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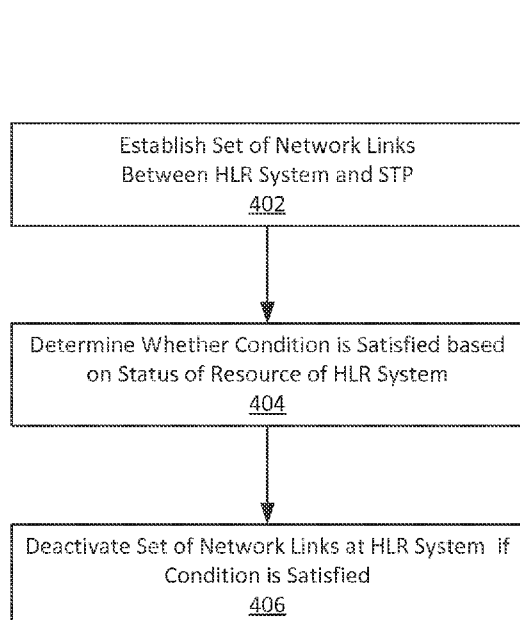


FIG. 4

(57) Abstract: Some examples provide a method where a set of network links is established between a Home Location Register (HLR) and a Signal Transfer Point (STP), and the set of network links carry network traffic from the STP to the HLR. A determination may be made whether a condition is satisfied based on a status of a resource of the HLR. The set of network links may be deactivated at the HLR if the condition is determined to be satisfied.



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**DEACTIVATING A NETWORK LINK AT A HOME LOCATION REGISTER (HLR)  
BASED ON A RESOURCE**

**BACKGROUND**

**[0001]** Generally, telecommunications networks utilize Signaling System No. 7 (SS7) signaling to control network services and capabilities, including services and capabilities on fixed communication networks and mobile communication networks. For mobile communication networks (e.g., cellular communication networks based on GSM, TDMA, or CDMA), Home Location Registers (HLRs) are utilized by mobile network operators to maintain a database of subscribers for their Mobile Switching Centers (MSCs) and the geographic coverage areas those MSCs service. A Visitor Location Register (VLR), on the other hand, maintains for a particular MSC a database of subscribers roaming within that particular MSC's geographic coverage area. During mobile network operations, SS7 signals are generally communicated between HLRs, VLRs, and other network entities over network links and through Signal Transfer Points (STPs), which are responsible for routing SS7 signals within a telecommunications network.

**BRIEF DESCRIPTION OF THE DRAWINGS**

**[0002]** Certain examples are described in the following detailed description in reference to the following drawings.

**[0003]** FIG. 1 illustrates an example HLR system.

**[0004]** FIGs. 2 and 3 illustrate example computer systems operating example HLRs.

**[0005]** FIGs. 4-7 illustrate example methods for deactivating a set of network links at a HLR system.

### DETAILED DESCRIPTION OF SPECIFIC EXAMPLES

**[0006]** When overloaded (e.g., due to lack of resources), traditional Home Location Register (HLR) systems often address the overload by discarding received network messages (e.g., HLR messages), increasing their buffer for receiving network messages, or reduce the size of responsive network messages. These traditional solutions typically address the issue but ultimately result in degraded HLR services, which in turn translates to poor service to subscribers.

**[0007]** This disclosure describes example techniques for deactivating a set of network links at a Home Location Register (HLR) system based on the status of a resource associated with the HLR system. As used herein, resources associated with a HLR system can include ones that are utilized, or merely available to, the HLR system. Examples of resources associated with a HLR system include, without limitation, a processor (e.g., CPU load), memory (e.g., primary or secondary memory usage), data storage device, a network connection (e.g., Signal System No. 7 link), or software (e.g., operating system or software application instance) of the HLR system. By deactivating the set of network links at the HLR system, various examples described herein can force a remote network entity (e.g., a Signal Transfer Point [STP]) that is sending network traffic to the HLR system to divert the network traffic away from the HLR system (e.g., to another HLR system). In this way, various examples may enable failover of HLR services between HLR systems having synchronized HLR data based on a status of a resource associated with the HLR system, and may subsequently facilitate restoration of HLR functionality at a HLR system based on a changed status of the resource. Accordingly, various examples can permit the HLR system to address overload issues without need for the remote network entity (e.g., the STP) to be aware of the HLR system's resource conditions.

**[0008]** Various examples described herein can be used to mitigate the impact a resource associated with a HLR system has on the HLR system's performance or functionality, particularly with respect to HLR services. According to some examples, a HLR system, having a set of network links established with a remote network entity (e.g., a Signal Transfer Point [STP]), monitors the status

of a resource associated with the HLR system. Based on the monitoring, the HLR system can identify an actual or potential issue at HLR system when a condition (e.g., defined by an administrator of the HLR system) is satisfied. For instance, the condition may be satisfied when the status of a resource indicates that its usage exceeds a threshold value defined by the condition.

**[0009]** When an actual or potential issue is identified (e.g., detected) by the HLR system in this manner, the HLR system can inactive the set of network links at the HLR system. In doing so, the HLR system can force the remote network entity (e.g., the STP) on the opposite end of the set network links to divert (e.g., route or reroute) network messages originally intended for the HLR system to another HLR system. In some examples, the other HLR system to which the STP diverts network messages is one having (e.g., having access to) HLR data similar to that the HLR system has. In some examples, the HLR data between the HLR system and the other HLR system is synchronized. For some examples, when the HLR system determines a second condition is satisfied, such as the identified issue being resolved or no longer present (e.g., the first condition is no longer satisfied), the HLR system reactivates the set of network links with the remote network entity. Upon reactivating the set of network links, the remote network entity may resume sending network traffic to the HLR system.

**[0010]** An example issue that may be identified by an HLR system can include a reduction in the number of active links between the HLR and a remote network entity (e.g., an STP), while the network traffic flow over the remaining active links in the set is maintained by the remote network entity (which may not be aware of the issue at the HLR system). The reduction in the number of active links may, for example, be caused by a network cable being severed, a faulty network link, or operator negligence. Inactivating the set of links at the HLR system when the issue of reduced number of active links is identified can assist the HLR system in avoiding overload situations, such over utilizing the set of network links (e.g., cause them to reach maximum capacity). Overutilization of the set of network links can cause the HLR system, or the remote network entity, to discard network messages (e.g., HLR message) in an effort to maintain at least partial HLR functionality at the HLR system, but at the expense of providing

unreliable HLR service (e.g., telecom subscribers being managed by the HLR being without telecommunications service).

**[0011]** Another example issue that may be identified by an HLR system described herein can include where a software application instance on the HLR system handling HLR messages becomes non-functional (e.g., is unresponsive to HLR messages), the amount of HLR messages by the HLR system (e.g., being sent to the HLR system by an STP) remains the same, and, as a result, one or more other software application instances that remain functional on the HLR system have to compensate (i.e., handle more HLR traffic because there are less functional software application instances available). Inactivating the set of links at the HLR system when this issue is identified (e.g., detect), the HLR system can avoid the software application instances being overloaded, which can result in the response time for HLR messages to increase and HLR messages to be discarded by the HLR system.

**[0012]** FIG. 1 illustrates an example HLR system 100. As shown, the HLR system 100 includes a communications module 102, a resource status module 104, a condition determination module 106, and a network link control module 108. Depending on the example, the HLR system 102 may comprise one or more servers, which may be operating on, or implemented using, one or more cloud-based resources, such as a System-as-a-Service (SaaS), Platform-as-a-Service (PaaS), or Infrastructure-as-a-Service (IaaS). For some examples, the components or the arrangement of components in the HLR system 100 may differ from what is depicted in FIG. 1. Additionally, in some examples, the HLR system 100 is associated with at least another HLR system such that the HLR system 100 and the other HLR system synchronize their HLR data (e.g., home subscriber information). In this way, the HLR system 100 and the other HLR system can provide each other geo-redundancy. For instance, where the HLR system 100 deactivates, at the HLR system 100, a set of network links previously established between the HLR system 100 and a STP, the STP may be forced to divert (e.g. route or reroute) the HLR network traffic originally intended for the HLR system 100 to the other HLR system, thereby providing redundancy.

**[0013]** As used herein, modules and other components of various examples may comprise, in whole or in part, machine-readable instructions or electronic circuitry. For instance, a module may comprise computer-readable instructions executable by a processor to perform one or more functions in accordance with various examples described herein. Likewise, in another instance, a module may comprise electronic circuitry to perform one or more functions in accordance with various examples described herein. The elements of a module may be combined in a single package, maintained in several packages, or maintained separately.

**[0014]** The communications module 102 may facilitate establishing a set of network links (e.g., network connections) between the HLR system 100 and a Signal Transfer Point (STP). The set of network links may carry network traffic from the STP to the HLR system 100, and may carry network traffic from the HLR system 100 to the STP. Additionally, the set of network links may include a Signal System No .7 (SS7) link, which can permit SS7 network traffic communicated over telecommunications networks to be communicated between the HLR system 100 and STP. For example, over the set of network links, the HLR system 100 may receive network messages, such as HLR request messages, and may send network messages, such as HLR response messages. The set of network links may also include Sigtran. According to some examples, the HLR system 100 maintains a database of subscriber information for home subscribers (e.g., home mobile phone subscribers) associated with a particular mobile network and geographic coverage area. Such subscriber information can include a profile for a home subscriber, which may describe a service, feature, status, or current location associated with the home subscriber. HLR messages received by the HLR system 100 over the set of network links, or responses to such HLR messages over the set of network links, may permit a remote network entities (e.g., Visitor Location Registers or a Mobile Switching Center) to access subscriber information being maintained by the HLR system 100.

**[0015]** The resource status module 104 may facilitate determining a status of a resource of the HLR system 100. In some examples, the resource status module 104 initially determines a first status of the resource of the HLR system

100 (at a first time) and then later determines a second status of the resource of the HLR system 100 (at a second time). The first status at the first time may be used by the condition determination module 106 to initially determine when a resource issue exists in the HLR system 100, and the second status at the second time may be used by the condition determination module 106 to later determine when the resource issue no longer exists in the HLR system 100.

**[0016]** The status of a resource can include an operational status of the resource, such as the resource is active (e.g., presently operating), inactive (e.g., not presently operating), suspended, degraded (e.g., partially operating), malfunctioning (e.g., operating with errors present), and the like. The status of the resource can include the operational load of the resource (e.g., network link is operating at or below maximum operational capacity), and the quality at which the resource is operating (e.g., operational quality is optimal or less than optimal).

**[0017]** The condition determination module 106 may facilitate determining whether a condition is satisfied based on a status of a resource of the HLR system 100. As described herein, the status of the resource may be determined by the resource status module 104. In some examples, the condition determination module 106 initially determines whether a first condition is satisfied based on a first status of the resource, as determined by the resource status module 104 at a first time. For those examples, the condition determination module 106 may later determine whether a second condition is satisfied based on a second status of the resource, as determined by the resource status module 104 at a second time. Satisfaction of the first condition based on the first status of the resource may determine that a resource issue exists in HLR system 100, and satisfaction of the second condition based on the second status of the resource may indicate that the resource issue has been resolved or no longer exists. Depending on the example, a condition may be associated with a particular set of resources of the HLR system 100, and can indicate whether an issue exists with respect to the set of resources. A condition may comprise a threshold value, which when met or exceeded, indicates the existence, non-existence, or resolution of a resource issue.

**[0018]** The network link control module 108 may facilitate deactivating a set of network links at the HLR system 100 (e.g., established at the HLR system 100 by the communications module 102), and may facilitate deactivating if a condition is determined to be satisfied by the condition determination module 106. Additionally, the network link control module 108 may facilitate deactivating a set of network links at the HLR system 100 if a first condition is determined to be satisfied by the condition determination module 106, and may facilitate reactivating the set of network links at the HLR system 100 (after the set of network links have been deactivated based on the first condition) if a second condition is determined to be satisfied by the condition determination module 106. As described herein, a first condition may be determined to be satisfied based on a first status of a resource of the HLR system 100 and, subsequently, a second condition may be determined to be satisfied based on a second status of the resource of the HLR system 100. In some examples, the second condition comprises the first condition no longer being satisfied, which may indicate the issue initially identified (e.g., detected) by the first condition has been resolved or no longer exists.

**[0019]** FIG. 2 illustrates an example computer system 200 operating an example HLR. As shown, the computer system 200 includes a computer-readable medium 202, a processor 204, and a communications interface 206. In various examples, the components or the arrangement of components of the computer system 200 may differ from what is depicted in FIG. 2. For instance, the computer system 200 can include more or less components than those depicted in FIG. 2.

**[0020]** The computer-readable medium 202 may be any electronic, magnetic, optical, or other physical storage device that stores executable instructions. For example, the computer-readable medium 202 may be a Random Access Memory (RAM), an Electrically-Erasable Programmable Read-Only Memory (EEPROM), a storage drive, an optical disc, or the like. The computer-readable medium 202 can be encoded to store executable instructions that cause the processor 204 to perform operations in accordance with various examples described herein. In various examples, the computer-readable medium

202 is non-transitory. As shown in FIG. 2, the computer-readable medium 202 includes Home Location Register (HLR) instructions 208, establishing network links instructions 210, determining resource status instructions 212, determining satisfaction of condition instructions 214, and deactivating network links instructions 216.

**[0021]** The processor 204 may be one or more central processing units (CPUs), microprocessors, or other hardware devices suitable for retrieval and execution of one or more instructions stored in the computer-readable medium 202. The processor 204 may fetch, decode, and execute the instructions 208, 210, 212, 214, and 216 to enable the computer system 200 to perform operations in accordance with various examples described herein. For some examples, the processor 204 may include one or more electronic circuits comprising a number of electronic components for performing the functionality of one or more of the instructions 208, 210, 212, 214, and 216.

**[0022]** The communications interface 206 may facilitate communication between the computer system 200 and a remote network entity, such as a Signal Transfer Point (STP), over a communications network, such as a Signal System No. 7 network or the like. For instance, instructions 208, 210, 212, 214, or 216 can cause the processor 204 to send or receive network traffic through the communications interface 206.

**[0023]** The HLR instructions 208 may cause the processor 204 to operate a HLR at the computer system 200. Accordingly, the HLR instructions 208 may cause the processor 204 to support such HLR functionality as maintaining subscriber information associated with a home subscriber, and providing such information to remote network entities (e.g., Visitor Location Registers [VLRs]). The establishing network links instructions 210 may cause the processor 204 to establish a set of network links between the HLR operating at the computer system 200 (e.g., by the HLR instructions 208) and a Signal Transfer Point (STP). As described herein, the set of network links may permit the HLR to receive network traffic from the STP, such as HLR messages.

**[0024]** The determining resource status instructions 212 may cause the processor 204 to determine a status of a resource of the computer system 200.

Examples of resources associated with the computer system 200 can include, without limitation, the processor 204 of the computer system 200, memory of the computer system 200 (e.g., Random Access Memory), data storage device of the computer system 200, a network link between the HLR and a remote network entity (e.g., Signal System No. 7 link between the HLR and an STP), or software operating on the computer system 200 (e.g., a HLR software application instance). In some instances, the resource may be a network link in the set of network links established by the establishing network links instructions 210.

**[0025]** The determining satisfaction of condition instructions 214 may cause the processor 204 to determine whether a condition is satisfied based on the status determined by the determining resource status instructions 212. The condition may be one associated with the resource for which the status is determined. Additionally, when satisfied, the condition may indicate the existence of an issue with respect to the resource, which may cause the computer system 200 to deactivate the set of network links established by the establishing network links instructions 210.

**[0026]** The deactivating network links instructions 216 may cause the processor 204 to deactivate the set of network links if the condition is determined to be satisfied by the determining satisfaction of condition instructions 214. In various examples, the set of network links is deactivated temporarily and remains deactivated until such time as the issue identified (e.g., detected) by the condition no longer exists or is resolved.

**[0027]** FIG. 3 illustrates an example computer system 300 operating an example HLR. As shown, the computer system 300 includes a computer-readable medium 302, a processor 304, and a communications interface 306. In various examples, the components or the arrangement of components of the computer system 300 may differ from what is depicted in FIG. 3. For instance, the computer system 300 can include more or less components than those depicted in FIG. 3.

**[0028]** As described herein, the computer-readable medium 302 may be any electronic, magnetic, optical, or other physical storage device that stores executable instructions. The computer-readable medium 302 can be encoded to

store executable instructions that cause the processor 304 to perform operations in accordance with various examples described herein. In various examples, the computer-readable medium 302 is non-transitory. As shown in FIG. 3, the computer-readable medium 302 includes Home Location Register (HLR) instructions 308, establishing network links instructions 310, determining resource first status instructions 312, determining satisfaction of first condition instructions 314, deactivating network links instructions 316, determining resource second status instructions 318, determining satisfaction of second condition instructions 320, and reactivating network links instructions 322.

**[0029]** As also described herein, the processor 304 may be one or more central processing units (CPUs), microprocessors, or other hardware devices suitable for retrieval and execution of one or more instructions stored in the computer-readable medium 302. The processor 304 may fetch, decode, and execute the instructions 308, 310, 312, 314, 316, 318, 320, and 322 to enable the computer system 300 to perform operations in accordance with various examples described herein. For some examples, the processor 304 may include one or more electronic circuits comprising a number of electronic components for performing the functionality of one or more of the instructions 308, 310, 312, 314, 316, 318, 320, and 322.

**[0030]** As described herein, the communications interface 306 may facilitate communication between the computer system 300 and a remote network entity, such as a Signal Transfer Point (STP), over a communications network, such as a Signal System No. 7 network or the like. For instance, instructions 308, 310, 312, 314, 316, 318, 320, and 322 can cause the processor 304 to send or receive network traffic through the communications interface 306.

**[0031]** The HLR instructions 308 may cause the processor 304 to operate a HLR at the computer system 300. Accordingly, the HLR instructions 308 may cause the processor 304 to support such HLR functionality as maintaining subscriber information associated with a home subscriber, and providing such information to remote network entities (e.g., Visitor Location Registers [VLRs]). The establishing network links instructions 310 may cause the processor 304 to establish a set of network links between the HLR operating at the computer

system 300 (e.g., by the HLR instructions 308) and a Signal Transfer Point (STP). As described herein, the set of network links may permit the HLR to receive network traffic from the STP, such as HLR messages.

**[0032]** The determining resource first status instructions 312 may cause the processor 304 to determine a first status of a resource of the computer system 300. As described herein, examples of resources associated with the computer system 300 can include, without limitation, the processor 304 of the computer system 300, memory of the computer system 300 (e.g., Random Access Memory), data storage device of the computer system 300, a network link between the HLR and a remote network entity (e.g., Signal System No. 7 link between the HLR and an STP), or software operating on the computer system 300 (e.g., a HLR software application instance).

**[0033]** The determining satisfaction of first condition instructions 314 may cause the processor 304 to determine whether a first condition is satisfied based on the first status determined by the determining resource first status instructions 312. The first condition may be one associated with the resource for which the first status is determined. Additionally, when satisfied, the first condition may indicate the existence of an issue with respect to the resource, which may cause the computer system 300 to deactivate the set of network links established by the establishing network links instructions 310.

**[0034]** The deactivating network links instructions 316 may cause the processor 304 to deactivate the set of network links if the first condition is determined to be satisfied by the determining satisfaction of first condition instructions 314. The set of network links is deactivated temporarily and remains deactivated until such time as the issue identified (e.g., detected) by the first condition no longer exists or is resolved. This is described below with respect to instructions 318, 320, and 322.

**[0035]** The determining resource second status instructions 318 may cause the processor 304 to determine a second status of a resource of the computer system 300. The resource for which the second status is determined may be the same as the resource for which the first status was determined by the determining resource first status instructions 312.

**[0036]** The determining satisfaction of second condition instructions 320 may cause the processor 304 to determine whether a second condition is satisfied based on the second status determined by the determining resource first status instructions 312. The second condition may be one associated with the resource for which the second status is determined. Additionally, when satisfied, the second condition may indicate the non-existence or resolution of the issue identified (e.g., detected) by the satisfaction of the first condition, which may cause the computer system 300 to reactivate the set of network links that were previously deactivated by the deactivating network links instructions 316.

**[0037]** The and reactivating network links instructions 322 may cause the processor 304 to reactivate the set of network links the second condition is determined to be satisfied by the determining satisfaction of second condition instructions 320. As described herein, the set of network links that are reactivated may have been previously deactivated by the deactivating network links instructions 316.

**[0038]** FIG. 4 illustrates an example methods 400 for deactivating a set of network links at a HLR system. Although execution of method 400 is described below with reference to the HLR system 100 of FIG. 1, execution of method 400 by other suitable systems or devices may be possible. The method 400 may be implemented in the form of executable instructions stored on a computer-readable medium or in the form of electronic circuitry.

**[0039]** In FIG. 4, method 400 begins at block 402, with the HLR system 100 establishing a set of network links between the HLR system 100 and a STP. At block 404, the HLR system 100 determines whether a condition is satisfied based on a status of a resource of the HLR system 100. The condition may assist in determining whether network traffic from the STP to the HLR system 100 should be diverted away from the HLR system 100 (e.g., by the STP), possibly to another HLR system having HLR data synchronized with the HLR system 100. At block 406, the HLR system 100 deactivates the set of network links at the HLR system 100 if the condition is determined to be satisfied at block 404.

**[0040]** FIG. 5 illustrates an example methods 500 for deactivating a set of network links at a HLR system. Although execution of method 500 is described

below with reference to the HLR system 100 of FIG. 1, execution of method 500 by other suitable systems or devices may be possible. The method 500 may be implemented in the form of executable instructions stored on a computer-readable medium or in the form of electronic circuitry.

**[0041]** In FIG. 5, method 500 begins at block 502, with the HLR system 100 establishing a set of network links between the HLR system 100 and a STP. At block 504, the HLR system 100 determines a status of a resource of the HLR system 100. At block 506, the HLR system 100 determines whether a condition is satisfied based on the status determined at block 504. The condition may assist in determining whether network traffic from the STP to the HLR system 100 should be diverted away from the HLR system 100 (e.g., by the STP), possibly to another HLR system having HLR data synchronized with the HLR system 100. At block 508, the HLR system 100 deactivates the set of network links at the HLR system 100 if the condition is determined to be satisfied at block 506.

**[0042]** FIG. 6 illustrates an example methods 600 for deactivating a set of network links at a HLR system. Although execution of method 600 is described below with reference to the HLR system 100 of FIG. 1, execution of method 600 by other suitable systems or devices may be possible. The method 600 may be implemented in the form of executable instructions stored on a computer-readable medium or in the form of electronic circuitry.

**[0043]** In FIG. 6, method 600 begins at block 602, with the HLR system 100 establishing a set of network links between the HLR system 100 and a STP. At block 604, the HLR system 100 determines whether a first condition is satisfied based on a first status of a resource of the HLR system 100. The first condition may assist in determining whether network traffic from the STP to the HLR system 100 should be diverted away from the HLR system 100 (e.g., by the STP), possibly to another HLR system having HLR data synchronized with the HLR system 100. At block 606, the HLR system 100 deactivates the set of network links at the HLR system 100 if the first condition is determined to be satisfied at block 604.

**[0044]** Subsequently, at block 608, the HLR system 100 determines whether a second condition is satisfied based on a second status of the resource

of the HLR system 100. The second may assist in determining whether the HLR system 100 should resume receiving network traffic from the STP. At block 610, the HLR system 100 reactivates the set of network links at the HLR system 100 if the second condition is determined to be satisfied at block 608.

**[0045]** FIG. 7 illustrates an example methods 700 for deactivating a set of network links at a HLR system. Although execution of method 700 is described below with reference to the HLR system 100 of FIG. 1, execution of method 700 by other suitable systems or devices may be possible. The method 700 may be implemented in the form of executable instructions stored on a computer-readable medium or in the form of electronic circuitry.

**[0046]** In FIG. 7, method 700 begins at block 702, with the HLR system 100 establishing a set of network links between the HLR system 100 and a STP. At block 704, the HLR system 100 determines a first status of a resource of the HLR system 100. At block 706, the HLR system 100 determines whether a first condition is satisfied based on the first status determined at block 704. The first condition may assist in determining whether network traffic from the STP to the HLR system 100 should be diverted away from the HLR system 100 (e.g., by the STP), possibly to another HLR system having HLR data synchronized with the HLR system 100. At block 708, the HLR system 100 deactivates the set of network links at the HLR system 100 if the first condition is determined to be satisfied at block 706.

**[0047]** Subsequently, at block 710, the HLR system 100 determines a second status of the resource of the HLR system 100. At block 712, the HLR system 100 determines whether a second condition is satisfied based on the second status determined at block 710. The second may assist in determining whether the HLR system 100 should resume receiving network traffic from the STP. At block 714, the HLR system 100 reactivates the set of network links at the HLR system 100 if the second condition is determined to be satisfied at block 712.

**[0048]** In the foregoing description, numerous details are set forth to provide an understanding of the subject disclosed herein. However, implementations may be practiced without some or all of these details. Other

implementations may include modifications and variations from the details discussed above. It is intended that the appended claims cover such modifications and variations.

**CLAIMS**

1. A method, comprising:  
establishing, at a Home Location Register (HLR) system, a set of network links between the HLR system and a Signal Transfer Point (STP), wherein the set of network links carry network traffic from the STP to the HLR system;  
determining whether a condition is satisfied based on a status of a resource of the HLR system; and  
if the condition is determined to be satisfied, deactivating the set of network links at the HLR system.
2. The method of claim 1, comprising determining the status of the resource.
3. The method of claim 1, comprising:  
determining whether a second condition is satisfied based on a second status of the resource; and  
if the second condition is determined to be satisfied, reactivating the set of network links at the HLR system if the second condition is determined to be satisfied.
4. The method of claim 3, wherein the second condition comprises the condition no longer being satisfied.
5. The method of claim 1, wherein the resource is a network link included in the set of network links, a data storage device utilized by the HLR system, a processor utilized by the HLR system, a memory utilized by the HLR system, or a software application instance operating on the HLR system.
6. The method of claim 1, wherein the resource is a HLR software application instance adapted to handle a HLR message included in the network traffic.

7. The method of claim 1, wherein the status relates to operational quality of the resource, or the status relates to operational load of the resource.

8. The method of claim 1, wherein the HLR system is part of a plurality of HLR systems having synchronized HLR data.

9. A non-transitory computer readable medium having instructions stored thereon, the instructions being executable by a processor of a computer system operating a Home Location Register (HLR), the instructions causing the processor to:

- establish a set of network links between the HLR and a Signal Transfer Point (STP), wherein the set of network links carry network traffic from the STP to the HLR,;

- determine a status of a resource of the computer system;

- determine whether a condition is satisfied based on the status; and

- if the condition is determined to be satisfied, deactivate the set of network links at the HLR.

10. The non-transitory computer readable medium of claim 9, wherein the instructions cause the processor to:

- determine a second status of the resource;

- determine whether a second condition is satisfied based on the second status; and

- if the second condition is determined to be satisfied, reactivate the set of network links at the HLR.

11. A Home Location Register (HLR) system, comprising:

- a communications module to establish a set of network links between the HLR system and a Signal Transfer Point (STP), wherein the set of network links carry network traffic from the STP to the HLR system;

- a resource status module to determine a status of a resource of the HLR system;

- a condition determination module to determine whether a condition is satisfied based on the status; and

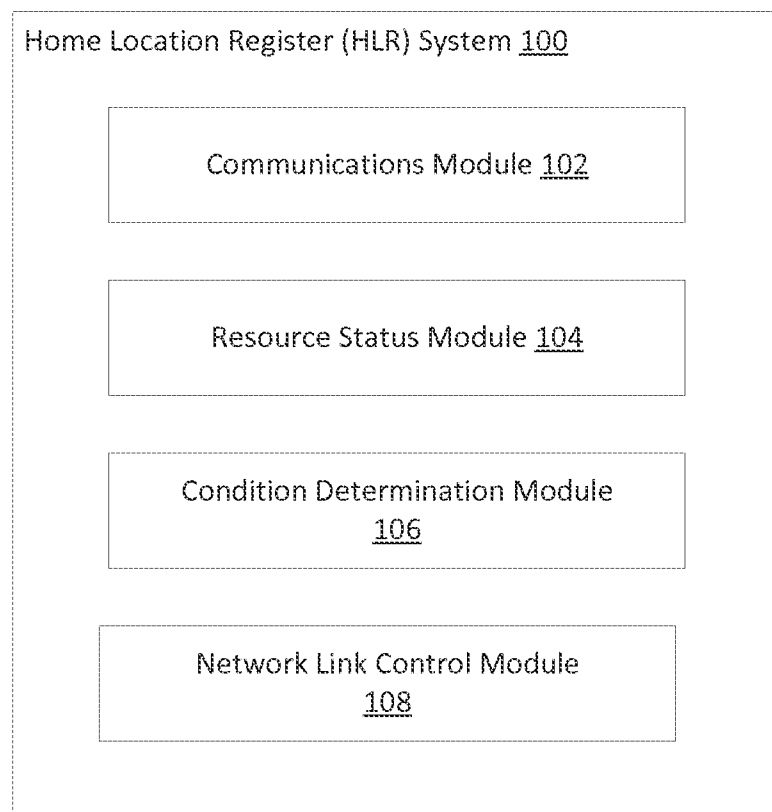
a network link control module to deactivate the set of network links at the HLR system if the condition is determined to be satisfied.

12. The HLR system of claim 11, wherein the resource is a network link included in the set of network links, a data storage device utilized by the HLR system, a processor utilized by the HLR system, a memory utilized by the HLR system, or a software application instance operating on the HLR system.

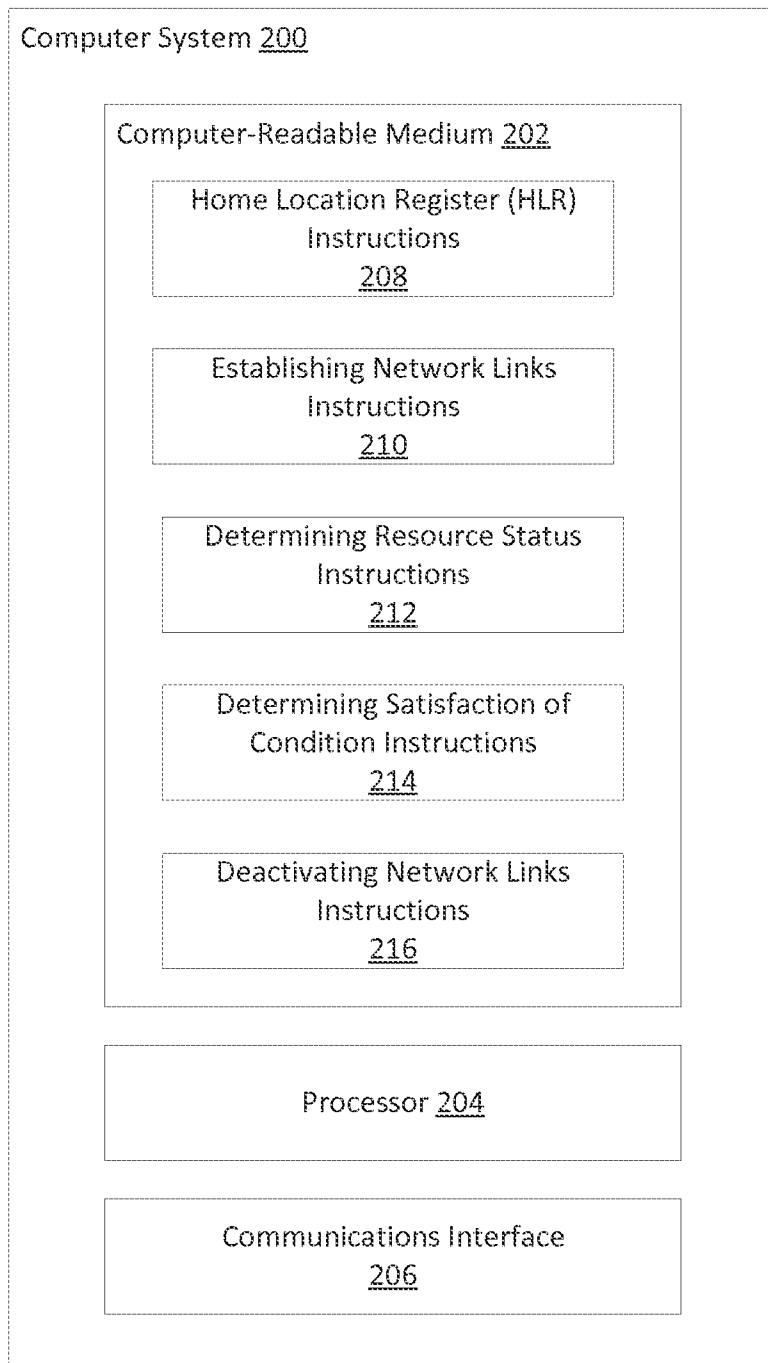
13. The HLR system of claim 11, wherein the resource is a HLR software application instance adapted to handle a HLR message included in the network traffic.

14. The HLR system of claim 11, wherein the status relates to operational quality of the resource, or the status relates to operational load of the resource.

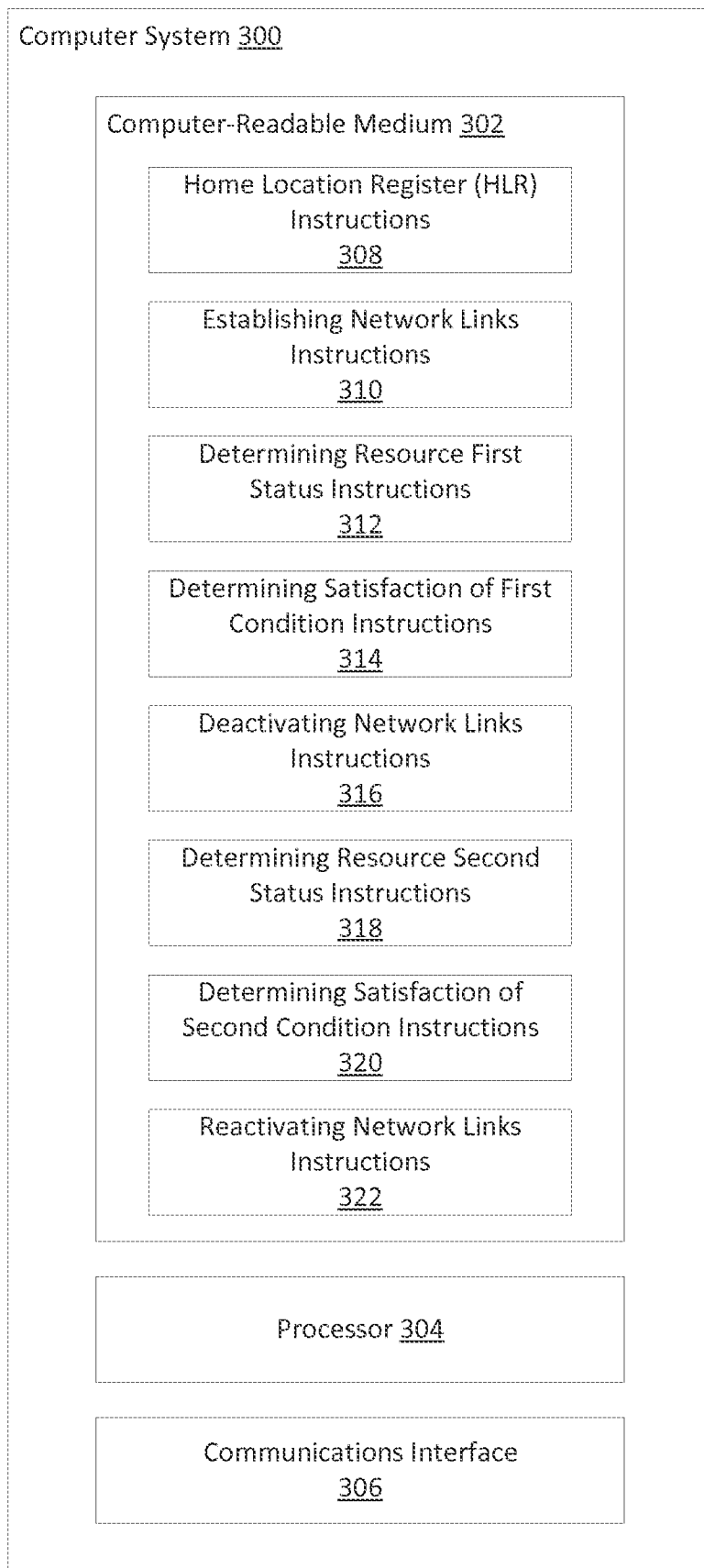
15. The HLR system of claim 11, wherein the HLR system is part of a plurality of HLR systems having synchronized HLR data.

**FIG. 1**

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**FIG. 2**

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**FIG. 3**

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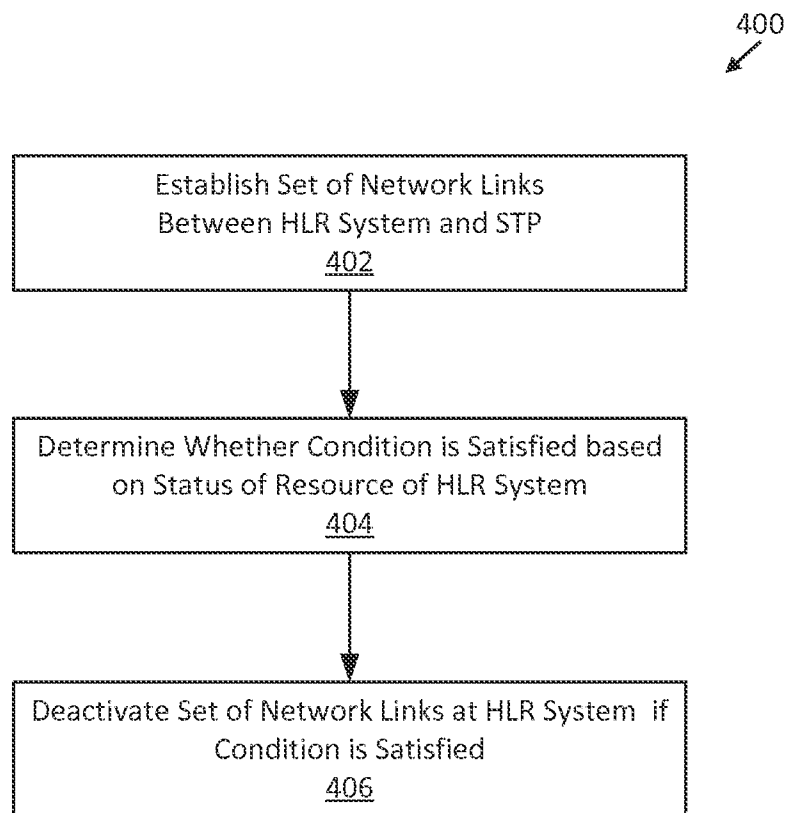


FIG. 4

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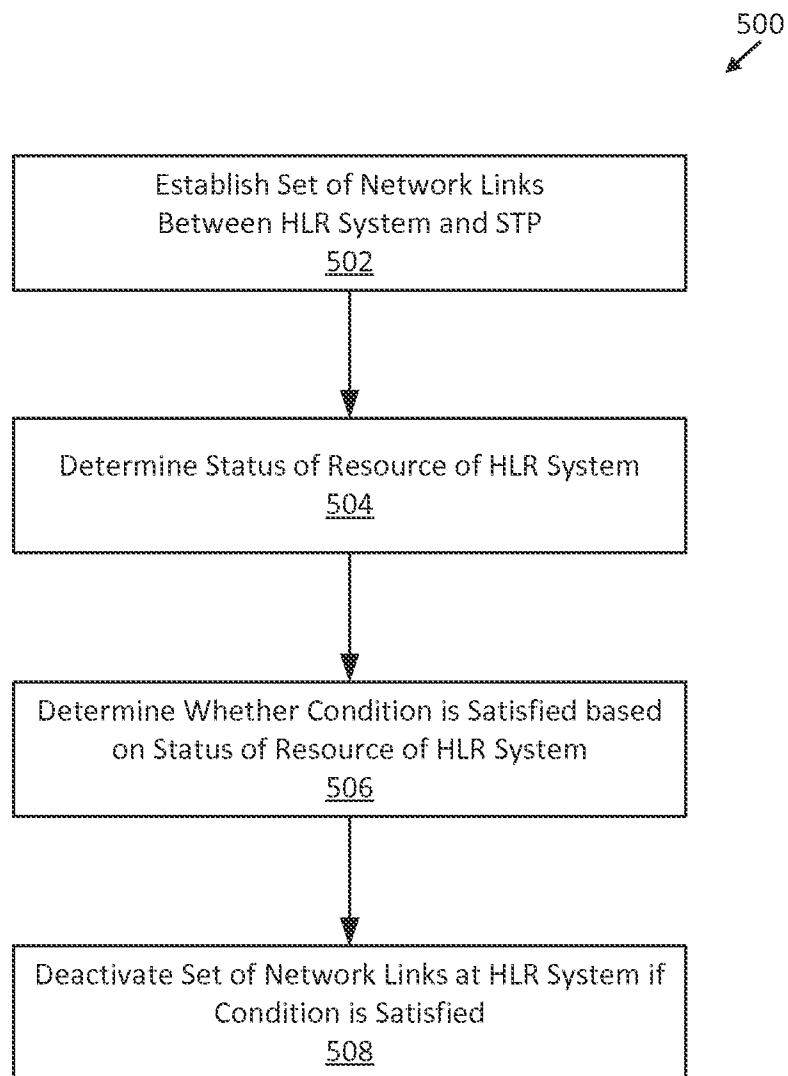
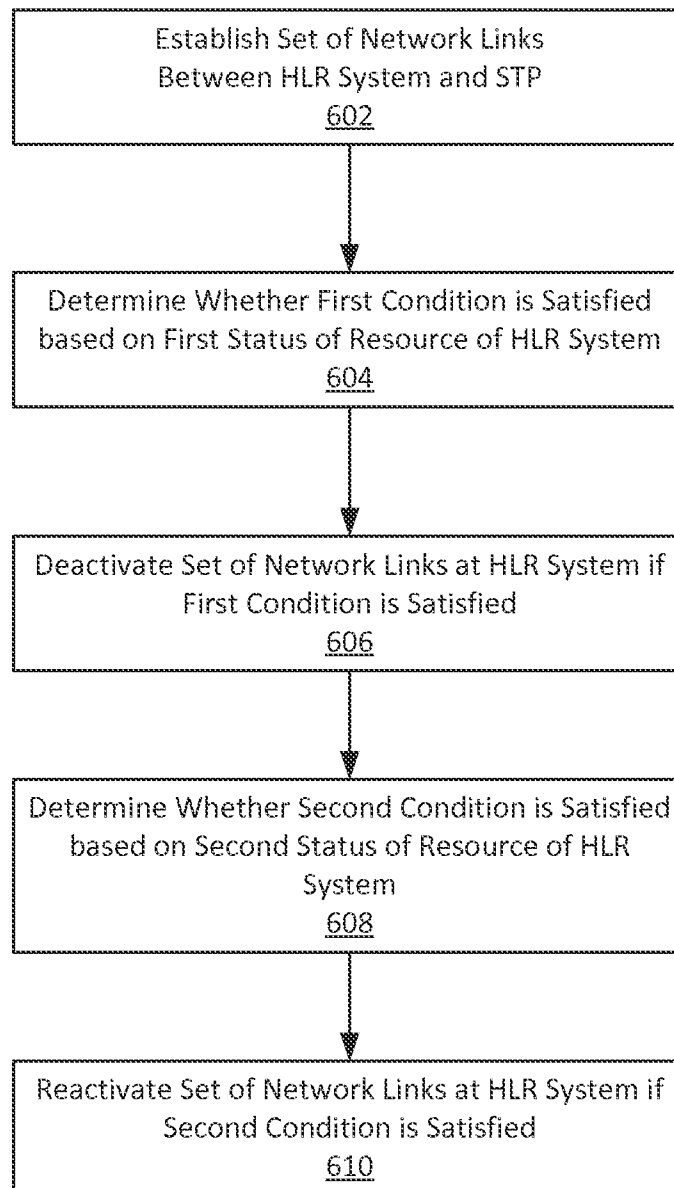
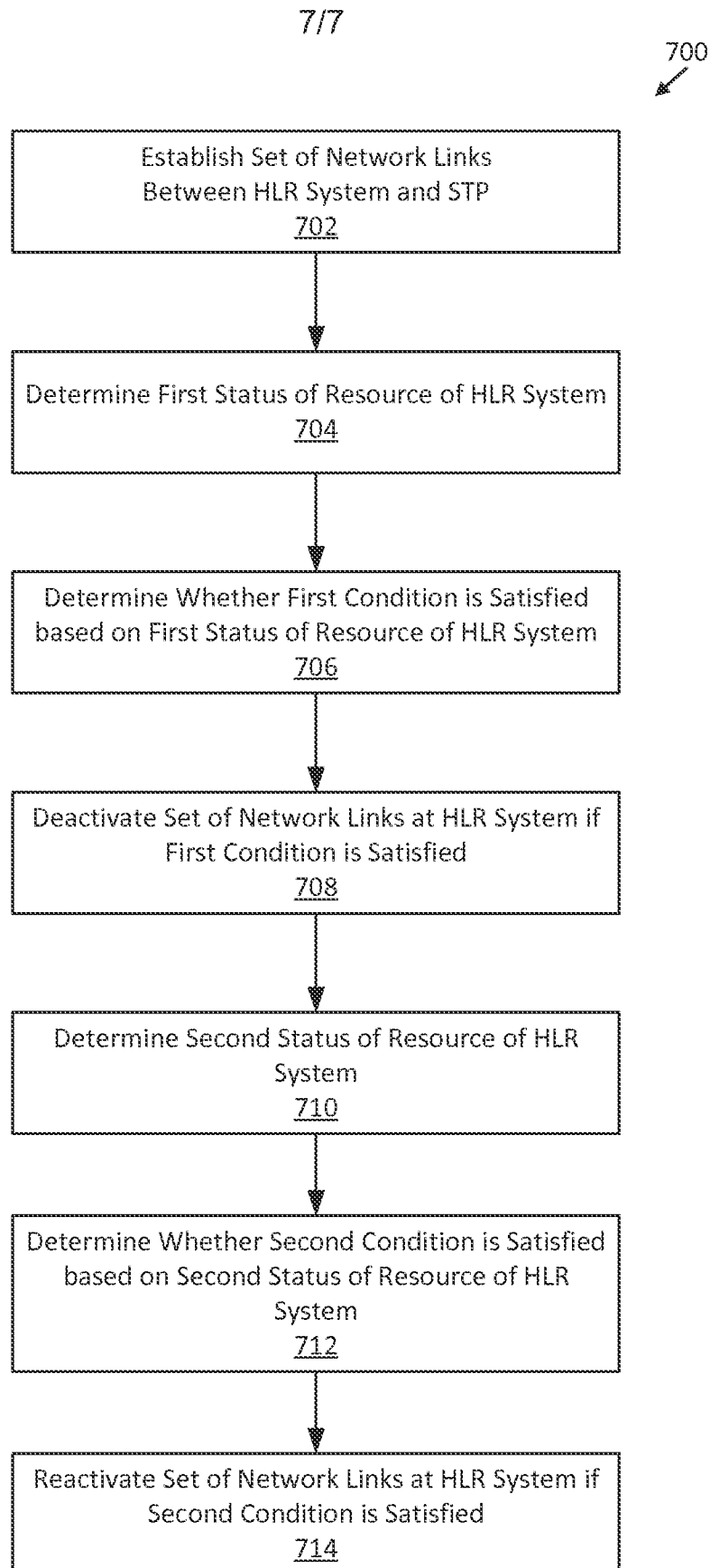


FIG. 5

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600  
↙**FIG. 6**

**FIG. 7**

## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2015/057291****A. CLASSIFICATION OF SUBJECT MATTER****H04W 76/04(2009.01)i, H04W 28/16(2009.01)i, H04W 8/04(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 76/04; G06F 15/173; H04L 12/24; G06F 17/30; H04Q 7/20; H04W 8/06; H04W 28/16; H04W 8/04

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: HLR(home location register), STP(signal transfer point), overload, determine, resource, condition, deactivate, links****C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                | Relevant to claim No. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Y         | US 2012-0096045 A1 (TIFFANY A. MOORE et al.) 19 April 2012<br>See paragraphs [0014]-[0049]; claim 14; and figure 1.               | 1-15                  |
| Y         | US 2004-0137904 A1 (KLAUS DAVID GRADISCHNIG) 15 July 2004<br>See paragraph [0018]; and figure 1.                                  | 1-15                  |
| Y         | US 2006-0246894 A1 (GUANGBIN MENG) 02 November 2006<br>See paragraph [0037].                                                      | 8, 15                 |
| A         | US 2014-0315545 A2 (CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS) 23 October 2014<br>See paragraphs [0041]-[0056]; and figures 2, 3. | 1-15                  |
| A         | KR 10-2010-0002808 A (KT CORPORATION) 07 January 2010<br>See paragraphs [0023]-[0034]; and figure 3.                              | 1-15                  |



Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

07 April 2016 (07.04.2016)

Date of mailing of the international search report

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2015/057291**

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
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