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(71) Applicant: **NOKIA SIEMENS NETWORKS OY** [FI/FI]; Karaportti 3, FI-02610 Espoo (FI).

(72) Inventor; and
(71) Applicant *(for US only)*: **NARAYANAN, Ram, Lakshmi** [US/US]; 1063 Morse Avenue, Apt. 8-101, Sunnyvale, CA 94089 (US).

(74) Agents: **GOLDHUSH, Douglas, H.** et al.; Squire Sanders (US) LLP, 8000 Towers Crescent Drive, 14th Floor, Vienna, VA 22182-6212 (US).

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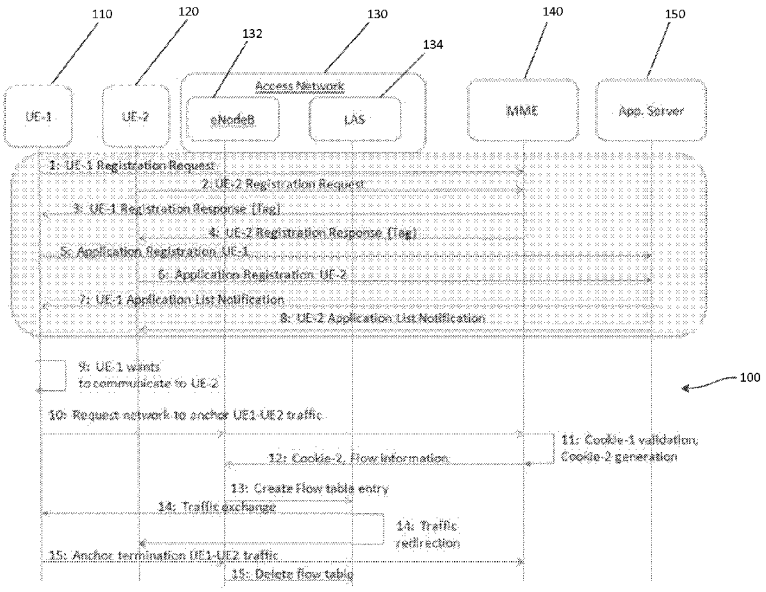


FIG. 1

(57) **Abstract**: Communication systems may benefit from a naming, traffic re-routing scheme based on application- layer traffic optimization services. A method may include sending a registration request to a first network element from at least two UE and receiving a registration response from the first network element to the at least two UE. The method may include sending an application registration to a second network element from the at least two UE and receiving an application list notification from the second network element to the at least two UE. The method may include exchanging an application-level message between the at least two UE. The method may include sending a request to anchor the at least two UE traffic to a third network element and receiving a unique identifier generated from the first network element to the at least two UE. The method may include exchanging application signaling and data between the at least two UE.

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TITLE:

Method and Apparatus for Traffic Re-routing Based on Application-Layer Traffic Optimization Services in Wireless Networks

BACKGROUND:

**Field:**

[0001] Certain embodiments relate to application-layer traffic optimization services in communication networks. More specifically, certain embodiments relate to a method and apparatus for naming, traffic re-routing scheme based on application-layer traffic optimization services in wireless networks.

**Description of the Related Art:**

[0002] Application-Layer Traffic Optimization (ALTO) is being standardized at the Internet Engineering Task Force (IETF). The goal of the ALTO service is to enable peer-to-peer (P2P) network users to exchange traffic among peers within the networks, and thereby minimizing the traffic that crosses the operator network. ALTO working groups have produced several documents including problem statements and requirements, to enable ALTO service. From these requirements many things may be kept open including provisioning of topology policies, and how the P2P application itself is recognized in the operator network. The ALTO standards have identified several use cases and problems including discovery of peers, traffic-based routing, and working for real-time communications. After careful investigation of those use cases, it may be difficult to map the ALTO server infrastructure in mobile networks.

[0003] In a use case, such as inter-chat message, video conferencing, video calling, and file sharing, which are commonly used applications in fixed networks, adoption of such applications and associated the use case is increasing in mobile networks, and the traffic between two endpoints are always anchored and routed back to the core networks. However, there

seems to be no optimal way to re-route traffic, and thus, transport networks are always being used for communications. In mobile networks the anchor point for traffic redirection occurs at the core of the network.

[0004] As the network is hierarchical, the network makes and allows user traffic to go only NORTH-SOUTH, and this may make the transport network congested more quickly because the traffic originates and terminates from same access network. Solutions like transport network offloading or radio network offloading may give extended benefits but these solutions make the system difficult to manage and to provide optimal traffic. Also, offloading type services are available in crowded areas, and there is no technique to minimize the growing transport network of P2P traffic. For example, the sharing of data among users is picking up in mobile networks, and the traffic originates from one UE (say UE-1) and goes to the core network and then is routed back to the same cell to another UE (say UE-2). Radio, transport, and core network are not optimized for such services, for example, transport networks get congested faster than expected.

[0005] Operators such as T-MOBILE® are deploying their own Voice Over IP (VoIP) client (or similar services) on their mobile devices, and want to improve the network utilizations. Furthermore the user does not tend to move (based on previous statistics that 85% of the time users are connected to the same cell) during an activity. If an operator wants to have optimal service then they must run the service and this is not possible with existing user base of SKYPE™, FACETIME™, GOOGLE+HANGOUTS™, and other similar applications. Operators do not have control on how, and when the users of these applications are going to communicate, and also with whom they are communicating.

[0006] Existing discovery mechanisms in the ALTO standards call for coordination and cooperation between operators, and P2P service, but these mechanisms may take a longer time. For example, these mechanisms have various shortcomings as follows. They are suitable for fixed networks, and

assume that the user traffic can be re-routed within the network. Further in mobile networks, the user traffic goes to the core network and no anchoring of traffic is possible within the radio and transport networks. Also, exposing network topology and policy to P2P may have inherent security risks for which the standards have yet to address.

SUMMARY:

[0007] According to a first embodiment, a method may include sending a first registration request to a first network element from a first user equipment and sending a second registration request to the first network element from a second user equipment. The method may also include receiving a registration response from the first network element to the first and the second user equipment. The method may further include sending an application registration to a second network element from the first and the second user equipment. The method may still further include receiving an application list notification from the second network element to the first and the second user equipment. The method may yet further include exchanging an application-level message between the first and the second user equipment based on the first and the second user equipment being registered and receiving the application list notification.

[0008] According to a second embodiment, an apparatus may include at least one processor and at least one memory including computer program code. Further, 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 send a first registration request to a first network element from a first user equipment and to send a second registration request to the first network element from a second user equipment. Also, 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 registration response from the first network element to the first and the second user equipment. Further, 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 send an application registration to a second network element from the first and the second user equipment. Still Further, 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 an application list notification from the second network element to the first and the second user equipment. Also, 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 exchange an application-level message between the first and the second user equipment based on the first and the second user equipment being registered and receiving the application list notification.

[0009] According to a third embodiment, an apparatus may include sending means for sending a first registration request to a first network element from a first user equipment and sending means for sending a second registration request to the first network element from a second user equipment. The apparatus may also include receiving means for receiving a registration response from the first network element to the first and the second user equipment. The apparatus may further include sending means for sending an application registration to a second network element from the first and the second user equipment. The apparatus may still further include receiving means for receiving an application list notification from the second network element to the first and the second user equipment. The apparatus may also include exchanging means for exchanging an application-level message between the first and the second user equipment based on the first and the second user equipment being registered and receiving the application list notification.

[0010] According to a fourth embodiment, a non-transitory computer readable medium may be encoded with instruction that, when executed in hardware, perform a process. The process may include the method according to the first

embodiment discussed above.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0011] For proper understanding of the invention, reference should be made to the accompanying drawings, wherein:

[0012] Figure 1 illustrates traffic re-routing for application-layer traffic optimization client according to certain embodiments.

[0013] Figure 2 illustrates a flow diagram of a method according to certain embodiments.

[0014] Figure 3 illustrates a block diagram of a system according to certain embodiments.

DETAILED DESCRIPTION:

[0015] Certain embodiments relate to application-layer traffic optimization (ALTO) services in communication networks. More specifically, certain embodiments relate to methods and apparatuses for traffic re-routing based on ALTO services in wireless networks. Certain embodiments include a process which leverages identification schemes that may be already in place for wireless networks such as 3G and 4G. Other embodiments include a process which leverage packet processing and an IP routing entity that is closer to the user from the wireless network side and may be able to make intelligent traffic re-routing decisions via a Liquid Application Server (LAS). It should be noted that some embodiments include a process which functions without a LAS. Other embodiments include a process which eliminates around 40% of traffic that goes between NORTH-SOUTH locally. Certain embodiments include a process which integrates well to ongoing standards such as ALTO. Other embodiments include a process that is compatible to all types of cellular technology 3G and 4G. Certain embodiments include a process which can be standardized so that interoperability between a peer-to-

peer (P2P) provider and device vendors without compromising security and privacy.

[0016] Certain embodiments include a process for 3G and 4G wireless infrastructure in which ALTO servers and clients can interact, and provides solutions that may address any ALTO problem statement and interface.

[0017] Other embodiments provide a technique that is secure and scalable to enable an ALTO client to use the mobile infrastructure, and at the same time benefit an operator by performing optimal traffic re-routing within the wireless networks.

[0018] Figure 1 illustrates traffic re-routing for application-layer traffic optimization client according to certain embodiments. In Figure 1, a signaling flow diagram 100 shows two users, User-A and User-B, for purposes of illustration only these users are using UE 110 and UE 120 devices respectively and running ALTO enabled clients. Both UEs (110, 120) perform registration (1) and (2) through their application service provider (ASP) 150 or via operator hosted service (OHS) and then exchange application level data directly. As an example, use cases that can be visualized are P2P download, Web real-time communication, and Voice or Video over IP communication. Figure 1 illustrates the sequence of message exchange that may occur between both UEs (110, 120) that are behind the same wireless access network/Mobility Management Entity (MME) 140 and access network 130 while accessing the ALTO based services.

## Registration Service

[0019] As shown in Figure 1, in certain embodiments, UE 110 sends a registration request to wireless network/MME 140 as part of Location Update/Attach (this is a standard 3GPP complaint registration request) at message-1. Also, UE 120 sends a registration request to wireless network/MME 140 as part of Location Update/Attach at message-2. It

should be noted that both UEs (110, 120) are behind the same wireless network/MME 140.

[0020] MME 140 (or any other suitable entity) may be actively involved during the Attach procedure. MME 140 may be configured to generate a tag to UE 110 at the end of Attach procedure, and MME 140 forwards the tag to UE 110 at message-3. The tag contains two portions, a first portion contains UE-Identification and a second portion contains a unique identifier, for example, say cookie-1. The first portion of the tag contains a UE Identifier, for example, GUTI-ID. This identification is already part of the Attach procedure, and the same is communicated in this step. The second portion of the tag contains cookie-1, which may be issued by the MME 140 or access network 130 to the UEs (110, 120) and the tag is verified by the network when the UEs (110, 120) present it for communication. In this embodiment, the message may be part of the Location Update (LU) procedure response and it is possible to have such tag generation when the UEs (110, 120) are performing a Radio Access Bearer (RAB) request. Either one or both of these mechanisms (LU, RAB) are possible.

[0021] Message-4 is similar to that of message-3, and UE 120 may be configured to receive the message from MME 140. These tags may be stored internally by UEs (110, 120) like any other identifiers and can be made available to ALTO client via OS API inside the UEs (110, 120).

[0022] At message-5, UE 110 may perform an application registration with application service provider (ASP) 150, for example in the case of VoIP application or download service application, ASP 150 may process login/password, and then may process the IP address or other information from UEs (110, 120). The UEs (110, 120) supply the opaque tag information that they received from wireless network/MME 140 with application server 150. Opaque tag contains cookie-1 that may mainly be used to identify the network that the users are currently attached to. The

issuing network may generate the cookie by preserving the privacy of the user, and not exposing the internal network topological structure.

[0023] Message-6 is similar to message-5, and UE 120 may perform the application registration.

[0024] At message-7, UE 110 after successfully completing the registration, may receive the list of tags that was part of the group (for certain P2P applications).

[0025] At message-8, UE 120 after successfully completing the registration, may receive the list of tags that was part of the group (for certain P2P application). UE 120 at this stage may receive a tag for UE 110 and UE 110 may also receive UE 110 tag (not shown). By way of example, message-7 and message-8 are shown for VoIP type communication, however, there may be other P2P communication where both message-7 and message-8 may not be present, and explicit requests can be made to resolve the remote peers via ASP 150.

**Service Usage**

[0026] As shown in Figure 1, at message-9, when both UE 110 and UE 120 are successfully registered and received each other's tag as part of presence information, and when UE 110 wants to exchange application level message with UE 120, for example VoIP call, then UE 110 internally checks for UE 120's first portion of tag identification and matches with UE 110's internal tag and once matched, UE 110 "knows" that both UEs (110, 120) are behind the same access point or same network. As the GUMMID matches that of its own operator and learns that the remote endpoint is locally routable.

[0027] At message-10, having learned that UE 120 is behind the same access network, UE 110 requests eNodeB 132 with a Request for Authority to Negotiate (RAN) request and supplies UE-2 120's identification tag and request MME 140 to anchor the traffic locally.

[0028] It should be noted that for illustration purposes only, RAB message has been used in Figure 1, however, a server that maintains the GUTI and unique identifier (cookie) association and is made available to all UE's (110, 120) in the access network can be used within the scope of certain embodiments.

[0029] At message-11, MME 140, upon receiving the request, verifies whether the cookie for UE 120 is correct, and it was generated by MME 140, and then MME 140 generates another unique identifier, for example, cookie-2. Then MME 140 performs paging to UE 120, (not shown) and passes cookie-2 to UE 120. So that UE 110 if it wants to get authentication may be able to use this temporary unique identifier, say cookie-2 as well. There are several other example use purposes for cookie-2, such as, (a) cookie-2 may be used as a seed for session keys between two UE 110 and UE 120 or (b) cookie-2 may contain time sensitive information and may be used by eNodeB to allow direct communication between UE 110 and UE 120 only for that time.

[0030] At message-12, MME passes cookie-2 to eNodeB 132 (optional Live Access Server (LAS) 134), along with flow information.

[0031] At message-13, eNodeB 132 forwards to LAS 134 (if present), to act as an anchor point for such traffic between UE 110 and UE 120 and eNodeB 132 creates a flow table entry. From this point on LAS 134 may forward all traffic re-routing functions. However, in certain embodiments, if there is no LAS 134 present, the eNodeB 132 after receiving IP packets from UE 110 may put in UE 120 output queue, and the same occurs for the packets that come from UE 120 to UE 110.

[0032] At message-14, application signalling and data transfer (traffic) exchange and redirection may occur between two UEs (110, 120) with LAS 134 being optional.

[0033] At message-15, the Lifetime of the session is controlled either by tear down of the RAB session or by explicit Transmission Control Protocol

(TCP) termination, or time out session, anchor termination, etc. Next, eNodeB 132 (or LAS 134) removes the session from its flow table.

[0034] Figure 2 illustrates a flow diagram of a method according to certain embodiments. At step 210, the method may include sending a registration request to a first network element from at least two UE.

[0035] At step 220, the method may also include receiving a registration response from the first network element to the at least two UE.

[0036] At step 230, the method may further include sending an application registration to a second network element from the at least two UE.

[0037] At step 240, the method may still further include receiving an application list notification from the second network element to the at least two UE.

[0038] At step 250, the method may include exchanging an application-level message between the at least two UE.

[0039] At step 260, the method may also include sending a request to anchor the at least two UE traffic to a third network element.

[0040] At step 270, the method may further include receiving a unique identifier generated from the first network element to the at least two UE.

[0041] At step 280, the method may still further include exchanging application signaling and data between the at least two UE.

[0042] Figure 3 illustrates a block diagram of a system according to certain embodiments. In one embodiment, a system may comprise several devices, such as, for example, network element 300, user equipment 325, and an App Server 350. Network element 300 may correspond to access network 130, shown in Figure 1. The system may comprise more than network element, user equipment, or App Server, although only one of each is shown for the purposes of illustration. Network element 300 may be an eNodeB or MME, as shown in Figure 1. User equipment 325 may be any Internet-connected device, such as a tablet computer, mobile phone, smart phone, laptop computer, desktop computer, personal digital assistant (PDA) or the like. App

Server 350 may be any application service provider (ASP) or the like.

[0043] Each of the devices in the system may comprise at least one processor, respectively indicated as 310, 335, and 360. At least one memory may be provided in each device, and indicated as 315, 340, and 365, respectively. The memory may comprise computer program instructions or computer code contained therein. One or more transceiver 305, 330, and 355 may be provided, and each device may also comprise an antenna, respectively illustrated as 320, 345, and 370. Although only one antenna each is shown, many antennas and multiple antenna elements may be provided to each of the devices. Other configurations of these devices, for example, may be provided. For example, network element 300, user equipment 325, and App Server 350 may be additionally or solely configured for wired communication and in such a case antennas 320, 345, and 370 may illustrate any form of communication hardware, without being limited to merely an antenna.

[0044] Transceivers 305, 330, and 355 may each, independently, be a transmitter, a receiver, or both a transmitter and a receiver, or a unit or device that may be configured both for transmission and reception.

[0045] Processors 310, 335, and 360 may 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 may be implemented as a single controller, or a plurality of controllers or processors.

[0046] Memories 315, 340, and 365 may 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 may be used. The memories may be combined on a single integrated circuit as the processor, or may be separate therefrom. Furthermore, the computer program instructions may be stored in the memory and may be processed by the processors may be any suitable form of computer program code, for example, a compiled or interpreted computer program written in any

suitable programming language.

[0047] The memory and the computer program instructions may be configured, with the processor for the particular device, to cause a hardware apparatus such as network element 300, user equipment 325, and ASP 350, to perform any of the processes described above (see, for example, Figure 1). Therefore, in certain embodiments, a non-transitory computer-readable medium may be encoded with computer instructions that, when executed in hardware, may perform a process, such as one of the processes described herein. Alternatively, certain embodiments of the invention may be performed entirely in hardware.

[0048] Thus, in certain embodiments, MME 140 is leveraged part of the ALTO Server and thus eliminates the need for a separate entity. Other embodiments include a process and apparatus which with a negotiation scheme between the ALTO Client and the network may enable traffic routed within eNodeB 132 or between eNodeB 132, and thus avoid the use of GTP tunnelling for traffic within eNodeB 132. This may result in a tremendous saving with regard to transport bandwidth and interactive communication and may further enable such services.

[0049] Alternatively, in some embodiments, the same techniques may be adopted between two eNodeBs (not shown) managed by MME 140, and between two MMEs (not shown). Further, to increase the location privacy, secured techniques can be applied, with different encoding schemes based on the above described framework. In addition, when Legal interception is enabled for the user or session, then intelligent routing traffic can be disabled or routed back to the LIG framework.

[0050] Thus, certain embodiments may improve user experience and encourage mobile users to utilize the bandwidth for such service. Moreover, certain embodiments may provide extended ALTO server and client use case for the mobile environment. Other embodiments may provide a 50% transport capacity savings for sessions that are behind the same eNodeB.

Furthermore, core network may be relieved from the top 5 traffic applications and savings in transport bandwidth for huge file transfer type applications, and P2P may result.

[0051] In some embodiments, there are no additional entities required, such as a separate ALTO Server being needed. Further, Quality of Service (QoS) can be enabled by providing only a few elements such as eNodeB 132 (and LAS 134) resulting in an easy to implement and deploy process and apparatus.

[0052] In other embodiment, a wireless specific tagging process/scheme enables secured communications resulting in trusted anchors and a controlled routing based on traffic and user policy.

[0053] Certain embodiments overcome the existing standards solutions, where policy and routing definitions are not clear, resulting in an environment where it may be difficult for legal interceptions to occur. Further, certain embodiments are backward compatible with legal interception.

[0054] 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. In order to determine the metes and bounds of the invention, therefore, reference should be made to the appended claims.

[0055] List of abbreviations:

| | |
|---|---|
| [0056] UE | User Equipment |
| [0057] MME | Mobility Management Entity |
| [0058] ALTO | Application Layer Traffic Optimization |

| | |
|---|---|
| [0059] LU | Location Update procedure |
| [0060] ASP | Application Service Provider |
| [0061] P2P | Peer-to-Peer communication |
| [0062] GUTI | Globally Unique Temporary Identity |
| [0063] LAS | Liquid Application Server |
| [0064] RAB | Radio Access Bearer |
| [0065] RAN | Request for Authority to Negotiate |

I CLAIM:

1. A method, comprising:

sending a first registration request to a first network element from a first user equipment;

sending a second registration request to the first network element from a second user equipment;

receiving a registration response from the first network element to the first and the second user equipment;

sending an application registration to a second network element from the first and the second user equipment;

receiving an application list notification from the second network element to the first and the second user equipment; and

exchanging an application-level message between the first and the second user equipment based on the first and the second user equipment being registered and receiving the application list notification.

2. The method of claim 1, further comprising:

sending a request to anchor the first and the second user equipment traffic to a third network element.

3. The method of claim 1, further comprising:

receiving unique identifiers generated from the first network element to the first and the second user equipment.

4. The method of claim 1, further comprising:

exchanging application signaling and data between the first and the second user equipment.

5. The method of claim 2, further comprising:

sending a request to the third network element to terminate anchoring traffic from the first and the second user equipment.

6. The method of claim 1, wherein the registration response includes a tag which comprises a first portion including user equipment identification and a second portion including unique identifiers for the first and the second user equipment generated by the first network element.

7. The method of claim 1, wherein the first network element comprises a mobility management entity and the second network element comprises an application server.

8. The method of claim 3, wherein the unique identifiers comprise of cookies.

9. An apparatus, comprising:

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

send a first registration request to a first network element from a first user equipment;

send a second registration request to the first network element from a second user equipment;

receive a registration response from the first network element to the first and the second user equipment;

send an application registration to a second network element from the first and the second user equipment;

receive an application list notification from the second network element to the first and the second user equipment; and

exchange an application-level message between the first and the second user equipment based on the first and the second user equipment being registered and receiving the application list notification.

10. The apparatus of claim 9, 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:

send a request to anchor the first and the second user equipment traffic to a third network element.

11. The apparatus of claim 9, 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 unique identifiers generated from the first network element to the first and the second user equipment.

12. The apparatus of claim 9, 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:

exchange application signaling and data between the first and the second user equipment.

13. The apparatus of claim 10, 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:

send a request to the third network element to terminate anchoring traffic from the first and the second user equipment.

14. The apparatus of claim 9, wherein the registration response includes a tag which comprises a first portion including user equipment

identification and a second portion including unique identifiers for the first and the second user equipment generated by the first network element.

15. The apparatus of claim 9, wherein the first network element comprises a mobility management entity and the second network element comprises an application server.

16. The apparatus of claim 11, wherein the unique identifiers comprise of cookies.

17. An apparatus, comprising:

sending means for sending a first registration request to a first network element from a first user equipment;

sending means for sending a second registration request to the first network element from a second user equipment;

receiving means for receiving a registration response from the first network element to the first and the second user equipment;

sending means for sending an application registration to a second network element from the first and the second user equipment;

receiving means for receiving an application list notification from the second network element to the first and the second user equipment; and

exchanging means for exchanging an application-level message between the first and the second user equipment based on the first and the second user equipment being registered and receiving the application list notification.

18. The apparatus of claim 17, further comprising:

sending means for sending a request to anchor the first and the second user equipment traffic to a third network element.

19. The apparatus of claim 17, further comprising:

receiving means for receiving unique identifiers generated from the first network element to the first and the second user equipment.

20. The apparatus of claim 17, further comprising:

exchanging means for exchanging application signaling and data between the first and the second user equipment.

21. The apparatus of claim 18, further comprising:

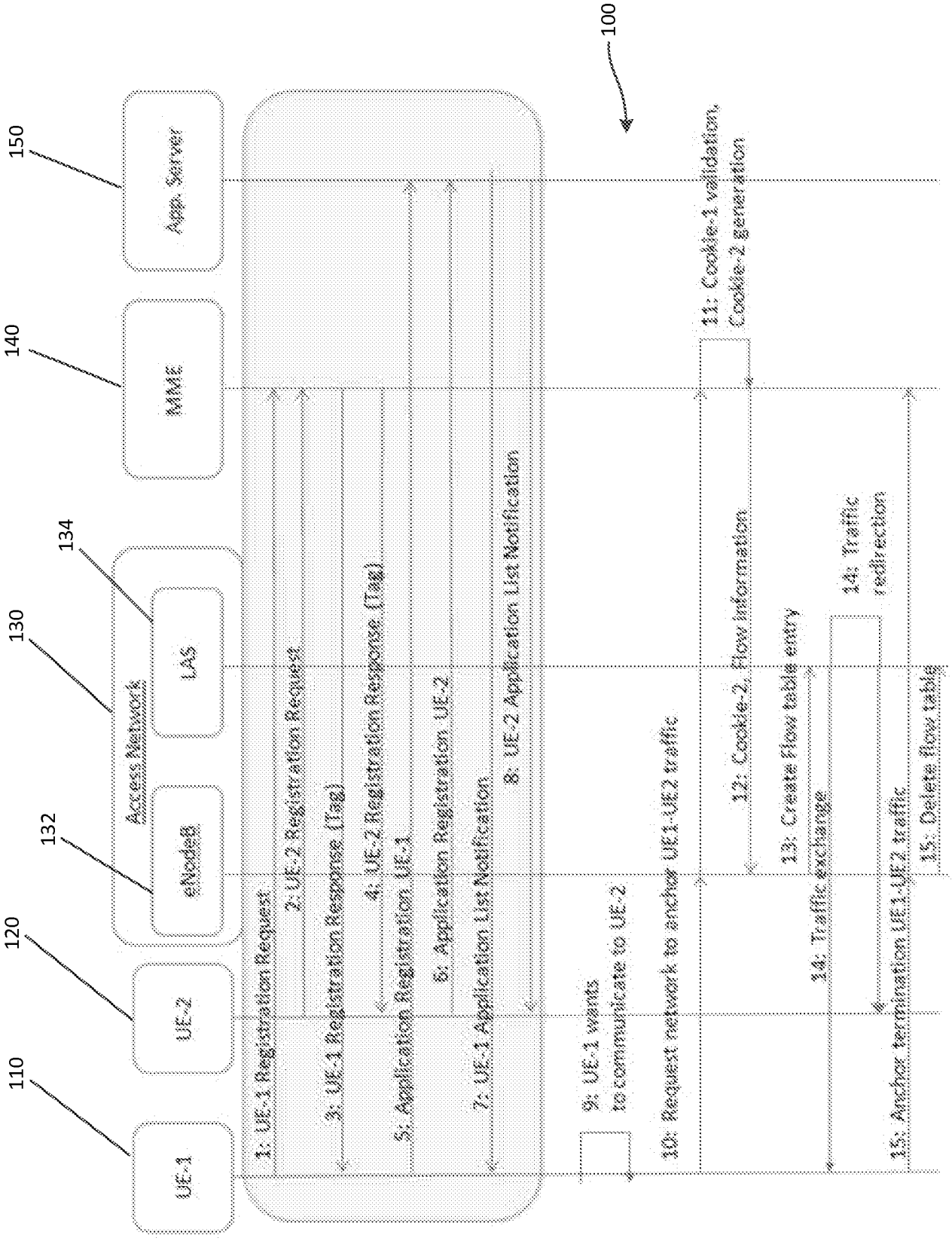
sending means for sending a request to the third network element to terminate anchoring traffic from the first and the second user equipment.

22. The apparatus of claim 17, wherein the registration response includes a tag which comprises a first portion including user equipment identification and a second portion including unique identifiers for the first and the second user equipment generated by the first network element.

23. The apparatus of claim 17, wherein the first network element comprises a mobility management entity and the second network element comprises an application server.

24. The apparatus of claim 19, wherein the unique identifiers comprise of cookies.

25. 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 one of claims 1-8.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Access Network
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eNodeB
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150
App. Server
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2: UE-2 Registration Request
3: UE-1 Registration Response (Tag)
4: UE-2 Registration Response (Tag)
5: Application Registration UE-1
6: Application Registration UE-2
7: UE-1 Application List Notification
8: UE-2 Application List Notification
9: UE-1 wants to communicate to UE-2
10: Request network to anchor UE1-UE2 traffic
11: Cookie-1 validation, Cookie-2 generation
12: Cookie-2, Flow information
13: Create Flow table entry
14: Traffic exchange
14: Traffic redirection
15: Anchor termination UE1-UE2 traffic
15: Delete flow table

FIG. 1

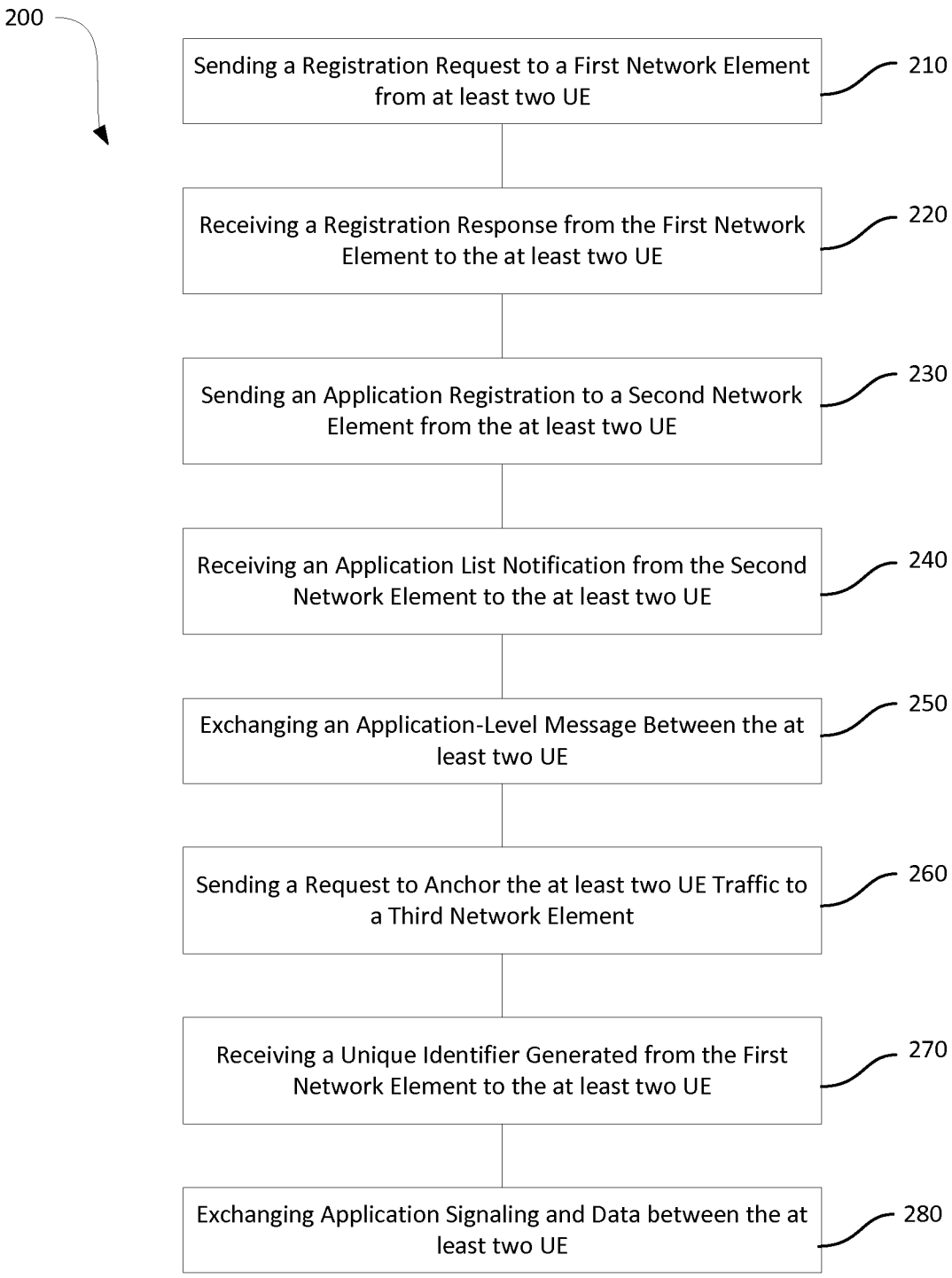
200
Sending a Registration Request to a First Network Element from at least two UE
210
Receiving a Registration Response from the First Network Element to the at least two UE
220
Sending an Application Registration to a Second Network Element from the at least two UE
230
Receiving an Application List Notification from the Second Network Element to the at least two UE
240
Exchanging an Application-Level Message Between the at least two UE
250
Sending a Request to Anchor the at least two UE Traffic to a Third Network Element
260
Receiving a Unique Identifier Generated from the First Network Element to the at least two UE
270
Exchanging Application Signaling and Data between the at least two UE
280

FIG. 2

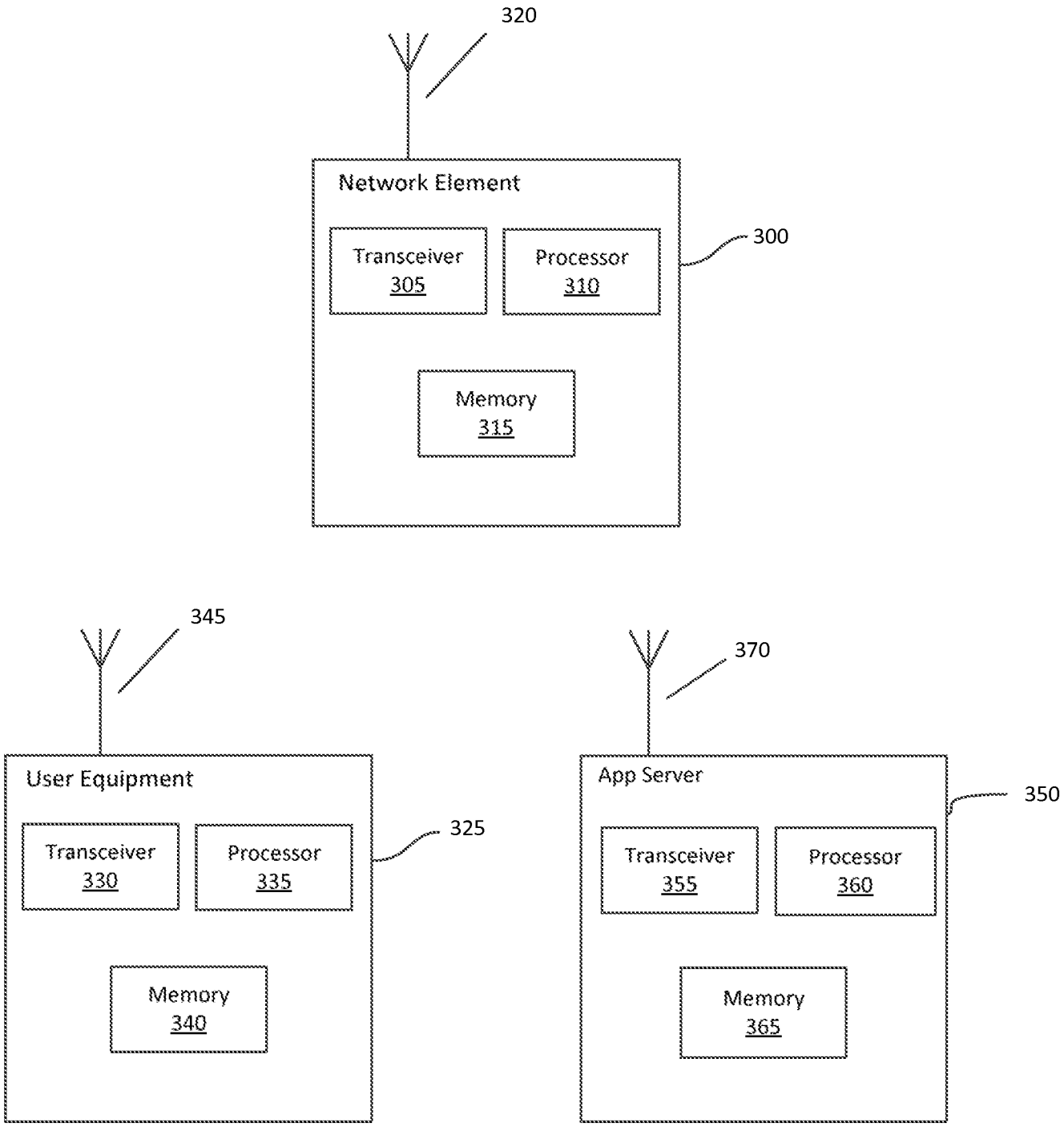
320
Network Element
Transceiver
305
Processor
310
300
Memory
315
345
User Equipment
Transceiver
330
Processor
335
325
Memory
340
370
App Server
350
Transceiver
355
Processor
360
Memory
365

FIG. 3

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/035797

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04W 4/08 (2013.01)
USPC - 713/171
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)
IPC(8) - G06F 15/16; H04W 4/08; H04L 9/32 (2013.01)
USPC - 455/414.1; 709/217; 713/171

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC- G06F 15/16; H04W 4/08; H04L 9/32 (2013.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Google, Orbit, Google Patents

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 2013/0013926 A1 (HAKOLA et al) 10 January 2013 (10.01.2013) entire document | 1-25 |
| Y | US 2004/0176100 A1 (FLORKEY et al) 09 September 2004 (09.09.2004) entire document | 1-25 |
| Y | US 2010/0107092 A1 (KINDBERG) 29 April 2010 (29.04.2010) entire document | 3,6,8,11,14,16,19,22,24 |
| A | US 2011/0296053 A1 (MEDVED et al) 01 December 2011 (01.12.2011) entire document | 1-25 |

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

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

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 24 May 2013 | 19 JUN 2013 |
| Name and mailing address of the ISA/US<br>Mail Stop PCT, Attn: ISA/US, Commissioner for Patents<br>P.O. Box 1450, Alexandria, Virginia 22313-1450<br>Facsimile No. 571-273-3201 | Authorized officer:<br>Blaine R. Copenheaver<br>PCT Helpdesk: 571-272-4300<br>PCT OSP: 571-272-7774 |