



- (51) **International Patent Classification:**
H04W 68/02 (2009.01)
- (21) **International Application Number:**
PCT/EP2013/058618
- (22) **International Filing Date:**
25 April 2013 (25.04.2013)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
61/640194 30 April 2012 (30.04.2012) US
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(81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

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(54) **Title:** METHOD TO INTRODUCE A STATE IN A DEVICE FOR REACHABILITY WHEN THE DEVICE IS NOT ATTACHED

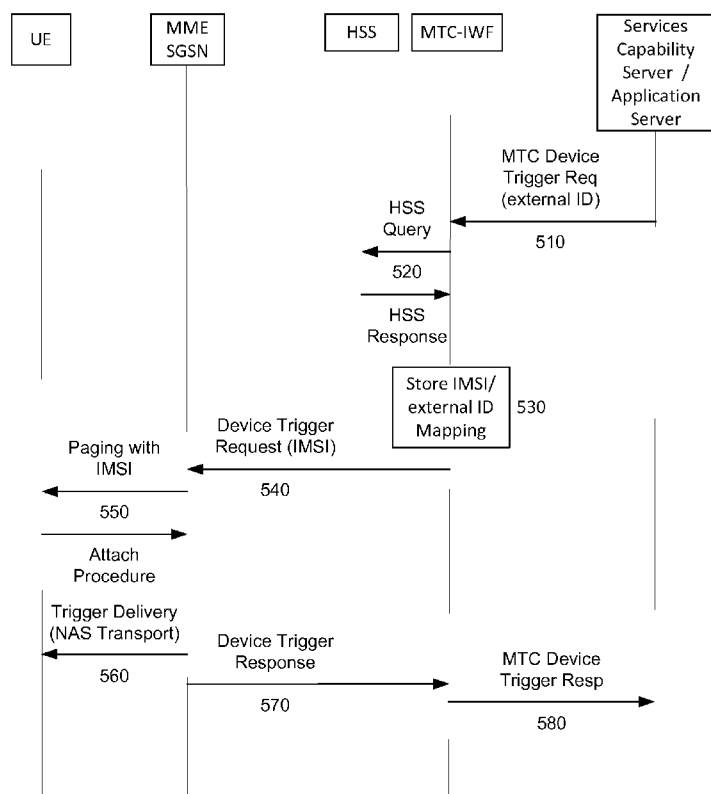


Figure 5

(57) **Abstract:** Communication systems, such as an evolved packet system, may benefit from methods for introducing a state in a device for reachability when the device is not attached. In particular, certain communication systems in which machine type communication devices are deployed may benefit from an offline triggering feature for machine type communication. A method can include detaching from a network. The method can also include listening to a paging channel of the network while remaining detached from the network. The method can further include reattaching upon detecting an appropriate indication in the paging channel.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, **Published:**
ML, MR, NE, SN, TD, TG).

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DESCRIPTION

TITLE:

Method to Introduce a State in a Device for Reachability when the Device is not Attached

5 CROSS-REFERENCE TO RELATED APPLICATION:

Field:

[0001] This application is related to and claims the priority of U.S. Provisional Patent Application 61/640,194, filed April 30, 2012, which is hereby incorporated herein by reference in its entirety.

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BACKGROUND:

Field:

[0002] Communication systems, such as an evolved packet system, may benefit from methods for introducing a state in a device for reachability when the device is not attached.

15 In particular, certain communication systems in which machine type communication devices are deployed may benefit from an offline triggering feature for machine type communication.

Description of the Related Art:

[0003] The evolved packet system (EPS), the successor of general packet radio system (GPRS), provides radio interfaces and packet core network functions for broadband wireless data access. EPS core network functions include the mobility management entity (MME), the packet data network gateway (PDN-GW) and the Serving Gateway (S-GW). An example of an evolved packet core architecture is illustrated in Figure 1 and is described by third generation partnership project (3GPP) technical specification (TS) 23.401, which is incorporated herein by reference in its entirety. A common packet domain core network can be used for both radio access networks (RANs), the global system for mobile communication (GSM) enhanced data rates for GSM evolution (EDGE) radio access network (GERAN) and the universal terrestrial radio access network (UTRAN).

[0004] For machine-type-communication (MTC) a functional entity called MTC interworking function (MTC-IWF) and several new interfaces, including S6m, Tsp, Tsms, T5a/b/c and T4, have been introduced to the 3GPP architecture. Figure 2 illustrates machine-type-communication additions to the 3GPP architecture, as well as the various interfaces identified. The MTC-IWF and the new interfaces in 3GPP Release 11 (Rel 11) can, for

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example, enable triggering of devices with or without a mobile subscriber integrated services digital network number (MSISDN) from an internal or external MTC server. The triggering of the devices may be, for example, in order to establish a packet data network (PDN) connection and/or packet data protocol (PDP) context. A 3GPP architecture for machine-type communication is discussed in 3GPP TS 23.682, which incorporated herein by reference in its entirety.

[0005] In general, offline device triggering is one of the MTC related features discussed in third generation partnership project (3GPP) technical specification (TS) 22.368 and 3GPP technical report (TR) 23.888, both of which are hereby incorporated herein by reference. As discussed therein, one way to attempt to trigger non-attached MTC devices is to use cell broadcast service (CBS).

SUMMARY:

[0006] According to certain embodiments, a method can include detaching from a network and listening to a paging channel of the network while remaining detached from the network. The method can also include reattaching upon detecting an appropriate indication in the paging channel.

[0007] In certain embodiments, a method can include receiving a request to trigger a detached user equipment paging the user equipment. The method can also include triggering the user equipment upon attachment of the user equipment responsive to the paging.

[0008] An apparatus, according to certain embodiments, can include at least one processor and at least one memory including computer program code. The at least one memory and the computer program code can be configured to, with the at least one processor, cause the apparatus at least to detach from a network and listen to a paging channel of the network while remaining detached from the network. The at least one memory and the computer program code can also be configured to, with the at least one processor, cause the apparatus at least to reattach upon detecting an appropriate indication in the paging channel.

[0009] An apparatus, in certain embodiments, can include at least one processor and at least one memory including computer program code. The at least one memory and the computer program code can be configured to, with the at least one processor, cause the apparatus at least to receive a request to trigger a detached user equipment and page the user equipment. The at least one memory and the computer program code can also be configured to, with the at least one processor, cause the apparatus at least to trigger the user equipment upon attachment of the user equipment responsive to the paging.

[0010] According to certain embodiments, an apparatus can include detaching means for detaching from a network and listening means for listening to a paging channel of the network while remaining detached from the network. The apparatus can also include reattaching means for reattaching upon detecting an appropriate indication in the paging channel.

[0011] In certain embodiments, an apparatus can include receiving means for receiving a request to trigger a detached user equipment. The apparatus can also include paging means for paging the user equipment. The apparatus can further include triggering means for triggering the user equipment upon attachment of the user equipment responsive to the paging.

[0012] A non-transitory computer readable medium can, according to certain embodiments, be encoded with instructions that, when executed in hardware, perform a process. The process can include detaching from a network and listening to a paging channel of the network while remaining detached from the network. The process can also include reattaching upon detecting an appropriate indication in the paging channel.

[0013] A non-transitory computer readable medium can, in certain embodiments, be encoded with instructions that, when executed in hardware, perform a process. The process can include receiving a request to trigger a detached user equipment paging the user equipment. The process can also include triggering the user equipment upon attachment of the user equipment responsive to the paging.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0014] For proper understanding of the invention, reference should be made to the accompanying drawings, wherein:

[0015] Figure 1 illustrates an evolved packet core architecture.

[0016] Figure 2 illustrates machine-type-communication additions to a third generation partnership project architecture.

[0017] Figure 3 illustrates a detach procedure with explicit indication according to certain embodiments.

[0018] Figure 4 illustrates a detach procedure with implicit or no indication about paging possible according to certain embodiments.

[0019] Figure 5 illustrates T5 based triggering according to certain embodiments.

[0020] Figure 6 illustrates T4 based triggering according to certain embodiments.

[0021] Figure 7 illustrates a method according to certain embodiments.

[0022] Figure 8 illustrates a system according to certain embodiments.

DETAILED DESCRIPTION:

[0023] Offline device triggering is a machine type communication (MTC), according to certain embodiments, can be configured to minimize the signaling and network context for devices that have long periods between activity, such as weeks, months, years, or the like. For example, an eCall device may only send data when the car is involved in an accident, but may need to be triggered from time to time for configuration purposes, such as for software (SW) or firmware (FW) updates. eCall devices are not attached when there is no accident, however. Moreover, there may be many machine type communication devices that have similar characteristics. Thus, certain embodiments are not limited to eCall devices. For example, certain embodiments may be applicable to devices that may communicate on a daily basis on average.

[0024] Certain embodiments may preserve offline location privacy as much as possible. Users may prefer not to leave every machine type communication device always attached, as this implies that the machine type communication device, and the user possessing the device, can always be traced using network based location determinations. Thus, many machine type communication devices may be detached most of the time. Accordingly, certain embodiments are able to trigger such devices even when they are offline and not attached.

[0025] Certain embodiments provide for offline triggering so that the network can reach the device even when the device is not attached with the network. Keeping the device detached from the network can have two effects. One effect is that signaling with the network is reduced, resulting in reduced context storage as well as reduced battery consumption in the device itself. Another effect is that when the device is detached user privacy may be more protected, if the network cannot track the device when it is not attached.

[0026] Certain embodiments, therefore, provide for ensuring that the user equipment (UE) listens to paging channel when detached. For example, the network can indicate paging possible after detach. This indication can be included in an detach request or detach accept, depending on whether the detach is initiated by the user equipment or the network. This indication can inform the user equipment that it should listen to a paging channel after detaching from the network.

[0027] Moreover, an extended discontinuous reception (DRX) cycle can be defined that the user equipment can use when it is detached. In certain embodiments, all networks can apply the same DRX cycle for the user equipment to use when it is detached. This can permit the user equipment to be reached, even if it is camping in a cell that belongs to a public land

mobile network (PLMN) different from the one from which it was detached. Alternatively, upon detach an extended DRX cycle of a set of extended DRX cycles can be identified to the user equipment, so that the user equipment can use an appropriate local extended DRX cycle. Typically, a network normally broadcasts the paging cycle that the user equipment should use when it is attached with the network. In addition, according to certain embodiments, a network can provide an extended paging cycle that the user equipment should use when it is not attached with the network.

[0028] The device can be configured to transition to a special sub-state upon receiving "detach with paging possible". Moreover, other aspects of certain embodiments can relate to actual triggering if the user equipment when it is offline.

[0029] Figure 3 illustrates a detach procedure with explicit indication according to certain embodiments. As shown in Figure 3, at 310, with a detach request, the network can indicate to the device that paging is possible when it is detached, namely when the device is not attached with the network. The user equipment can process the detach request normally and can, at 320, accept the detach request.

[0030] Upon receiving an indication from the network that paging is possible in the detach request, the device can activate an extended DRX cycle and listen to paging periodically. The user equipment can move to EMM-DEREGISTERED state and can, for example, move to a sub-state PAGING-POSSIBLE. The user equipment may also perform measurements that result in cell-selection/reselection. The user equipment, however, does not need to initiate any other procedures, such as periodic updates with the network.

[0031] Figure 3 illustrates a network-initiated detach request. A similar procedure may be followed during a user equipment-initiated detach, namely the indication that paging is possible can be included in the detach accept.

[0032] Figure 4 illustrates a detach procedure with implicit or no indication about paging possible according to certain embodiments. Thus, in such embodiments, the user equipment can listen to paging based on configuration information after a detach procedure. As shown in Figure 4, at 410 the network can initiate a detach request. Then, the user equipment can process the detach request normally and can, at 420, accept the detach request. Based on configuration within the user equipment, the user equipment can determine that paging is possible, even if this is not explicitly indicated in the detach request.

[0033] The device can then activate an extended DRX cycle and listen to paging periodically. As described above, the user equipment can move to EMM-DEREGISTERED state and optionally to a sub-state PAGING-POSSIBLE, for example. The user equipment may also perform measurement(s) that can result in cell-selection/reselection. The user equipment is not, however, required to initiate any other procedures such as periodic updates

with the network.

[0034] As above, similar processing can occur when the detach is user equipment initiated. Moreover, similar processing can also apply when the user equipment performs an implicit detach. In other words, while no detach request or detach accept messages need to be exchanged, when in a detached state the user equipment can activate an extended DRX cycle and listen to paging periodically.

[0035] Various state transitions can occur in the user equipment. If the user equipment moves to a cell that is known not to be able to provide normal service, then the user equipment can enter a sub-state LIMITED-SERVICE. If no cell can be selected or the device is in a manual network selection mode and no cell of the selected PLMN has been found or if the selected cell is a non-3GPP cell, the user equipment can enter a sub-state NO-CELL-AVAILABLE. If a universal subscriber identity module (USIM) has been removed and consequently the device does not have an international mobile subscriber identity (IMSI), then the device can move to a NO-IMSI state. Upon transitioning to these states, the user equipment does not need to listen to the paging channel.

[0036] Various procedures can be used to trigger the user equipment when the user equipment is offline. The following conditions may be useful to fulfill in or to perform triggering of the user equipment when the user equipment is not registered. The application server (AS) or the services capability server (SCS) can have access to the geographic location coordinates for the user equipment when the user equipment is attached. Moreover, the user equipment's last known location can be reported to the interworking function (IWF) when the user equipment performs tracking area or routing area update. This reporting can be based on the fact that the network knows that it may try to reach the user equipment when it is not attached.

[0037] The IWF and/or HSS can store the last known serving node information for the user equipment. The IWF can also choose to provide a list of serving nodes, if the network topology information is available in the IWF. If the HSS returns more than one serving node, then the paging can be performed in a wider area.

[0038] Upon receiving a trigger request from the IWF, the serving node can determine that the user equipment context is marked detached and is not available. Thus, the serving node can page the user equipment with IMSI to trigger an attach. The serving network can know the extended DRX value. This procedure can work irrespective of how the user equipment is triggered. For example, the user equipment can be triggered via Tsms interface directly from the application server to the SMSC to serving node, via T4 from IWF to SMSC to serving node, or via T5 direct interface from IWF to MME/SGSN. Figures 5 and 6 illustrate how the offline triggering works via T5 and T4 respectively.

[0039] Figure 5 illustrates T5 based triggering according to certain embodiments. As shown in Figure 5, at 510, a services capability server / application server can send an MTC device trigger required message, including an external ID (extID) to the MTC-IWF. If the MTC-IWF does not already have an IMSI/external ID mapping, the MTC-IWF can, at 520, send a home subscriber server (HSS) query to the HSS, and response back an HSS response.

[0040] At 530, the MTC-IWF can store the IMSI/external ID mapping. Also, the MTC-IWF can, at 540, send a device trigger request with the IMSI to serving node, namely the MME/SGSN. Although the storing is shown before the sending of the trigger request, the order can be reversed, or the two actions can be taken in parallel.

[0041] If the user equipment is not attached to the serving node, the serving node can be aware of this lack of attachment and can, at 550, send a paging with IMSI to the user equipment. Responsive to the paging, the UE can initiate an attach procedure with the serving node.

[0042] Then, trigger delivery can occur using NAS transport at 560. Meanwhile, the serving node can report a device trigger response, at 570, to the MTC-IWF. Likewise, the MTC-IWF can, at 580, provide an MTC device trigger response to the SCS/AS.

[0043] Figure 6 illustrates T4 based triggering according to certain embodiments. As shown in Figure 6, the procedure may be similar in many respects to the process shown in Figure 5. For a discussion of the similar aspects, see the discussion of Figure 5, above. However, in Figure 6, once the MTC-IWF has identified the IMSI corresponding to the target UE, the MTC-IWF can send a short message service (SMS) submit request with IMSI to an SMS service center (SMS-SC), at 640. The SMS-SC can then, at 645, relay the SMS submit request with IMSI to the serving node. Once the device has been triggered, the serving node can, at 670, send an SMS submit response to the SMS-SC. The SMS-SC can then, at 675, forward the SMS submit response to the MTC-IWF.

[0044] Certain embodiments can provide offline triggering that minimizes the signaling and network context for devices that have long periods between activity, wherein long periods can include weeks, months, or years. Moreover, certain embodiments can enhance location privacy, as the user equipment can be offline as opposed to being always attached. Certain embodiments can additionally provide battery saving for the user equipment as compared to requiring the user equipment to be always attached. For example, an extended paging cycle in addition to the regular paging cycle for the user equipment can permit the user equipment to check for paging relatively infrequently. Furthermore, in certain embodiments all the networks apply a standardized extended DRX cycle value, thereby permitting the user equipment to handling paging while detached and in a roaming location.

[0045] Figure 7 illustrates a method according to certain embodiments. As shown in

Figure 7, a method can include, at 710, detaching from a network. The method can also include, at 720, listening to a paging channel of the network while remaining detached from the network. The method can further include, at 730, reattaching upon detecting an appropriate indication in the paging channel.

5 [0046] The method can also include, at 705, receiving an indication from a network indicating that paging is possible after detach. The listening can be performed contingent upon receiving the indication from the network.

[0047] The method can further include, at 723, applying an extended discontinuous reception cycle configured to permit paging reception at predetermined times. The
10 method can include, at 725, transitioning to a sub-state of paging possible upon receiving in detach message an indication that paging is possible.

[0048] The method can additionally include, at 727, performing measurements for cell selection or reselection while detached.

[0049] The method can also include, at 729, discontinuing listening to paging upon
15 entering at least one state of no cell available, no international mobile subscriber identity, or limited service.

[0050] At 740, the method can, moreover, include receiving a request to trigger a detached user equipment. The method can also include, at 750, paging the user equipment. The method can further include, at 760, triggering the user equipment upon
20 attachment of the user equipment responsive to the paging. The method can also include at 770, providing a detach message to the user equipment indicating paging possible.

[0051] Figure 8 illustrates a system according to certain embodiments of the invention. In one embodiment, a system may include multiple devices, such as, for example, user equipment 810, network element 820, and interworking function 830. The network element
25 can be a serving node, such as an MME or SGSN. Each of these devices may include at least one processor, respectively indicated as 814, 824, and 834. At least one memory is provided in each device, and indicated as 815, 825, and 835, respectively. The memory may include computer program instructions or computer code contained therein. Transceivers 816, 826, and 836 are provided, and each device may also include an antenna, respectively
30 illustrated as 817, 827, and 837. Other configurations of these devices, for example, may be provided. For example, user equipment 810, network element 820, and interworking function 830 may be configured for wired communication, rather than wireless communication, and in such a case antennas 817, 827, and 837 would illustrate any form of communication hardware, without requiring a conventional antenna.

35 [0052] Transceivers 816, 826, and 836 can each, independently, be a transmitter, a receiver, or both a transmitter and a receiver, or a unit or device that is configured both for

transmission and reception.

[0053] Processors 814, 824, and 834 can be embodied by any computational or data processing device, such as a central processing unit (CPU), application specific integrated circuit (ASIC), or comparable device. The processors can be implemented as a single
5 controller, or a plurality of controllers or processors.

[0054] Memories 815, 825, and 835 can independently be any suitable storage device, such as a non-transitory computer-readable medium. A hard disk drive (HDD), random access memory (RAM), flash memory, or other suitable memory can be used. The memories can be combined on a single integrated circuit as the processor, or may be separate therefrom.

10 Furthermore, the computer program instructions stored in the memory and which may be processed by the processors can be any suitable form of computer program code, for example, a compiled or interpreted computer program written in any suitable programming language.

[0055] The memory and the computer program instructions can be configured, with the
15 processor for the particular device, to cause a hardware apparatus such as user equipment 810, network element 820, and interworking function 830, to perform any of the processes described above (see, for example, Figures 3-7). Therefore, in certain embodiments, a non-transitory computer-readable medium can be encoded with computer instructions that, when executed in hardware, perform a process such as one of the processes described herein.

20 Alternatively, certain embodiments of the invention can be performed entirely in hardware.

[0056] Furthermore, although Figure 8 illustrates a system including a user equipment, network element, and interworking function, embodiments of the invention may be applicable to other configurations, and configurations involving additional elements, as illustrated herein.

[0057] According to certain embodiments, a method includes detaching from a network.

25 The method also includes listening to a paging channel of the network while remaining detached from the network. The method further includes reattaching upon detecting an appropriate indication in the paging channel.

[0058] The method can also include receiving an indication from a network indicating that paging is possible after detach.

30 [0059] The listening can be performed contingent upon receiving the indication from the network.

[0060] The method can further include applying an extended discontinuous reception cycle configured to permit paging reception at predetermined times.

35 [0061] The method can include transitioning to a sub-state of paging possible upon receiving in detach message an indication that paging is possible.

[0062] The method can additionally include performing measurements for cell selection or

reselection while detached.

[0063] The method can also include discontinuing listening to paging upon entering at least one state of no cell available, no international mobile subscriber identity, or limited service.

5 [0064] In certain embodiments, a method includes receiving a request to trigger a detached user equipment. The method also includes paging the user equipment. The method further includes triggering the user equipment upon attachment of the user equipment responsive to the paging.

10 [0065] The method can also include providing a detach message to the user equipment indicating paging possible.

[0066] An apparatus, according to certain embodiments, includes at least one processor and at least one memory including computer program code. The at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to detach from a network. The at least one memory and the computer
15 program code are also configured to, with the at least one processor, cause the apparatus at least to listen to a paging channel of the network while remaining detached from the network. The at least one memory and the computer program code are further configured to, with the at least one processor, cause the apparatus at least to reattach upon detecting an appropriate indication in the paging channel.

20 [0067] The at least one memory and the computer program code can be configured to, with the at least one processor, cause the apparatus at least to receive an indication from a network indicating that paging is possible after detach.

[0068] The listening can be performed contingent upon receiving the indication from the network.

25 [0069] The at least one memory and the computer program code can also be configured to, with the at least one processor, cause the apparatus at least to apply an extended discontinuous reception cycle configured to permit paging reception at predetermined times.

30 [0070] The at least one memory and the computer program code can additionally be configured to, with the at least one processor, cause the apparatus at least to transition to a sub-state of paging possible upon receiving in detach message an indication that paging is possible.

[0071] The at least one memory and the computer program code can further be configured to, with the at least one processor, cause the apparatus at least to perform
35 measurements for cell selection or reselection while detached.

[0072] The at least one memory and the computer program code can also be configured

to, with the at least one processor, cause the apparatus at least to discontinue listening to paging upon entering at least one state of no cell available, no international mobile subscriber identity, or limited service.

[0073] An apparatus, in certain embodiments, includes at least one processor and at least one memory including computer program code. The at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to receive a request to trigger a detached user equipment. The at least one memory and the computer program code are also configured to, with the at least one processor, cause the apparatus at least to page the user equipment. The at least one memory and the computer program code are further configured to, with the at least one processor, cause the apparatus at least to trigger the user equipment upon attachment of the user equipment responsive to the paging.

[0074] The at least one memory and the computer program code can be configured to, with the at least one processor, cause the apparatus at least to provide a detach message to the user equipment indicating paging possible.

[0075] According to certain embodiments, an apparatus includes detaching means for detaching from a network. The apparatus also includes listening means for listening to a paging channel of the network while remaining detached from the network. The apparatus further includes reattaching means for reattaching upon detecting an appropriate indication in the paging channel.

[0076] The apparatus can also include receiving means for receiving an indication from a network indicating that paging is possible after detach.

[0077] The listening can be performed contingent upon receiving the indication from the network.

[0078] The apparatus can further include scheduling means for applying an extended discontinuous reception cycle configured to permit paging reception at predetermined times.

[0079] The apparatus can include state means for transitioning to a sub-state of paging possible upon receiving in detach message an indication that paging is possible.

[0080] The apparatus can additionally include measuring means for performing measurements for cell selection or reselection while detached.

[0081] The apparatus can also include suspending means for discontinuing listening to paging upon entering at least one state of no cell available, no international mobile subscriber identity, or limited service.

[0082] In certain embodiments, an apparatus includes receiving means for receiving a request to trigger a detached user equipment. The apparatus also includes paging means

for paging the user equipment. The apparatus further includes triggering means for triggering the user equipment upon attachment of the user equipment responsive to the paging.

[0083] The apparatus can also include detaching means for providing a detach message to the user equipment indicating paging possible.

[0084] A non-transitory computer readable medium is, according to certain embodiments, encoded with instructions that, when executed in hardware, perform a process. The process includes detaching from a network. The process also includes listening to a paging channel of the network while remaining detached from the network. The process further includes reattaching upon detecting an appropriate indication in the paging channel.

[0085] The process can also include receiving an indication from a network indicating that paging is possible after detach.

[0086] The listening can be performed contingent upon receiving the indication from the network.

[0087] The process can further include applying an extended discontinuous reception cycle configured to permit paging reception at predetermined times.

[0088] The process can include transitioning to a sub-state of paging possible upon receiving in detach message an indication that paging is possible.

[0089] The process can additionally include performing measurements for cell selection or reselection while detached.

[0090] The process can also include discontinuing listening to paging upon entering at least one state of no cell available, no international mobile subscriber identity, or limited service.

[0091] A non-transitory computer readable medium is, in certain embodiments, encoded with instructions that, when executed in hardware, perform a process. The process includes receiving a request to trigger a detached user equipment. The process also includes paging the user equipment. The process further includes triggering the user equipment upon attachment of the user equipment responsive to the paging.

[0092] The process can also include providing a detach message to the user equipment indicating paging possible.

[0093] One having ordinary skill in the art will readily understand that the invention as discussed above may be practiced with steps in a different order, and/or with hardware elements in configurations which are different than those which are disclosed. Therefore, although the invention has been described based upon these preferred embodiments, it would be apparent to those of skill in the art that certain modifications, variations, and

alternative constructions would be apparent, while remaining within the spirit and scope of the invention.

WE CLAIM:

1. A method, comprising:

detaching from a network;

5 listening to a paging channel of the network while remaining detached from the network; and

reattaching upon detecting an appropriate indication in the paging channel.

2. The method of claim 1, further comprising:

receiving an indication from a network indicating that paging is possible after detach.

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3. The method of claim 2, wherein the listening is performed contingent upon receiving the indication from the network.

4. The method of any of claims 1-3, further comprising:

15 applying an extended discontinuous reception cycle configured to permit paging reception at predetermined times.

5. The method of any of claims 1-4, further comprising:

20 transitioning to a sub-state of paging possible upon receiving in detach message an indication that paging is possible.

6. The method of any of claims 1-5, further comprising:

performing measurements for cell selection or reselection while detached.

25

7. The method of any of claims 1-6, further comprising:

discontinuing listening to paging upon entering at least one state of no cell available, no international mobile subscriber identity, or limited service.

8. A method, comprising:

5 receiving a request to trigger a detached user equipment;
paging the user equipment; and

triggering the user equipment upon attachment of the user equipment responsive to the paging.

10 9. The method of claim 8, further comprising:

providing a detach message to the user equipment indicating paging possible.

10. An apparatus, comprising:

at least one processor; and

15 at least one memory including computer program code,

wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to

detach from a network;

listen to a paging channel of the network while remaining detached from the network;

20 and

reattach upon detecting an appropriate indication in the paging channel.

11. The apparatus of claim 10, wherein the at least one memory and the computer program code can be configured to, with the at least one processor, cause the apparatus at
25 least to receive an indication from a network indicating that paging is possible after detach.

12. The apparatus of claim 11, wherein the at least one memory and the computer program code can be configured to, with the at least one processor, cause the apparatus at least to listen contingent upon receiving the indication from the network.

5 13. The apparatus of claim 10-12, wherein the at least one memory and the computer program code can be configured to, with the at least one processor, cause the apparatus at least to apply an extended discontinuous reception cycle configured to permit paging reception at predetermined times.

10 14. The apparatus of claim 11-13, wherein the at least one memory and the computer program code can additionally be configured to, with the at least one processor, cause the apparatus at least to transition to a sub-state of paging possible upon receiving in detach message an indication that paging is possible.

15 15. The apparatus of claim 11-14, wherein the at least one memory and the computer program code can further be configured to, with the at least one processor, cause the apparatus at least to perform measurements for cell selection or reselection while detached.

20 16. The apparatus of claim 11-15, wherein the at least one memory and the computer program code can also be configured to, with the at least one processor, cause the apparatus at least to discontinue listening to paging upon entering at least one state of no cell available, no international mobile subscriber identity, or limited service.

17. An apparatus, comprising:

25 at least one processor; and

at least one memory including computer program code,

wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to

receive a request to trigger a detached user equipment;

page the user equipment; and

trigger the user equipment upon attachment of the user equipment responsive to the paging.

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18. The apparatus of claim 17, wherein the at least one memory and the computer program code can be configured to, with the at least one processor, cause the apparatus at least to provide a detach message to the user equipment indicating paging possible.

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19. An apparatus, comprising:

detaching means for detaching from a network;

listening means for listening to a paging channel of the network while remaining detached from the network;

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reattaching means for reattaching upon detecting an appropriate indication in the paging channel.

20. The apparatus of claim 19, further comprising:

receiving means for receiving an indication from a network indicating that paging is possible after detach.

20

21. The apparatus of claim 20, wherein the listening is performed contingent upon receiving the indication from the network.

22. The apparatus of any of claims 19-21, further comprising:

25

scheduling means for applying an extended discontinuous reception cycle configured to permit paging reception at predetermined times.

23. The apparatus of any of claims 19-22, further comprising:

state means for transitioning to a sub-state of paging possible upon receiving in detach message an indication that paging is possible.

5

24. The apparatus of any of claims 19-23, further comprising:

measuring means for performing measurements for cell selection or reselection while detached.

10

25. The apparatus of any of claims 19-24, further comprising:

suspending means for discontinuing listening to paging upon entering at least one state of no cell available, no international mobile subscriber identity, or limited service.

26. An apparatus, comprising:

15

receiving means for receiving a request to trigger a detached user equipment;

paging means for paging the user equipment; and

triggering means for triggering the user equipment upon attachment of the user equipment responsive to the paging.

20

27. The apparatus of claim 26, further comprising:

detaching means for providing a detach message to the user equipment indicating paging possible.

25

28. A non-transitory computer readable medium encoded with instructions that, when executed in hardware, perform a process, the process comprising the method according to any of claims 1-9.

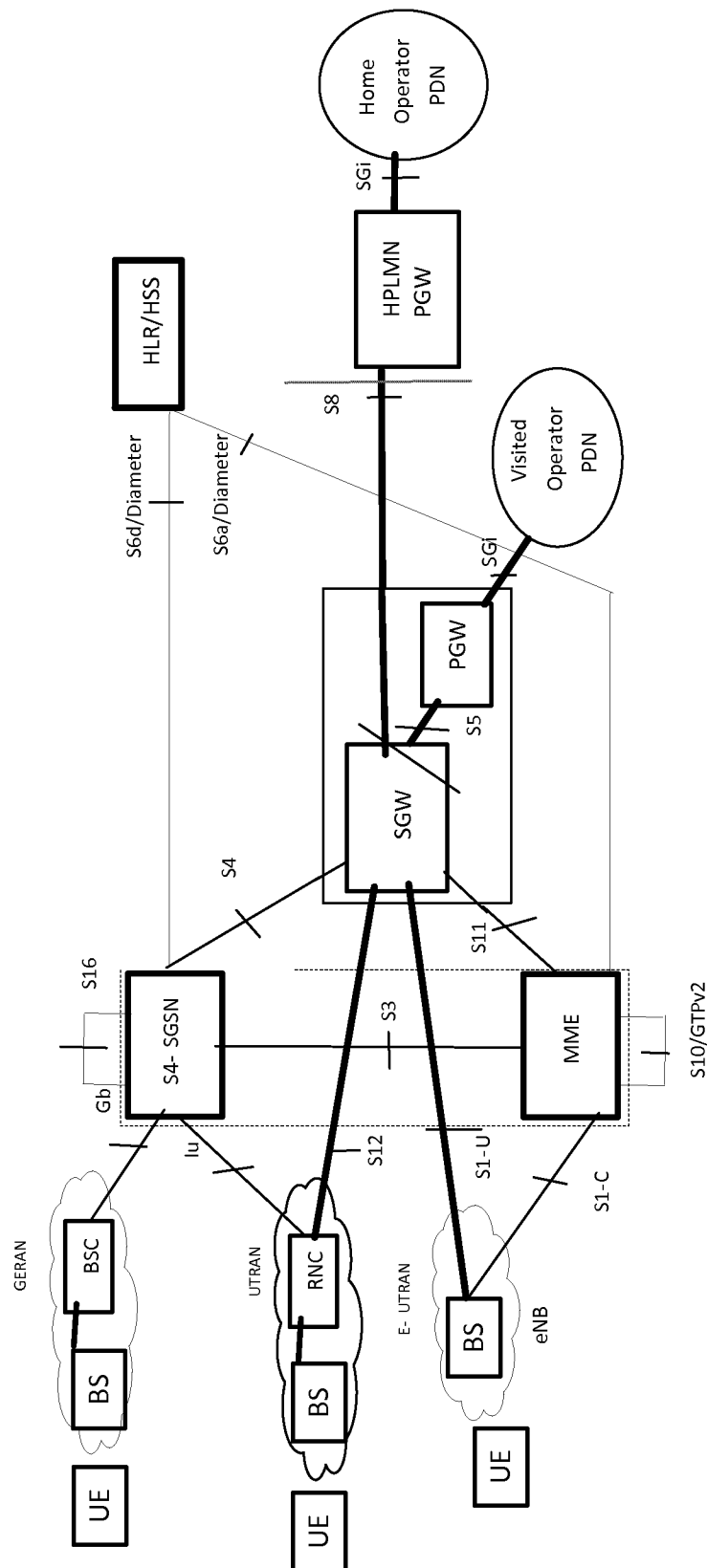


Figure 1

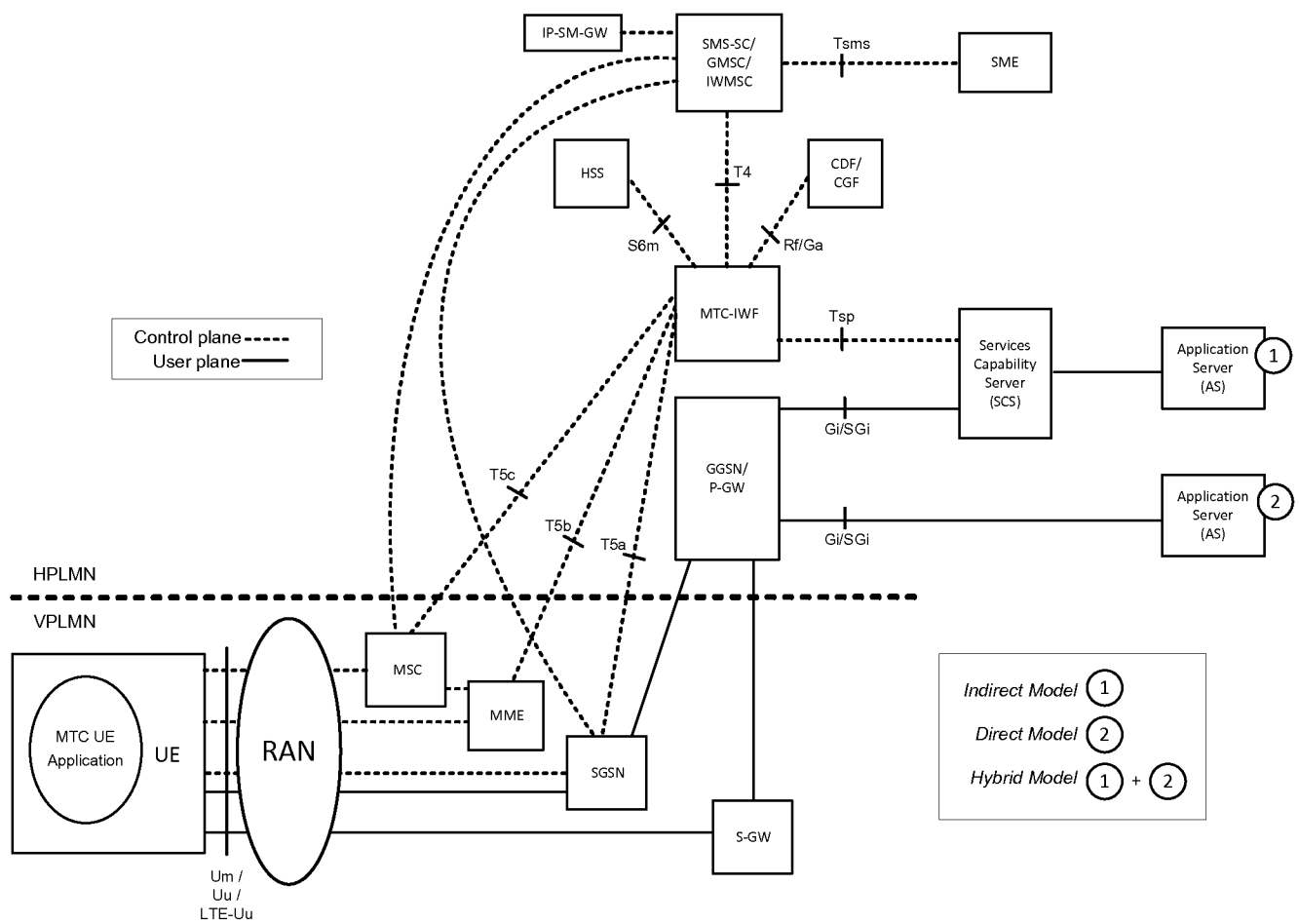


Figure 2

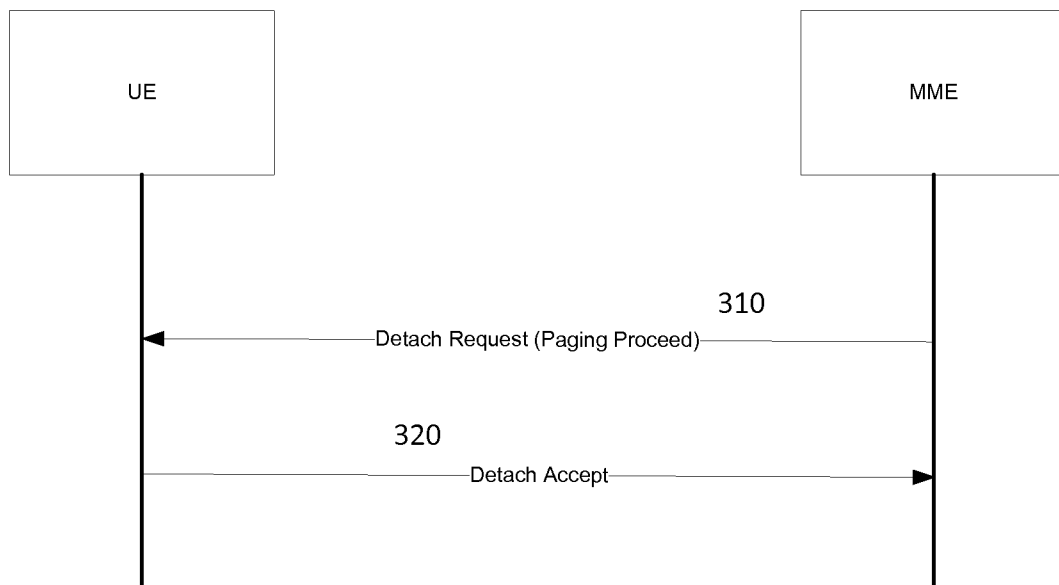


Figure 3

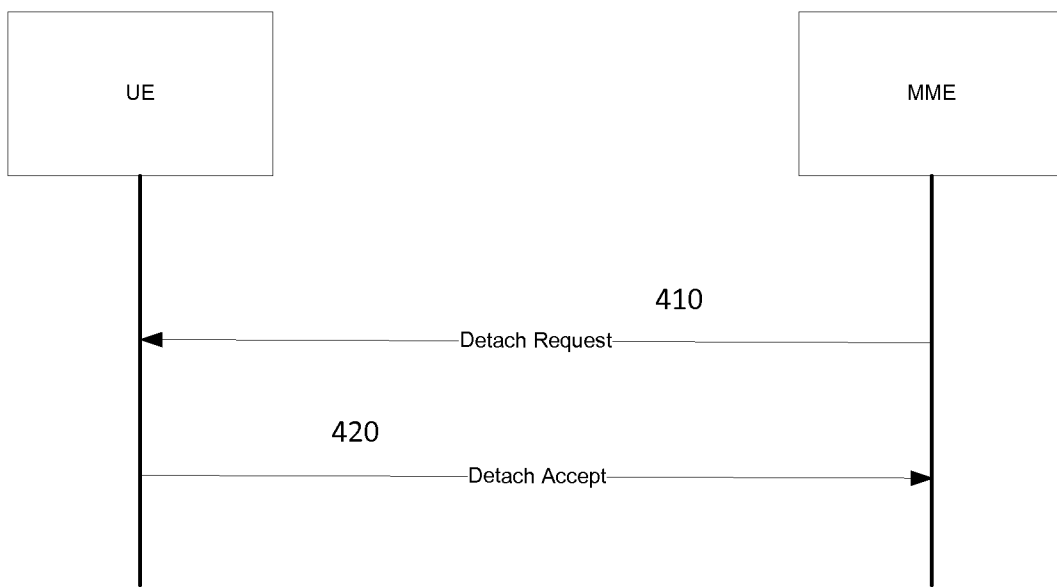


Figure 4

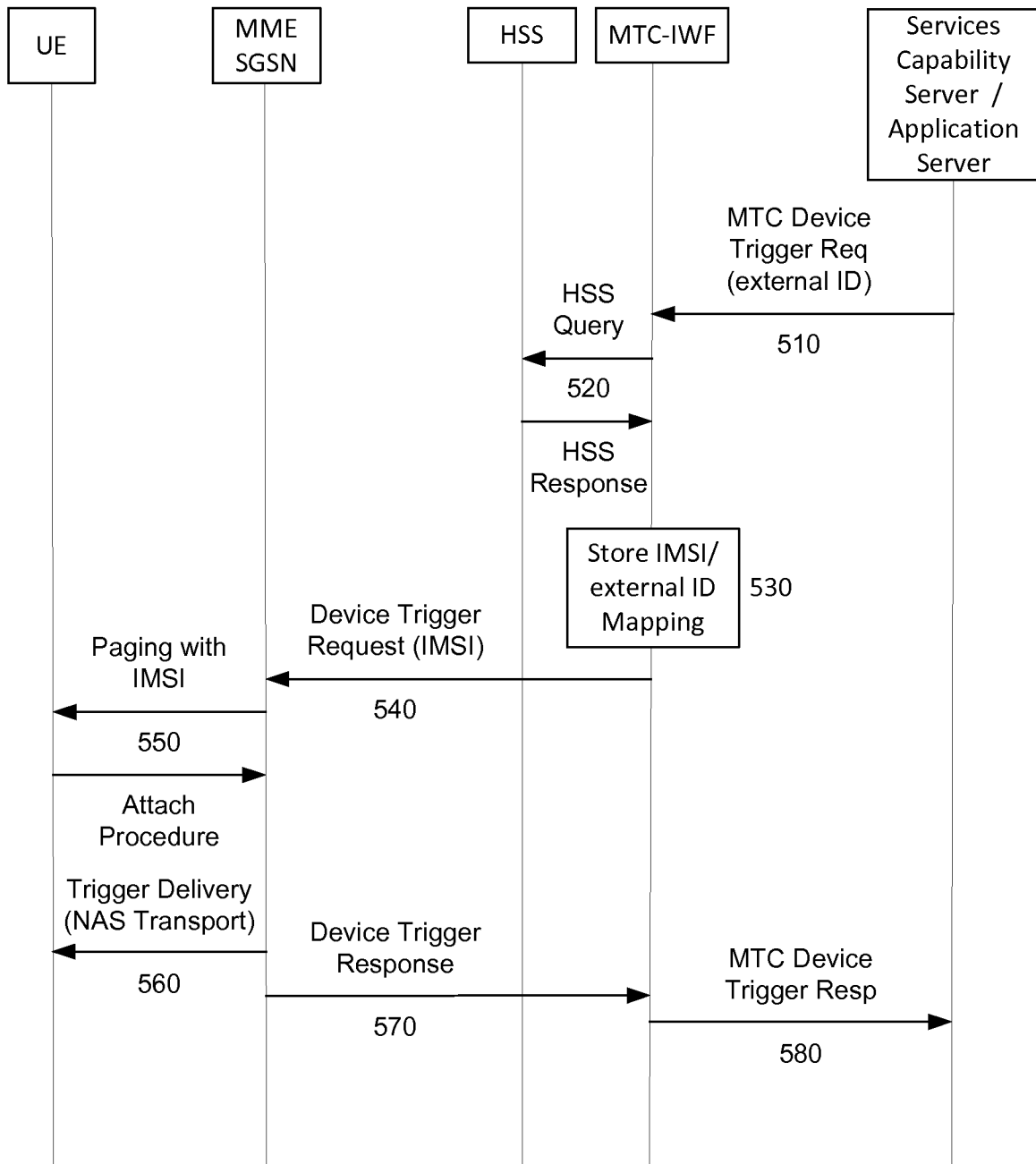


Figure 5

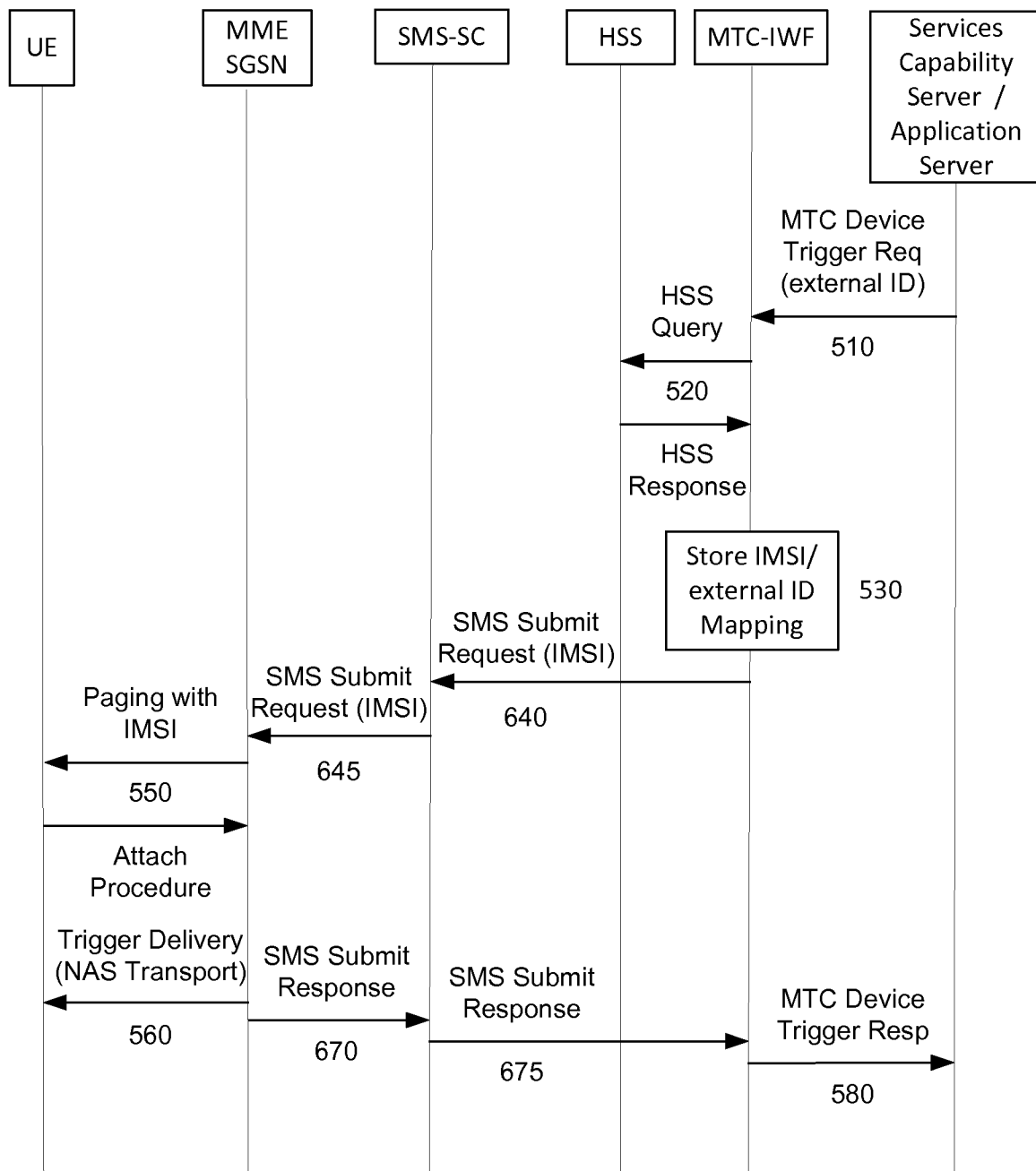


Figure 6

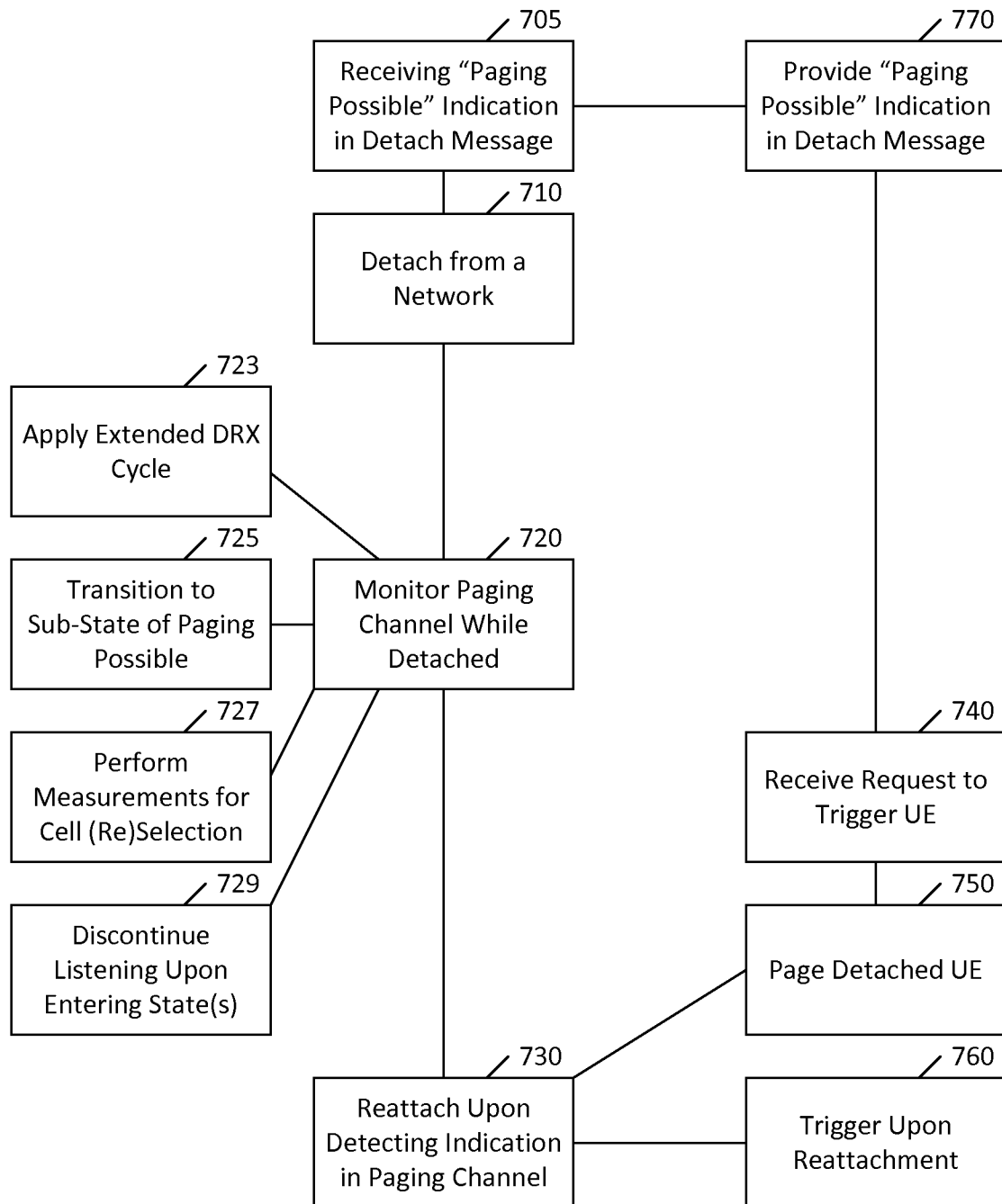


Figure 7

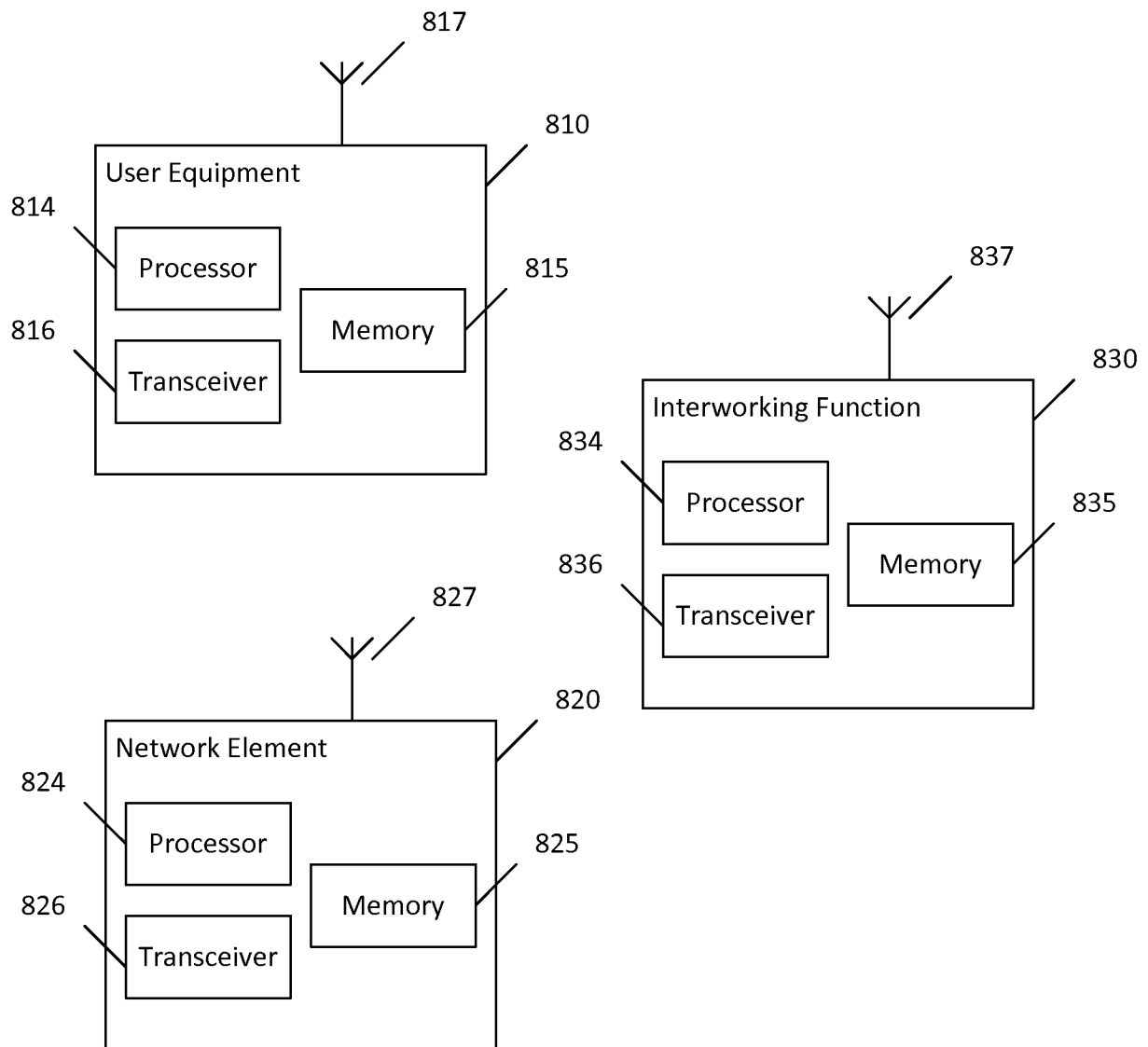


Figure 8