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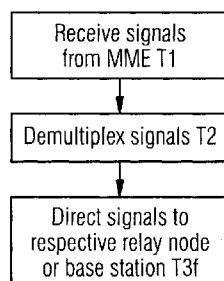


FIG 9A

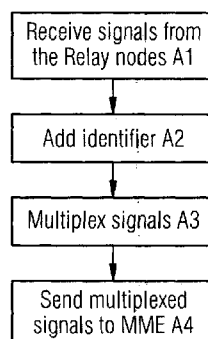


FIG 9B

(57) Abstract: A method comprising causing a first connection to be established between a base station and a network entity; receiving information from a relay node associated with said base station; and sending said received information from the base station to said network entity, wherein said information is sent such that said network entity is able to distinguish information which has been received from the relay node via the base station from information received from the base station itself.



DESCRIPTION

TITLE

5 A METHOD AND APPARATUS

FIELD OF THE INVENTION

The present invention relates to a method and apparatus and in particular but not exclusively to a method and apparatus usable
10 in a system comprising a base station with at least one relay.

BACKGROUND

A communication system can be seen as a facility that enables communication sessions between two or more entities such as
15 mobile communication devices and/or other stations associated with the communication system. A communication system and a compatible communication device typically operate in accordance with a given standard or specification which sets out what the various entities associated with the system are permitted to do
20 and how that should be achieved. For example, the standard or specification may define if a communication device is provided with a circuit switched carrier service or a packet switched carrier service or both.

25 Communication protocols and/or parameters which shall be used for the connection are also typically defined. For example, the manner how the communication device can access the communication system and how communication shall be implemented between communicating devices, the elements of the communication network
30 and/or other communication devices is typically based on predefined communication protocols.

In a wireless communication system at least a part of the communication between at least two stations occurs over a
35 wireless link. Examples of wireless systems include public land

mobile networks (PLMN), satellite based communication systems and different wireless local networks, for example wireless local area networks (WLAN). The wireless systems can be divided into cells, and are therefore often referred to as cellular systems.

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A user can access the communication system by means of an appropriate communication device. A communication device of a user is often referred to as user equipment (UE). A communication device is provided with an appropriate signal receiving and transmitting arrangement for enabling communications with other parties. Typically a communication device is used for enabling the users thereof to receive and transmit communications such as speech and data. In wireless systems a communication device provides a transceiver station that can communicate with e.g. a base station of an access network servicing at least one cell and/or another communications device. Depending on the context, a communication device or user equipment may also be considered as being a part of a communication system. In certain applications, for example in ad-hoc networks, the communication system can be based on use of a plurality of user equipment capable of communicating with each other.

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The communication may comprise, for example, communication of data for carrying communications such as voice, electronic mail (email), text message, multimedia and so on. Users may thus be offered and provided numerous services via their communication devices. Non-limiting examples of these services include two-way or multi-way calls, data communication or multimedia services or simply an access to a data communications network system, such as the Internet. The user may also be provided broadcast or multicast content. Non-limiting examples of the content include downloads, television and radio programs, videos, advertisements, various alerts and other information.

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30

3rd Generation Partnership Project (3GPP) is standardizing an architecture that is known as the long-term evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) radio-access technology. The aim is to achieve, inter alia, reduced latency, higher user data rates, improved system capacity and coverage, and reduced cost for the operator. A further development of the LTE is referred to herein as LTE-Advanced. The LTE-Advanced aims to provide further enhanced services by means of even higher data rates and lower latency with reduced cost. The various development stages of the 3GPP LTE specifications are referred to as releases.

Since the new spectrum bands for international mobile telecommunications (IMT) contain higher frequency bands and LTE-Advanced is aiming at a higher data rate, coverage of one Node B (base station) can be limited due to the high propagation loss and limited energy per bit. Relaying has been proposed as a possibility to enlarge the coverage. Apart from this goal of coverage extension, introducing relay concepts may also help in the provision of high-bit-rate coverage in a high shadowing environment, reducing average radio-transmission power at the User Equipment (UE). This may lead to long battery life, enhanced cell capacity and effective throughput, e.g., increasing cell-edge capacity, balancing cell load, enhancing overall performance, and reducing deployment costs of radio access networks (RAN). The relaying would be provided by entities referred to as Relay stations (RSs) or Relay Nodes (RNs).

As specified in TR 36.814, relaying is considered as one of the potential techniques for LTE-A, where the relay node (RN) is wirelessly connected the radio-access network via a donor cell. The interface between UE and RN is named as Uu interface and the link is access link. Considering the backward compatibility as required by TR 36.913, the Uu would be consistent with the Release 8 interface as defined in LTE. While between RN and DeNB, the link

is considered as backhaul link and this interface is denoted as Un interface.

According to one aspect of the present invention, there is
5 provided a method comprising causing a first connection to be
established between a base station and a network entity; re-
ceiving information from a relay node associated with said base
station; and sending said received information from the base
station to said network entity, wherein said information is sent
10 such that said network entity is able to distinguish information
which has been received from the relay node via the base station
from information received from the base station itself.

According to another aspect of the present invention, there is
15 provided an apparatus in a base station comprising means for
causing a first connection to be established between said base
station and a network entity; means for receiving information
from a relay node associated with said base station; and means
for sending said received information from the base station to
20 said network entity, wherein said information is sent such that
said network entity is able to distinguish information which has
been received from the relay node via the base station from
information received from the base station itself.

25 According to a further aspect of the present invention, there is
provided an apparatus in a network entity comprising means for
providing a plurality of connections with a base station, a first
connection being used for information intended for said base
station itself and a second connection being used for information
30 intended for a relay node connected to said base station; and
means for sending information to a base station, said information
intended for said base station itself being sent on the first
connection and information intended for the relay node being sent
on said second connection.

According to a further aspect of the present invention, there is provided an apparatus in a network entity comprising means for providing a connection with a base station,; and means for sending information to a base station, said information intended for said
5 base station itself being sent on the said connection with first identification information and information intended for the relay node being sent on said connection with second different identification information.

10 BRIEF DESCRIPTION OF DRAWINGS

Some embodiments of the invention will now be described in further detail, by way of example only, with reference to the following examples and accompanying drawings, in which:

15 Figure 1 shows a cell with three relay nodes:

Figure 2 shows the interfaces between a relay node, a base station and a UE (user equipment);

Figure 3 shows a non-transparent S1 proxy based arrangement;

Figure 4 shows a set up procedure for the non-transparent
20 S1 proxy based arrangement;

Figure 5 shows a first transparent S1 proxy based arrangement;

Figure 6 shows a set up procedure to two transparent S1 proxy based arrangement;

25 Figure 7 shows a second transparent S1 proxy based arrangement;

Figure 8 shows a block diagram of an apparatus usable with some embodiments of the invention;

Figure 9a and b show a flow diagrams for the second
30 transparent S1 proxy based arrangement; and

Figure 10 shows a signal flow embodying the invention for a handover request.

DETAILED DESCRIPTION OF SOME EMBODIMENTS

As specified in 3GPP TR 36.814 (Third Generation Partnership Project) relaying is considered as one of the potential techniques for LTE-A where a relay node is wirelessly connected to the radio access network via a donor cell. Some embodiments
5 of the invention are described in the context of the LTE-A proposals. However, other embodiments of the invention can be used in any other scenario which for example requires or uses one or more relays.

10 Reference is made to Figure 1 which shows part of a LTE radio access network (RAN). An access node 2 is provided. The access node can be a base station of a cellular system, a base station of a wireless local area network (WLAN) and/or WiMax (Worldwide Interoperability for Microwave Access). In certain systems the
15 base station is referred to as Node B, or enhanced Node B (e-NB). For example in LTE-A, the base station is referred to as e-NB. The base station which supports a relay may be referred to as a D(donor)eNB. The term base station is intended to include the use of any of these access nodes or any other suitable access node.

20 The base station 2 has a cell 8 associated therewith. In the cell, there is provided three relay nodes 4. This is by way of example only. In practice there may be more or less than three relay nodes. One of the relay nodes 4 is provided close to the edge of the cell to extend coverage. One of the relay nodes 4 is provided in a
25 traffic hotspot and one of the relay nodes is provided at a location where there is an issue of shadowing from for example buildings. Each of the relay nodes has a coverage area 14 associated therewith. The coverage area may be smaller than the cell 8, of a similar size to the cell or larger than the cell.

30 A relay link 10 (represented by the thicker arrow) is provided between each relay node 4 and the base station 2. The cell has user equipment 6. The user equipment is able to communicate directly with the base station 2 or with the base station 2 via a respective relay node 4 depending on the location of the user
35 equipment 6. In particular, if the user equipment 6 is in the

coverage area associated with a relay node, the user equipment may communicate with the relay. The connections between the user equipment and the relay node and the direct connections between the user equipment and the base station are referenced 12 and
5 represented by the thinner arrows.

The UE or any other suitable communication device can be used for accessing various services and/or applications provided via a communication system. In wireless or mobile communication
10 systems the access is provided via an access interface between mobile communication devices (UE) 6 and an appropriate wireless access system. The UE 6 can typically access wirelessly a communication system via at least one base station. The communication devices can access the communication system based
15 on various access techniques, such as code division multiple access (CDMA), or wideband CDMA (WCDMA), the latter technique being used by communication systems based on the third Generation Partnership Project (3GPP) specifications. Other examples include time division multiple access (TDMA), frequency division
20 multiple access (FDMA), space division multiple access (SDMA) and so on. In a wireless system a network entity such as a base station provides an access node for communication devices.

Each UE may have one or more radio channels open at the same time
25 and may receive signals from more than one base station and/or other communication device.

A "type 1" RN has been proposed, which is an inband relaying node having a separate physical cell ID (identity), support of HARQ
30 (Hybrid automatic repeat request) feedback and backward compatibility to Release 8 (Rel 8) UEs. Release 8 is one of the versions of LTE.

In the RAN2 #65bis meeting (this is part of 3GPP), RAN 2 agreed
35 with the definition for the nodes and the interfaces as shown in

figure 2. The wireless interface 12 between UE 6 and RN is named the Uu interface. For those embodiments where backward compatibility is desirable for example where compliance with a particular version of 3GPP standards TR 36.913 and TR36.321 is provided, the Uu interface would be consistent with the Release 8 interface as defined in LTE. The wireless interface 10 between the relay node 4 and the donor e-NB 2 is the Un interface. The link is considered as backhaul link.

Currently in RAN2/3 discussions, a total of four relay system architecture have been proposed: see for example R2-095336, "TP to internal TR on relay architecture options", Ericsson, ST-Ericsson, 3GPP TSG-RAN WG2 #67, Shenzhen, China, 24th - 28th August 2009.

The four relay architectures can be summarised as follows.

Alternative 1: Full-L3 relay, transparent for the DeNB;

The U(User)-plane packets of a UE served by the RN are delivered via the Relay's P/S(packet switched)-GW. The UE's P/S-GW maps the incoming IP packets to the GTP tunnels corresponding to the EPS (evolved packet system) bearer of the UE and sends the tunnelled packets to the IP address of the RN. The tunnelled packets are routed to the RN via the Relay's P/S-GW, as if they were packets destined to the RN as a UE.

Alternative 2: Proxy S1/X2;

There is a GTP tunnel per UE bearer, spanning from the SGW (signalling gateway)/PGW (packet data network gateway) of the UE to the donor eNB, which is switched to another GTP tunnel at the DeNB, going from the DeNB to the RN (one-to-one mapping).

Alternative 3: RN bearers terminate in DeNB;

The baseline solution is enhanced by integrating the SGW/PGW functionality for the RN into the DeNB. The routing path is

optimized as packets do not have to traverse via a second PGW/SGW but otherwise the same functionality and packet handling apply as in case of Alternative 1.

5 Alternative 4: S1 U-Plane terminated in DeNB.

The U-plane of the S1 interface is terminated at the DeNB. The PGW/SGW serving the UE maps the incoming IP packets to the GTP tunnels corresponding to the EPS bearer of the UE and sends the
10 tunnelled packets to the IP address of the DeNB.

The first and third alternatives make the donor-eNB (DeNB) transparent to UE-gateway (UE-GW) and may have a minimal impact on existing eNB operation. In contrast, the second and fourth
15 alternatives fit the DeNB to support the proxy of IP (Internet Protocol) packets to a relay node (RN) or to transit the data with a layer-2 format. These latter two alternatives may require the operation of existing eNBs to change.

20 The second proposed architecture, a Relay GW, (gateway) which has "Home eNB GW" type of functionality, is proposed, which results in the "Proxy" architecture. In this arrangement, the or each RN may establish only one S1 interface, both terminated in the DeNB, irrespective of the number of MMEs (mobility management entities).

25 The S1 interface is the interface between the eNB and the evolved packet core network. The MME is an entity of the evolved packet core network. The S1 interface may be between the eNB and the MME. This is schematically shown in Figure 3. First and second relay nodes 4 are connected to the base station 2 via respective links

30 10. The base station 2 is connected to the MME 20 via link 24. This arrangement may be considered to be a "non-transparent aggregated S1 proxy" based arrangement, in which RN 4 is handled by DeNB 2 as its cell, but not as an independent eNB, when the DeNB 2 communicates with the MME 20. The MME 20 is not aware of

35 the RN 4, since the RN 4 is hidden by a non-transparent S1 proxy

in DeNB. Since the RN 4 is associated with the cell of the DeNB 2, it should have the same eNB ID (left 20bits of the CGI (Cell Global Identifier)) as the DeNB 2.

5 With this arrangement, for every RN, one S1 connection is setup between the RN 4 and the DeNB 2, but only one S1 connection is set up for the DeNB 2 and all of its RNs 4 between the DeNB 2 and the MME 20.

10 Reference is made to Figure 4 which shows the RN setup procedures for the non-transparent S1 proxy based arrangement. In the first stage S1, a procedure is performed involving the RN 4, the DeNB 2 and the MME 20 to allow the RN to be attached. The procedure is analogous to the attachment of a UE. The MME 20 can be
15 considered to regard the RN as being a UE. In this arrangement the DeNB 2 can be regarded as being a RN gateway. The RN 4 as a UE accesses the network and acquires an IP (Internet Protocol) address to setup a session with the network.

20 In the next stage S2, the RN 4, the DeNB 4, the MME 20 and an Operations and Maintenance (O&M) entity 26 are involved. The RN 4 receives node configuration information from the O&M entity 26. Thus after the RN 4 obtains the IP address, the RN 4 can setup a connection with the O&M system for configuration and main-
25 tenance.

In the third stage S3, the S1 interface is set up between the RN 3 and the DeNB 2. In the fourth stage S4, after the RN 4 initiates S1 setup with the DeNB 2, the existing S1 connections of the DeNB
30 may need to be updated, for example to register one or more new tracking area codes (TAC) corresponding to the RN cell(s) toward the MME 20, if the TAC is new to the DeNB. The existing "eNB Configuration Update" procedure for the S1 interfaces can be used for this purpose.

Since the RN 4 is hidden from the MME 20 by the DeNB 2, the MME 20 sends messages to the DeNB 2. The DeNB 2 needs to set up two tables. One table is a UE context based mapping table, which is used for S1 message forwarding on the control plane. The other
5 table is a GTP (GPRS (General Packet Radio Service) tunnel protocol) tunnel mapping table, which is used for GTP-U (user) packet forwarding in the user plane. The DeNB 2 thus inspects the S1 messages between the RN and MME to set up the UE context based mapping table, which is used by the DeNB 2 to forward S1 messages
10 between the MME and the RN, and to set up the GTP tunnel mapping table, which is used to forward GTP-U packet between a S-GW (signalling gateway) and the RN. This is described in specification 3GPP TR36.806.

15 In this arrangement, if a RN 4 hands over (HO) from one DeNB 2 (source DeNB) to another DeNB (target DeNB) following the UE HO procedure, the target DeNB is transparent to the S1 interface of the relay node, and the S1 interface of the relay node still terminates in the source DeNB. This will result in a longer S1
20 interface, which brings longer delay on both the control and user planes. One way to address this is to relocate the S1 proxy of the relay node from the source DeNB to the target DeNB. But this may not be suitable in some embodiments as there may conflict with the "non-transparent S1 proxy" based solution, which has the RN's
25 eNB ID the same as that of its DeNB. It should be appreciated that this may be relevant to mobile RNs 4.

With the "non-transparent aggregated S1 proxy" based solution, the MME 20 assumes that the UE accesses the network directly
30 through the DeNB, since the MME is not aware of the RN. The "Non-transparent aggregated S1 proxy" based arrangement will mean that a plurality of RNs associated with the same DeNB, and having the same eNB ID, will request independent OAM (operations, administration and maintenance) sessions with the OAM system. In
35 this arrangement, a one-to-one connection mapping is provided at

said base station between the connection between the relay node and the base station and the associated connection for that relay node between the base station and the MME.

5 In some embodiments of the invention, a "transparent S1 proxy" based arrangement is used. In some embodiments, a "transparent non-aggregated S1 proxy" based arrangement is provided. In this regard, reference is made to Figures 5 and 6. In this arrangement, for every RN 4, one S1 connection 10 is setup between RN and DeNB
10 and a corresponding connection is set up between the DeNB 2 and the MME 20. In this arrangement, the RN appears to the MME to be an eNB. In the arrangement shown in Figure 5, first and second relays 4 are shown. The first relay node 4 has as first S1 connection 10 to the eNB 2 and the second relay node 4 has a second
15 S1 connection to the eNB 2. The eNB 2 has three S1 connections 24 to the MME 20. The first S1 connection is for the first relay node, the second S1 connection is for the second relay node and the third connection is for the eNB itself.

20 Reference is made to Figure 6 which shows the relay node set up procedure for some embodiments of the invention. The first two stages S1 and S2 are as described in Figure 4. Reference is made to the stages shown in box 26 which show the "transparent non-aggregated S1 proxy" arrangement message flow. In stage 3',
25 the S1 connection is set up between the RN and the eNB.

In stage S4', the DeNB 2 directly initiates a new S1 connection with the MME 20 for this RN 4, and simply forwards the S1 Setup message from RN to MME. When the RN 4 setups and/or removes a S1
30 connection with the DeNB 2, the DeNB 2 is arranged to setup and/or remove the corresponding S1 connection to the MME 20 for that RN 4. In this arrangement, the DeNB 2 does not hide the RN as its cell. Rather the MME will be aware of the RN and will consider that RN to be an independent eNB, having a logical end-to-end S1
35 interface between the RN and the MME. Since the RN is considered

to be an independent eNB and has a different eNB ID to that of the DeNB 2, proxy relocation in consequence of RN handover from one eNB to another can be supported. Furthermore this arrangement is such that the impact to the OAM function can also be reduced since each RN is considered to be an eNB and can have its own OAM session.

Some embodiments have 1:1 mapping at the DeNB, that is one S1 connection between the RN and the eNB maps to one S1 connection between the eNB and the MME. This may make message forwarding easier since the DeNB does not need to inspect the S1 messages to set up a UE context or GTP tunneling mapping table.

Often, the connection between the MME and the DeNB is wired, so the additional S1 connections may be accommodated without difficulty, in some embodiments of the invention.

Reference is made to Figures 6 and 7 which show the "transparent aggregated S1 proxy" based arrangement of some embodiments of the invention. As with some of the previous embodiments of the invention, the DeNB does not hide the RN as its cell. Rather the MME will be aware of the RN and will consider the RN to effectively be an independent eNB, having its own identity (and not the identity of the DeNB) and having a logical end-to-end S1 interface between RN and MME. Since the RN is independent of the DeNB, from the perspective of the MME, having a different eNB ID to that of the DeNB, proxy relocation in consequence of handover of the RN can be supported. Further impact to the OAM function can also be reduced since each RN is considered to be an eNB and can have its own OAM session.

In the "transparent aggregated S1 proxy" arrangement, for every RN 4, one S1 connection is setup between the RN 4 and the DeNB 2, but only one S1 connection is setup for the DeNB 2 and all its RNs 4 between the DeNB 2 and the MME 20. Thus in the arrangement

shown in Figure 7, the first relay node 4 has a first S1 connection 10 with the eNB 2 and the second relay node 4 has a second S1 connection 10 with the eNB 2. There is a single S1 connection 24 between the eNB and the MME which is shared by the eNB and the two relay nodes.

Reference is made to Figure 6 which shows the relay node set up procedure for some embodiments of the invention. The first two stages S1 and S2 are as described in Figure 4. Reference is made to the stages shown in box 28 which shows the "transparent aggregated S1 proxy" arrangement message flow. In stage 3'', the S1 connection is set up between the RN and the eNB.

This is followed by stage S4''. When a RN 4 setups and/or removes a S1 connection with the DeNB, the DeNB 2 needs to update the MME 20 of this change. To update the MME, a IE (information element) of "Served eNB to Add" or "Served eNB to Delete" is included in the eNB Configuration Update message sent from the eNB 2 to the MME. This message will make MME be aware of the addition of or removal of the RN.

The IE for adding a relay node may be referred to as "Served eNB to Add". This information element may comprise the Global eNB ID of the RN, eNB name of the RN, Supported TAs (Tracking area) of the RN, Default paging DRX (Discontinuous Reception) and other required information. The eNB ID will be used for message routing by the MME and is the unique identifier of one eNB. The eNB may also have a name. Commonly, different eNB will be given different names.

The IE for removing a relay node may be referred to as "Served eNB to Delete" and may include the Global eNB ID of RN.

To support multiple eNBs (that is the DeNB and at least one relay nodes) on one S1 connection, the eNB ID of the DeNB or of the RN

is added to the S1 messages so that the messages can be de-multiplexed at MME, DeNB or RN. In one embodiment, the MME adds the destination eNB ID (this being the ID of the RN or the DeNB) to the S1 messages, which will be used by DeNB to forward the S1 message to respective RN if required. In this embodiment, the DeNB does not need to monitor S1 message to set up a mapping table based on UE context.

The DeNB/RN also adds its eNB ID to S1 message, which will be used by MME so that the MME know the source eNB (that is the RN or DeNB) of this S1 message.

Reference is made to Figure 9a which shows a flow diagram of a method performed by the base station when receiving signals from the MME. In step T1, the base station receives the signals from the MME on the common connection. In step T2, the base station demultiplexes the received signals. In step T3, the base station directs the signals to either to the base station or to the respective relay node in dependence on the identification information included in the demultiplexed signals.

Reference is made to Figure 9b which shows a flow diagram of a method performed by the base station when receiving signals from the relay nodes. In step A1, the base stations receive the signals from the relay nodes. In step A2, the base station adds respective identity information from the relay nodes as well as the signals to be sent by the base station itself. In step A3, the signals are multiplexed together and in step A4 the multiplexed signal is sent to the MME.

Reference is now made to Figure 10 which shows a message flow in a "transparent aggregated S1 proxy" based arrangement where the S1 message is for example a HO Request. In step B1, the DeNB 2 receives a HO Request message from a first RN-1 4. The DeNB 2 adds an IE (information element) identifying the Source eNB to the HO

Request. The Source eNB in this example is the first RN-1 4. The modified request is sent by the eNB 2 to the MME 20, in step B2. When the MME 20 responds to the first RN-1 4, the MME 20 adds IE identifying the Destination eNB to the acknowledgement of the HO Request. In this example, the destination eNB is set to be the first RN-1 4. The acknowledgement is sent by the MME 20 to the DeNB 2 in step B3. In step B4, the DeNB sends the acknowledgement to the first relay node RN-1 4. The same procedure may be used for the second RN-2 4. Thus steps B5 to B8 correspond generally to steps B1 to B4 but with the second relay node being added as the identifier.

Reference is made to Figure 8 which shows an apparatus 201 which may be used in embodiments of the invention. The apparatus 201 comprises at least one memory 200. The apparatus also comprises at least one data processing unit 202 and transmit/receive circuitry 208 for transmitting/receiving signals to/from the relay node via a wireless connection. The transmit part of the circuitry will up convert signals from the base band to the transmitting figure and may provide suitable modulation and/or encoding. The receive part of the circuitry 208 is able to down convert the received signals to the baseband and may provide suitable demodulation and/or decoding. The apparatus is has input/output interface 204 which connects the transmit/receive circuitry to an antenna 205.

The transmit/receive circuitry 208 is connected to the memory 200 and the data processing unit 202. The data processing unit 202 is also connected to the memory 200.

The apparatus also comprises second transmit/receive circuitry 210 for transmitting/receiving signals to/from the MME via a wired connection. In some alternative embodiments of the invention, the connection with the MME may be a wireless connection. The apparatus is has a second input/output interface 212 which

connects the transmit/receive circuitry to a wired connection. The transmit/receive circuitry 208 is connected to the memory 200 and the data processing unit 202.

5 This apparatus may be provided in the base station. The MME may be made up of similar elements but may for example omit the wireless components such as the interface 204 and transmit/receive circuitry 208.

10 The required data processing unit and functions of a relay node and a base station apparatus as well as the MME may be provided by means of one or more data processors. The above described functions may be provided by separate processors or by an integrated processor. The data processing may be distributed
15 across several data processing modules. A data processor may be provided by means of, for example, at least one chip. Appropriate memory capacity can also be provided in the relevant nodes. An appropriately adapted computer program code product or products may be used for implementing the embodiments, when loaded on an
20 appropriate data processing apparatus, for example in a processor apparatus associated with the base station, processing apparatus associated with relay node and/or a data processing apparatus associated with a GW. The program code product for providing the operation may be stored on, provided and embodied by means of an
25 appropriate carrier medium. An appropriate computer program can be embodied on a computer readable record medium. A possibility is to download the program code product via a data network.

A non-limiting example of mobile architectures where the herein
30 described principles may be applied is known as the Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The eNBs may provide E-UTRAN features such as user plane Radio Link Control/Medium Access Control/Physical layer protocol (RLC/MAC/PHY) and control plane Radio Resource Control (RRC)
35 protocol terminations towards the user devices.

It is noted that whilst embodiments have been described in relation to LTE, similar principles can be applied to any other communication system where relaying is employed. Therefore, although certain embodiments were described above by way of example with reference to certain exemplifying architectures for wireless networks, technologies and standards, embodiments may be applied to any other suitable forms of communication systems than those illustrated and described herein.

It is also noted herein that while the above describes exemplifying embodiments of the invention, there are several variations and modifications which may be made to the disclosed solution without departing from the scope of the present invention.

CLAIMS:

1. A method comprising:

causing a first connection to be established between a base
5 station and a network entity;

receiving information from a relay node associated with
said base station; and

sending said received information from the base station to
said network entity, wherein said information is sent such that
10 said network entity is able to distinguish information which has
been received from the relay node via the base station from
information received from the base station itself.

2. A method as claimed in claim 1, wherein the base station has
15 first identity information and the relay node has second
different identity information.

3. A method as claimed in claim 1 or 2, comprising causing a
second connection to be established between said base station and
20 said relay node.

4. A method as claimed in claim 3, wherein a logical end-to-end
connection is provided between said relay node and said network
entity.

25

5. A method as claimed in claim in any preceding claim, wherein
causing said first connection comprises:

causing a base station connection to be provided between
said base station and said network entity for information to be
30 sent directly to a user equipment by said base station and/or
directly received from said user equipment by said base station;
and

causing a separate relay node connection to be provided
between said base station and said network entity for information
35 to be sent to a user equipment by said base station via said relay

node and/or for information received from that user equipment by said base station via said relay node.

6. A method as claimed in claim 4 and 5, wherein a one-to-one connection mapping is provided at said base station between said second connection and said relay node connection.

7. A method as claimed in any of claims 1 to 4, comprising multiplexing messages from said relay node with messages from the base station itself onto said first connection.

8. A method as claimed in claim 7, comprising adding respective identity information associated with said base station and said relay node to said messages.

9. A method as claimed in any of claims 1 to 4, 7 or 8 comprising demultiplexing messages received on said first connection and determining if said messages are for said relay node or said base station itself.

10. A method as claimed in claim 9, wherein said determining if said messages are for said relay node or said base station itself is performed in dependence on identity information in said messages.

11. A method as claimed in any of claims 1 to 4 or 7 to 10, comprising sending information indicating that a connection with said relay node is being one of being set up or removed to said network entity.

12. A method as claimed in claim 11, comprising sending said information indicating that a connection is being set up or removed is provided in a base station configuration update message.

13. A method as claimed in claim 10 or 11, wherein said information indicating that a connection is being set up or removed comprises one or more of: identity information of said relay node; name information of said relay node; tracking area information; and default paging discontinuous transmission.

14. A method as claimed in any preceding claim, wherein said network entity comprises a mobility management entity.

15. A method as claimed in any preceding claim, wherein at least one of the connections is a S1 connection

16. Apparatus in a base station comprising:

means for causing a first connection to be established between said base station and a network entity;

means for receiving information from a relay node associated with said base station; and

means for sending said received information from the base station to said network entity, wherein said information is sent such that said network entity is able to distinguish information which has been received from the relay node via the base station from information received from the base station itself.

17. Apparatus as claimed in claim 16, wherein the base station has first identity information and the relay node has second different identity information associated therewith.

18. Apparatus as claimed in claim 16 or 17, comprising means for causing a second connection to be established between said base station and said relay node.

19. Apparatus as claimed in claim 18, wherein said means for causing said first and second connections is configured such that a logical end-to-end connection is provided between said relay node and said network entity

20. Apparatus as claimed in claim in any of claim 16 to 19, wherein said means for causing said first connection is configured to cause a base station connection to be provided between
5 said base station and said network entity for information to be sent directly to a user equipment by said base station and/or directly received from said user equipment by said base station and to cause a separate relay node connection to be provided between said base station and said network entity for information
10 to be sent to a user equipment by said base station via said relay node and/or for information received from that user equipment by said base station via said relay node.

21. Apparatus as claimed in claim 19 and 20, comprising mapping
15 means for providing a one-to-one connection mapping at said base station between said second connection and said relay node connection.

22. Apparatus as claimed in any of claims 16 to 19, comprising
20 multiplexing means for multiplexing messages from said relay node with messages from the base station itself onto said first connection.

23. Apparatus as claimed in claim 22, comprising means for
25 adding respective identity information associated with said base station and said relay node to said messages.

24. Apparatus as claimed in any of claims 16 to 19, 22 or 23 comprising demultiplexing means for demultiplexing messages
30 received on said first connection and means for determining if said messages are for said relay node or said base station itself.

25. Apparatus as claimed in claim 26, wherein said determining
35 means is configured to determine if said messages are for said

relay node or said base station itself in dependence on identity information in said messages.

26. Apparatus as claimed in any of claims 16 to 19 or 22 to 25,
5 comprising means for providing information to be sent, indicating that a connection with said relay node is being one of being set up or removed, to said network entity.

27. Apparatus as claimed in claim 26, wherein said providing
10 means is configured to provide said information indicating that a connection is being set up or removed in a base station configuration update message.

28. Apparatus as claimed in claim 26 or 27, wherein said
15 information indicating that a connection is being set up or removed comprises one or more of: identity information of said relay node; identity information used by said base station to identify said relay node; tracking area information; and default paging DRX.

29. Apparatus as claimed in any of claims 16 to 29, wherein at
20 least one of the connections is a S1 connection

30. A base station comprising an apparatus as claimed in any
25 of claims 16 to 29.

31. Apparatus in a network entity comprising:

means for providing a plurality of connections with a
base station, a first connection being used for information
30 intended for said base station itself and a second connection being used for information intended for a relay node connected to said base station; and

means for sending information to a base station, said
information intended for said base station itself being sent on

the first connection and information intended for the relay node being sent on said second connection.

32. Apparatus in a network entity comprising:

5 means for providing a connection with a base station, ;
and

 means for sending information to a base station, said
information intended for said base station itself being sent on
the said connection with first identification information and
10 information intended for the relay node being sent on said
connection with second different identification information.

33. A network entity comprising the apparatus of any of claims
31 or 32.

FIG 1

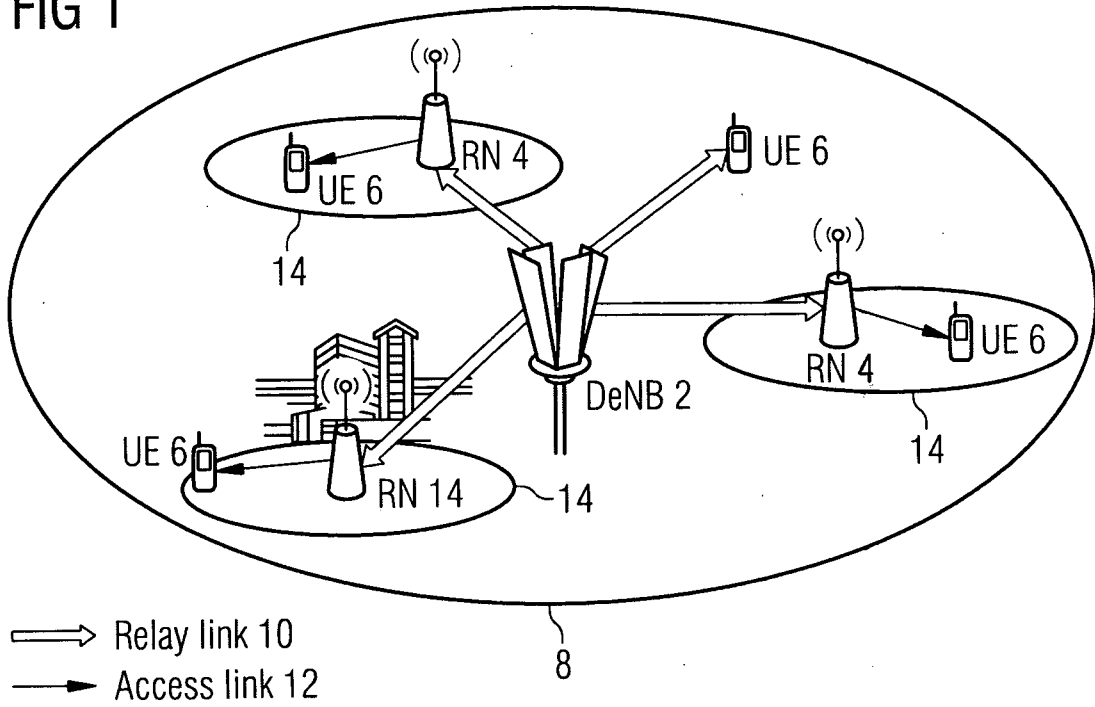


FIG 2

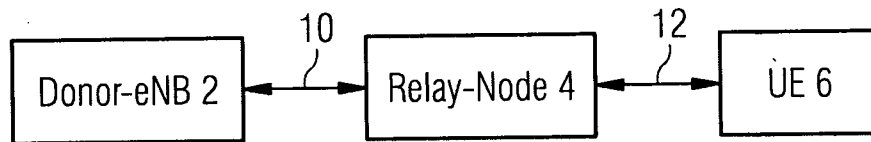


FIG 3

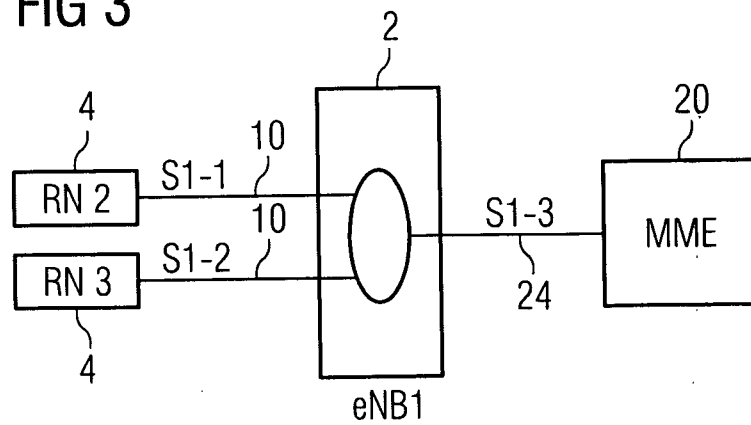


FIG 4

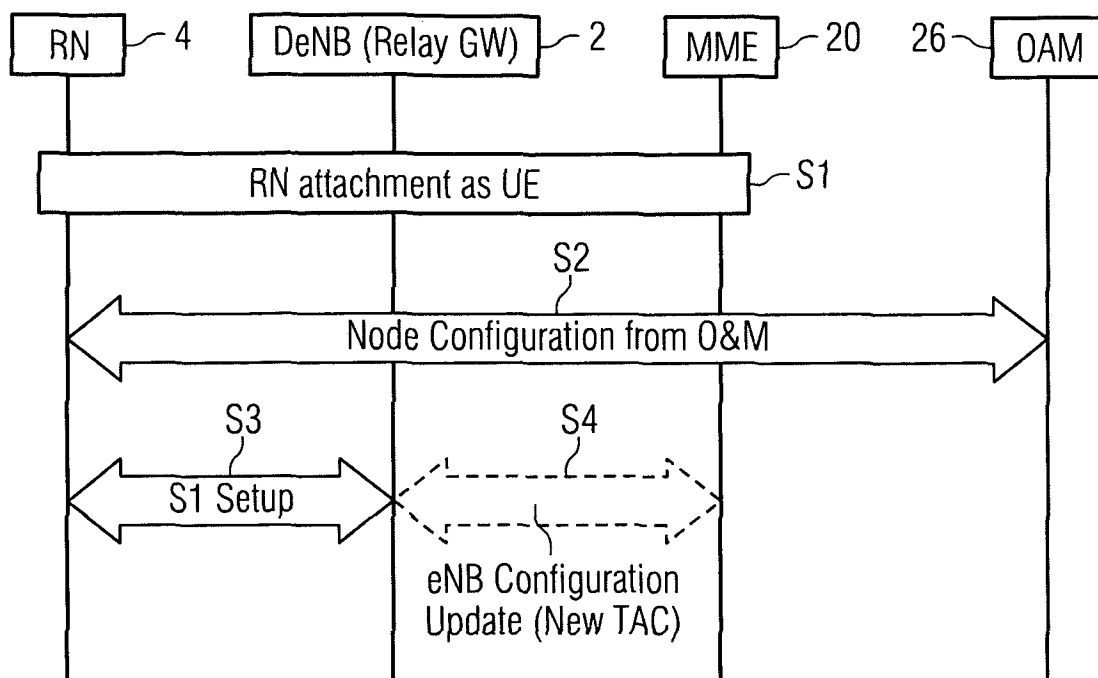


FIG 5

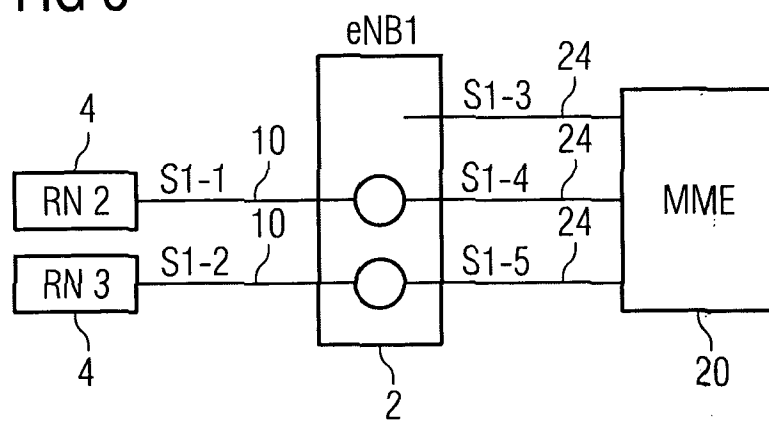


FIG 6

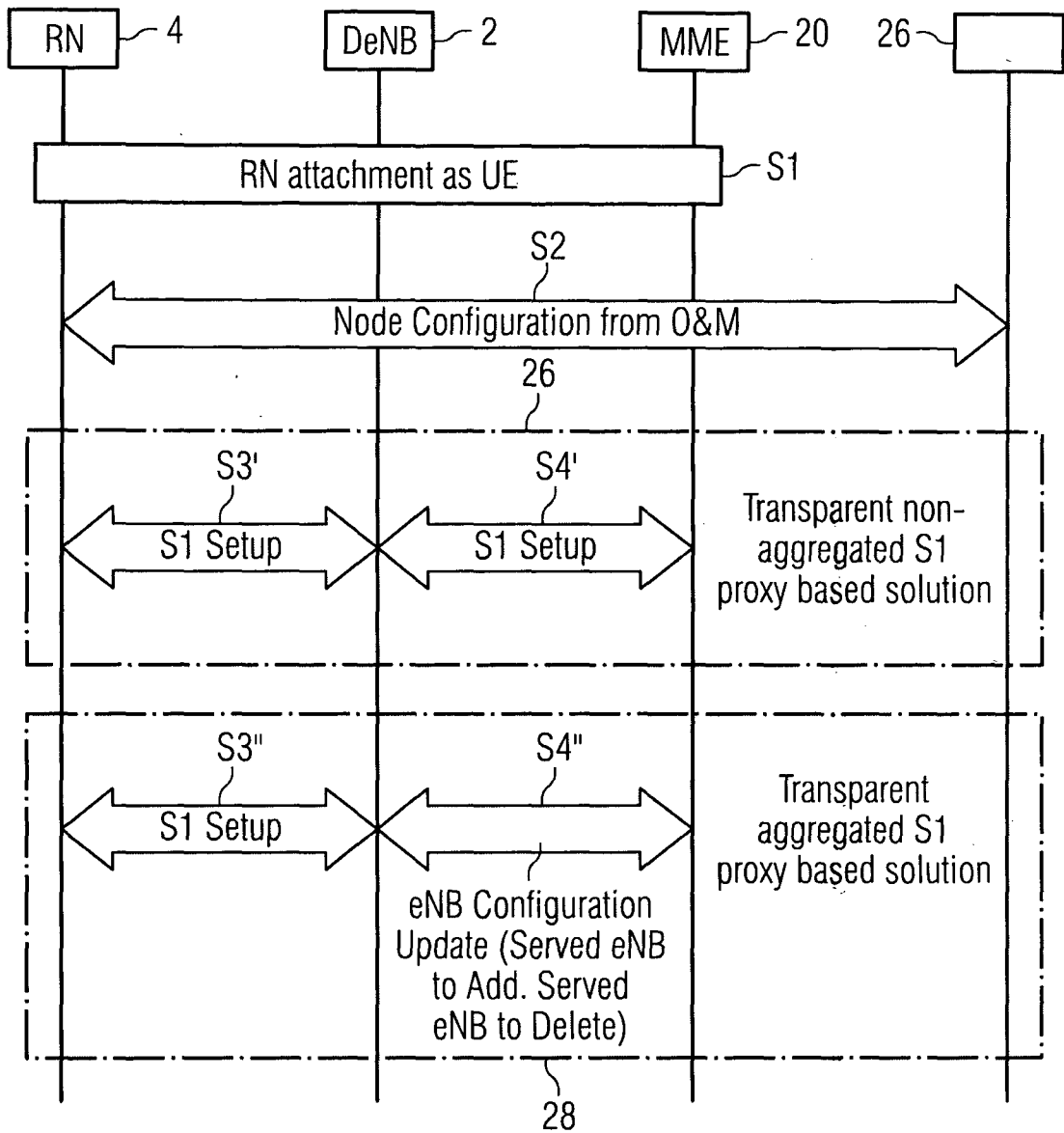


FIG 7

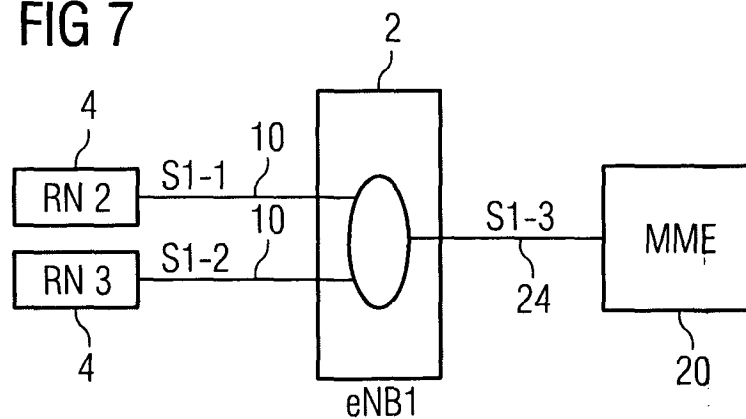


FIG 8

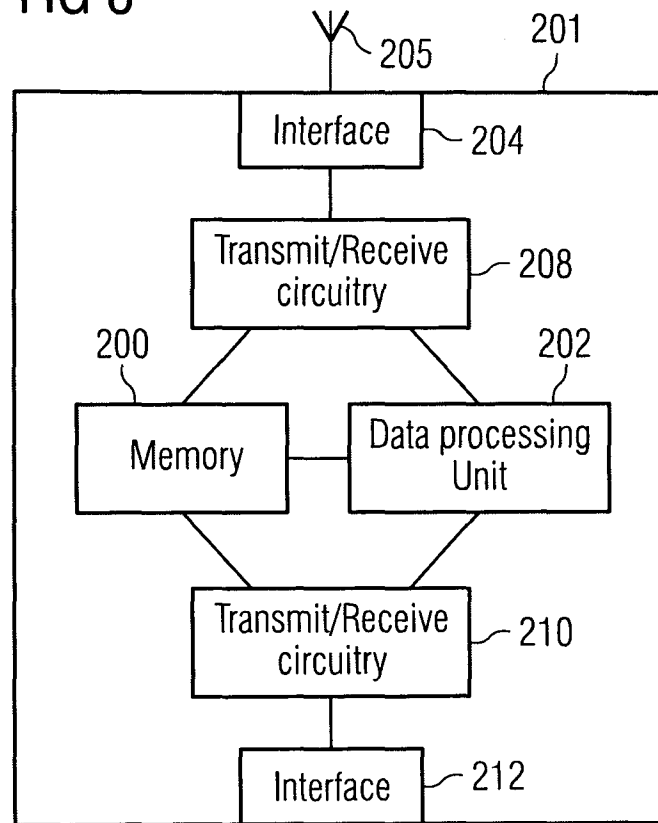


FIG 9A

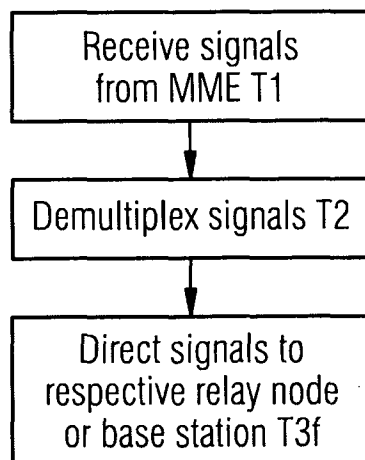


FIG 9B

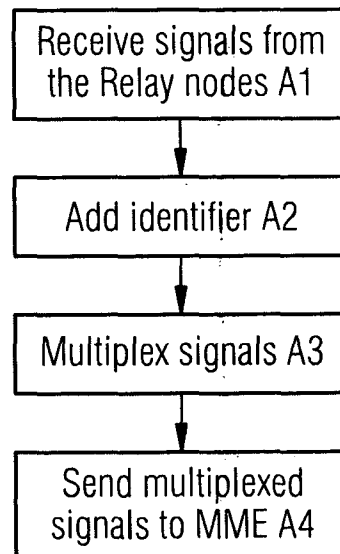
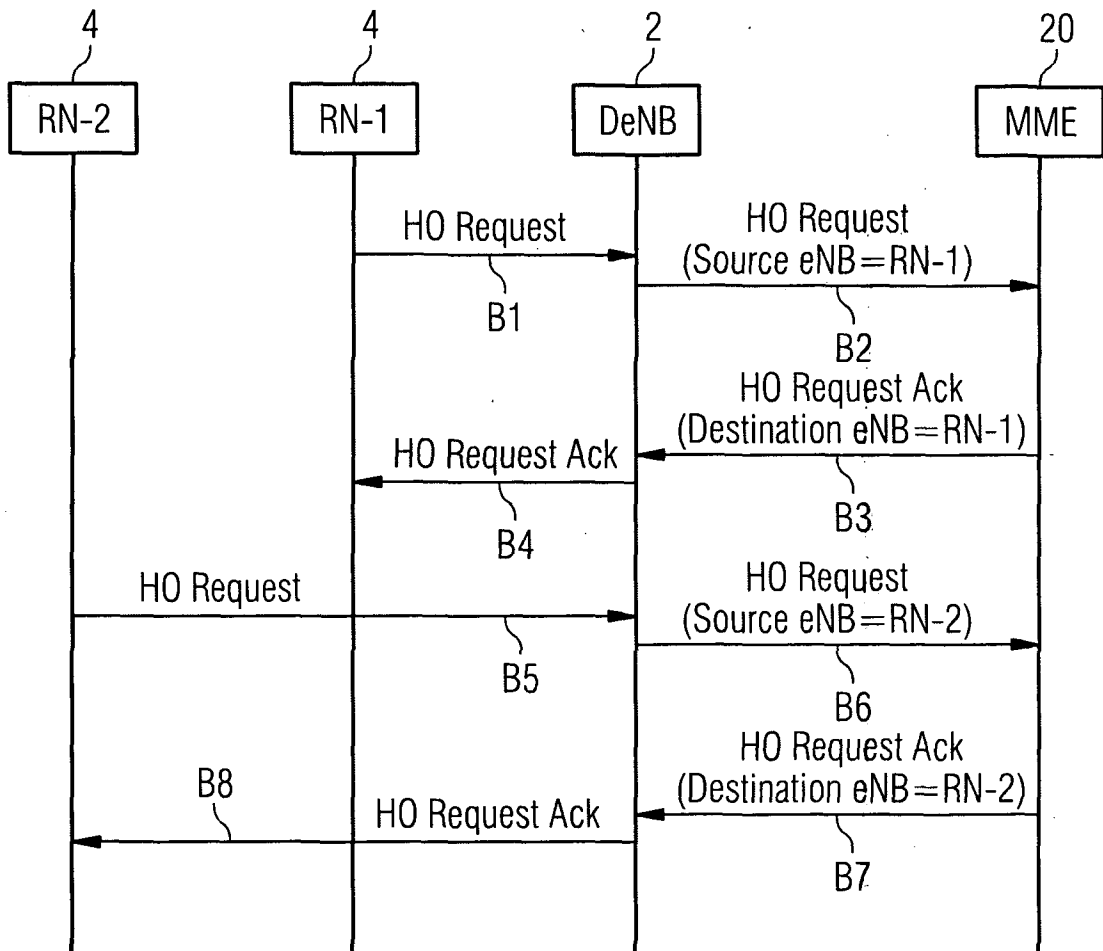


FIG 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2010/000212

A. CLASSIFICATION OF SUBJECT MATTER

H04W 76/02 (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)

IPC:H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

CNPAT,CNKI,WPI,EPODOC: LTE, relay+, donor, base station, eNodeB, distinguish+, path, connection, different

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ERICSSON et al. TP to internal TR on relay architecture options 3GPP TSG-RAN WG2 #67, 28 Aug. 2009 (28.08.2009), chapter 2.1.3.1	1-33
A	3GPP 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network(E-UTRAN); Architecture description; Release 9; 3GPP Dec. 2009 (12.2009), TS 36.401 V9.0.0, the whole document	1-33
A	WO2010/010962A1 (SHARP KABUSHIKI KAISHA et al.) 28 Jan. 2010 (28.01.2010) the whole document	1-13

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

☒ See patent family annex.

* Special categories of cited documents:	“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
“A” document defining the general state of the art which is not considered to be of particular relevance	“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
“E” earlier application or patent but published on or after the international filing date	“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
“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)	“&”document member of the same patent family
“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	

Date of the actual completion of the international search 29 Oct. 2010 (29.10.2010)	Date of mailing of the international search report 18 Nov. 2010 (18.11.2010)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer YANG, Jibin Telephone No. (86-10)62413491

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2010/000212

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	3GPP 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access(E-UTRA) and Evolved Universal Terrestrial Radio Access Network(E-UTRAN);Overall description; Stage 2 (Release 9); 3GPP Sep. 2009 (09.2009) , TS 36.300 V9.1.0 , the whole document	1-33

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2010/000212

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO2010/010962A1	28.01.2010	US2010022184 A1	28.01.2010