



US009270770B2

(12) **United States Patent**  
**Willis**

(10) **Patent No.:** **US 9,270,770 B2**

(45) **Date of Patent:** **Feb. 23, 2016**

(54) **SYSTEM AND METHOD FOR OPTIMIZING PUBLICATION OF OPERATING STATES**

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1201 days.

(21) Appl. No.: **11/172,736**

(22) Filed: **Jun. 30, 2005**

(65) **Prior Publication Data**

US 2006/0047822 A1 Mar. 2, 2006

**Related U.S. Application Data**

(60) Provisional application No. 60/521,765, filed on Jun. 30, 2004.

(51) **Int. Cl.**  
**G06F 15/16** (2006.01)  
**H04L 29/08** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **H04L 67/24** (2013.01); **H04L 67/14** (2013.01)

(58) **Field of Classification Search**  
CPC ..... H04L 67/14; H04L 67/24  
USPC ..... 709/230, 228  
See application file for complete search history.

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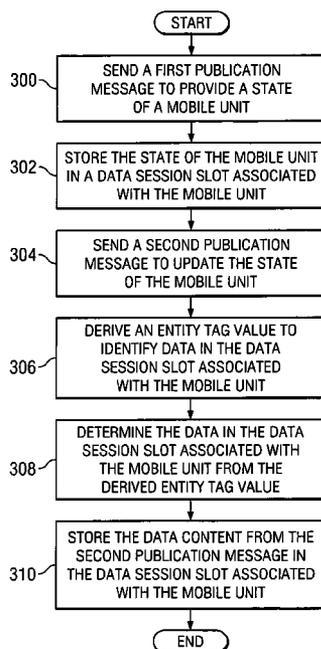
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(57) **ABSTRACT**

A system and method for optimizing publication operating states includes sending a first publication message to provide an operating state of a mobile unit. The operating state of the mobile unit is stored in a data session slot associated with the mobile unit. A second publication message is sent to update the operating state of the mobile unit. An entity tag value is derived from identifiers in accounting information of the second publication message to identify data in the data session slot associated with the mobile unit.

**17 Claims, 3 Drawing Sheets**



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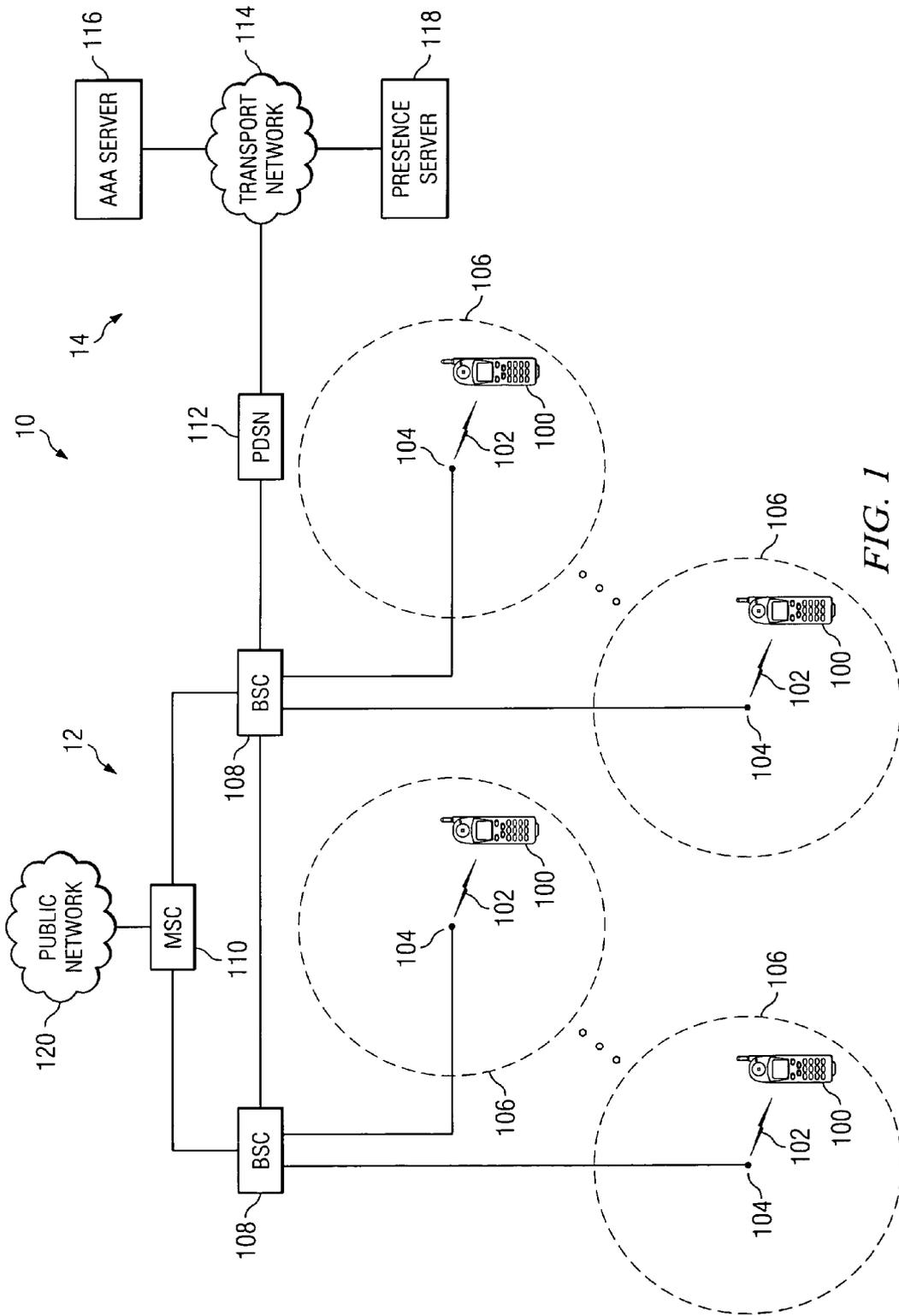


FIG. 1

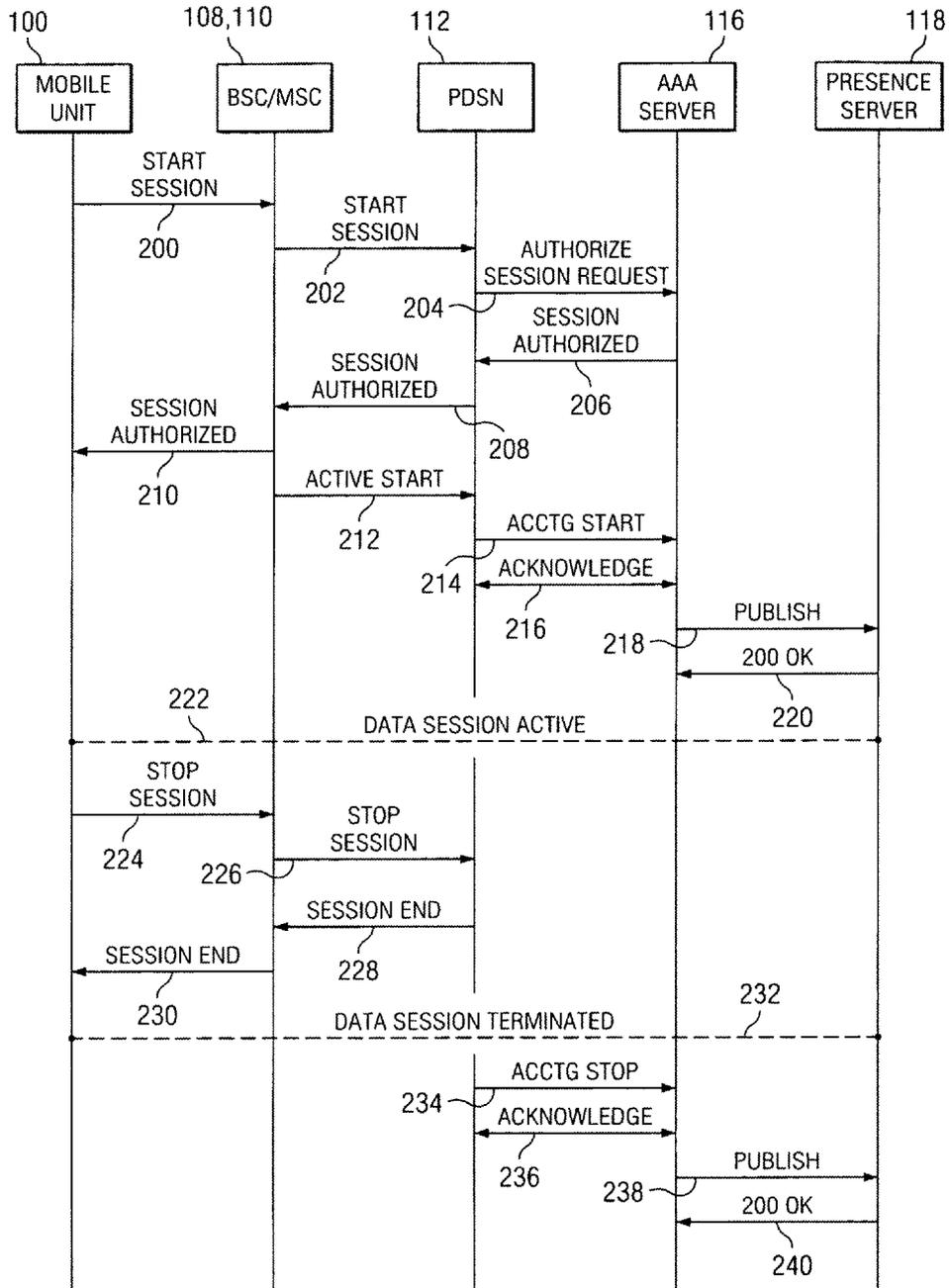
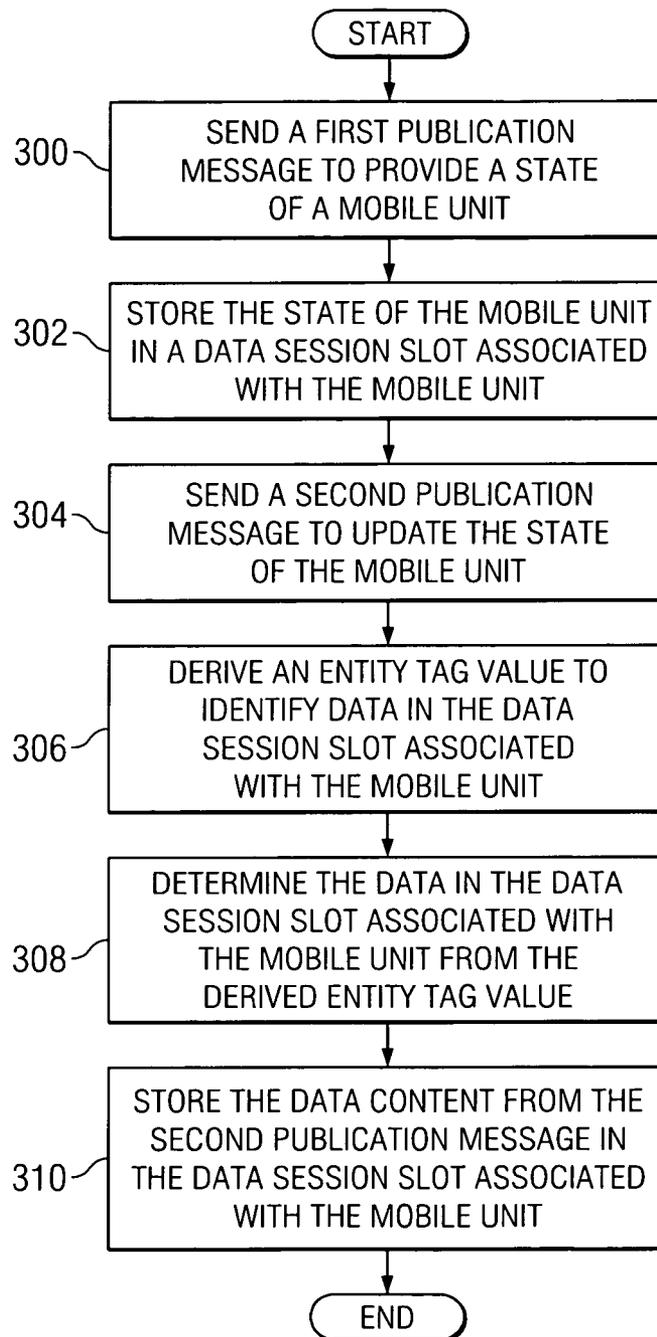


FIG. 2

*FIG. 3*

## SYSTEM AND METHOD FOR OPTIMIZING PUBLICATION OF OPERATING STATES

### RELATED APPLICATION

This application claims the benefit under 35 U.S.C. §119 (e) of U.S. Provisional Application Ser. No. 60/521,765 entitled: "Mechanism for Optimization of IS-835 Data Session State using SIP Events," filed on Jun. 30, 2004 and incorporated by reference herein.

### TECHNICAL FIELD OF THE INVENTION

This invention relates generally to the field of communications and more specifically to a system and method for optimizing publication of operating states.

### BACKGROUND

Presence information may be published to a presence server. Entity tag values identify the data associated with a data session. The presence server includes data session slots that store data associated with a data session's operating state. Conventionally, publication messages related to the data session slot included an old entity tag value in the request and the new operating state. The presence server replaced the stored operating state with the new operating state and returned a new entity tag value associated with the new operating state. The new entity tag value was then used in the next publication message. Therefore, the entity tag value traditionally changed with every new publication of the operating state. An authentication, authorization, and accounting (AAA) server updated the stored entity tag value with each transaction. Therefore, the AAA server kept an entity tag value to identify the data content. If the AAA server was implemented as a redundant cluster, the entity tag value was stored in a persistent storage or communicated across all nodes in a cluster. Storing the entity tag value and/or communicating the entity tag value across all nodes in the cluster is an expensive task.

If the entity tag value identifying the data content in the data session slot was lost, new data session slots were allocated, which also caused the sequence of operating states to be lost. Allocating additional data session slots required additional storage capacity and composition logic in the presence server to compare the operating states in the different slots and determine what information to report to applications that subscribed to the operating state of the mobile unit. An increased workload consequently occurred on the presence server.

### SUMMARY OF THE DISCLOSURE

From the foregoing, it may be appreciated by those skilled in the art that a need has arisen for an improved system and method for publishing operating states. In accordance with the present invention, disadvantages and problems associated with conventional publication of operating states may be reduced or eliminated.

According to one embodiment of the invention, a system and method for optimizing publication of operating states includes sending a first publication message to provide an operating state of a mobile unit. The operating state of the mobile unit is stored in a data session slot associated with the mobile unit. A second publication message is sent to update the operating state of the mobile unit. An entity tag value is derived from identifiers in accounting information of the sec-

ond publication message to identify data in the data session slot associated with the mobile unit.

Certain embodiments of the invention may provide one or more technical advantages. A technical advantage of one embodiment includes deriving an entity tag with an associated value that identifies a specific instance of data content of a data session. Providing for a derivation of the entity tag value allows for a determination without having to store the entity tag value.

Another technical advantage of another embodiment includes reducing the allocation of additional data session slots to store subsequent operating states if the entity tag value identifying the data in a previous state is lost. Operating states may be provided to applications without having to allocate additional data session slots if the entity tag value identifying the data content in a data session slot is lost.

Certain embodiments of the invention may include none, some, or all of the above technical advantages. One or more other technical advantages may be readily apparent to one skilled in the art from the figures, descriptions, and claims included herein.

### BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and its features and advantages, reference is now made to the following description, taken in conjunction with the accompanying drawings, wherein like reference numerals represent like parts, in which:

FIG. 1 is a block diagram illustrating a communication system that provides operating states of mobile units;

FIG. 2 is a call-flow diagram illustrating an example of providing the operating state of a mobile unit using an AAA server;

FIG. 3 is a flowchart illustrating an example of providing the operating state of a mobile unit using an AAA server.

### DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a communication system 10 that provides operating states of mobile units 100. System 10 includes a wireless network 12 in which wireless transmissions of mobile unit 100 originate in geographically delimited cells. System 10 also includes a wireline network 14 in which the transmissions of mobile unit 100 are used to determine the operating state of mobile unit 100.

Wireless network 12 includes mobile units 100 that communicate information using a wireless link 102. Mobile units 100 may be cell phones, data phones, portable data devices, portable computers, handheld devices, handsets, or other suitable devices capable of communicating information over a wireless link 102.

Wireless link 102 may be a radio frequency (RF) link. The wireless link may be based on any suitable technology or standard, such as Code Division Multiple Access (CDMA) 2000 or GSM. In the illustrated embodiment, wireless link 102 comprises a CDMA link based on a CDMA standard. Wireless link 102 communicates the transmissions of mobile unit 100 to base transceiver station (BTS) 104.

BTSs 104 receive information destined for mobile unit 100 and wirelessly communicate the information to mobile unit 100 over wireless link 102. BTSs 104 each cover a geographic region, or cell 106, of wireless network 12 and communicate with mobile units 100 in cell 106. Each BTS 104 may wirelessly communicate with multiple mobile units located within its cell 106. BTS 104 includes a packet control function (PCF) to manage the sending and receiving of data to and/or from

mobile unit **100**. PCFs may be logic encoded in media, micro-controllers, application-specific integrated circuits, state machines, and/or any other type of device for manipulating information in a logical manner.

Base station controllers (BSC) **108** connect to BTS **106** and to each other. Wireless network **12** may include several BSCs **108**. BSCs **108** connect to mobile switching center (MSC) **110**. BSCs **108** and MSC **110** provide switch and soft handoff functionality for wireless network **12**. In this way, information, such as voice, video, audio, text, and/or any other type of information, is routed to and from mobile units **100** and connections are maintained with mobile units **100** as they move throughout wireless network **12**. MSC **110** is also able to perform authentication and set up and disconnect calls for mobile units **100** serviced by BTSs **104**. MSC **110** communicates with a public network **120**. Public network **120** may include any transport network **102** may include any combination of gateways, routers, hubs, switches, access points, base stations, and any other hardware and/or software that may implement any suitable protocol or communication.

Wireless network **12** connects to wireline network **14** through a packet data serving node (PDSN) **112**. PDSN **112** includes a router that directs traffic between wireless network **12** and wireline network **14**.

Wireline network **14** includes a transport network **114** that connects one or more servers to each other and to PDSN **112**. In the illustrated embodiment, servers include an AAA server **116** and a presence server **118**. Transport network **114** may include a public switched telephone network (PSTN), a local area network (LAN), a wide area network (WAN), any other public or private data network, a local, regional, or global communication network such as the Internet, an enterprise intranet, other suitable wireline communication link, or any combination of the preceding.

AAA server **116** gathers accounting information, planning information, and measurements reflecting the performance of system **10**. Accounting information may refer to information used to assess a cost for the communication session. AAA server **116** may generate accounting records for the data session of mobile unit **100**. The accounting records may be communicated to elements in system **10** through accounting information. AAA server **116** may operate with any suitable protocol.

Presence server **118** processes information to determine the state of mobile unit **100**, such as presence information. Presence information may include any suitable information that describes the location of the relevant user, the availability of that user, the reachability of the user, and/or preferred modes of communication for the user for the purposes of communicating with other users. Examples of presence information include, but are not limited to, information indicating whether a user is currently logged into a particular network or component, information identifying a wireless network in which the user is currently located, information indicating whether the user has used a particular component of network **10** within a predetermined time period, information identifying an activity presently scheduled for the user, and information specifying a physical location of the user. Presence server **118** may operate with any suitable protocol.

In operation, when mobile unit **100** desires a data session, which may, for example, be triggered by the initiation of an application at mobile unit **100** and/or the activation of mobile unit **100**, a data session is initiated between mobile unit **100**, BTS **104**, and a serving node. In the illustrated embodiment, the data session of mobile unit **100** is a wireless session. Establishing a data session may involve allocating RF resources between mobile unit **100** and serving BTS **104**,

allocating an IP address to mobile unit **100**, and/or any other appropriate function. While mobile unit **100** is in operation, AAA server **116** may generate accounting information that includes the operating state of mobile unit **100**. AAA server **116** reports the accounting information to presence server **118**. AAA server **116** may use any suitable protocol to communicate with presence server **118**, such as Session Initiation Protocol (SIP). If SIP is used, AAA server **116** provides the accounting information to presence server **118** using a PUBLISH message. The PUBLISH message may include a data element (an entity tag) with an associated value to identify a specific instance of data content stored in a data session slot of presence server **118**.

In particular embodiments, presence server **118** derives the entity tag value associated with a PUBLISH message. The derivation of the entity tag value occurs when there is no entity tag value or an unrecognized entity tag value is within the PUBLISH message. Therefore, presence server **118** does not need to store the entity tag value or create a new data session slot to store the new operating state of mobile unit **100** if the entity tag value for a PUBLISH message is lost by AAA server **116**.

Data contained in the accounting information may be used to derive the entity tag value. The accounting information includes a session identifier (session-ID) and a correlation identifier (correlation-ID). The session-ID uniquely identifies the data session, and the correlation-ID uniquely identifies the authorization operation granting permission to instantiate the data session. The session-ID and correlation-ID are used to construct the entity tag value. The session-ID and correlation-ID may occur in any suitable representation, such as each identifier represented in the accounting information by strings of up to eight characters in length. The entity tag value may be constructed using any suitable operation, such as concatenating the two strings.

Modifications, additions, or omissions may be made to system **10** without departing from the scope of the invention. For example, system **10** may include any suitable number of elements. Moreover, one or more functions performed by an element in system **10** may be implemented in whole or in part by other elements. For example, a single server may implement the functions of AAA server **116** and presence server **118**. Any suitable logic comprising software, hardware, other logic, or any suitable combination of the preceding may perform the functions of any component in system **10**.

FIG. 2 is a call-flow diagram that illustrates providing the operating state of mobile unit **100** using AAA server **116**. The call-flow diagram may use any suitable signaling protocol such as SIP to exchange messages.

Mobile unit **100** requests to establish a data session at message **200**. BSC **108** and MSC **110** pass the start request to PDSN **112** at message **202**. PDSN **112** requests authorization from AAA server **116** to authenticate and authorize the request for a data session at message **204**. In the illustrated embodiment, AAA server **116** returns a positive authorization to PDSN **112** at message **206**. In another embodiment, AAA server **116** may not authorize the request and the call-flow would subsequently terminate. The positive authorization propagates to BSC **108** and MSC **110** at message **208** and to mobile unit **100** at message **210**. BSC **108** and MSC **110** send an airlink active start request to PDSN **112** at message **212**. PDSN **112** sends an accounting start request to AAA server **116** at message **214**. The accounting start request informs AAA server **116** to begin tracking the usage of mobile unit **100** and generating accounting information associated therewith. The accounting information may include the operating

state of mobile unit **100**. AAA server **116** acknowledges the accounting start request by sending an ACK to PDSN **112** at message **216**.

AAA server **116** sends a PUBLISH message to presence server **118** at message **218**. The PUBLISH message may include any suitable information, including the session-ID, the correlation-ID, and the operating state of mobile unit **100**. In the illustrated embodiment, the PUBLISH message indicates that mobile unit **100** has an active data session in addition to other relevant information. The first PUBLISH message reporting the operating state of mobile unit **100** creates a new data session slot in presence server **118** that stores the operating state. The data session slot stores the operating state associated with mobile unit **100** for this particular data session in presence server **118**.

Based on the information in the PUBLISH message, presence server **118** generates the entity tag value. Presence server **118** acknowledges the PUBLISH message by sending a 200OK to AAA server **116** at message **220**. The 200OK includes an entity tag value identifying the data in the data session slot derived by presence server **118**. The data session of mobile unit **100** is active at instance **222** and persists until termination.

At message **224**, mobile unit **100** decides to terminate the data session and sends a termination request to BSC **108** and MSC **110**. BSC **108** and MSC **110** send an airlink active stop request to PDSN **112** at message **226**. PDSN **112** acknowledges the termination at message **228** and BSC **108** and MSC **110** acknowledge the termination at message **230**. The data session ends and is terminated at instance **232**.

The termination of the data session causes the operating state of mobile unit **100** to change. Therefore, PDSN **112** sends an accounting stop record to AAA server **116** at message **234**. PDSN **112** acknowledges the accounting stop record at message **236**. AAA server **116** sends a PUBLISH message indicating session termination to presence server **118** at message **238**. In the illustrated embodiment, the PUBLISH message contains the entity tag value returned in message **220**, which is from presence server **118** when the data session originally started. Presence server **118** tries to match this entity tag value with data in a data session slot. If presence server **118** finds a match, it stores the operating state into the identified data session slot and returns a 200OK to AAA server **116** at message **240**. In another embodiment, if AAA server **116** does not have the entity tag value to identify the data, AAA server **116** may derive the entity tag value from the session-ID and the correlation-ID. Presence server **118** tries to match the derived entity tag value with data in a data session slot. In yet another embodiment, any suitable client may derive the entity tag value using the derivation techniques as described with respect to AAA server **116**.

In other embodiments, if presence server **118** fails to match the entity tag value received in the PUBLISH message or if the PUBLISH message does not contain an entity tag value, presence server **118** may deduce the entity tag value using the session-ID and the correlation-ID in the accounting information. The operating state changes are stored in the data session slot corresponding to the entity tag value. By deducing the entity tag value from the session-ID and the correlation-ID, it may not be necessary to send the entity tag value to AAA server **116**.

Particular embodiments provide entity tag values that remain invariant to new publications of states, even if the publication is updating the state of the continuing data session. Therefore, the number of persistent storage updates required to synchronize the entity tag values across nodes of a cluster of AAA servers **116** is reduced.

Modifications, additions, or omissions may be made to the call-flow diagram. For example, additional AAA servers may be included in system **10**, which requires some communication between AAA server **116** and the additional AAA servers. For example, a mirroring operation may provide entity tag values to the additional AAA servers. As another example, the additional AAA servers may deduce the entity tag value without AAA server **116** performing a mirroring operation. In addition, messages may be performed in any suitable manner.

FIG. **3** is a flowchart illustrating an example of providing the operating state of mobile unit **100** using AAA server **116**. AAA server **116** sends a first publication message to presence server **118** that includes the operating state of mobile unit **100** at step **300**. The state's data content is stored in a data session slot in presence server **118** associated with mobile unit **100** at step **302**. If the operating state of mobile unit **100** changes, AAA server **116** sends a second publication message to update the operating state of mobile unit **100** at step **304**. An entity tag value is derived to identify the data in the data session slot at step **306**. From the derived entity tag value, the data in the data session slot is determined at step **308**. The operating state's data content from the second publication message is stored at step **310** in the data session slot associated with mobile unit **100**.

Modifications, additions, or omissions may be made to the flowchart. For example, AAA server **116** may send any suitable number of publication messages to presence server **118** to update the operating state of mobile unit **100**. Additionally, steps may be performed in any suitable manner.

While this disclosure has been described in terms of certain embodiments and generally associated methods, alterations and permutations of the embodiment and methods will be apparent to those skilled in the art. Accordingly, the above description of example embodiments does not constrain this disclosure. Other changes, substitutions, and alterations are also possible without departing from the scope and spirit of this disclosure.

What is claimed is:

1. A method for optimizing publication of operating states, comprising:
  - receiving, at a presence server, a first publication message from an authorization, and accounting (AAA) server, the first publication message associated with an initiation of a data session by a mobile unit, the first publication message comprising an operating state of a mobile unit;
  - creating, by the presence server, a data session slot storing the operating state of the mobile unit during the data session, the data session slot identified by a first entity tag value;
  - sending, by the presence server, the first entity tag value to the AAA server;
  - receiving from the AAA server a second publication message communicating a session identifier value, a correlation value, a second entity tag value, and an update of the operating state of the mobile unit during the data session, wherein:
    - the session identifier value comprises a first string of characters uniquely identifying the data session, and
    - the correlation identifier value comprises a second string of characters uniquely identifying authorization granting permission to instantiate the data session;
  - determining that the second entity tag value of the second publication message does not match the first entity tag value identifying the data session slot for storing, by the presence server, the operating state of the mobile unit during the data session;

in response to determining that the second entity tag value of the second publication message does not match the first entity tag value, deriving by the presence server, the first entity tag value from the session identifier value and the correlation identifier, wherein deriving the entity tag value comprises performing an operation on the first string of characters and the second string of characters to construct the entity tag value;

using the first entity tag value to identify the data session slot storing the operating state of the mobile unit during the data session; and

storing the update of the operating state of the mobile unit in the data session slot.

**2.** A system for optimizing publication of operating states, comprising:

one or more first hardware devices operable to store a plurality of messages; and

one or more second hardware devices operable to:

receive, at a presence server, a first publication message from an authentication, authorization, and accounting (AAA) server, the first publication message associated with an initiation of a data session by a mobile unit, the first publication message comprising an operating state of a mobile unit;

create, by the presence server, a data session slot storing the operating state of the mobile unit during the data session, the data session slot identified by a first entity tag value;

send, by the presence server, the first entity tag value to the AAA server; receiving from the AAA server a second publication message communicating a session identifier value, a correlation value, a second entity tag value, and an update of the operating state of the mobile unit during the data session, wherein:

the session identifier value comprises a first string of characters uniquely identifying the data session, and

the correlation identifier value comprises a second string of characters uniquely identifying authorization granting permission to instantiate the data session;

determine that the second entity tag value of the second publication message does match the first entity tag value identifying the data session slot for storing, by the presence server, the operating state of the mobile unit during the data session;

in response to determining that the second entity tag value of the second publication message does not match the first entity tag value, derive, by the presence server, the first entity tag value from the session identifier value and the correlation identifier value, wherein deriving the entity tag value comprises performing an operation on the first string of characters and the second string of characters to construct the entity tag value;

use the first entity tag value to identify the data session slot storing the operating state of the mobile unit during the data session; and

store the update of the operating state of the mobile unit in the data session slot.

**3.** A non-transitory computer readable medium including logic for optimizing publication of operating states, the logic operable to:

receive, at a presence server, a first publication message from an authentication, authorization, and accounting (AAA) server, the first publication message associated

with the initiation of a data session by mobile unit, the first publication message comprising an operating state of a mobile unit;

creating, by the presence server, a data session slot storing the operating state of the mobile unit during the data session, the data session slot identified by a first entity tag value;

sending, by the presence server, the first entity tag value to the AAA server;

receiving from the AAA server a second publication message communicating a session identifier value, a correlation value, a second entity tag value, and an update of the operating state of the mobile unit during the data session, wherein:

the session identifier value comprises a first string of characters uniquely identifying the data session, and the correlation identifier value comprises a second string of characters uniquely identifying authorization granting permission to instantiate the data session;

determine that the second entity tag value of the second publication message does not match the first entity tag value identifying the data session slot for storing, by the presence server, the operating state of the mobile unit during the data session;

in response to determining that the second entity tag value of the second publication message does not match the first entity tag value, derive, by the presence server, the first entity tag value from the session identifier value and the correlation identifier value, wherein deriving the entity tag value comprises performing an operation on the first string of characters and the second string of characters to construct the entity tag value;

use the first entity tag value to identify the data session slot storing the operating state of the mobile unit during the data session; and

store the update of the operating state of the mobile unit in the data session slot.

**4.** The method of claim 1, further comprising keeping the derived entity tag value constant over a sequence of publication messages that communicate a plurality of updates of the operating state of the mobile unit.

**5.** The method of claim 4, further comprising determining the entity tag value to apply to a publication message if results of a sequence of publication messages are not tracked.

**6.** The method of claim 4, further comprising allowing for a determination of the data session slot by deducing the entity tag value if results of the sequence of publication messages are not tracked.

**7.** The system of claim 2, further operable to concatenate the session identifier value and the correlation identifier value.

**8.** The system of claim 2, further operable to keep the derived entity tag value constant over a sequence of publication messages that communicate a plurality of updates of the operating state of the mobile unit during a data session.

**9.** The system of claim 8, further operable to determine the entity tag value to apply to a publication message if results of a sequence of publication message are not tracked.

**10.** The system of claim 8, wherein a second AAA server is operable to deduce the entity tag value if results of the sequence of publication messages are not tracked.

**11.** The computer readable medium of claim 2, the logic operable to derive the entity tag value includes concatenating the session identifier value and the correlation identifier value.

**12.** The computer readable medium of claim 3, the logic further operable to keep the derived entity tag value constant

over a sequence of publication messages that communicate a plurality of updates of the state of the mobile unit.

13. The computer readable medium of claim 12, the logic further operable to determine the entity tag value to apply to a publication message if results of a sequence of publication 5 messages are not tracked.

14. The computer readable medium of claim 12, the logic further operable to allow for a determination of the data session slot by deducing the entity tag value if results of the sequence of publication messages are not tracked. 10

15. The method of claim 1, wherein the second publication message identifies a termination of the data session by the mobile unit.

16. The system of claim 2, wherein the second publication message identifies a termination of the data session by the mobile unit. 15

17. The system of claim 3, wherein the second publication message identifies a termination of the data session by the mobile unit.

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