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(54) **Title**: METHODS, SYSTEMS, AND COMPUTER READABLE MEDIA FOR SHARING DIAMETER BINDING DATA

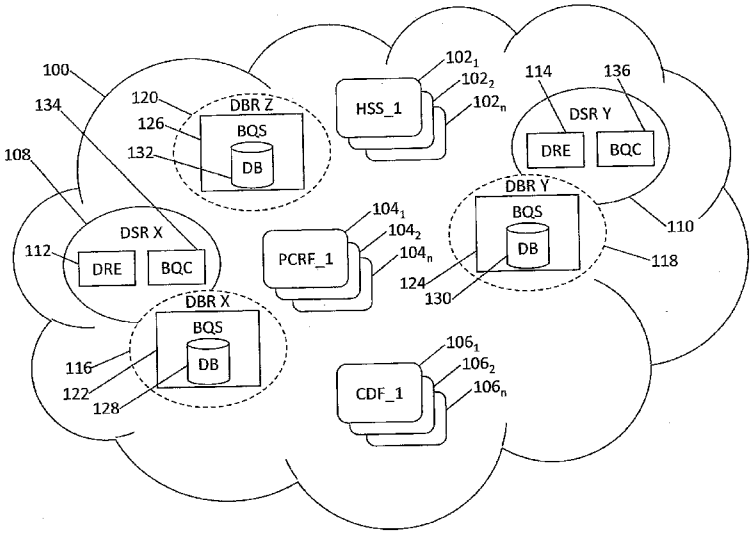

FIG. 1

(57) **Abstract**: According to one aspect, the subject matter described herein includes a method for sharing Diameter binding data. The method includes receiving, by a first Diameter signaling router (DSR), a first Diameter message requiring processing. The method also includes selecting, by the first DSR, a processing element to perform the required processing from a plurality of processing elements. The method further includes routing, by the first DSR, the received first Diameter message to the selected processing element. The method further includes creating, by the first DSR, a binding record associating the selected processing element with information associated with the received first Diameter message. The method further includes communicating, by the first DSR, the binding record to a second DSR.

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DESCRIPTION

METHODS, SYSTEMS, AND COMPUTER READABLE MEDIA FOR SHARING DIAMETER BINDING DATA

PRIORITY CLAIM

This application claims the benefit of U.S. Provisional Patent Application Serial No. 61/448,041, filed March 1, 2011; the disclosure of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The subject matter described herein relates to sharing Diameter binding data. More specifically, the subject matter relates to methods, systems, and computer readable media for sharing Diameter binding data.

BACKGROUND

The Diameter protocol is a next generation authentication, authorization, and accounting (AAA) protocol. The Diameter base protocol is defined in IETF RFC 3588, the disclosure of which is incorporated by reference herein in its entirety. Commonly used within the Internet multimedia subsystem (IMS) architecture, the Diameter protocol was derived from the remote authentication dial-in user service (RADIUS) protocol. Historically, the RADIUS protocol was employed by Internet service providers (ISPs) to provide a secure communication channel between an ISP's access server and a secure location where user credential information was stored, e.g., a lightweight directory access protocol (LDAP) server. While the RADIUS protocol provided a standardized AAA exchange protocol, the emergence of new technologies and applications necessitated the development of a protocol capable of meeting ever-changing demands. Diameter aims to extend the standardized approach of RADIUS while providing expanded functionality and remaining open to future development.

As the prevalence of the Diameter protocol increases within providers' telecommunication networks, many providers are turning to distributed architectures for processing and routing the accompanying increase in

volume of Diameter message traffic. While a distributed architecture may offer a provider advantages such as load balancing and redundancy, it also presents various issues. One such issue is sharing Diameter binding data within such a distributed architecture.

Accordingly, a need exists for methods, systems, and computer readable media for sharing Diameter binding data.

SUMMARY

According to one aspect, the subject matter described herein includes a method for sharing Diameter binding data. The method includes receiving, by a first Diameter signaling router (DSR), a first Diameter message requiring processing. The method also includes selecting, by the first DSR, a processing element to perform the required processing from a plurality of processing elements. The method further includes routing, by the first DSR, the received first Diameter message to the selected processing element. The method further includes creating, by the first DSR, a binding record associating the selected processing element with information associated with the received first Diameter message. The method further includes communicating, by the first DSR, the binding record to a second DSR.

According to another aspect, the subject matter described herein includes a system for sharing Diameter binding data. The system includes a first DSR. The first DSR includes a Diameter routing engine module configured to receive a first Diameter message requiring processing, select a processing element to perform the required processing from a plurality of processing elements, and route the received first Diameter message to the selected processing element. The first DSR also includes a binding query client module configured to create a binding record associating the selected processing element with information associated with the received first Diameter message and communicate the binding record to a second DSR.

As used herein, the term "node" refers to a physical computing platform including one or more processors and memory.

As used herein, the term "module" refers to software in combination with hardware (such as a processor) and/or firmware for implementing features described herein.

The subject matter described herein can be implemented in software in combination with hardware and/or firmware. For example, the subject matter described herein may be implemented in software executed by one or more processors. In one exemplary implementation, the subject matter described herein may be implemented using a non-transitory computer readable medium having stored thereon computer executable instructions that when executed by the processor of a computer control the computer to perform steps. Exemplary computer readable media suitable for implementing the subject matter described herein include non-transitory computer readable media, such as disk memory devices, chip memory devices, programmable logic devices, and application specific integrated circuits. In addition, a computer readable medium that implements the subject matter described herein may be located on a single device or computing platform or may be distributed across multiple devices or computing platforms.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter described herein will now be explained with reference to the accompanying drawings of which:

Figure 1 is a network diagram illustrating an exemplary network environment for sharing Diameter binding data in accordance with embodiments of the subject matter described herein;

Figures 2A and 2B are respectively first and second portions of an exemplary message sequence for utilizing a distributed Diameter binding repository (DBR) to share Diameter binding data in accordance with embodiments of the subject matter described herein;

Figures 3A and 3B are respectively first and second portions of an exemplary message sequence for utilizing a centralized DBR to share Diameter binding data in accordance with embodiments of the subject matter described herein;

Figure 4 is an exemplary Diameter binding data table for sharing Diameter binding data in accordance with embodiments of the subject matter described herein; and

Figure 5 is a flow chart illustrating an exemplary process for sharing Diameter binding data in accordance with embodiments of the subject matter described herein.

DETAILED DESCRIPTION

Methods, systems, and computer readable media for sharing Diameter binding data are provided. Figure 1 is a network diagram illustrating an exemplary network environment for sharing Diameter binding data in accordance with embodiments of the subject matter described herein. Referring to Figure 1, network environment **100** may include one or more processing elements. For example, network environment **100** may include home subscriber server (HSS) processing elements **102_1**, **102_2**, and **102_n**. HSS processing elements **102_1**, **102_2**, and **102_n** may contain subscription related information such as subscriber profiles and may be utilized in the performance of authentication, authorization, and accounting functions. Network environment **100** may also include policy and charging rules function (PCRF) processing elements **104_1**, **104_2**, and **104_n**. PCRF processing elements **104_1**, **104_2**, and **104_n** may serve as central policy decision points for network environment **100** and may make real-time policy decisions based on aggregated information pertaining to network environment **100**. Network environment **100** may further include one or more charging entity processing elements, such as charging data function (CDF) processing elements, on-line charging function (OCF) processing elements, off-line charging function (OFCF) processing elements, and/or charging gateway function (CGF) processing elements. For example, network environment **100** may include CDF processing elements **106_1**, **106_2**, and **106_n**.

Processing elements within network environment **100** (e.g., HSS processing elements **102_1**, **102_2**, and **102_n**, PCRF processing elements **104_1**, **104_2**, and **104_n**, and/or CDF processing elements **106_1**, **106_2**, and **106_n**) may

communicate with one another via Diameter messages, and network environment **100** may further include one or more Diameter signaling routers (DSRs) for routing such Diameter messages between network environment **100**'s processing elements. For example, network environment **100** may include DSR "X" **108** and DSR "Y" **110**. DSR "X" **108** and DSR "Y" **110** may respectively include Diameter routing engine (DRE) modules **112** and **114**, which may be configured to route Diameter messages between various Diameter nodes (e.g., HSS processing elements $\mathbf{102_1}$, $\mathbf{102_2}$, and $\mathbf{102_n}$, PCRF processing elements $\mathbf{104_1}$, $\mathbf{104_2}$, and $\mathbf{104_n}$, and/or CDF processing elements $\mathbf{106_1}$, $\mathbf{106_2}$, and $\mathbf{106_n}$) within network environment **100** via various Diameter interfaces (e.g., Gy, Ro, Rf, and S6a interfaces) and may enable DSR "X" **108** and/or DSR "Y" **110** to function as Diameter routing agents, Diameter proxy agents, and/or Diameter translation agents for Diameter messages within network environment **100**.

DSR "X" **108** and DSR "Y" **110** may be part of a distributed Diameter routing platform for network environment **100** and may work in collaboration to route Diameter messages within network environment **100**. For example, DSR "X" **108** and DSR "Y" **110** may utilize load sharing to distribute the Diameter message routing requirements of network environment **100** amongst each other. Working in collaboration to route Diameter messages within network environment **100**, however, may require each of DSR "X" **108** and DSR "Y" **110** to be cognizant of the routing being performed by its counterpart. For example, it may be advantageous for DSR "Y" **110** to be aware that DSR "X" **108** has routed Diameter messages associated with a specific Diameter session or associated with a specific subscriber to a particular processing element within network environment **100** for performing processing required by such messages. Moreover, the identity of particular processing elements within network environment **100** may be obscured from other processing elements that need to communicate with them (e.g., the identities of one or more CDFs may be unknown to one or more charging trigger functions (CTFs)). In such scenarios, DSR "X" **108** may form a binding record associating such a specific Diameter session or subscriber

with the particular processing element being utilized to perform the required processing within network environment **100**.

In accordance with embodiments of the subject matter described herein, such Diameter binding data may be shared within network environment **100** (e.g., between DSR "X" **108** and DSR "Y" **110**). For example, network environment **100** may include one or more Diameter binding repositories (DBRs) for facilitating the sharing of Diameter binding data between DSR "X" **108** and DSR "Y" **110**. In some embodiments, DSR "X" **108** and DSR "Y" **110** may each be associated with their own respective DBR. For example, DSR "X" **108** may be associated with DBR "X" **116** and DSR "Y" **110** may be associated with DBR "Y" **118**. In such embodiments, DBR "X" **116** may be collocated at a common network node with DSR "X" **108** and/or DBR "Y" **118** may be collocated at a common network node with DSR "Y" **110**. In some embodiments, DSR "X" **108** and DSR "Y" **110** may both be associated with a centralized DBR, such as DBR "Z" **120**. In such embodiments, DBR "Z" **120** may be collocated at a common network node with DSR "X" **108**, collocated at a network node with DSR "Y" **110**, or located at a network node distinct from DSR "X" **108** and DSR "Y" **110**.

DBR "X" **116**, DBR "Y" **118**, and DBR "Z" **120** may respectively include binding query server (BQS) modules **122**, **124**, and **126** for respectively hosting binding databases **128**, **130**, and **132**. Binding databases **128**, **130**, and **132** may include one or more binding records generated by DSR "X" **108** and/or DSR "Y" **110** associating information associated with received Diameter messages with one or more processing elements. For example, binding databases **128**, **130**, and **132** may include one or more binding records generated by DSR "X" **108** and/or DSR "Y" **110** associating Diameter session identification information, username information, international mobile subscriber identity (IMSI) information, Internet protocol (IP) multimedia subsystem (IMS) private identity (IMPI) information, IMS public identity (IMPU) information, session initiation protocol (SIP) uniform resource identifier (URI) information, network access identifier (NAI) information, mobile/dialable number information, IMS charging identifier (ICID) information, and/or user IP address information associated

with Diameter messages received by DSR "X" **108** and/or DSR "Y" **110** with one or more processing elements of network environment **100** (e.g., HSS processing elements $\mathbf{102}_1$, $\mathbf{102}_2$, and $\mathbf{102}_n$, PCRF processing elements $\mathbf{104}_1$, $\mathbf{104}_2$, and $\mathbf{104}_n$, and/or CDF processing elements $\mathbf{106}_1$, $\mathbf{106}_2$, and $\mathbf{106}_n$).

DSR "X" **108** and DSR "Y" **110** may respectively include binding query client (BQC) modules **134** and **136** for generating and communicating binding queries to one or more of DBR "X" **116**'s BQS module **122**, DBR "Y" **118**'s BQS module **124**, and DBR "Z" **120**'s BQS module **126** for retrieving one or more binding records respectively stored within binding databases **128**, **130**, and **132**. Table 1 illustrates an exemplary query for retrieving a binding record.

Subscriber Identifier: <user1@sample.com>
Assigned Processing Element: <CDF_2>
Sequence Number: <00001>
Timestamp: < January 1, 1900 00:00 UTC>

Table 1: Exemplary Binding Record Query

As Table 1 illustrates, a query for retrieving a binding record may include information for identifying a binding record such as a subscriber identifier associated with a received Diameter message that requires processing (e.g., processing by an OCF processing element). Such a query may also include an initial assignment (e.g., a default OCF processing element) for performing the required processing if a binding record matching the query is not located. Such a query may further include a sequence number for identifying lost requests and a timestamp for measuring latency.

Upon receiving a query for retrieving a binding record, DBR "X" **116**'s BQS module **122**, DBR "Y" **118**'s BQS module **124**, and/or DBR "Z" **120**'s BQS module **126** may identify a binding record associated with the query and, in response, generate and communicate a query response to the requesting DSR (e.g., to DSR "X" **108**'s BQC module **134** or DSR "Y" **110**'s BQC module **136**). Table 2 illustrates an exemplary query response.

Subscriber Identifier: <user1@sample.com>
Assigned Processing Element: <CDF_1>
Sequence Number: <00001>
Timestamp: < January 1, 1900 00:00 UTC>

Table 2: Exemplary Binding Record Query Response

As Table 2 illustrates, a query response may include the subscriber identifier associated with the received Diameter message requiring processing. The query response may also include information identifying a processing element for performing the required processing (e.g., information identifying a CDF processing element). The query may also include the sequence number of the request and the timestamp of the request.

Figures 2A and 2B are respectively first and second portions of an exemplary message sequence for utilizing a distributed DBR to share Diameter binding data in accordance with embodiments of the subject matter described herein. Referring to Figure 2A, at step 1, DSR "X" **108** may receive a Diameter message requiring processing. For example, DSR "X" **108** may receive a credit control request (CCR) message requiring processing. DSR "X" **108** may select a processing element to perform the processing required by the received CCR message. For example, DSR "X" **108** may select "CDF_1" $\mathbf{106_1}$ to perform the processing required by the received CCR message. In some embodiments, DSR "X" **108** may select a processing element to perform the processing required by the received Diameter message based on a load-balancing algorithm (e.g., a round-robin or weighted distribution scheme). Such an algorithm may be designed so a processing element with a relatively small load is selected for received Diameter messages requiring processing that are associated with a new Diameter session (i.e., a session which has not previously been associated with a particular processing element). In some embodiments, such an algorithm may select a processing element to perform the processing required by the received Diameter message based on load status information maintained by DSR **108** (e.g., Diameter transport connection congestion and/or abnormally high response delays) and/or load information

received from one or more processing elements (e.g., "TOO_BUSY" responses).

At step 2, DSR "X" **108** may create a binding record associating the selected processing element (e.g., "CDF_1" **106_1**) with information associated with the received CCR message (e.g., a session identifier associated with the received CCR message and/or a subscriber identifier associated with the received CCR message) and may store the binding record in DBR "X" **116**'s binding database **128**. At step 3, DSR "X" **108** may communicate the binding record to DSR "Y" **110**. In some embodiments, DSR "X" **108** may communicate the binding record by synchronizing DBR "X" **116**'s binding database **128** with DBR "Y" **118**'s binding database **130**. For example, DSR "X" **108** may send a DBR update message to DSR "Y" **110** containing the binding record associating the selected processing element (e.g., "CDF_1" **106_1**) with information associated with the received CCR message (e.g., a session identifier associated with the received CCR message and/or a subscriber identifier associated with the received CCR message) and, at step 4, DSR "Y" **110** may store the binding record in DBR "Y" **118**'s binding database **130**, thereby updating DBR "Y" **118**'s binding database **130** to reflect the binding created by DSR "X" **108**. At step 5, DSR "X" **108** may route the received Diameter message (e.g., the received CCR message) to the selected processing element (e.g., "CDF_1" **106_1**).

Referring to Figure 2B, at step 6, DSR "Y" **110** may receive a Diameter message requiring processing. For example, DSR "Y" **110** may receive a CCR message requiring processing. At step 7, DSR "Y" **110** may identify the binding record created by DSR "X" **108** and stored in DBR "Y" **118**'s binding database **130**. For example, DSR "Y" **110** may identify the binding record created by DSR "X" **108** and stored in DBR "Y" **118**'s binding database **130** based on information associated with the received CCR message (e.g., a session identifier associated with the received CCR message and/or a subscriber identifier associated with the received CCR message). Having identified the binding record, DSR "Y" **110** may select a processing element specified by the binding record (e.g., "CDF_1" **106_1**) to perform the required processing for the received CCR message. At step 8,

DSR "Y" **110** may route the received Diameter message (e.g., the received CCR message) to the selected processing element (e.g., "CDF_1" **106_1**).

Figures 3A and 3B are respectively first and second portions of an exemplary message sequence for utilizing a centralized DBR to share Diameter binding data in accordance with embodiments of the subject matter described herein. Referring to Figure 3A, at step 1, DSR "X" **108** may receive a Diameter message requiring processing. For example, DSR "X" **108** may receive a CCR message requiring processing. DSR "X" **108** may select a processing element to perform the processing required by the received CCR message. For example, DSR "X" **108** may select "CDF_1" **106_1** to perform the processing required by the received CCR message. At step 2, DSR "X" **108** may create a binding record associating the selected processing element (e.g., "CDF_1" **106_1**) with information associated with the received CCR message (e.g., a session identifier associated with the received CCR message and/or a subscriber identifier associated with the received CCR message). At step 3, DSR "X" **108** may communicate the binding record to a centralized DBR, for example, DBR "Z" **120** which, at step 4, may store the binding record in DBR "Z" **120**'s binding database **132**, thereby updating DBR "Z" **120**'s binding database **132** to reflect the binding created by DSR "X" **108**. At step 5, DSR "X" **108** may route the received Diameter message (e.g., the received CCR message) to the selected processing element (e.g., "CDF_1" **106_1**).

Referring to Figure 3B, at step 6, DSR "Y" **110** may receive a Diameter message requiring processing. For example, DSR "Y" **110** may receive a CCR message requiring processing. At step 7, DSR "Y" **110** may query DBR "Z" **120** for a binding record associated with information associated with the received CCR message (e.g., a session identifier associated with the received CCR message and/or a subscriber identifier associated with the received CCR message). For example, DSR "Y" **110** may query DBR "Z" **120** for a binding record using a query such as the exemplary binding record query illustrated by Table 1. At step 8, DBR "Z" **120** may identify the binding record created by DSR "X" **108** and stored in DBR "Z" **120**'s binding database **132**. For example, DBR "Z" **120** may

identify the binding record created by DSR "X" **108** based on information associated with the received CCR message (e.g., a session identifier associated with the received CCR message and/or a subscriber identifier associated with the received CCR message). At step 9, DBR "Z" **120** may respond to DSY "Y" **110**'s query with a query response message identifying a processing element specified by the identified binding record (e.g., "CDF_1" **106_1**) to perform the required processing for the received CCR message. For example, DBR "Z" **120** may respond to DSY "Y" **110**'s query with a query response message such as the exemplary binding record query response illustrated by Table 2. At step 10, DSR "Y" **110** may select the processing element specified by the query response message (e.g., "CDF_1" **106_1**) and may route the received Diameter message (e.g., the received CCR message) to the selected processing element (e.g., "CDF_1" **106_1**).

Figure 4 is an exemplary Diameter binding data table for sharing Diameter binding data in accordance with embodiments of the subject matter described herein. Referring to Figure 4, Table **400** may include columns for specifying one or more Diameter session identifiers, user names, IMSIs, IMPIs, IMPUs, SIP URIs, NAIs, mobile/dialable numbers, user IP addresses, and or processing element identifiers/addresses. Table **400** may include one or more entries for associating information associated with Diameter messages requiring processing with one or more processing elements for performing the required processing. For example, Table **400** may include an entry associating Diameter session "aaa://10.0.0.1:1;1", user name "user1@sample.com", IMSI "310150999999991", IMPI "sip:user1@sample.com", IMPU "sip:user1@sample.com", SIP URI "sip:user1@sample.com", NAI "user1@sample.com", mobile/dialable number "919-460-0001", user IP address "10.0.0.1", and processing element identifier "CDF_1". Table **400** may also include an entry associating Diameter session "aaa://10.0.0.2:1;1", user name "user2@sample.com", IMSI "310150999999992", IMPI "sip:user2@sample.com", IMPU "sip:user2@sample.com", SIP URI "sip:user2@sample.com", NAI "user2@sample.com", mobile/dialable number "919-460-0002", user IP

address "10.0.0.2", and processing element identifier "CDF_2". Table **400** may further include an entry associating Diameter session "aaa://10.0.0.3:1;1", user name "user3@sample.com", IMSI "310150999999993", IMPI "sip:user3@sample.com", IMPU "sip:user3@sample.com", SIP URI "sip:user3@sample.com", NAI "user3@sample.com", mobile/dialable number "919-460-0003", user IP address "10.0.0.3", and processing element identifier "CDF_1". Table **400** may be stored in the binding database of one or more DBRs. For example, Table **400** may be stored in one or more of DBR "X" **116**'s binding database **128**, DBR "Y" **118**'s binding database **130**, and/or DBR "Z" **120**'s binding database **132**.

Figure 5 is a flow chart illustrating an exemplary process for sharing Diameter binding data in accordance with embodiments of the subject matter described herein. Referring to Figure 5, in step **500**, a first Diameter message requiring processing is received by a first DSR. For example, DSR "X" **108** may receive a CCR message requiring processing. In step **502**, a processing element is selected by the first DSR from a plurality of processing elements to perform the required processing. For example, "CDF_1" $\mathbf{106_1}$ may be selected from amongst CDF processing elements $\mathbf{106_1}$, $\mathbf{106_2}$, and $\mathbf{106_n}$ by DSR **108**. In step **504**, the received first Diameter message is routed by the first DSR to the selected processing element. For example, the received CCR message may be routed by DSR "X" **108** to "CDF_1" $\mathbf{106_1}$. In step **506**, a binding record associating the selected processing element with information associated with the received first Diameter message is created by the first DSR. For example, a binding record associating "CDF_1" $\mathbf{106_1}$ with information associated with the received CCR message (e.g., a session identifier associated with the received CCR message and/or a subscriber identifier associated with the received CCR message). In step **508**, the binding record is communicated by the first DSR to a second DSR. For example, DSR "X" **108** may send a DBR update message to DSR "Y" **110** and DBR "Y" **118** may be updated to include the binding record created by DSR "X" **108** associating "CDF_1" $\mathbf{106_1}$ with information associated with the received CCR message (e.g., a session identifier associated with the

received CCR message and/or a subscriber identifier associated with the received CCR message).

It will be understood that various details of the subject matter described herein may be changed without departing from the scope of the subject matter described herein. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation, as the subject matter described herein is defined by the claims as set forth hereinafter.

CLAIMS

What is claimed is:

1. A method for sharing Diameter binding data, the method comprising:

receiving, by a first Diameter signaling router (DSR), a first Diameter message requiring processing;

selecting, by the first DSR, a processing element to perform the required processing from a plurality of processing elements;

routing, by the first DSR, the received first Diameter message to the selected processing element;

creating, by the first DSR, a binding record associating the selected processing element with information associated with the received first Diameter message; and

communicating, by the first DSR, the binding record to a second DSR.

2. The method of claim 1 further comprising:

receiving, by the second DSR, a second Diameter message requiring processing;

selecting, by the second DSR based on the communicated binding record and information associated with the received second Diameter message, the processing element previously selected by the first DSR to perform the required processing; and

routing, by the second DSR, the received second Diameter message to the selected processing element.

3. The method of claim 2 wherein communicating, by the first DSR, the binding record to the second DSR comprises:

storing, by the first DSR, the binding record in a first Diameter binding repository (DBR) associated with the first DSR; and

synchronizing the first DBR and a second DBR associated with the second DSR, wherein synchronizing the first DBR and the second DBR includes storing, by the second DSR, the binding record in the second DBR.

4. The method of claim 3 wherein selecting, by the second DSR, the processing element previously selected by the first DSR comprises

selecting the processing element based on the binding record stored in the second DBR.

5. The method of claim 4 wherein selecting, by the second DSR, the processing element previously selected by the first DSR comprises identifying the binding record based on the information associated with the received second Diameter message.

6. The method of claim 2 wherein communicating, by the first DSR, the binding record to the second DSR comprises:

storing, by the first DSR, the binding record in a Diameter binding repository (DBR) associated with the first DSR and the second DSR; and

retrieving, by the second DSR, the binding record from the DBR.

7. The method of claim 6 wherein selecting, by the second DSR, the processing element previously selected by the first DSR comprises selecting, by the second DSR, the processing element based on the binding record retrieved from the DBR.

8. The method of claim 6 wherein retrieving, by the second DSR, the binding record comprises identifying the binding record based on the information associated with the received second Diameter message.

9. The method of claim 6 wherein the DBR is collocated at a first network node with the first DSR, and the second DSR is located at a second network node distinct from the first network node.

10. The method of claim 6 wherein the DBR is collocated at a first network node with the second DSR, and the first DSR is located at a second network node distinct from the first network node.

11. The method of claim 6 wherein the DBR is located at a first network node, the first DSR is located at a second network node distinct from the first network node, and the second DSR is located at a third network node distinct from the first network node and the second network node.

12. The method of claim 1 wherein at least one of the first DSR and the second DSR comprises at least one of a Diameter routing agent, a

Diameter proxy agent, a Diameter redirect agent, and a Diameter translation agent.

13. The method of claim 2 wherein at least one of the information associated with the received first Diameter message and the information associated with the received second Diameter message comprises at least one of Diameter session identification information, username information, international mobile subscriber identity (IMSI) information, Internet protocol (IP) multimedia subsystem (IMS) private identity (IMPI) information, IMS public identity (IMPU) information, session initiation protocol (SIP) uniform resource identifier (URI) information, network access identifier (NAI) information, mobile/dialable number information, IMS charging identifier (ICID) information, and user IP address information.

14. The method of claim 1 wherein the binding record creates an association between a Diameter session that the received first Diameter message is associated with and at least one of a charging entity associated with the selected processing element, a policy and charging rules function (PCRF) associated with the selected processing element, and a home subscriber server (HSS) associated with the selected processing element.

15. The method of claim 14 wherein the binding record creates the association between the Diameter session that the received first Diameter message is associated with and a charging entity associated with the selected processing element, and wherein the charging entity comprises at least one of a charging data function (CDF), an on-line charging function (OCF), an off-line charging function (OFCF), and a charging gateway function (CGF).

16. The method of claim 1 wherein the binding record creates an association between a subscriber identifier that the received first Diameter message is associated with and at least one of a charging entity associated with the selected processing element, a policy and charging rules function (PCRF) associated with the selected

processing element, and a home subscriber server (HSS) associated with the selected processing element.

17. The method of claim 16 wherein the binding record creates the association between the subscriber identifier that the received first Diameter message is associated with and a charging entity associated with the selected processing element, and wherein the charging entity comprises at least one of a charging data function (CDF), an on-line charging function (OCF), an off-line charging function (OFCF), and a charging gateway function (CGF).

18. A system for sharing Diameter binding data, the system comprising:

a first Diameter signaling router (DSR) comprising:

a Diameter routing engine module configured to receive a first Diameter message requiring processing, select a processing element to perform the required processing from a plurality of processing elements, and route the received first Diameter message to the selected processing element; and

a binding query client module configured to create a binding record associating the selected processing element with information associated with the received first Diameter message and communicate the binding record to a second DSR.

19. The system of claim 18 comprising the second DSR, wherein the second DSR is configured to:

receive a second Diameter message requiring processing;

select, based on the communicated binding record and information associated with the received second Diameter message, the processing element previously selected by the first DSR to perform the required processing; and

route the received second Diameter message to the selected processing element.

20. The system of claim 19 wherein the first DSR is configured to communicate the binding record to the second DSR by storing the binding record in a first Diameter binding repository (DBR) associated

with the first DSR, the first DBR being configured to synchronize with a second DBR associated with the second DSR, wherein the first DBR is configured to synchronize with the second DBR by storing the binding record in the second DBR.

21. The system of claim 20 wherein the second DSR is configured to select the processing element based on the binding record stored in the second DBR.

22. The system of claim 21 wherein the second DSR is configured to select the processing element by identifying the binding record stored in the second DBR based on the information associated with the received second Diameter message.

23. The system of claim 19 wherein the first DSR is configured to communicate the binding record to the second DSR by storing the binding record in a Diameter binding repository (DBR) associated with the first DSR and the second DSR, and wherein the second DSR is configured to retrieve the binding record from the DBR.

24. The system of claim 23 wherein the second DSR is configured to select the processing element previously selected by the first DSR based on the binding record retrieved from the DBR.

25. The system of claim 23 wherein the second DSR is configured to retrieve the binding record by identifying the binding record based on the information associated with the received second Diameter message.

26. The system of claim 23 wherein the DBR is collocated at a first network node with the first DSR, and the second DSR is located at a second network node distinct from the first network node.

27. The system of claim 23 wherein the DBR is collocated at a first network node with the second DSR, and the first DSR is located at a second network node distinct from the first network node.

28. The system of claim 23 wherein the DBR is located at a first network node, the first DSR is located at a second network node distinct from the first network node, and the second DSR is located at a third

network node distinct from the first network node and the second network node.

29. The system of claim 18 wherein at least one of the first DSR and the second DSR comprises at least one of a Diameter routing agent, a Diameter proxy agent, a Diameter redirect agent, and a Diameter translation agent.

30. The system of claim 19 wherein at least one of the information associated with the received first Diameter message and the information associated with the received second Diameter message comprises at least one of Diameter session identification information, username information, international mobile subscriber identity (IMSI) information, Internet protocol (IP) multimedia subsystem (IMS) private identity (IMPI) information, IMS public identity (IMPU) information, session initiation protocol (SIP) uniform resource identifier (URI) information, network access identifier (NAI) information, mobile/dialable number information, IMS charging identifier (ICID) information, and user IP address information.

31. The system of claim 18 wherein the binding record creates an association between a Diameter session that the received first Diameter message is associated with and at least one of a charging entity associated with the selected processing element, a policy and charging rules function (PCRF) associated with the selected processing element, and a home subscriber server (HSS) associated with the selected processing element.

32. The system of claim 31 wherein the binding record creates the association between the Diameter session that the received first Diameter message is associated with and a charging entity associated with the selected processing element, and wherein the charging entity comprises at least one of a charging data function (CDF), an on-line charging function (OCF), an off-line charging function (OFCF), and a charging gateway function (CGF).

33. The system of claim 18 wherein the binding record creates an association between a subscriber identifier that the received first

Diameter message is associated with and at least one of a charging entity associated with the selected processing element, a policy and charging rules function (PCRF) associated with the selected processing element, and a home subscriber server (HSS) associated with the selected processing element.

34. The system of claim 33 wherein the binding record creates the association between the subscriber identifier that the received first Diameter message is associated with and a charging entity associated with the selected processing element, and wherein the charging entity comprises at least one of a charging data function (CDF), an on-line charging function (OCF), an off-line charging function (OFCF), and a charging gateway function (CGF).

35. A non-transitory computer readable medium comprising computer executable instructions that when executed by a processor of a computer control the computer to perform steps comprising:

receiving, by a first Diameter signaling router (DSR), a first Diameter message requiring processing;

selecting, by the first DSR, a processing element to perform the required processing from a plurality of processing elements;

routing, by the first DSR, the received first Diameter message to the selected processing element;

creating, by the first DSR, a binding record associating the selected processing element with information associated with the received first Diameter message; and

communicating, by the first DSR, the binding record to a second DSR.

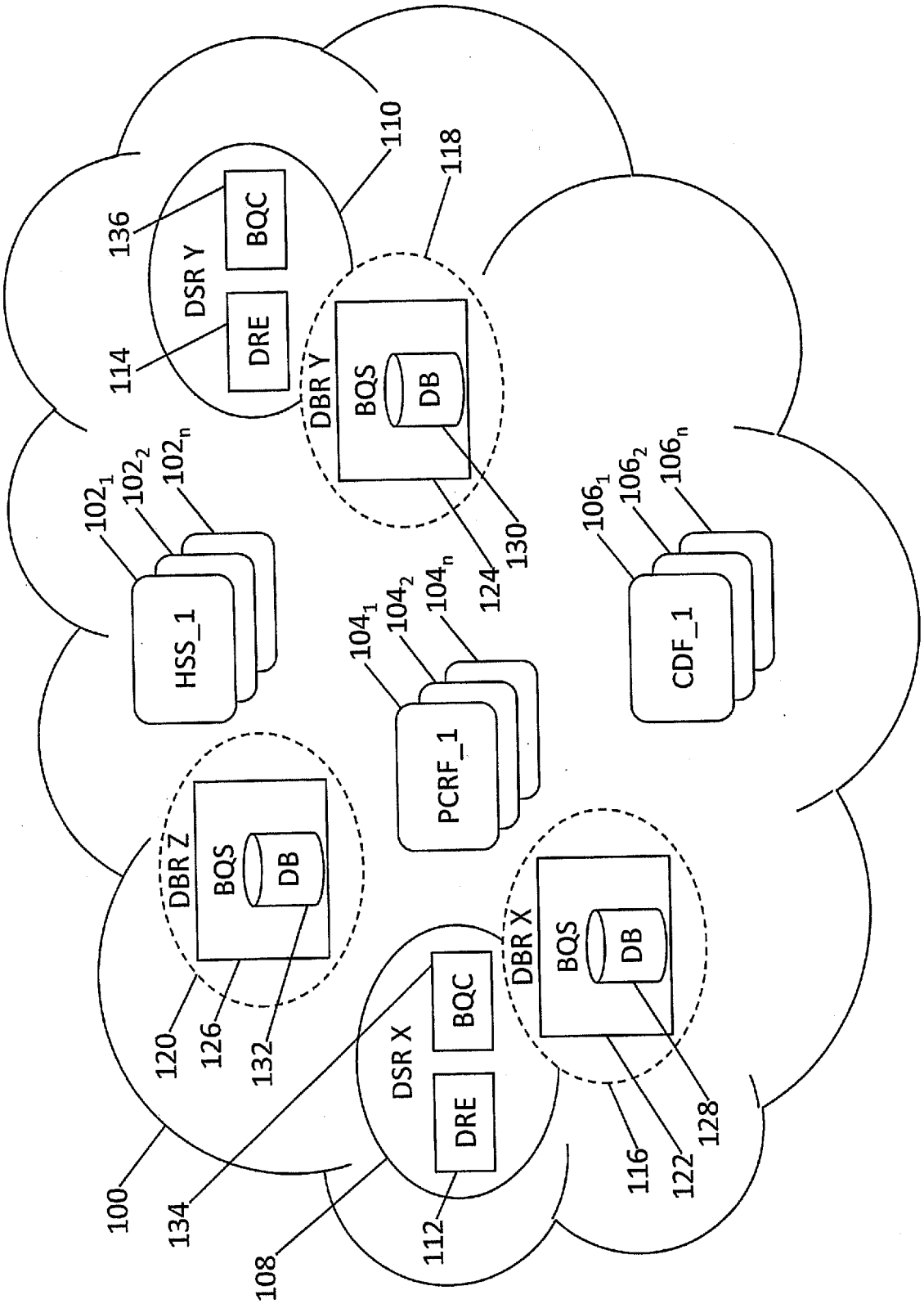
100
102$_1$
102$_2$
102$_n$
HSS_1
104$_1$
104$_2$
104$_n$
PCRF_1
106$_1$
106$_2$
106$_n$
CDF_1
108
110
112
114
DRE
DSR Y
BQC
DSR X
116
118
120
122
124
126
128
130
132
134
DBR Y
BQS
DB
DBR Z
DBR X
136

FIG. 1

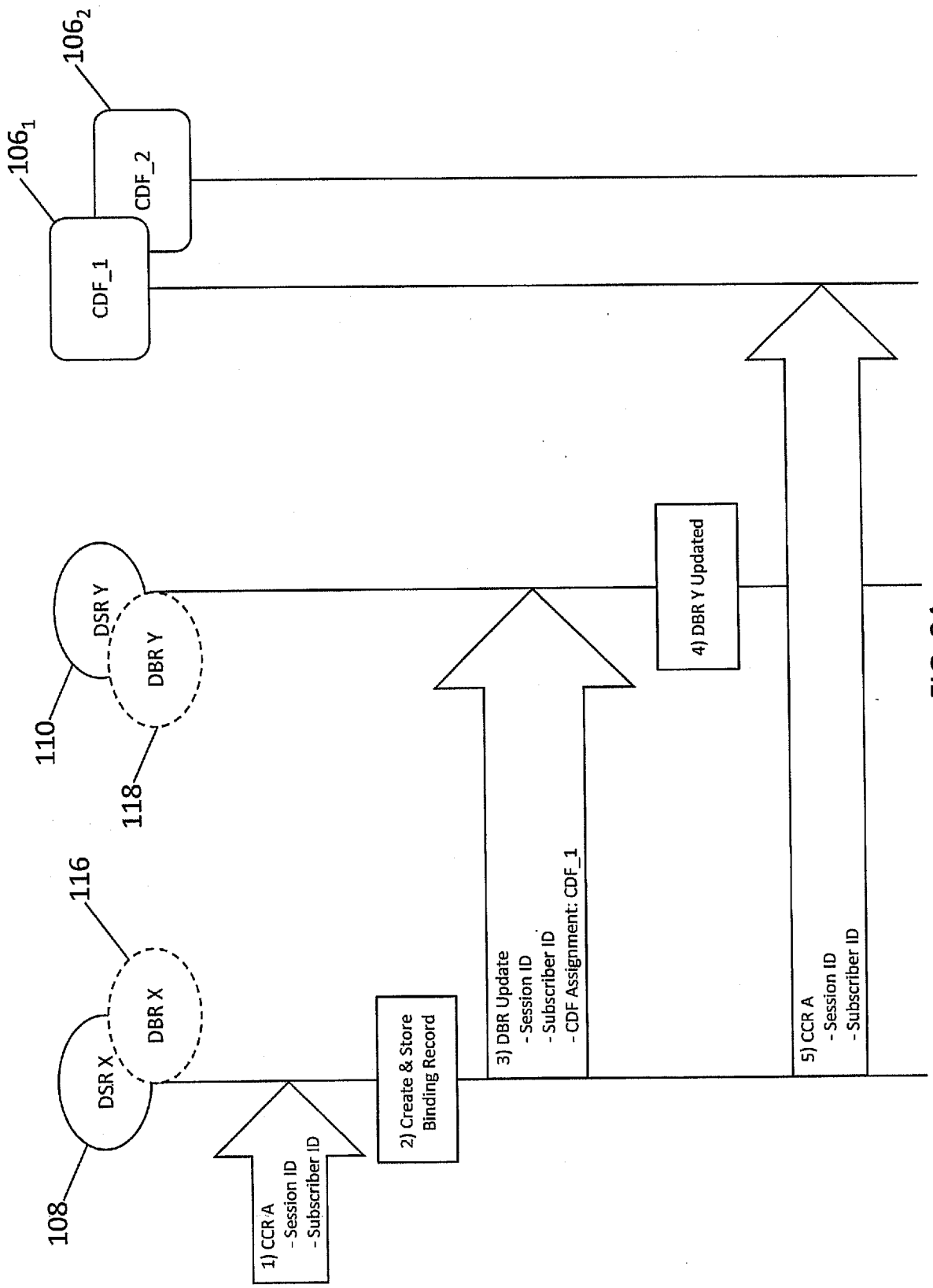
106_2
106_1
CDF_2
CDF_1
DSR Y
DBR Y
110
118
116
DSR X
DBR X
108
1) CCR A
- Session ID
- Subscriber ID
2) Create & Store
Binding Record
3) DBR Update
- Session ID
- Subscriber ID
- CDF Assignment: CDF_1
4) DBR Y Updated
5) CCR A
- Session ID
- Subscriber ID

FIG. 2A

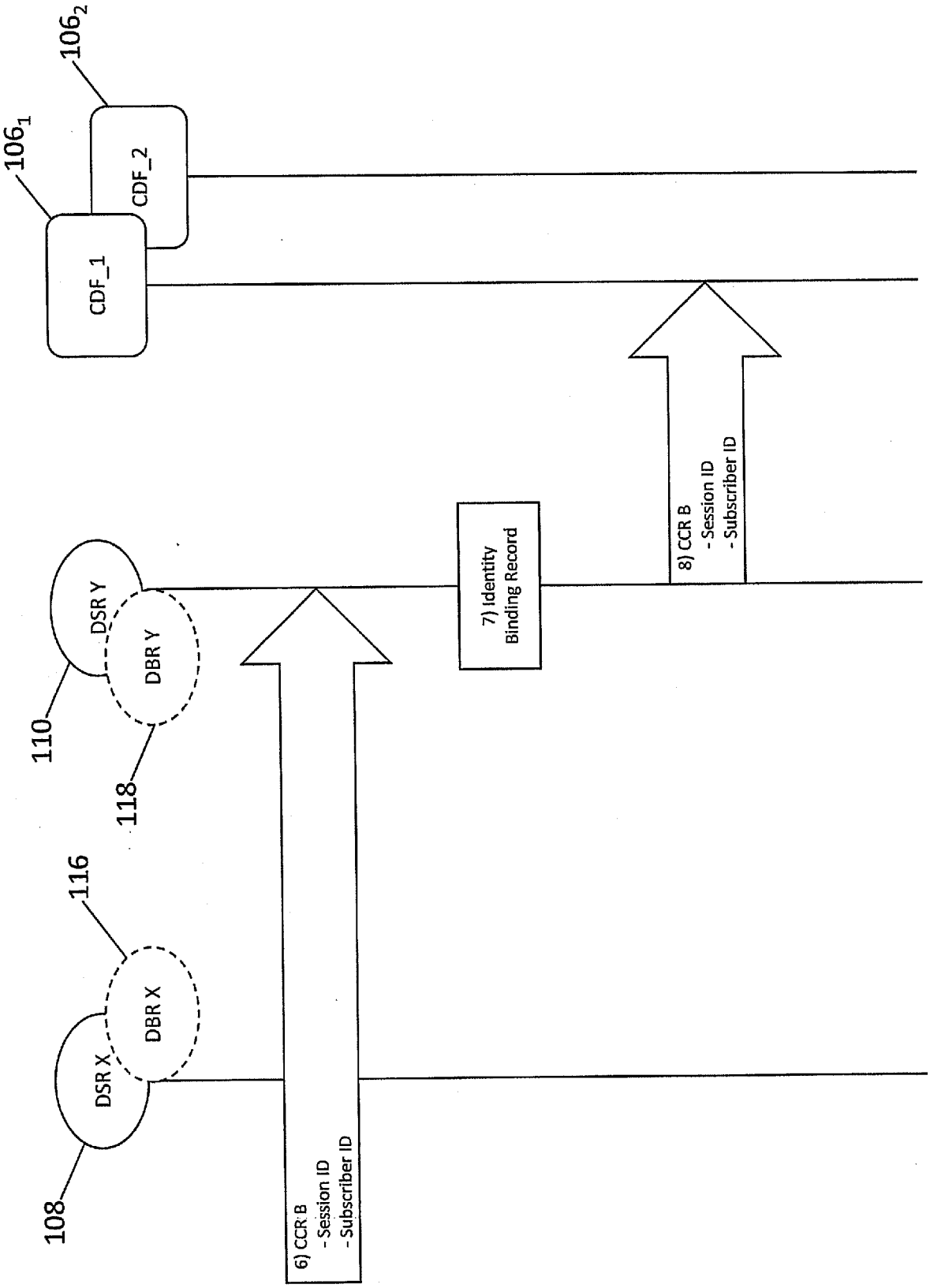
106_2
106_1
CDF_2
CDF_1
DSR Y
DBR Y
110
118
116
DSR X
DBR X
108
6) CCR B
- Session ID
- Subscriber ID
7) Identity
Binding Record
8) CCR B
- Session ID
- Subscriber ID

FIG. 2B

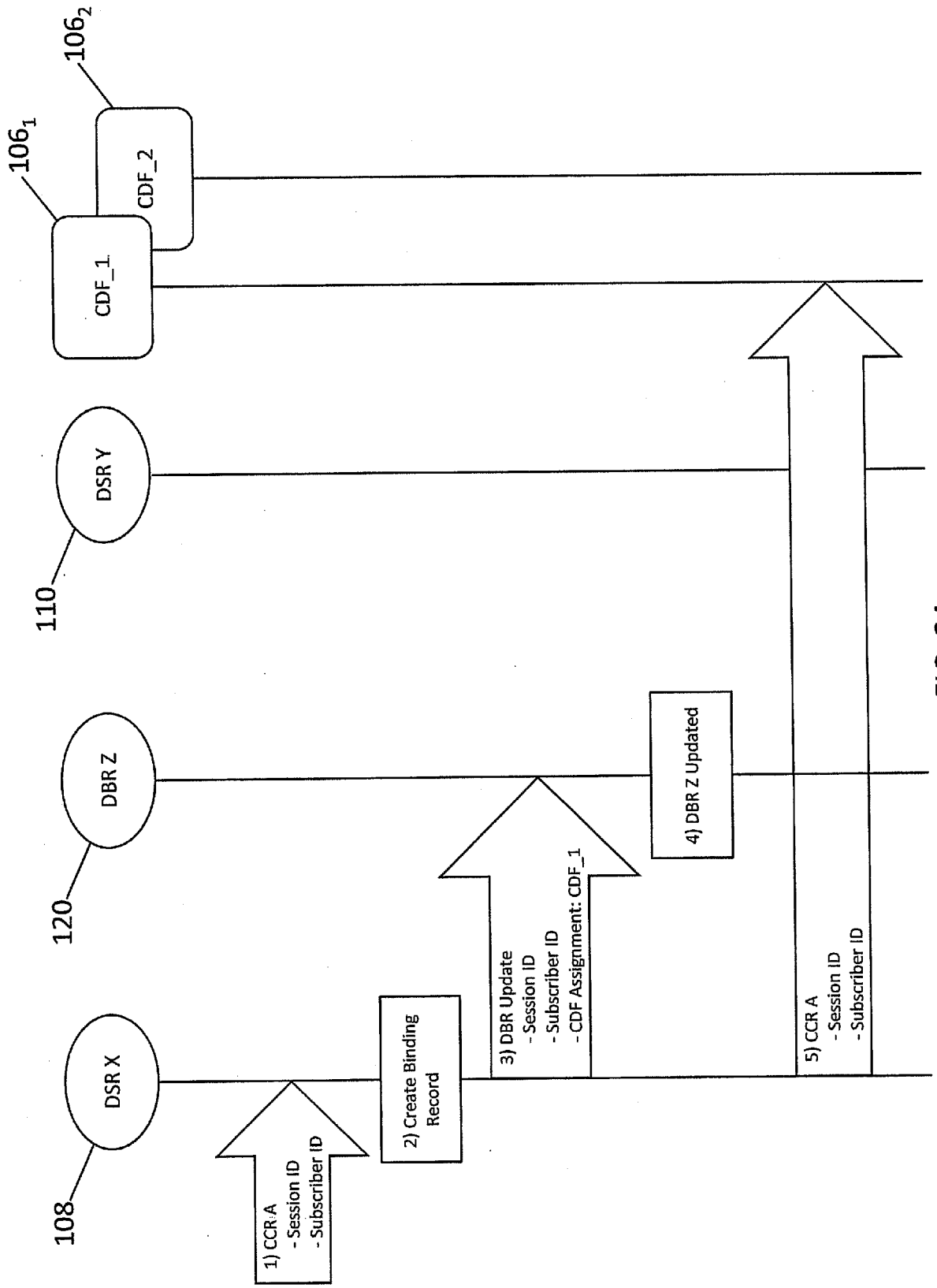
106_2
106_1
CDF_2
CDF_1
DSR Y
110
DBR Z
120
DSR X
108
1) CCR A
- Session ID
- Subscriber ID
2) Create Binding Record
3) DBR Update
- Session ID
- Subscriber ID
- CDF Assignment: CDF_1
4) DBR Z Updated
5) CCR A
- Session ID
- Subscriber ID

FIG. 3A

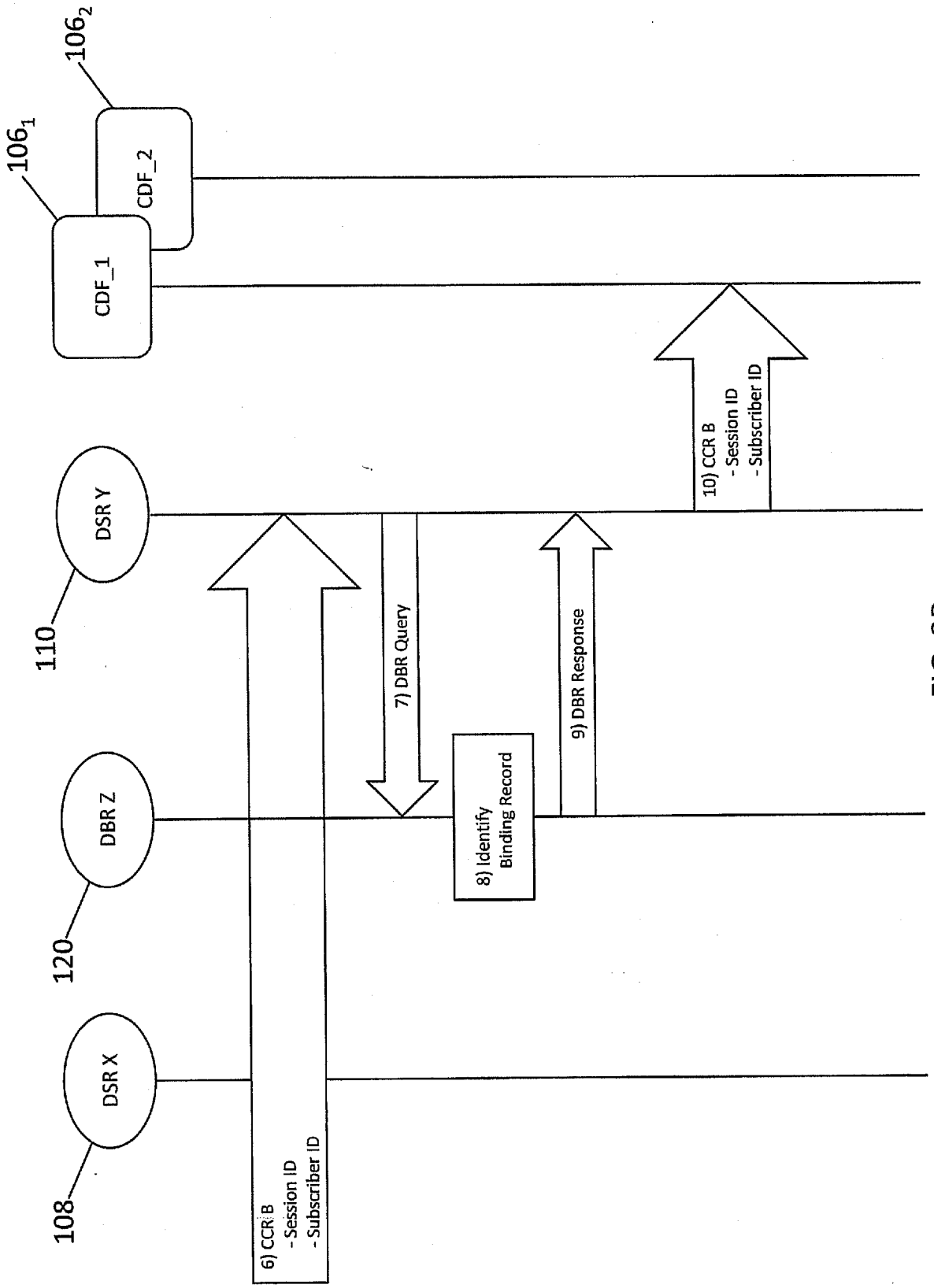
106_2
106_1
CDF_2
CDF_1
DSR Y
110
DBR Z
120
DSR X
108
6) CCR B
- Session ID
- Subscriber ID
7) DBR Query
8) Identify
Binding Record
9) DBR Response
10) CCR B
- Session ID
- Subscriber ID

FIG. 3B

Exemplary Diameter Binding Data

Diameter Session Id	User Name	IMSI	IMPI	IMPU	SIP URI	NAI	Mobile/ Dialable Number	User IP Address	CDF Identifier / Address
aaa://10.0.0.1:1;1	user1 @sample .com	3101 5099 9999 991	sip:user1 @sample .com	sip:user1 @sample .com	sip:user1 @sample .com	user1 @sample .com	919-460-0001	10.0.0.1	CDF_1
aaa://10.0.0.2:1;1	user2 @sample .com	3101 5099 9999 992	sip:user2 @sample .com	sip:user2 @sample .com	sip:user2 @sample .com	user2 @sample .com	919-460-0002	10.0.0.2	CDF_2
aaa://10.0.0.3:1;1	user3 @sample .com	3101 5099 9999 993	sip:user3 @sample .com	sip:user3 @sample .com	sip:user3 @sample .com	user3 @sample .com	919-460-0003	10.0.0.3	CDF_1

400

FIG. 4

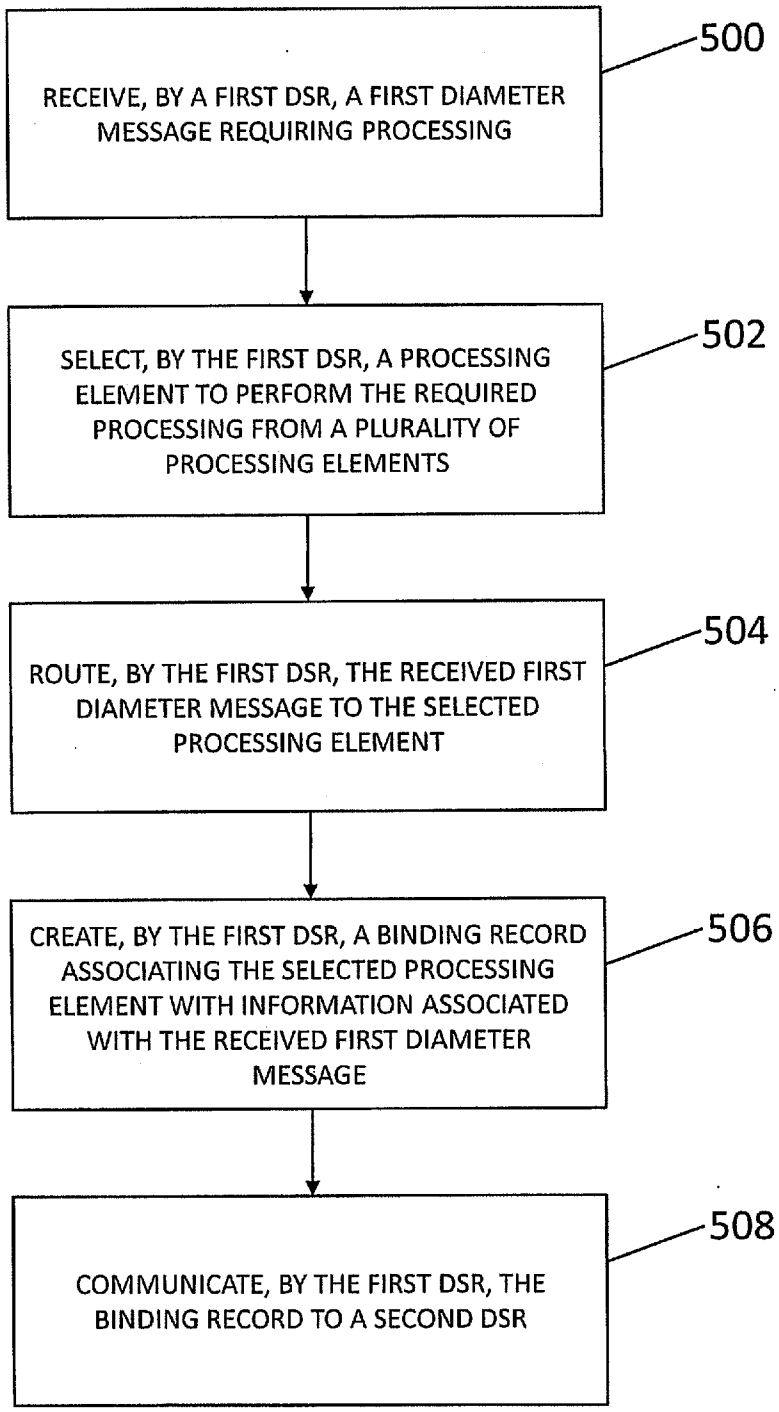
RECEIVE, BY A FIRST DSR, A FIRST DIAMETER MESSAGE REQUIRING PROCESSING
500
SELECT, BY THE FIRST DSR, A PROCESSING ELEMENT TO PERFORM THE REQUIRED PROCESSING FROM A PLURALITY OF PROCESSING ELEMENTS
502
ROUTE, BY THE FIRST DSR, THE RECEIVED FIRST DIAMETER MESSAGE TO THE SELECTED PROCESSING ELEMENT
504
CREATE, BY THE FIRST DSR, A BINDING RECORD ASSOCIATING THE SELECTED PROCESSING ELEMENT WITH INFORMATION ASSOCIATED WITH THE RECEIVED FIRST DIAMETER MESSAGE
506
COMMUNICATE, BY THE FIRST DSR, THE BINDING RECORD TO A SECOND DSR
508

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/027263

A. CLASSIFICATION OF SUBJECT MATTER

H04W 8/02(2009.01)i, H04W 8/18(2009.01)i

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)
H04W 8/02; H04W 24/00; H04K 1/00; H04L 12/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: diameter , message , routing

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010-0291923 A1 (XIAOYUN ZHOU et al.) 18 November 2010 See claims 1-11 and figures 1-7.	1-35
A	EP 2242205 A1 (ZTE CORPORATION) 20 October 2010 See claims 1-7 and figures 1-4.	1-35
A	US 2006-0078119 A1 (JUNG HOON JEE et al.) 13 April 2006 See claims 1-10 and figures 1-10.	1-35

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 JUNE 2012 (13.06.2012)	**14 JUNE 2012 (14.06.2012)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/027263

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EP 2242205 A1	20.10.2010	CN 101227391 A	23.07.2008
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