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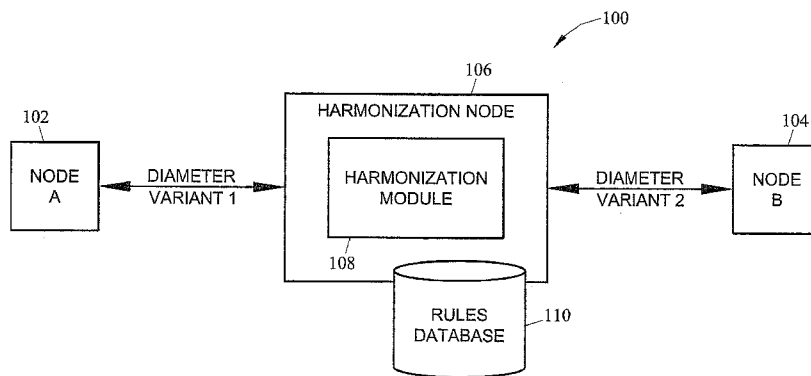
FIG. 1

(57) **Abstract**: According to one aspect, the subject matter described herein includes a method for providing Diameter protocol harmonization. The method includes steps occurring at a Diameter node. The method further includes determining a first Diameter protocol associated with received Diameter information that is to be sent to a destination. The method also includes determining a second Diameter protocol associated with the destination. The method further includes harmonizing the received Diameter information such that the harmonized Diameter information is compatible with the second Diameter protocol. The method also includes providing the harmonized Diameter information to the destination.

DESCRIPTION
METHODS, SYSTEMS, AND COMPUTER READABLE MEDIA FOR DIAMETER PROTOCOL HARMONIZATION

5   PRIORITY CLAIM

This application claims the benefit of U.S. Provisional Patent Application Serial No. 61/304,310 filed February 12, 2010; the disclosure of which is incorporated herein by reference in its entirety.

10   STATEMENT OF INCORPORATION BY REFERENCE

The disclosures of each of the following commonly-owned, co-pending U.S. Patent Applications filed on February 11, 2011 are hereby incorporated herein by reference in their entireties:

"Methods, Systems, And Computer Readable Media For Inter-
15 Diameter-Message Processor Routing," Attorney Docket No. 1322/399/2 (Serial No. not yet assigned);

"Methods, Systems, And Computer Readable Media For Source Peer Capacity-Based Diameter Load Sharing" Attorney Docket No. 1322/399/3 (Serial No. not yet assigned);

20   "Methods, Systems, And Computer Readable Media For Inter-Message Processor Status Sharing," Attorney Docket No. 1322/399/4 (Serial No. not yet assigned);

"Methods, Systems, And Computer Readable Media For Providing Priority Routing At A Diameter Node," Attorney Docket No. 1322/399/5
25 (Serial No. not yet assigned);

"Methods, Systems, And Computer Readable Media For Providing Peer Routing At A Diameter Node," Attorney Docket No. 1322/399/6/2 (Serial No. not yet assigned);

"Methods, Systems, And Computer Readable Media For Providing
30 Origin Routing At A Diameter Node," Attorney Docket No. 1322/399/7 (Serial No. not yet assigned);

"Methods, Systems, And Computer Readable Media For Providing Local Application Routing At A Diameter Node," Attorney Docket No. 1322/399/8 (Serial No. not yet assigned);

"Methods, Systems, And Computer Readable Media For Answer-
5   Based Routing Of Diameter Request Messages," Attorney Docket No. 1322/399/9 (Serial No. not yet assigned);

"Methods, Systems, And Computer Readable Media For Performing Diameter Answer Message-Based Network Management At A Diameter Signaling Router (DSR)," Attorney Docket No. 1322/399/10 (Serial No. not
10   yet assigned);

"Methods, Systems, And Computer Readable Media For Multi-Interface Monitoring And Correlation Of Diameter Signaling Information," Attorney Docket No. 1322/399/11 (Serial No. not yet assigned);

"Methods, Systems, And Computer Readable Media For Diameter
15   Network Management," Attorney Docket No. 1322/399/13 (Serial No. not yet assigned); and

"Methods, Systems, And Computer Readable Media For Diameter Application Loop Prevention," Attorney Docket No. 1322/399/14 (Serial No. not yet assigned).

20

TECHNICAL FIELD

The subject matter described herein relates to methods, systems, and computer readable media for communications in a communications network. More particularly, the subject matter described herein relates to methods,
25   systems, and computer readable media for Diameter protocol harmonization.

BACKGROUND

Diameter is an authentication, authorization and accounting (AAA) protocol for computer networks, and is a successor to Radius. The Diameter
30   base protocol is defined in International Engineering Task Force (IETF) request for comments (RFC) 3588 which is incorporated by reference herein in its entirety. Extensions to the base protocol also exist, with some

extensions having defined standards. For example, RFC 4072 defines Diameter Extensible Authentication Protocol (EAP) Application.

While a standard may generally describe scope and other characteristics of a Diameter protocol, the standard may also allow for various implementation choices. For example, vendor 'A' may implement or use a Diameter protocol that creates Diameter messages that are different (e.g., partially or fully incompatible) from Diameter messages created using a second vendor's implementation. Diameter protocol incompatibility can cause various problems. For example, Diameter nodes that use incompatible Diameter protocols may be unable to effectively communicate.

Accordingly, there exists a need for methods, systems, and computer readable media for Diameter protocol harmonization.

SUMMARY

According to one aspect, the subject matter described herein includes a method for providing Diameter protocol harmonization. The method includes steps occurring at a Diameter node. The method further includes determining a first Diameter protocol associated with received Diameter information that is to be sent to a destination. The method also includes determining a second Diameter protocol associated with the destination. The method further includes harmonizing the received Diameter information such that the harmonized Diameter information is compatible with the second Diameter protocol. The method also includes providing the harmonized Diameter information to the destination.

According to another aspect, the subject matter described herein includes a system for providing Diameter protocol harmonization. The system includes a Diameter node. The Diameter node includes a communications interface for receiving Diameter information that is to be sent to a destination. The Diameter node also includes a harmonization module for determining a first Diameter protocol associated with the received Diameter information, for determining a second Diameter protocol associated with the destination, for harmonizing the received Diameter information such that the harmonized Diameter information is compatible

with the second Diameter protocol, and for providing the harmonized Diameter information to the destination.

The subject matter described herein can be implemented in software in combination with hardware and/or firmware. For example, the subject

5   matter described herein can be implemented in software executed by a processor. In one exemplary implementation, the subject matter described herein may be implemented using a 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

10   computer readable media suitable for implementing the subject matter described herein include non-transitory devices, 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

15   device or computing platform or may be distributed across multiple devices or computing platforms.

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

As used herein, the terms "function" or "module" refer to software in

20   combination with hardware and/or firmware for implementing features described herein.

As used herein, the term "Diameter protocol" may refer to any Diameter protocol framework or implementation thereof. For example, a Diameter protocol may be a Diameter protocol implementation, a Diameter

25   protocol version, a variant of a Diameter protocol version, a Diameter protocol variant, or a version of a Diameter protocol variant.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the subject matter described herein will

30   now be explained with reference to the accompanying drawings, wherein like reference numerals represent like parts, of which:

Figure 1 is a network diagram illustrating an exemplary network including a Diameter node having a harmonization module according to an embodiment of the subject matter described herein;

Figure 2 is a diagram illustrating exemplary information for determining a Diameter protocol according to an embodiment of the subject matter described herein;

Figure 3 is a diagram illustrating exemplary information for determining a harmonization rule set to be applied according to an embodiment of the subject matter described herein;

Figure 4 is a diagram illustrating exemplary information for determining rules associated with a harmonization rule set to be applied according to an embodiment of the subject matter described herein;

Figure 5 is block diagram illustrating an exemplary Diameter signaling router for providing Diameter protocol harmonization according to an embodiment of the subject matter described herein; and

Figure 6 is a flow chart illustrating exemplary steps for providing Diameter protocol harmonization according to an embodiment of the subject matter described herein.

DETAILED DESCRIPTION

Reference will now be made in detail to exemplary embodiments of the subject matter described herein, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

Figure 1 is a network diagram illustrating an exemplary communications network **100** according to an embodiment of the subject matter described herein. In the embodiment illustrated in Figure 1, communications network **100** may include a Diameter harmonization node **106** having a harmonization module **108** and having access to a rules database **110**. Communications network **100** may also include additional Diameter nodes, such as Node A **102** and Node B **104**.

Diameter nodes (e.g., Node A **102**, and Node B **104**, and harmonization node **106**) may be nodes capable of implementing or using a

Diameter protocol. For example, a Diameter node may comprise a mobility management entity (MME), a home subscriber server (HSS) and/or authentication, authorization, and accounting (AAA) server, a Bearer Binding and Event Reporting Function (BBERF), a policy charging enforcement

5 function (PCEF), a policy charging and rules function (PCRF), a subscriber profile repository (SPR), a serving gateway (SGW), a packet data network gateway (PDN GW), a Diameter peer node, a Diameter agent, a network node, a policy engine, a policy server, an application function (AF), an application server, a Diameter signaling agent, a long term evolution (LTE)

10 node, an Internet protocol (IP) multimedia subsystem (IMS) network node, a server, a node, a database, a computing platform, or a Diameter signaling router (DSR).

In some embodiments, harmonization node **106** may comprise a DSR. A DSR may be any suitable entity for routing or relaying Diameter

15 signaling messages between Diameter nodes. For example, a DSR may be a LTE signaling router, an LTE Diameter signaling router, a Diameter signaling agent, a Diameter proxy agent, a Diameter relay agent, a Diameter routing agent, a Diameter translation agent, or a Diameter redirect agent. A DSR may include functionality for processing various messages and may

20 include various communications interfaces for communication with Diameter nodes, e.g., 3rd Generation Partnership Project (3GPP) LTE communications interfaces and other (e.g., non-LTE) communications interfaces. In one embodiment, DSR related functionality, including the subject matter described herein, may be included in one or more modules

25 (e.g., a harmonization module and a routing module).Harmonization node **106** and/or harmonization module **108** may include functionality for performing Diameter protocol harmonization. Diameter protocol harmonization may include any actions for providing Diameter information in a compatible or appropriate form. For example, Diameter protocol

30 harmonization may include receiving, modifying, generating, and/or providing Diameter information between Diameter nodes that use various Diameter protocols.

Diameter protocols may be defined, described, and/or implemented by various entities. For example, a Diameter protocol version and/or variant may be defined by a standards setting entity, such as IETF, International Telecommunication Union (ITU), European Telecommunications Standards 5 Institute (ETSI), 3GPP, governmental agencies, and/or other organizations. In another example, a Diameter protocol version and/or variant may be defined by other entities, e.g., open source projects, product vendors, and network operators.

In one embodiment, Diameter protocol harmonization may include 10 adding, deleting, and/or modifying one or more portions of a Diameter message. For example, Diameter protocol harmonization may include adding, deleting, and/or modifying an attribute value pair (AVP) of a Diameter message. In another example, harmonization may include adding, deleting, and/or modifying parameters and/or values contained in an AVP. 15 In yet another example, harmonization may include adding, deleting, and/or modifying message portions, such as a header portion and a payload portion.

In one embodiment, Diameter protocol harmonization may use one or more harmonization rules for performing Diameter protocol harmonization. 20 For example, a harmonization rule may include information for converting Diameter information from a first Diameter protocol version into a second Diameter protocol version. For instance, the harmonization rule may include information indicating portions of a Diameter message to be modified and indicating modifications to be performed on the portions.

25 Harmonization node **106** may include or have access to one or more databases, such as rules database **110**. Rules database **110** may include any suitable data structure for storing or maintaining harmonization rules. Harmonization node **106** may include or have access to a reporting database. The reporting database may store information about messages 30 and associated processing (e.g., call detail records (CDRs)). The stored information at reporting database may be usable for various purposes, such as accounting, billing, maintenance, and authentication.

Referring to the embodiment shown in Figure 1, harmonization node **106**, including harmonization module **108**, may be an intermediate node for communications between Node A **102** and Node B **104**. Node A **102** may utilize a Diameter protocol (e.g., Diameter Variant 1) that is partially or fully

5   incompatible with a second Diameter protocol (e.g., Diameter Variant 2) utilized by Node B **104**.

Harmonization node **106** may receive Diameter messages (e.g., Diameter request messages and Diameter answer messages) from Node A **102** and/or Node B **104**. In one embodiment, harmonization node **106** may

10   determine a Diameter protocol associated with a received Diameter message. For example, harmonization node **106** may have access to stored Diameter protocol information for various nodes and/or applications executing at the nodes. For instance, harmonization node **106** may access a data structure that includes information associating Diameter nodes and

15   utilized Diameter protocols. By comparing header information of a received Diameter message with stored Diameter protocol information, harmonization node **106** may determine that a Diameter message originating from Node B **104** is associated with a particular Diameter protocol. In another example, harmonization node **106** may determine a Diameter protocol associated with

20   a received Diameter message based on an examining the message structure, or a portion thereof. For instance, harmonization node **106** may use a parser module and Diameter protocol definitions to identify characteristics (e.g., particular AVP information) of a received message that indicate an associated Diameter protocol.

25   In one embodiment, harmonization node **106** may determine a Diameter protocol associated with a destination (e.g., a node, a host, a realm, a domain, a network segment, or a network) to which a received Diameter message is addressed or may traverse. For example, harmonization node **106** may determine, by examining a header portion of a

30   Diameter message, that the Diameter message is addressed to Node B **104**. Using one or more methods, harmonization node **106** may determine that Node B **104** utilizes a particular Diameter protocol. In another example, harmonization node **106** may determine, by examining one or more portions

of a received Diameter message, an intermediate (e.g., a next hop) destination to send the received Diameter message, or Diameter information therein. In this example, harmonization node **106** may determine that the intermediate destination utilizes a particular Diameter protocol.

5   In one embodiment, harmonization node **106** may determine that Diameter protocol harmonization should be performed. For example, after receiving a Diameter message destined for Node B **104**, harmonization node **106** may determine that the Diameter protocol associated with the received Diameter message is incompatible with the Diameter protocol associated

10   with the message's destination, Node B **104**.

In response to determining that Diameter protocol harmonization should be performed, harmonization node **106** may perform Diameter protocol harmonization. In one embodiment, Diameter protocol harmonization may include modifying a received Diameter message so as to

15   make the Diameter message compatible with a Diameter protocol used by a destination. For example, a header portion of a received Diameter message sent from Node A **102** may be modified at harmonization node **106** so it is compatible for processing at Node B **104**. After modification, the modified Diameter message may be sent to the destination.

20   In another embodiment, Diameter protocol harmonization may include generating a new Diameter message that is based on the received Diameter message. For example, harmonization module **108** may use a harmonization rule to modify or convert Diameter information from a received Diameter message to be compatible with a Diameter protocol used by a

25   destination and may include the modified Diameter information in the new Diameter message. After generating a Diameter message that is based on the received Diameter message, the generated Diameter message may be sent to the destination and the received Diameter message may be discarded.

30   It will be appreciated that Diameter protocol harmonization may be depend on various factors, e.g., Diameter protocols involved and Diameter information to be communicated. For example, harmonizing a Diameter message originating from Node A **102** and destined for Node B **104** may

include a set of harmonization rules and/or processing steps. Likewise, harmonizing a Diameter message originating from Node B **104** and destined for Node A **102** may include a different set of harmonization rules and/or processing steps.

5   Figure 2 is a diagram illustrating exemplary information usable for determining a Diameter protocol according to an embodiment of the subject matter described herein. In one embodiment, the exemplary information may be stored at a database, e.g., rules database **110**, and/or other data structure. For example, the exemplary information may be located at or integrated with one or more Diameter nodes, e.g., harmonization node **106**, Node A **102**, and Node B **104**. In another example, one or more Diameter nodes may have access to the exemplary information stored at a distinct database node.

          Referring to Figure 2, a table **200** represents any suitable data structure for storing information usable for determining a Diameter protocol associated with Diameter information and/or a destination for Diameter information. In the embodiment illustrated in Figure 2, table **200** may include Diameter host identifiers (IDs), application IDs, and associated Diameter protocol IDs. Diameter host IDs may be uniform resource identifiers (URIs) or other identifiers for identifying Diameter nodes. For instance, a Diameter host ID may indicate an origination node for a Diameter message received at a harmonization node **106**. A Diameter host ID may also be usable to identify a vendor and/or network associated with the origination node.

          Application IDs may be values or other information for identifying applications that use a Diameter protocol. For example, an application ID may identify an authentication application, an authorization application, an accounting application, or a vendor specific application. As shown in the embodiment illustrated in Figure 2, a Diameter host ID may be associated with various application IDs.

30   Diameter protocol IDs may be values or other information for identifying particular Diameter protocols or groups of Diameter protocols. For example, a Diameter protocol ID may be a version number, a variant number, a value based on a global identifying scheme, or a value based on

a local (e.g., vendor specified) identifying scheme. In another example, a Diameter protocol ID may indicate all Diameter protocols that are compatible with a vendor, a product, or a product version. For example, a Diameter protocol ID "1" may indicate a Tekelec-compatible Diameter protocol, a

5   Diameter protocol ID "2" may indicate a Cisco-compatible Diameter protocol, and a Diameter protocol ID "3" may indicate an Ericsson-compatible Diameter protocol.

In one embodiment, a Diameter host ID and an application ID may be associated with a Diameter protocol IDs. For example, as illustrated in table

10   **200**, a Diameter host ID "www.tekelec.com" and an application ID "88" may be associated with a Diameter protocol ID "1". In another example illustrated in table **200**, a Diameter host ID "www.vzw.com" and an application ID "88" may be associated with a Diameter protocol ID "2". In yet another example illustrated in table **200**, a Diameter host ID "www.vzw.com" and an

15   application ID "15" may be associated with a Diameter protocol ID "3".

In one embodiment, harmonization node **106** and/or harmonization module **108** may use table **200**, or information therein, for determining Diameter protocols. For example, harmonization node **106** may examine a header portion of a received Diameter message and discover an origination

20   host ID and an application ID. Using the origination host ID and the application ID, harmonization node **106** may query data structure **200** for a Diameter protocol ID associated with the origination node. In another example, harmonization node **106** may examine a header portion of a received Diameter message and discover a destination host ID and an

25   application ID. Using the destination host ID and the application ID, harmonization node **106** may query data structure **200** for a Diameter protocol ID associated with a destination.

Figure 3 is a diagram illustrating exemplary information for determining a harmonization rule set to be applied according to an

30   embodiment of the subject matter described herein. As used herein, a harmonization rule set may include one or more harmonization rules. In one embodiment, the exemplary information may be stored at a database, e.g., rules database **110**, and/or other data structure. For example, the

exemplary information may be located at or integrated with one or more Diameter nodes, e.g., harmonization node **106**, Node A **102**, and Node B **104**. In another example, one or more Diameter nodes may have access to the exemplary information stored at a distinct database node.

5   Referring to Figure 3, a table **300** represents any suitable data structure for storing information usable for determining a harmonization rule set to be applied in harmonizing Diameter information. In the embodiment illustrated in Figure 3, table **300** may include ingress Diameter protocols ID, egress Diameter protocols ID, and associated harmonization rule set IDs.

10   Ingress Diameter protocol IDs may identify Diameter protocols associated with ingress Diameter information. For instance, an ingress Diameter protocol ID may identify a Diameter protocol that is utilized by an origination node of a received Diameter message. Egress Diameter protocol IDs may identify Diameter protocols associated with egress Diameter information.

15   For instance, an egress Diameter protocol ID may identify a Diameter protocol utilized by a destination node that is to receive Diameter information. Harmonization rule set IDs may be values or other information for identifying harmonization rule sets.

        In one embodiment, an ingress Diameter protocol ID and an egress

20   Diameter protocol ID may be associated with a harmonization rule set ID. For example, as illustrated in table **300**, an ingress Diameter protocol ID "1" and an egress Diameter protocol ID "2" may be associated with a harmonization rule set ID "1". In another example illustrated in table **300**, an ingress Diameter protocol ID "2" and an egress Diameter protocol ID "1" may

25   be associated with a harmonization rule set ID "2". In yet another example illustrated in table **300**, an ingress Diameter protocol ID "1" and an egress Diameter protocol ID "3" may be associated with a harmonization rule set ID "3".

        In one embodiment, harmonization node **106** and/or harmonization

30   module **108** may use table **300**, or information therein, for determining harmonization rule sets to apply during Diameter protocol harmonization. For example, using an ingress Diameter protocol ID and an egress Diameter protocol ID, harmonization node **106** may query table **300** for an appropriate

harmonization rule set ID. In one embodiment, an appropriate harmonization rule set ID may indicate a particular harmonization rule set for harmonizing Diameter information associated with the ingress Diameter protocol such that the harmonized Diameter information is compatible with the egress Diameter protocol. For example, a harmonization rule set may indicate multiple rules or processing steps for converting and/or generating a Diameter message, or portion therein, from an ingress Diameter protocol to an egress Diameter protocol.

Figure 4 is a diagram illustrating exemplary information for determining rules associated with a harmonization rule set according to an embodiment of the subject matter described herein. In one embodiment, the exemplary information may be stored at a database, e.g., rules database **110**, and/or other data structure. For example, the exemplary information may be located at or integrated with one or more Diameter nodes, e.g., harmonization node **106**, Node A **102**, and Node B **104**. In another example, one or more Diameter nodes may have access to the exemplary information stored at a distinct database node.

Referring to Figure 4, a table **400** represents any suitable data structure for storing information usable for determining rules associated with a harmonization rule set. In the embodiment illustrated in Figure 4, table **400** may include harmonization rule set IDs and associated harmonization rules. As stated above, harmonization rule set IDs may be values or other information for identifying harmonization rule sets. Harmonization rules may include instructions, processing steps, and/or other information for modifying and/or generating Diameter information. For example, a harmonization rule may indicate a particular portion or portions of a Diameter message to modify and particular modifications to perform. In another example, a harmonization rule may indicate particular information (e.g., a vendor specific AVP) to add to a Diameter message. In yet another example, a harmonization rule may indicate particular information to delete in a Diameter message.

In one embodiment, a harmonization rule set ID may be associated with one or more harmonization rules. For example, as illustrated in table

400, harmonization rule set ID "1" may be associated with three harmonization rules, e.g., 'ADD AVP: "Server Capacity" AVP: Default value = "300"', 'MODIFY AVP: Format AVP Containing IMSI Value into ITU E.212 Format", and 'DELETE AVP: Delete "ATT_Host" AVP'. As illustrated in table

5   **400**, each rule may include a different action or processing step to be performed. In one embodiment, a harmonization rule set may include priority and/or ordering information. For example, a harmonization rule set may include information indicating in what order associated harmonization rules are to be applied.

10   In one embodiment, harmonization node **106** and/or harmonization module **108** may use table **400**, or information therein, for determining rules associated with a harmonization rule set. For example, harmonization node **106** may determine a harmonization rule set ID based on an ingress Diameter protocol ID and an egress Diameter protocol ID. Using the

15   harmonization rule set ID, harmonization node **106** may query data structure **400** for each harmonization rule. In one embodiment, harmonization node **106** and/or harmonization module **108** may apply the associated harmonization rules during Diameter protocol harmonization. After applying the harmonization rules, Diameter information may be harmonized such that

20   the Diameter information is compatible for processing at a destination node.

        Figure 5 is block diagram illustrating an exemplary DSR **102** for providing Diameter protocol harmonization according to an embodiment of the subject matter described herein.

        Referring to the embodiment illustrated in Figure 5, DSR **102** includes

25   one or more message processors (MPs) **500A-D** for sending, receiving, and/or processing various messages, such as Diameter messages. MPs **500A-D** may include one or more communications interfaces for communicating signaling messages (e.g., Diameter messages) and/or inter-MP messages. For example, MPs **500A-D** may send and receive Diameter

30   request messages between external entities, e.g., Node A **102** and Node B **104**. MPs **500A-D** may also send and receive messages (e.g., Diameter messages and other non-Diameter messages) between internal entities. For

example, MP **500A** may screen a Diameter message and relay it to MP **500C** for further processing.

MPs **500A-D** may include or have access to one or more harmonization modules, e.g., harmonization modules **108A-D**. Harmonization modules **108A-D** may include any functionality described herein associated with Diameter protocol harmonization. In one embodiment, MPs **500A-D** and harmonization modules **108A-D** may include functionality for handling particular messages. For example, harmonization module **108A** at MP **500A** may handle communications with Node A **102** and harmonization module **108D** at MP **500D** may handle communications with Node B **104**.

MPs **500A-D** and/or harmonization modules **108A-D** may include or have access to one or more databases, such as rules databases **110A-D** and a reporting database. Rules databases **110A-D** may include any suitable data structure for storing or maintaining harmonization rules. In one embodiment, rules databases **110A-D** may include functionality for handling particular messages and/or Diameter protocols. For example, rules database **110A** may include with rules for converting a Diameter protocol associated with a particular service provider or a particular equipment vendor and rules database **110B** may include with rules for converting Diameter credit control messages.

In one embodiment where a DSR **102** includes multiple processors (e.g., a distributed architecture), each processor (e.g., an MP **500**) may be capable of providing Diameter protocol harmonization, or a portion thereof, e.g., regardless of which processor receives a Diameter message. For example, MP **500A** may receive a Diameter request message from Node A **102** that is destined for Node B **104**. MP **500A** and/or harmonization module **108A** may harmonize the received Diameter message to a Diameter protocol compatible for processing at Node B **104**. MP **500A** may relay or route the harmonized Diameter message to another entity, e.g., to Node B **104** or to MP **500D** for delivery to Node B **104**.

In some embodiments, two or more MPs **500** may work together to harmonize a Diameter message. For example, MP **500B** may receive a

Diameter request message from Node A **102** that is destined for Node B **104**. MP **500B** and/or harmonization module **108B** may partially harmonize the received Diameter message to a Diameter protocol or other format compatible for further processing at MP **500C**. MP **500A** may send the

5   partially harmonized Diameter message to MP **500C**. MP **500C** may receive the partially harmonized Diameter message. MP **500C** and/or harmonization module **108C** may further harmonize the received Diameter message to a Diameter protocol compatible for processing at Node B **104**. MP **500A** may relay or route the harmonized Diameter message to Node B **104**.

10   Figure 6 is a flow chart illustrating exemplary steps for providing Diameter protocol harmonization according to an embodiment of the subject matter described herein. In one embodiment, one or more exemplary steps described herein may be performed at or performed by harmonization node **106**, e.g., a DSR or a processor (e.g., an MP) in a DSR. In another

15   embodiment, one or more exemplary steps described herein may be performed at or performed by harmonization module **108** located at various Diameter nodes, e.g., Node A **102** and Node B **104**.

         Referring to the embodiment illustrated in Figure 6, at step **600**, a first Diameter protocol may be determined that is associated with received

20   Diameter information. The received Diameter information may be for sending to a destination. For example, harmonization node **106** (e.g., a DSR) may receive a Diameter signaling message from Node A **102**. The received message may be intended for Node B **104**. Harmonization node **106** may use the message and other accessible information (e.g., table **200**

25   in rules database **110**) in determining that the received Diameter message uses a particular Diameter protocol (e.g., a Diameter Variant 1).

         At step **602**, a second Diameter protocol may be determined that is associated with the destination. Continuing from the example stated above, harmonization node **106** may determine a Diameter protocol that is

30   associated with Node B **104**.

         In one embodiment, the first Diameter protocol and the second Diameter protocol may each include a Diameter protocol implementation, a Diameter protocol version, a variant of a Diameter protocol version, a

Diameter protocol variant, a version of a Diameter protocol variant, a Diameter protocol defined by a standards entity, or a Diameter protocol defined by a non-standards entity.

At step **604**, the received Diameter information may be harmonized
5   such that the harmonized Diameter information is compatible with the second Diameter protocol. Continuing from the example stated above, harmonization node **106** may use harmonization rules to harmonize the received Diameter message from its original Diameter protocol to the Diameter protocol used by Node B **104**.

10   In one embodiment, harmonizing the Diameter information may include adding, deleting, and/or modifying the received Diameter information, or a portion thereof. In another embodiment, harmonizing the Diameter information may include generating a new Diameter message based on the received Diameter information. For example, the received Diameter
15   information and/or the harmonized Diameter information may include a Diameter message, AVP information, parameter information, value information, message header information, or message payload information.

At step **606**, the harmonized Diameter information may be provided to the destination. For example where harmonizing the received Diameter
20   information include generating a Diameter message, providing the harmonized Diameter information to the destination may include sending the generated Diameter message to the destination. In another example where harmonizing the received Diameter information include modifying a received Diameter message, providing the harmonized Diameter information to the
25   destination may include sending the modified Diameter message to the destination.

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
30   for the purpose of illustration only, and not for the purpose of limitation.

CLAIMS

What is claimed is:

1.   A method for providing Diameter protocol harmonization, the method
comprising:

5   at a Diameter node:

determining a first Diameter protocol associated with received
Diameter information that is to be sent to a destination;

determining a second Diameter protocol associated with the
destination;

10   harmonizing the received Diameter information such that the
harmonized Diameter information is compatible with the second
Diameter protocol; and

providing the harmonized Diameter information to the
destination.

15 2. The method of claim 1 wherein the first Diameter protocol and the
second Diameter protocol each include a Diameter protocol
implementation, a Diameter protocol version, a variant of a Diameter
protocol version, a Diameter protocol variant, a version of a Diameter
protocol variant, a Diameter protocol defined by a standards entity, or

20   a Diameter protocol defined by a non-standards entity.

3.   The method of claim 1 wherein the destination includes a node, a
host, a realm, a domain, a network segment, or a network.

4.   The method of claim 1 wherein harmonizing the Diameter information
includes generating, using a harmonization rule, a new Diameter

25   message based on the received Diameter information and wherein
providing the harmonized Diameter information to the destination
includes sending the new Diameter message to the destination.

5.   The method of claim 1 wherein harmonizing the Diameter information
includes modifying, using a harmonization rule, the received Diameter

30   information and wherein providing the harmonized Diameter
information to the destination includes sending the modified Diameter
information to the destination.

6.   The method of claim 1 wherein one or more harmonization rule is stored at a database.

7.   The method of claim 1 wherein at least one of the received Diameter information and the harmonized Diameter information includes a Diameter message, attribute value pair (AVP) information, parameter information, value information, message header information, or message payload information.

8.   The method of claim 1 wherein the Diameter node comprises a Diameter signaling router (DSR), a Diameter relay agent, a Diameter redirect agent, a Diameter translation agent, a Diameter proxy agent, a Diameter node, a mobility management entity (MME), a home subscriber server (HSS) and/or authentication, authorization, and accounting (AAA) server, a Bearer Binding and Event Reporting Function (BBERF), a serving gateway (SGW), a packet data network gateway (PDN GW), a policy charging enforcement function (PCEF), a policy charging and rules function (PCRF), a subscriber profile repository (SPR), a Diameter agent, a network node, a policy engine, a policy server, an application function (AF), an application server, a Diameter signaling agent, a long term evolution (LTE) node, an Internet protocol (IP) multimedia subsystem (IMS) network node, a server, a node, a processor, a database, or a computing platform.

9.   A system for providing Diameter protocol harmonization, the system comprising:

a Diameter node including:

a communications interface for receiving Diameter information that is to be sent to a destination; and

a harmonization module for determining a first Diameter protocol associated with the received Diameter information, for determining a second Diameter protocol associated with the destination, for harmonizing the received Diameter information such that the harmonized Diameter information is compatible with the second Diameter protocol, and for providing the harmonized Diameter information to the destination.

10. The system of claim 9 wherein the first Diameter protocol and the second Diameter protocol each include a Diameter protocol implementation, a Diameter protocol version, a variant of a Diameter protocol version, a Diameter protocol variant, a version of a Diameter protocol variant, a Diameter protocol defined by a standards entity, or a Diameter protocol defined by a non-standards entity.

11. The system of claim 9 wherein the destination includes a node, a host, a realm, a domain, a network segment, or a network.

12. The system of claim 9 wherein harmonizing the received Diameter information includes generating, using a harmonization rule, a new Diameter message based on the received Diameter information and wherein providing the harmonized Diameter information to the destination includes sending the new Diameter message to the destination.

13. The system of claim 9 wherein harmonizing the received Diameter information includes modifying, using a harmonization rule, the received Diameter information and wherein providing the harmonized Diameter information to the destination includes sending the modified Diameter information to the destination.

14. The system of claim 9 comprising a database for storing one or more harmonization rules.

15. The system of claim 9 wherein at least one of the received Diameter information and the harmonized Diameter information includes a Diameter message, attribute value pair (AVP) information, parameter information, value information, message header information, or message payload information.

16. The system of claim 9 wherein the system comprises a Diameter signaling router, a Diameter relay agent, a Diameter redirect agent, a Diameter translation agent, a Diameter proxy agent, a Diameter node, a mobility management entity (MME), a home subscriber server (HSS) and/or authentication, authorization, and accounting (AAA) server, a Bearer Binding and Event Reporting Function (BBERF), a serving gateway (SGW), a packet data network gateway (PDN GW),

a policy charging enforcement function (PCEF), a policy charging and rules function (PCRF), a subscriber profile repository (SPR), a Diameter agent, a network node, a policy engine, a policy server, an application function (AF), an application server, a Diameter signaling agent, a long term evolution (LTE) node, an Internet protocol (IP) multimedia subsystem (IMS) network node, a server, a node, a processor, a database, or a computing platform.

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

at a Diameter node:

determining a first Diameter protocol associated with received Diameter information that is to be sent to a destination;

determining a second Diameter protocol associated with the destination;

harmonizing the received Diameter information such that the harmonized Diameter information is compatible with the second Diameter protocol; and

providing the harmonized Diameter information to the destination.
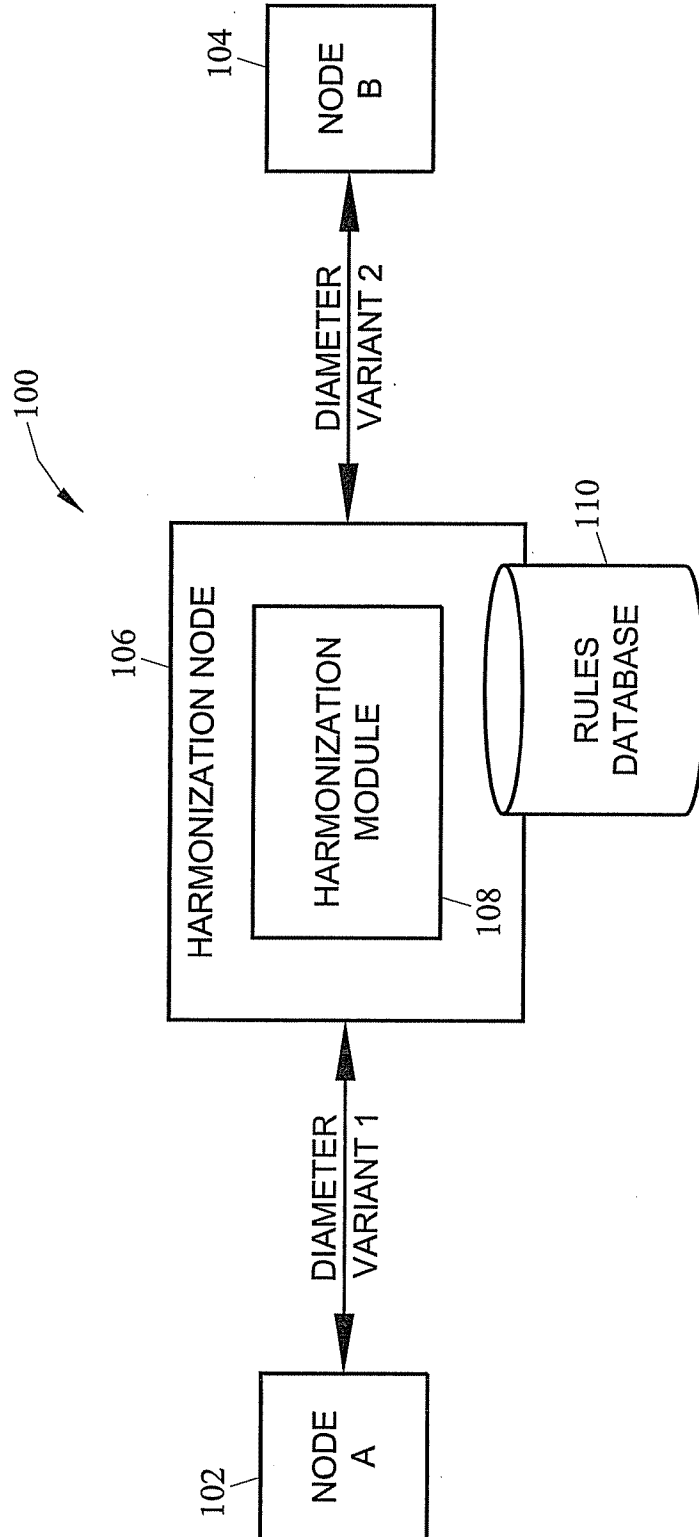
FIG. 1

DIAMETER Host ID	Application ID	DIAMETER Protocol ID
www.tklc.com	88	1
www.vzw.com	88	2
www.vzw.com	15	3

200

FIG. 2

Ingress DIAMETER Protocol ID	Egress DIAMETER Protocol ID	Harmonization Rule Set ID
1	2	1
2	1	2
1	3	3

300

FIG. 3

Harmonization Rule Set ID	Harmonization Rule
1	ADD AVP: "Server Capacity" AVP: Default value = 300
1	MODIFY AVP: Format AVP Containing IMSI value: ITU E.212
1	DELETE AVP: Delete "ATT_Host" AVP

400

FIG. 4

FIG. 5

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┌─────────────────────────────────────────┐
│     DETERMINING A FIRST DIAMETER         │──600
│  PROTOCOL ASSOCIATED WITH RECEIVED       │
│   DIAMETER INFORMATION THAT IS TO BE     │
│         SENT TO A DESTINATION            │
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│  DETERMINING A SECOND DIAMETER PROTOCOL  │──602
│     ASSOCIATED WITH THE DESTINATION      │
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│     HARMONIZING THE RECEIVED DIAMETER    │──604
│   INFORMATION SUCH THAT THE HARMONIZED   │
│    DIAMETER INFORMATION IS COMPATIBLE    │
│    WITH THE SECOND DIAMETER PROTOCOL     │
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│    PROVIDING THE HARMONIZED DIAMETER     │──606
│      INFORMATION TO THE DESTINATION      │
└─────────────────────────────────────────┘
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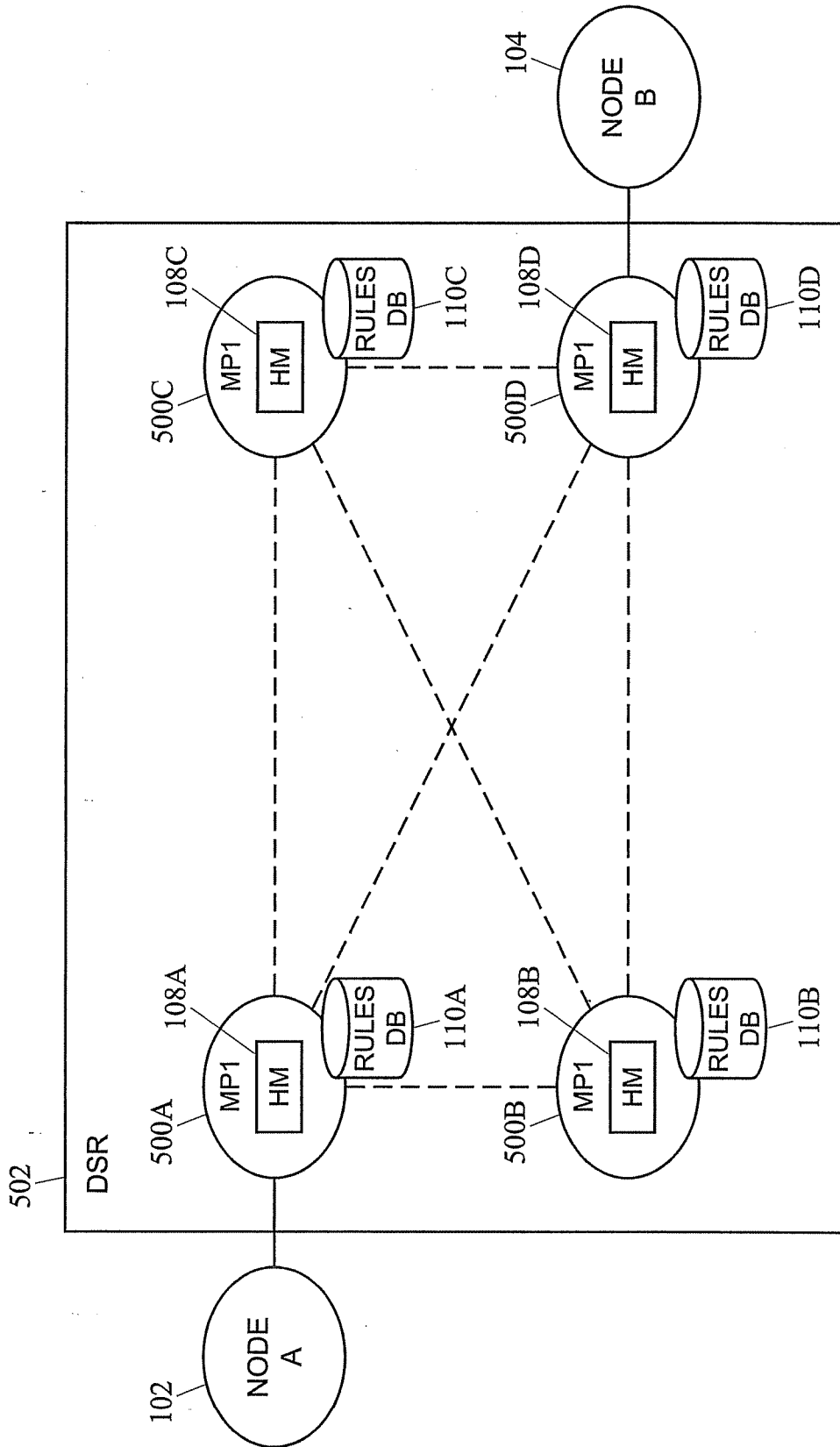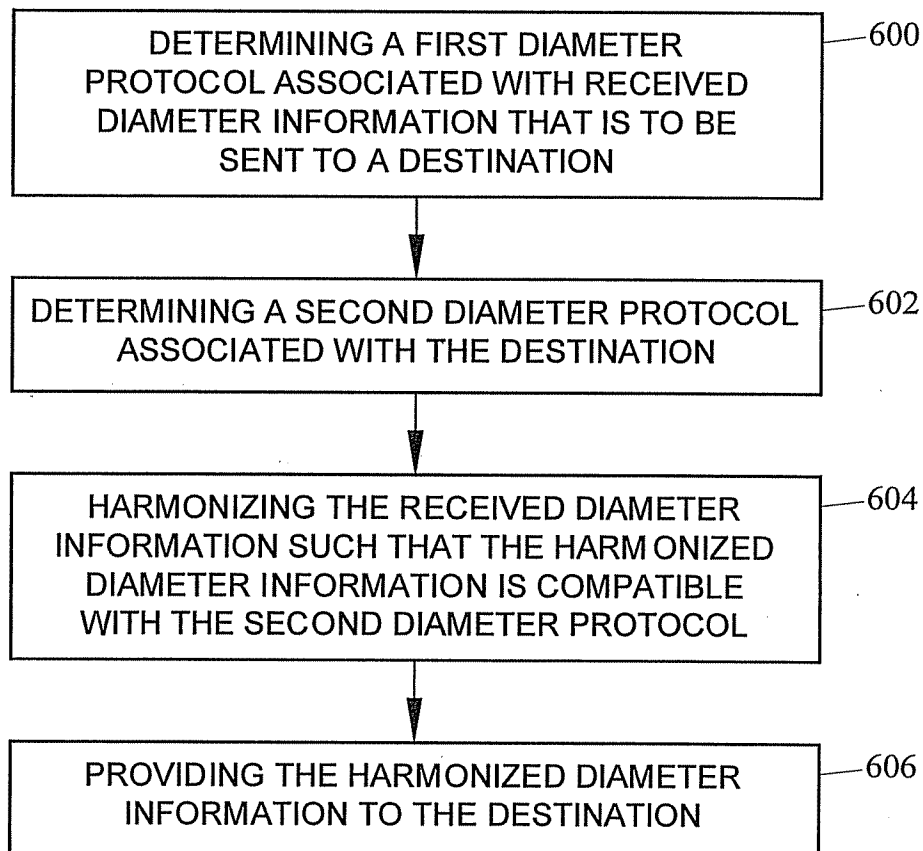
FIG. 6