCR dispatcher module 2008 may communicate with the Diameter protocol library module 2006 over interface 5, which may be used to: forward a Diameter message to a nominated destination-host; generate a Diameter response to the originating diameter node (e.g., instead of forwarding to another Diameter node); generate a redirect response to the originating diameter node; and perform other similar operations. Interface 5 may also be used by the DCR core 2002 to initialize a Diameter protocol library (e.g., by specifying application support).

[0183] The Diameter protocol library 2006 may include system libraries (e.g., libdbprotocol.so, libdbparser.so, etc.) as well other information that may be used to implement base diameter protocol functionality. Information retrieved from the Diameter protocol library 2006 may also be used to: perform capabilities exchanges with each configured peer (which may be loaded via interface 9); maintain connectivity using device watchdogs; provide an application programming interface (API) that allows the DCR core 2002 to send and receive messages from other Diameter nodes; and provide a notification interface so that the DCR core 2002 can be made aware of important Diameter events.

[0184] The message handler modules 2010 and the DCR dispatcher module 2008 may communicate with a session store 2020 via interface 6. The DCR core 2002 may receive routing configuration information over interface 7.

[0185] The DCR core 2002 may receive DCR Diameter configuration information over interface 8. The DCR Diameter configuration information may include a DCR realm based routing table and a topology tree that organizes the Diameter peers 2004 into a topology that may be used to derive load balancing and failover rules.

[0186] In an embodiment, the routing configuration information and logic may be decoupled from other aspects related to Diameter connectivity. This allows the DCR core 2002 to support failover and load balancing operations across all of the configured peers, while at the same time, not cluttering the routing logic with all of the peer and connectivity knowledge.

[0187] In an embodiment, the DCR routing configuration information may only include information for choosing an appropriate destination domain. For example, the DCR may be configured such that a telecommunications operator with a requirement to route messages to one of two data centers according to some business rules can define domains representing the possible destinations.

[0188] The DCR core 2002 may receive peer config-

uration information over interface 9, which may be used to load configured peers. The DCR core 2002 may send data requests to user defined caches via interface 10, and to external lookup engines/databases via interface 11.

[0189] As mentioned above, the DCR system may arrange network elements into a logical tree topology. The base Diameter library (on top of which messages processed by the DCR system may be built) maintains the peer configuration as a simple unstructured list. In an embodiment, the DCR system may, through configuration, arrange the elements of the base Diameter library's peer configuration list into a logical tree topology reflecting: at the top level, the high level routing domains (e.g., destinations chosen by routing logic); within a domain, a prioritized list of peer groups for availability purposes; and within a peer group, an unordered list of peers for load balancing purposes. This topology arrangement enables the DCR dispatcher 2008 to be given a high level destination domain and to route messages to specific peers by applying failover and load balancing rules. This also enables components which load the topology configuration at run time to be informed of peer availability.

[0190] In an embodiment, the topology arrangement may include at least one domain in a DCR deployment, at least one peer-group per domain, and at least one peer per peer-group. Peer groups within a domain may be prioritized, such that routing within a domain may be directed to the highest priority peer group that is available. Peer groups may specify how many peer failures can be tolerated before the peer group is to be considered unavailable. Peer groups may also specify the load balancing algorithms (e.g., round robin, weighted round robin, least outstanding messages, etc.) that are to be used when routing messages to the peer group's constituent peers.

[0191] In an embodiment, the DCR system may be configured to filter messages based on user defined criteria. This filtering may be performed at the beginning, middle, or end of the request processing operations. In an embodiment, filtering may be performed after the request processing operations to maximize the data available for use by the filtering operations. In an embodiment, the outcome from the filter process may be a Boolean value, which may be made available to the DCR dispatcher 2008, which may generate either an error response (if the message is to be filtered) or route the message to the destination node (message is not filtered).

[0192] In an embodiment, the dynamic context router system may be configured to append information, such as domain failover information, to the messages in the transaction queue. This enables the dynamic context router to subsequently take actions using this additional information which would otherwise not be possible. The DCR system may also store a destination domain in the transaction queue. In an embodiment, if a failover is later initiated, the DCR system may choose an alternative destination host based on the originally chosen destination

domain.

[0193] In an embodiment, the DCR system may be configured to process messages by decoding a received message into an internal representation of the message (e.g., a structured message format proprietary to the DCR system), and passing it to a routing logic module/ pipeline responsible for performing the routing operations. In an embodiment, the internal representation may be an AVS.

[0194] In an embodiment, the DCR system may implement a fixed pipeline model (e.g., a model in which each module includes a number of optional steps for performing a specific set of tasks) to control the processing of the message. For example, Diameter request messages received by the DCR system may be processed by a request pipeline, which may make routing decisions and/or manipulate the message using a discrete number of configurable steps.

[0195] As discussed above with reference to FIG. 20, each of the message handling modules (e.g., request handler module 2012, response module 2014, failover handler module 2016, etc.) may be a pipeline, and the various DCR message handling operations may be managed by a separate pipeline depending on the type of message or type of operation (e.g., requests, responses, failovers, etc.). For example, messages originating from the Diameter protocol library module 2006 may be passed (e.g., via the DCR dispatcher module 2008, etc.) to the appropriate pipelines/modules within the message handling module 2010 responsible for processing the message. Each pipeline may be configured in accordance with user preferences, network requirements, deployment environment and/or user requirements. Each pipeline may also be configured on a "per message type" and/or "per application" bases.

[0196] In the various embodiments, each pipeline may be minimally configured or extensively configured. For example, a pipeline may be minimally configured to handle situations where the Diameter realm based routing table provides all of the information necessary to route a message, or extensively configured to handle situations requiring custom processing involving lookups and routing logic.

[0197] Each of the message handling pipelines/modules may include a number of sub-modules (steps) that provide a set of highly customizable functions. For example, each module/step may be configured to perform a specific set of operations such as:

interacting with the default session store (e.g., when session state only needs to store a destination choice); interacting with a user defined session store (e.g., for more complex session store operations); augmenting the incoming message by performing external and internal lookups (e.g., via interfaces 10 and 11 of FIG. 20) using keys from the incoming message or from the results of other lookups; examining the con-

tents of augmented message to choose one or more destination domains or to perform message destination hunting operations; preparing message to be routed by modifying, adding or removing AVPs from one or more messages; filtering messages via a user defined white-list or black-list (e.g., refusing to route the message), etc. Each sub-module (step) may have a specific set of permissions that limit the allowable operations available to that step, which may be based on a number of configurable factors (e.g., type of module requesting the operation, deployment environment, network conditions, etc.).

[0198] In an embodiment, each pipeline may be a fixed message handling pipeline that aids the management of routing decisions and/or message manipulation operations.

[0199] In an embodiment, each pipeline may be configured at an application command level granularity. For example, each pipeline may be configured for Gx-based credit control requests.

[0200] In an embodiment, the DCR system may be configured to detect the existence of an empty pipeline (e.g., a pipeline that is not configured, is configured to exclude all steps, etc.) and perform routing operations using the routing functionality of the base Diameter protocol.

[0201] In the various embodiments, the DCR system may include one or more of a request handling pipeline, a response handling pipeline, and a failover handling pipeline.

[0202] FIG. 21 illustrates a request pipeline 2102 for processing Diameter request messages. The request pipeline 2102 may be a part of the DCR core, which may utilize the request pipeline 2102 to make routing decisions (e.g., locating a destination node, determining that the message cannot be routed, etc.) and/or to manipulate messages. The routing logic used to process the messages may be specific to the received message or message type. In an embodiment, the routing logic may be dynamic and/or attached to each pipeline stage via a proprietary DCR scripting language.

[0203] In an embodiment, each incoming request message may be passed to the request pipeline 2102, which is then identified by application and command. An empty routing ticket may be constructed upon entry to the pipeline process, which is then populated with a decoded internal representation of the received request message.

[0204] The request pipeline 2102 may include a number of discrete steps, stages, or modules (herein steps which may be performed in sequence as a message passes through the pipeline 2102), with each step performing a distinct DCR operation. Each step of the pipeline may populate different portions of the routing ticket, which may include portions for: the decoded request message (AVS type structure); raw data (e.g., message data not decoded); a request action; lookup results;

session state; destination domain(s); a filter decision; and redirect AVPs. In the example illustrated in FIG. 21, the request pipeline 2102 includes a realm routing lookup step 2110, a session lookup step 2112, a gather data step 2114, a routing core step 2116, a prepare AVS step 2118, a filter step 2120, a dispatcher step 2122, and a session update step 2124.

[0205] In the realm routing lookup step 2110, the request pipeline may perform a lookup on a configured realm based routing table. The realm based routing table may have the same or similar characteristics as a standard Diameter routing table (as described in Diameter standards RFC 3588), or may be a modified version of a standard Diameter routing table.

[0206] In an embodiment, the realm based routing table may include the following modifications over a standard Diameter routing table: a configuration column containing an "Override Destination" flag, which may express whether the destination read from a row in the table can be overridden; a configuration column containing an "Override Action" flag, which may express whether the action read from this row in the table can be overridden; a "Redirect host usage" column and a "Redirect max cache time" column, which may be used when the action is redirect and the redirect response message should populate correspondingly named AVPs; a server column renamed to domain, which may contain the name of a DCR configured domain rather than a specific host (as would be the case under Diameter standards RFC3588).

[0207] As mentioned above, the DCR system may be configured to perform decoding operations in multiple phases. In such configurations, the incoming request message may be partially decoded during the realm routing lookup step 2110 (e.g., only the header and base protocol routing AVPs may be extracted). The entire message may or may not be fully decoded (at a later stage) depending on an outcome of the lookup operations. For example, if there is no match resulting from the table look, or if the action is proxy and the destination domain is assigned, the message may be fully decoded. On the other hand, the message may be partially decoded if the action is relay or redirect, and the destination domain is assigned. The DCR system may also be configured to cause the message to be handled (e.g., routing the message, rejecting the message, etc.) at a later stage/step when there is no match on the table lookup by fully decoding the message but not setting a destination domain. In an embodiment, the outcome of the realm routing lookup step 2110 may be overridden depending on the value of the override flags in a matched table row.

[0208] The session lookup step 2112 may be performed as part of establishing session stickiness. In the session lookup step 2112, the DCR system may determine if the message belongs to a known and previously routed session. If so, the destination host and destination domain may be set in the routing ticket. In an embodiment, the session lookup step 2112 may be minimally configured for applications that do not need to maintain

session state other than the routing destination. In an embodiment, the session lookup step 2112 may be more extensively configured (e.g., via a proprietary DCR language) to perform custom operations and/or to include a custom session store.

[0209] In the gather data step 2114, the DCR system may gather data upon which routing decisions may depend (e.g., via cache lookups, external lookups, reference data lookups, etc.), configure the execution of the required lookups, reference the predefined lookup definitions and/or provide keys from any data available in the routing ticket. In an embodiment, the DCR system may populate a lookup results section of the routing ticket with the results of lookups performed as part of the gather data step 2114.

[0210] In the routing core step 2116, the DCR system may make routing decisions based on any of the information available in the routing ticket. As part of the routing core step 2116, the DCR system may also populate the destination domain in the routing ticket (assuming it was not already set by previous stages or it is allowed to override a previously set value) and/or override request actions (e.g., proxy, relay, redirect, unset, etc.) populated in the realm table (e.g., via the realm table lookup step 2110 discussed above). In an embodiment, when the request action is "unset," as part of the routing core step 2116, the DCR system may choose a method of delivery (e.g., proxy, relay or redirect) in addition to making a routing decision. In an embodiment, routing decisions made in the routing core step 2116 may be configured via a proprietary DCR language to perform custom logic/operations.

[0211] In the prepare AVS step 2118, the DCR system may make modifications to the message before it is sent. These modifications may include the addition of new AVPs, the modification of existing AVPs or the removal of AVPs. In an embodiment, the prepare AVS step 2118 may be limited to modifying the message within the routing ticket. In an embodiment, details of how the messages are modified in the prepare AVS step 2118 may be configured via a proprietary DCR language.

[0212] In the filter step 2120, the DCR system may filter messages based on user defined criteria. In an embodiment, the user-defined criteria may be specified via a proprietary DCR language.

[0213] In the dispatcher step 2122, the DCR system may choose a specific host. If a destination host and a destination domain are not specified by earlier stages in the pipeline 2102 (i.e., no host, no domain), an error response message may be sent to the network node originating the message (e.g., the source node). If a destination host is provided but there is no destination domain (i.e., provided host, no domain), the message may be routed to the specified destination host, and an error response may be sent to the originator of the message if the host is unavailable. If a destination host and a destination domain are both provided (i.e., provided host, provided domain), the message may be routed to the pro-

vided destination host, and an alternative destination host may be attempted if the specified one is unavailable. If no destination host is provided (i.e., no host, provided domain), an appropriate destination host may be chosen from the specified destination domain (e.g., via performing failover and load balancing operations), and an error response may be sent to the originator of the message if there are no available hosts within the domain.

[0214] As discussed above, messages handling operations may be facilitated by passing a routing ticket along various stages of a message handling pipeline. The dispatcher step 2122 may receive the routing ticket populated with: an action (e.g., Proxy, Relay, Redirect, etc.); a non-specific list of destination domains or a specific destination-host (if the message arrived at the DCR with this already set); the message to be sent (which may be a modified message); redirect related AVPs (which may be specified if the action is redirect); and/or a decision (e.g., yes, no) from the filter stage of the request pipeline.

[0215] In an embodiment, in the dispatcher step 2122, the DCR system may examine the routing ticket and perform operations (e.g., make calls to the Diameter protocol library) based on the contents of the examined message.

[0216] In an embodiment, in the dispatcher step 2122, the DCR system may generate a response message to be sent back to the originating peer with the Result-Code AVP set to "DIAMETER_UNABLE_TO_COMPLY" if the message filtering flag is set.

[0217] In an embodiment, in the dispatcher step 2122, the DCR system may select a peer from the specified domain if the action is proxy or relay, the destination-host is not specified and the destination-domain is specified. The highest priority available peer group from the domain may be chosen and a peer from within the chosen peer group may be chosen by performing a load balancing algorithm. If there are no available peer groups, an error response may be generated with Result-Code set to "DIAMETER_UNABLE_TO_DELIVER".

[0218] In an embodiment, in the dispatcher step 2122, the DCR system may route the message to a specified destination-host if the action is proxy or relay, the destination-host is specified and the Destination-Domain is not specified (e.g., when the destination-host is provided by the incoming message or else populated by session stickiness processing). A message may be sent to a peer regardless of the state of its containing peer group (e.g., when a parent peer group is unavailable but the required child peer is available). If the specified peer is unavailable then an error may be returned to the originator specifying a Result-Code set to "DIAMETER_UNABLE_TO_DELIVER".

[0219] In an embodiment, in the dispatcher step 2122, the DCR system may send a message to a specified destination-host if the action is proxy or relay, the destination-host is specified, and the destination-realm is specified. If the destination-host it is not available, the dispatcher may choose an alternative destination-host from the nominated destination-realm.

[0220] In an embodiment, in the dispatcher step 2122, the DCR system may send a redirect response to the originating node specifying the accompanying redirect related AVPs, Redirect-Cache-Usage and Redirect-Max-Cache-Time if the if the action is Redirect.

[0221] In an embodiment, in the dispatcher step 2122, the DCR system may perform message manipulation operations (e.g., changing the end-to-end-id, Route-Record and Origin-Host AVPs) if the message is to be routed onward and the topology hiding option is configured for the message.

[0222] The dispatcher step 2122 may receive multiple possible destination domains as part of hunting operations. When the dispatcher is required to route a message and it detects that destination domain is actually a list of possible destinations, the dispatcher may strip the first destination from the list and use it as the destination domain. The rest of the list may be stored in the transaction queue of the Diameter protocol library module and used by the response handling pipeline to determine the next destination that is to be tried if a response message indicates a failure.

[0223] In an embodiment, if a destination host and a destination domain are not specified by earlier stages in the pipeline 2102 (i.e., no host, no domain), an error response message may be sent to the network node originating the message (e.g., the source node). If a destination host is provided but there is no destination domain (i.e., provided host, no domain), the message may be routed to the specified destination host, and an error response may be sent to the originator of the message if the host is unavailable. If a destination host and a destination domain are both provided (i.e., provided host, provided domain), the message may be routed to the provided destination host, and an alternative destination host may be attempted if the specified one is unavailable. If no destination host is provided (i.e., no host, provided domain), an appropriate destination host may be chosen from the specified destination domain (e.g., via performing failover and load balancing operations), and an error response may be sent to the originator of the message if there are no available hosts within the domain.

[0224] In the session update step 2124, the DCR system may update one or more session stores by inserting new session entries, updating existing sessions and/or deleting session entries.

[0225] In an embodiment, the DCR system may be configured to process Diameter response messages via a response pipeline 2202, an example of which is illustrated in FIG. 22. The response pipeline 2202 may be a part of the DCR core. The response pipeline 2202 may include a number of discrete steps, stages, or modules (herein steps), each step performing a distinct DCR operation.

[0226] The DCR system may construct an empty routing ticket at an entry to the pipeline and populate the empty routing ticket with a decoded internal representation of the Diameter response message, as well as with

data stored with the matching original request. Each step of the pipeline may populate different portions of the routing ticket, which may include portions for: the decoded response message (AVS type structure); raw data (e.g., message data not decoded); the originally decoded request message (AVS type structure); any data that was stored with the request in the transaction queue; destination domain list; lookup results; and a response action (e.g., Send, Send-Next, Respond, Redirect).

[0227] In an embodiment, the response pipeline 2202 may be a subset of the request pipeline and/or include steps that perform operations similar to those performed by the request pipeline steps. In the illustrated example of FIG. 22, the response pipeline 2202 includes a gather data step 2210, a routing core step 2212, a prepare AVS step 2214 and a dispatcher step 2216. In the gather data step 2210, the DCR system may gather data upon which routing decisions may depend (e.g., via cache lookups, external lookups, reference data lookups, etc.). The DCR system may also configure the execution of the required lookups, reference the predefined lookup definitions and provide keys from any data available in the routing ticket. In the routing core step 2212, the DCR system may make routing decisions based on any of the information available in the routing ticket. In the prepare AVS step 2214, the DCR system may make modifications to the message before it is sent (e.g., adding new AVPs, modifying existing AVPs or removing AVPs). In the dispatcher step 2216, the DCR system may choose a specific host.

[0228] In an embodiment, the DCR system may be configured to accommodate component, system node and partial network failures, as well as discrete message delivery failures, in failover operations using a failover pipeline 2302, an example of which is illustrated in FIG. 23. The failover pipeline 2302 may be a part of the DCR core. The failover pipeline 2302 may include a number of discrete steps, stages, or modules (herein steps), each step performing a distinct DCR operation. In the illustrated example of FIG. 23, the failover pipeline 2302 includes a dispatcher step 2310 and a session update step 2312.

[0229] For example, in an embodiment, the DCR system may detect a transport failure and initiate Diameter failover procedures by sending the outstanding messages destined for the failed peer to the DCR failover pipeline 2302 for reprocessing. The DCR failover pipeline 2302 may choose an alternative destination for the message (e.g., based on the original destination host and/or original destination domain) in the dispatcher step 2310, and update the session store with the updated destination in session update step 2312. If the DCR system determines that the message cannot be re-routed, the DCR system may generate a response message to be sent to the requesting node. If the DCR system determines that the message can be re-routed, the message is re-routed to the alternative destination determined in the dispatcher step 2310. In the session update step 2312, the session store may be updated with new destination information.

[0230] In an embodiment, the DCR system (e.g., in the

DCR failover pipeline 2302) may be configured to determine when it is not possible to route to an alternative destination by determining if the message was originally sent to a fixed destination to which no alternative destination is acceptable (e.g., the message requires a specific destination node) and/or by determining if all acceptable alternative peers are unavailable.

[0231] In an embodiment, the DCR system may perform application level operations in response to receiving a redirect message. As discussed above, the DCR system may receive redirect response messages from network peers, which may be processed without performing application-level operations in response to receiving the message. In an embodiment, the DCR system may be configured to perform application-level operations (e.g., update an application level cache in order to avoid unnecessary or incorrect routing of future messages) in response to receiving a redirect message. The DCR system may be configured to perform the application level redirect operations using a redirect pipeline 2402, an example of which is illustrated in FIG. 24. The redirect pipeline 2402 may be a part of the DCR core. The redirect pipeline 2402 may include a number of discrete steps, stages, or modules (herein steps), each step performing a distinct DCR operation. For example, the redirect pipeline may include a redirect step 2410 and a dispatcher step 2412.

[0232] In the various embodiments, the DCR system may create a cache with an identity, a configured key and an AVS for storage.

[0233] In the various embodiments, reference data may be configured by: defining a named reference data lookup by configuring the structure of the stored data; populating the reference data by importing a structured file, such as a file containing comma separated values; and/or allowing incremental updates to the reference data by importing file updates. Reference data may be non-volatile and persist across restarts.

[0234] As mentioned above, the DCR system may perform operations to establish session stickiness. For example, each time a session initialization message is routed through the DCR, the DCR system may make a determination as to whether session stickiness is required, and add session information to a session store if it is determined that session stickiness is required. Likewise, when the DCR system receives a session update message or a terminate message, the DCR system may update or remove entries from the session stores, respectively. In an embodiment, the various session sticky behaviors may be implemented in two separate parts of the DCR request processing pipeline. In an embodiment, the DCR system include a session store that uses known AVPs as keys and stores only routing information.

[0235] In an embodiment, the DCR system may perform topology hiding operations. Since Diameter is an end to end protocol, when Diameter client applications interact with server applications, the clients, through inspection of base routing AVPs, can learn about the mul-

tiplicity and addresses of server nodes, as well as the hops involved in reaching those servers. In some cases (e.g., where inter-PLMN routing of Diameter messages is performed) it is desirable to hide the server locations from client applications. In an embodiment, the DCR system may operate as a joint server and client Diameter node. In this manner, intermediate nodes cannot determine the true destination of a Diameter message because the information contained within the message will list the DCR system as the source/destination.

[0236] In an embodiment, the DCR system may perform topology hiding operations via AVP manipulation in order to make messages being routed by the DCR appear to originate from the DCR. In an embodiment, the manipulation of the AVPs for topology hiding may be performed within a dispatcher module or step (e.g., dispatcher step 2122) in a message processing pipeline. The dispatcher's topology configuration may include the ability to indicate if topology hiding should be applied on a per domain basis. For example, in a request processing pipeline (e.g., request pipeline 2102) the dispatcher (e.g., dispatcher step 2122) may receive a routing ticket with a destination domain(s) and a destination-host. If a selected destination domain requires topology hiding, then the dispatcher may modify the relevant AVPs such as the Origin-Host AVP and the Route-Record AVP to contain the DCR Diameter identity, and modify the End-to-End-ID AVP for the onward hop. In this case, the dispatcher (e.g., dispatcher step 2216) in the response processing pipeline (e.g., response pipeline 2202) may subsequently need to make equivalent topology hiding modifications. Topology hiding may also be applied in the same manner if it is required by the origin domain.

[0237] As discussed above, each of the request handling pipeline 2102, response handling pipeline 2202, failover handling pipeline 2302, and redirect pipeline 2402 may include a dispatcher step or module (herein dispatcher) responsible for mapping the destination domain decisions to specific destination hosts (with reference to the peer topology). In an embodiment, the dispatcher may map messages arriving from Diameter peers to the correct message handler, and handle notifications from the Diameter library about peer state changes and transaction queue sizes, such that the DCR system can make informed routing decisions.

[0238] In an embodiment, the DCR system may be configured to notify the dispatcher of peer state changes (e.g., via the Diameter library), which may be used by the dispatcher to make informed routing decisions by combining the peer topology and peer state.

[0239] In an embodiment, the dispatcher may translate a non-specific domain destination into a specific peer for routing by choosing the highest priority available peer group in the specified domain, and choosing a peer from the chosen peer group based on the configured load balancing algorithm

[0240] The various embodiments may be implemented on any of a variety of commercially available server de-

vices, such as the server 2500 illustrated in FIG. 25. Such a server 2500 typically includes a processor 2501 coupled to volatile memory 2502 and a large capacity non-volatile memory, such as a disk drive 2503. The server 2500 may also include a floppy disc drive, compact disc (CD) or DVD disc drive 2506 coupled to the processor 2501. The server 2500 may also include network access ports 2504 coupled to the processor 2501 for establishing data connections with a network 2505, such as a local area network coupled to other operator network computers and servers.

[0241] The processor 2501 may be any programmable microprocessor, microcomputer or multiple processor chip or chips that can be configured by software instructions (applications) to perform a variety of functions, including the functions of the various embodiments described below. Multiple processors 2501 may be provided, such as one processor dedicated to wireless communication functions and one processor dedicated to running other applications. Typically, software applications may be stored in the internal memory 2502, 2503 before they are accessed and loaded into the processor 2501. The processor 2501 may include internal memory sufficient to store the application software instructions.

[0242] The foregoing method descriptions and the process flow diagrams are provided merely as illustrative examples and are not intended to require or imply that the steps of the various embodiments must be performed in the order presented. As will be appreciated by one of skill in the art the order of steps in the foregoing embodiments may be performed in any order. Words such as "thereafter," "then," "next," etc. are not intended to limit the order of the steps; these words are simply used to guide the reader through the description of the methods. Further, any reference to claim elements in the singular, for example, using the articles "a," "an" or "the" is not to be construed as limiting the element to the singular.

[0243] The various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present invention.

[0244] The hardware used to implement the various illustrative logics, logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an ap-

plication specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but, in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration. Alternatively, some steps or methods may be performed by circuitry that is specific to a given function.

[0245] In one or more exemplary aspects, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. The steps of a method or algorithm disclosed herein may be embodied in a processor-executable software module which may reside on a tangible, non-transitory computer-readable storage medium. Tangible, non-transitory computer-readable storage media may be any available media that may be accessed by a computer. By way of example, and not limitation, such as, non-transitory computer-readable media may comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that may be used to store desired program code in the form of instructions or data structures and that may be accessed by a computer. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk, and blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of non-transitory computer-readable media. Additionally, the operations of a method or algorithm may reside as one or any combination or set of codes and/or instructions on a tangible, non-transitory machine readable medium and/or computer-readable medium, which may be incorporated into a computer program product.

[0246] The preceding description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the following claims and the principles and novel features disclosed herein.

Claims

1. A method of communicating signaling information in a telecommunications signaling network, comprising:

receiving, in a first processor, a first message encoding signaling information from a source component;
 decoding the received first message into an internal representation;
 processing the internal representation of the message via a pipeline having a plurality of stages, each stage containing one or more procedures for performing a specific set of tasks;
 performing application level routing operations using contextual information derived from the internal representation to identify a destination component;
 encoding the signaling information contained in the internal representation into a second message; and
 sending the second message encoding the signaling information to the identified destination component.

2. The method of claim 1, wherein performing application level routing operations using contextual information derived from the internal representation to identify a destination component comprises using at least one pipeline stage to make a routing decision using a discrete number of configurable procedures.

3. The method of claim 1, wherein the pipeline type is one of a request handler pipeline, a response handler pipeline, a failover handler pipeline, or a redirect handler pipeline.

4. The method of claim 1, wherein the pipeline type and instance is selected on a per message type or on a per application basis.

5. The method of claim 1, wherein the pipeline has a plurality of stages that include at least one stage from the group consisting of a realm routing lookup stage, a session lookup stage, a gather data stage, a routing core stage, a prepare attribute value stream (AVS) stage, a filter stage, a dispatcher stage, a session update stage, and a redirect stage.

6. A server configured for use in a telecommunications signaling network, comprising:

a processor configured with processor-executable instructions to perform operations comprising:

receiving a first message encoding signal-

- ing information from a source component;
 decoding the received first message into an
 internal representation;
 processing the internal representation of
 the message via a pipeline having a plurality
 of stages, each stage containing one or
 more procedures for performing a specific
 set of tasks;
 performing application level routing opera-
 tions using contextual information derived
 from the internal representation to identify
 a destination component;
 encoding the signaling information con-
 tained in the internal representation into a
 second message; and
 sending the second message encoding the
 signaling information to the identified desti-
 nation component.
7. The server of claim 1, wherein the processor is con-
 figured with processor-executable instructions to
 perform operations such that performing application
 level routing operations using contextual information
 derived from the internal representation to identify a
 destination component comprises using at least one
 pipeline stage to make a routing decision using a
 discrete number of configurable procedures.
8. The server of claim 1, wherein the processor is con-
 figured with processor-executable instructions to
 perform operations such that the pipeline type is one
 of a request handler pipeline, a response handler
 pipeline, a failover handler pipeline, or a redirect han-
 dler pipeline.
9. The server of claim 1, wherein the processor is con-
 figured with processor-executable instructions to
 perform operations such that the pipeline type and
 instance is selected on a per message type or on a
 per application basis.
10. The server of claim 1, wherein the processor is con-
 figured with processor-executable instructions to
 perform operations such that the pipeline has a plu-
 rality of stages that include at least one stage from
 the group consisting of a realm routing lookup stage,
 a session lookup stage, a gather data stage, a routing
 core stage, a prepare attribute value stream (AVS)
 stage, a filter stage, a dispatcher stage, a session
 update stage, and a redirect stage.
11. A non-transitory server-readable storage medium
 having stored thereon server-executable instruc-
 tions configured to cause a server to perform oper-
 ations comprising:
- receiving a first message encoding signaling in-
 formation from a source component;
- decoding the received first message into an in-
 ternal representation of the message;
 processing the internal representation of the
 message via a pipeline having a plurality of stag-
 es, each stage containing one or more proce-
 dures for performing a specific set of tasks;
 performing application level routing operations
 using contextual information derived from the in-
 ternal representation to identify a destination
 component;
 encoding the signaling information contained in
 the internal representation into a second mes-
 sage; and
 sending the second message encoding the sig-
 naling information to the identified destination
 component.
12. The non-transitory server-readable storage medium
 of claim 1, wherein the stored server-executable in-
 structions are configured to cause a server to per-
 form operations such that performing application lev-
 el routing operations using contextual information
 derived from the internal representation to identify a
 destination component comprises using at least one
 pipeline stage to make a routing decision using a
 discrete number of configurable procedures.
13. The non-transitory server-readable storage medium
 of claim 1, wherein the stored server-executable in-
 structions are configured to cause a server to per-
 form operations such that the pipeline type is one of
 a request handler pipeline, a response handler pipe-
 line, a failover handler pipeline, or a redirect handler
 pipeline.
14. The non-transitory server-readable storage medium
 of claim 1, wherein the processor is configured with
 processor-executable instructions to perform oper-
 ations such that the pipeline type and instance is
 selected on a per message type or on a per applica-
 tion basis.
15. The non-transitory server-readable storage medium
 of claim 1, wherein the stored server-executable in-
 structions are configured to cause a server to per-
 form operations such that the pipeline has a plurality
 of stages that include at least one stage from the
 group consisting of a realm routing lookup stage, a
 session lookup stage, a gather data stage, a routing
 core stage, a prepare attribute value stream, AVS,
 stage, a filter stage, a dispatcher stage, a session
 update stage, and a redirect stage.

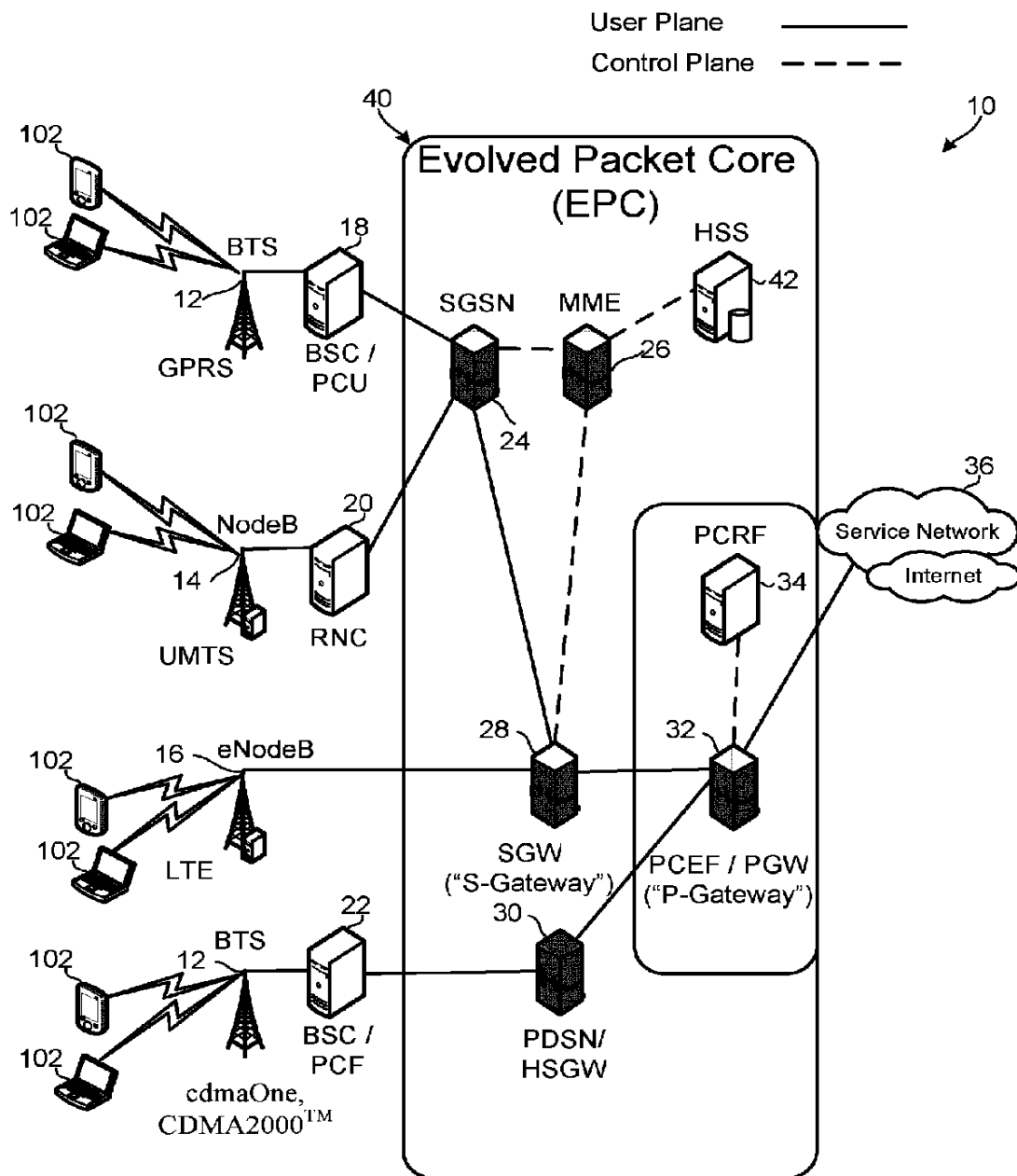


FIG. 1

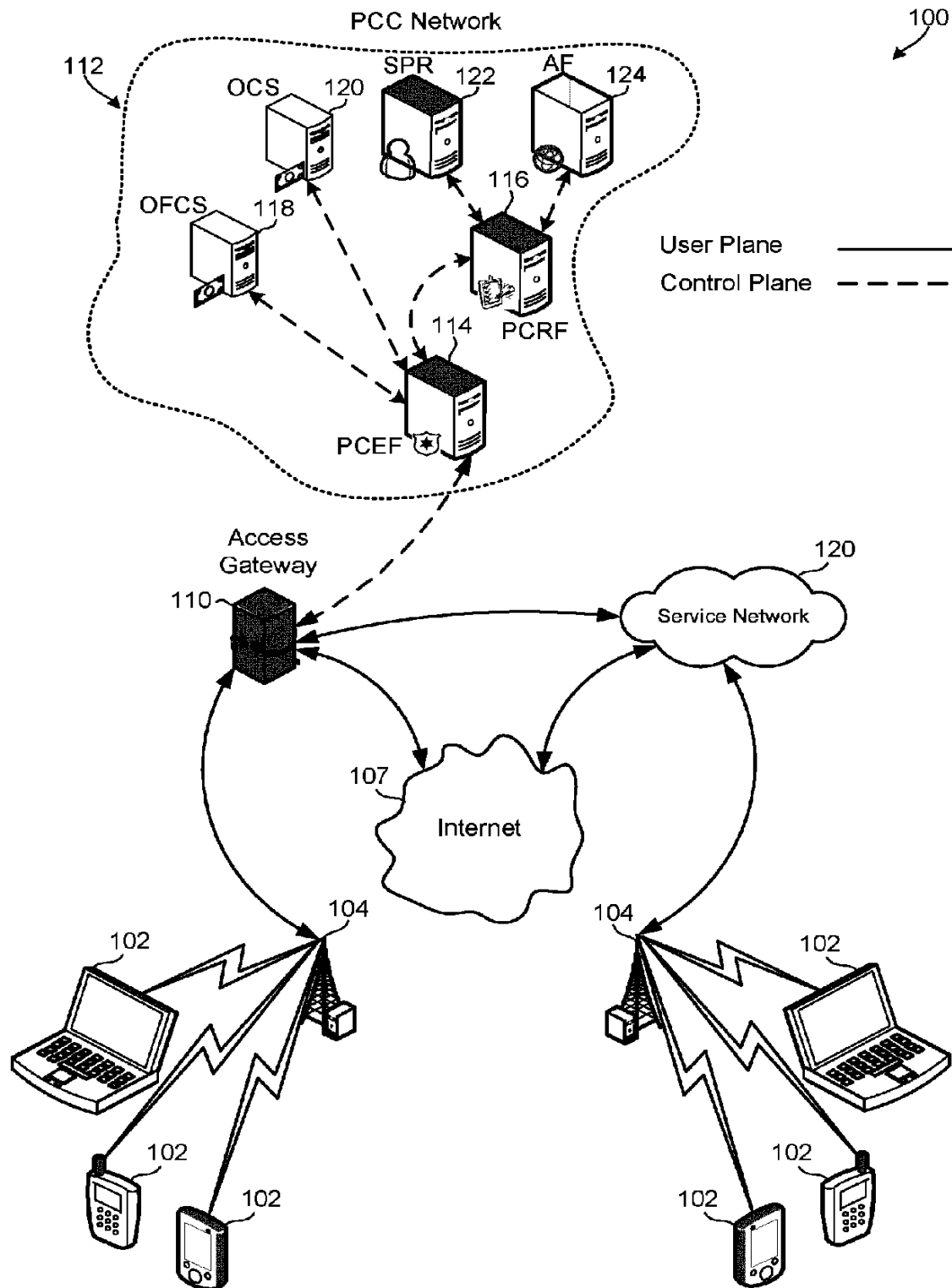


FIG. 2

Policy and Charging Control (PCC) Architecture

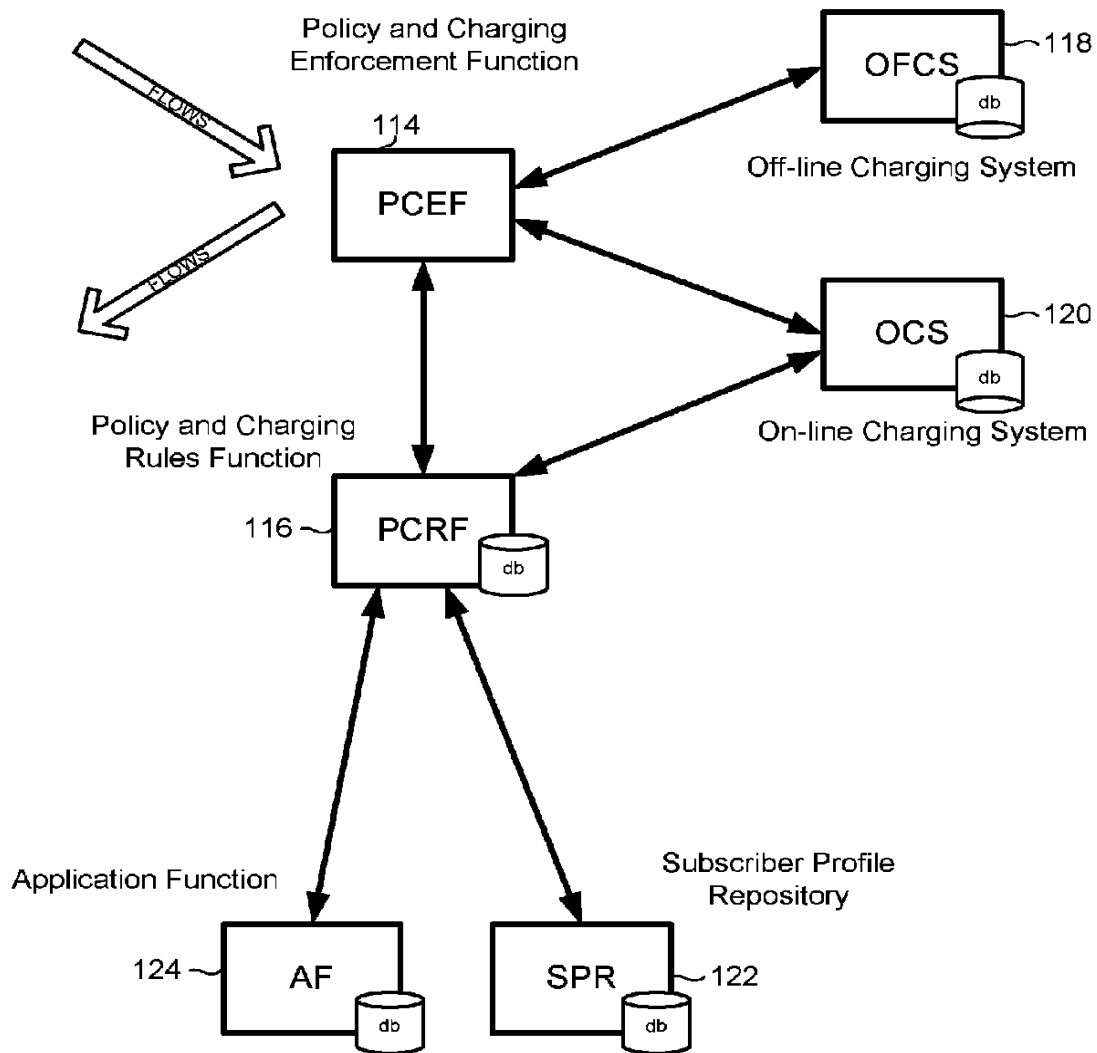


FIG. 3

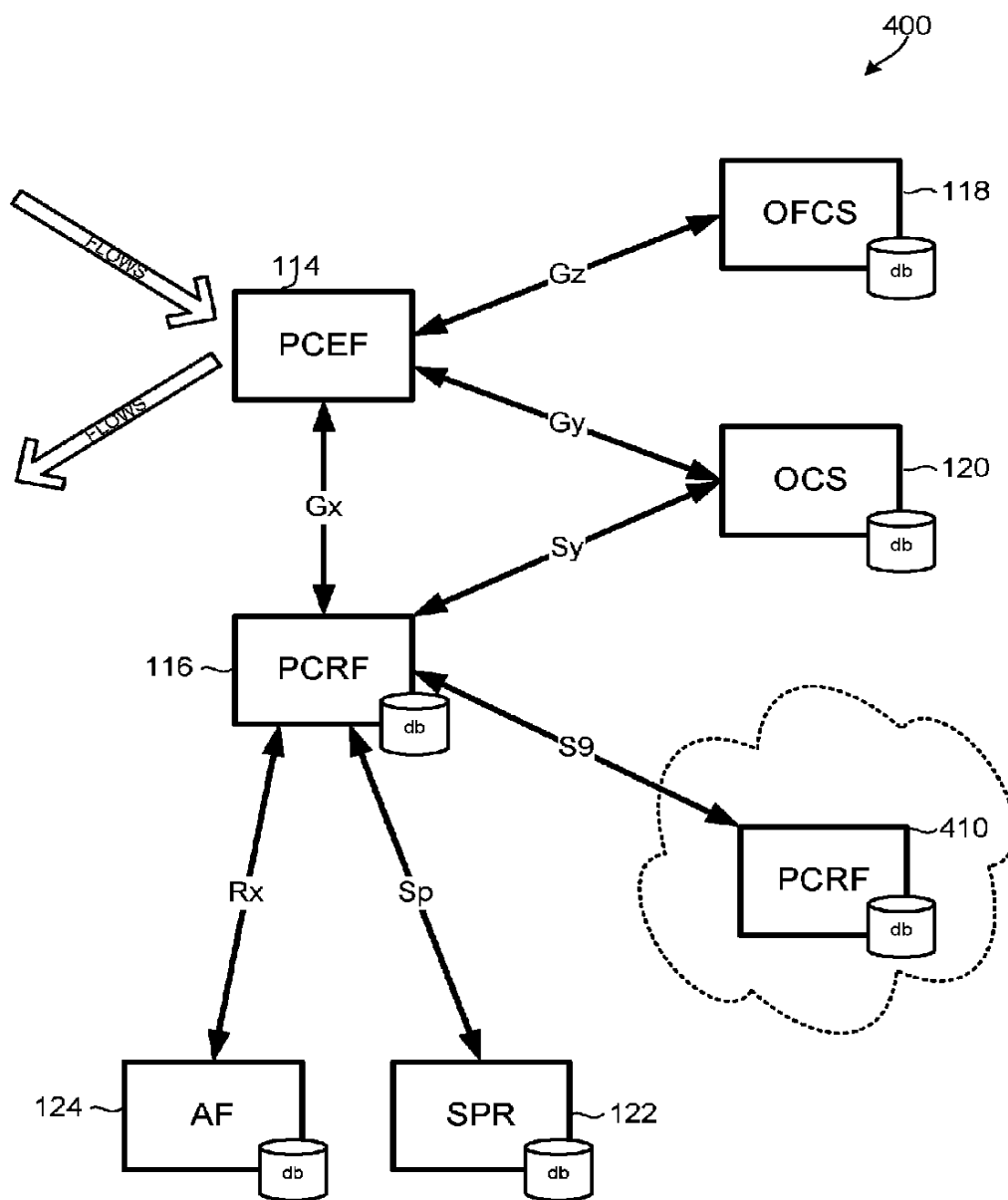
Communication Interfaces/Protocols

FIG. 4

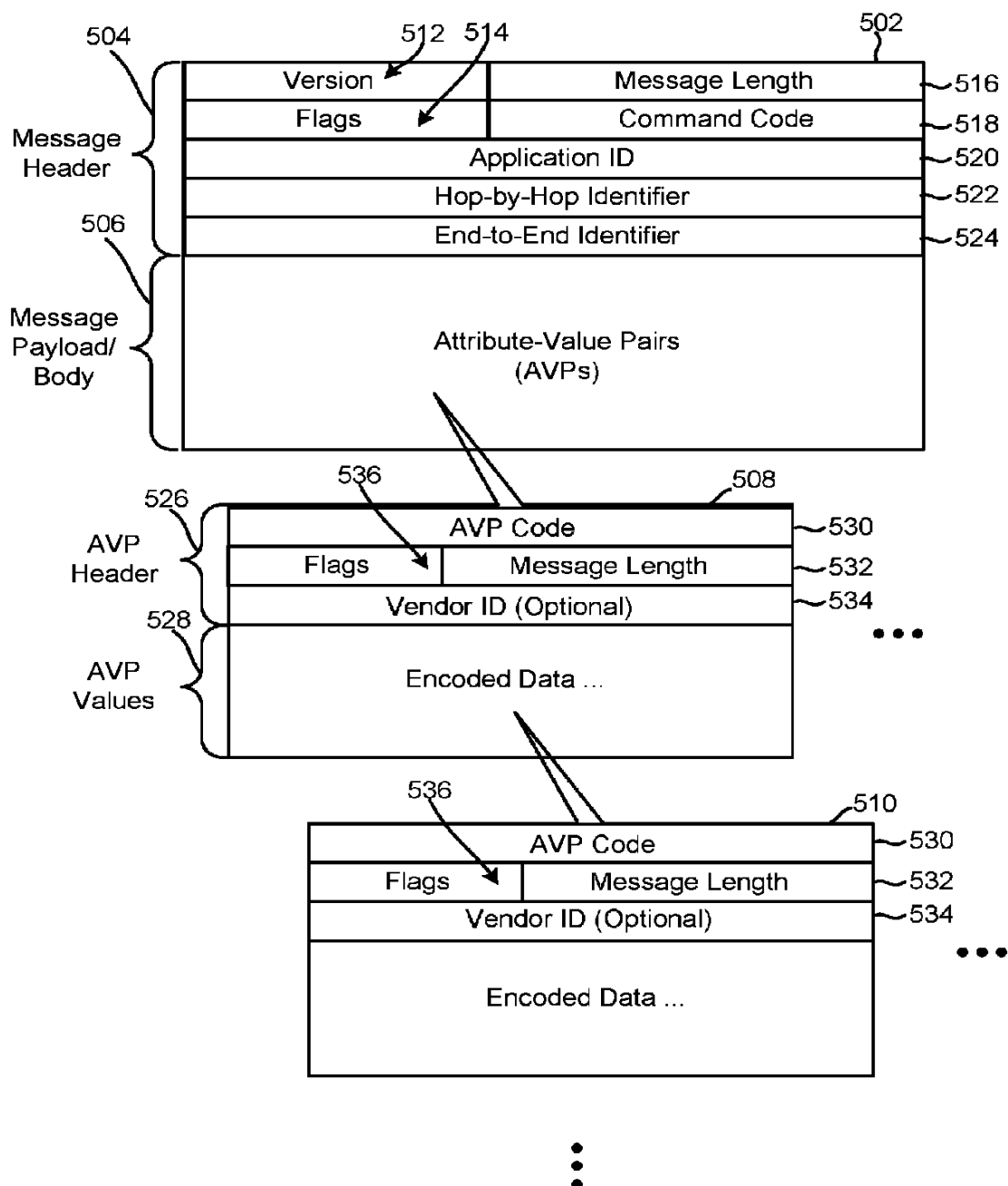


FIG. 5

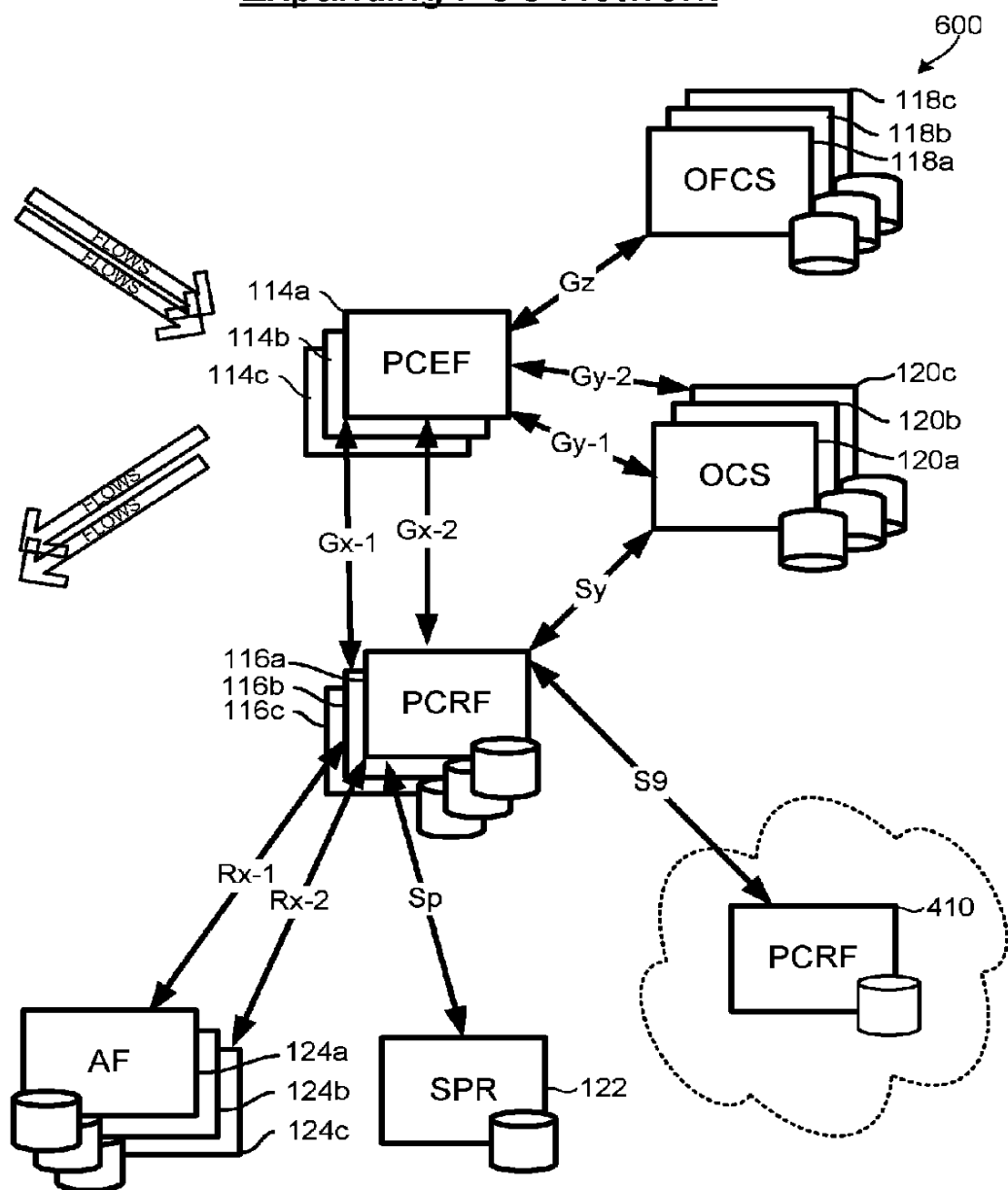
Expanding PCC Network

FIG. 6

PCC Architecture -- DRA

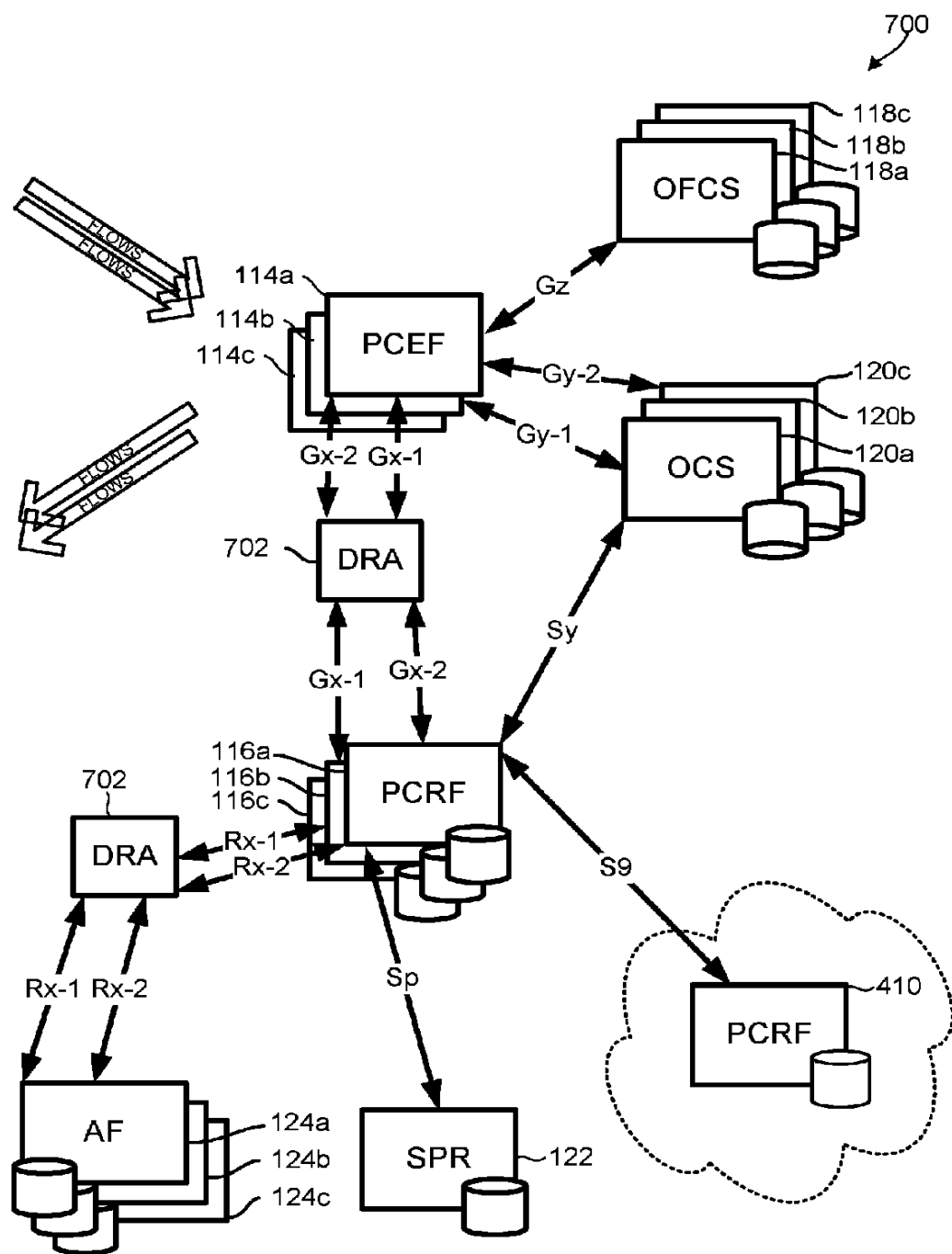


FIG. 7A

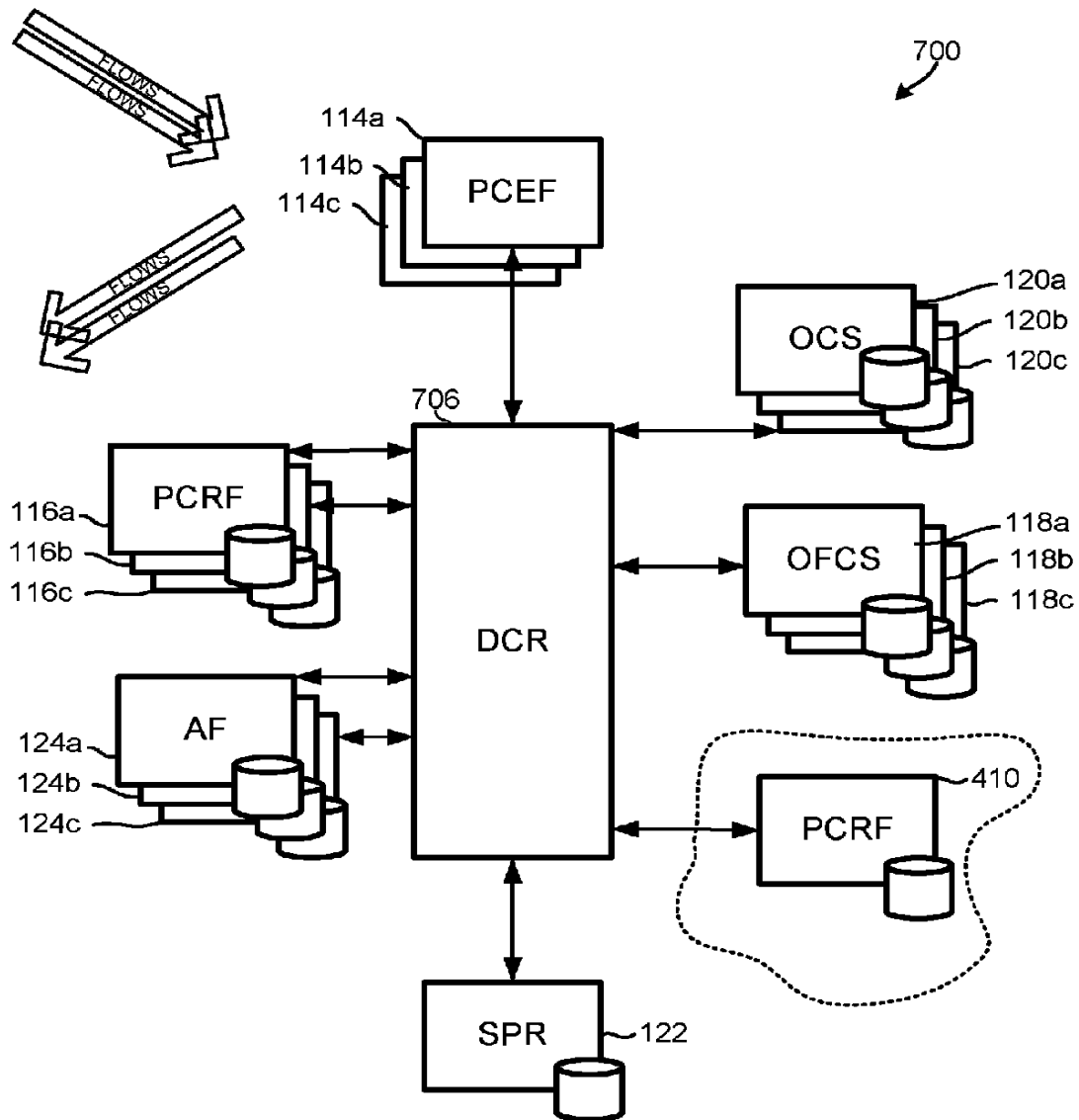
PCC Architecture -- DCR

FIG. 7B

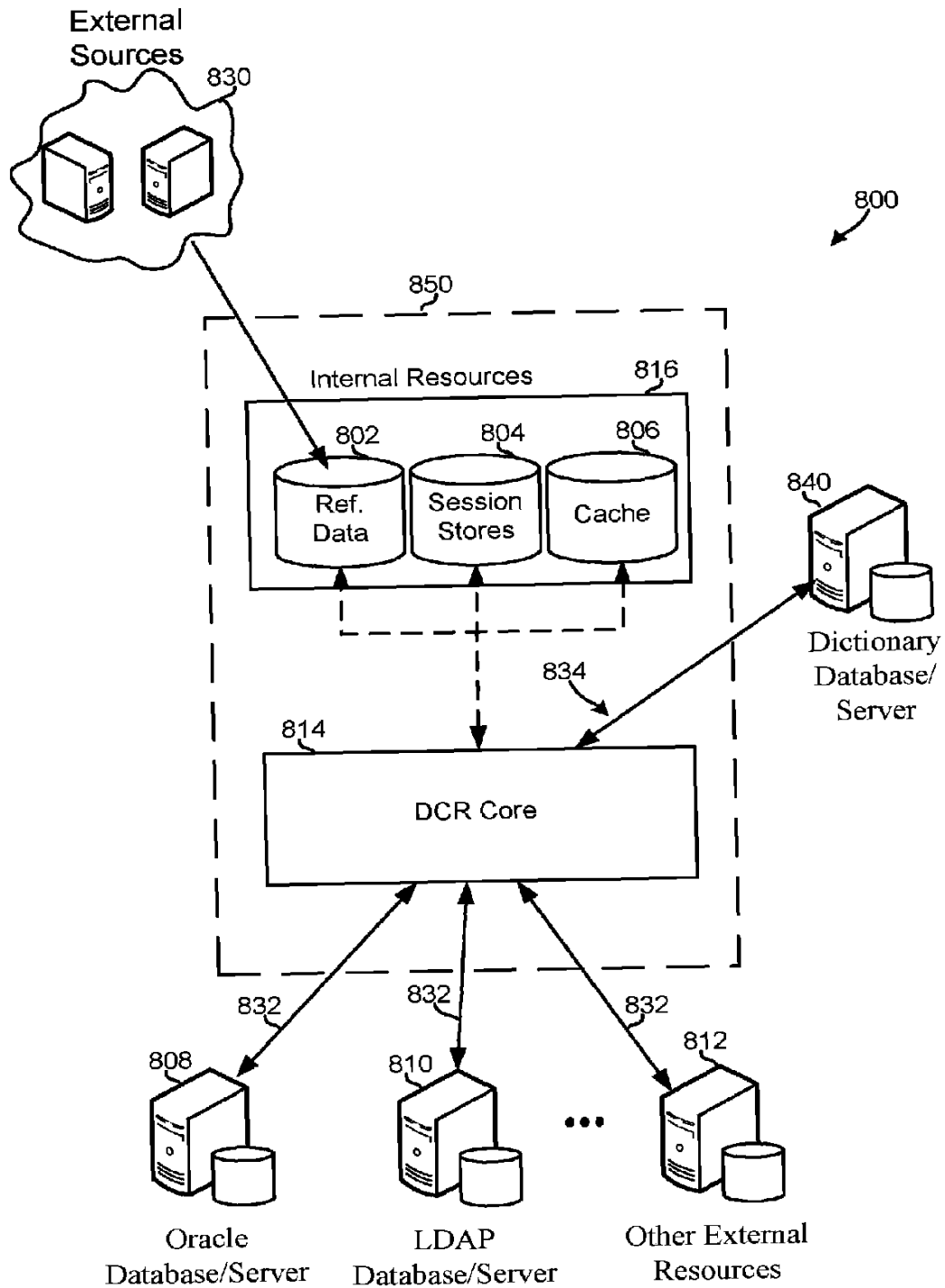


FIG. 8

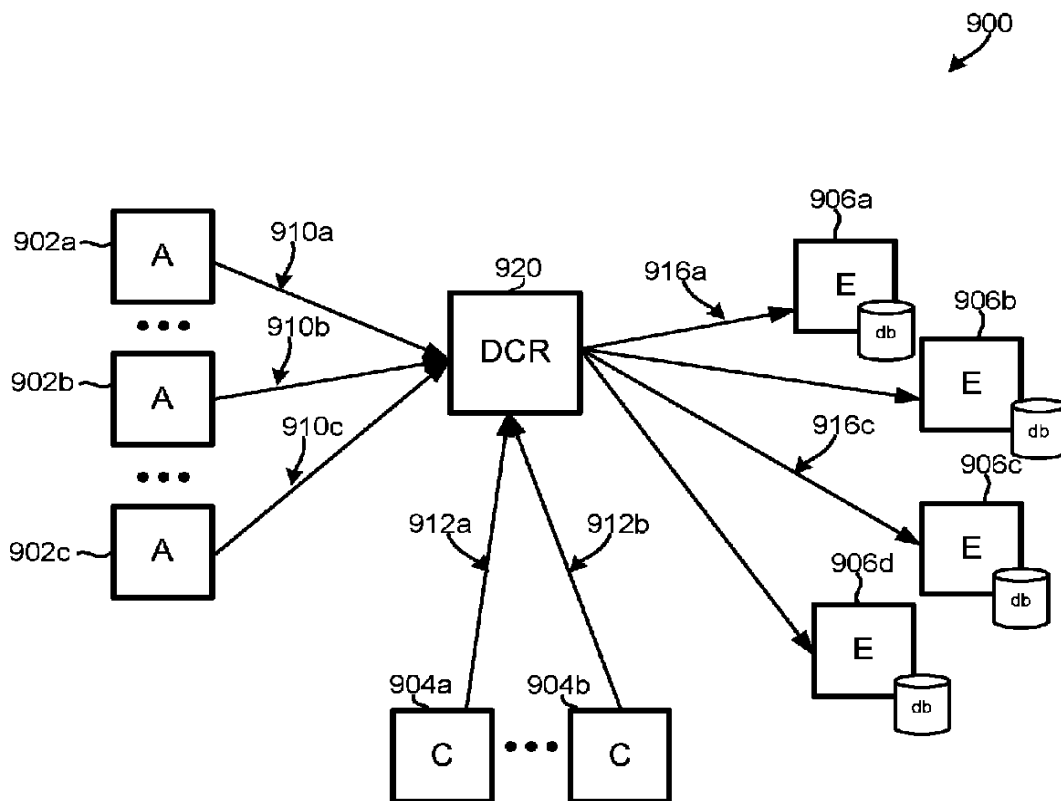


FIG. 9

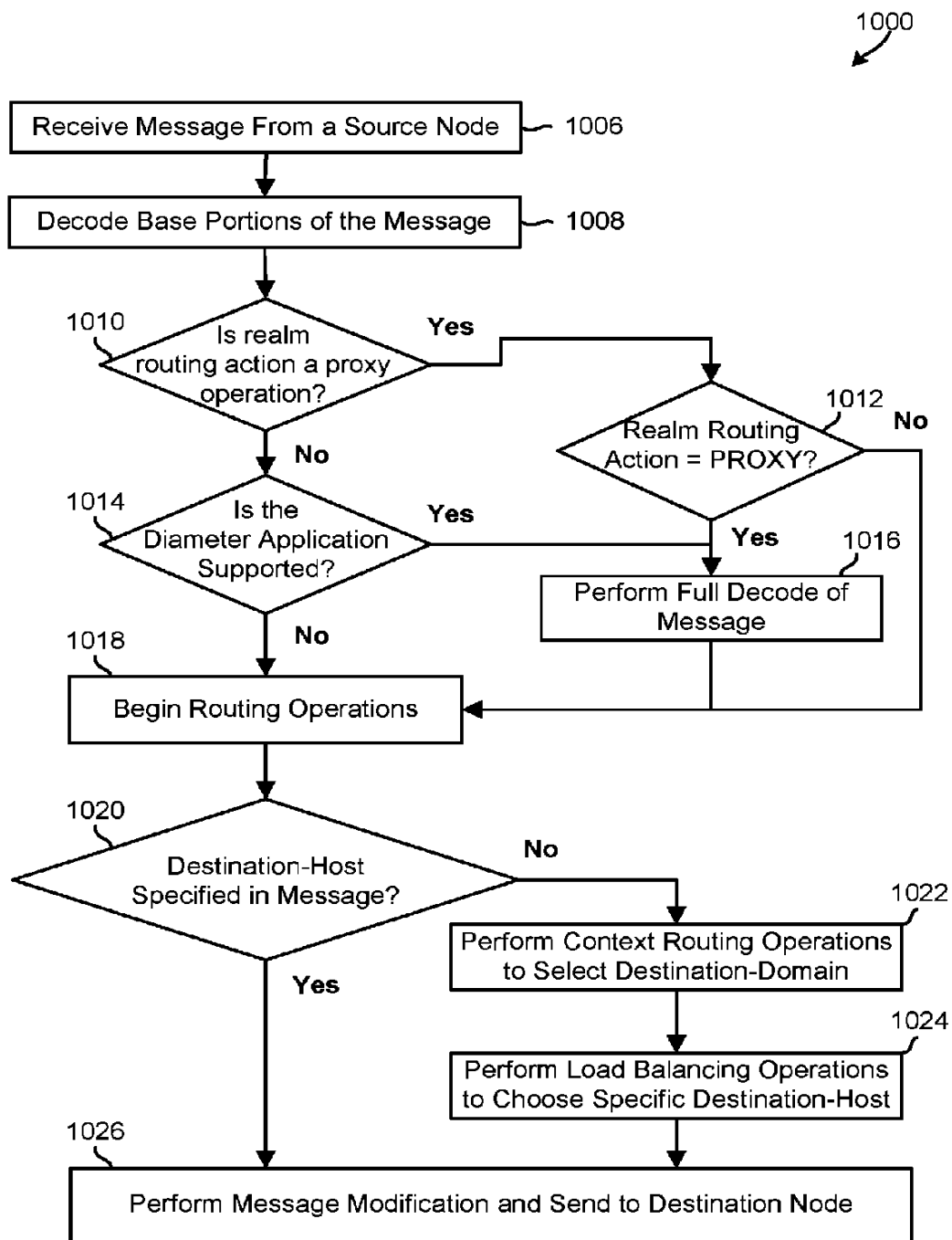


FIG. 10A

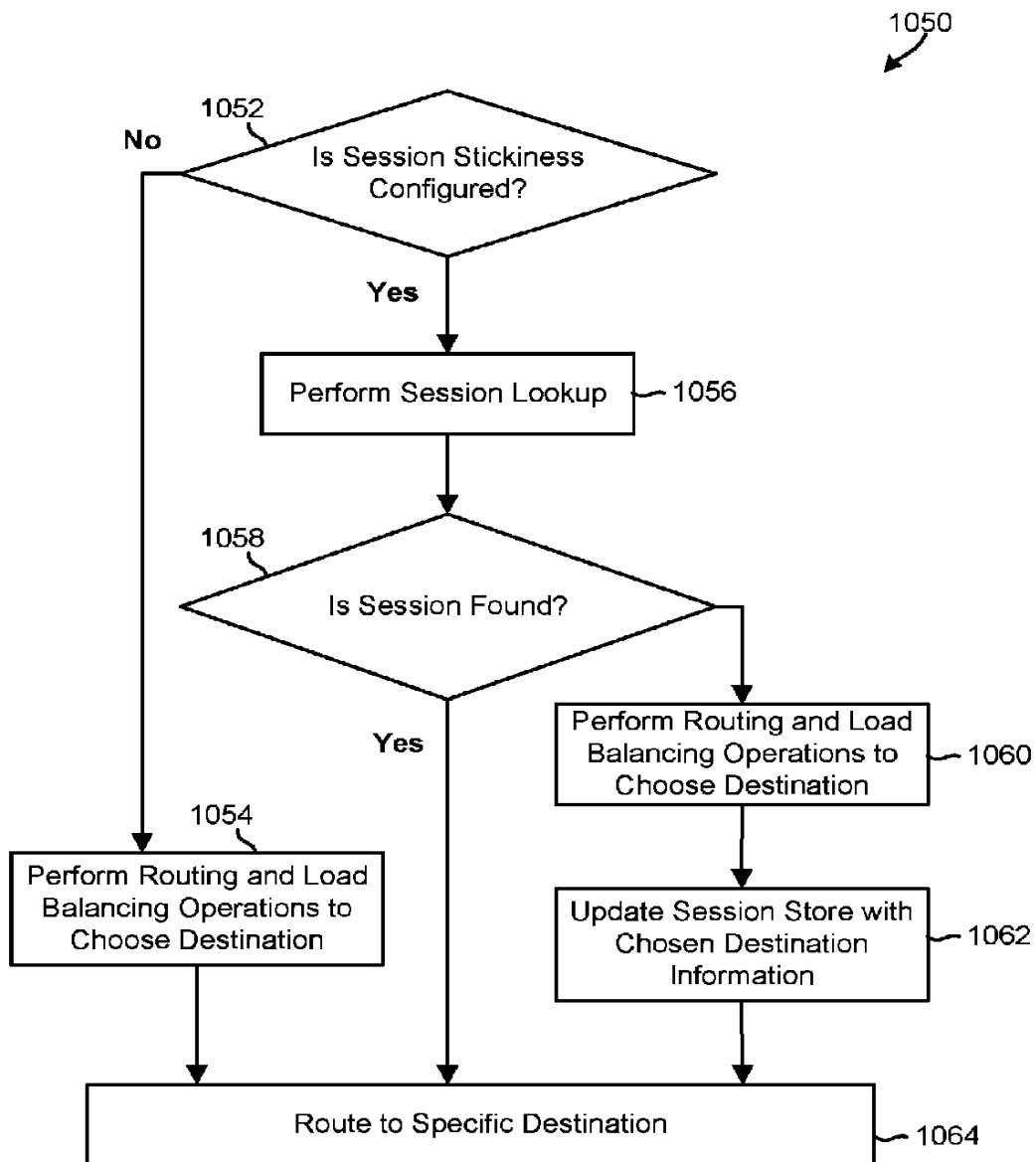


FIG. 10B

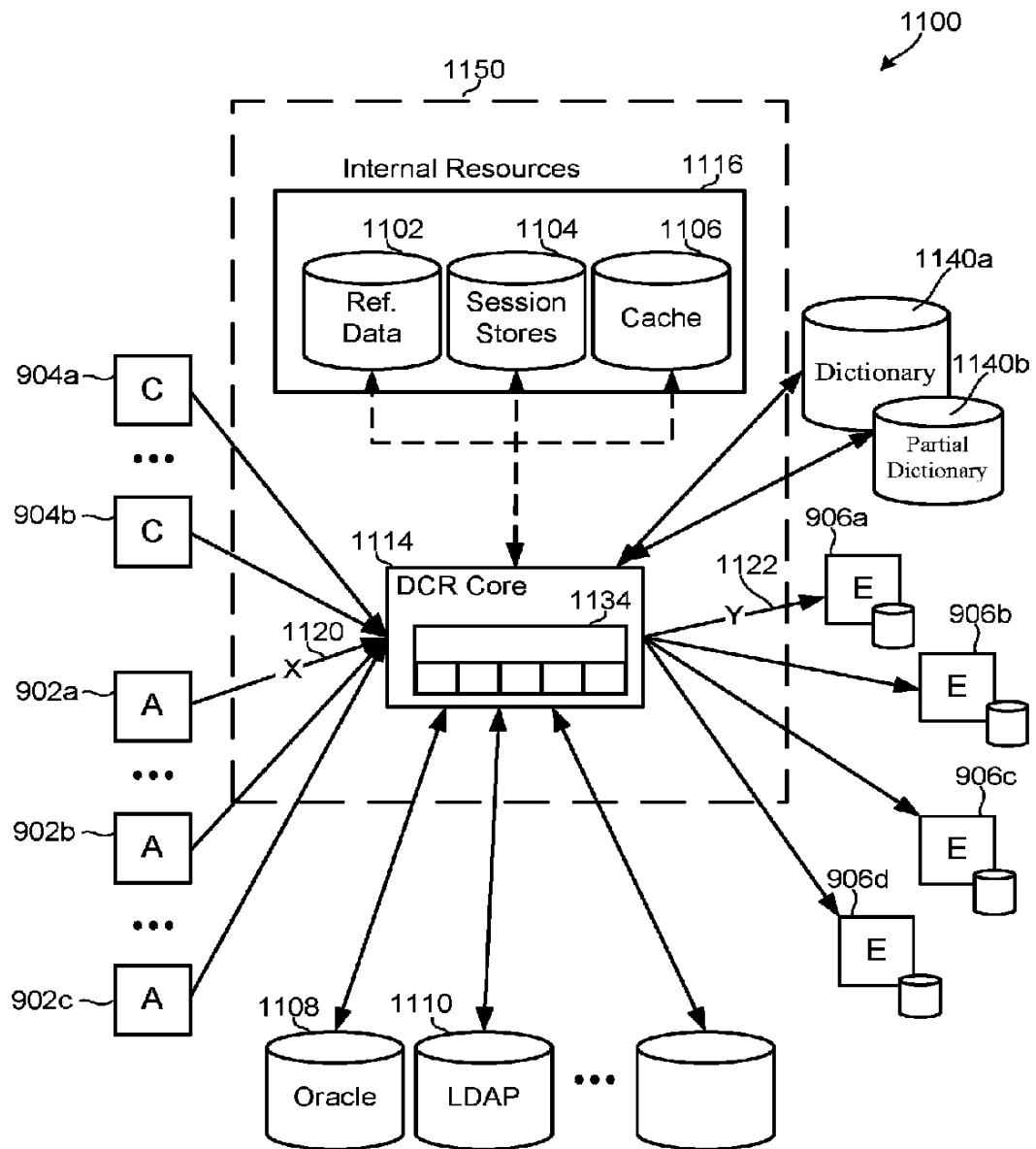


FIG. 11

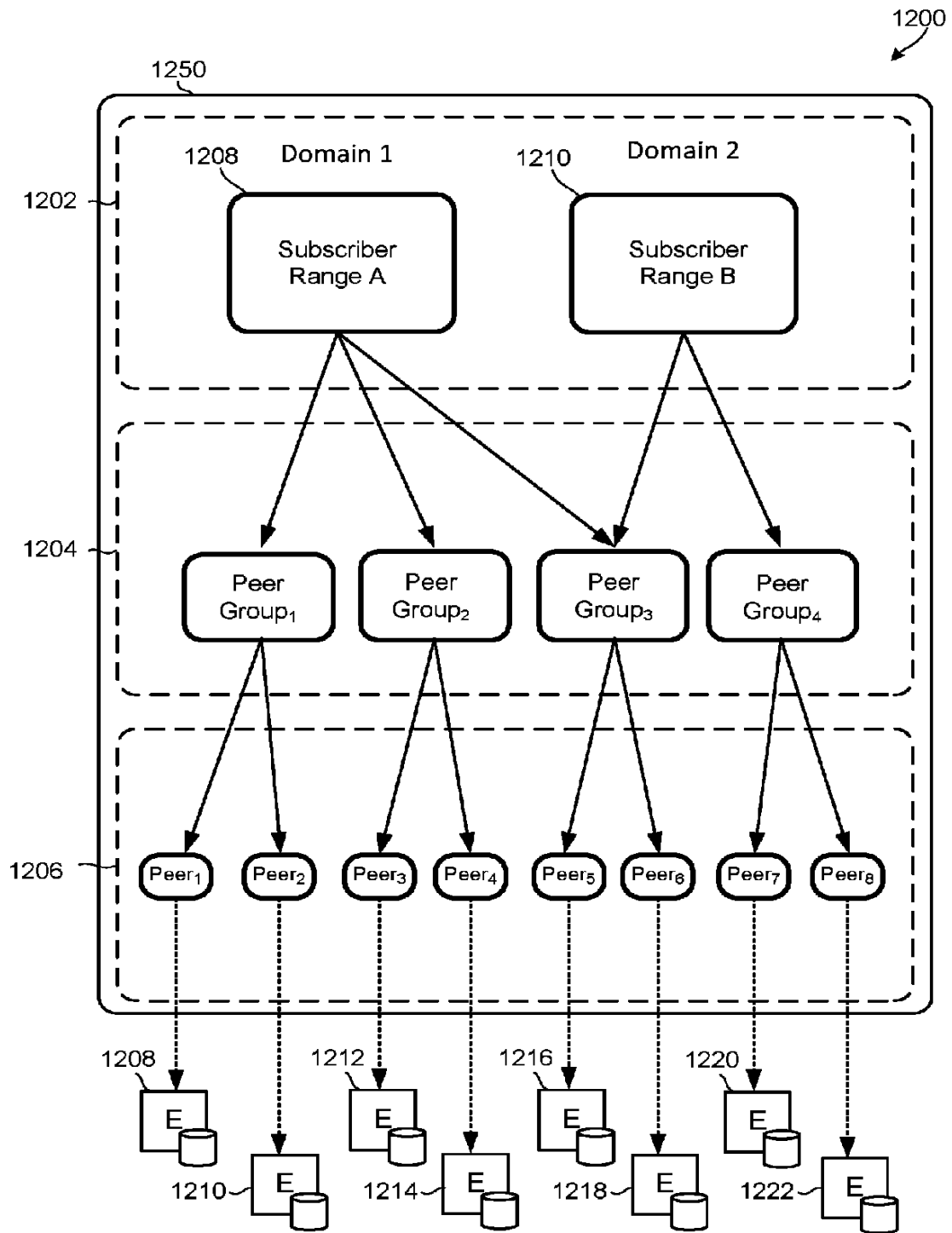
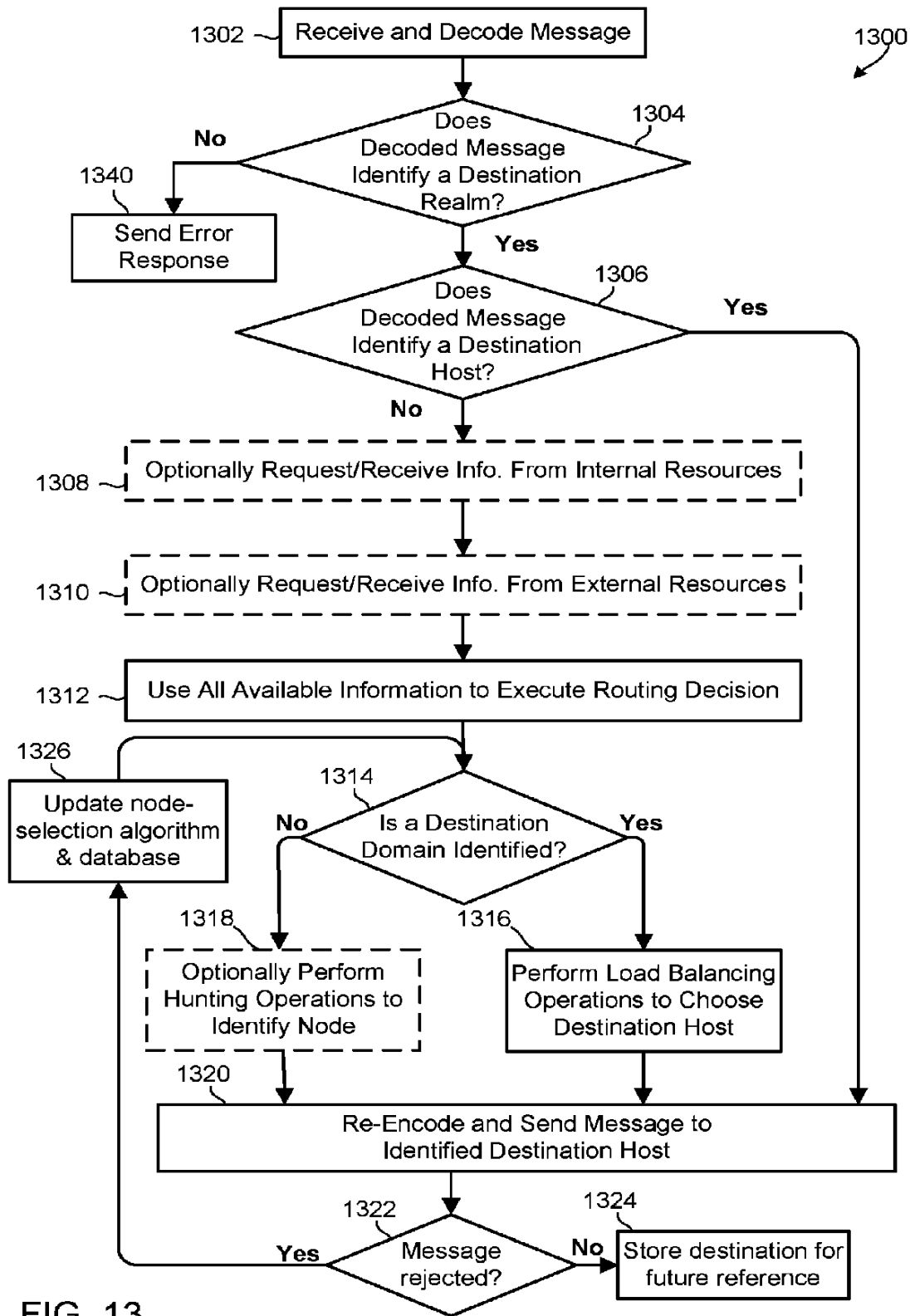


FIG. 12



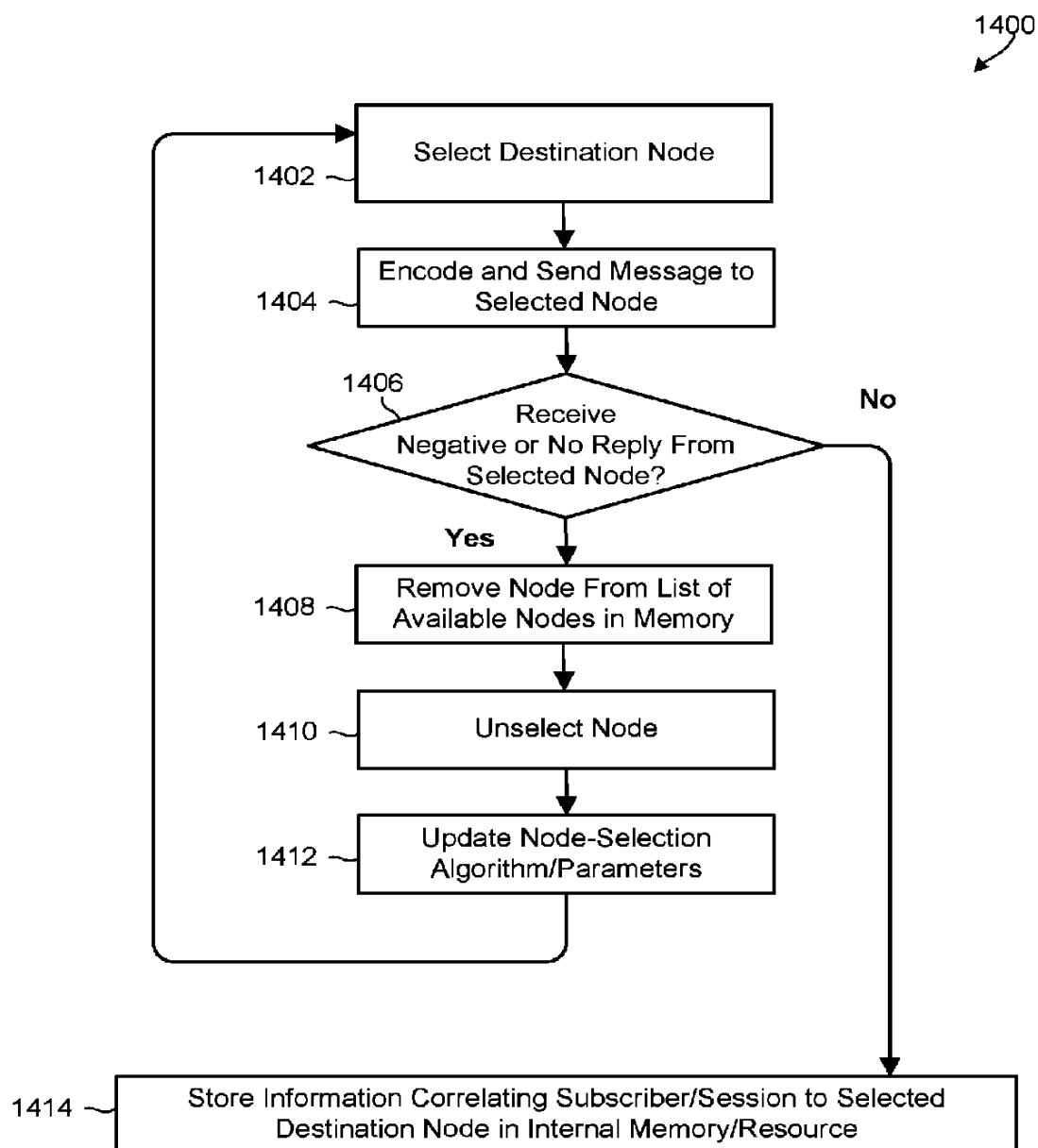


FIG. 14

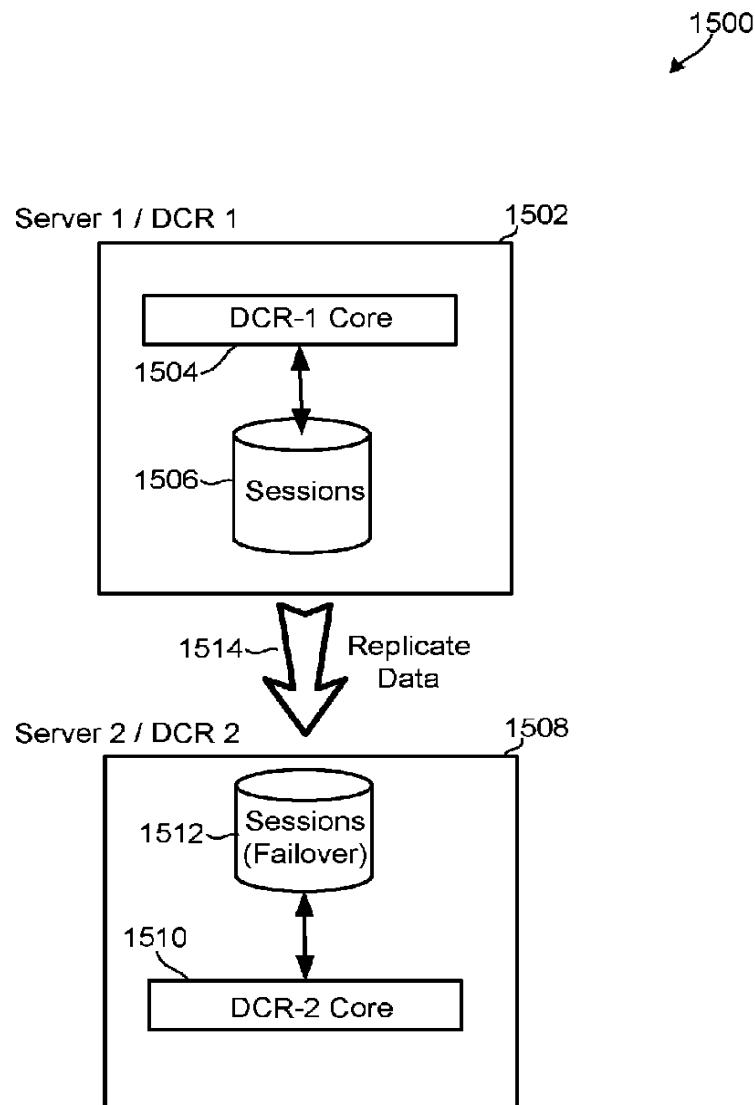


FIG. 15A

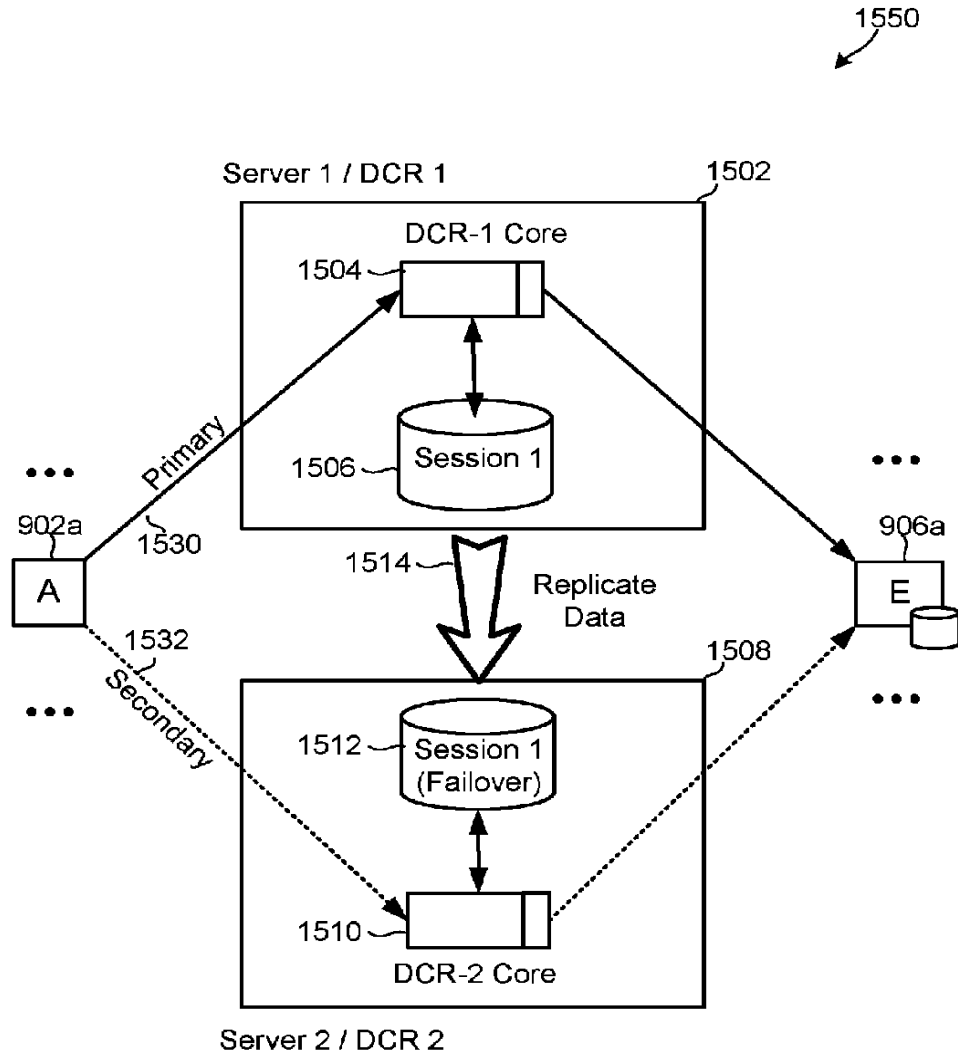


FIG. 15B

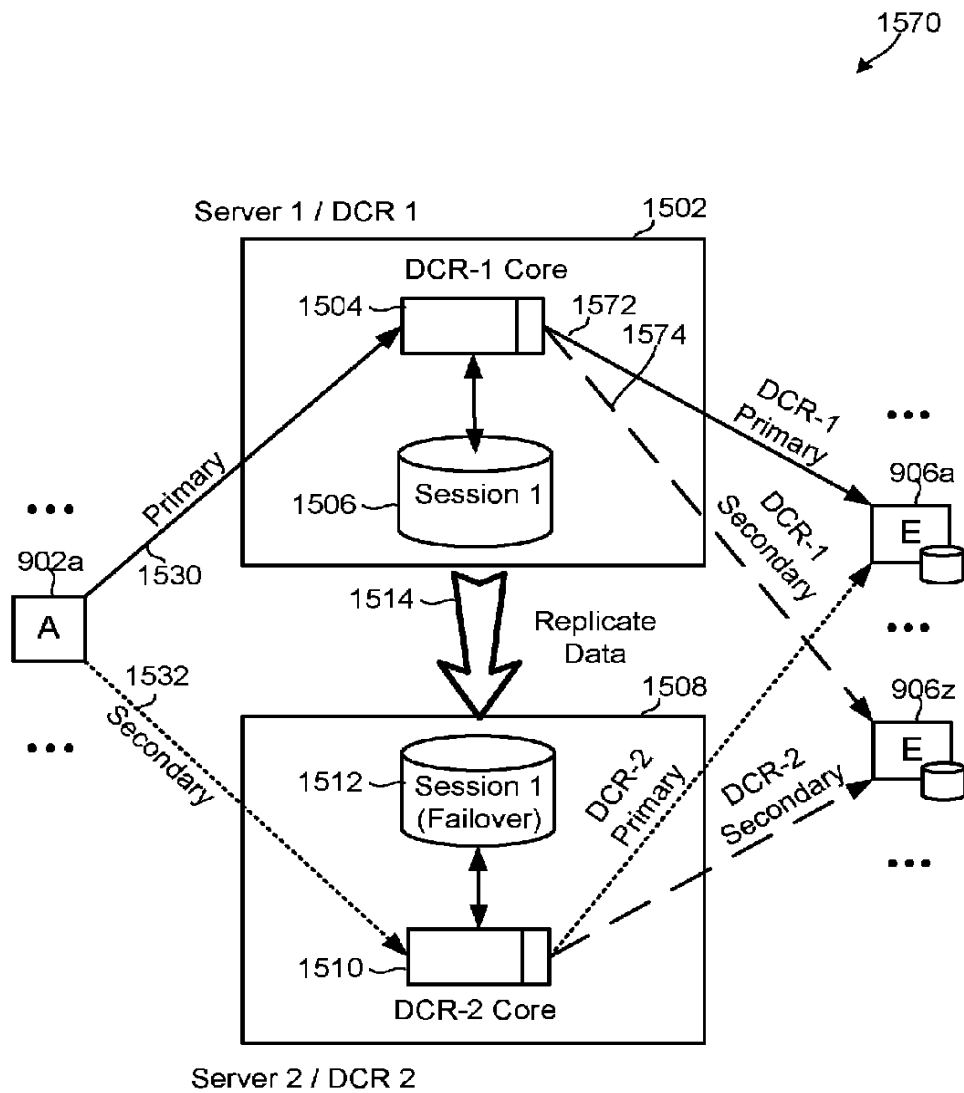


FIG. 15C

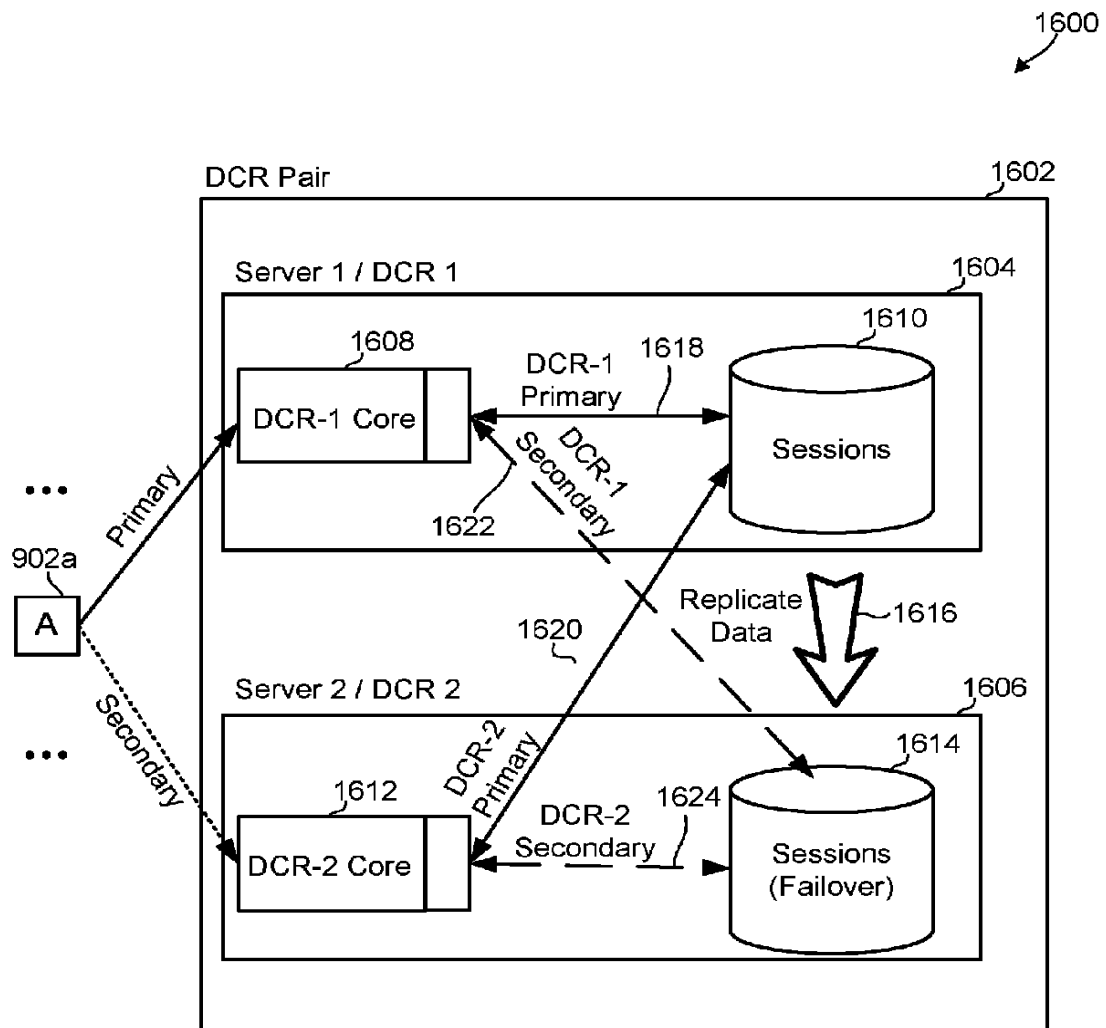


FIG. 16

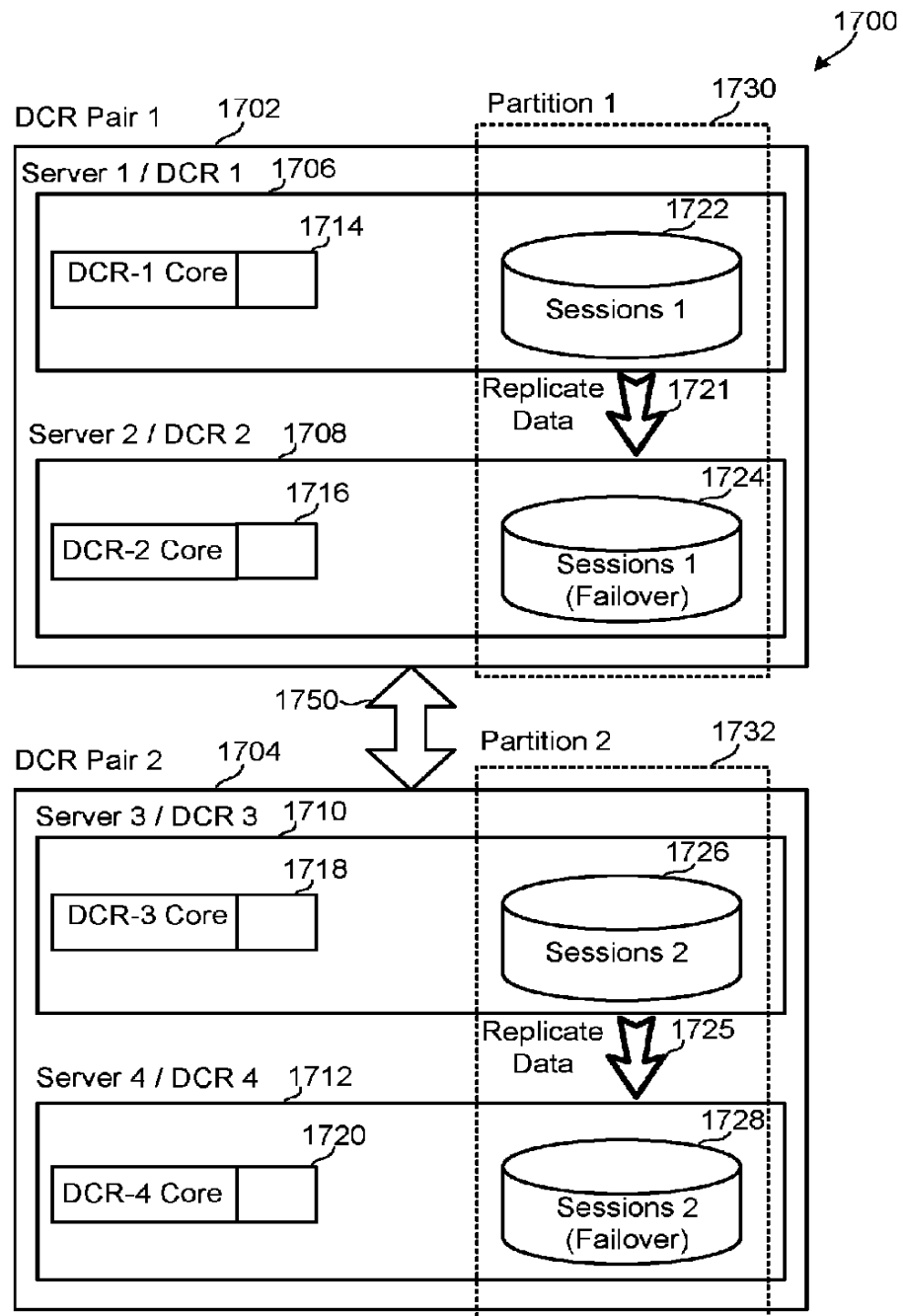


FIG. 17A

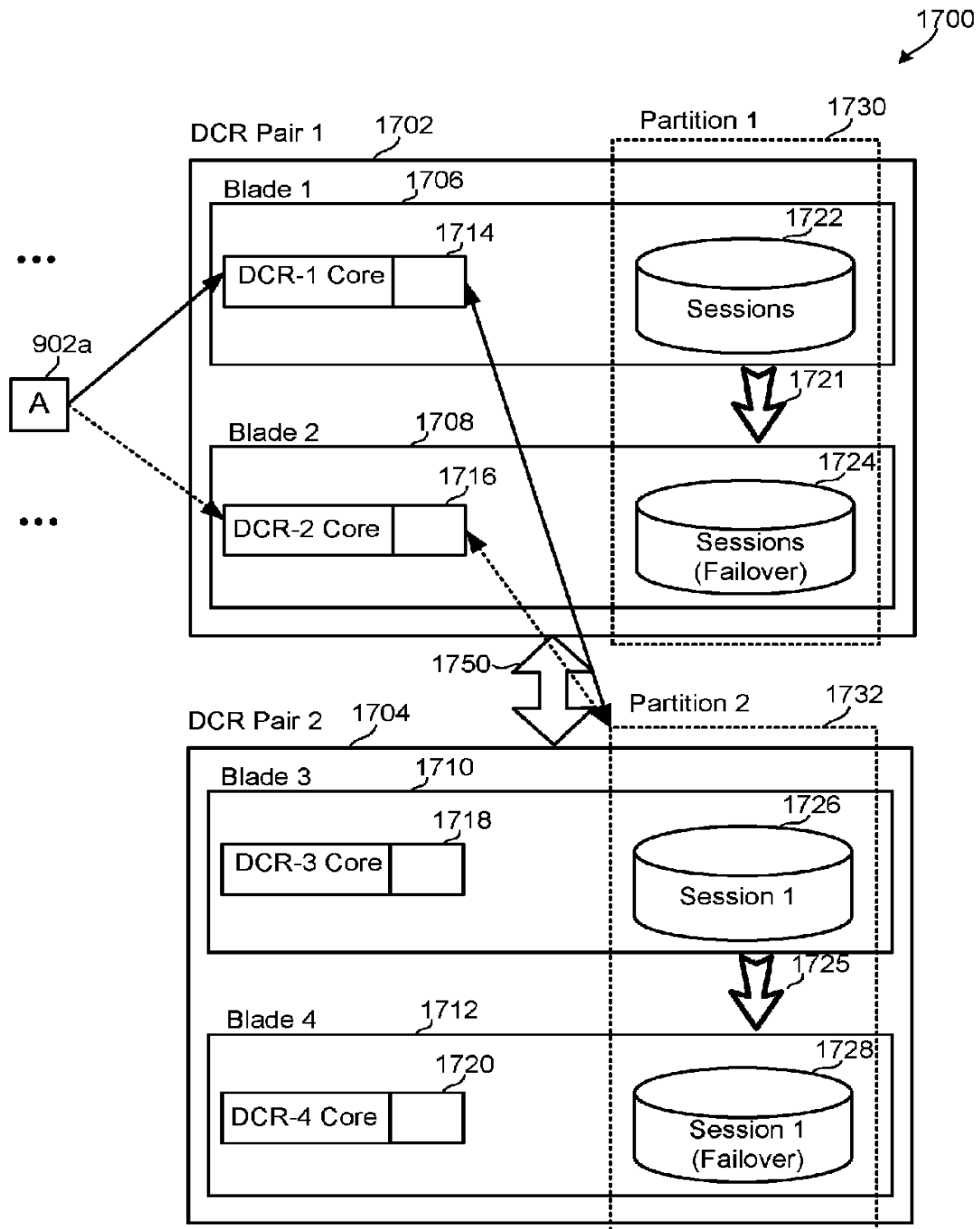


FIG. 17B

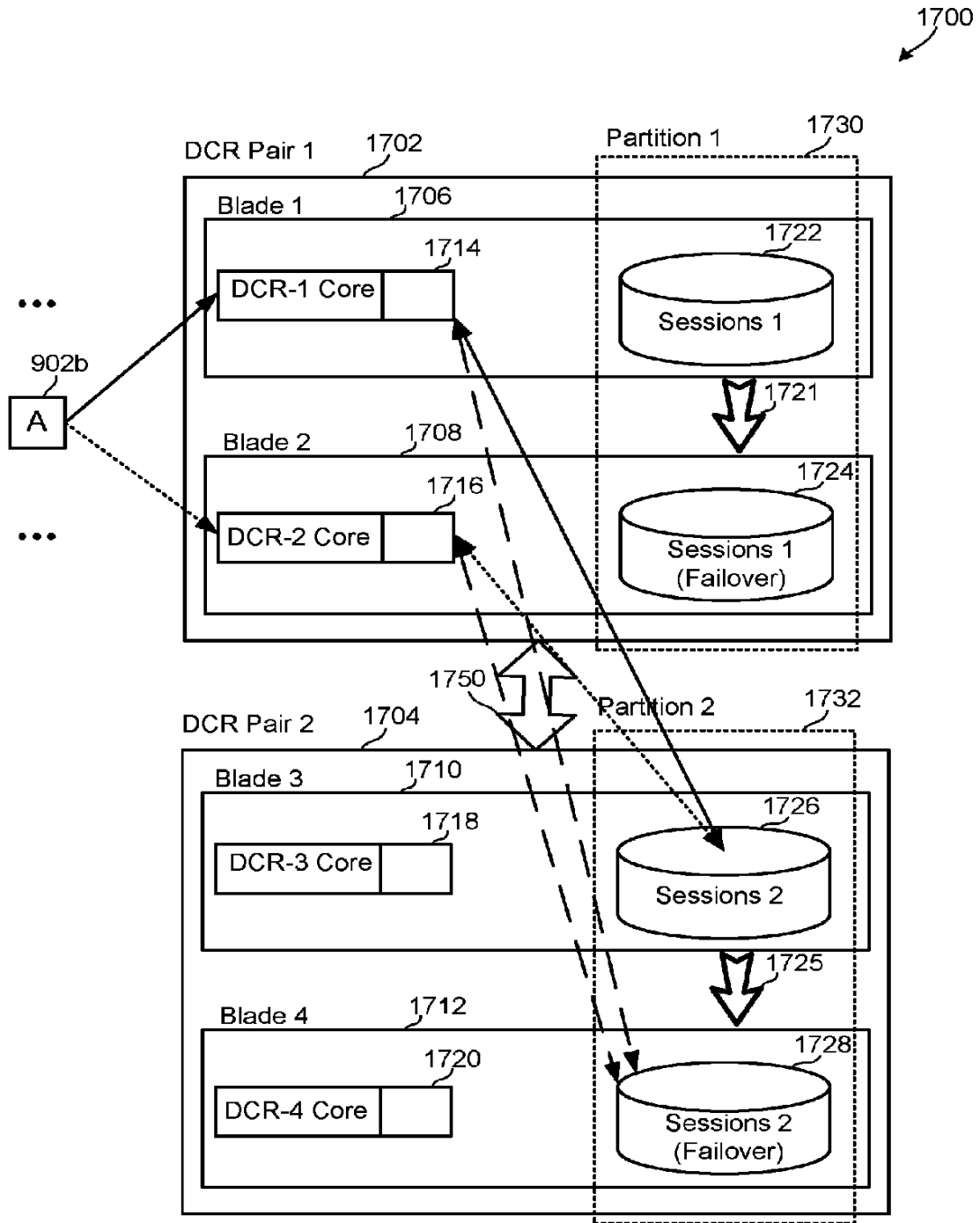


FIG. 17C

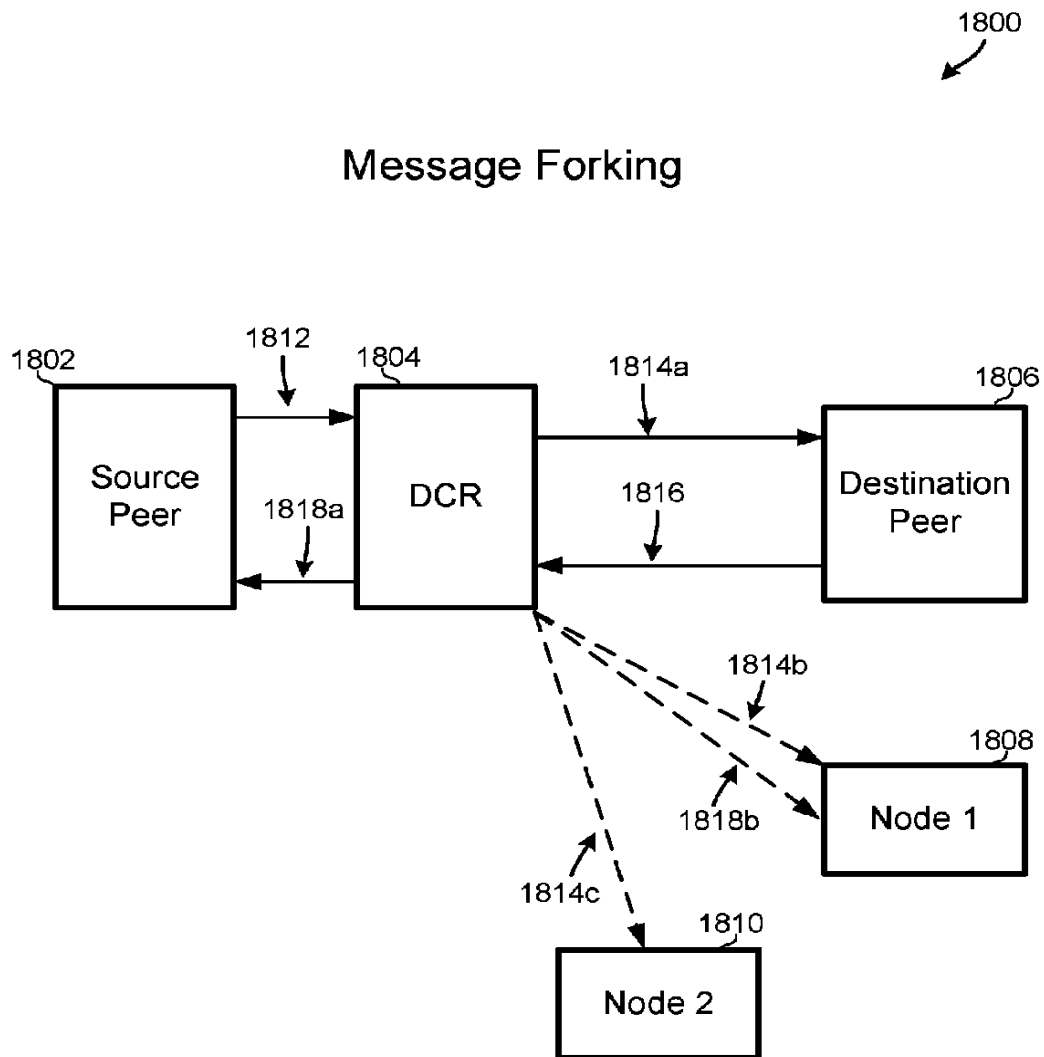


FIG. 18

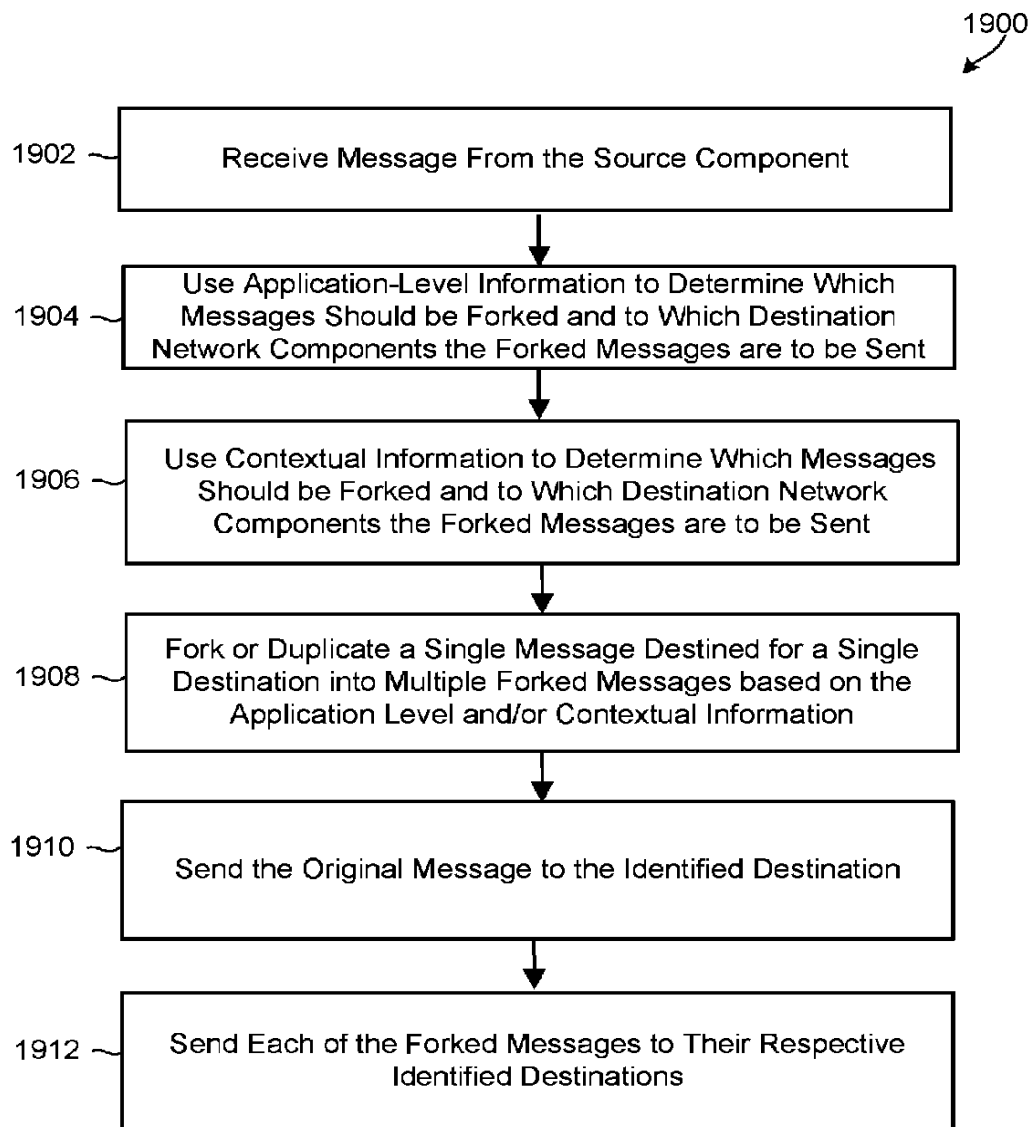


FIG. 19

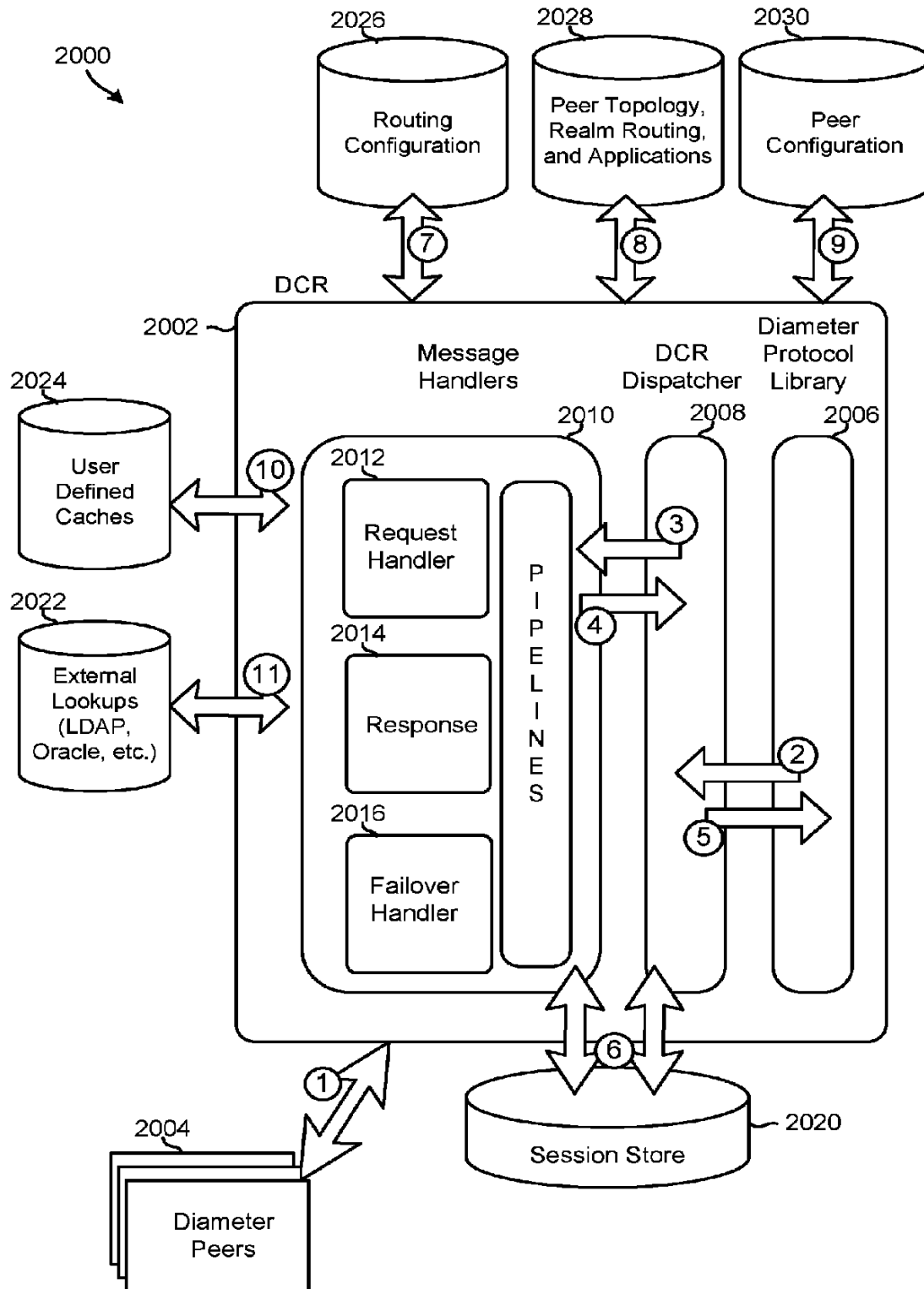


FIG. 20

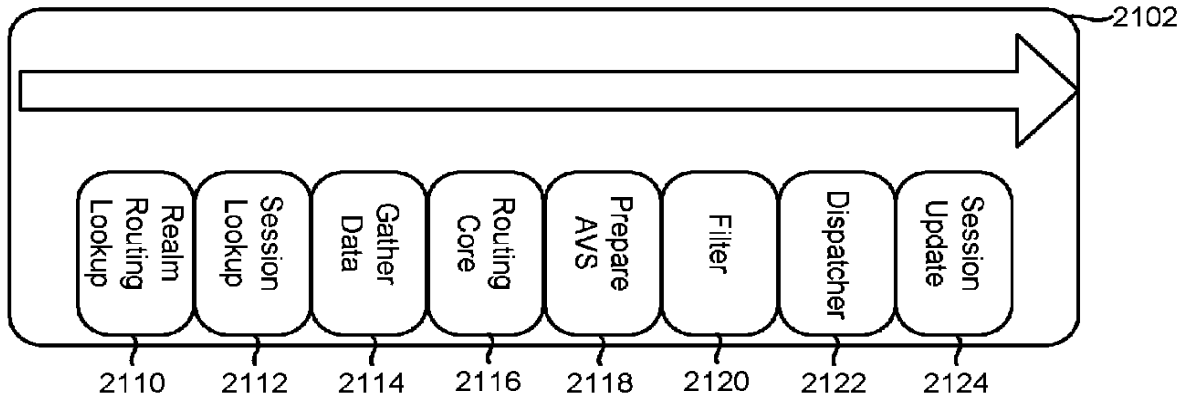


FIG. 21

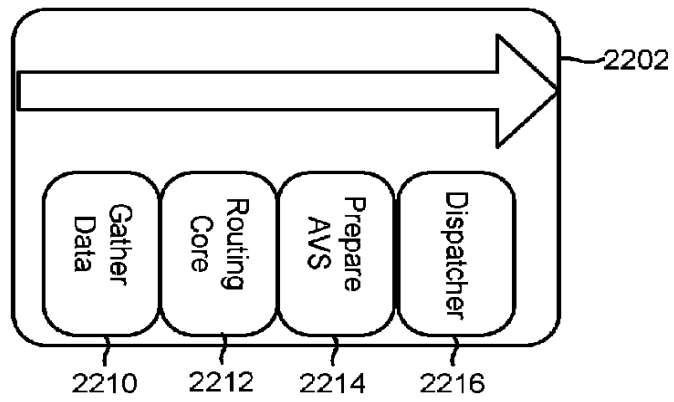


FIG. 22

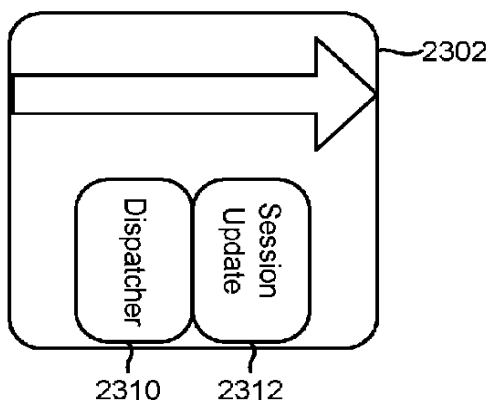


FIG. 23

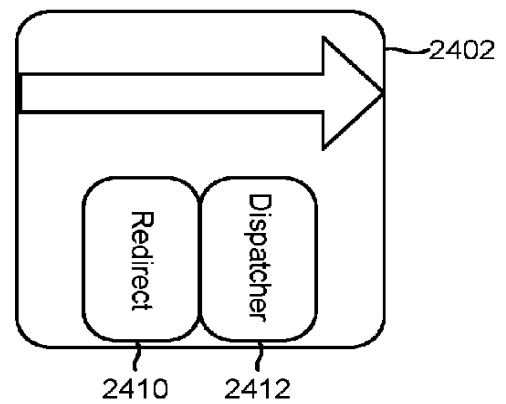


FIG. 24

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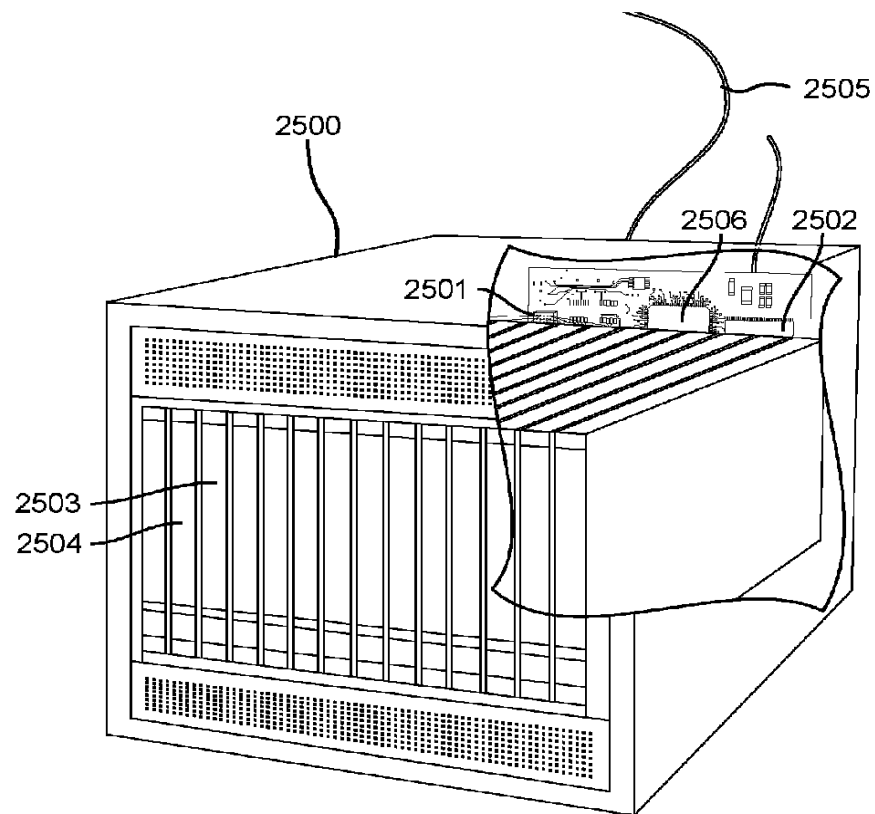


FIG. 25



EUROPEAN SEARCH REPORT

Application Number
EP 11 19 3499

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 262 199 A1 (HUAWEI TECH CO LTD [CN]) 15 December 2010 (2010-12-15)	1,3,5,6, 8,10,11, 13,15	INV. H04L12/56 H04L29/08 H04L29/06
Y	* paragraphs [0020], [0022], [0023] * * paragraphs [0037] - [0039] * * paragraphs [0092] - [0095] * * figures 2,4,6 *	2,4,7,9, 12,14	
X	----- J. Korhonen, M. Jones, L. Morand, T. Tsou: "Clarifications on the Routing of Diameter Requests Based on the Username and the Realm", 31 December 2009 (2009-12-31), XP002671488, Retrieved from the Internet: URL:http://tools.ietf.org/html/rfc5729 [retrieved on 2012-03-14] * paragraph [04.4] *	1,5,6, 10,11,15	
Y	----- WOOD J ET AL: "A Web Services Architecture for Visualization", ESCIENCE, 2008. ESCIENCE '08. IEEE FOURTH INTERNATIONAL CONFERENCE ON, IEEE, PISCATAWAY, NJ, USA, 7 December 2008 (2008-12-07), pages 1-7, XP031399597, ISBN: 978-1-4244-3380-3 * pages 2-4; figures 1,2 *	2,7,12	TECHNICAL FIELDS SEARCHED (IPC) H04L
Y	----- US 6 427 173 B1 (BOUCHER LAURENCE B [US] ET AL) 30 July 2002 (2002-07-30) * paragraphs [0068] - [0070] * * paragraphs [0119] - [0128] * * paragraphs [0082], [0083] * * figures 3,6 *	4,9,14	
2 The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 14 March 2012	Examiner Kesting, Christiane
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 (03.02.2012) (P04001)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 19 3499

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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14-03-2012

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- *3rd Generation Partnership Project Technical Specification Group Services and System Aspects, Policy and Charging Control Architecture*, 12 June 2011
[0065]

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MULTIPLE SUBSCRIBER SERVICE PROFILES PER MOBILE STATION IN A CELLULAR COMMUNICATIONS SYSTEM

BACKGROUND OF THE INVENTION

5 Technical Field of the Invention

The present invention relates to cellular communications systems and, in particular, to the maintaining of multiple subscriber service profiles for a given mobile station operating within a cellular communications system.

10 Description of Related Art

In a conventional cellular communications system, a one-to-one relationship is typically maintained between the mobile station and the subscription for that mobile station. In this regard, the "subscription" refers to the contract entered into by a user (also referred to as the "subscriber") with a cellular service provider. The subscription defines not only to whom billing for cellular services should be charged, but also sets forth the particular types of cellular calling services and features that are to be provided to the subscriber. Once the subscribed to cellular calling services and features have been defined, this data is collected in a subscriber service profile that is stored and maintained in a database. The service profile is linked in that database to an identification of the mobile station for the subscriber. Thus, the conventional system also maintains a one-to-one relationship between each mobile station and the service profile that defines the cellular services and features provided to that mobile station.

In most cases, there are no difficulties experienced with maintaining this one-to-one relationship between a mobile station and its associated subscription/service profile. However, situations do arise where the provision of a single subscription/service profile presents a problem. For example, many individual subscribers utilize their mobile stations for both business and personal calls. Often times the charges incurred by the subscriber for business cellular calls may be reimbursed by their employer. As only one bill is generated for the associated subscription, the subscriber must carefully review each billing statement, excise out the charges for business related calls, and submit those charges for employer reimbursement. In an analogous situation, a corporate subscriber may maintain a cellular telephone for employee use during business hours for business purposes. At the same time, however, the corporate subscriber may desire to give the using employee the privilege of access to cellular service for personal calls. Again, as only one bill is generated, some segregation of cellular service charges

must be made, and a corresponding deduction from employee pay applied for the cost of personal calls.

There is a need then for a technique that would not only enable a mobile station user to differentiate between business and personal calls, but also separately account for such calls in service billings.

SUMMARY OF THE INVENTION

To address the foregoing needs, a subscription for cellular service is associated with plural service profiles. Thus, a one-to-many relationship is established between a mobile station and its associated subscription/service profiles. Different billing statements for use of the same mobile station are then generated for each service profile to allow for segregated billing of service charges incurred for mobile station use.

The home location register (HLR) of the cellular network stores plural service profiles for such subscribed mobile stations. Each of the service profiles is associated with a different billing identification to allow service charges incurred for use of the single mobile station to be properly allocated between the different profiles. The user selects in the mobile station (MS) a particular one of the profiles to be active. At each registration, an identification of this selected service profile is sent to the serving cellular network, and the selected service profile is downloaded from the home location register. Alternatively, the user selects the active service profile to be down-loaded from the home location register by sending a feature code to the cellular network. Furthermore, selection of the active service profile for down-loading may be made by the network in accordance with a stored schedule maintained by the home location register.

Charging on a per service profile basis is made for both in-coming and out-going calls. In each case, appropriate toll tickets are generated by the network. These toll tickets identify not only the subscription for the mobile station involved in the call, but also the particular active one of the plural service profiles for that mobile station to which the service charges should be applied. By processing these toll tickets, a billing center may segregate the billing of service charges incurred for mobile station use against each of the plural service profiles.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be acquired by reference to the following Detailed Description when taken in conjunction with the accompanying Drawings wherein:

FIGURE 1 is a schematic diagram of a cellular telephone network of the present invention;

FIGURE 2 is a node operation and signal flow diagram illustrating selection at mobile station registration between plural available service profiles;

5 FIGURE 3 is a node operation and signal flow diagram illustrating selection using a feature code transmission between plural available service profiles;

FIGURE 4 is a node operation and signal flow diagram illustrating selection according to a schedule between plural available service profiles;

10 FIGURE 5 is a node operation and signal flow diagram illustrating a first embodiment for effectuating a call set up and delivery;

FIGURE 6 is a node operation and signal flow diagram illustrating a second embodiment for effectuating a call set up and delivery;

FIGURE 7 is a flow diagram illustrating handling of an outgoing call from a mobile station associated with plural service profiles; and

15 FIGURE 8 is a flow diagram illustrating handling of an incoming call to a mobile station associated with plural service profiles.

DETAILED DESCRIPTION OF THE DRAWINGS

Reference is now made to FIGURE 1 wherein there is shown a schematic diagram of a cellular telephone network 10 including a plurality of interconnected switching nodes (SN) 12. Although only two switching nodes 12 are shown, it will be understood that the network 10 likely includes many more interconnected nodes. The first and second switching nodes 12(1) and 12(2) may comprise any one of a number of known telecommunications switching devices, including those commonly used and known in the art for providing either digital or analog cellular telephone service to a plurality of mobile stations (MS) 14. The switching nodes 12 are interconnected with each other for communication via both voice trunks 18 (illustrated with broken lines) and signaling links 16 (illustrated with solid lines) providing a known ISUP (or R1 or R2) type connection. The voice trunks 18 provide voice and data communications paths used to carry subscriber communications between the switching nodes 12. The signaling links 16 carry command signals between the switching nodes 12. These signals may be used, for example, in setting up and tearing down voice and data communications links over the voice trunks 18 and controlling the provision of calling services to the mobile stations 14.

35 The switching nodes 12 are also connected to a home location register (HLR) 20 through their associated visitor location register (VLR) 40 by means of

signaling links 22 providing a known Mobile Application Part (MAP) or IS-41 type connection. The home location register 20 stores information relating to the mobile stations 14 and their subscriptions comprising location information and service profile information. In connection with the present invention, as will be described in more detail below, the home location register 20 in particular stores plural service profiles for at least one of the mobile stations.

In one cellular system implementation, illustrated generally at 23, the switching node 12 is further connected to at least one associated base station controller (BSC) 24 via both a signaling link 26 and a voice trunk 28. Only one base station controller 24 is shown connected to switching node 12(2) in order to simplify the illustration. The voice trunk 28 provides a voice and data communications path used to carry subscriber communications between the second switching node 12(2) and its base station controller 24. The signaling link 26 carries command signals between the node 12 and its associated base station controller 24. The signaling link 26 and trunk 28 are collectively commonly referred to in the art as the "A interface". The base station controller 24 is then connected to a plurality of base stations (BS) 30 which operate to effectuate radio frequency communications with proximately located mobile stations 14 over an air interface 32. The base station controller 24 functions in a well known manner to control this radio frequency communications operation.

In another cellular system implementation, illustrated generally at 25, the switching node 12(1) is further connected to a plurality of base stations (BS) 30 which operate to effectuate radio frequency communications with proximately located mobile stations 14 over the air interface 32. In this implementation, the functionality provided by the base station controller 24 (see, generally at 23) is instead provided by the switching node 12(1).

Although direct communications links (signaling and/or trunk) are illustrated in FIGURE 1, it is understood by those skilled in the art that the links are not necessarily direct between the illustrated nodes, and may instead pass through many other communications nodes (not shown) of the mobile network, and perhaps even utilize other communications networks (such as the public switched telephone network - PSTN). Illustration of the links in a "virtual" manner as shown in FIGURE 1 is therefore by way of simplification of the drawing and the communications relationship between the various included nodes within the network 10.

For each cellular service subscription associated with a served mobile station 14, the home location register 20 stores service profile information 34

relating to cellular services and features subscribed to by the subscriber for that served mobile station. If conventional service is provided to a mobile station 14, the service profile information 34 associated with that mobile station subscription comprises a single service profile 36 per subscription. Conversely, and in accordance with the present invention, plural service profiles 38(n), where $n > 1$, may comprise the service profile information 34 associated with a single mobile station 14. For mobile stations 14 having subscriptions that support plural service profiles 38(n), any one of those plural profiles may be selected, either by the system or by the subscriber (with some restrictions), for use at a specific time or in connection with a specific call.

When a mobile station 14 makes an initial registration with the system through a particular switching node 12, that switching node requests a subscriber service profile 36 or 38(n) relating to that mobile station, and its corresponding subscription, from the home location register 20. This subscriber service profile 36 or 38(n) information is downloaded from the home location register 20 for storage in a visitor location register (VLR) 40 associated with the switching node 12. Service for both in-coming and out-going calls is then provided to the mobile station 14 by the serving switching node 12 in accordance with the downloaded service profile 36 or 38(n).

In accordance with one embodiment of the present invention, the subscriber enters a service profile selection code into the mobile station 14, and this selection information is conveyed by the serving switching node 12 to the home location register 20 at each registration. The home location register 20 processes the selection information to identify the proper one of the n available service profiles 38(n) for the mobile station 14. This profile is then downloaded to the visitor location register 40.

In another embodiment of the present invention, the subscriber sends a feature code through the mobile station 14. This feature code is indicative of the activation of a certain one of the n available service profiles 38(n) for the mobile station 14. Responsive to receipt of the feature code, the proper service profile 38(n) is identified by the home location register 20 and downloaded to the visitor location register 40. That particular service profile 38(n) is further marked as being active by the home location register 20. In response to any subsequent registration of the mobile station, the home location register 20 automatically retrieves the active one of the service profiles 38(n) for a visitor location register 40 download. Deactivation of the currently activated service profile occurs when the mobile station powers-off or when the mobile station has been idle for longer than a

predetermined time period. Alternatively, the selected service profile 38(n) continues to remain active until such time as a new selection is made through feature code entry.

5 In yet another embodiment of the present invention, the activation of a certain one of the n available service profiles 38(n) depends on a subscriber or service provider defined schedule 42 for the mobile station 14. This schedule may, for example, designate that a business related one of the service profiles 38(n) be active during weekday business hours, while a personal related one of the service profiles be active at all other times. As another application, the schedule may
10 designate that a first employee related service profile 38(n) be active during a first weekday time shift, a second employee related service profile be active during a second weekday time shift, a third employee related service profile be active during a third weekday time shift, and that no service profile be active on weekends. No matter what the particular schedule that is established, in response to a registration,
15 the home location register 20 identifies (based on the schedule 42) the proper active one of the n available service profiles 38(n) for the mobile station 14. This profile is then downloaded to the visitor location register 40.

In each case, a different billing identification 44(n) is provided for each of the n available service profiles 38(n) for the mobile station 14. A billing center 46
20 for the service provider receives toll tickets (TTs) relating to calling charges, processes the toll tickets with respect to the mobile station and particular active service profile thereof, and then accordingly generates a separate billing statement for each identification 44(n) effectively allocating cellular service costs properly among various usages and subscribers. Taking, for example, the previous scenario
25 where a business service profile 38(n) and personal service profile are provided for a single mobile station 14, one business billing statement and one personal billing statement are generated by the billing center 46. This allows the subscriber to account between business and personal calling expenses. Similarly, for the previous multi-shift related service profiles 38(n), one billing statement is
30 generated for each weekday time shift. This allows an employer to allocate business calling expenses by shift and/or the assigned personnel. In order to generate this billing information, properly allocated to the plural service profiles, each toll ticket generated by the network 10 during a call and communicated to the billing center 46 must include information identifying the mobile
35 station/subscription at issue, and further include information identifying, or allowing the billing center to identify, the particular one of the service profiles 38(n) that is active for the call.

Furthermore, if needed or desired, each of the plural service profiles 38(n) may be associated with a different directory number. Thus, not only is a single mobile station associated with different service profiles, but it may also be accessed by a caller through the dialing of any one of a number of different directory numbers. This allows each one of a number of potential users of the mobile station to have a unique telephone directory number for in-coming calls. In connection with the handling of such calls, a number of billing options are available. First, an in-coming call dialed to a certain directory number may be delivered to the mobile station regardless of whether the service profile associated with that number is currently active. Billing is made either to the service profile for the called number, or the service profile that is currently active. Second, the alternative holds true: no call delivery occurs unless the service profile associated with the dialed number is currently active. Billing is made to the active service profile of the called number.

Reference is now made to FIGURE 2 wherein there is shown a node operation and signal flow diagram illustrating selection at mobile station registration between plural available service profiles. The subscriber selects (action 200) a particular one of plural available service profiles 38(n) for use by making an appropriate entry into the mobile station 14. This selection is stored (action 202) by the mobile station. The mobile station 14 then makes a registration with the cellular telephone network by transmitting a registration message 204 to the serving switching node 12 through the serving base station 30 (and perhaps the serving base station controller 24). This registration message 204 includes information, perhaps stored in an included parameter, identifying the subscriber selected one of plural available service profiles 38(n). Responsive thereto, the switching node 12 sends a registration notification message 206 to the home location register 20 through the visitor location register 40 requesting the selected one of the service profiles 38(n) associated with the registering mobile station 14. The home location register 20 retrieves the selected one of the service profiles 38(n), and sends that information in message 208 back for storage (action 210) in the visitor location register 40 associated with the requesting switching node 12. In-coming and out-going calling service is thereafter provided to the mobile station in accordance with the down-loaded service profile. If desired, the selected 200 service profile remains active until the mobile station has been idle for longer than a predetermined time period (action 212).

Reference is now made to FIGURE 3 wherein there is shown a node operation and signal flow diagram illustrating selection using a feature code transmission between plural available service profiles. A feature request is dialed

(action 220) by a subscriber into their mobile station 14. This feature request (perhaps in the form of an appropriately formatted star code) identifies a subscriber selected one of plural available service profiles 38(n) for activation, and may further present a personal identification number (PIN) indicating authorization for the selection. A feature origination message 222 is then sent by the mobile station 14 (over the air interface and through the base station) to the switching node 12. In response thereto, the switching node 12 sends a feature request message 224, including the dialed feature code, to the home location register 20. The home location register 20 then processes the message 224 to determine whether the subscriber is authorized to use the feature (action 226), and if so, what actions need to be taken in response to the request (action 228) and what instructions, if any, need to be presented to the mobile switching center to effectuate the feature (action 230). In particular, with respect to the actions 228 taken, the home location register 20 marks the subscriber selected one of plural available service profiles 38(n) as being active. A feature request return result message 232, confirming activation of the selected service profile 38(n), is then sent by the home location register 20 back to the mobile station 14 through the switching node 12. The home location register 20 also retrieves the selected one of the service profiles 38(n), and sends that information in message 234 back for storage (action 236) in the visitor location register 40 associated with the switching node 12. In-coming and out-going calling service is thereafter provided to the mobile station in accordance with the downloaded service profile.

Once a subscriber selected one of plural available service profiles 38(n) has been marked as being active, it remains active until the mobile station powers-off (action 238), the mobile station has been idle for longer than a predetermined time period (action 240), or a new selection is made by the subscriber through feature code entry (action 220). The feature code entry (action 220) may alternatively simply de-activate the currently active service profile (taken in actions 228), with activation of a service profile requiring the entry of another feature code.

Once a service profile 38(n) is activated, it is made available at each time the mobile station 14 registers. The mobile station 14 makes a registration with the cellular telephone network by transmitting a registration message 242 to the serving switching node 12 through the serving base station 30 (and perhaps the serving base station controller 24). Responsive thereto, the switching node 12 sends a registration notification message 244 to the home location register 20 through the visitor location register 40 requesting the currently active one of the service profiles 38(n) associated with the registering mobile station 14. The home location register

20 retrieves the active one of the service profiles 38(n), and sends that information in message 246 back for storage (action 248) in the visitor location register 40 associated with the requesting switching node 12. In the event that none of the service profiles 38(n) is currently active, the home location register 20 returns a registration denied message 250 back the switching node 12. If possible, the reason for denial is conveyed to the mobile station in message 252. This prompts the subscriber to activate one of the plural service profiles 38(n) through feature code entry (action 220), resulting in a down-loading of the selected one of the service profiles 38(n) in message 234 for storage (action 236) in the visitor location register 40 associated with the switching node 12.

Reference is now made to FIGURE 4 wherein there is shown a node operation and signal flow diagram illustrating selection according to a schedule between plural available service profiles. A schedule 42 designating the activation periods for each of plural available service profiles 38(n) of a mobile station 14 is stored (action 260) in the home location register 20. The schedule 42 may be either service provider or subscriber defined. The mobile station 14 subsequently makes a registration with the cellular telephone network by transmitting a registration message 262 to the serving switching node 12 through the serving base station 30 (and perhaps the serving base station controller 24). Responsive thereto, the switching node 12 sends a registration notification message 264 to the home location register 20 through the visitor location register 40 requesting the schedule 42 defined active one of the service profiles 38(n) associated with the registering mobile station 14. The home location register 20 retrieves the service profile 38(n) identified by the schedule as being active, and sends that information in message 266 back for storage (action 268) in the visitor location register 40 associated with the requesting switching node 12. In-coming and out-going calling service is thereafter provided to the mobile station in accordance with the down-loaded service profile.

Reference is now once again made to FIGURE 1. Although not necessarily a requirement, the cellular telephone network 10 is preferably implemented as a wireless intelligent network (IN) and thus further includes at least one service control point (SCP) 48. The switching nodes 12 (also referred to as service switching points (SSPs) in this configuration) are connected to the service control point 48 by means of the signaling links 22 which utilize protocols such as Mobile Application Part (MAP), IS-41, Intelligent Network Application Part (INAP), or Transaction Capability Application Part (TCAP). The home location register 20 is preferably implemented in conjunction with the service control point 48. The

service control point 48 provides a centralized processing platform for implementing the "intelligence" of the network 10. In the context of the present invention, this intelligence comprises the administration over the plural service profiles 38(n) available to certain ones of the mobile stations 14. This administration primarily involves the operations described herein for selecting which one of the service profiles 38(n) is to be active at any one time (either in response to subscriber selection, feature code selection, or scheduling selection). Alternatively, a separate combined service switching point/service control point (SSP/SCP or SSCP) 50 is provided for handling of calls implicating multiple service profile 38(n) selection. This combined service switching point/service control point 50 is connected to the switching nodes 12 via both voice trunks 18 (illustrated with broken lines) and signaling links 16 (illustrated with solid lines) providing a known ISUP (or R1 or R2) type connection, and is connected to the home location register by means of the signaling links 22 which utilize protocols such as Mobile Application Part (MAP), IS-41, Intelligent Network Application Part (INAP), or Transaction Capability Application Part (TCAP). Although not specifically illustrated, it is understood that the intelligent network further includes intelligent peripherals (IPs) and other nodes as needed to implement in a known manner any desired intelligent network services.

Reference is now made to FIGURE 5 wherein there is shown a node operation and signal flow diagram illustrating a first embodiment for effectuating a call set up and delivery. A call 300 dialed to the directory number (B-number) of a mobile station 14 originates from another cellular subscriber or the public switched telephone network (PSTN), and is received at a first (originating or gateway) switching node 12(1). The originating switching node 12(1) determines whether the calling party is entitled to receive any intelligent network services (action 302). One such service may comprise the plural service profile 38(n) service of the present invention. If so, the originating switching node 12(1) sends an originating access message 304 to the home location register 20 (service control point 48). This message 304 requests an identification of each intelligent network service to which either the calling party is entitled. The list of such services (including, for example, the plural service profile 38(n) service) is returned to the originating switching node 12(1) in message 306. The identified services in the returned list are then evaluated and organized (action 308) for implementation in connection with the call 300.

With respect to call handling in the context of the plural service profile 38(n) service of the present invention, the call is routed 310 to the particular

combined service switching point/service control point 50 supporting that service (assuming the home location register 20 cannot provide all necessary support, including billing). In this regard, the combined service switching point/service control point 50 has knowledge (perhaps down-loaded from, or accessed from the home location register 20) of the plural service profiles 38(n) associated with the calling/called party. The active one of the plural service profiles 38(n) is then implemented (action 312) in connection with the call, and a toll ticket for billing is generated 314 specifically identifying the active profile of a given subscription be charged. The call is then routed 316 back to the originating switching node 12(1). As a further refinement of the call handling process, the call leg routings 310 and 316 may be dropped (if desired), as generally indicated with "X" markings, from the call 300 once generation 314 of the toll ticket associating the call with the proper service profile is completed. Another toll ticket for billing is then generated 318 by the originating switching node 12(1) identifying that the given subscription be charged. These toll tickets are processed by the billing center 46 to generate a charge for the call, with that charge being assessed against the currently active one of the service profiles 38(n) of the calling party subscription. As another refinement, the billing information relating to the active service profile 38(n) is sent to the originating switching node 12(1) to be included in its generated 318 toll ticket, thus obviating the need for a separate toll ticket generated 314 by the service switching point/service control point 50.

Now that the appropriate one of the plural service profiles 38(n) has been associated with the call, and following the actuation of any other appropriate intelligent network services in connection with the call, the originating switching node 12(1) interrogates the home location register 20 with a location request (send routing) message 320. The location request (send routing) message 320 is processed by the home location register 20 to determine the location (i.e., second or serving switching node 12(2)) within the cellular network 10 of the called mobile station 14. Responsive to this interrogation, the home location register 20 messages the serving switching node 12(2) for the called mobile station 14 with a routing request (provide roaming) message 322 to prepare for the call. The serving switching node 12(2) then determines in action 324, to some selected degree of granularity, the location (for example, location area) of the called mobile station 14. This location may be identified, for example, based on information resulting from a most recent registration (not shown) of the called mobile station 14 as stored in the visitor location register (not shown) associated with the serving switching node 12(2). Alternatively, the serving switching node 12(2) may page (not shown) the

called mobile station 14, and process the page response (not shown) to make a more precise location determination. In accordance with this determined location, the serving switching node 12(2) selects in action 326 an appropriate routing number (for example, a temporary location directory number (TLDN) or a roaming number) for that location. In this instance, the routing number is selected from a plurality of such numbers associated with the serving switching node 12(2). The selected routing number is then returned 328 to the originating switching node 12(1) via the home location register 20. The incoming call is then delivered (through connected) 330 to the serving switching node 12(2) using the routing number for attempted completion to the called mobile station 14. Completion of the call involves further routing 332 the incoming call to the currently serving base station 30 (perhaps through the base station controller 24), and then to the called mobile station 14 over the air interface 32. The serving switching node 12(2) handles the call in accordance with the down-loaded, visitor location register stored, service profile of the called mobile station. It is recognized that this down-loaded service profile may comprise one of a number of service profiles 38(n) assigned to the called mobile station 14 subscriber and currently designated as active (see, FIGURES 2, 3 and 4). A toll ticket (TT) is accordingly generated (action 334) against the active one of the service profiles for the called mobile station. Toll ticket processing enables the billing center 46 to properly generate a charge for the call, with that charge being assessed against the currently active one of the service profiles 38(n) of the called party subscription.

Reference is now made to FIGURE 6 wherein there is shown a node operation and signal flow diagram illustrating a second embodiment for effectuating a call set up and delivery. A call 300 dialed to the directory number (B-number) of a mobile station 14 originates from another cellular subscriber or the public switched telephone network (PSTN), and is received at a first (originating or gateway) switching node 12(1). The originating switching node 12(1) determines whether the calling party is entitled to receive any intelligent network services (action 302). One such service may comprise the plural service profile 38(n) service of the present invention. If so, the originating switching node 12(1) sends an originating access message 304 to the home location register 20 (service control point 48). This message 304 requests an identification of each intelligent network service to which either the calling party is entitled. The list of such services (including, for example, the plural service profile 38(n) service) is returned to the originating switching node 12(1) in message 306. The identified services in

the returned list are then evaluated and organized (action 308) for implementation in connection with the call 300.

5 Routing of the call to a service switching point/service control point 50 is not required in this embodiment as the home location register 20 (service control point 48) support all aspects (including billing) for the plural service profile 38(n) service of the present invention. Thus, responsive to the originating access message 304, the active one of the plural service profiles 38(n) is then implemented (action 312') in connection with the call, and a toll ticket for billing is generated 314' specifically identifying that the specific active profile of a subscription be charged. 10 Another toll ticket for billing is then generated 318 by the originating switching node 12(1) identifying that the subscription be charged. These toll tickets are processed by the billing center 46 to generate a charge for the call, with that charge being assessed against the currently active one of the service profiles 38(n) of the identified calling party subscription. As a refinement to the process, 15 the billing information relating to the active service profile 38(n) is sent to the originating switching node 12(1) to be included in its generated 318 toll ticket, thus obviating the need for a separate toll ticket generated 314' by the home location register 20.

Now that the appropriate one of the plural service profiles 38(n) has been 20 associated with the call, and following the actuation of any other appropriate intelligent network services in connection with the call, the originating switching node 12(1) interrogates the home location register 20 with a location request (send routing) message 320. The location request (send routing) message 320 is processed by the home location register 20 to determine the location (i.e., second 25 or serving switching node 12(2)) within the cellular network 10 of the called mobile station 14. Responsive to this interrogation, the home location register 20 messages the serving switching node 12(2) for the called mobile station 14 with a routing request (provide roaming) message 322 to prepare for the call. The serving switching node 12(2) then determines in action 324, to some selected degree of 30 granularity, the location (for example, location area) of the called mobile station 14. This location may be identified, for example, based on information resulting from a most recent registration (not shown) of the called mobile station 14 as stored in the visitor location register (not shown) associated with the serving switching node 12(2). Alternatively, the serving switching node 12(2) may page (not shown) the 35 called mobile station 14, and process the page response (not shown) to make a more precise location determination. In accordance with this determined location, the serving switching node 12(2) selects in action 326 an appropriate routing number

(for example, a temporary location directory number (TLDN) or a roaming number) for that location. In this instance, the routing number is selected from a plurality of such numbers associated with the serving switching node 12(2). The selected routing number is then returned 328 to the originating switching node 12(1) via the home location register 20. The incoming call is then delivered (through connected) 330 to the serving switching node 12(2) using the routing number for attempted completion to the called mobile station 14. Completion of the call involves further routing 332 the incoming call to the currently serving base station 30 (perhaps through the base station controller 24), and then to the called mobile station 14 over the air interface 32. The serving switching node 12(2) handles the call in accordance with the down-loaded, visitor location register stored, service profile of the called mobile station. It is recognized that this down-loaded service profile may comprise one of a number of service profiles 38(n) assigned to the called mobile station 14 subscriber and currently designated as active (see, the process of FIGURES 2, 3 and 4). A toll ticket (TT) is accordingly generated (action 334) against the active one of the service profiles for the called mobile station. Toll ticket processing enables the billing center 46 to properly generate a charge for the call, with that charge being assessed against the currently active one of the service profiles 38(n) of the called party subscription.

Reference is now made to FIGURE 7 wherein there is shown a flow diagram illustrating handling of an outgoing call from a mobile station associated with plural service profiles. In step 100, a call origination is received by the process. This received call origination 100 includes an identification of digits dialed for an outgoing call and/or code dialings. A determination is then made in step 102 as to whether the received call concerns a user designated and transmitted activation (feature) code. If yes, an appropriate action is taken in step 104 in response to the code. For example, the sent code may identify a subscriber selected one of plural available service profiles 38(n) for activation (see, FIGURE 3). Other actions relevant to the plural service profile 38(n) service of the present invention and involving a feature code selection are presented below. It should further be noted that a specific feature code may be recognized that would prevent unauthorized entry of feature codes to specify certain actions and changes. An appropriate confirming announcement with respect to the action (such as confirming the selection of a certain service profile) is then sent back to the mobile station in step 106, and the call is terminated. If no, a determination is then made in step 108 as to whether the received call concerns a user designated and transmitted escape code. This escape code signals the process to switch between

available service profiles 38(n) for a current call only. This differs from the activation code of step 102 where a semi-permanent switch of service profiles may be made. Accordingly, if yes, a toggle is set in step 110. Thereafter, or if no in step 108, a determination is made in step 114 as to whether a scheduling feature (42, FIGURE 1) for the user is currently enabled. The scheduling feature enables the user (or the subscriber, if different) to select based on time of day, and day of week parameters, which of the plural service profiles 38(n) is to be active. If the scheduling feature is enabled, then the appropriate one of the service profiles based on the schedule is selected in step 116 to be implemented in connection with the call. Through the use of an appropriate activation (feature) code (step 102), the user may selectively choose not to have an established schedule be activated and followed. In the event the schedule designates the current time of day and day of week are black-out periods for user originated calls, an appropriate confirming announcement with respect to the black-out is then sent back to the mobile station in step 106, and the call is terminated. If no (in step 114), the default one of the plural service profiles 38(n) for the user, or the user activated one of the plural service profiles (step 104), is selected in step 118 to be implemented in connection with the call. Following selection of a service profile (116 or 118), a determination is made in step 120 as to whether the toggle was previously set in step 110. If yes, the service profile effective for the call is switched in step 122 from that selected in steps 116 or 118, to one of the other service profiles for the duration of the current call only. Thereafter, or if no in step 120, the call is screened in step 124 according to the active service profile in order to determine if call completion is permitted. In this regard, there are two kinds of screening lists that are implemented for each of the service profiles. The first is an outgoing allowed list. If the dialed digits (step 100) meet the parameters of the allowed list, call completion is permitted. Charging for the call is then made against the active service profile in step 126 and the call is completed 128. The second is an outgoing restricted list. If the dialed digits (step 100) meet the parameters of the restricted list, call completion is rejected in step 130. An appropriate confirming announcement with respect to the restriction is then sent back to the mobile station in step 106, and the call is terminated.

Reference is now made to FIGURE 8 wherein there is shown a flow diagram illustrating handling of an incoming call to a mobile station associated with plural service profiles. In step 200, an incoming call is received dialed to a particular directory number (i.e., the B number). A determination is then made in step 202 as to which of a number of available profiles is currently in effect. This

determination may be made by having a different profile 38 associated with each B number, and thus selecting the profile for the dialed B number. In accordance with the present invention, the determination is made by having multiple profiles 38(n) associated with each individual B number, and then selecting that profile which is either currently selected by the called subscriber as being active or is active based on a schedule. The process then selects the proper profile 38(n) in step 204.

Once the proper profile 38(n) has been determined and selected, the process next screens against the calling party telephone number (i.e., the A number) in step 206. This screening process is performed against a list of A number from which it is permissible for the called mobile station to receive an incoming call. The list can be as specific as including particular numbers, or a general as including broad source indications (like prefixes and area codes). If the A number is not authorized by the list, the incoming call is rejected in step 208. If the A number is on the list, the incoming call is next processed through a diversion selection function in step 210.

With respect to the diversion selection function, the process may implement location based diversion in step 212. In accordance with location base diversion, the incoming call is diverted for call delivery based on called mobile station location. A number of different diversion options are available contingent on mobile station roaming status. The subscriber may, for example, specify delivery of the call to the mobile station, or alternatively delivery to a forwarding directory number (C number). The selection of one delivery option over another option depends upon the current roaming status (public or private network) of the mobile station in combination with the options specifically assigned by the subscriber for that status.

The process of diversion selection may further implement a mobile status based diversion in step 214. In accordance with mobile status based diversion, the incoming call is diverted for call delivery based on called mobile station operational status. A number of different diversion options are available contingent on mobile station operational status. The subscriber may, for example, designate the mobile station itself as the first point of contact as long as the mobile station is currently in active operational mode. If the mobile station is currently in inactive operational mode, however, the incoming call is instead routed in accordance with a diversion routing in step 216. Furthermore, if the mobile station is currently active, but is busy or there is no answer to the incoming call alert, the incoming call is again instead routed in accordance with the diversion routing of step 216.

The diversion routing of step 216 specifies the manner with which call delivery is to be accomplished. As a general rule, this manner of accomplishing call delivery is specified by the subscriber based on the currently effective operation status of the called mobile station at the time of delivery. For example, if the current status of the mobile station is either inactive, busy or no answer, diversion routing may specify forwarding of the incoming call to a certain directory number (perhaps, comprising a voice mail box for the subscriber or other selected C number). Optionally, other delivery mechanisms may be employed. Examples of these mechanisms include sequential paging, sequential time based paging, or called party controlled completion (CPCC) services. Sequential paging refers to a delivery mechanism where a list of forwarding numbers to be sequentially tried is maintained to handling step 216 diversion routing instances. If one of the numbers on the list is busy, the call is routed to an identified end of list destination (typically comprising a voice mail box). If the last number on the list is reached without completing a successful call set-up, then the call is also routed to an identified end of list destination. Furthermore, if a time out occurs without making a successful call set-up, then the call is also routed to an identified end of list destination. Sequential time based paging refers to a delivery mechanism use of certain one or more of the numbers on the list is restricted in time. For example, a business hours dialing list and a non-business hours dialing list may be maintained. Thus, certain numbers are effective only at certain times of the day (or perhaps day of the week), and those effective numbers are sequentially tried during step 216 diversion routing. Called party controlled completion refers to a delivery mechanism where the called party exercises control over how an incoming call is to be handled (such as, for example, transfer to voice mail, forward to alternate number, and the like).

Once A number screening and diversion function have been performed, the process moves to charge for the incoming call against the active service profile in step 218 and the call is completed 220. It is recognized that in some instances completion of the call will not occur, the process accordingly returns (also dotted path 222) back to the diversion function 210 for further handling. Such handling may, for example, comprise retrieving a different forward to number in the case of the sequential call delivery mechanism.

Although preferred embodiments of the method and apparatus of the present invention have been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements,

modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

WHAT IS CLAIMED IS:

1. A cellular telephone system serving a plurality of mobile stations, comprising:
at least one home location register storing service profile information for
5 each of the served mobile stations, wherein the stored service profile information comprises plural different service profiles maintained for each of certain ones of the mobile stations.
2. The system as in claim 1 wherein each of the plural different service
10 profiles maintained for each of the certain ones of the mobile stations has a billing identification in order to allow for segregated billing by service profile of service charges incurred with respect to use of the certain mobile stations.
3. The system as in claim 1 further comprising means for selecting an
active one of the plural different service profiles for application in providing
cellular telephone service to the certain mobile station.
- 15 4. The system as in claim 3 wherein the means for selecting comprises a schedule that identifies which of the plural different service profiles is to be active at any given time.
5. The system as in claim 3 wherein the means for selecting comprises
20 a feature code selection that identifies which of the plural different service profiles is to be active at any given time.
6. The system as in claim 3 wherein the means for selecting comprises
a default selection that identifies which of the plural different service profiles is to be active.
7. A method for providing cellular telephone service to a mobile
25 station, comprising the steps of:
storing for that mobile station a plurality of different service profiles; and
activating a certain one of the plurality of different service profiles for
application in providing cellular telephone service to the certain mobile station.
8. The method as in claim 7 wherein the step of storing comprises the
30 step of maintaining a billing identification for each of the plural service profiles in

order to allow for segregated billing by service profile of service charges incurred with respect to use of the mobile station.

9. The method as in claim 7 wherein the step of activating comprises the steps of:

5 establishing an activation schedule defining times when each of the plural service profiles is to be active for application in providing cellular telephone service to the certain mobile station; and

activating ones of the plural service profiles in accordance with the established schedule.

10 10. The method as in claim 7 wherein the step of activating comprises the steps of:

selecting by a user of the mobile station of a certain one of the plural service profiles to be active for application in providing cellular telephone service; and

15 communicating that selection at mobile station registration to activate the certain service profile.

11. The method as in claim 10 wherein the step of activating further comprises the step of maintaining the certain service profile as active until the expiration of a predetermined time period.

20 12. The method as in claim 7 wherein the step of activating comprises the steps of:

making a feature code selection identifying a certain one of the plural service profiles to be active for application in providing cellular telephone service; and

sending that feature code to activate the certain service profile.

25 13. The method as in claim 12 wherein the step of activating further comprises the step of maintaining the certain service profile as active until the expiration of a predetermined time period.

30 14. The method as in claim 7 wherein the step of activating comprises the step of activating a designated default one of the plural service profiles for application in providing cellular telephone service.

15. A method for handling a call origination in a cellular telephone system, comprising the steps of:

determining if a calling party is entitled to utilize a plural service profiles per subscriber service;

5 if yes, determining which one of the plural service profiles for the calling party is currently active;

applying the currently active one of the plural service profiles to the call origination; and

10 billing service charges for the call origination against the currently active service profile.

16. The method as in claim 15 wherein the step of determining comprises the step of choosing the one of the plural service profiles selected by the calling party.

15 17. The method as in claim 15 wherein the step of determining comprises the step of choosing the one of the plural service profiles dictated by a schedule.

18. The method as in claim 17 further including the step of rejecting the call origination if the schedule indicates that a call black-out period is currently in effect.

20 19. The method as in claim 15 wherein the step of determining comprises the step of choosing a default one of the plural service profiles.

20. The method as in claim 15 wherein the step of billing comprises the step of generating at least one toll ticket for the call origination that identifies not only the calling party but also the active one of the plural service profiles for that
25 calling party.

21. The method as in claim 15 further including the steps of:
screening a called number for the call origination against a screening list associated with the active one of the plural subscriber profiles; and
permitting the call origination if the step of screening is passed.

22. A method for handling a call delivery in a cellular telephone system, comprising the steps of:

determining if a called party is entitled to utilize a plural service profiles per subscriber service;

5 if yes, determining which one of the plural service profiles for the called party is currently active;

applying the currently active one of the plural service profiles to the call delivery; and

10 billing service charges for the call delivery against the currently active service profile.

23. The method as in claim 22 wherein the step of determining comprises the step of choosing the one of the plural service profiles selected by the called party.

24. The method as in claim 22 wherein the step of determining
15 comprises the step of choosing the one of the plural service profiles dictated by a schedule.

25. The method as in claim 22 further including the step of applying diversion in connection with delivery of the call to a particular forward to number based on current called mobile station location.

20 26. The method as in claim 22 further including the step of applying diversion in connection with delivery of the call to a particular forward to number based on called mobile station status.

27. The method as in claim 22 further including the step of completing the call.

25 28. An intelligent network implementation for a cellular telephone system, comprising:

an originating switching node receiving a call from a calling party, the originating node detecting whether the calling party is subscribed to a plural service profiles per subscriber service; and

30 a service switching point/service control point (SSCP) through which the call is routed by the originating switching node if the calling party is subscribed

to the plural service profiles per subscriber service, the service switching point/service control point determining which one of the plural service profiles for the calling party is currently active, and generating a toll ticket for the call to be applied against the currently active service profile for the calling party.

5 29. The system as in claim 28 further including:

 a home location register connected to the originating switching node, the home location register storing information concerning the plural service profiles for the calling party;

 wherein the originating switching node determines whether the calling party
10 is subscribed by querying the home location register storing the plural service profiles information.

 30. The system as in claim 28 further including a billing center for collecting toll tickets for calls and generating segregated billing of service charges incurred with respect to use of each service profile for the calling party.

15 31. The system as in claim 28 further including a destination switching node serving a called party for the call, wherein the called party is subscribed to the plural service profiles per subscriber service, and the destination switching node serving the called party in accordance with a currently active one of the plural service profiles for the called party, and generating a toll ticket for the call to be
20 applied against the currently active service profile for the called party.

 32. The system as in claim 31 further including:

 a visitor location register connected to the destination switching node, the visitor location register storing information concerning the currently active one of the plural service profiles for the called party.

25 33. An intelligent network implementation for a cellular telephone system, comprising:

 an originating switching node receiving a call from a calling party, the originating node detecting whether the calling party is subscribed to a plural service profiles per subscriber service; and

30 a home location register/service control point (HLR/SCP) connected to the originating switching node, the home location register storing information concerning the plural service profiles for the calling party, the home location

register/service control point further being queried by the originating switching node to detect the calling party subscription to the plural service profiles per subscriber service, the home location register/service control point still further determining which one of the plural service profiles for the calling party is
5 currently active, and generating a toll ticket for the call to be applied against the currently active service profile for the calling party.

34. The system as in claim 33 further including a billing center for collecting toll tickets for calls and generating segregated billing of service charges incurred with respect to use of each service profile for the calling party.

10 35. The system as in claim 33 further including a destination switching node serving a called party for the call, wherein the called party is subscribed to the plural service profiles per subscriber service, and the destination switching node serving the called party in accordance with a currently active one of the plural
15 service profiles for the called party, and generating a toll ticket for the call to be applied against the currently active service profile for the called party.

36. The system as in claim 35 further including:
a visitor location register connected to the destination switching node, the visitor location register storing information concerning the currently active one of the plural service profiles for the called party.

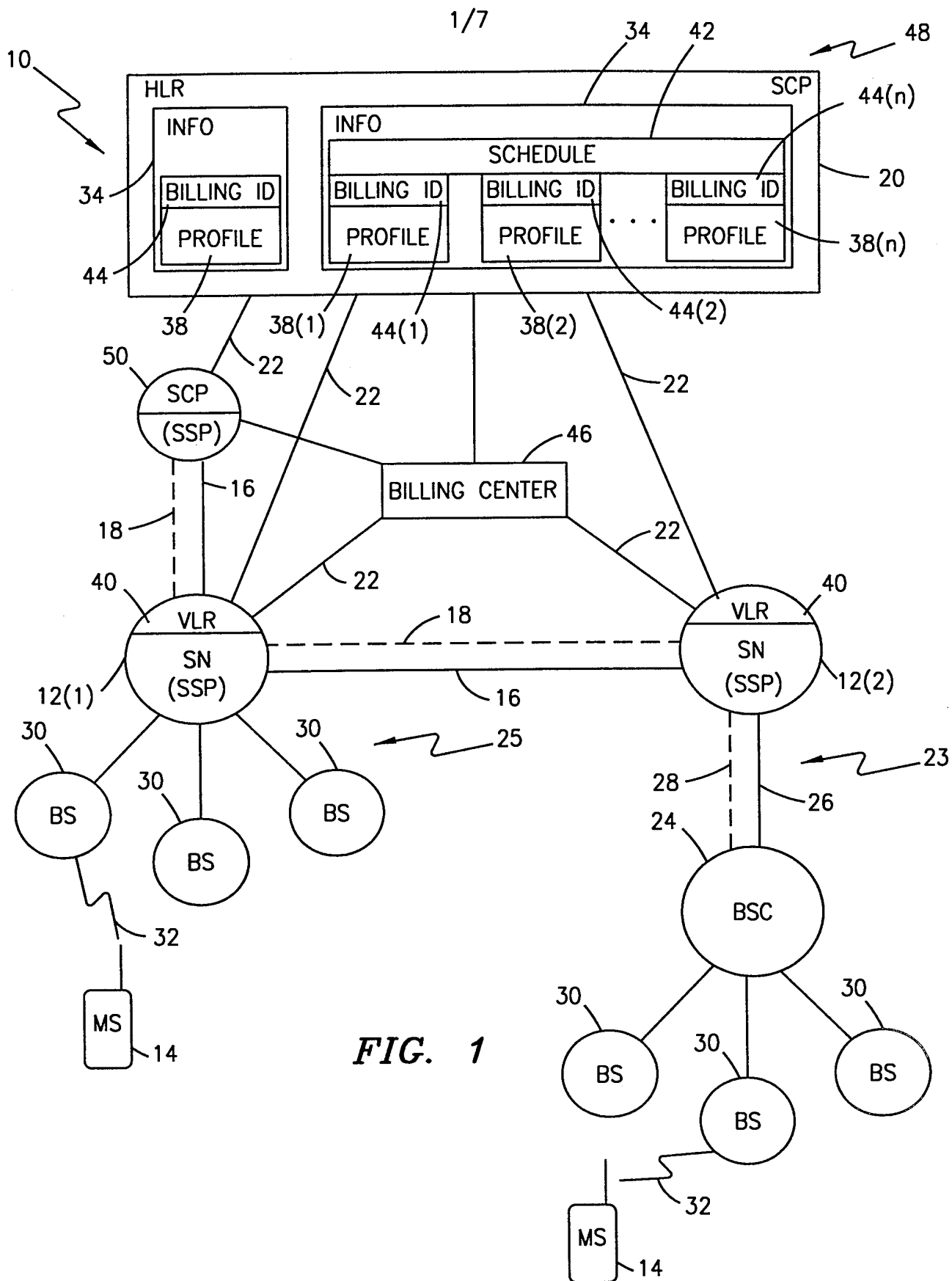
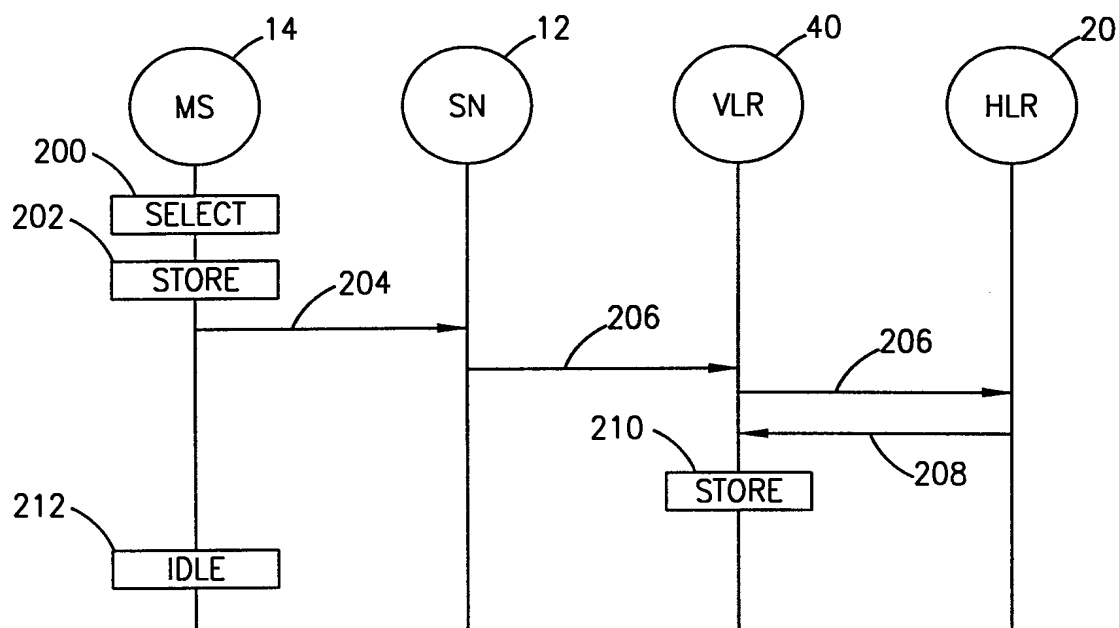
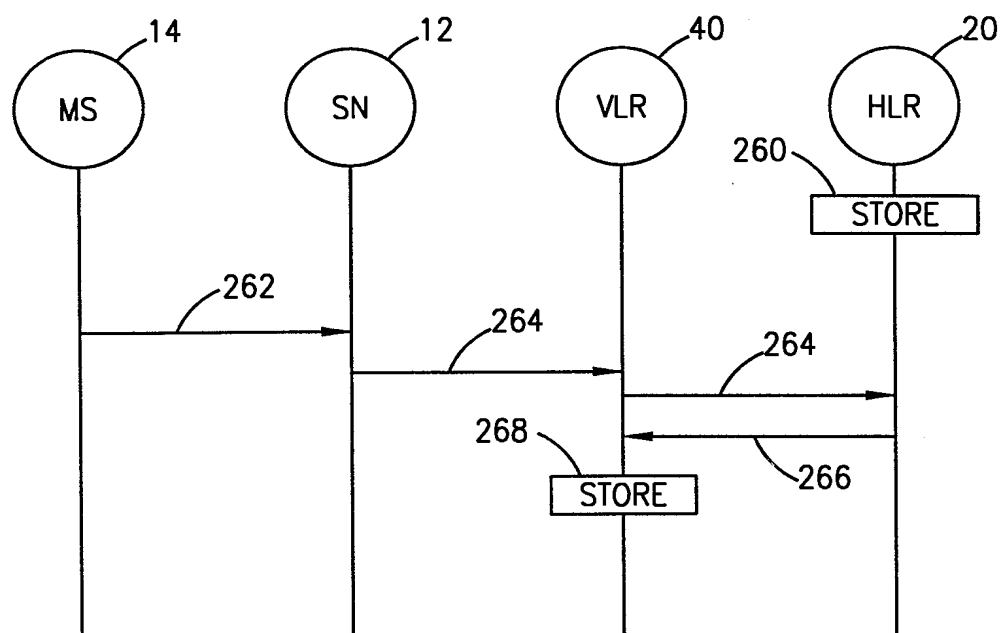
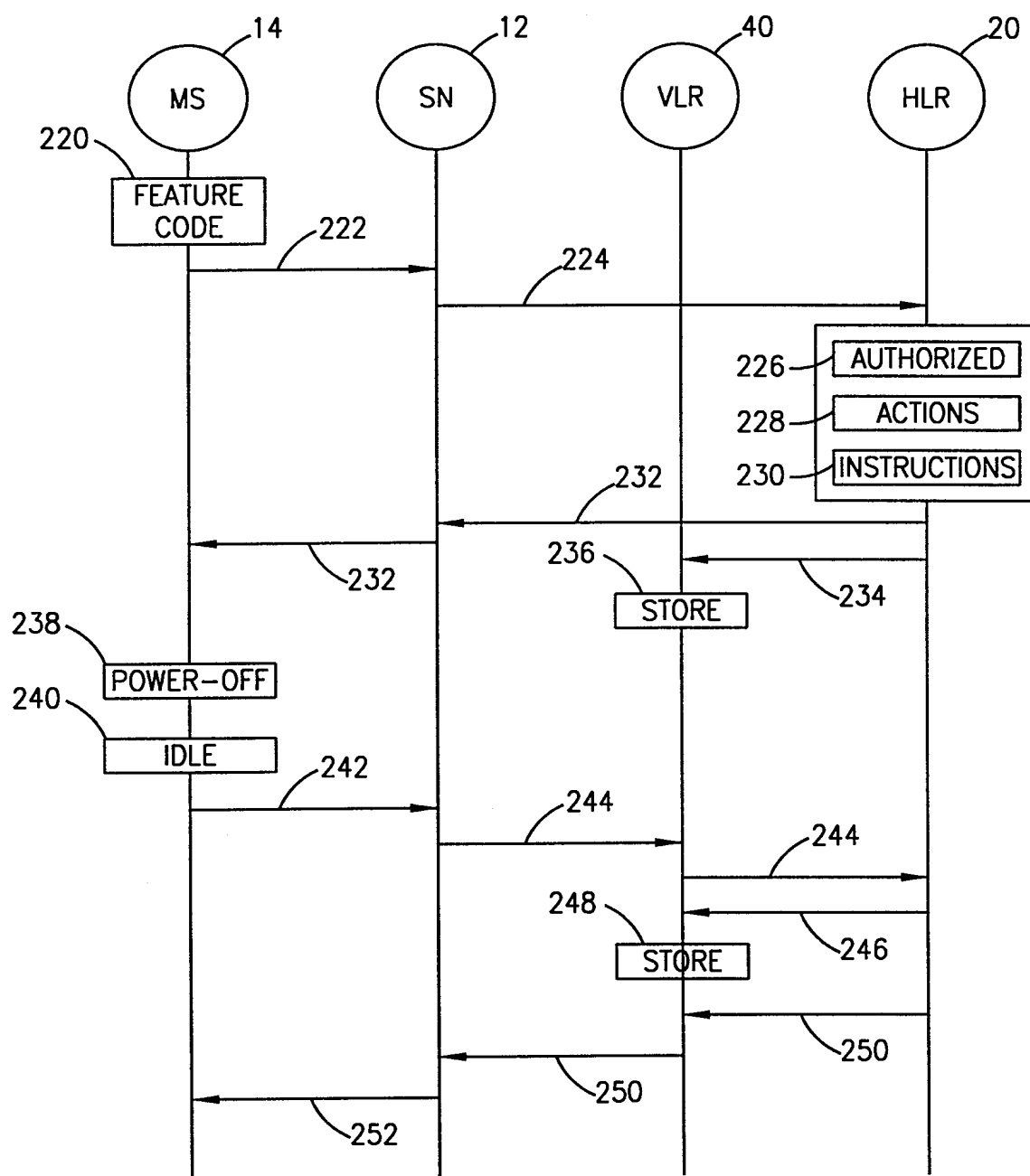


FIG. 1

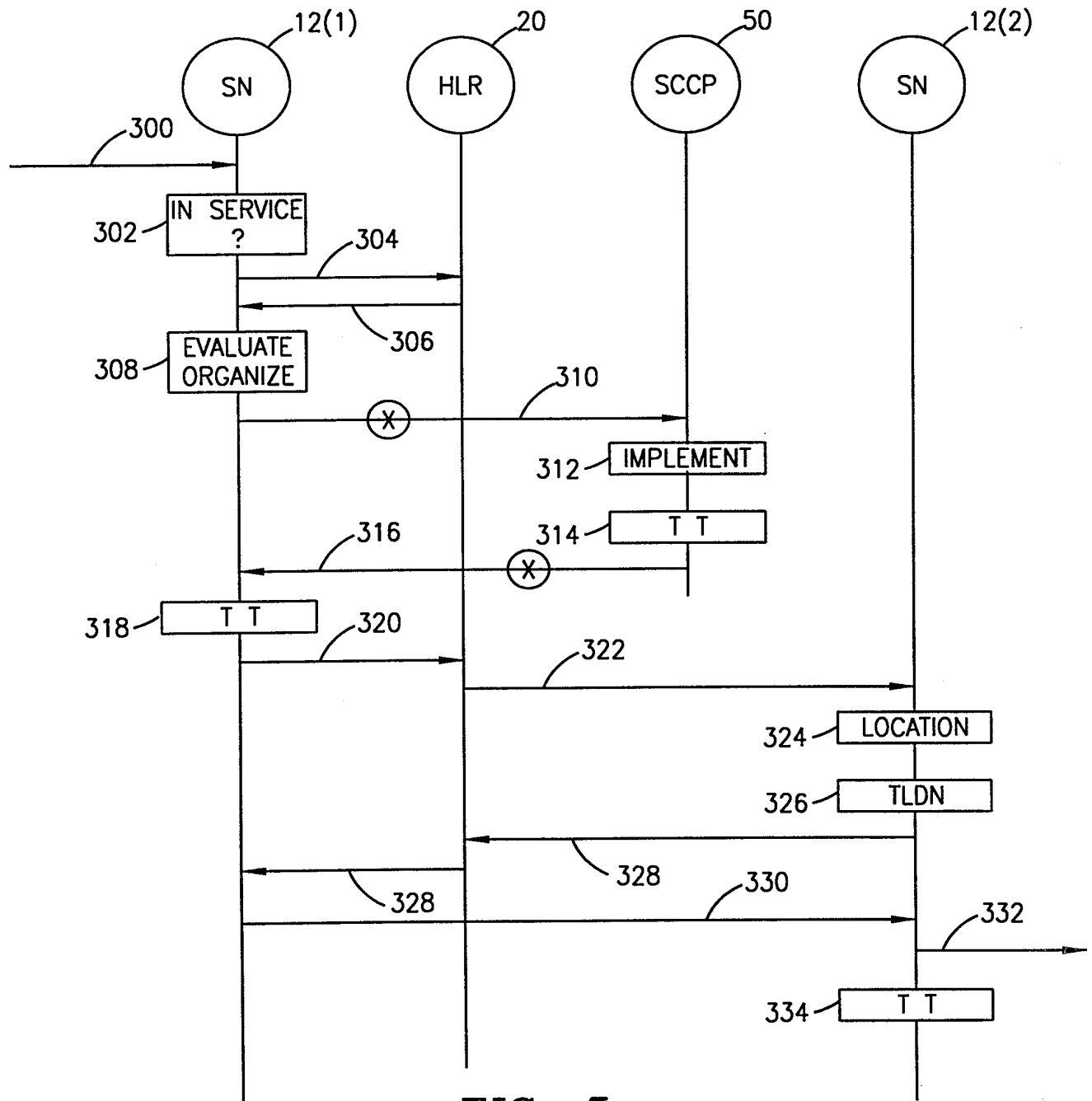
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**FIG. 2****FIG. 4**

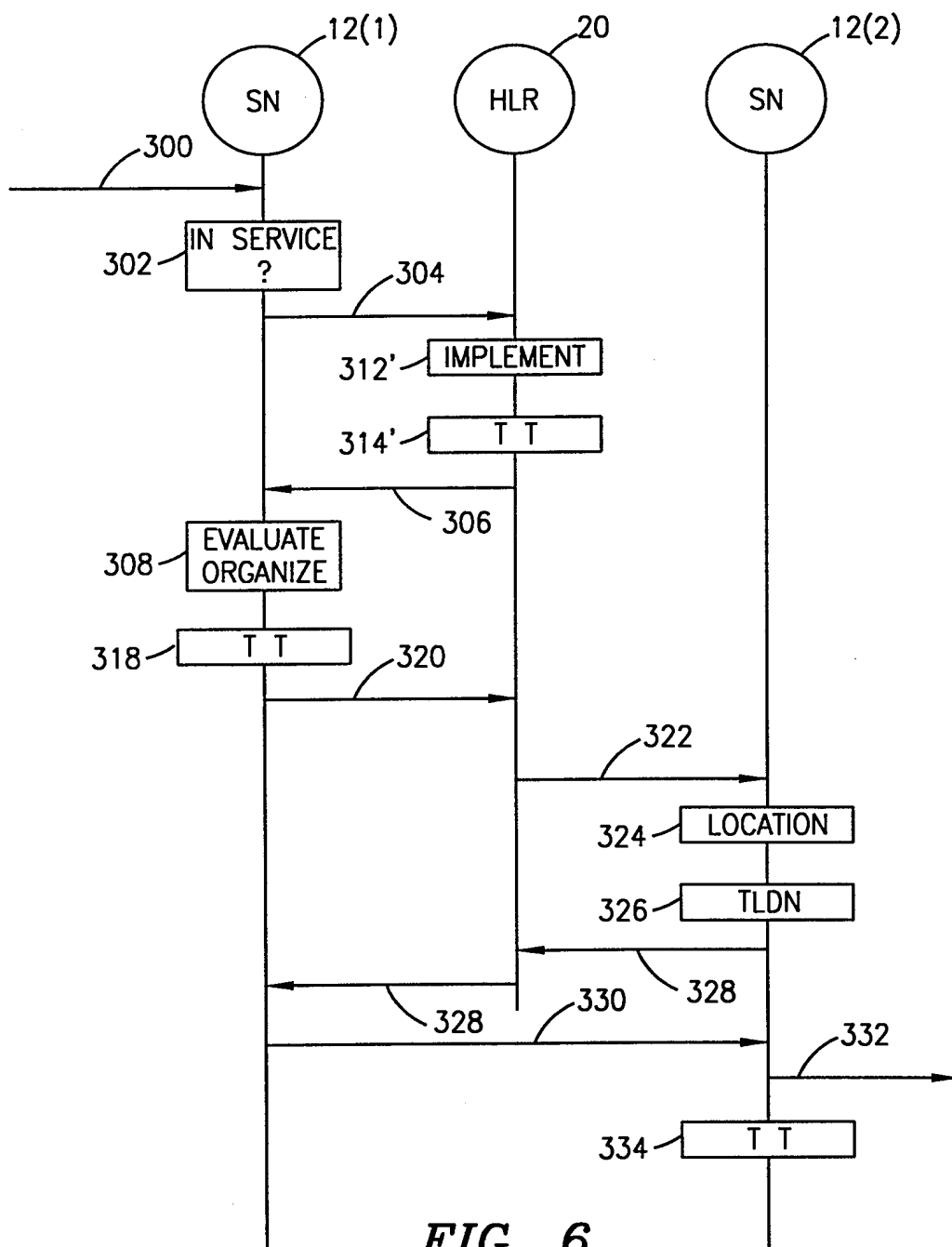
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**FIG. 3**

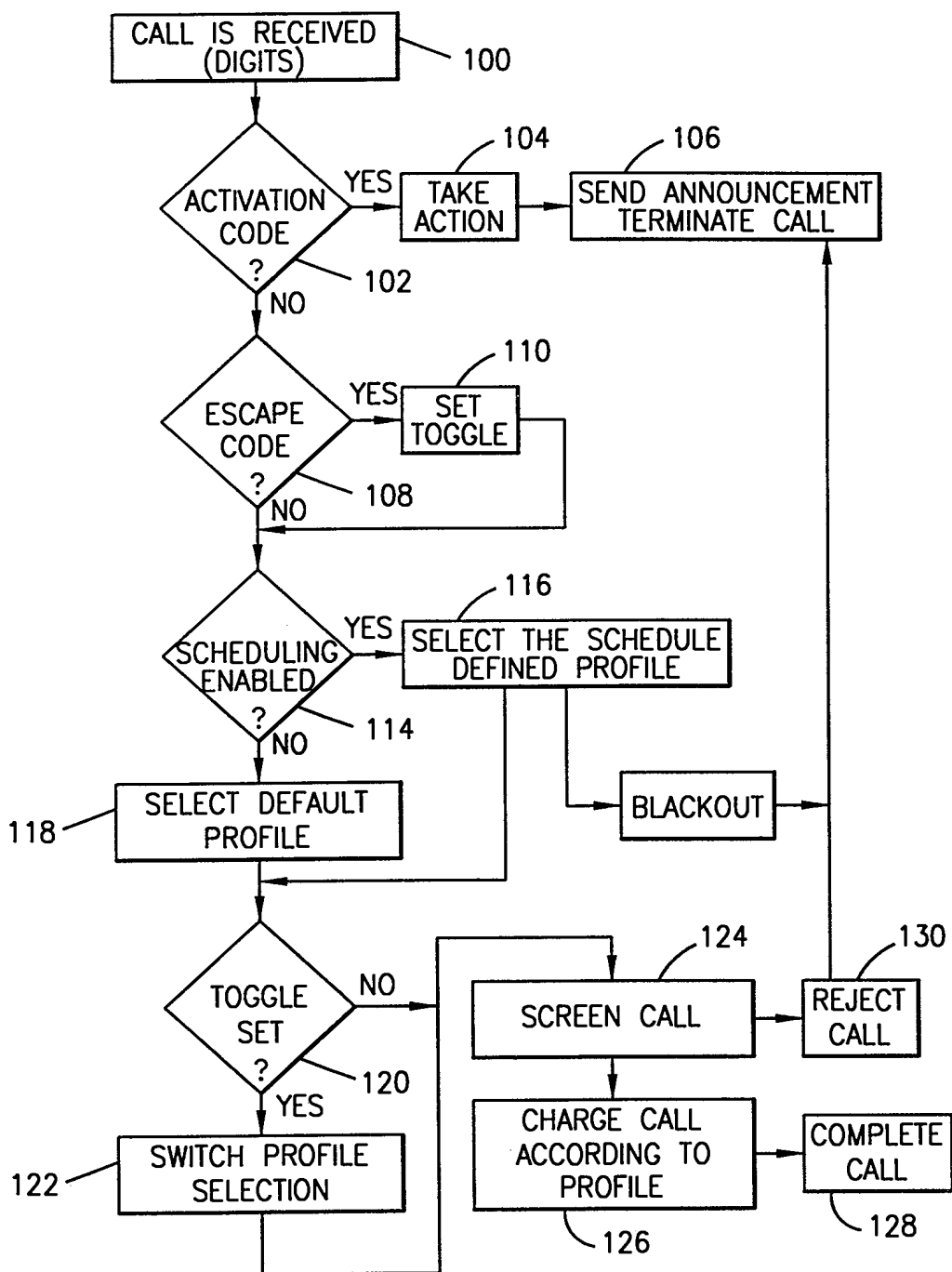
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**FIG. 5**

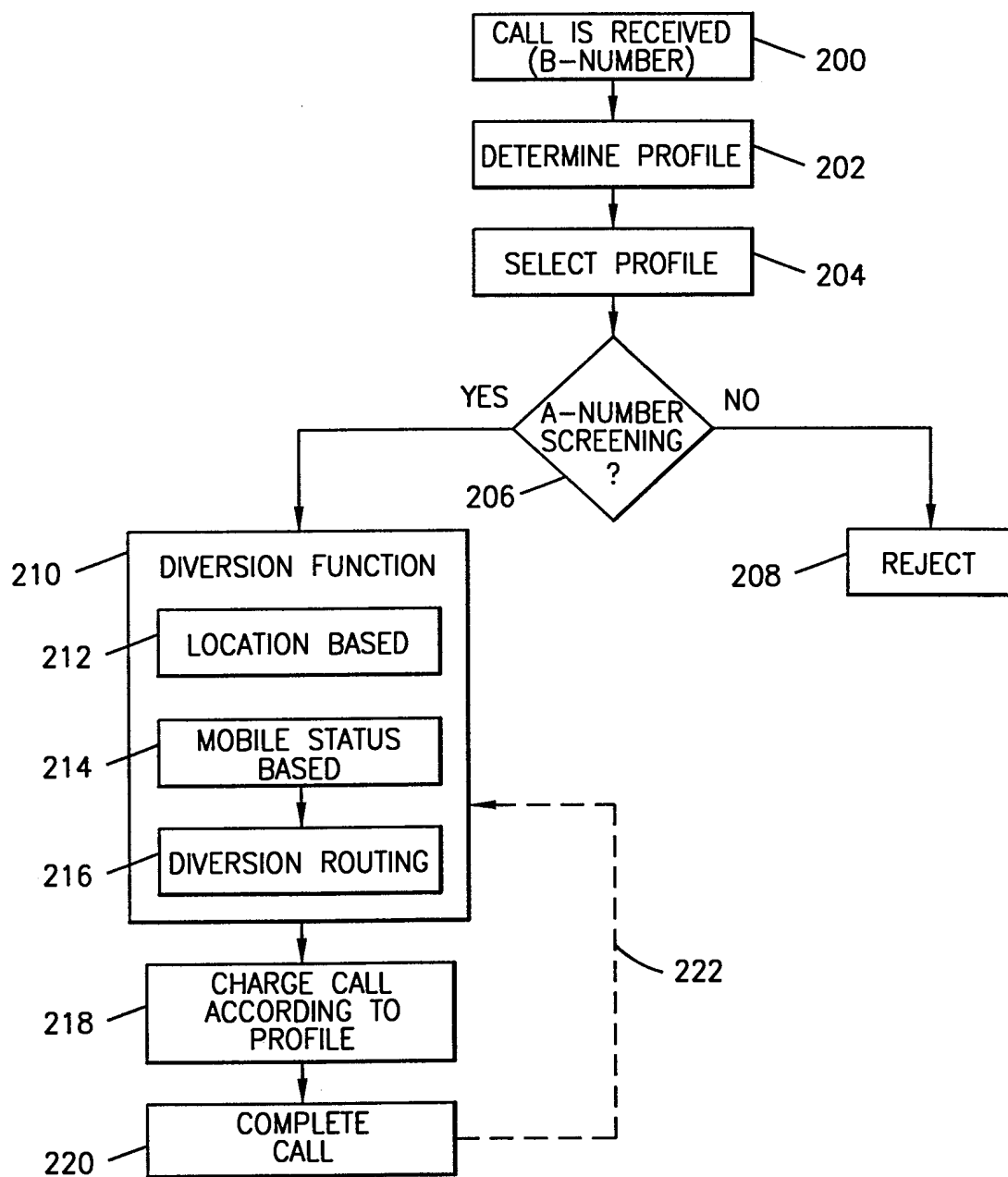
5/7

**FIG. 6**

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**FIG. 7**

7/7

**FIG. 8**

INTERNATIONAL SEARCH REPORT

International Application No

PCT/SE 98/02111

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H04Q7/22 H04M15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04Q H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 561 706 A (FENNER PETER R) 1 October 1996	1-3, 5, 7, 8, 12, 15, 16, 20-23, 27-36
A	see column 2, line 28 - column 5, line 59 ---	9, 10, 17, 18
Y	WO 97 30559 A (ERICSSON GE MOBILE INC) 21 August 1997	1-3, 5, 7, 8, 12, 15, 16, 20-23, 27-36
A	see page 7, line 14 - page 19, line 4 --- -/--	13, 25, 26



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>SHERBURNE T J ET AL: "TIME ACTIVATED SUBSCRIBER PRIVILEGES" MOTOROLA TECHNICAL DEVELOPMENTS, vol. 25, 1 July 1995, page 59 XP000524341 see the whole document -----</p>	

INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5561706 A	01-10-1996	NONE	
W0 9730559 A	21-08-1997	US 5815808 A AU 2204197 A EP 0882374 A	29-09-1998 02-09-1997 09-12-1998

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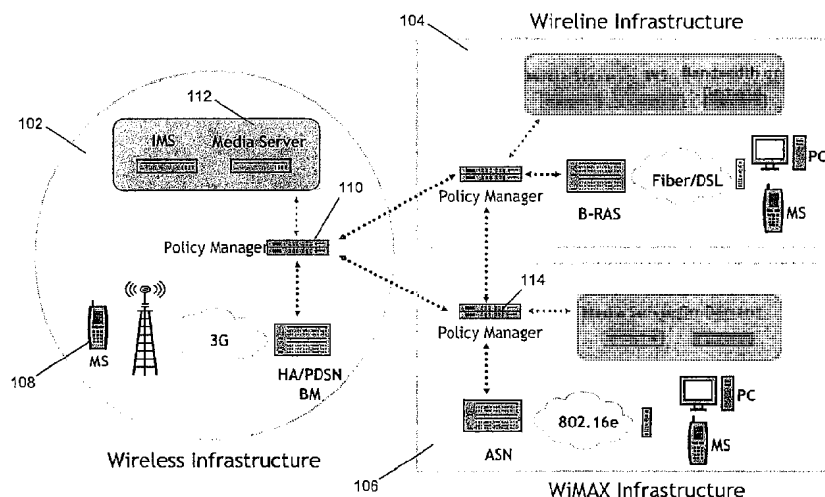
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(54) Title: DISTRIBUTED POLICY SERVICES FOR MOBILE AND NOMADIC NETWORKING



(57) Abstract: A method of disseminating topology information related to a subscriber in a system having one or more networks, each network having access devices and policy functions, includes identifying a current location of the subscriber by a serving policy function. The method further includes forwarding information relating to the current location from the serving policy function to an anchor policy function associated with the subscriber. The process of identifying the location of the subscriber and forwarding the information to the anchor policy server is repeated each time the subscriber changes its physical location. The system uses the current location information to route policy information from the anchor policy function to the policy function that is serving the subscriber. The system may use a push model, a pull model, or a combination thereof, to disseminate the topology information.

DISTRIBUTED POLICY SERVICES FOR MOBILE AND NOMADIC NETWORKING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit of the following Patent Applications:
U.S. Provisional Patent Application Serial No. 60/783,232, filed March 17, 2006.
U.S. Provisional Patent Application Serial No. 60/783,230, filed March 17, 2006.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to communication systems and services for distributing digital content, and more particularly, to techniques for properly associating subscribers with appropriate policy servers regardless of the physical location of the subscriber.

[0003] FIG. 1 shows a prior art system 10 for delivering digital content to a number of subscribers. An application function 12 (in this example a P-CSCF; proxy call session control function), provides session setup functions to enable subscribers to make VoIP calls, or can also be a server, which serves digital content such as a video stream to one of several subscribers 14. The subscribers may include any of a number of electronic devices such as telephones or personal computers. These electronic devices may be wireless or they may be connected to a local wired network.

[0004] During a session, the digital content the application server 12 provides to a subscriber 14 may pass through a number of network components. The content passes through enforcement points(s), but the signaling to request policy is signaled between the policy elements in the diagram – the policy router 16 and the policy server 18 as well as the enforcement point.

[0005] The enforcement point 20 is an edge device, such as a cable modem termination system (CMTS), GPRS gateway support node (GGSN), a packet data serving node (PDSN), etc. In general, an enforcement point can be any entity in the network through which packets traverse during the subscriber's session. The enforcement points

20 are not dedicated to any particular application server 12, but instead resources on the enforcement points are allocated to the subscriber's application session by the policy function (e.g., the policy server 18 in this example) in the network.

[0006] "Policy function" is used as the generic term for an entity in the network that is performing policy. The primary purpose of the policy function is providing the appropriate Quality of Service for the session, as well as managing any billing and accounting information associated with the session. The policy function is responsible for conveying or "pushing" a policy decision to the enforcement point 20, and making sure the correct set of policies for the subscriber is set. The policy function thus controls the enforcement point 20 via on behalf of the application server 12.

[0007] The policy router 16 in the above diagram is a policy function that also can route or forward policy requests to a downstream policy function. In the example of FIG. 1, the application server 12 conveys a policy request to the policy server 20 via the policy router 16.

[0008] In general, FIG. 1 shows a service provider policy environment supporting multiple applications, multiple subscribers and multiple subscriber edge devices. The subscriber edge devices 20 function as policy enforcement points for operator policies relating to Quality of Service, Bandwidth Management, and Admission Control.

SUMMARY OF THE INVENTION

[0009] The following are some key goals of the policy environment provided by the described embodiments:

- Applications should not require knowledge of the network topology or technology. The policy servers in the network should take care of the topology abstraction so applications can remain topology unaware.
- The policy environment should scale to countrywide deployments.
- The actual network topology should be dynamic. Network subscribers, policy servers, enforcement points, and their interconnections can be added, changed, or

deleted. Administrative provisioning may be minimized

- Subscribers should be able to access applications from different networks and different service providers. This type of roaming behavior means the enforcement points associated with the subscriber could change over time. Also, a subscriber could potentially access services and applications from different networks and providers, potentially at the same time.
- Network subscribers should be able to access the network from different subscriber edge devices at different times (i.e., the subscribers are nomadic) or move between one subscriber edge device and another during the same session (i.e., the subscribers are mobile).
- Regardless of where the subscriber is attaching from, the subscriber should be provided with the consistent set of policies. Policy governs the following types of attributes of a subscriber's service:
 - the subscribers' entitlements (i.e., what services and content they can and cannot access.
 - the quality of service for a subscriber – how good of a user experience for a service, or how much bandwidth a subscriber is allowed to get for any service
 - what the subscriber should be charged for a particular service or application
- In order for the customer to be provided with a consistent set of policies, there should be a mechanism by which the policy function in the network responsible for controlling the enforcement points (typically, this is referred to as the 'visited' network), be able to communicate with the 'home' policy function, which contains all the information about the subscriber's policies.

[0010] In one aspect, the invention is a method of disseminating topology information related to a subscriber in a system having one or more networks, each network having access devices and policy functions. The method includes identifying a current location of the subscriber by a serving policy function. The method further includes forwarding information relating to the current location from the serving policy

function to an anchor policy function associated with the subscriber.

[0011] One embodiment further includes performing the identifying step and the forwarding step each time the subscriber moves to a different serving policy function. Another embodiment further includes using the information related to the current location of the subscriber to route policy information related to the subscriber from the anchor policy function to the serving policy function.

[0012] One embodiment further includes further includes routing policy information related to the subscriber and requests for the policy information by implementing a push model. Another embodiment further includes routing policy information related to the subscriber and requests for the policy information by implementing a pull model.

[0013] One embodiment further includes maintaining, with the anchor policy function, state information associated with the subscriber, and executing policy rules according to the state information.

[0014] In another embodiment, the serving policy function and the anchor policy function are located in different service provider networks, such that the step of forwarding information relating to the current location further includes conveying the information relating to the current location across at least one service provider network boundaries.

[0015] One embodiment further includes the serving policy function implementing one or more resource level policy rules to limit or control policy decisions associated with the subscriber, based upon resource consumption in the network for which the serving policy server oversees resource control.

[0016] Yet another embodiment further includes decoupling the serving policy function from the anchor policy function. One embodiment further includes disseminating the information relating to the current location of the subscriber to one or more other policy functions in the system.

[0017] Another aspect is a system for disseminating topology information related to a subscriber in a network having one or more sub-networks, each sub-network having access devices and policy functions. The system includes a serving policy function for identifying a current location of the subscriber, and an anchor policy function associated with the subscriber for receiving information relating to the current location from the serving policy function.

[0018] In one embodiment, each time the subscriber moves to a different serving policy function, the different serving policy function identifies the current location of the subscriber and forwards the current location to the anchor policy function.

[0019] In another embodiment, the network routes policy information related to the subscriber from the anchor policy function to the serving policy function using the information related to the current location of the subscriber.

[0020] In one embodiment, the network routes policy information related to the subscriber and requests for the policy information by implementing a push model. In another embodiment, the network routes policy information related to the subscriber and requests for the policy information, by implementing a pull model.

[0021] In one embodiment, the anchor policy function maintains state information associated with the subscriber, and executes policy rules according to the state information. In another embodiment, the serving policy function and the anchor policy function are located in different service provider networks, such that the information relating to the current location is conveyed across at least one service provider network boundaries.

[0022] In another embodiment, the serving policy function implements one or more resource level policy rules to limit or control policy decisions associated with the subscriber, based upon resource consumption in the sub-network for which the serving policy server oversees resource control.

[0023] In one embodiment, the serving policy function is decoupled from the

anchor policy function.

[0024] Another embodiment further includes one or more other policy functions in the network. The information relating to the current location of the subscriber is disseminated to the one or more other policy functions.

BRIEF DESCRIPTION OF DRAWINGS

[0025] FIG. 1 shows a prior art system 10 for delivering digital content to a number of subscribers.

[0026] FIG. 2 shows an exemplary embodiment of a system architecture constructed and arranged according to the invention.

[0027] FIGs. 3 and 4 show the serving PS 150 forwarding registration information to the designated policy router

[0028] FIGs. 5 and 6 illustrate the routing of policy requests from the policy router, to the anchor, then to the serving PS.

[0029] FIG. 7 illustrates an embodiment in which the location of the application function resides in the same network as the anchor PS.

[0030] FIG. 8 is an exemplary message flow for one embodiment of the system shown in FIG. 2.

[0031] FIG. 9 illustrates a 'Pulling' model for disseminating policies.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] FIG. 2 shows an exemplary embodiment of a system architecture constructed and arranged according to the invention. The exemplary system shown in FIG. 2 includes a wireless network 102, a wireline network 104 and a WiMAX (i.e., IEEE 802.16) network 106.

[0033] In the wireless network 102, a subscriber 108 uses a mobile device (MS) to

access the wireless network 102. The subscriber 108 subscribes to a particular access provider, for example Sprint®. The subscriber's policy function 110 is located within the Sprint wireless network 102.

[0034] Consider the situation in which the subscriber 108 "roams" to another access provider's network. In this example, the Sprint network 102 is considered the subscriber's "home network." The policy function 110 in the sprint network (a policy manager in this example) is the subscriber's "home policy function" – or the "anchor policy function."

[0035] Suppose the subscriber roams to an access provider that supports a different type of network, for example a WiMAX wireless network 106. Once the subscriber 108 is connected into the WiMAX network, the subscriber may want to access applications 112 that are located in its home network (i.e., the Sprint network 102). To accomplish this, the policies of the subscriber 108 that reside in the home policy function 110 need to ultimately be implemented in the network in which the subscriber is visiting (i.e., the WiMAX network 106).

[0036] However, the home/anchor policy function 110 from the wireless network 102 does not and cannot directly control the WiMAX network 106 (i.e., the network into which the subscriber has roamed). For a variety of security reasons, a network provider typically does not allow an outside entity to directly control its network equipment for policy enforcement. Therefore, the home/anchor policy function must communicate and coordinate with the "visited" policy function, in this example the policy manager 114 in the WiMAX network 106, to allocate the necessary network assets. This visited policy function is also referred to herein as the "serving" policy function, because it is the policy function responsible for serving the subscriber in the visited network.

[0037] The described embodiments include techniques and mechanisms that fulfill the following objectives:

1. Associate a given subscriber with a particular policy server, even when the subscriber accesses the network in a mobile or nomadic fashion. The subscriber can therefore be associated with the appropriate visited policy function, and the

correct home/anchor policy function

2. Free an application from determining which policy server is responsible for determining the policy for accessing a given application, even when the subscriber accesses the network in a mobile or nomadic fashion
3. Allow a policy server to map application addressing (typically the 5-tuple IP source address, IP destination address, source port, destination port, and protocol), as well as other the subscriber identifiers such as MAC addresses or email ID (Invariant Subscriber Identifier or ISI), to the network edge device currently supporting a particular subscriber.

[0038] Each subscriber station in the access network is associated with an invariant subscriber identifier (ISI) dependant on the particular access technologies that the subscriber uses. Examples of an ISI include an Electronic Serial Number, a phone number, a Mobile Station Integrated Services Digital Network number (MS-ISDN), an International Mobile Subscriber Identifier, an Ethernet Media Access Control (MAC) address, among others. Unlike an IP address range that can change each time the subscriber accesses the network from a different access device, the ISI is associated with the subscriber and doesn't change from access to access, or when the subscriber accesses the network via a different subscriber access device. The extent to which (i) the ISI number codes the "typical" location from which the subscriber accesses the network, and (ii) sequential identifiers are likely provisioned from the same location, can make the mapping operation more efficient, but is not specifically required by the embodiments describe herein.

[0039] A Policy Server (hereinafter "PS") can "learn" or be provisioned with information identifying which ISIs they typically serve. In this way a particular PS becomes the "anchor" PS for a given set of subscribers. Being the "anchor" PS means that PS will always be the ultimate policy decision maker for the associated subscriber, regardless of where the subscriber may be currently accessing the network.

STATEFULNESS

[0040] The anchor PS for a particular subscriber is stateful of the subscriber. Being

“stateful” means that whenever the subscriber is on the network, the anchor PS is aware of (i.e., has information regarding) the state of the subscriber, in terms of which applications requiring policy the subscriber has invoked. Even when the subscriber moves across the network, for example to another region of the network that has its own policy server, policy requests ultimately need to interact with the anchor PS for that subscriber. Because the anchor PS is aware of the subscriber, it can make policy decisions based on subscriber-centric parameters (i.e., parameters specific to that subscriber). For example, the anchor PS can execute policy rules that determine what a subscriber may or may not do, based on who he is, what tier or packages of service he has purchased or is entitled to, and how many of such application sessions he may be allowed, among others.

[0041] Although the anchor PS is stateful of the subscriber and its policy parameters, the anchor PS may not have information regarding what network resources the subscriber is utilizing. This is because the anchor PS may not be the serving PS, if the subscriber is roaming, as an example. The anchor PS is in the home network, and if the subscriber is in a location that is being served by another PS (visited PS or serving PS because the subscriber has roamed into another part of the network or to another provider), then it is only the visited or serving PS that is aware of the network resources the subscriber is utilizing. As a result, the serving or visited PS can be in charge of network resource-centric policies (i.e., policies specific to those network resources). The visited or serving PS can execute the policy rules that focus on setting thresholds for resource consumption. Because the serving PS is the one interfacing with the enforcement points, and it is aware of all the sessions that are being admitted over the enforcement points it controls, it is aware of the resources that are being utilized. As a result, the serving PS can enforce policy rules that control the amount of resources (e.g., bandwidth, or number of sessions) that can be admitted over the enforcement points.

[0042] The anchor PS is therefore responsible for executing subscriber-centric policies, and the visited or serving PS is responsible for executing resource-centric policies. An anchor policy server that is stateful of the subscriber's sessions can implement subscriber-aware policy rules to control what a subscriber is entitled to do.

For example, the anchor PS can deny a third session if the subscriber already has two simultaneous sessions running. Or, the anchor PS can deny a request for video if the subscriber currently has a voice application running. For the same scenario, the anchor PS could allow the request for video if the subscriber is in an elite (i.e., "gold") service tier, even when the voice application is already running.

PERCOLATION OF TOPOLOGY THROUGH THE NETWORK

[0043] Each time a subscriber registers onto the network, information about the subscriber's point of attachment (i.e., topology) must be percolated through the relevant policy functions in the network. This ensures that for roaming subscribers, the correct set of policy functions will participate in the policy activity when applications are invoked. The result is that subscriber-centric policies, as well as resource-centric policies, are properly executed and enforced.

[0044] There are several ways in which this topology information can be disseminated. As shown the diagrams of FIGs. 3 and 4, the serving policy server 150 can forward registration information 152 to the designated policy router 154 in the network (this designation information can be provisioned on the serving policy server, or it can be algorithmically derived by the serving policy server).

[0045] The policy router can then be responsible for forwarding the registration information to the anchor PS designated for the subscriber. The policy router can gain information regarding which anchor PS is designated for a particular subscriber in a number of different ways, for example:

- The policy router can be provisioned with the information;
- The policy router can retrieve the information via an external database lookup;
- The policy router can algorithmically derive the information (for example, based on the telephone number of the device the subscriber is using, use the area code to locate the anchor); or,
- The anchor PS can percolate the topology information to the policy router.

[0046] Once the policy router forwards the registration information to the designated anchor PS, both the policy router and the anchor PS know which serving or visited PS is currently associated with the subscriber. If the subscriber physically moves, a new serving PS may be associated with the subscriber. When this happens, the registration process happens all over again and the anchor and the policy router will “discover” or “learn” the new association as described above.

[0047] Alternatively, the serving PS may use similar mechanisms as above to send the topology information to the anchor PS as well. For example, when the subscriber registers, the serving PS can use the realm information in the registration to determine which anchor policy server should receive the registration/topology information.

REGISTRATION AND TOPOLOGY LEARNING

[0048] Subscribers access the network via subscriber access equipment such as a Cable Modem Termination System (CMTS), Packet Data Serving Node (PDSN), Gateway GPRS Serving Node (GGSN) or Broadband Remote Access Server (B-RAS) device that will typically assign a dynamic IP networking address to the subscriber station. A PS provides the Policy Decision Function (PDF – determines the rules for Quality of Service, admission control, and packet processing disciplines, and how the particular session should be charged) for application data streams flowing from network applications to the subscriber through subscriber access equipment.

[0049] Once the subscriber registers onto the network, the subscriber may invoke applications through signaling with the application function. The application function may reside in a centralized location, and the application function is unaware of the physical location of the subscriber with respect to the network.

[0050] When a subscriber initiates a request for a session from an application server, the application function/server issues a request to the PS for a policy decision, which ultimately decides the policies (QoS treatment and the charging rules associated with the particular session as well as potentially entitlements). The PS evaluates the request against the rules that have been provisioned on the PS (rules can be based on information such as subscriber tier, time of day, network usage) and pushes down the

policy decision (QoS policy decision as well as charging) down to the subscriber access equipment, i.e., the enforcement point.

[0051] As the network gets larger, it is usually desirable to partition the PDF across multiple PSs, each signaling a set of subscriber access equipment. A policy router allows applications to have a single point of contact for policy decisions across the network and frees applications from knowledge of the network topology or subscriber location. The policy router maintains the knowledge of which subscriber access device is serving the subscriber and which PSs (serving and anchor) may implement policy decisions related to the subscriber.

[0052] In a mobile network, when a subscriber first accesses the system, the subscriber access equipment signals the network IP address and the ISI to its associated PS. In non-mobile networks, the PS may learn of the subscriber association through other means, including SNMP, or through provisioning. The PS will learn the association of the subscriber to the enforcement point relationship and provide the information to the policy router. The policy router can now use the information to perform its policy routing function – which is when an application issues a request to the policy router, it can now figure out which PS to route the request to based on either the subscriber IP address or the ISI.

[0053] PSs can also be provisioned to be the ‘anchor’ PS for a particular subscriber, so that no matter where the subscriber is physically located (the subscriber could move between different enforcement points), the policy requests are always routed to the anchor PS. It is then the responsibility of the anchor PS to route the request to the serving PS responsible for serving the particular enforcement point with which the subscriber is now associated. The policy router can use the ISI to route the request to the anchor PS, and the anchor PS can use either the ISI or the subscriber IP address in order to route to the serving PS.

[0054] This anchoring technique is useful when there is a distribution of policy functions in the network due to scalability, as well as when subscribers are roaming between networks or network providers.

[0055] FIGs. 5 and 6 illustrate the routing of policy requests from the policy router, to the anchor, then to the serving PS. Each PS can route appropriately based on the topology information learned during the registration process.

[0056] In one embodiment the application function, and the policy router, reside in a third party network or application provider's domain. In another embodiment, all policy components reside in different networks or provider domains.

[0057] In the scenario described above, the subscriber accesses an application that is located at a centralized part of the network. The application function issues the policy request to its default PS – which in this case is the policy router. The policy router is then responsible for forwarding the policy request to the relevant anchor PS in order for the anchor PS to execute subscriber centric policies. The anchor PS executes its relevant policy rules, and then forwards the request onto the serving PS.

PUSH MODEL

[0058] The policy interactions described so far implement a “push” model for policy distribution; the application function ‘pushes’ the request to the policy router, the policy router ‘pushes’ the request onto the anchor PS, and the anchor ‘pushes’ the request to the serving PS.

[0059] The topology learning process is critical in being able to implement the push model for policy. When a subscriber accesses an application that requires QoS, the application will signal the request to the policy router. The policy router may evaluate certain global or application specific policy rules before looking up the anchor PS for the subscriber and forwarding the QoS request to that anchor PS for evaluation. The policy router and the anchor PS could be in the subscriber's ‘home network’ domain (e.g., if this is a Sprint subscriber, and the subscriber is accessing a Sprint service from another network, the application, the policy router and the anchor PS involved in the transaction would all be within Sprint's domain).

[0060] The anchor PS evaluates the QoS request with respect to subscriber policy

rules (referred to herein as subscriber-centric rules – e.g., how many sessions the particular subscriber is allowed to have concurrently, or what applications and services is the subscriber entitled to, or has the subscriber exceeded some usage limit, for example). If the QoS request is evaluated as being acceptable, the anchor PS sends the request to the ‘serving’ PS interfacing to the subscriber access device currently serving the subscriber.

[0061] If required, the anchor PS may also evaluate the QoS request based on administrative policy rules (for example, if the subscriber was roaming in another administrative domain). Ultimately the serving PS will send the QoS directive to the subscriber access equipment to implement the QoS for the subscriber. The serving PS may reside in a visited network. The serving PS will execute policy rules around resource usage – controlling the amount of resources that are consumed on the access network.

[0062] For example, the serving PS can deny a subscriber’s request for resources if the total bandwidth consumed on the access network over which the subscriber is receiving service (under the domain of the visited/serving policy server) exceeds some predetermined threshold X. Another example – the serving PS can deny a video request from a subscriber if the bandwidth consumed for all video applications over a particular enforcement point (under the control of the serving/visited policy server) exceeds some predetermined threshold Y. Or, the serving PS can deny the above request for video the total number of voice sessions currently being delivered over a particular enforcement point exceeds another predetermined threshold Z.

[0063] Alternatively, the application function could also reside in the same domain/network as the anchor PS, in which case the application function will signal directly to the anchor PS and treat the anchor as the application function’s default PS. The anchor PS performs both the policy routing functions (because it is routing to the serving PS) as well as the PS responsible for executing the subscriber-centric policy rules. The anchor policy server is also directly interfacing to the application function.

[0064] FIG. 7 illustrates an embodiment in which the location of the application function resides in the same network as the anchor PS, and thus using the anchor PS as the application function’s default PS.

[0065] In the system shown in FIG. 7, the subscriber's serving PS may be in a visited network (e.g., Telus), but the subscriber is a Verizon customer and his anchor policy server is in the Verizon network, along with the applications the subscriber wishes to access. In some embodiments, networks operated by different commercial entities cooperate through what is referred to herein as "policy peering." Using the roaming information associated with the subscriber, the serving and anchor policy servers can implement policy inter-operator service level agreements (SLAs) and other business agreements.

[0066] An application request can originate from a subscriber physically located in a network or provider different from that in which the anchor PS resides. The policy request is ultimately forwarded onto the serving or visited PS. In this scenario, the visited PS can be used to limit what the third party application can request of the visited network. For example, based on the agreed-to business arrangement between two parties (the access network provider and the content provider) the visited policy server can keep track of what has been admitted into the network for content/applications invoked by the third party content/application provider

[0067] Depending on the scale of the deployment, the logical policy functions (such as routing, anchor, serving, etc.) can be co-located to reduce complexity of the architecture.

[0068] In the wireless world, when the subscriber de-registers from the subscriber access equipment, a de-registration message is sent to the serving PS, which is forwarded to the policy router. FIG. 8 is an exemplary message flow for one embodiment. The policy router forwards the de-registration event to the anchor PS to indicate that the subscriber is no longer accessible on the network or associated with a serving PS. Alternatively, the de-registration message can be directly forwarded from the serving PS to the anchor PS as well.

[0069] Generally a subscriber will be associated with a particular anchor PS, and this relationship should be persistent in most instances. However, there may be cases where the subscriber's anchor PS changes over time. Periodically, based on an

administratively set timer, the policy router and the anchor PS may flush the ISI from the range of served ISI. This may be done in case there is a more efficient PS that could serve the subscriber based on the subscriber access equipment typically used.

PULL MODEL

[0070] Another method of policy distribution is implemented via the 'pull' model. In the pull model, the client/subscriber invokes a policy request directly, instead of the request coming from the application function. The client may use messaging like RSVP to trigger a request from the access equipment (enforcement point). The access equipment may initiate a policy request from its designated serving PS. The serving policy server may need to retrieve the correct set of policies for the subscriber from the anchor PS. Using the same type of mechanisms that were used during the topology discovery/distribution phase, the serving PS could 'pull' for the correct set of policies from the anchor PS. It is likely that in large-scale deployments, both push and pull models are implemented in the network.

[0071] FIG. 9 illustrates a 'Pulling' model for disseminating policies, in which the subscriber triggers a policy request. The Access network equipment could pull for policies from the Serving PS. The serving PS, using the same type of methods that it used for the distribution of topology information, can pull for the policy for the subscriber from the anchor PS. The types of policies that can be pulled include subscriber entitlements (what services/applications is the subscriber entitled to have access to), QoS treatment for any one of the services, how the services should be billed (flat rate billing, or per byte billing, or time based billing, etc).

[0072] When the subscriber first registers onto the network, the serving PS is aware of whether the subscriber is roaming or not. The anchor PS is also aware of the subscriber's roaming status. Roaming information can be inferred from messaging from the access network equipment when the subscriber first attaches to the network. The subscriber's realm information that is present in the initial attachment message can provide information about the subscriber. For example, the subscriber may be a Verizon wireless subscriber roaming into the Telus network. The information from the

subscriber/client will indicate that he is a Verizon wireless subscriber. The serving PS uses this information to determine which anchor PS or policy router should receive the topology information (in a push from the serving PS) and provide policy information (in a pull by the serving PS).

[0073] Various policy servers can also use the subscriber's realm information to execute policy rules against the subscriber. For example, the serving PS in the Telus network may have rules, which provide a different level of treatment if the subscriber is a Verizon subscriber, as opposed to a subscriber of some other service provider. If there are service level agreements or business agreements put in place between Telus and Verizon, the Telus serving PS may be used to implement those business rules, such as providing enhanced QoS for voice, video or data services. In some embodiments, the realm information is also used to provide differential billing, in which a subscriber is billed differently for the various applications as a function of the particular realm.

[0074] The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of the equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A method of disseminating topology information related to a subscriber in a system having one or more networks, each network having access devices and policy functions, comprising:
 identifying a current location of the subscriber by a serving policy function; and,
 forwarding information relating to the current location from the serving policy function to an anchor policy function associated with the subscriber
2. The method of claim 1, further including performing the identifying step and the forwarding step each time the subscriber moves to a different serving policy function.
3. The method of claim 1, further including using the information related to the current location of the subscriber to route policy information related to the subscriber from the anchor policy function to the serving policy function.
4. The method of claim 1, further including routing policy information related to the subscriber and requests for the policy information by implementing a push model.
5. The method of claim 1, further including routing policy information related to the subscriber and requests for the policy information by implementing a pull model.
6. The method of claim 1, further including maintaining, by the anchor policy function, state information associated with the subscriber, and executing policy rules according to the state information.
7. The method of claim 1, wherein the serving policy function and the anchor policy function are located in different service provider networks, such that the step of forwarding information relating to the current location further includes conveying the information relating to the current location across at least one service provider network boundaries.

8. The method of claim 1, further including the serving policy function implementing one or more resource level policy rules to limit or control policy decisions associated with the subscriber, based upon resource consumption in the network for which the serving policy server oversees resource control.

9. The method of claim 1, further including decoupling the serving policy function from the anchor policy function.

10. The method of claim 1, further including disseminating the information relating to the current location of the subscriber to one or more other policy functions in the system.

11. A system for disseminating topology information related to a subscriber in a network having one or more sub-networks, each sub-network having access devices and policy functions, comprising:

a serving policy function for identifying a current location of the subscriber; and,
an anchor policy function associated with the subscriber for receiving information relating to the current location from the serving policy function.

12. The system of claim 11, wherein each time the subscriber moves to a different serving policy function, the different serving policy function identifies the current location of the subscriber and forwards the current location to the anchor policy function.

13. The system of claim 11, wherein the network routes policy information related to the subscriber from the anchor policy function to the serving policy function using the information related to the current location of the subscriber.

14. The system of claim 11, wherein the network routes policy information related to the subscriber and requests for the policy information, by implementing a push model.

15. The system of claim 11, wherein the network routes policy information related to the subscriber and requests for the policy information, by implementing a pull model.

16. The system of claim 11, wherein the anchor policy function maintains state information associated with the subscriber, and executes policy rules according to the state information.

17. The system of claim 11, wherein the serving policy function and the anchor policy function are located in different service provider networks, such that the information relating to the current location is conveyed across at least one service provider network boundaries.

18. The system of claim 11, wherein the serving policy function implements one or more resource level policy rules to limit or control policy decisions associated with the subscriber, based upon resource consumption in the sub-network for which the serving policy server oversees resource control.

19. The system of claim 11, wherein the serving policy function is decoupled from the anchor policy function.

20. The system of claim 11, further including one or more other policy functions in the network, wherein the information relating to the current location of the subscriber is disseminated to the one or more other policy functions.

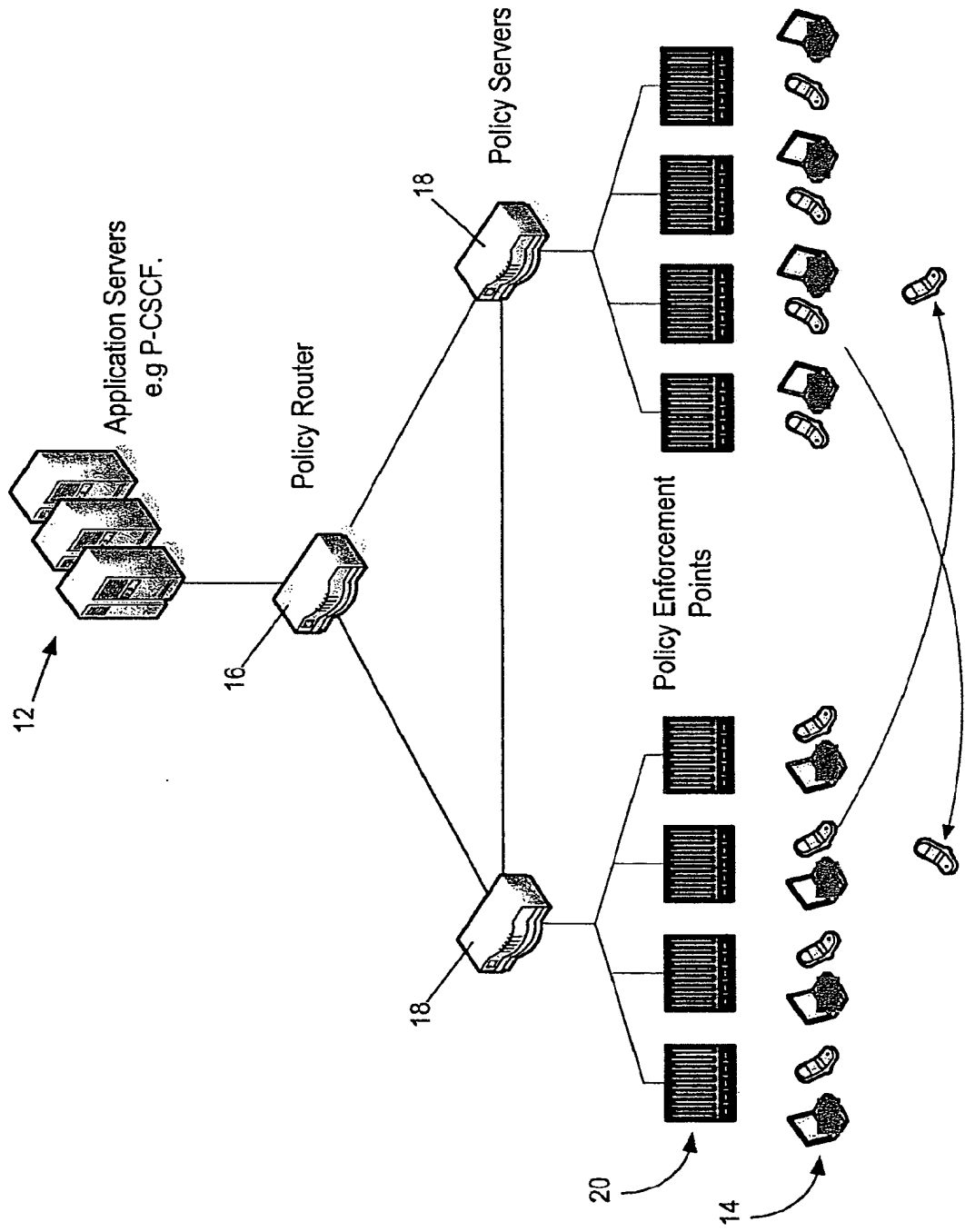


FIG. 1

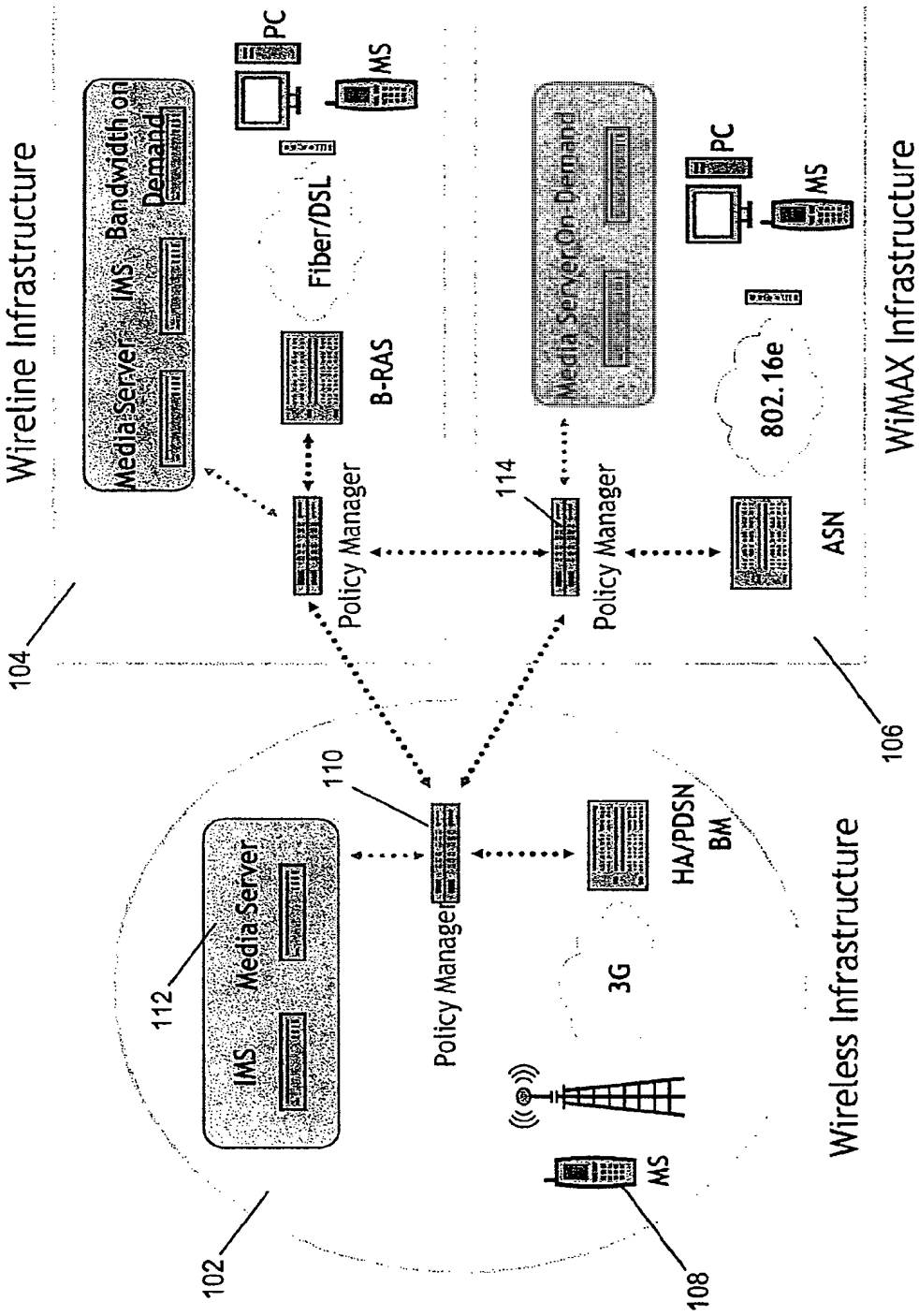


FIG. 2

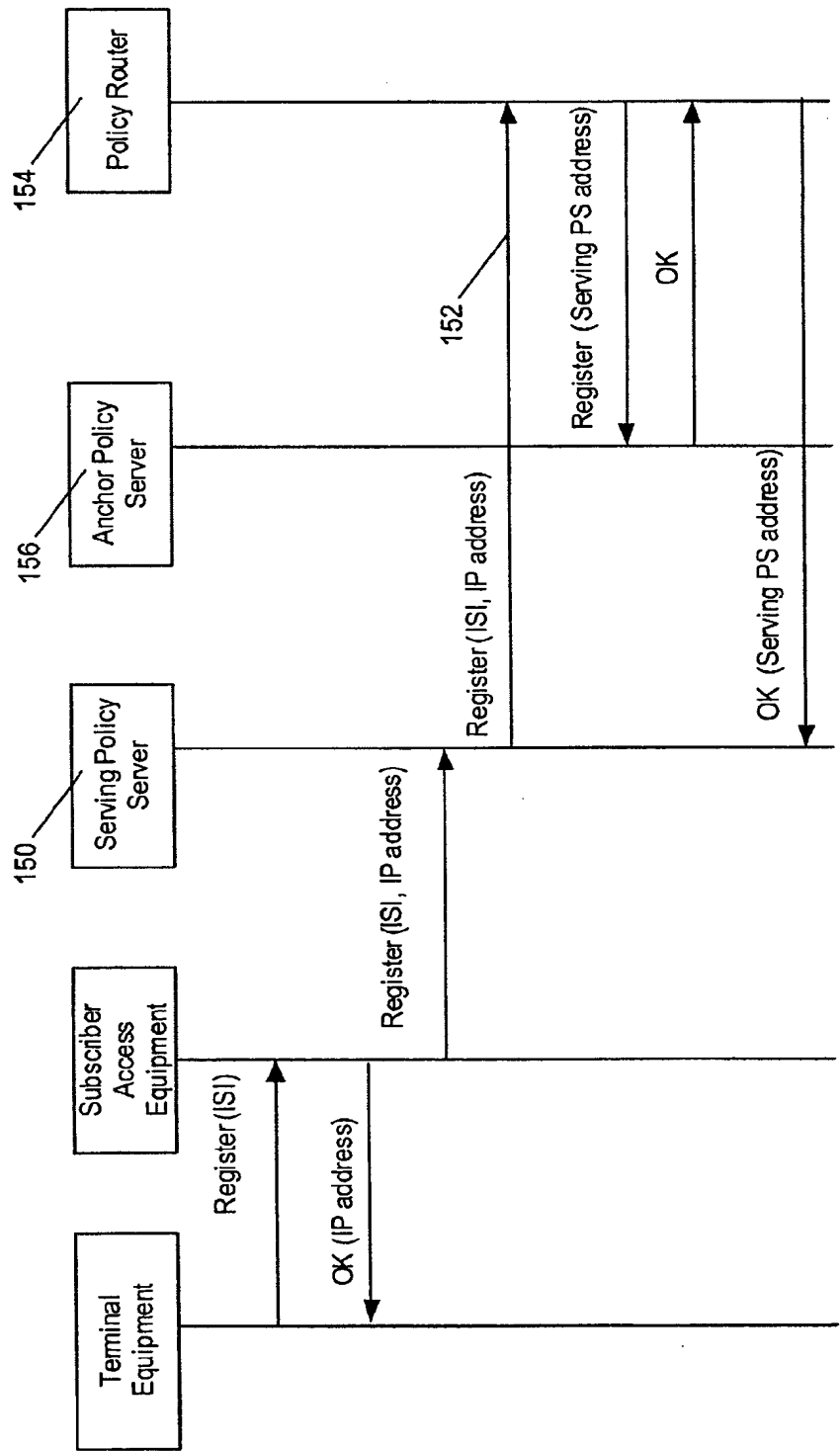


FIG. 3

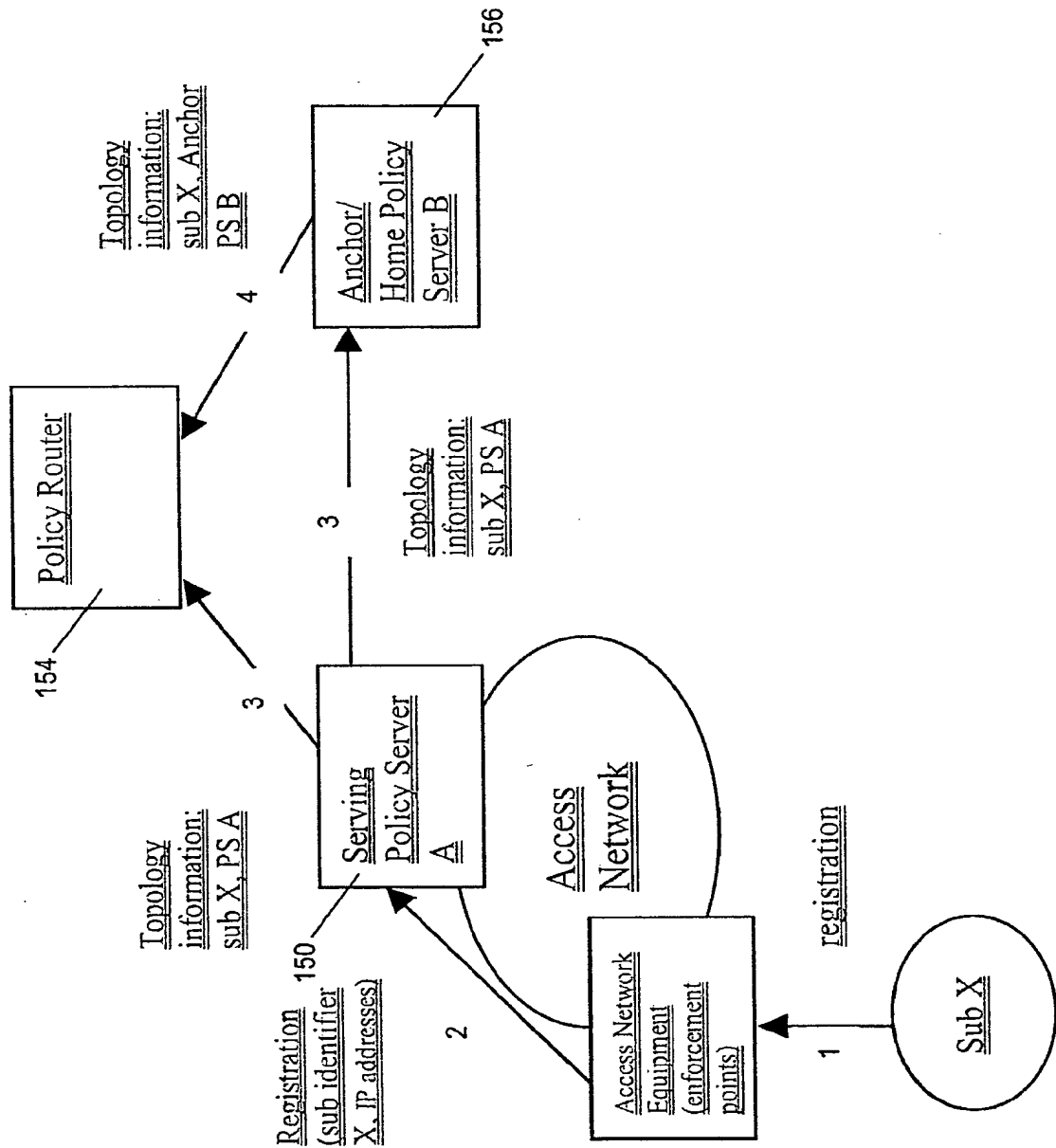


FIG. 4

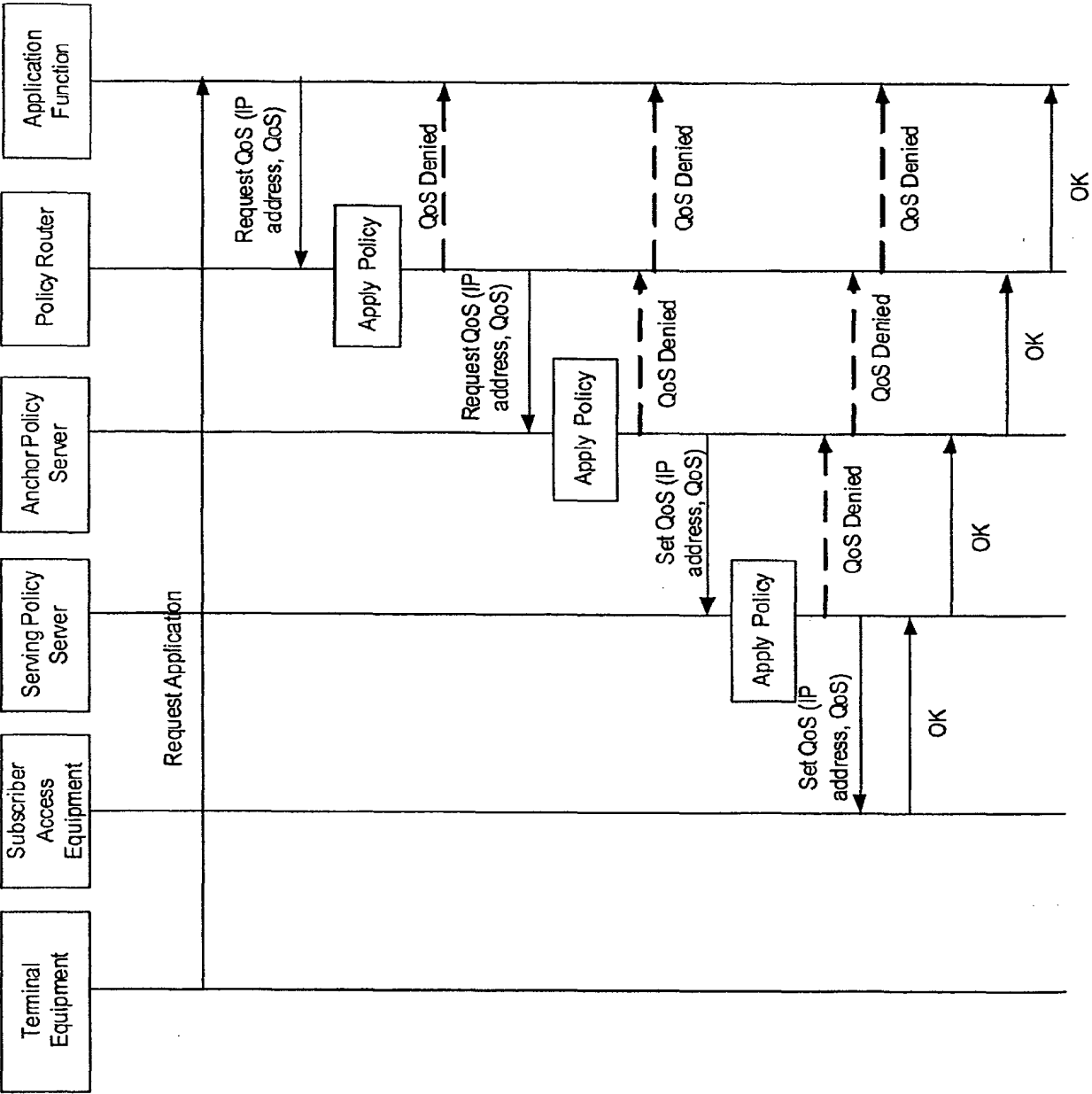


FIG. 5

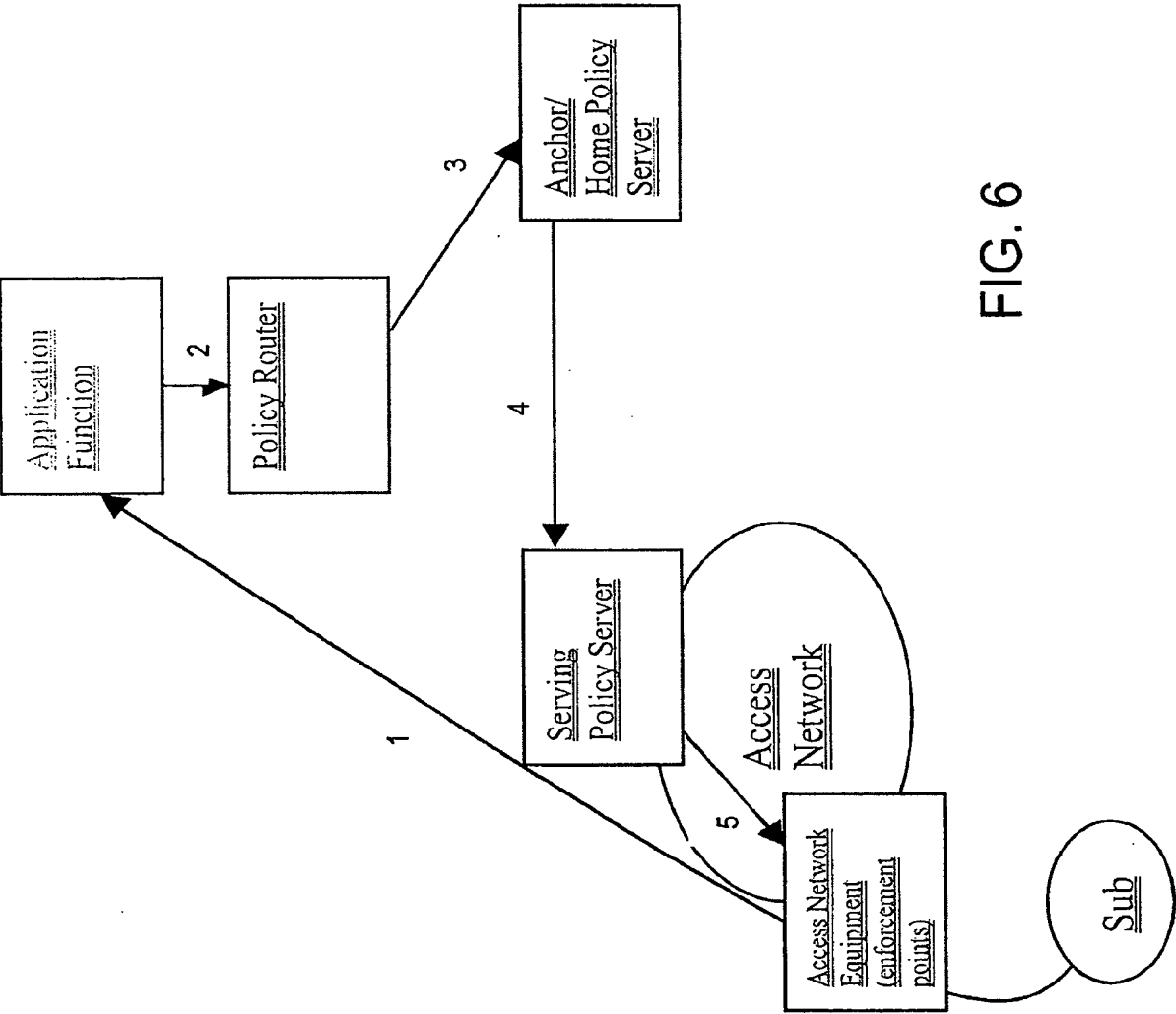


FIG. 6

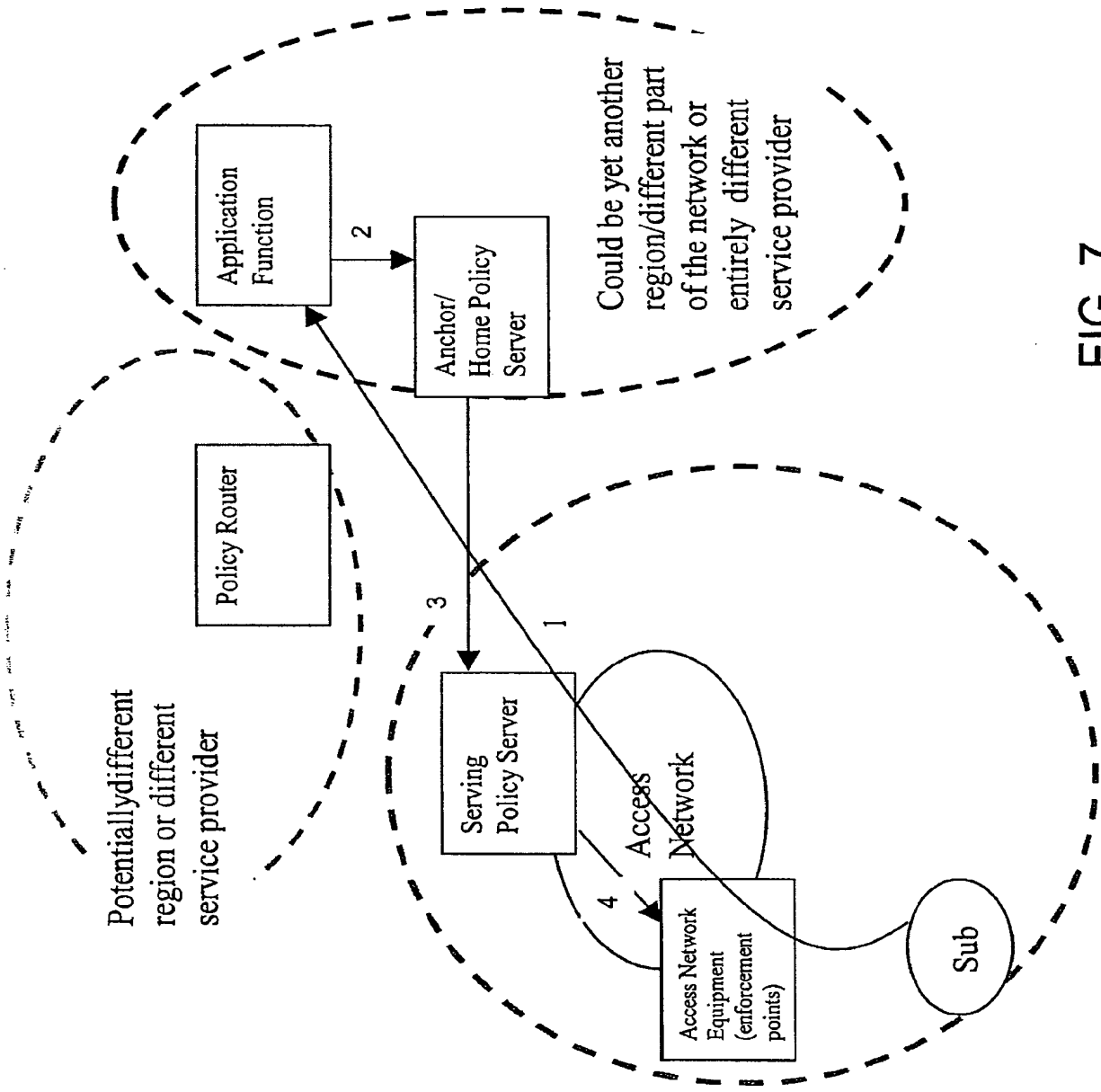


FIG. 7

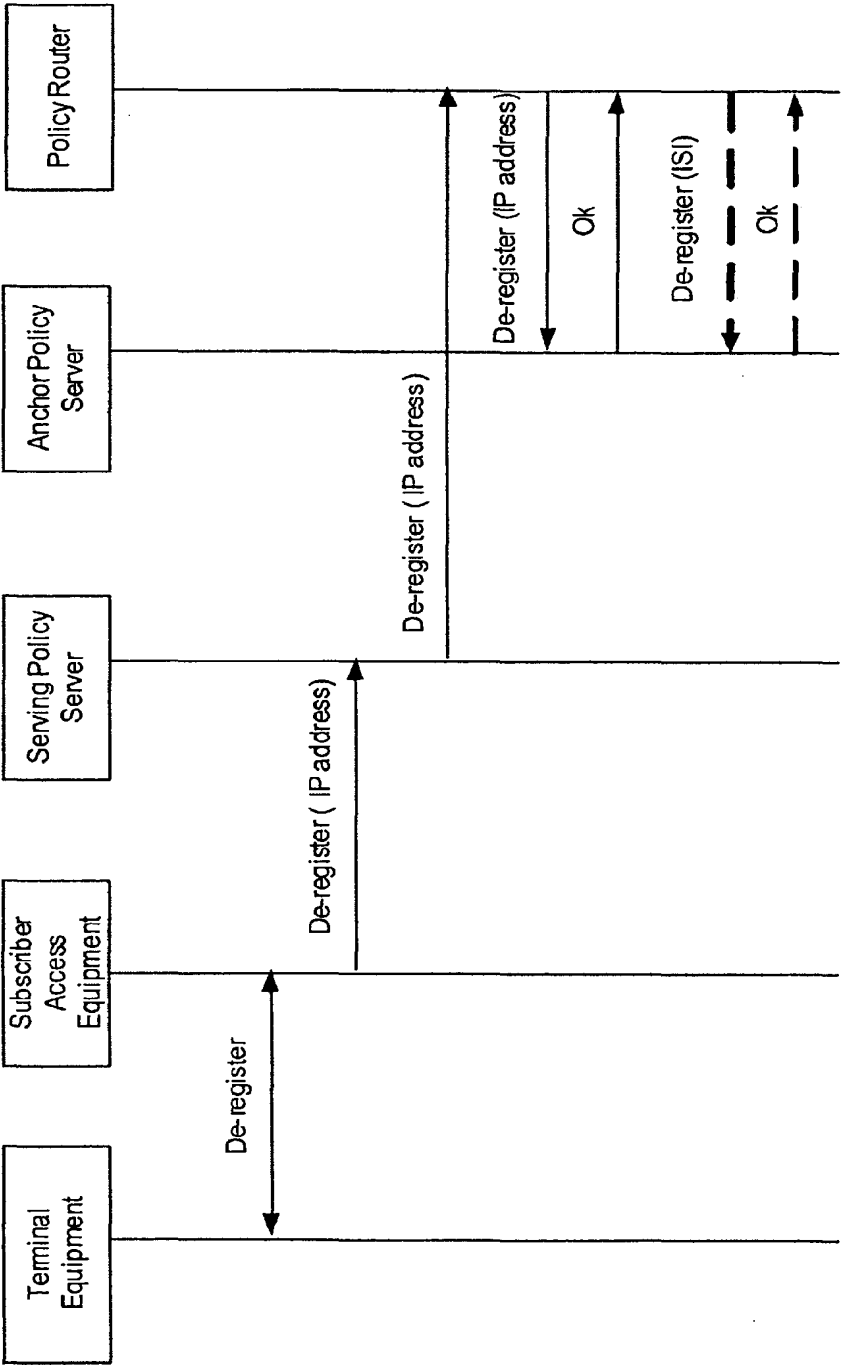


FIG. 8

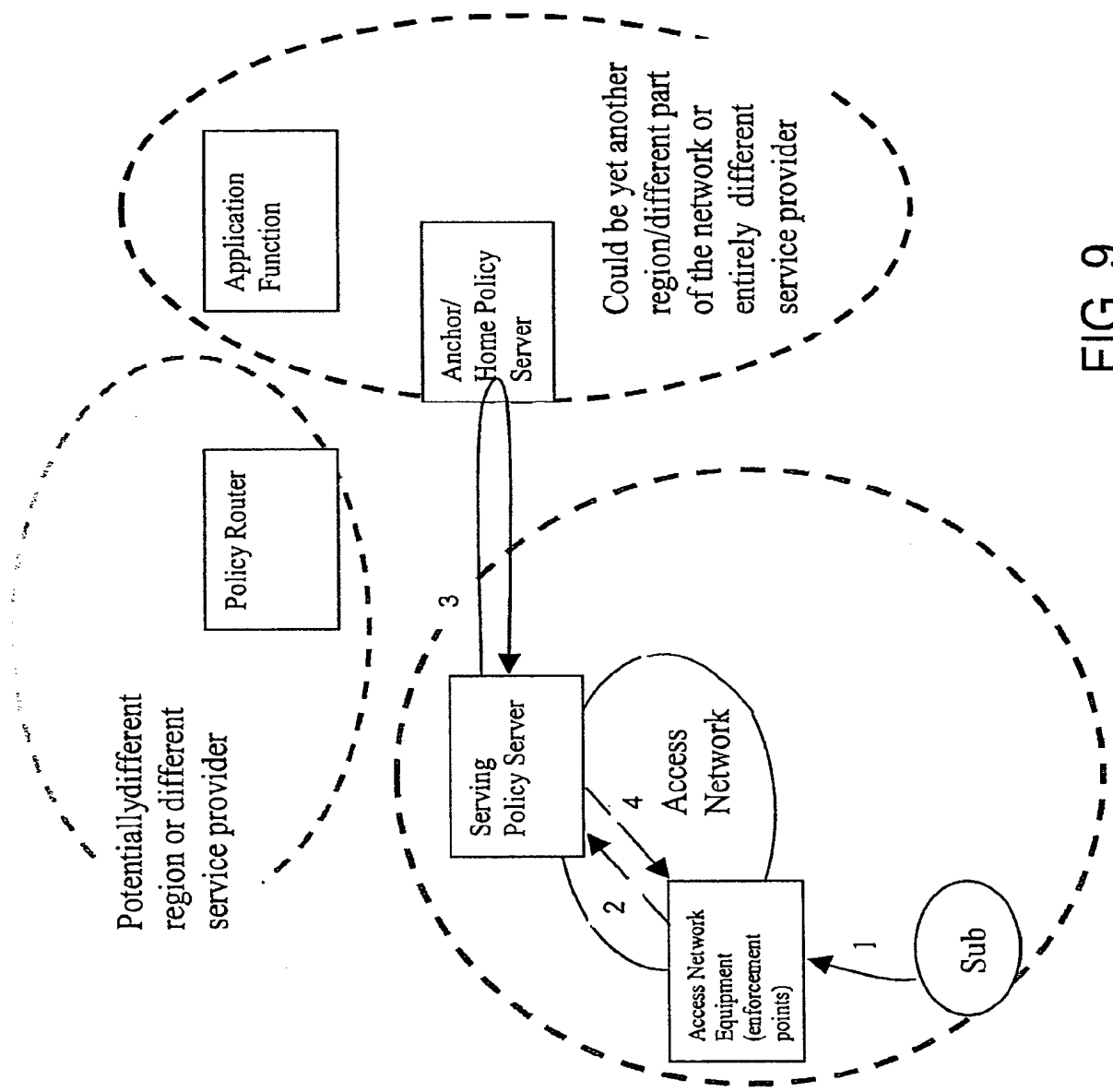


FIG. 9

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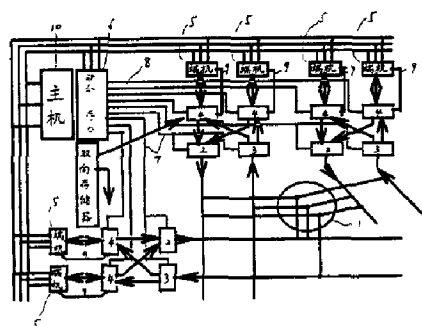
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[54] 发明名称 并行运算、交换、控制多用平台

[57] 摘要

本发明公开了一种并行运算、交换、控制多用平台，由数据、地址、命令总线及总线控制、命令寄存器、外设接口和双端口 RAM 及一全互联控制电路组成，其中，命令寄存器、外设接口及总线控制均挂在所述的总线上，外设接口与双端口 RAM 的一端口之间有双向入出的数据端口及读写控制相连，一具有三个双向入出端口的逻辑可逆运算器，其三个双向端口分别与双端口 RAM 的另一端口相连，命令寄存器全部连到所述的全互联控制电路，另有读写控制分别到双端口 RAM。



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1、一种并行运算、交换、控制多用平台，由数据、地址、命令总线及总线控制、命令寄存器、六个外设接口和双端口 RAM、组成，其特征在于：还进一步包括一全互联控制电路，其中所述的命令寄存器、外设接口及总线控制均
5 挂在所述的总线上，该等外设接口与双端口 RAM 的一端口之间有双向入出的数据端口及读写控制相连；一具有三端口的逻辑可逆运算器，其每个端口各有一输入端口和输出端口，该逻辑可逆运算器的三个输入端口分别通过一二选一电路而与双端口 RAM 的另一端口的输出两两相连，三个输出端口分别通过一二分配器而与双端口 RAM 的另一端口的输入两两相连；所述的命令寄存器全部连
10 到所述的全互联控制电路，另有读写控制分别到双端口 RAM，有方向选择控制分别到二选一电路、一二分配器。

2、根据权利要求 1 所述的并行运算、交换、控制多用平台，其特征在于：所述的一个逻辑可逆运算器六端口与六个外设接口和六个双端口 RAM 一一对应，以此单元为基础可并行扩展 2、3、4……个单元组，所述命令寄存器的字
15 长亦相应地跟着扩展到 12、18、24 位……。

3、根据权利要求 1、2 所述的并行运算、交换、控制多用平台，并行扩展的单元组之间通过全互联控制电路连通各个单元组的各个端口，每两个端口之间均有一连通控制开关，连通控制开关信号由命令寄存器的存储内容决定。

4、根据权利要求 1 或 2 所述的并行运算、交换、控制多用平台，其特征
20 在于：所述的逻辑可逆运算器由一个加法运算器与两个减法运算器构成。

5、根据权利要求 1 所述的并行运算、交换、控制多用平台，其特征在于：所述的逻辑可逆运算器的位片可多位级联或通过拼接扩展一个位片的进制值域。

6、根据权利要求 1 所述的并行运算、交换、控制多用平台，其特征在于：
25 有一工作模式控制电路连到命令寄存器，及进制设定电路，控制平台的运算或交换工作状态。

并行运算、交换、控制多用平台

本发明属于数据处理技术领域，具体涉及一种可广泛应用于并行控制、并行数据处理、并行通信交换、计算机网络及智能模拟等领域的多用智能平台。

5 代表数据处理先端技术的计算机自 40 年代问世以来，一直沿袭着冯·诺依曼机的体系结构，其主要特点是：第一，程序内存、串行处理；第二，存储地址与存储内容分开；第三，只能被动执行确定程序。50 多年来尽管计算机技术取得了突飞猛进的发展，但人们也越来越深刻地感受到传统计算机体系结构所带来的限制。例如科学技术的发展对计算机提出了越来越多的要求，某些
10 应用领域甚至需要每秒运算 1 万亿次甚至更快的高性能计算机。诸如新型药物设计、生物分子结构、催化剂和酶的性质、人类基因、新材料性质、湍流、海洋回流、核聚变能源系统设计、核爆炸模拟、量子色动力学、密码学、全球天气预报、灾害性风暴预报、地震预测、石油勘探中的三维地震资料处理等。

而计算机自问世以来一直遵循着循序串行的运算方法。为了提高计算机的
15 速度，人们通过提高时钟频率减少指令的执行时间，但这总要有一个局限。因此开拓了并行运算的研究，使多个向量处理机和一个中央存储器连接在一起，构成了超级计算机。高性能处理器的出现和价格的逐渐降低，使大规模并行处理（MPP）机的体系结构具有一定的发展潜力。但真正使 MPP 的潜力得到充分的发挥，还需在系统设计和应用设计上找到有效驱动大量处理器协同工作的
20 原理与途径。应该说，这一问题的解决，在冯型机框架下有一定的难度，原因在于冯型机是按地址方式工作的，各计算机之间没有内在的联系，即没有自组织性，因而在多机之间，不论是任务分配还是实时通信都是难以解决的问题，它在本质上只面对 1 个信息源。因而必须创造一种机制，使有多少个外设，就允许多少个外设直接面向环境同步接受并处理信息，且保证子系统之间能够实
25 时并行交互作用。

本发明的目的就在于突破串行工作、地址操作及程序化运行方式的框架，

而提供一种以自组织原理为基础，实现读写算同步，可开放性并行读写算，具有子系统透明化功能耦合、且能串并行自适应交互作用的多用智能平台。

5 本发明的进一步目的是结合具有多值态的逻辑可逆运算器，而提供一种具有多值态的、模数统一的、系统结构与功能可扩展的多功能一体化多用智能平台。

本发明是一种并行运算、并行交换、并行控制，人脑智能模拟多用平台，由数据、地址、命令总线及总线控制、命令寄存器、六个外设接口和双端口 RAM、全互联控制电路组成，其中，命令寄存器、外设接口及总线控制均挂在所述的总线上，该等外设接口与双端口 RAM 的一端口之间有双向入出的数据
10 端口及读写控制相连；一具有三端口的逻辑可逆运算器，其每个端口各有一输入端口和输出端口，该逻辑可逆运算器的三个输入端口分别通过一二选一电路而与双端口 RAM 的另一端口的输出两两相连，三个输出端口分别通过一二分配器而与双端口 RAM 的另一端口的输入两两相连；所述的命令寄存器有读写控制分别到双端口 RAM，有方向选择控制分别到二选一电路、一二分配器。

15 根据上述技术方案，其中一个逻辑可逆运算器六端口与六个外设接口和六个双端口 RAM 一一对应，以此单元为基础可并行扩展 2、3、4……个单元组，所述命令寄存器的字长亦相应地跟着扩展到 12、18、24 位……。

并行扩展的单元组之间通过全互联控制电路联通各个单元组的各个端口，每两个端口之间均有一联通控制开关，联通控制开关信号由命令寄存器的存储
20 内容决定。

逻辑可逆运算器由一个加法运算器与两个减法运算器构成。

逻辑可逆运算器的位片可多位级联或通过拼接扩展一个位片的进制值域，如由 8 扩展到 16 进制，或由 16 扩展到 32 进制。

进一步可有一工作模式控制电路联到命令寄存器，及进制设定电路，控制
25 平台的工作状态——运算或交换。

本发明并行运算、交换、控制多用平台用于运算的优点是并行、适应多种

进制代码运算交换，适应连续模拟量运算，具有实时性，可逆向逻辑运算；用于交换的优点是并行、高速、实时双向、自选路由；用于控制的优点是互为因果，实时双向，模数统一，任意一个端机都能做为主机实施全局控制。

5 发明并行运算、交换、控制多用平台可用于多子系统功能随机耦合，多存储器交互存取及联想读写，可在运算、交换、控制领域，体现其多用性及多功能性，因而适用面广，且具有极强的自开发性——除上述并行运算、并行交换、并行控制以外，用于人脑智能模拟领域的应用开发。

下面结合附图及具体实施例对本发明再作进一步详细的说明。

图 1 是本发明的电路原理示意图；

10 图 2 是本发明的并行处理原理示意图；

图 3 是本发明的逻辑可逆运算器的实施例连接示意图；

图 4 是本发明的全互联的控制电路。

首先，请参见图 1，本发明是以逻辑可逆运算器 1 为核心，配合二选一电路 2、一二分配器 3、双端口 RAM 4、命令寄存器 6 及总线控制 10 和外设接口 5 组成。

15

其中，命令寄存器 6、外设接口 5 及总线控制 10 均挂在由数据、地址、控制线组成的三总线 11 上。外设接口 5 与双端口 RAM 4 的一端口之间通过双向入出的数据端口与读写控制 9 相连，双端口 RAM 4 的另一端口的输出分别两两连接于二选一电路 2 的输入端，其输入亦分别两两连接于一二分配器 3 的输出端。

20

该逻辑可逆运算器 1 的三个输入端口分别与一二选一电路 2 的输出端相连，三个输出端口分别与一二分配器 3 的输入端相连。命令寄存器 6 有读写控制 8 与双端口 RAM 4 连接，实现面向运算器的读写控制，有方向选择控制 7 与二选一电路 2、一二分配器 3 相连，实现对二选一电路 2、一二分配器 3 的逻辑控制，将面向逻辑可逆运算器 1 的单向入出转变为面向双端口 RAM 4 的双向入出，使本发明多用智能平台可通过命令寄存器 6，实现串并读写、串

25

并交换、串并运算、串并控制，及实时双向读写、实时双向交换、实时并行运算、实时双向控制。

参见图 3 所示，逻辑可逆运算器 1 具体可由一加法运算器 $A1 + B1 = C1$ 和二减法运算器 $C2 - B2 = A2$ 、 $C3 - A3 = B3$ 组成，将其中的输入端口 $A1$ 与 $A3$ 5 并接、 $B1$ 与 $B2$ 并接、 $C2$ 与 $C3$ 并接，组成一具有三个输入端口 $A1$ ($A3$)、 $B1$ ($B2$)、 $C2$ ($C3$)，三个输出端口 $C1$ 、 $A2$ 、 $B3$ 的运算器，体现了一种 $A + B = C$ 、 $C - A = B$ 、 $C - B = A$ 的逻辑可逆运算关系。图中， $A1(A3)$ 、 $A2$ 为 A 口， $B1(B2)$ 、 $B3$ 为 B 口， $C2(C3)$ 、 $C1$ 为 C 口，设 A 与 B 入则 C 出， C 与 A 入则 B 出， C 与 B 入则 A 出，运算器具逻辑可逆性，可双向同步入出、同步加减
10 运算。具体应用时，可三口同时入，三口同时出，可逆向逻辑推理及运算。

逻辑可逆运算器 1 与外设接口 5 及双端口 RAM 4 可呈对应关系的扩展，命令寄存器可相应地扩展字长或增加控制级数，使本发明在命令寄存器的读写控制 8 的控制下，可完成并行运算、交换与控制。

参见图 1 所示，当把外设接口 5 视为端机，总线控制 10 视为主机，主机
15 或端机，对于各口双口 RAM 4 的并行读写，与地址选通，是同一信号，且并行读写信号，是通过命令寄存器 6 以位为单位读写相应的双口 RAM 4（此对应关系是可编程的，当然也可以是固定的）。因并行读写只能对各双口 RAM 的 0 地址操作，所以各双口 RAM，都配有地址发生器，读时向外推出数据，写时向里推入数据。主机与端机、端机与端机的数据交换，则是通过双口 RAM
20 确定其通讯协议的，且这种协议具有并行性。各双口 RAM 的并行读写，还有一层含义，即各口的双口 RAM，在同时读写时，交换与运算的过程隐含在内，即完成双向读写的同时，亦完成了双向交换及运算，即读写算同步完成。

本发明多用智能平台的各个端机都能通过总线共享命令寄存器 6，并行读写各口的双口 RAM 4，至于哪一个端机能占用命令寄存器，由总线控制 10 按
25 优先申请原则裁决。

命令寄存器 6 中的命令字决定哪些双口 RAM 读或写，各双口 RAM 的读

写及相应的运算、交换、控制功能都通过一条命令在一个时钟周期完成。

如实现运算，并行读 A、B 口，则 A、B 的运算结果写在 C 口，并行读 A、C 口，则 A、C 的运算结果写在 B 口，并行读 B、C 口，则 B、C 的运算结果写在 A 口。

5 如实现交换或控制，可在 A 口给一设置，由 A、B、C 三口的运算关系决定，B、C 两口可双向同步交换或控制，具体是交换还是控制，由外设确定。如是交换，各外设接口接群入群出设备或主被叫用户；如是控制，各外设接口接传感器或执行器。同样的，在 B 口给一设置，A、C 两口可双向同步交换或控制，在 C 口给一设置，A、B 两口可双向同步交换或控制。

10 4 个运算器通过全互联控制电路，可在 24 个端口之间实现任意两个端口的交换，及任意两个端口中的任意两个脚的交换，可通过一条指令在一个时钟周期实现 8 个端口之间的双向同步交换（24 个端口中任意组合）。

本发明多用智能平台通过模式切换，运算与交换两种功能模式可选；通过串并行读写控制，交换与运算串行、并行两种模式可选；通过模式切换，固定
15 主机与多主机两种模式可选。另外，主机串行读写、与并行读写两种模式可选，主机参与交换、运算，和不参与而只进行设定控制两种模式可选。其关键在于主机与端机都能共用命令寄存器，并行读写各口的双口 RAM，至于哪一个端机能并行读写，由总线控制 10 来分配解决。

参见图 4 所示，命令寄存器按交换需求接节点控制。命令寄存器的输出命令直接通过与门控制互联节点，通过交换模式控制直接接到设置端口。如 1 与
20 4 交换 1 与 4 与后控制 2 与 5 节点开关，再通过交换模式控制，使 1 与 4 直接控制设置端 3 与 6。设置端可以是恒高，1 与 4 作为开关控制。

组成本发明的核心运算器——逻辑可逆运算器 1 的加法运算器和减法运算器，更可是具有多值态的加法运算器和减法运算器，此项技术已另案申请，在
25 此不予赘述。

上述的多用智能平台，具有多值运算、交换、多种进制代码选择设定、互

为因果关系控制等功能。具有多值态，适应多种进制代码运算处理及交换，如 8、16 以至 32、64……进制代码。具有开放性，可随意以运算器位片为基础级联拼接使用，具体可根据需要在片级，以位为单位多位级联，又可在板级以片为单位多片级联。且不管怎样级联，都不存在进借位累加延迟时间问题。

5 上述的多用智能平台，具模数统一、储算一体化的特点，可实时非程序化数据处理及控制。具地址与数据口统一、运算与交换功能合一的特点，可实现互为因果关系控制。系统各端口的参量，可动态交互定义及互补定义，因而体现了系统的自组织及互为因果目的性。相对于冯机及其运算器，它解决了多值态、多种进制代码运算问题，解决了系统自组织透明化、及非程序化功能耦合
10 问题，解决了因扩展字长而产生的进借位累加延迟时间问题，解决了系统的自组织及开放性问题，解决了信息处理系统的时空统一、模数统一、逻辑可逆、与不可逆的统一问题。

 上述的多用智能平台的核心逻辑可逆运算器，用于交换，一个可实现 6 大口之间的任意交换—— $(1+6) \times 6 / 2 = 21$ 种交换关系。4 个逻辑可逆运算器通
15 过全互联控制电路、可实现 24 个端口之间的任意交换—— $(1+24) \times 24 / 2 = 300$ 种交换关系。用于运算，一个运算器可实现 3 口并行输入、3 口并行输出，以八进制多值态逻辑可逆运算器位片为例，它可满足八位二进制码的并行运算，满足除 2 进制代码以外，3、4、5、6、7、8 进制代码的一位加减运算，多位片组合即可满足多位、多种进制代码的并行运算，且可和差同时输出。4 个运
20 算器组合可实现 12 个口同时输入，12 个口同时输出，满足 12 个操作数的 12 种加减运算。用于控制，以八进制多值态逻辑可逆运算器位片为例，可实现多值态（2—8）之间的，互为因果关系双向控制。多位片组合，可 16 值或 32 至 64、128 值态……可选，及多口多脚之间的并行控制、互补控制，及互为因果关系控制。

25 上述多用智能平台的最大特点：一是具有开放性，片级板级都可根据实际需要，随意增加大口的数量，及增加各口管脚的数量或多值状态，还可将主板

做成可随意级联扩展形式的。扩展后各大口与各管脚之间，如上所述同样可以 $(1+N) \times N/2$ 的关系，实现全互联双向交换及控制。二是具有并行性，即可通过并行读写各口的双口 RAM，实现全并行运算，又可通过设置某个口，实现并行双向交换，或并行双向控制。三是各端机，均可作为主机，实施全局

5 控制。

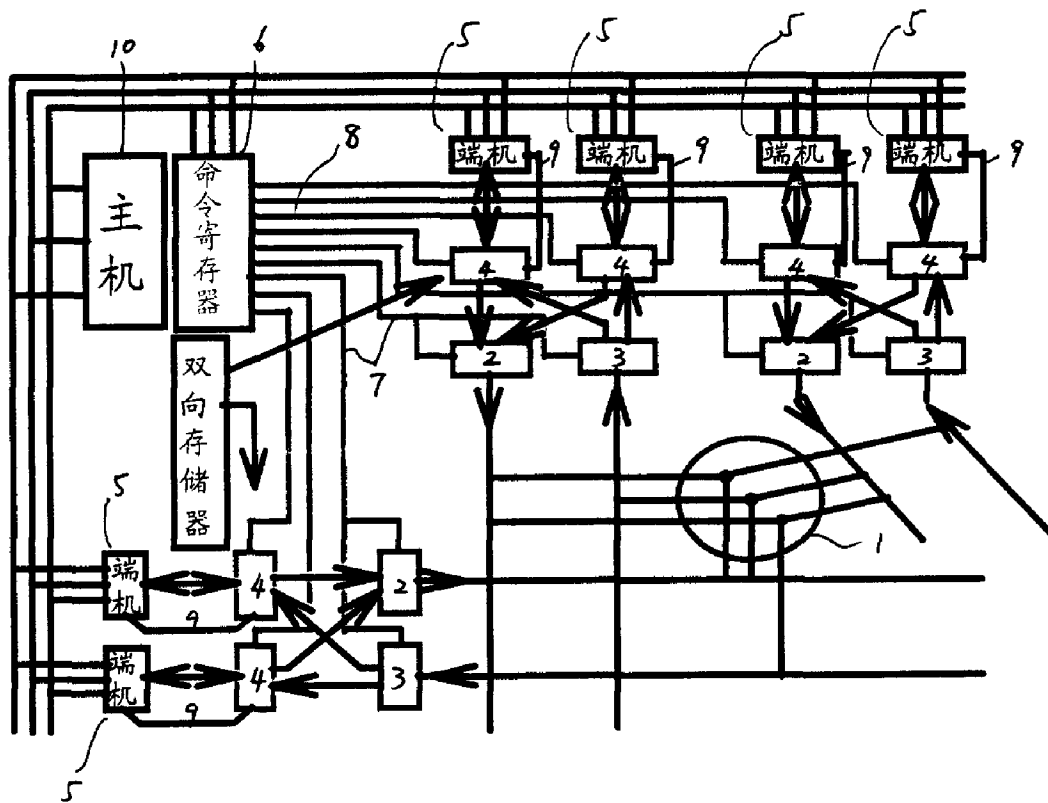


图 1

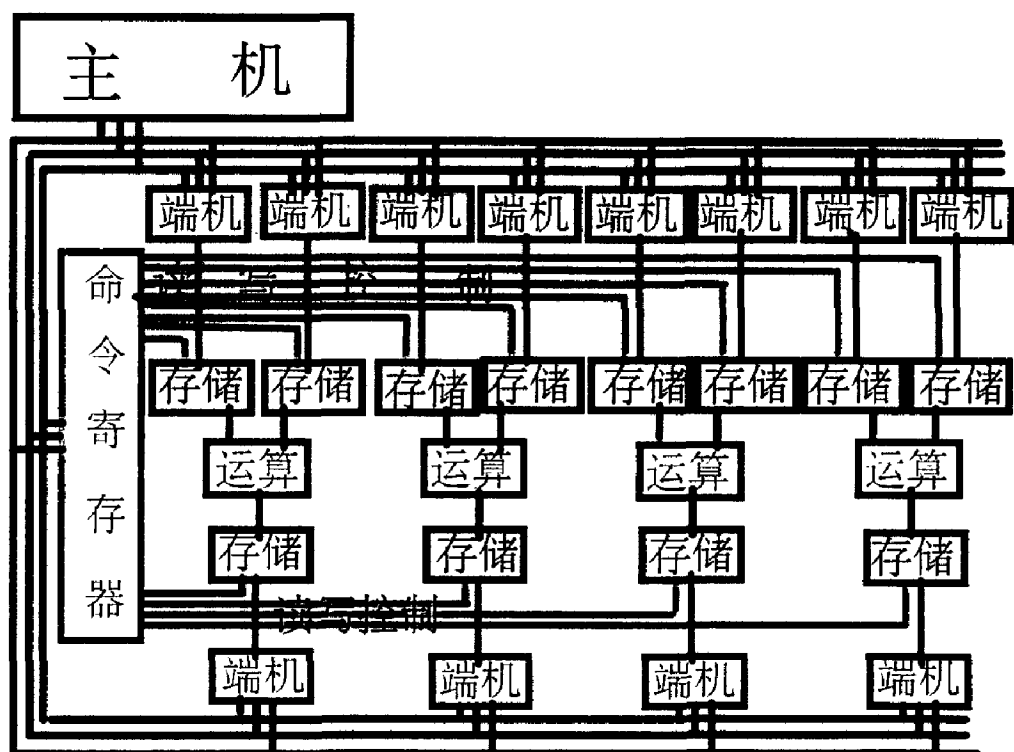


图 2

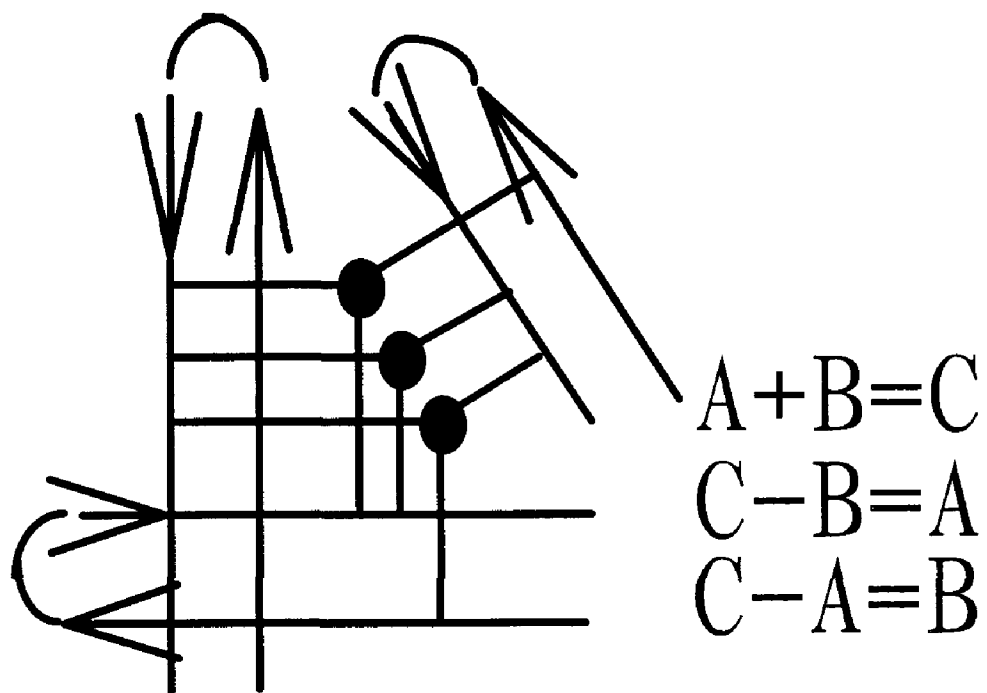


图 3

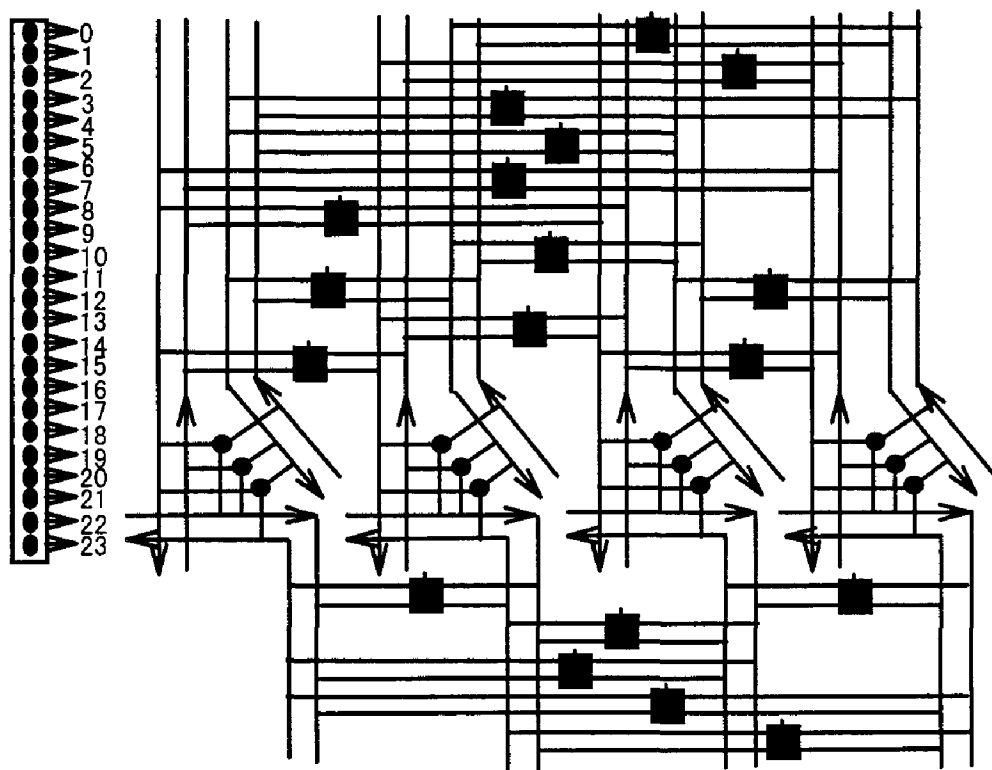


图 4

Electronic Patent Application Fee Transmittal

Application Number:	13237827			
Filing Date:	20-Sep-2011			
Title of Invention:	ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION			
First Named Inventor/Applicant Name:	Gregory G. Raleigh			
Filer:	Krista Susan Jacobsen			
Attorney Docket Number:	RALEP034 [26WV-160511]			
Filed as Small Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Submission- Information Disclosure Stmt	2806	1	90	90
Total in USD (\$)				90

Electronic Acknowledgement Receipt

EFS ID:	19098385
Application Number:	13237827
International Application Number:	
Confirmation Number:	1814
Title of Invention:	ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	107265
Filer:	Krista Susan Jacobsen
Filer Authorized By:	
Attorney Docket Number:	RALEP034 [26WV-160511]
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Filing Date:	20-SEP-2011
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Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$90
RAM confirmation Number	8503
Deposit Account	505876
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	P034_trans_letter.pdf	274566	no	2
			4c2c9bdf1716bfa46bfb4743a7f2f0a3b345515		
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	P034IDS.pdf	613284	no	6
			97c99a0835a4bd56b241897464995af137e57ac7		
Warnings:					
Information:					
3	Foreign Reference	2043_EP2466831A1.pdf	1530373	no	63
			fcc550ea4f7f61dc3b1fb7695c6b44459cb7cf30		
Warnings:					
Information:					
4	Foreign Reference	2044_WO1999027723A1.pdf	904456	no	36
			a688012e12d1ad3b8550a0c726a94bd72b28a6fa		
Warnings:					
Information:					
5	Foreign Reference	2045_WO2007133844.pdf	1180849	no	30
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Warnings:					
Information:					
6	Foreign Reference	2046_CN1310401A.pdf	992440	no	13
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Warnings:					
Information:					
8	Non Patent Literature	3038_ASA.pdf	786693	no	24
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Warnings:					
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9	Fee Worksheet (SB06)	fee-info.pdf	30653	no	2
			0c8d0a6d7207c0d929bfff052d6d586c52e61016a		
Warnings:					
Information:					
			Total Files Size (in bytes):	7410957	
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Examiner:

Gregory G. Raleigh

RUDY, Andrew J.

Serial No. 13/237,827

Art Unit: 3687

Filed: September 20, 2011

Conf. No.: 1814

Title: Adapting Network Policies Based on Device Service Processor Configuration

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**SUBMISSION OF INFORMATION DISCLOSURE STATEMENT AFTER RECEIPT
OF NOTICE OF ALLOWANCE BUT PRIOR TO PAYMENT OF ISSUE FEE**

Madam:

In accordance with the duty of disclosure under 37 CFR §1.56 and pursuant to 37 CFR §§ 1.97-1.98, Applicant hereby submits the references listed on the enclosed Form PTO-SB/08A.

The present Information Disclosure Statement is being filed after Applicant received the Notice of Allowance in the above-captioned application, but before Applicant has paid the Issue Fee. Accordingly, pursuant to 37 C.F.R. § 1.97(d), Applicant is submitting both the fee set forth in 37 C.F.R. § 1.17(p) and the certification statement set forth in 37 C.F.R. § 1.97(e).

Applicant respectfully requests consideration of the listed references.

CONCLUSION

Applicant respectfully requests that the Examiner consider the references listed in the IDS submitted herewith. In accordance with 37 C.F.R. § 1.97(d)-(e), the IDS is being filed prior to payment of the issue fee, with both the certification statement and fee specified in 37 C.F.R. § 1.97(d)-(e).

The Commissioner is authorized to charge any fee deficiency or credit any overpayment to Deposit Account 50-5876.

Respectfully submitted,

Date: May 21, 2014

By: 

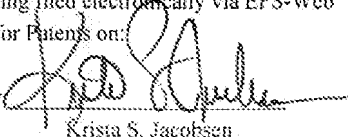
Krista S. Jacobsen
Reg. No. 59,374

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being filed electronically via EFS-Web addressed to the Commissioner for Patents on:

Date: May 21, 2014

By:


Krista S. Jacobsen

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Examiner:

Gregory G. Raleigh *et al.*

RUDY, Andrew J.

Serial No. 13/237,827

Art Unit: 3687

Filed: September 20, 2011

Conf. No.: 1814

Title: Adapting Network Policies Based on Device Service Processor Configuration

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**COMMUNICATION REGARDING INFORMATION DISCLOSURE STATEMENT
SUBMITTED ON MAY 21, 2014**

Madam:

Applicant submits this communication to bring to the Office's attention, and to apologize for, Applicant's erroneous certification of three of Applicant's own patents in the information disclosure statement (IDS) filed on May 21, 2014 in the above-captioned application. These three patents are all included in the benefit claim of the above-captioned application, and therefore the Office was already aware of them before Applicant filed the IDS on May 21, 2014. Nevertheless, the three patents were all known to individuals designated in 37 CFR 1.56(c) more than three months prior to the filing of the May 21, 2014 IDS, and therefore Applicant's certification of them in the IDS was in error.

On May 21, 2014, Applicant submitted an IDS using Form PTO-SB/08A in the above-captioned case. Because Applicant had already received a Notice of Allowance, Applicant paid the applicable fee set forth in 37 C.F.R. § 1.17(p) and certified that "no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement."

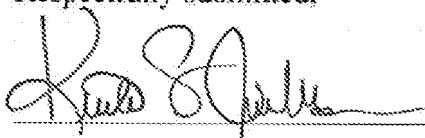
After filing the May 21, 2014 IDS, Applicant discovered that the IDS inadvertently listed three of Applicants' own patents: U.S. Patent No. 8,391,834, U.S. Patent No. 8,626,115, and U.S. Patent No. 8,589,541. Each of these patents, or the application from which it issued, is included in the benefit claim of the above-captioned application, and therefore the Office was aware of the patents and their associated applications before the submission of the May 21, 2014 IDS. Nevertheless, these three patents were all known to individuals designated in 37 CFR 1.56(c) more than three months prior to the filing of the May 21, 2014 IDS, and therefore Applicant's certification of them was in error.

Applicant sincerely apologizes for the erroneous certification of the three patents in the May 21, 2014 IDS. If Applicant needs to take any action beyond submission of this communication to address the identified error, please contact Applicant's representative at the phone number set forth below.

The Commissioner is authorized to charge any fee deficiency or credit any overpayment to Deposit Account 50-5876.

Respectfully submitted,

Date: June 12, 2014

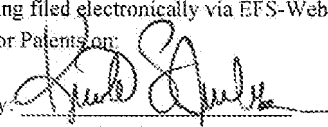
By: 

Krista S. Jacobsen
Reg. No. 59,374
(408) 455-5539

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Date: June 12, 2014

By: 

Krista S. Jacobsen

Electronic Acknowledgement Receipt

EFS ID:	19293785
Application Number:	13237827
International Application Number:	
Confirmation Number:	1814
Title of Invention:	ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	107265
Filer:	Krista Susan Jacobsen
Filer Authorized By:	
Attorney Docket Number:	RALEP034 [26WV-160511]
Receipt Date:	12-JUN-2014
Filing Date:	20-SEP-2011
Time Stamp:	21:39:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	P034_IDS_Letter_re_cert_error.pdf	342532 be5befbcbdae4af25469c68c07a876186774b2bd8	no	2

Warnings:

Information:

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.



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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/237,827	09/20/2011	Gregory G. Raleigh	RALEP034 [26WV-160511]	1814
107265 7590 07/02/2014 Headwater Partners I LLC - Outside Firm 1 555 Twin Dolphin Drive, Suite 310 Redwood Shores, CA 94065			EXAMINER RUDY, ANDREW J	
			ART UNIT 3687	PAPER NUMBER
			NOTIFICATION DATE 07/02/2014	DELIVERY MODE 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):

patent@headwaterllc.com
krista@jacobseniplaw.com

**UNITED STATES DEPARTMENT OF COMMERCE****U.S. Patent and Trademark Office**

Address : COMMISSIONER FOR PATENTS

P.O. Box 1450

Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
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13/237,827

20 September, 2011

RALEIGH ET AL.

RALEP034 [26WV-

160511]

Headwater Partners I LLC - Outside Firm 1 555 Twin Dolphin Drive, Suite 310 Redwood Shores, CA 94065		EXAMINER	
		ANDREW JOSEPH RUDY	
		ART UNIT	PAPER
		3687	20140627

DATE MAILED:

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

Commissioner for Patents

Applicant's May 21, 2014 Information Disclosure Statement (IDS) has been reviewed. The claims remain allowed. Note the attached IDS.

/ANDREW JOSEPH RUDY/
Primary Examiner
Art Unit: 3687

Doc code: IDS

PTO/SB/08a (01-10)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	13237827
Filing Date	2011-09-20
First Named Inventor	Gregory G. Raleigh
Art Unit	3687
Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6185576	B1	2001-02-06	Mcintosh, Lowrie	
	2	7320029	B2	2008-01-15	Rinne et al.	
	3	7539132	B2	2009-05-26	Werner et al.	
	4	8391834b	B2	2013-03-05	Raleigh, Gregory G.	
	5	8539561	B2	2013-09-17	Gupta et al.	
	6	8180881	B2	2012-05-15	Seo et al.	
	7	8626115	B2	2014-01-07	Raleigh, Gregory G. et al.	
	8	8275415	B2	2012-09-25	Huslak, Nicholas S.	

**INFORMATION DISCLOSURE
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First Named Inventor	Gregory G. Raleigh
Art Unit	3687
Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

9	8300575	B2	2012-10-30	Willars, Per	
10	8315593	B2	2012-11-20	Gallant et al.	
11	8589541	B2	2013-11-19	Raleigh et al.	
12	8666395	B2	2014-03-04	Silver, Andrew	

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U.S.PATENT APPLICATION PUBLICATIONS

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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20110238545	A	2011-09-29	Fanaian, Nabil Ruh et al.	
	2	20040170191	A	2004-09-02	Guo et al.	
	3	20040203833	A	2004-10-14	Rathunde, Dale F. et al.	
	4	20050186948	A	2005-08-25	Gallagher et al.	
	5	20070147317	A	2007-06-28	Smith et al.	

Application Number	13237827
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Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

	6	20080025230	A	2008-01-31	Patel et al.	
	7	20080056273	A	2008-03-06	Pelletier et al.	
	8	20080270212	A	2008-10-30	Blight et al.	
	9	20100030890	A	2010-02-04	Dutta et al.	
	10	20110110309	A	2011-05-12	Bennett, James D.	

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	1	1310401	CN	A	2001-08-29	Wang, Di Xing		☐
	2	2466831	EP	A1	2012-06-20	Openet Telecom Ltd. - Mcnamee et al.		☐
	3	2007133844	WO	A	2007-11-22	Camiant, Inc.		☐
	4	1999027723	WO	A1	1999-06-03	Telefonaktiebolaget LM Ericsson		☐

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Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

NON-PATENT LITERATURE DOCUMENTS			Remove
Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	"End to End QoS Solution for Real-time Multimedia Application;" Computer Engineering and Applications, 2007, 43 (4): 155-159, by Tan Zu-guo, Wang Wen-juan; Information and Science School, Zhanjian Normal College, Zhan jiang, Guangdong 524048, China	☐
	2	"ASA/PIX: Allow Split Tunneling for VPN Clients on the ASA Configuration Example," Document ID 70917, January 10, 2008	☐

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EXAMINER SIGNATURE

Examiner Signature	/Andrew Joseph Rudy/	Date Considered	06/27/2014
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13237827
	Filing Date		2011-09-20
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	3687	
	Examiner Name	Andrew J RUDY	
	Attorney Docket Number	RALEP034 [26WV-160511]	

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5131020	A	1992-07-14	Liebesny et al.	
	2	5325532	A	1994-06-28	Crosswy et al.	
	3	6640334	B	2003-10-28	Rasmussen, John H.	
	4	7409447	B	2008-08-05	Assadzadeh, Alireza	
	5	7614051	B	2009-11-03	Glaum et al.	
	6	7668612	B	2010-02-23	Okkonen, Harri	
	7	7805140	B2	2010-09-28	Friday et al.	
	8	8223741	B	2012-07-17	Bartlett et al.	

**INFORMATION DISCLOSURE
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First Named Inventor	Gregory G. Raleigh
Art Unit	3687
Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

9	8370483	B	2013-02-05	Choong Jason et al.	
10	8725899	B	2014-05-13	Short et al.	
11	8605691	B2	2013-12-10	Soomro et al.	
12	8645518	B	2014-02-04	David, Scott L.	
13	8655357	B1	2014-02-18	Gazzard et al.	
14	8670334	B	2014-03-11	Keohane et al.	
15	8676925	B	2014-03-18	Liu et al.	
16	8693323		2014-04-08	McDysan, David E.	
17	8706863		2014-04-22	Fadell, Anthony	

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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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**INFORMATION DISCLOSURE
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Filing Date	2011-09-20
First Named Inventor	Gregory G. Raleigh
Art Unit	3687
Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

1	20020188732	A1	2002-12-12	Buckman et al.	
2	20040243992	A	2004-12-02	Gustafson et al.	
3	20070226775	A	2007-09-27	Andreasen et al.	
4	20080010379	A	2008-01-10	Zhao, Hang	
5	20080034419	A	2008-02-07	Mullick et al.	
6	20080139210	A	2008-06-12	Gisby et al.	
7	20090254857	A	2009-10-08	Romine et al.	
8	20100235329	A	2010-09-16	Koren et al.	

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Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² j	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	1878160	CN	A	2006-12-13	Jiang, Yong		☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13237827
	Filing Date		2011-09-20
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	3687	
	Examiner Name	Andrew J RUDY	
	Attorney Docket Number	RALEP034 [26WV-160511]	

NON-PATENT LITERATURE DOCUMENTS			Remove
Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1		☐
If you wish to add additional non-patent literature document citation information please click the Add button Add			
EXAMINER SIGNATURE			
Examiner Signature			Date Considered
<p>*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.</p>			
<p>¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.</p>			

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STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	13237827
Filing Date	2011-09-20
First Named Inventor	Gregory G. Raleigh
Art Unit	3687
Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☒ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Krista S. Jacobsen/	Date (YYYY-MM-DD)	2014-08-04
Name/Print	Krista S. Jacobsen	Registration Number	59374

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

[19] 中华人民共和国国家知识产权局

[51] Int. Cl.

H04L 29/00 (2006.01)

H04N 7/24 (2006.01)



[12] 发明专利申请公开说明书

[21] 申请号 200610099396.5

[43] 公开日 2006 年 12 月 13 日

[11] 公开号 CN 1878160A

[22] 申请日 2006. 7. 19

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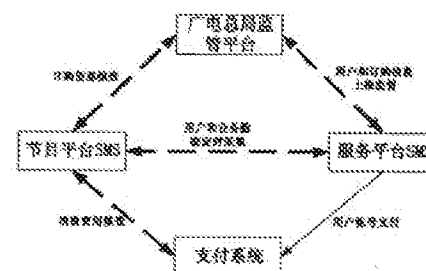
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[54] 发明名称

一种节目交换系统

[57] 摘要

本发明提供一种节目交换系统，其核心为：服务平台将其存储的用户收视信息分别传输至监管平台和与其有节目交换的节目平台，节目平台将服务平台传输来的用户收视信息传输至监管平台，监管平台根据服务平台和节目平台分别传输来的用户收视信息对节目交换进行监管。本发明的节目交换系统和节目交换方法中的节目平台、服务平台和监管平台分工明确，且本发明对节目平台和服务平台以及传输网络都没有任何额外的要求，易于实施，降低了节目交换系统的建设成本及维护运营成本；本发明能够保证节目平台与服务平台分成结算的准确性和公证性；从而实现了提高节目交换系统可实用性的目的。



1、一种节目交换系统，包括：至少一个节目平台和至少一个服务平台，一个服务平台与至少一个节目平台进行节目交换，其特征在于，所述节目平台中设置有第一复用加扰设备，所述服务平台中设置有解扰设备和第二复用加扰设备；

第一复用加扰设备根据预定的服务平台授权信息为服务平台提供复用加扰节目流；

服务平台前端的解扰设备根据预定的服务平台授权信息对节目平台提供的节目流进行解扰，并将解扰后的节目流传输至第二复用加扰设备；

第二复用加扰设备根据其接收的节目流、预定的用户授权信息为用户提供复用加扰节目流。

2、如权利要求 1 所述的一种节目交换系统，其特征在于，所述解扰设备为：机顶盒和承载有服务平台授权信息的节目平台用户智能卡。

3、如权利要求 1 所述的一种节目交换系统，其特征在于，所述节目平台中还设置有节目服务控制模块；

节目服务控制模块：用于根据预定的服务平台授权信息对服务平台提供的节目服务进行开启/关停控制。

4、如权利要求 1 或 2 或 3 所述的一种节目交换系统，其特征在于，所述节目交换系统中还设置有监管平台；

服务平台将其存储的用户收视信息分别传输至监管平台和与其有节目交换的节目平台；

所述节目平台将所述服务平台传输来的用户收视信息传输至监管平台；

所述监管平台根据所述服务平台和所述节目平台分别传输来的用户收视

信息对节目交换进行监管。

5、如权利要求 4 所述的一种节目交换系统，其特征在于，监管平台为：对行业进行监管的节目监管平台，和/或处于第三方支付状态的支付监管平台。

6、如权利要求 5 所述的一种节目交换系统，其特征在于，所述监管平台为节目监管平台时，所述服务平台包括：第一收视信息传输模块和第二收视信息传输模块，且所述节目监管平台设置有第一一致性核查模块；

第一收视信息传输模块：用于采用服务平台与节目监管平台之间的节目监管接口将服务平台的用户管理系统和条件接收系统中的用户数据和用户订购数据传输至节目监管平台；

第二收视信息传输模块：用于采用服务平台与节目平台之间的节目监管接口将服务平台的用户管理系统中的与节目平台相关的用户数据和用户订购数据传输至节目平台；

第一一致性核查模块：用于对服务平台和节目平台分别传输来的用户数据和用户订购数据进行一致性核查。

7、如权利要求 6 所述的一种节目交换系统，其特征在于，所述服务平台与节目监管平台之间的节目监管接口为：基于广电总局的《有线数字电视节目平台与监管平台数据交换协议、内容与格式要求》的节目监管接口；所述服务平台与节目平台之间的节目监管接口为：周期性上报的服务平台销售明细、单用户的业务明细、指定日期的产品销售数量、业务发展报告。

8、如权利要求 6 所述的一种节目交换系统，其特征在于，所述节目监管平台与节目平台之间设置有节目监管接口，该接口为：基于广电总局的《用户管理系统与监管平台数据交换接口技术要求》的节目监管接口。

9、如权利要求 5 所述的一种节目交换系统，其特征在于，所述监管平台

为支付监管平台时,所述服务平台包括:第三收视信息传输模块和第四收视信息传输模块,且所述支付监管平台设置有第二一致性核查模块;

第三收视信息传输模块:用于采用服务平台与支付监管平台之间的支付接口将服务平台的用户管理系统中的用户节目支付费用数据传输至支付监管平台;

第四收视信息传输模块:用于采用服务平台与节目平台之间的节目监管接口将服务平台的用户管理系统中的与节目平台相关的节目销售收入数据传输至节目平台;

第二一致性核查模块:用于对服务平台传输来的用户节目支付费用数据和节目平台传输来的用户节目销售收入数据进行一致性核查。

10、如权利要求9所述的一种节目交换系统,其特征在于,所述服务平台与支付监管平台之间的支付接口包括下述接口中的一个或多个:建立支付关系的接口、解除支付关系的接口、支付费用接口、支付记录总额对帐接口、支付记录明细对帐接口、服务平台产品支付记录的交易总额对帐接口。

11、如权利要求9所述的一种节目交换系统,其特征在于,所述节目平台与支付监管平台之间设置有用户帐户支付核查接口,节目平台将所述服务平台传输来的节目销售收入数据通过所述用户帐户支付核查接口传输至支付监管平台;

所述用户帐户支付核查接口包括:服务平台产品支付记录明细对帐。

12、如权利要求1或2或3所述的一种节目交换系统,其特征在于,所述节目平台和/或服务台中设置有分成结算模块;

当分成结算模块设置于节目平台时,节目平台通过节目交换接口从服务平台获取分成结算信息;

所述分成结算信息包括:节目销售收入数据,或者获取用户数据和节目销

售收入数据;

分成结算模块:用于根据预定结算分成协议、分成结算信息进行分成结算。

13、如权利要求12所述的一种节目交换系统,其特征在于,所述预定结算分成协议为下述一种或多种:基于固定时长统谈的分成协议、基于节目授权量的分成协议、基于节目授权时长的分成协议、基于节目销售收入的分成协议。

14、如权利要求12所述的一种节目交换系统,其特征在于,所述预定结算分成协议包括:节目平台与节目提供商之间的结算分成协议、和/或节目平台与服务平台之间的结算分成协议。

15、如权利要求14所述的一种节目交换系统,其特征在于,所述节目平台与服务平台之间的结算分成协议包括:分成策略协议,和/或累积奖励协议。

16、如权利要求12所述的一种节目交换系统,其特征在于,所述分成结算信息包括下述一种或多种:周期性的服务平台销售明细、单用户的业务明细,指定日期的产品销售数量、周期性的业务发展报告。

一种节目交换系统

技术领域

本发明涉及网络通讯技术领域，具体涉及一种节目交换系统。

背景技术

随着社会的进步，产业的分工越来越细化，就有线电视服务而言，已由模拟电视时期的内容制作与节目传输“一体化”模式，演进为内容制作与节目传输分离的“台网分离”模式。

在国内，典型的“台网分离”模式的应用场景为：广电网络公司提供数字电视网络，然后，广电网络公司从节目平台购买节目内容。数字电视用户通过向广电网络公司订购节目，即可收看丰富的数字电视节目。最后，节目平台与广电网络公司进行结算分成。在这个应用场景中广电网络公司做为服务平台向用户提供数字电视服务。

在这种“台网分离”模式下，节目平台与服务平台分工协作，向用户提供数字电视服务。节目平台提供丰富的数字电视节目，服务平台提供节目收视服务。目前，节目平台与服务平台之间的节目交换方法主要有如下两种：

方法一：完全开放方式，如附图1所示。

图1中，节目平台通过传输网络直接向服务平台提供清流或固定加扰的节目流，服务平台通过传输网络从节目平台获取节目流，对于固定加扰的节目流，服务平台则需要进行固定解扰，然后，服务平台通过数字电视前端系统对节目流进行复用加扰，并让调制后的节目流进入服务平台的有线网络。

服务平台可以通过SMS（用户管理系统）发展用户并进行节目销售授权。

节目平台和服务平台之间签订节目使用协议，并按照固定时长进行结算分成。

由于节目平台进入传输网络的节目流一般为清流或固定加扰的节目流，使节目流容易被破解，使该方法安全性低；由于节目平台和服务平台之间没有实际的节目控制通道，只能完全按照签订的节目通过人为方式来实现节目服务，无法灵活控制节目服务的开启和关停，使节目服务控制不灵活；在这种节目交换方法中，不存在监管关系，也没有良好的监控措施，节目平台和服务平台只能采用按固定时长的统谈方式，使结算分成方式单一。

方法二、两级加密，共同授权方式，实现了“用户透明，计费准确”，达到了对节目平台加扰传输的数字电视节目进行版权保护的目的。方法二具体如附图2所示。

图2中，节目平台加扰下传的数字付费电视节目，在服务平台前端不解扰，直接进入服务平台的有线网络，在服务平台运营范围内的数字电视用户收看节目平台数字付费电视节目时，必须同时获得节目平台和服务平台的授权。由于每次服务平台的用户授权都需要同时发送到节目平台，节目平台可以准确获知服务平台用户节目的收视情况，因此，节目平台和服务平台之间可以采用固定时长、节目授权量、节目授权时长等方式进行结算分成。

在方式二中，节目平台为实现对用户收视情况、服务平台实际收入等的监管，需要建设多家CAS（条件接收系统），且CAS的数量与各服务平台的CAS厂家数量相当，使节目平台的CAS数量众多；服务平台的SMS需要通过IP网络提供的通道实时地将用户数据和节目销售授权信息传送给节目平台的SMS，该IP网络要求安全性高，双向具有足够大的带宽，且需要保持实时的连接，从而在IP网络通道的建设和运营上需要成本投入；由于服务平台的用户数据和授权信息都需要在节目平台上存储，随着服务平台数量的增多，服务平台用户数量的增多，节目平台系统需要不断升级扩容，节目平台升级扩容压力大使运营成本不断升高。上述原因使节目平台在CAS的建设和运营上成本高昂。

由于节目授权采用同密方式，要求节目平台的CAS和服务平台的CAS必须为同一厂家的CAS系统，而且，服务平台的CAS系统必须支持两级加密，使方法二对服务平台的CAS要求严格。

由于节目在节目平台和服务平台上两级加密，共同授权，因此，一次销售授权处理需要经过的设备和系统很多，不但增加了节目平台、服务平台的建设复杂度，而且，任何设备或系统的不稳定都会影响整个节目交换的处理过程，使系统稳定性差。

发明内容

本发明的目的在于，提供一种节目交换系统，通过预定的服务平台授权信息，使服务平台成为节目平台的用户，使节目平台能够方便的对其与服务平台之间的节目交换进行管理，避免了节目交换对节目平台、服务平台的CAS、SMS以及传输网络的额外要求，降低了节目交换系统的建设成本和运营成本。

为达到上述目的，本发明提供一种节目交换系统，包括：至少一个节目平台和至少一个服务平台，一个服务平台与至少一个节目平台进行节目交换，所述节目平台中设置有第一复用加扰设备，所述服务平台中设置有解扰设备和第二复用加扰设备；

第一复用加扰设备根据预定的服务平台授权信息为服务平台提供复用加扰节目流；

服务平台前端的解扰设备根据预定的服务平台授权信息对节目平台提供的节目流进行解扰，并将解扰后的节目流传输至第二复用加扰设备；

第二复用加扰设备根据其接收的节目流、预定的用户授权信息为用户提供复用加扰节目流。

下述技术方案为可选技术方案。

所述解扰设备为：机顶盒和承载有服务平台授权信息的节目平台用户智能

卡。

所述节目平台中还设置有节目服务控制模块；

节目服务控制模块：用于根据预定的服务平台授权信息对服务平台提供的节目服务进行开启/关停控制。

所述节目交换系统中还设置有监管平台；

服务平台将其存储的用户收视信息分别传输至监管平台和与其有节目交换的节目平台；

所述节目平台将所述服务平台传输来的用户收视信息传输至监管平台；

所述监管平台根据所述服务平台和所述节目平台分别传输来的用户收视信息对节目交换进行监管。

监管平台为：对行业进行监管的节目监管平台、和/或处于第三方支付状态的支付监管平台。

所述监管平台为节目监管平台时，所述服务平台包括：第一收视信息传输模块和第二收视信息传输模块，且所述节目监管平台设置有第一一致性核查模块；

第一收视信息传输模块：用于采用服务平台与节目监管平台之间的节目监管接口将服务平台的用户管理系统和条件接收系统中的用户数据和用户订购数据传输至节目监管平台；

第二收视信息传输模块：用于采用服务平台与节目平台之间的节目监管接口将服务平台的用户管理系统中的与节目平台相关的用户数据和用户订购数据传输至节目平台；

第一一致性核查模块：用于对服务平台和节目平台分别传输来的用户数据和用户订购数据进行一致性核查。

所述服务平台与节目监管平台之间的节目监管接口为：基于广电总局的《有线数字电视节目平台与监管平台数据交换协议、内容与格式要求》的节目

监管接口；所述服务平台与节目平台之间的节目监管接口为：周期性上报的服务平台销售明细、单用户的业务明细、指定日期的产品销售数量、业务发展报告。

所述节目监管平台与节目平台之间设置有节目监管接口，该接口为：基于广电总局的《用户管理系统与监管平台数据交换接口技术要求》的节目监管接口。

所述监管平台为支付监管平台时，所述服务平台包括：第三收视信息传输模块和第四收视信息传输模块，且所述支付监管平台设置有第二一致性核查模块；

第三收视信息传输模块：用于采用服务平台与支付监管平台之间的支付接口将服务平台的用户管理系统中的用户节目支付费用数据传输至支付监管平台；

第四收视信息传输模块：用于采用服务平台与节目平台之间的节目监管接口将服务平台的用户管理系统中的与节目平台相关的节目销售收入数据传输至节目平台；

第二一致性核查模块：用于对服务平台传输来的用户节目支付费用数据和节目平台传输来的用户节目销售收入数据进行一致性核查。

所述服务平台与支付监管平台之间的支付接口包括下述接口中的一个或多个：建立支付关系的接口、解除支付关系的接口、支付费用接口、支付记录总额对帐接口、支付记录明细对帐接口、服务平台产品支付记录的交易总额对帐接口。

所述节目平台与支付监管平台之间设置有用户帐户支付核查接口，节目平台将所述服务平台传输来的节目销售收入数据通过所述用户帐户支付核查接口传输至支付监管平台；

所述用户帐户支付核查接口包括：服务平台产品支付记录明细对帐。

所述节目平台和/或服务平台中设置有分成结算模块;

当分成结算模块设置于节目平台时,节目平台通过节目交换接口从服务平台获取分成结算信息;

所述分成结算信息包括:节目销售收入数据,或者获取用户数据和节目销售收入数据;

分成结算模块:用于根据预定结算分成协议、分成结算信息进行分成结算。

所述预定结算分成协议为下述一种或多种:基于固定时长统谈的分成协议、基于节目授权量的分成协议、基于节目授权时长的分成协议、基于节目销售收入的分成协议。

所述预定结算分成协议包括:节目平台与节目提供商之间的结算分成协议、和/或节目平台与服务平台之间的结算分成协议。

所述节目平台与服务平台之间的结算分成协议包括:分成策略协议、和/或累积奖励协议。

所述分成结算信息包括下述一种或多种:周期性的服务平台销售明细、单用户的业务明细、指定日期的产品销售数量、周期性的业务发展报告。

通过上述技术方案的描述可知,本发明通过预定的服务平台授权信息,使服务平台成为节目平台的用户,使节目平台能够方便的对其与服务平台之间的节目交换进行管理;本发明中节目平台为服务平台提供节目的授权与服务平台为有线电视用户提供节目的授权完全独立,不但通过两级加密保证了节目交换的安全性,还避免了节目交换对节目平台、服务平台的CAS、SMS以及传输网络的额外要求,易于实施,且简化了节目交换的实现过程,提高了节目交换系统的稳定性,保证了节目交换运营的安全性,降低了节目交换维护的复杂度,从而降低了节目交换系统的建设成本和运营成本;本发明的节目平台能够按照预先签订的授权信息即节目使用协议灵活控制对服务平台提供节目服务的开启和关停,节目服务控制灵活,既提高了业务运营的灵活性,又达到了对节目

平台加扰传输的数字电视节目进行版权保护的目地;本发明通过在节目交换系统中设置监管平台,使节目平台、服务平台和监管平台分工明确,使节目平台能够专注于提供节目内容服务,服务平台能够专注于提供节目收视服务;本发明的监管平台可以为节目监管平台、支付监管平台,节目监管平台可以利用行业公用监管系统,如广电总局监管平台,支付监管平台可以利用第三方支付系统,如银行等,通过监管平台对服务平台上报至节目平台的运营数据进行核查,充分保证了节目平台与服务平台进行结算的基础数据的准确性,从而保证节目平台与服务平台分成结算的准确性和公证性;本发明的节目平台与服务平台之间的结算分成方式灵活多样;从而通过本发明提供的技术方案实现了提高节目交换系统实用性、可运营性的目的。

附图说明

图1是现有技术的节目交换方法的示意图一;

图2是现有技术的节目交换方法的示意图二;

图3是本发明实施例的节目交换系统示意图;

图4是本发明实施例的节目交换系统实现节目交换的示意图。

具体实施方式

本发明的节目交换系统的核心在于:节目平台中设置的第一复用加扰设备根据预定的服务平台授权信息为服务平台提供复用加扰节目流,服务平台前端的解扰设备根据预定的服务平台授权信息对节目平台提供的节目流进行解扰,并将解扰后的节目流传输至服务平台中设置的第二复用加扰设备,第二复用加扰设备根据其接收的节目流、预定的用户授权信息为用户提供复用加扰节目流。

下面基于本发明的核心思想、结合附图对本发明提供的节目交换系统进行详细描述。

为保证本发明节目交换系统中的节目平台能够方便的对其与服务平台之间的节目交换进行管理,同时,使服务平台能够安全、方便的为有线电视用户提供的有线电视节目,降低节目平台、服务平台的运营成本、降低有线电视用户收看电视节目的成本,本发明的节目交换系统中的节目平台、服务平台进行节目交换的过程如附图3所示。

图3中,节目平台将服务平台作为一个用户来管理,即在节目平台中对服务平台进行用户开户,节目平台将对该服务平台的授权信息承载于智能卡中,并向服务平台发放智能卡。这样,节目平台能够根据授权信息为服务平台提供相应的节目流,而且该节目流是加密的节目流,即节目平台根据预定的服务平台授权信息对相应的节目流进行复用加扰处理,然后,将复用加扰处理后的节目流传输至服务平台,节目平台对节目流的复用加扰处理过程由节目平台中的第一复用加扰设备来实现。

智能卡中的授权信息包括:一个或多个PDK(个人密钥)、每个节目的SK(加密密钥)等。服务平台使用PDK可以从节目平台传输来的加扰节目流中的EMM(授权管理信息)中解出每个节目的SK,SK数量随着智能卡上授权的节目数而不同,SK更新周期由CA系统(条件授权)确定,如1个月,服务平台可通过节目流中的EMM的版本号自动确定是否更新SK。

节目平台可以根据预定的服务平台授权信息对其为服务平台提供的节目服务进行开启/关停控制,该控制功能由节目平台的节目服务控制模块来实现。

在服务平台前端,通过解扰设备如机顶盒和节目平台分配的智能卡,对节目平台传输来的节目流进行解扰,服务平台对节目流进行解扰的过程由服务平台的解扰设备来实现。服务平台前端重新对解扰后的节目流根据预定的用户授权信息进行复用加扰,复用加扰后的节目流进入服务平台的有线电视网络。服务平台对节目流进行复用加扰的过程由服务平台中设置的第二复用加扰设备来实现。

在服务平台运营范围内的有线电视用户收看节目平台的数字付费电视节目时，只需获得服务平台的授权即可。这样，服务平台的用户节目销售授权在服务平台前端系统中即可完成，无需实时请求节目平台的授权。

本发明为了使节目平台能够专注于提供节目内容服务、服务平台能够专注于提供节目收视服务、保证节目平台与服务平台进行结算的基础数据的准确性，本发明在图3的节目交换系统中设置了监管平台。

上述监管平台可以为对用户收视信息中的用户数据和用户订购数据进行监管的节目监管平台，也可以为对用户收视信息中的用户节目支付费用数据和节目销售收入数据进行监管的支付监管平台，由此，本发明的节目交换系统可以包括：至少一个节目平台、至少一个服务平台和节目监管平台，可以包括：至少一个节目平台、至少一个服务平台和支付监管平台，也可以同时包括：至少一个节目平台、至少一个服务平台、节目监管平台和支付监管平台。

当本发明的节目交换系统包括至少一个节目平台、至少一个服务平台、节目监管平台和支付监管平台时，节目交换系统实现节目交换方法的示意图如附图4所示。

图4中，本发明的节目交换系统包括：至少一个节目平台、至少一个服务平台、节目监管平台和支付监管平台。节目监管平台可以为公用的对行业进行监管的平台如广电总局监管平台，支付监管平台为处于第三方支付状态的平台，如银行、支付网关等支付系统。

服务平台需要将其存储的用户收视信息分别传输至节目监管平台、支付监管平台和节目平台。用户收视信息的具体传输过程为：服务平台和节目监管平台之间设置有节目监管接口，服务平台采用其与节目监管平台之间的节目监管接口将SMS和CAS中存储的用户数据和用户订购数据传输至节目监管平台。这部分功能由服务平台中的第一收视信息传输模块来实现。服务平台和节目平台之间设置有节目监管接口，服务平台采用其与节目平台之间的节目监管接口将

SMS中存储的与节目平台相关的用户数据和用户订购数据传输至节目平台，这部分功能由服务平台中的第二收视信息传输模块来实现。服务平台与支付监管平台之间设置有支付接口，服务平台采用其与支付监管平台之间的支付接口将SMS中存储的用户节目支付费用数据传输至支付监管平台，这部分功能由服务平台中的第三收视信息传输模块来实现；服务平台采用其与节目平台之间的节目监管接口将SMS中存储的与节目平台相关的节目销售收入数据传输至节目平台，这部分功能由服务平台中的第四收视信息传输模块来实现。

由于服务平台可以将用户数据、用户订购数据和节目销售收入数据一起传输至节目平台，所以，第三收视信息传输模块和第四收视信息传输模块可以将分别获取到的用户数据、用户订购数据和节目销售收入数据采用服务平台与节目平台之间的节目监管接口一起传输至节目平台。

服务平台可以采用主动定期上报的方式如日报、周报、月报等方式将上述信息分别上报至节目监管平台、支付监管平台和节目平台，服务平台也可以在接收到节目监管平台、支付监管平台或节目平台的请求时，根据请求中的信息上报上述信息。服务平台可以根据请求中包含的指定时间段，如指定的日期、指定的日期段等，上报指定时间段内的用户收视信息，服务平台也可以根据请求中包含的指定收视用户信息，上报指定收视用户的用户收视信息，还可以根据请求中包含的指定时间段、指定收视用户信息，上报指定收视用户在指定时间段内的用户收视信息。

节目平台在接收到服务平台传输来的用户数据和用户订购数据后，将其上报至节目监管平台，通过上述节目平台与节目监管平台之间的数据传输，使节目监管平台可以对服务平台上报的数据和节目平台上报的数据进行一致性核查，这部分功能由节目监管平台中的第一一致性核查模块实现。由于服务平台上报至节目监管平台如广电总局监管平台的数据具有较高的真实可靠性，所以，节目监管平台通过对服务平台上报至节目平台的数据进行一致性核查，能

够确定服务平台上报至节目平台的数据是否准确，从而，保证了节目平台能够从服务平台处获得真实、可信的数据，最终，保证了节目平台与服务平台进行结算的基础数据的准确性，使节目平台与服务平台的分成结算具有准确性和公证性。

服务平台需要将其用户管理系统中存储的用户节目支付费用数据传输至支付监管平台，这样，服务平台的收视用户即有线电视用户可以通过支付监管平台来完成节目订购费用的缴纳。节目平台在接收到服务平台上报的用户节目销售收入数据后，采用其与支付监管平台之间的用户帐户支付核查接口将用户节目销售收入数据上报至支付监管平台，使支付监管平台可以根据有线电视用户缴纳的节目订购费用对服务平台上报至节目平台的用户节目销售收入数据进行一致性核查，以证实节目平台从服务平台处获取的用户节目销售收入数据的正确性，最终，使节目平台与服务平台的分成结算具有准确性和公证性。这部分功能由支付监管平台中的第二一致性核查模块来实现。

节目平台还可以根据结算分成协议、预定的服务平台授权信息对其从服务平台获取的用户数据和节目销售授权数据进行多种形式的分成结算。这里的结算分成可以为：节目平台与服务平台之间的分成结算，还可以为节目平台与节目提供商之间的结算分成。这里的结算分成协议可以为基于固定时长统谈的结算分成协议、或基于节目授权量的结算分成协议、或基于节目授权时长的结算分成协议、或基于节目销售收入的结算分成协议中的一种或多种，如采用基于节目授权量+节目授权时长的结算分成协议、再如采用基于节目授权量+节目销售收入的结算分成协议等。上述结算分成过程由分成结算模块来实现，分成结算模块可设置于节目平台，也可以设置于服务平台，当然，节目平台和服务平台之间都可以设置分成结算模块。

从上述描述中可以看出，本发明中的节目平台不再需要对服务平台的收入情况及用户的收视情况进行监管，使节目平台能够专注于提供节目内容服务。

服务平台能够专注于提供节目收视服务,本发明对节目平台、服务平台的SMS和CAS、以及传输网络没有特殊的要求,使节目交换系统的建设成本、运营维护成本低、易于实施,且提高了节目平台与服务平台之间的运营灵活性。

本发明不限制服务平台、节目平台、支付监管平台、节目监管平台之间的接口形式,下面以提供一种具体的接口实现方式。

本发明中节目平台与服务平台之间的节目监管接口的通用属性如表1所示。也就是说,本发明中节目平台与服务平台之间交换的接口数据均包括表1中的内容。

表1

属性名称	说明
版本号	版本编号。
源系统标识	数据来源系统的标识号
目的系统标识	数据目标系统的标识号
交易流水号	一次操作的流水号
交易类型	交易分类
交易时间	若该值为空,默认为当前时刻。

表1中,版本号、源系统标识、目的系统标识、交易类型为消息校验信息,交易流水号和交易时间为消息标识信息。消息校验信息主要用于接收端判断其接收到的消息是否为合法的消息,消息标识信息主要用于表示该消息是针对哪个请求的应答消息。当节目平台与服务平台之间采用同步通讯方式时,接口数据可以不包括消息标识信息。

服务平台与节目平台之间的节目监管接口为:周期性上报的服务平台销售明细如服务平台月度销售明细、单用户的业务明细、指定日期的产品销售数量、业务发展报告如业务发展日报,业务发展周报等。

当节目平台向服务平台请求服务平台月度销售明细时,节目平台向服务平台发送的月度销售明细请求的接口数据如表2所示。

表2

属性名称	备注
月份	可以是自然月，也可以是双方约定的财政月，由于涉及到服务平台、节目交换平台、监管平台三方比对数据，简单起见，建议使用自然月。

服务平台在接收到指定月请求信息后，根据请求信息中的月份信息获取用户数据和用户订购数据，并发送至节目平台。服务平台发送至节目平台的接口数据中的用户数据和用户订购数据如表3所示。

表3

服务平台返回月度业务明细	
属性名称	备注
成功标志	成功返回码
智能卡卡号	发生订购的智能卡卡号
CAS的标识	条件授权系统的系统标识
订购类型	0000 — 个体订购；0001 — 大客户方式订购
大客户标识	大客户订购时的大客户标识
产品编号	订购的服务平台产品的编号，该产品中包含节目平台的节目
整月订购标志	是否整月订购
订购天数	订购服务的天数
销售金额	给用户实际月售价，单位为分
支付系统标识	本次消费费用支付的发生系统
支付帐号	本次消费的支付帐号
支付流水号	本次消费支付的交易流水号

表3中，智能卡卡号、订购类型、产品编号、订购天数、销售金额等属于用户订购数据；大客户标识、整月订购标志、支付系统标识、支付帐号、支付流水号等属于用户数据。

在上述例子中，服务平台也可以在预定的日期根据表3所示的格式主动向节目平台上报一个月的用户数据和用户订购数据。

当服务平台确定节目平台传输来的指定月的接口数据有误时，可以向节目平台返回如表4所示的信息。

表4

服务平台返回错误结果	
属性名称	备注
错误标志	错误码
错误描述	错误的详细信息

节目平台向服务平台发送请求某收视用户的用户数据和用户订购数据的请求信息如表5所示。

节目平台请求参数	
属性名称	备注
智能卡卡号	发生订购的智能卡卡号
CAS的标识	条件授权系统的系统标识

服务平台在接收到某收视用户请求信息后,根据请求信息中的智能卡号、CAS的标识获取用户数据和用户订购数据,并发送至节目平台。服务平台发送至节目平台的接口数据中的用户数据和用户订购数据如表6所示。

表6

服务平台返回用户业务明细		
属性名称		备注
成功标志		成功返回码
智能卡卡号		发生订购的智能卡卡号
CAS的标识		条件授权系统的系统标识
用户编号		服务平台用户编号
N 个 已 订 购 产 品 信 息	产品编号	服务平台定义的产品编号,该产品中包含节目平台的节目
	产品名称	服务平台的产品名称
	服务开始时间	若该值为空,默认为当前时刻。
	服务截止时间	若该值为空,默认为当前时刻。
	支付系统标识	支付系统的标识
	支付帐号	用户的支付帐号
	支付流水号	本次消费支付的交易流水号

当服务平台确定节目平台传输来的指定某收视用户收视信息的接口数据有误时,可以向节目平台返回如表4所示的错误信息。

节目平台向服务平台发送请求指定日期的用户订购数据的请求信息如表8所示。

表7

节目平台请求参数	
属性名称	备注
日期	表示获取从该日期到当前查询时间点的当天订购节目平台节目的数量(不需要扣除授权到期的用户)

服务平台在接收到指定日期的请求信息后，根据指定的日期获取用户订购数据，并发送至至节目平台。服务平台发送至节目平台的接口数据中的用户订购数据如表8所示。

表8

服务平台返回节目平台节目销售明细		
属性名称		备注
成功标志		成功返回码
日期		查询的日期
N个 产品 销售 信息	产品编号	服务平台的产品编号，该产品中包含节目平台的节目
	产品名称	服务平台的产品名称
	销售数量	产品购买数量

当服务平台确定节目平台传输来的指定日期的接口数据有误时，可以向节目平台返回如表4所示的信息。

服务平台主动向节目平台上报日报的接口数据中的用户数据和用户订购数据如表9所示。

表9

服务平台请求参数		
属性名称		备注
日期		
产品 用户 发展 情况	产品编号	服务平台的产品编号，该产品中包含节目平台的节目
	产品名称	服务平台的产品名称
	新增订购数	产品新购买数量
	取消订购数	产品退订的数量

节目平台在确定其接收到的服务平台上报日报的接口数据正确时，向服务平台返回的信息如表10所示。

表10

节目平台返回明细	
属性名称	备注
成功标志	成功返回码

节目平台在确定其接收到的服务平台上报日报的接口数据错误时，向服务平台返回的信息如表4所示。

节目平台向服务平台请求指定时间段内如一周内新增用户的用户数据和用户订购数据。节目平台通过该请求可以获得一周内各产品新增的收视用户数量,以及具体的新增收视用户信息。获取的数据主要用作产品销售情况统计分析使用。节目平台向服务平台发送请求指定一周内新增用户请求的接口数据中的用户数据和用户订购数据如表11所示。

表11

节目平台请求参数	
属性名称	备注
周日期	使用周一的日期表示一周

服务平台在接收到指定周请求信息后,根据请求信息中的周日期获取用户数据和用户订购数据,并发送至节目平台。服务平台发送的指定周的接口数据中的用户数据和用户订购数据如表12所示。

表12

服务平台返回周订购明细			
属性名称		备注	
成功标志		成功返回码	
周日期		查询的周日期	
N 条 产 品 销 售 信 息	产品编号		服务平台的产品编号,该产品中包含节目平台的节目
	产品名称		服务平台的产品名称
	新增订购用户总数		新购买产品的用户数量,具体明细信息在下面的“M个新增用户信息”
	M个新增用户信息	用户编号	服务平台新购买产品的用户编号
		CAS标识	用户对应的CAS标识
	取消订购用户总数		取消购买产品的用户数量,具体明细信息在下面的“K个取消订购用户信息”
	K个取消订购用户信息	用户编号	服务平台取消购买产品的用户编号
		CAS标识	用户对应的CAS标识

服务平台在确定其接收到的节目平台传输来的指定周请求信息的接口数据有误时,向节目平台返回的信息如表4所示。

服务平台与支付监管平台之间的支付接口包括:建立支付关系的接口、解除支付关系的接口、支付费用接口、支付记录总额对帐接口、支付记录明细对帐接口、服务平台产品支付记录的交易总额对帐接口中的一个或多个。

本发明中服务平台与支付监管平台之间的支付接口的通用属性如表13所示。也就是说，本发明中服务平台与支付监管平台之间交换的接口数据均包括表13中所示的内容。

表13

属性名称	说明
交易编码	交易编码，区别不同的业务
支付系统编号	支付系统编号，服务平台中对应支付系统的编号
交易流水号	流水号，为异步通讯的标识，客户端生成，服务端在应答包中原样返回。说明：如果服务端返回的报文大于一个包，则这一组包的流水号相同
是否存在后续包	是否还有后续包，'1'有，'0'无
包序号	包序号，从1开始
业务员编码	操作员或业务终端，只作为审计日志的信息
校验字	包体校验属性

表13中，支付系统编号、是否存在后续包、包序号、业务员编码和校验字为消息校验信息，交易编码和交易流水号为消息标识信息。消息校验信息主要用于接收端判断其接收到的消息是否为合法的消息，消息标识信息主要用于表示该消息是针对哪个请求的应答消息。当节目平台与支付监管平台之间采用同步通讯方式时，接口数据可以不包括消息标识信息。

服务平台与支付监管平台之间产生的请求信息和响应信息都使用表13所示的报文结构。

表13中的交易编码，客户端必须写入遵守系统提供的交易编码规则，服务端在应答报文中原样返回。上述客户端为发送请求信息的一方，上述服务端为发送响应信息的一方。

交易流水号为异步通讯的标识，由客户端生成，服务端在应答报文中原样返回。如果服务端返回的报文大于一个包，则这一组包的流水号相同。

是否存在后续包：当对应一个请求有多个应答报文时，必须通过该属性来说明是还有后续包，还是应答结束。如果有多个应答包，则只有最后一个应答包的多包标志为0，其它包的多包标志都为1。

包序号：对于每个请求，相应的一个或多个应答包都从1开始编号，依次

连续加一。

校验字属性为报文的校验属性，使用MD5算法产生32位的字符串，取前4个和后4的字符，交叉后的字符串作为校验字，如果MD5串第一个字符为A0，第二个字符为A1，依次类推，那么最后产生的校验字为A0A28A1A29A2A30A3A31。正确报文：[5399990001 11 1 赵云625dlc2a 11]。MD5算法为输入记录信息字符串+双方约定的密钥，对输入信息使用MD5算法产生128比特数字摘要，128比特数字摘要转换为32字节16进制字符串。另外，计算校验字属性的值时，将校验字属性设置为空格。

下面对服务平台向支付监管平台发送用户节目支付费用数据的具体过程进行详细说明。

服务平台与支付监管平台之间需要建立支付关系。建立支付关系的具体过程为：支付监管平台向服务平台发送请求建立收视用户的支付关系的接口数据，接口数据中的请求信息如表14、表15所示。

表14

功能简述	支付系统向服务平台请求建立用户的支付关系
交易编码	0401
备注说明	支付系统 → 服务平台

表15

支付系统请求参数	
属性名称	备注
订户编码	用户证号
识别码	支付系统提供的用户标识码，当建立/解除支付关系时操作员要输入用户ID和识别码，用于防止操作员输入用户编号时敲错
支付帐号	支付帐号

表15中包含支付监管平台需要获取的用户节目支付费用数据具体包括的参数，如订户编码、识别码、支付帐号等。

服务平台在确定其接收的支付监管平台传输来的请求信息的接口数据正确时，根据支付监管平台需要获取的参数，将相应的数据发送至支付监管平台，

服务平台与支付监管平台建立支付关系。服务平台向支付监管平台发送的接口数据中的用户节目支付费用数据具体如表16所示。

表16

服务平台返回正确结果	
属性名称	备注
成功标志	成功返回码
订户编码	服务平台的用户编号
识别码	支付提供的用户标识码
支付帐号	支付帐号

支付监管平台在正确接收到服务平台传输来的用户节目支付费用数据时，支付监管平台与服务平台之间成功建立支付关系。

服务平台在确定其接收的支付监管平台传输来的请求信息的接口数据错误时，向支付监管平台返回的数据如表4所示。

服务平台与支付监管平台解除支付关系的具体过程为：支付监管平台向服务平台发送请求解除收视用户的支付关系的接口数据，接口数据中的请求信息如表17、表18所示。

表 17

功能简述	支付系统向服务平台请求解除用户的支付关系
交易编码	0402
备注说明	支付系统 → 服务平台

表 18

属性名称	备注
订户编码	服务平台的用户ID
识别码	支付系统提供的用户标识码

表18中包含支付监管平台需要解除支付关系的用户信息，如订户编码、识别码等。

服务平台在确定其接收的支付监管平台传输来的请求解除信息的接口数据正确时，根据请求解除信息中的用户信息进行解除操作，并向支付监管平台发送解除成功的信息，具体如表19所示。

表 19

服务平台返回正确结果	
属性名称	备注
成功标志	成功返回码

服务平台在确定其接收的支付监管平台传输来的请求解除信息的接口数据错误时，向支付监管平台发送解除失败的信息，具体如表4所示。

在服务平台与支付监管平台之间建立支付关系后，服务平台在需要收视用户进行费用支付时，向支付监管平台发送请求收视用户费用支付的接口数据，接口数据中的请求信息如表20、表21所示。

表20

功能简述	服务平台向支付系统发送为用户进行支付的请求
交易编码	0403
备注说明	服务平台 → 支付系统

表21

服务平台请求参数		
属性名称	备注	
用户编号	用户的编号	
结算月	结算的月份	
总笔数	扣款的总笔数	
总费用	扣款的总费用，单位分	
N条 产品 明细 费用	产品编号	服务平台的产品编号，该产品中包含节目平台的节目
	结算费用	产品的订购费用，单位分
	业务时长	产品的订购时长

表21中包含需要费用支付的收视用户信息和收视用户需要支付的费用信息。

支付监管平台在确定其接收的服务平台传输来的请求收视用户费用支付的接口数据正确，并在收视用户支付费用后，向服务平台发送费用支付成功的信息，具体如表22所示。

表22

支付系统返回正确结果	
属性名称	备注
成功标志	成功返回码
结算月	要支付的月份
总费用	支付的总费用，单位分

支付监管平台在确定其接收的服务平台传输来的请求收视用户费用支付的接口数据错误时，向服务平台发送错误信息，具体如表4所示。

支付监管平台还可以向服务平台发送对帐请求的接口数据，对帐请求可以分为总额对帐请求和明细对帐请求。接口数据中的总额对帐请求信息如表23、表24所示。

表 23

功能简述	支付系统向服务平台发送的对帐请求
交易编码	0404
备注说明	支付系统 → 服务平台

表 24

属性名称	备注
起始序列号	对帐的起始序列号，即支付流水号
截至序列号	对帐的截至序列号

服务平台在确定其接收的支付监管平台传输来的总额对帐请求信息的接口数据正确时，向服务平台发送总额对帐接口数据正确的信息，具体如表 25 所示。

表 25

服务平台返回正确结果	
属性名称	备注
成功标志	成功返回码
起始序列号	对帐的起始序列号，即支付流水号
截至序列号	对帐的截至序列号
总笔数	扣款的总笔数
总费用	扣款的总费用，单位分
总时长	产品的订购总时长，单位天

服务平台在确定其接收的支付监管平台传输来的总额对帐请求信息的接口数据错误时，向服务平台发送总额对帐接口数据错误的信息，具体如表 4 所

示。

接口数据中的明细对帐请求信息如表 26、表 27 所示。

表 26

功能简述	支付系统向服务平台发送的对帐请求
交易编码	0405
备注说明	支付系统 → 服务平台

表 27

支付系统请求参数	
属性名称	备注
起始序列号	对帐的起始序列号，即支付流水号
截至序列号	对帐的截至序列号

服务平台在确定其接收的支付监管平台传输来的明细对帐请求信息的接口数据正确时，向服务平台发送明细对帐接口数据正确的信息，具体如表 28 所示。

表 28

服务平台返回正确结果		
属性名称		备注
成功标志		成功返回码
起始序列号		对帐的起始序列号，即支付流水号
截至序列号		对帐的截至序列号
总笔数		扣款的总笔数
N条产品明 细费用	产品编号	服务平台的产品编号，该产品中包含节目平台的节目
	结算费用	产品的订购费用，单位分
	业务时长	产品的订购时长

服务平台在确定其接收的支付监管平台传输来的明细对帐请求信息的接口数据错误时，向服务平台发送明细对帐接口数据错误的信息，具体如表 4 所示。

节目平台与支付监管平台之间的接口数据包括如下几种情况：

节目平台在需要与服务平台的产品支付记录的交易总额对帐时，向支付监管平台发送产品支付记录交易总额对帐请求信息，具体如表 29、30 所示。

表 29

功能简述	节目平台向支付系统发送的对服务平台交易总帐请求
交易编码	0501
备注说明	节目平台 → 支付系统

表 30

节目平台请求参数	
属性名称	备注
起始序列号	对帐的起始序列号, 即支付流水号
截至序列号	对帐的截至序列号
产品编号	服务平台的产品编号, 该产品中包含节目平台的节目
总笔数	扣款的总笔数
总费用	扣款的总费用, 单位分

支付监管平台在确定其接收的服务平台传输来的产品支付记录交易总额对帐请求信息的接口数据正确时, 向服务平台发送产品支付记录交易总额对帐接口数据正确的信息, 具体如表 31 所示。

表 31

支付系统返回正确结果	
属性名称	备注
成功标志	成功返回码
起始序列号	对帐的起始序列号, 即支付流水号
截至序列号	对帐的截至序列号
产品编号	服务平台的产品编号, 该产品中包含节目平台的节目
总笔数误差	扣款的总笔数误差, 如果为0则表示一致
总费用误差	扣款的总费用误差, 单位分, 如果为0则表示一致

支付监管平台在确定其接收的服务平台传输来的产品支付记录交易总额对帐请求信息的接口数据错误时, 向服务平台发送产品支付记录交易总额对帐接口数据错误的信息, 具体如表 4 所示。

本发明中节目平台与支付监管平台之间的用户帐户支付核查接口的通用属性如表 13 所示。也就是说, 本发明中服务平台与支付监管平台之间交换的接口数据均包括表 13 中所示的内容。

节目平台在需要与服务平台的产品支付记录明细对帐时, 向支付监管平台发送产品支付记录交易明细对帐请求信息, 具体如表 32、表 33 所示。

表 32

功能简述	节目平台向支付系统发送的对服务平台交易明细帐请求
交易编码	0502
备注说明	节目平台 → 支付系统

表 33

节目平台请求参数		
属性名称		备注
起始序列号		对帐的起始序列号, 即支付流水号
截至序列号		对帐的截至序列号
产品编号		服务平台的产品编号, 该产品中包含节目平台的节目
N条 支付 明细	交易流水号	支付交易的流水号
	结算费用	产品的订购费用, 单位分
	业务时长	产品的订购时长

支付监管平台在确定其接收的节目平台传输来的产品支付记录交易明细对帐请求信息的接口数据正确时, 向服务平台发送产品支付记录交易明细对帐接口数据正确的信息, 具体如表 34 所示。

表 34

支付系统返回正确结果		
属性名称		备注
成功标志		成功返回码
起始序列号		对帐的起始序列号, 即支付流水号
截至序列号		对帐的截至序列号
产品编号		服务平台的产品编号, 该产品中包含节目平台的节目
误差笔数		
N条 误差 支付 明细	误差类型	
	交易流水号	误差的支付交易的流水号
	结算费用	误差的费用, 单位分
	业务时长	误差的订购时长

支付监管平台在确定其接收的节目平台传输来的产品支付记录交易明细对帐请求信息的接口数据错误时, 向服务平台发送产品支付记录交易明细对帐接口数据错误的信息, 具体如表 4 所示。

服务平台与节目监管平台之间的节目监管接口参见广电总局发布的《有线数字电视节目平台与监管平台数据交换协议、内容与格式要求》, 在本实施例

中不再详细描述。

节目平台与节目监管平台之间的节目监管接口参见广电总局发布的《用户管理系统与监管平台数据交换接口技术要求》，在本实施例中不再详细描述。

节目平台与节目提供商之间的节目结算分成协议如表 35 所示。

表 35

项目名称	取值含义
策略编号	分成策略编号
策略描述	分成策略内容或用途的简述
策略有效时间	策略开始生效时间
策略失效时间	策略失效时间
节目平台编号	与节目商进行结算分成的节目平台的编号
节目标识	节目编号，节目是基本的分成实体单位
月份	对指定月份可以执行优惠定价，不指定则表示对所有月份都生效
分成方式	0 — 固定分成，统谈固定金额； 1 — 动态分成，节目平台节目销售收入的千分比；
具体数值	当分成方式为“0 — 固定分成，统谈固定金额”时指具体分成金额（分）； 当分成方式为“1 — 动态分成，节目平台产品销售收入的千分比”时指分成比例（千分比）；
月度参考价格	指整月最低价格（整月保底价格），当计算出通过分成方式计算出的整月价格低于该参考价格时，则采用该参考价格（分）
合同号	分成策略对应的合同号
备注信息	策略相关信息的说明

本发明的节目平台与服务平台之间的节目结算分成协议包括两部分的内容：一部分是分成策略协议；另一部分是为了鼓励服务平台的运营，在分成结算后对业务开展较好的服务平台进行累积奖励，即累积奖励协议；这两个部分共同组成了完整的结算分成协议。

节目平台与服务平台之间传输的分成策略协议的接口数据如表 36 所示。

表 36

项目名称	取值含义
策略编号	分成策略编号
策略描述	分成策略内容或用途的简述
策略有效时间	策略开始生效时间
策略失效时间	策略失效时间
服务平台编号	与节目平台进行结算分成的服务平台的编号
节目标识	节目编号，节目是基本的分成实体单位
产品标识	服务平台定义的产品标识
大客户标识	服务平台定义的大客户标识，可对服务平台指定的大客户的消费分成进行特殊定价，可以不指定，不指定则表示对所有客户都生效
月份	对指定月份可以执行优惠定价，可以不指定，不指定则表示对所有月份都生效
分成方式	0 — 固定分成，统谈固定金额； 1 — 动态分成，服务平台产品销售收入的分比； 2 — 动态分成，服务平台实际节目授权量的分比进计算的费用；
具体数值	分成方式为“0 — 固定分成，统谈固定金额”时指具体分成金额(分)； 分成方式为“1 — 动态分成，服务平台产品销售收入的分比”时指分成比例(分比)； 分成方式为“2 — 动态分成，服务平台实际节目授权量的分比进计算的费用”时指授权量分成比例(分比)；
单次授权价格	分成方式为“2 — 动态分成，服务平台实际节目授权量的分比进计算的费用”时单次授权的价格(分)
月度参考价格	指整月最低价格(整月保底价格)，当计算出通过分成方式计算出的整月价格低于该参考价格时，则采用该参考价格(分)
合同号	分帐策略对应的合同号
备注信息	策略相关信息的说明

节目平台与服务平台之间传输的累积奖励协议的接口数据如表 37 所示。

表 37

字段名称	取值含义
协议编号	累积奖励协议编号
协议有效时间	协议开始生效时间

协议失效时间	协议失效时间
服务平台编号	与节目平台进行结算分成的服务平台的编号
奖励周期	可以是月累积奖励、季累积奖励或年累积奖励
累积类别	0 — 用户数，在奖励周期内按服务平台中消费节目的用户数量进行累积； 1 — 销售收入，在奖励周期内按服务平台中节目的销售收入进行累积；
奖励阈值	能够进行奖励的最低值
奖励方式	0 — 奖励固定的金额； 1 — 按实际销售收入累积的千分比；
奖励值	分成方式为“固定分成，统谈固定金额”时指具体分成金额； 分成方式为“动态分成，服务平台产品销售收入的百分比”时指分成比例（百分比）
最高奖励金额	奖励的最高上限金额（分）
合同号	累积奖励协议对应的合同号
描述信息	策略相关信息的说明

虽然通过实施例描绘了本发明，本领域普通技术人员知道，本发明有许多变形和变化而不脱离本发明的精神，本发明的申请文件的权利要求包括这些变形和变化。

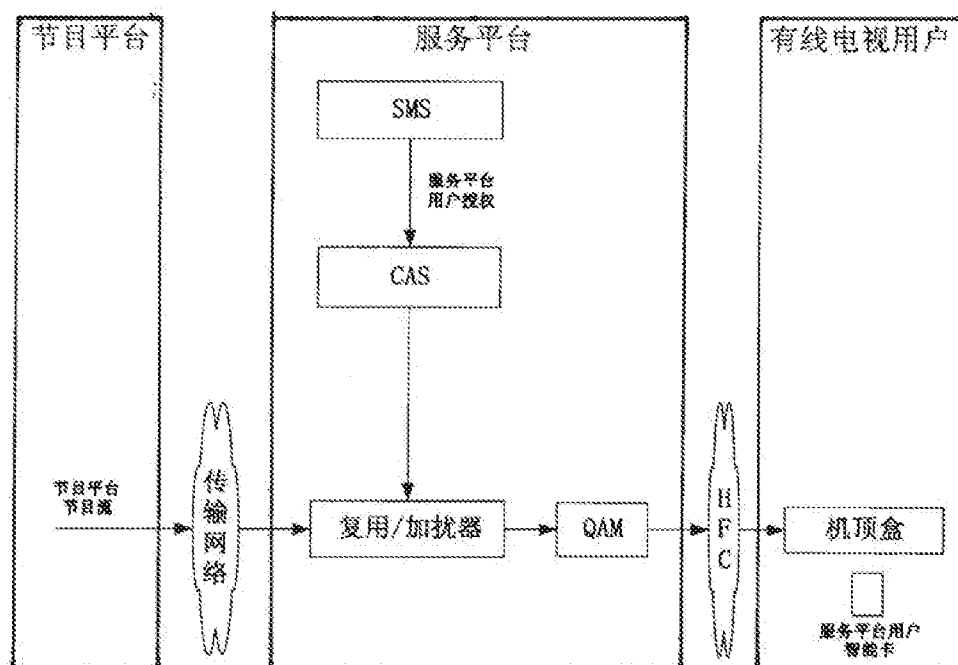


图1

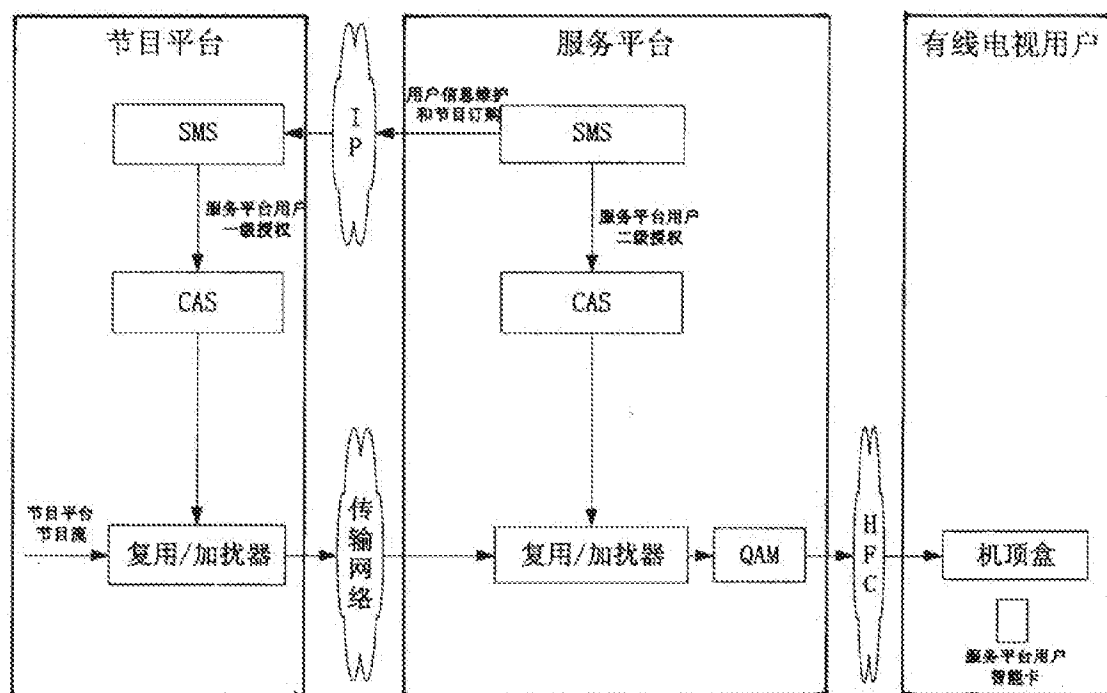


图2

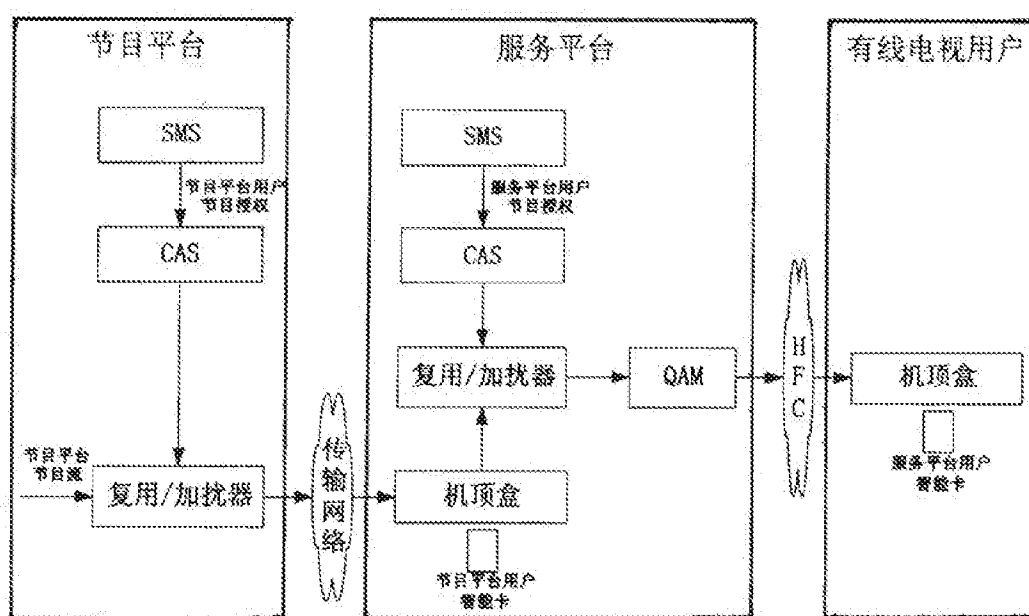


图 3

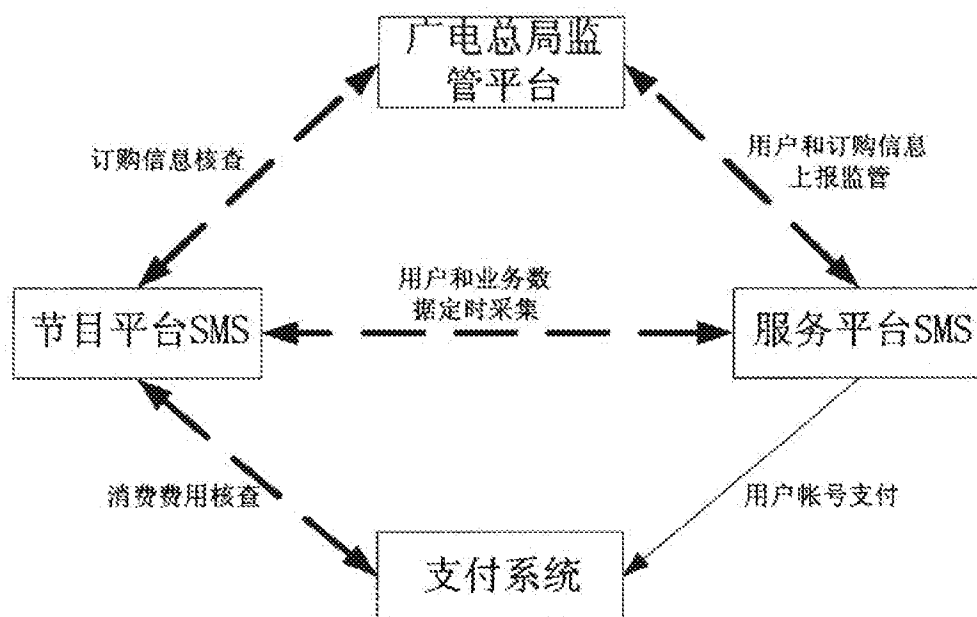


图 4

Electronic Patent Application Fee Transmittal

Application Number:	13237827			
Filing Date:	20-Sep-2011			
Title of Invention:	ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION			
First Named Inventor/Applicant Name:	Gregory G. Raleigh			
Filer:	Krista Susan Jacobsen			
Attorney Docket Number:	RALEP034 [26WV-160511]			
Filed as Small Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Submission- Information Disclosure Stmt	2806	1	90	90
Total in USD (\$)				90

Electronic Acknowledgement Receipt

EFS ID:	19770663
Application Number:	13237827
International Application Number:	
Confirmation Number:	1814
Title of Invention:	ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	107265
Filer:	Krista Susan Jacobsen
Filer Authorized By:	
Attorney Docket Number:	RALEP034 [26WV-160511]
Receipt Date:	04-AUG-2014
Filing Date:	20-SEP-2011
Time Stamp:	18:39:41
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$90
RAM confirmation Number	5284
Deposit Account	505876
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 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	Transmittal Letter	P034_IDS_trans_letter.pdf	863407	no	2
			7b7640970976f632f60ef4256edee0a77b92ad29		

Warnings:

Information:

2	Information Disclosure Statement (IDS) Form (SB08)	P034IDS.pdf	612891	no	6
			1e92e9161db125b12366bea8b61a0405bb103209		

Warnings:

Information:

3	Foreign Reference	Jiang.pdf	10963497	no	34
			3beb6debd2ebd6470e65bb7d92def5fd16d49ae		

Warnings:

Information:

4	Fee Worksheet (SB06)	fee-info.pdf	30652	no	2
			126a715ceebfe200e573d1ea2b3f4065fdff869e		

Warnings:

Information:

Total Files Size (in bytes):	12470447
-------------------------------------	----------

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

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Examiner:

Gregory G. Raleigh et al.

RUDY, Andrew J.

Serial No. 13/237,827

Art Unit: 3687

Filed: September 20, 2011

Conf. No.: 1814

Title: Adapting Network Policies Based on Device Service Processor Configuration

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**SUBMISSION OF INFORMATION DISCLOSURE STATEMENT AFTER RECEIPT
OF NOTICE OF ALLOWANCE BUT PRIOR TO PAYMENT OF ISSUE FEE**

Madam:

In accordance with the duty of disclosure under 37 C.F.R. §1.56 and pursuant to 37 C.F.R. §§ 1.97-1.98, Applicant hereby submits the references listed on the enclosed Form PTO-SB/08A.

The present Information Disclosure Statement is being filed after Applicant received the Notice of Allowance in the above-captioned application, but before Applicant has paid the Issue Fee. Accordingly, pursuant to 37 C.F.R. § 1.97(d), Applicant is submitting both the fee set forth in 37 C.F.R. § 1.17(p) and the certification statement set forth in 37 C.F.R. § 1.97(e).

Applicant respectfully requests consideration of the listed references.

CONCLUSION

Applicant respectfully requests that the Examiner consider the references listed in the IDS submitted herewith. In accordance with 37 C.F.R. § 1.97(d)-(e), the IDS is being filed prior to payment of the issue fee, with both the certification statement and fee specified in 37 C.F.R. § 1.97(d)-(e).

The Commissioner is authorized to charge any fee deficiency or credit any overpayment to Deposit Account 50-5876.

Respectfully submitted,

Date: August 4, 2014

By: 

Krista S. Jacobsen
Reg. No. 59,374

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being filed electronically via EFS-Web addressed to the Commissioner for Patents on:

Date: August 4, 2014

By: 

Krista S. Jacobsen

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)

107265 7590 05/09/2014
 Headwater Partners I LLC - Outside Firm 1
 350 Marine Parkway, Suite 300
 Redwood Shores, CA 94065

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.

Krista S. Jacobsen	(Depositor's name)
	(Signature)
August 5, 2014	(Date)

APPLICATION NO.	FILED DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/237,827	09/20/2011	Gregory G. Raleigh	RALEP034 (26XV-160511)	1814
TITLE OF INVENTION: ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION				

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	08/11/2014
EXAMINER	ART UNIT	CLASS-SUBCLASS				
RUDY, ANDREW J	3687	726-001000				

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 Krista S. Jacobsen 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)

Headwater Partners I LLC

Redwood City, 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 reuply 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 505876 (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
☐ Applicant asserting small entity status. See 37 CFR 1.27
☐ Applicant changing to regular undiscounted fee status.

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.

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.

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 August 5, 2014

Typed or printed name Krista S. Jacobsen

Registration No. 59374

Electronic Patent Application Fee Transmittal

Application Number:	13237827			
Filing Date:	20-Sep-2011			
Title of Invention:	ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION			
First Named Inventor/Applicant Name:	Gregory G. Raleigh			
Filer:	Krista Susan Jacobsen			
Attorney Docket Number:	RALEP034 [26WV-160511]			
Filed as Small Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	2501	1	480	480
Publ. Fee- Early, Voluntary, or Normal	1504	1	0	0

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

Electronic Acknowledgement Receipt

EFS ID:	19776275
Application Number:	13237827
International Application Number:	
Confirmation Number:	1814
Title of Invention:	ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	107265
Filer:	Krista Susan Jacobsen
Filer Authorized By:	
Attorney Docket Number:	RALEP034 [26WV-160511]
Receipt Date:	05-AUG-2014
Filing Date:	20-SEP-2011
Time Stamp:	13:14:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$480
RAM confirmation Number	9974
Deposit Account	505876
Authorized User	

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Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

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Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 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)	P034_issue_fee_trans.pdf	498987	no	1
			74dcb24dffaa183e3447c475114fedfe110af96		

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	32055	no	2
			f184c9963a2cfe9aa164cc984eb9125801e211c		

Warnings:

Information:

Total Files Size (in bytes):			531042
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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/237,827	09/20/2011	Gregory G. Raleigh	RALEP034 [26WV-160511]	1814
107265 7590 08/11/2014 Headwater Partners I LLC - Outside Firm 1 555 Twin Dolphin Drive, Suite 310 Redwood Shores, CA 94065			EXAMINER RUDY, ANDREW J	
			ART UNIT 3687	PAPER NUMBER
			NOTIFICATION DATE 08/11/2014	DELIVERY MODE 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):

patent@headwaterllc.com
krista@jacobseniplaw.com

**UNITED STATES DEPARTMENT OF COMMERCE****U.S. Patent and Trademark Office**

Address : COMMISSIONER FOR PATENTS

P.O. Box 1450

Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
---------------------------------	-------------	---	---------------------

13/237,827

20 September, 2011

RALEIGH ET AL.

RALEP034 [26WV-

160511]

Headwater Partners I LLC - Outside Firm 1 555 Twin Dolphin Drive, Suite 310 Redwood Shores, CA 94065		EXAMINER	
		ANDREW JOSEPH RUDY	
		ART UNIT	PAPER
		3687	20140806

DATE MAILED:

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

Commissioner for Patents

Applicant's Information Disclosure Statement (IDS) submitted August 4, 2014 has been reviewed. Note the attached IDS.

/ANDREW JOSEPH RUDY/
Primary Examiner
Art Unit: 3687

Doc code: IDS

PTO/SB/08a (01-10)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13237827
	Filing Date		2011-09-20
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	3687	
	Examiner Name	Andrew J RUDY	
	Attorney Docket Number	RALEP034 [26WV-160511]	

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5131020	A	1992-07-14	Liebesny et al.	
	2	5325532	A	1994-06-28	Crosswy et al.	
	3	6640334	B	2003-10-28	Rasmussen, John H.	
	4	7409447	B	2008-08-05	Assadzadeh, Alireza	
	5	7614051	B	2009-11-03	Glaum et al.	
	6	7668612	B	2010-02-23	Okkonen, Harri	
	7	7805140	B2	2010-09-28	Friday et al.	
	8	8223741	B	2012-07-17	Bartlett et al.	

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	13237827
Filing Date	2011-09-20
First Named Inventor	Gregory G. Raleigh
Art Unit	3687
Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

9	8370483	B	2013-02-05	Choong Jason et al.	
10	8725899	B	2014-05-13	Short et al.	
11	8605691	B2	2013-12-10	Soomro et al.	
12	8645518	B	2014-02-04	David, Scott L.	
13	8655357	B1	2014-02-18	Gazzard et al.	
14	8670334	B	2014-03-11	Keohane et al.	
15	8676925	B	2014-03-18	Liu et al.	
16	8693323		2014-04-08	McDysan, David E.	
17	8706863		2014-04-22	Fadell, Anthony	

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	13237827
Filing Date	2011-09-20
First Named Inventor	Gregory G. Raleigh
Art Unit	3687
Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

1	20020188732	A1	2002-12-12	Buckman et al.	
2	20040243992	A	2004-12-02	Gustafson et al.	
3	20070226775	A	2007-09-27	Andreasen et al.	
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7	20090254857	A	2009-10-08	Romine et al.	
8	20100235329	A	2010-09-16	Koren et al.	

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	1	1878160	CN	A	2006-12-13	Jiang, Yong		☐

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(Not for submission under 37 CFR 1.99)

Application Number	13237827
Filing Date	2011-09-20
First Named Inventor	Gregory G. Raleigh
Art Unit	3687
Examiner Name	Andrew J RUDY
Attorney Docket Number	RALEP034 [26WV-160511]

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(Not for submission under 37 CFR 1.99)

Application Number	13237827
Filing Date	2011-09-20
First Named Inventor	Raleigh, Gregory G.
Art Unit	3687
Examiner Name	Rudy, Andrew J.
Attorney Docket Number	RALEP034

20	6782412		2004-08-24	Brophy, Kevin et al.	
21	6081591		2000-06-27	Skoog, Frederick H.	
22	6064878		2000-05-16	Denker, John Stewart et al.	
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28	8353001		2013-01-08	HERROD, Allan	
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to document,
/J.G/
7/22/2014

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Application Number	13/237,827
Filing Date	September 20, 2011
First Named Inventor	Gregory G. Raleigh, et al.
Art Unit	3627
Examiner Name	Not Yet Assigned
Attorney Docket Number	26WV-160511 [RALEP034]

Sheet 11 of 17

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No. ¹	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number-Kind Code ² (if known)			
		2008/0098062	04-24-2008	BALIA	
		2008/0109679	05-08-2008	WRIGHT et al	
		2008/0120688	05-22-2008	QIU et al	
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		2008/0160958	07-04-2008	ABICHANDANI et al	
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. ¹	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶
		Country Code ³ "Number" ⁴ "Kind Code" ⁵ (if known)				

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Signature

/Andrew Joseph Rudy/

Date
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Application Number	13/237,827
Filing Date	September 20, 2011
First Named Inventor	Gregory G. Raleigh, et al.
Art Unit	3627
Examiner Name	Not Yet Assigned
Attorney Docket Number	26WV-160511 [RALEP034]

Sheet	8	of	17
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U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No. ¹	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number-Kind Code ² (if known)			
		2006/0034256	02-16-2006	ADDAGATLA et al	
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. ¹	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶
		Country Code ³ "Number" ⁴ "Kind Code" ⁵ (if known)				
	F22	WO 2008/017837 A1	02-14-2008	Symbian Software Limited		
	F23	WO 2008/051379 A2	05-02-2008	Verizon Services Corp.		
	F24	WO 2008/066419 A1	06-05-2008	Telefonaktiebolaget LM Ericsson		

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Signature

/Andrew Joseph Rudy/

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06/04/2013

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/237,827	09/09/2014	8832777	RALEP034 [26WV-160511]	1814

107265 7590 08/20/2014

Headwater Partners I LLC - Outside Firm 1
555 Twin Dolphin Drive, Suite 310
Redwood Shores, CA 94065

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 0 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):

Gregory G. Raleigh, Woodside, CA;
James Lavine, Corte Madera, CA;

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Raleigh et al	Patent No.: 8,832,777
Serial No.: 13/237,827	Issue Date: September 9, 2014
Filing Date: September 20, 2011	Conf. No.: 1814
Title: Adapting Network Policies Based on Device Service Processor Configuration	

Commissioner for Patents
Office of Data Management
ATTN: Certificate of Correction Branch
P.O. Box 1450
Alexandria, VA 22313-1450

MISCELLANEOUS COMMUNICATION REGARDING
CERTIFICATE OF CORRECTION

Applicant/Patentee (hereinafter, “Applicant”) respectfully requests that the Office issue a Certificate of Correction for U.S. Patent No. 8,832,777 to correct typographical errors in claims 1, 8, and 19. The two errors being corrected are the Office’s errors.

Claim 8 - Office’s Error

In Applicant’s amendment filed on March 28, 2014, claim 8 recites:

8. The method recited in claim 1, wherein the device credential is a first device credential, and wherein the end-user device is a first end-user device, and wherein the service policy is a first access network control policy, and further comprising:
associating the first device credential with the first end-user device;
determining whether a second device credential, associated with an authenticating end-user device, is the first device credential;
determining whether the authenticating end-user device is the first end-user device;

enforcing the first access network control policy when the second device credential is the first device credential and the authenticating end-user device is the first end-user device; and

enforcing a second access network control policy when the second device credential is not the first device credential or the authenticating end-user device is not the first end-user device.

But in the issued patent, claim 8 recites:

8. The method recited in claim 1, wherein the device credential is a first device credential, and wherein the end-user device is a first end-user device, and wherein the service policy is a first access network control policy, and further comprising: **associating first device** credential with the first end-user device;

determining whether a second device credential, associated with an authenticating end-user device, is the first device credential;

determining whether the authenticating end-user device is the first end-user device;

enforcing the first access network control policy when the second device credential is the first device credential and the authenticating end-user device is the first end-user device; and

enforcing a second access network control policy when the second device credential is not the first device credential or the authenticating end-user device is not the first end-user device.

The word “the” should be inserted between the words “associating” and “first”.

Claim 19 - Office’s Error

In Applicant’s amendment filed on March 28, 2014, claim 19 recites:

19. The method recited in claim 16, wherein obtaining the trusted data usage report comprises obtaining the trusted data usage **report from** a good customer feedback source.

But in the issued patent, claim 19 recites:

19. The method recited in claim 16, wherein obtaining the trusted data usage report comprises obtaining the trusted data usage **report is from** a good customer feedback source.

The word “is” between “report” and “from” should be deleted.

CONCLUSION

Applicant respectfully requests issuance of the Certificate of Correction to correct the errors in claims 1, 8, and 19. The Office is authorized to charge any fee deficiency or credit any overpayment to Deposit Account 50-5876.

Respectfully submitted,

Date: February 8, 2018

By: /James E. Harris/

James E. Harris
Reg. No. 40,013
Patent Counsel
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703
(903) 201-6212

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being filed electronically via EFS-Web addressed to the Commissioner for Patents on:

Date: Feb. 9, 2018

By: /Ann Taylor/
Ann Taylor

UNITED STATES PATENT AND TRADEMARK OFFICE CERTIFICATE OF CORRECTION

Page 1 of 1

PATENT NO. : 8,832,777

APPLICATION NO.: 13/237,827

ISSUE DATE : September 9, 2014

INVENTOR(S) : Raleigh et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In column 69, line 12, (the sixth line of claim 8) the phrase "associating first" should be changed to --associating the first --

In column 70, line 12, (the third line of claim 19) the phrase "report is from" should be changed to --report from--

MAILING ADDRESS OF SENDER (Please do not use customer number below):

Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	31751829
Application Number:	13237827
International Application Number:	
Confirmation Number:	1814
Title of Invention:	ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	107265
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP034 [26WV-160511]
Receipt Date:	09-FEB-2018
Filing Date:	20-SEP-2011
Time Stamp:	14:52:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Certificate of Correction	P034_ReqforCoC.pdf	71059	no	4
			7c94fe920845cde300eee6897980b88b3fa4d442		

Warnings:

Information:					
2	Request for Certificate of Correction	P034_COCForm.pdf	164271	no	2
			93efc6d881a3e0c4e7d28dc65c7dd15ce0a3f80		
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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 8,832,777 B2
APPLICATION NO. : 13/237827
DATED : September 9, 2014
INVENTOR(S) : Raleigh et al.

Page 1 of 1

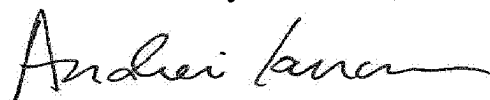
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

In Column 69, Line 12, (the sixth line of Claim 8) the phrase “associating first” should be changed to -
-associating the first--

In Column 70, Line 12, (the third line of Claim 19) the phrase “report is from” should be changed to
--report from--

Signed and Sealed this
Thirteenth Day of March, 2018



Andrei Iancu
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE CERTIFICATE OF CORRECTION

Page 1 of 1

PATENT NO. : 8,832,777

APPLICATION NO.: 13/237,827

ISSUE DATE : September 9, 2014

INVENTOR(S) : Raleigh et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Section (60), page 2, col. 1, line 44 should state:

Pat. No. 8,626,115, said application No. 12/695,019 is

MAILING ADDRESS OF SENDER (Please do not use customer number below):

Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	34834341
Application Number:	13237827
International Application Number:	
Confirmation Number:	1814
Title of Invention:	ADAPTING NETWORK POLICIES BASED ON DEVICE SERVICE PROCESSOR CONFIGURATION
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	107265
Filer:	James E. Harris/Jennifer Smith
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP034 [26WV-160511]
Receipt Date:	11-JAN-2019
Filing Date:	20-SEP-2011
Time Stamp:	15:51:51
Application Type:	Utility under 35 USC 111(a)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Certificate of Correction	P034_CoC.pdf	164124	no	2
			9097e540731c747aa395d04986b610eb61a a4072		

Warnings:

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Total Files Size (in bytes):	164124
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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 8,832,777 B2
APPLICATION NO. : 13/237827
DATED : September 9, 2014
INVENTOR(S) : Raleigh et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page

Item (60), page 2, Column 1, Line 44 should state:
Pat. No. 8,626,115, said application No. 12/695,019 is

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Twelfth Day of February, 2019



Andrei Iancu
Director of the United States Patent and Trademark Office