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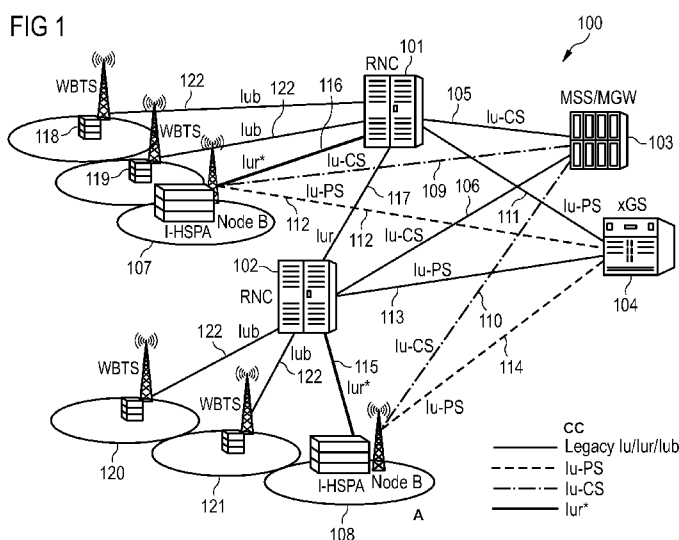
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(54) Title: BASE STATION APPARATUS AND METHOD FOR ROUTING A CONNECTION TO AN INTERFACE OF THE BASE STATION APPARATUS

FIG 1

A: node B
CC: Interface lu/lur/lub patrimonial

(57) Abstract: A Base Station Apparatus (107, 108) is described, comprising a Synchronisation Device (204), a first interface (212), a second interface (209). The Synchronisation Device (204) is adapted to receive a User Equipment connection (202, 203, 205) comprising a CS connection (205, 305, 405, 505) and a PS connection (202, 302, 402, 502). During the PS connection (202) is deactivated, the Synchronisation Device (204) is able to route the CS connection (205) to the first interface (209) and during the PS connection (202) is deactivated, the Synchronisation Device (204) is able to route the PS connection (202) to the second interface (212).

BASE STATION APPARATUS AND METHOD FOR ROUTING A CONNECTION TO AN INTERFACE OF THE BASE STATION APPARATUS

Technical field of the invention

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The following invention relates to the technical field of communication networks. In particular the present invention relates to a Base Station Apparatus, to a Controlling Apparatus, to a method for routing a CS connection to a first interface of the Base Station Apparatus and routing a PS connection to a second interface of the Base Station Apparatus, to a method for Controlling a CS connection and a PS connection of the Base Station Apparatus, to a further method for Controlling a CS connection and a PS connection of the Base Station Apparatus, to a computer-readable medium, to a program element, to a system for controlling a PS connection, a CS connection of a User Equipment connection and to a use of a Drift Radio Network Controller function for forwarding a connection from a Base Station to a Controlling Apparatus and a message.

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Background of the invention

The 3GPP UTRAN / HSPA (3rd Generation Partnership Project UMTS (Universal Mobile Telecommunication System) Terrestrial Radio Access and Network) / (High Speed Packet Access) evolution (I-HSPA) examples may be provided for a flat radio access to a mobile communication network. In HSPA evolution network the network may deliver PS only services (Packet Switched, Packet Service) in a Base Station or in a Base Transceiver Station (BTS) with RNC (Radio Network Controller) functionality. Such a (PS only) BTS with RNC functionality may be known as iNB (I-HSPA NodeB).

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However, when CS (Circuit Switched, Circuit Service) services may be initiated on an iNB in addition to the PS services, a SRNS/SRNC (Serving Radio Network Subsystem/ Serving Radio Network Controller) may be relocated between iNB and an associated RNC (Radio Network Controller).

A SRNC can be located in an RNC or/and NodeB. A SRNS may comprise at least one RNC and at least 1 NodeB.

10 The SRNS or SRNC functionality may be relocated to the RNC since CS services may be provided only in an RNC. The iNB, iNB or iNB may only provide an Iu_cs CP (Iu Circuit Switched Control Plane) interface but the CS user plane may only be supported in the associated RNC. For example, the relocation
15 of the SRNC functionality may also be used in shared networks if direct connection to iNB may not be allowed or available.

An RNC WBTS (WCDMA (Wideband Code Division Multiple Access) BTS) and an iNB share a common carrier and therefore mobility
20 between an iNB cell and a WBTS cell may be supported.

An RNC WBTS may be any traditional BTS (Base Transceiver Station), which may not implement RNC functionalities.

25 The RNC may support SRNC (Serving RNC) and DRNC (Drift RNC) functionality. An Iur-interface may be configured between iNB and RNC for connecting the iNB to the RNC. Thus, the iNB and the RNC may communicate via an Iur-interface.

30 If the iNB receives a CS (Circuit Switched) call, the RNC associated with the iNB may be responsible for acting as the SRNC. Furthermore, the RNC may be responsible for handling a CS call and PS (Packet Switched) data calls. In an example, a CS call may be handled using an AMR (Adaptive Multiple Rate)

codec. There may or may not be multiple RABs (Radio Access Bearer) established for packet data use.

If CS call is made the iNB may be responsible of acting as a
5 CRNC (Controlling RNC) for substantially all traffic, which may be transmitted via the carrier

The document 3GPP TR 25.999, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network;
10 High-Speed Packet Access (HSPA) evolution; Frequency Division Duplex (FDD)", Release 7, V7.1.0, 2008-03, may describe a framework for the evolution of the FDD mode of the 3GPP HSPA WCDMA-based radio access technology.

15 The document 3GPP TSG-RAN WG3 Meeting #55, "Enhanced SRNS Relocation for the HSPA Evolution", Qualcomm Europe, 12-16 February 2007, St. Louis, USA, R3-070158 may disclose an enhanced SRNS relocation procedure with hard handover.

20 The document 3GPP TS 25.331, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Radio Resource Control (RRC); Protocol Specification", Release 8, V8.4.0, 2008-09, may specify the radio resource control protocol for the UE-UTRAN radio interface.

25 The document 3GPP TS 23.060, "3rd Generation Partnership Project; Technical Specification Group Services and System Aspect; General Packet Radio Service (GPRS); Service Description; Stage 2", Release 8, V8.2.0, 2008-09, may define a service
30 description for the general packet radio service (GPRS) which may be a packet bearer service and a main part of the packet domain.

The document TS 25.401 "3rd Generation Partnership Project Technical Specification Group Radio Access Network, UTRAN overall description", Release 8, V 8.1.0, 2008-09, may describe the overall architecture of the UTRAN, including internal interfaces and assumptions on the radio and Iu interfaces.

There may be a need to handle CS traffic and PS traffic in a HSPA evolution more efficiently.

Summary of the invention

According to an exemplary embodiment of the present invention, a Base Station Apparatus, a Controlling Apparatus, a method for routing a CS connection to a first interface of a Base Station Apparatus and a PS connection to a second interface of a Base Station Apparatus, a method for controlling a CS connection and a PS connection of a Base Station Apparatus, with a Controlling Apparatus, a computer-readable medium, a program element, a system for controlling a PS connection and a CS connection of a user equipment connection and a use of a Drift Radio Network Controller function may be provided.

According to an exemplary embodiment of the present invention, a Base Station Apparatus may comprise a Synchronisation Device, a first interface, a second interface. In an example the Synchronization Device may be adapted to receive a User Equipment connection. The User Equipment connection may be a connection which comprises a CS (Circuit Switched) connection and a PS (Packet Switched) connection.

During at least one portion of the PS connection may be deactivated or the PS connection may be inactive the Synchroniza-

tion Device may be able to route the CS connection to the first interface. In an example, the Synchronization Device may also be able to route the at least one portion of the PS connection to the second interface of the Base Station Apparatus, during the PS connection may be deactivated

In an example a deactivated PS connection may be a PS connection whose application layer, user part or data stream layer may be deactivated. In other words, the signalling bearer of the PS connection and/or the data bearer of the PS connection may be setup and routed to the first interface. However, no data may be sent over the connection to the interface.

For example a PS user plane or the PS connection may be separated in an application layer or a user part and in a transport layer. The application layer can be PDP (Packet Data Protocol) context which may be used for describing the characteristic of the connection. The PDP context may comprise the network and address type, the APN (Access Point Name), the QoS, priorities, billing, etc. for the connection.

The user plane may comprise a transport layer connection (ie., transport layer having RAB), e.g. an ATM connection, and an application layer connection.

The transport layer may be routed without transporting user data. For example, a virtual path of the ATM connection may be routed to the second interface and/or to the first interface and the application layer connection associated with the transport layer connection may be deactivated. Thus, as soon, as user traffic may be available, the routed transport layer connection may be activated and the user traffic may be transported using the lower layer transport connection.

Thus, a substantially permanent Iu-PS interface may be provided at the second interface of the Base Station Apparatus. At least during a deactivated PS connection an Iu-PS interface may be provided at the Base Station Apparatus. Therefore, the core network (CN), in particular the PS CN or the SGSN may be able to find the Iu-PS interface at substantially the same location. The CN may quickly find the corresponding location of the interface, e.g. an IP address of the interface. This interface may substantially be located at the same location.

Deactivation of the PS connection may also mean that an Iu connection may be set up and / or that an SCCP connection may be set up but the PS user plane and/or the PS control plane, both laying on the application layer, may be deactivated.

A PS user plane may be split into a PS application layer and a transport layer.

A PS control plane may be associated with the PS user plane and may be split in a control application layer and a control transport layer.

A CS user plane may be split into a CS application layer and a transport layer.

A CS control plane may be associated with the CS user plane and may be split in a control application layer and a control transport layer.

In an example, the PS connection may be a PS user plane connection, an application layer connection, a PS user part or a PS data stream. This PS connection may be transported by a GTP-U transport connection, by a PS bearer or by a PS trans-

port connection. A PS (packet switched) user plane application layer connection or a PS user part may transport packet oriented traffic as for example data traffic.

5 A PS control plane may comprise a PS control application layer and a PS control layer transport connection. The PS control transport connection or the PS control bearer may use SCCP (Signaling Connection Control Part) for transporting PS control information of a PS control application layer connection for an associated PS connection. A PS control layer application connection may use the RANAP protocol.

In another example, the CS connection may be a CS application layer connection, a CS user part or a CS stream. This CS connection may be transported by an ATM or IP connection. A CS (circuit switched) user plane, in particular a CS application connection and/or CS stream and a CS transport connection, may comprise circuit switched traffic as for example voice or fax traffic.

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A CS control connection may use SCCP on a transport layer for transporting CS control information for an associated CS connection. The CS control connection may also use RANAP as a communication protocol.

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The CS user plane transport layer may use AAL2 and may lay below the CS application layer, the CS user part, the CS stream layer or user plane application layer.

30 There may not be the need to send anything to PS CN if the PS user part or the PS user plane application layer connection may be inactive. However the Base Station Apparatus or the iNB may be able to setup PS-related RAB (Radio Access Bearer) whenever requested by UE or by SGSN. If a CS application

layer connection or a CS user part may be ongoing or may be active, i.e. CS user data may be sent via the CS user plane bearer, a parallel PS-related RAB could be setup via a iNB connection.

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In another example, if a CS user part connection parallel to a PS user part connection may be active, the PS RAB may be set up by an RNC or iNB. However, a GTP-U tunnel may terminate in the iNB. The GTP-U tunnel may be used to transport
10 the PS user plane traffic.

In an example, the User Equipment connection, i.e. the connection between a Base Station Apparatus and a UE (User
15 Equipment) may use the Uu interface. The User Equipment connection may comprise a CS UE connection and/or a PS UE connection.

In another example, the first interface and the second interface may be different interfaces of the Base Station Apparatus, which may be logically separated and/or which may be
20 physically separated.

In an example, the PS UE connection and the CS UE connection
25 originate from the same source, from the same source RNC or from the same UE, i.e. a PS/CS UE. The PS UE connection may correspond to the PS user part and the CS UE connection may correspond to the CS user part. In other words, in an example, in the Synchronisation Device the PS UE traffic and the
30 CS UE traffic may be mapped to the PS user plane application connection and the CS user plane application connection, respectively.

According to another exemplary embodiment of the present invention, a Controlling Apparatus may comprise a CS Controlling Device and a PS Controlling Device. In an example the CS Controlling Device may be adapted for controlling a CS connection, a CS application layer connection or a CS user part in a Base Station Apparatus and the PS Controlling Device may be adapted for controlling a PS connection, a PS application layer connection or a PS user part in the Base Station Apparatus. In an example, the CS Controlling Device and the PS Controlling Device may be separated such that at least one portion of the PS Controlling Device can be deactivated during the PS connection in the Base Station Apparatus may be deactivated.

According to another exemplary embodiment of the present invention, a further Controlling Apparatus may be provided, which may comprise a CS Controlling Device and a PS Controlling Device. The CS Controlling Device may be adapted for controlling a CS connection in a Base Station and the PS Controlling Device may be adapted for controlling a PS connection in the Base Station Apparatus. In an example the PS connection may be bypassing the Controlling Apparatus.

According to another exemplary embodiment of the present invention, a method for routing a CS connection to a first interface of a Base Station Apparatus and for routing a PS connection to a second interface of a Base Station Apparatus may be provided. The method may comprise providing a User Equipment connection comprising a CS connection and a PS connection, separating the CS connection and the PS connection and routing the CS connection to the first interface of the Base Station Apparatus during the PS connection may be deactivated.

In an example the method may further comprise routing the PS connection to the second interface during the PS connection may be deactivated.

5 In an example, an inactive connection or a deactivated connection may be routed even if no user data may be transported. In other words, routing a connection may mean routing or preparing a transport connection for a user part in order to be prepared to route the traffic to the desired destination,
10 tion, when the user part or user traffic may be available. For example, the PS connection or the user part of a PS connection may be routed to the second interface or to the Iu-PS interface.

15 According to another exemplary embodiment of the present invention, a method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus may be provided. The method may use a Controlling Apparatus and may comprise separating a CS Controlling Device
20 and a PS Controlling Device in the Controlling Apparatus. In an example the method may further comprise deactivating at least one portion of the PS Controlling Device in the Controlling Device during the PS connection in the Base Station Apparatus may be deactivated.

25 According to another exemplary embodiment of the present invention a method for relocating a PS Controlling Device may be provided. The method may provide requesting a relocation of the PS Controlling Device between a Base Station Apparatus and a Controlling Apparatus or between an iNB and RNC. Fur-
30 thermore, the method may comprise relocating a CS connection independently from a PS connection.

According to another exemplary embodiment of the present invention, a further method for controlling a CS connection and

a PS connection of a Base Station Apparatus with a Controlling Apparatus may be provided. The method may comprise controlling the CS connection of the Base Station Apparatus with a CS Controlling Device and controlling the PS connection of the Base Station Apparatus with a PS Controlling Device. In an example the PS connection may bypass the Controlling Apparatus.

According to yet another exemplary embodiment of the present invention, a system for controlling a PS connection and a CS connection of a User Equipment connection may be provided. In an example the system may comprise at least one Base Station Apparatus and at least one Controlling Apparatus. For example, the PS Controlling Device of the Controlling Apparatus can be deactivated during the PS connection may be deactivated. In another example the Synchronization Device of the Base Station Apparatus may be able to route the CS connection to the first interface during the PS connection is deactivated and the Synchronization Device may be further able to route the PS connection to the second interface, during the PS connection may be deactivated.

According to yet another exemplary embodiment of the present invention, the use of a Drift Radio Network Controller function may be provided for providing a connection from a Base Station Apparatus to a Controlling Apparatus. Therefore, utilizing a Drift Radio Network Controller function for providing a connection from a Base Station Apparatus to a Controlling Apparatus may be provided.

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In an example, a Drift Radio Network Controlling Device in an iNB or a Drift Radio Network Controlling function in an iNB may allow to provide a Iur interface to the Controlling Appa-

ratus. Thus, the Drift Radio Network Controlling function may be utilized to communicate with the Controlling Apparatus.

According to another exemplary embodiment of the present invention, a computer-readable medium may be provided, wherein the computer-readable medium may comprise program code, which program code, when being executed by a processor is adapted to carry out at least one method selected from the group of methods consisting of the method for routing a CS connection to a first interface of a Base Station Apparatus and a PS connection to a second interface of a Base Station Apparatus, the method for controlling a CS connection and a PS connection of the Base Station Apparatus with a Controlling Apparatus and a further method for controlling a CS connection and a PS connection for Base Station Apparatus with a Controlling Apparatus.

According to yet another exemplary embodiment of the present invention, a program element may be provided wherein the program element comprises a program, which, when being executed on a processor may carry out at least one method selected from the group of methods consisting of the method for routing a CS connection to a first interface of a Base Station Apparatus and a PS connection to a second interface of a Base Station Apparatus, the method for controlling a CS connection and a PS connection of the Base Station Apparatus with a Controlling Apparatus and a further method for controlling a CS connection and a PS connection for Base Station Apparatus with a Controlling Apparatus.

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A computer-readable medium may be a floppy disk, a hard disk, an USB (Universal Serial Bus) storage device, a RAM (Random Access Memory), a ROM (read only memory) or an EPROM (Erasable Programmable Read Only Memory). A computer readable me-

dium may also be a data communication network, e.g. the Internet, which may allow downloading a program code.

According to another exemplary embodiment of the present invention a message for signalling relocation parameter may be provided, wherein the message may be adapted to inform a core network about relocation of an interface.

In an example the message may be a signal sequence, which when being received by a core network, e.g. by a SGSN/GGSN may be adapted to provide adapted network parameter for the interface. In particular, the interface may be the second interface. The message may be at least one message selected from the messages consisting of a RAB modification request message, a PS signalling message, a RAB Modify Request message and a relocation request message. In an example, the message may be transferred between UE and SGSN. The message may comprise parameter such as a new or modified IP address of the interface, in particular of the PS interface.

The method for relocating may comprise requesting a relocation of an SRNC functionality between RNCs or iNBs or between RNC and iNB separated and independent for CS and PS traffic where involved nodes and traffic is indicated in the request by corresponding parameters.

In other words, relocating, proxying or relaying of the PS Controlling Device or of the PS Controlling functionality may be controlled individually for a CS user plane and/or for a PS user plane. Relocating may be controlled by sending a message to the PS Controlling Device comprising parameters, which may instruct the PS Controlling Device to relocate the PS Controlling Device.

Proxying may mean relaying including converting of addresses or address translating. In this application relaying may mean relaying and simultaneously translating of an address. Thus, proxying may allow hiding the real source of a message.

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In a mobile communication environment at least two different types of Mobile Stations (MS), of User Equipments (UEs), of users or of terminals may be differentiated.

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In an example a UE may be a PS only UE. A 'PS only' UE may only provide PS traffic in a UE connection. Thus, a PS only UE may only comprise a PS UE connection. In other words, a PS only UE may convert services which the user of the UE may utilize in PS traffic. Thus, the UE connection may only comprise a PS connection. For example, a voice service may be converted in a packet stream or in packet data, for example by using VoIP (Voice over IP (Internet Protocol)).

15

However, legacy equipment may also have to be supported by iNB. Legacy equipment or legacy UEs may differentiate between CS traffic and PS traffic. Therefore, legacy equipment, such as a GSM UE (Global System for Mobile Communication) or a UMTS UEs (Universal Mobile Telecommunication System) may provide within one UE connection a CS connection for CS traffic and a PS connection for PS traffic. An example for CS traffic may be a voice service or a fax service, and an example for PS traffic may be web browsing or sending of SMS (short Message Service).

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In another example the PS traffic may base on the GPRS standard (General Packet Radio Service).

A UE connection may be a connection or traffic data or user data which may be transmitted via the same carrier or the same bearer on the air interface. The carrier of the air interface may be utilized to exchange data between a Base Station, such as an iNB or an eNB. Therefore, the traffic exchange between a PS only UE and a Base Station Apparatus (BS) or a legacy PS/CS UE, i.e. a UE which may differentiate CS and PS traffic, may always be via a carrier on the air interface used from the UE and the corresponding BS.

In the case of a legacy UE, the Base Station (BS), and in particular the Radio Network Controller (RNC) of the Base Station may be responsible to split the received traffic and to distribute the traffic to an associated network. Thus, for example the RNC may be responsible to split CS and PS traffic and to distribute the PS traffic to a PS based network such as an IP network or the Internet and to distribute the CS traffic to a CS network such as a PSTN (Public Switch Telephone Network) or a PLMN (Public Land Mobile Network). A CS network may base on TDM technology (Time Division Multiplex) or ATM technology (Asynchronous Transfer Mode).

An iNB may base on Rel99, i.e. Release 99 of the 3GPP specifications, and/or on HSPA downlink/uplink technology, which may allow providing a connection to a mobile network for a User Equipment.

An iNB may be a NodeB which may comprise an RNC, e.g. an SRNC, and therefore an iNB may be able to directly being connected to a packet network. The connection of an iNB to a packet network may be realized via an SGSN (Serving GPRS Support Node). In an example the iNB may comprise the NodeB and the RNC in a single housing.

Since the RNC may be included in the iNB, the SGSN of the packet network, i.e. the entry device into the packet network, may see the iNB or the I-HSPA NodeB as an RNC. Therefore, a connection between iNB and SGSN may use an Iu-PS interface or a Iu ps interface. INB or iNB may also be connected to the GGSN (Gateway GPRS Support Node) of the packet network using an Iu ps or a Gn interface.

User may move in an area and this move may cause an iNB node change and/or a cell change. Depending on the circumstances or depending on the activated connections (CS and/or PS) the change of the cell may or may not be visible in core network. If a user connection may be active the iNB change may be performed by means of SRNS relocation procedure and therefore, the change may be detectible or visible in the core network, i.e. in the SRNS.

Also if a user, e.g. by activating a legacy User Equipment, may initiate a CS call on the iNB, relocation may be triggered within the iNB. In other words, when a handover from a first iNB to a second iNB may have to be conducted since a User Equipment may move within a mobile network, a SRNC functionality which may originally have been located within the iNB may be relocated to an RNC associated with the iNB. Relocating may mean switching on the SRNC functionality at the RNC and switching off the functionality in the iNB.

In another example, if a UE connected to an iNB may initiate a CS connection or may activate a CS connection for example by initiating a CS call on the iNB, also a SRNC functionality may be relocated from the iNB to the associated RNC. Relocating a SRNC functionality from an iNB to an RNC may be a heavy procedure for the Core Network (CN), i.e. relocating may be a processing intensive procedure generating a heavy load in the

core network since a plurality of messages may have to be exchanged between the network nodes.

In other words, a SRNS Relocation procedure may be used to
5 move the RAN (Radio Access Network) to the CN connection
point at the RAN side, i.e. from the source SRNC to the target RNC. The source SRNC and the target RNC may be CN connection points. In the SRNS relocation procedure, the Iu links
10 may be relocated. If the target RNC may be connected to the
same SGSN as the source SRNC, an Intra-SGSN SRNS Relocation
procedure may be performed. If the routing area is changed,
this procedure may be followed by an Intra-SGSN Routing Area
Update procedure.

15 A relocation procedure may cause load to CN as the relocation
procedure may require locating the target RAN node and possible
target CN serving the target RAN and forwarding a relocation
request to the target node. After the relocation procedure the
Target CN node may perform security procedures, may
20 authorize the user access to the target system and may perform
admission control procedures to be able to serve a user.
At the same time the Target CN node (SGSN) may update the
user location to GGSN and may reserve resources for a call
from target RAN node. After admission control and resource
25 reservation the SGSN may also inform the HLR about new location
of the user equipment. Informing the HLR (Home Location
Register) may be required using Gr interface during Inter-
SGSN relocation.

30 The Core Network may be connected to an iNB or an RNC via an
Iu interface, e.g. via an Iu-CS or an Iu-PS interface. For
example, a xGS, e.g. a SGSN or a GGSN (Gateway GPRS Support
Node) may be part of a PS CN. A MSS (a Mobile Service Sys-

tem), a MGW (Media Gateway) or a MSC (Mobile Switching Centre) may be part of a CS CN.

Since relocating of a SRNC, of a SRNC device or a SRNC functionality may be a processing intensive procedure, either the
5 number of relocations should be minimized or the relocation procedure may be simplified.

In an I-HSPA NodeB always when a CS call may be performed relocation of a RNC functionality to the RNC may be performed,
10 e.g. relocation of a SRNC functionality, of a Controlling Device or of an SRNC device or relocating a respective functionality. Thus, independently whether a shared carrier may be required to handle a CS connection and a PS connection or
15 not, a relocation of the SRNC to the RNC may be executed. The CS and the PS connections may be included in a single UE connection between a legacy UE and a BS. Therefore, the CS connection and the PS connection may share the UE connection. In other words, the UE connection may comprise a CS user connection and a PS user connection. A shared carrier may be re-
20 quired when a PS connection and a CS connection may be active simultaneously. An active connection may be a connection which may be routed and which may carry traffic. In other words, a UE may actively participate on an active connection.
25 A UE not actively participating on a connection may go to an idle mode. However, even if the connection may be not active, the UE may be connected to the CN via the Access Network.

After the CS call or the CS connection may have been finished
30 a further relocation may be executed for reverse relocating, proxying and/or relaying back or relocating back the SRNC functionality from the RNC to the I-HSPA NodeB if the user of the legacy UE may continue using a PS service.

In the case a user may not be PS attached, the reverse relocation to the iNB may not be needed. The reverse relocation may be needed if iNB may act as drift RNC for CS. This may mean that if a CS call may be ended or finished, a PS only

5 call SRNC functionality (a SRNC functionality for a PS only call or for a PS only data stream) could still stay in the centralized RNC or the SRNC functionality can be relocated to the iNB. The decision for relocating the SRNC functionality may base on a decision of the SRNC or of the central SRNC.

10 The reverse relocation may only be needed if a PS SRNS functionality may have been moved to a central element such as an RNC.

Therefore, it may be an aspect of the present invention to

15 prevent that a CS call may affect a PS usage. In other words, it may be an aspect of the present invention to handle CS connections and PS connections independently in an iNB or in an I-HSPA NodeB. Thus, only in a case when a CS call and a PS call, or a CS connection and a PS connection from the same UE

20 may be activated at the same time, a relocation of the SRNC functionality should be conducted. Thus, a plurality of unnecessary relocations may be prevented. Unnecessary relocations may be relocations which may have been conducted but may have not been used, e.g. if a SRNC may be relocated and

25 CS traffic only or PS traffic only may be sent.

Carrier sharing, for handling a CS connection and a PS connection within one UE connection or on the same carrier may have been introduced in I-HSPA. Thus, an iNB may be adapted

30 such, that when a CS call may be made or a CS connection may be activated, the functionality of carrier sharing may allow the iNB to act as Drift RNC (DRNC) for the CS connection, while the associated RNC may act as a serving RNC or as a CS Controlling Device.

The Drift RNC may act as a CS Forwarding Device. The Drift RNC may allow connecting an iNB to an RNC via a Iur interface. Using the iNB as a Drift RNC and the RNC as a Serving RNC may require that the UE and/or the end user stay connected to a BTS (Base Transceiver Station) or to an iNB and may not change the BTS. However, this procedure may require that for every CS call a relocation to the RNC may be conducted. Depending on the use case or on the network scenario, i.e. depending of the type of UE and depending on the connections which may be activated in parallel, a different part of the connection may be relocated or a proxy and/or relay functionality may be applied. The PS controlling device or the PS controlling function may be moved to a central RNC by relocating or by proxying and/or relaying.

According to an aspect of the invention, the number of relocations visible to CN should be minimized to be able to reduce the load of the CN.

Therefore, an aspect of the present invention may be splitting a CS functionality and a PS functionality, e.g. in form of a CS Controlling Device and a PS Controlling Device within the RNC. This splitting may allow the iNB to act as a Serving RNC (SRNC) for the PS core or for the PS CN and the RNC to take the role of the Serving RNC for the CS CN. Thus, for the different type of traffic, the different serving RNC functionalities are located at different places, i.e. in the RNC and/or in the iNB. In other words, the SRNC functionality for CS traffic may permanently be "relocated" in the RNC and the SRNC functionality for PS traffic or for a PS connection may only be on demand relocated to the RNC, i.e. as required.

Relocation of the SRNC PS may be required if simultaneously a CS connection and a PS connection of a common UE or of a com-

mon UE connection may have to be handled. Handling simultaneously CS user traffic and PS user traffic of a UE may require a shared carrier for the UE. The shared carrier may require collocated SRNC CS functionality and SRNC PS functionality. A
5 collocated SRNC CS functionality and SRNC PS functionality, for example a collocated CS Controlling Device and a PS Controlling Device, may be achieved by collocating the SRNC CS functionality and the SRNC PS functionality within one single apparatus such as an RNC.

10

Collocating SRNC CS functionality and SRNC PS functionality may allow coordinating between SRNC CS functionality and SRNC PS functionality for handling a CS connection and a PS connection on a shared carrier on the air interface of an iNB
15 associated with the RNC. In an example collocating may also mean connecting the SRNC CS functionality and the SRNC PS functionality such that these functionalities can coordinate one another or interact.

20

In other words, by permanently locating an SRNC CS functionality within the RNC, in particular within an RNC external to the iNB, relocating an SRNC CS functionality for every CS call may be prevented. For example, a plurality of calls of a legacy UE may base on CS or a plurality of calls of UE may be
25 CS only connections. Therefore, in most cases of a legacy UE or a CS/PS UE connection a relocation of SRNC CS functionality in the RNC may be prevented.

30

This aspect may cover CS only or PS only relocation towards CN. However, relocation requests may exist, which may allow separated CS or PS relocations or both. Individual CS and/or PS relocations may be conducted be conducted at different points in time. This may differ from relocating CS and PS at the same time.

According to an aspect of the invention a separated CS user part and/ or PS user part relocation may be occure between RNC functionalities which may be split between the Base Station Apparatus and the Controlling Apparatus, in particular
5 between iNB and RNC.

In a small number of cases a PS user connection or a PS user part may be established by a CS/PS UE simultaneously or in parallel to the CS connection. Only in such cases, where the
10 UE may establish simultaneously to an existing CS user connection an additional PS user connection a relocation of the SRNC PS functionality from the iNB to the RNC may be required. Therefore, the number of relocations may be reduced by separating the SRNC functionality according to the traffic
15 type, i.e. according to CS and PS traffic.

According to an aspect of the present invention a NodeB PS breakout in flat architecture may be provided.

20 PS only traffic which may be sent to the iNB from a PS only UE may be handled in the iNB directly and may directly be sent to an SGSN. Thus, CS traffic and PS traffic of different UEs, in particular PS only traffic and CS only traffic, may be handled separately or independently in the iNB. Therefore,
25 in a particular example a legacy UE may be seen as a CS only UE since the number of cases, where a legacy UE equipment in parallel to an existing CS connection may establish a PS connection, for example for writing SMS (Short Message System) or for web browsing, may be minimal.

30

In an example, the RNC comprising the SRNC CS may be the real SRNC, but a PS session, a PS user part or a PS connection may not be transferred to the RNC. Therefore, in an example an RNC may not be aware or prepared for PS connections at all or

the RNC may have a simple control for PS connection and an Iu connection for the PS domain may remain in the iNB. In other words, splitting the SRNC functionality in an SRNC CS functionality, e.g. a CS Controlling Device, and an SRNC PS functionality, e.g. a PS Controlling Device, may allow providing an Iu PS interface as a second interface of the Base Station Apparatus or for the iNB, whereas the Iu CS connection may be provided at the RNC.

10 The SRNC PS functionality for handling the PS traffic portion of a UE connection of a legacy UE may be deactivated during CS only traffic may be exchanged with the UE. The PS traffic portion and/or the CS only traffic may be user traffic or a user plane traffic of PS and CS, respectively. This may allow
15 the Base Station Apparatus or the iNB to route CS traffic of the legacy UE to a first interface of the iNB and PS traffic, i.e. PS traffic of a separate 'PS only' UE which may be connected in parallel to the legacy UE to the iNB, to the second interface of the Base Station Apparatus. Such a solution for
20 separate handling of CS and PS traffic in particular can be used if only CS traffic may be needed during a call or during an active connection. CS only traffic may either be required due to inactivity in the PS core or if an operator may not allow and/or may not require simultaneous CS and PS usage.

25 PS only traffic or a PS only connection, in particular the user part of a PS only connection, may also be routed via SRNC PS. A connection, which may be inactive or deactivated may also be routed to the second interface, even if substantially no traffic may be provided via this connection. The
30 connection, in particular the transport layer of the connection, may be routed to the second interface for the case, for example that PS only traffic may have to be handled by the iNB or by the Base Station Apparatus or for the case that PS

traffic from a legacy UE or from a CS/PS UE may have to be handled. However, as soon as PS traffic from the same legacy UE may arrive, which may already provide CS traffic, the SRNC PS functionality may be relocated to the RNC.

5 According to another exemplary embodiment of the present invention, the Base Station Apparatus may further comprise a CS Forwarding Device or a DRNC CS functionality. In an example the CS Forwarding Device may be adapted to forward CS traffic or CS information of the CS connection to the first inter-
10 face.

According to another exemplary embodiment of the present invention, the Base Station Apparatus may further comprise a PS Controlling Device, wherein the PS Controlling Device may be
15 adapted to detect the activation of the PS connection or of the PS user part, wherein the PS connection may be associated with the CS connection. The PS Controlling Device may further be adapted to collocate at least a portion of the PS Controlling Device to the CS Controlling Device during the PS con-
20 nection may be active.

Two types of UEs may have to be differentiated. A legacy UE, which may be a 'CS/PS UE' and which may provide CS and PS traffic simultaneously and the 'PS only UE' may have to be
25 distinguished. If a CS user connection of a UE may be active and at the same time the PS Controlling Device may detect a PS user connection associated with the CS user connection may be activated, the PS Controlling Device may trigger a collocation of the PS Controlling Device or a portion of the PS Controlling Device with the CS Controlling Device. The CS Con-
30 trolling Device may be located in an external device, such as an RNC or Controlling Apparatus and therefore also the PS Controlling Device or the portion of the PS Controlling Device may be collocated to the external device.

In case where a PS only UE may provide PS traffic, a relocation of the PS Controlling Device may be prevented even if a CS connection of the CS/PS UE may be active.

- 5 A DRNC function and a SRNC function may be individual for each individual UE. When a SRNC function of a first user equipment may be moved to RNC but the SRNC function of a second user equipment may remain in iNB.
- 10 However, even if the CS/PS part may be relocated or moved to the RNC, the SRNC PS functionality for the PS traffic may still be possible and/or available in the iNB. I.e. a CS/PS UE may use CS connection and PS connection and at the same time a PS only UE may use a PS connection in the iNB. In
- 15 other words, the CS/PS part may be a part of a SRNC or of a DRNC which may be able to handle CS traffic and PS traffic from the same UE. The CS/PS part may be relocated to the RNC, but in the iNB still a PS only SRNC may be active to handle PS only traffic in the iNB directly. A PS only SRNC function-
- 20 ality or a PS only device may stay in the iNB in order to handle the PS traffic, which may be provided by a PS only UE.

According to another exemplary embodiment of the present invention, the PS Controlling Device may be adapted to request

25 a relocation of the PS Controlling Device.

The PS Controlling Device may be adapted to request SRNC relocation to an RNC. In an example the PS Controlling Device may provide an indication about the location of the second

30 interface. In a further example the second interface may be a Iu-PS termination point to be used and indicating where the PS Controlling Device or the SRNC PS function is allocated (eg., in iNB or in RNC). The indication may comprise prede-

defined parameters to indicate where the SRNC PS function may be allocated.

According to another exemplary embodiment of the present invention, the PS Controlling Device may be adapted to exchange coordination information with a Controlling Apparatus.

In an example the PS Controlling Device may be adapted to receive information from an external device, e.g. from an RNC and/or from a CS controlling device. The received or exchanged information may comprise coordination information. The coordination information may relate to shared functions of RNC or SRNC CS or related to an actual status of user activity, eg. an actual status of ongoing CS calls related to the iNB coverage or controlling device. In other words, the coordination information may comprise information about the active CS calls routed via the Base Station Apparatus. In an example these calls are calls within the coverage of the iNB or within cells covered by the Base Station Apparatus.

20

In a further example the PS Controlling Device may be adapted for sending a predefined relocation request message to an external apparatus such as for example an RNC, an SRNC or a controlling device when the PS controlling device may detect that PS user data may need to be transferred between UE and SGSN. The message may be sent if the PS user data may need to be transferred during a CS connection for the UE may be active and the PS user data may need to be transferred without interrupting the CS call and/or without interrupting the provided CS service. Thus, the predetermined message may be sent if PS user data may need to be transferred while the CS call may be maintained.

30

The predetermined relocation request message may indicate actual IuPS termination points, eg., i-NB, SGSN, and may indicate PS application layer connection related parameters.

- 5 According to another exemplary embodiment of the present invention the PS Controlling Device may be adapted to request a Controlling Apparatus to establish a PS connection of a User Equipment via the Base Station Apparatus.
- 10 The PS connection may connect a core network directly with the Base Station Apparatus. The Base Station Apparatus, in particular the PS Controlling Device may be adapted to send a request to an RNC and/or to a controlling apparatus in order to establish a PS data path of the indicated UE via the Base
- 15 Station Apparatus.

According to another exemplary embodiment of the present invention, the PS Controlling Device may be adapted to receive a request from a user equipment for setting-up a PS connection between the user equipment and a core network in accordance with the parameters from the user equipment and/or from

20 other devices, such as RNC, SGSN, HLR (Home Location Register), GGSN. The parameters or a list of parameter may comprise the PDP context.

25

The user equipment (UE) may indicate to the PS Controlling Device by means of a message to set-up a PS data path between the UE and a core network of a UE, for example a SGSN, in accordance with parameters comprised in the message, i.e. the

30 request message.

According to an exemplary embodiment of the present invention, the PS Controlling Device may be adapted to receive a signalling message from a user equipment and/ or from a core

network. The PS Controlling Device may be further adapted to send at least the received signalling to a Controlling Apparatus to indicate that the Base Station Apparatus may maintain the PS connection and/or a user equipment connection.

5

In an example the Base Station Apparatus and/or the Controlling Apparatus may be adapted to receive a PS signalling message from an SGSN or from a UE and to send the received PS signalling message to the RNC with added information to indicate that iNB and/or the PS controlling device may maintain an Iu-PS connection and/or an Uu connection. In other words, a signalling message may be received in the iNB. This information may be modified, e.g. additional information may be added, and the modified message may be sent to the RNC.

10

According to another exemplary embodiment of the present invention, the PS Controlling Device may be adapted to receive a PS signalling message from a Controlling Apparatus, to differentiate a destination of the message and to send the received PS signalling message toward the indicated destination. Additionally the PS Controlling Device may further be adapted for indicating that the PS connection may be terminated in at least one of the group consisting of the Base Station Apparatus, the SRNC PS proxy or relay and the PS controlling device.

20

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Thus, for example the PS Controlling Device may be adapted to receive a PS signalling message from an RNC to discriminate or to differentiate the message destination from the message content or dependent on the message content and to send the received PS signalling message toward the indicated destination, i.e. UE or SGSN, and indicating that an Iu PS termination point may be located in Base Station Apparatus, in an SRNC PS proxy or relay or in a PS controlling device

30

According to another exemplary embodiment of the present invention, the CS Controlling Device may be an external apparatus to the Base Station Apparatus.

- 5 According to yet another exemplary embodiment of the present invention, the external apparatus may be a Radio Network Controller (RNC).

According to another exemplary embodiment of the present invention, collocating a PS Controlling Device and a CS Controlling Device may comprise at least one collocation method of the group of collocation methods consisting of relocating the PS Controlling Device, e.g. the SRNC PS, relaying the PS Controlling Device to the CS Controlling Device and proxying
10 the PS Controlling Device to the CS Controlling Device. Collocating a device may also be understood as collocating a corresponding functionality. Thus, collocating may comprise activating a functionality at a predefined time.

- 20 According to another exemplary embodiment of the present invention, the Synchronization Device may further be adapted to continue routing the PS connection to the second interface during the PS connection is active, in particular during the user part of the PS connection may be active. In a case,
25 where no CS traffic may be provided and a legacy UE may only provide PS traffic and/or a PS only UE may provide PS only traffic, the PS traffic may be routed to the second interface of the Base Station Apparatus. The PS traffic or the PS data stream may use a transport connection on a lower layer, which
30 may already have been routed to the second interface.

Therefore, a PS Core Network (PS CN) can be connected to the second interface of an iNB. The PS CN may always be able to

receive the PS traffic at the second interface, e.g. an Iu-PS interface.

According to yet another exemplary embodiment of the present invention, the Base Station Apparatus may be at least one Base Station Apparatus selected from the group of Base Station Apparatuses consisting of a Base Station, a BTS, a NodeB, an enhanced NodeB, an eNodeB, an eNB, an iNB, and an I-High Speed Packet Access NodeB (I-HSPA NodeB).

Therefore, also existing Base Stations may be extended using the splitting of the CS Controlling Device and the PS Controlling Device of an SRNC functionality. Thus, retrofitting of existing BSs may be possible, e.g. by including RNC functionality such as DRNC and/or SRNC in the existing BS.

According to another exemplary embodiment of the present invention, at least one device of the CS Forwarding Device, the PS Controlling Device and the CS Controlling Device may be at least one device selected from the group of devices consisting of a Serving Radio Network Controller (SRNC), a Controlling Radio Network Controller (CRNC) and a Drift Radio Network Controller (DRNC).

According to another exemplary embodiment of the present invention, the CS Controlling Apparatus and the PS Controlling Apparatus may be adapted to coordinate one another such that if the CS connection and the PS connection in the Base Station Apparatus are simultaneously activated, a shared carrier access to the Base Station Apparatus can be provided for a User Equipment.

In an example providing a shared carrier may require that an SRNC functionality may coordinate CS traffic as well as PS

traffic. Therefore, in a case where an SRNC functionality may be split in an SRNC CS functionality and an SRNC PS functionality, the SRNC CS functionality, i.e. the CS Controlling Device, and the SRNC PS functionality, i.e. a PS Controlling Device, may coordinate one another such that a shared carrier can be provided in the direction to a PS/CS UE.

According to yet another exemplary embodiment of the present invention, for deactivating the at least one portion of the PS Controlling Device the at least one portion of the PS Controlling Device can be reverse relocated from the Controlling Apparatus and/or proxied from the Controlling Apparatus and/or relayed from the Controlling Apparatus.

In an example during a CS connection and a PS connection may be simultaneously active, a PS Controlling Device may be collocated to a CS Controlling Device and in the case that the PS connection may be deactivated, the PS Controlling Device can be reverse relocated to the Base Station Apparatus or can be relayed back to the Base Station Apparatus or can be relocated to the Base Station Apparatus. When the PS Controlling Device or the SRNC PS functionality may be located in the iNB or in the Base Station Apparatus, a PS connection can be handled independently from a CS connection.

It has also to be noted that exemplary embodiments of the present invention and aspects of the invention have been described with reference to different subject-matters. In particular, some embodiments have been described with reference to apparatus type claims whereas other embodiments have been described with reference to method type claims. However, a person skilled in the art will gather from the above and the following description that unless other notified in addition to any combination between features belonging to one type of

subject-matter also any combination between features relating to different subject-matters in particular between features of the apparatus claims and the features of the method claims may be considered to be disclosed with this application.

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These and other aspects of the present invention will become apparent from and elucidated with reference to the embodiments described hereinafter.

10 Exemplary embodiments of the present invention will be described in the following with reference to the following drawings.

Brief description of the drawings

15

Fig. 1 shows a network diagram of a I-HSPA network topology for a shared carrier solution for a better understanding of the present invention.

20 Fig. 2 shows a block diagram of an access network according to an exemplary embodiment of the present invention.

Fig. 3 shows a block diagram of an access network with a simultaneously active CS call and PS call according to an exemplary embodiment of the present invention.

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Fig. 4 shows a further block diagram of an access network for a mobile communication network according to an exemplary embodiment of the present invention.

30 Fig. 5 shows a further block diagram of the access network comprising an iNB with proxying functionality and an RNC according to an exemplary embodiment of the present invention.

Fig. 6 shows a block diagram of a Base Station Apparatus according to an exemplary embodiment of the present invention.

Fig. 7 shows a block diagram of a Controlling Apparatus according to an exemplary embodiment of the present invention.

Fig. 8 shows a flow diagram for a method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus according to an exemplary embodiment of the present invention.

Fig. 9 shows a flow diagram of a method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus according to an exemplary embodiment of the present invention.

Fig. 10 shows a flow diagram of a further method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus according to an exemplary embodiment of the present invention.

Detailed description

The illustration in the drawings is schematic. In different drawings, similar or identical elements are provided with the same reference numerals.

Fig. 1 shows a network diagram of I-HSPA network topology for a shared carrier solution for a better understanding of the present invention.

30

The communication network 100 comprises a plurality of Base Stations and Radio Network Controller. The Radio Network Controller 101, 102 are connected to the core network. The core network comprises the CS part of the core network which is

shown by the MSS 103 (Mobile Service System) or the MGW 103 (Media Gateway). The PS part of the core network (CN) is shown by the xGS 104, e.g. an SGSN 104 or a GGSN 104. As can be seen from Fig. 1, the Radio Network Controllers (RNC) 101, 102 are connected to the MSS 103 with the Iu-CS interfaces 105, 106. Therefore, the RNCs 101, 102 can be used for providing separated PS traffic and CS traffic.

The Iu-CS interface may comprise a transport connection for CS traffic on a transport layer and a user connection or a user part for CS traffic on an application layer.

The Iu-PS interface may comprise a transport connection for PS traffic on a transport layer and a user connection or a user part for PS traffic on an application layer.

The CS user part may be on an application layer and the CS transport connection may be on a transport layer, wherein the application layer may be a higher layer than the transport layer.

The PS user part may be on an application layer and the PS transport connection may be on a transport layer, wherein the application layer may be a higher layer than the transport layer.

Beside the RNC 101, 102 also the I-HSPA NodeB 107, 108, which comprise an RNC are connected with the Iu-CS interface 109, 110 or the Iu-CS link 109, 110 to the CS core network 103.

The RNCs 101 as well as the I-HSPA 107, 108 or iNB 107, 108 are connected to the PS portion of the core network via the interfaces Iu PS 111, 112, 113, 114 or links Iu PS 111, 112, 113, 114. This direct connection may allow for a PS breakout

in the iNB 107, 108 or on a BS level. In other words, the PS CN may directly be connected to a BS, e.g. to an iNB.

The I-HSPA NodeB 108 is connected to the RNC 102 via the link or interface Iur* 115. The I-HSPA NodeB 107 is connected to the RNC 101 via link Iur* or via the Iur* interface 116. The Iur* interface may allow directly connecting an iNB 107, 108 to an RNC 101, 102.

The RNCs 101, 102 are connected one with another using the link 117 or the Iur interface 117. The WBTS Base Stations, legacy Base Stations, GSM Base Stations or UMTS Base Stations 118, 119, 120 and 121 are connected to the RNCs 101, 102 using the Iub interfaces 122.

15

The legacy 118, 119, 120, 121 BTS or WBTS 118, 119, 120, 121 as well as the I-HSPAs 107, 108 allow a legacy UE to connect with a CS and/or PS traffic or connection using a shared carrier solution. In a shared carrier solution, both CS and PS traffic are transmitted by the same carrier on the air interface.

20

As a rule for the interface of iNBs 107, 108 or of I-HSPAs 107, 108, it is possible to connect the iNB 107, 108 to an SGSN control and/or user plane, a GGSN user plane (UP), a MSC 103 control plane (CP) and to a RNC 101, 102 user plane and/or control plane (UP/CP). The interface type of an iNB 107, 108 towards a GGSN 104/ SGSN 104 is the Iu PS interface 114, 112.

30

The UP may comprise the application layer and the transport layer for user data.

The CP may comprise a control protocol as application layer and a transport protocol for control data.

5 The interface type of the iNB 107, 108 towards the MSC 103 is the Iu CS interface 110, 109 and the interface type of the iNB 107, 108 towards the RNC 101, 102 is the Iur* interface. The Iur* may be adapted to relocate CS/PS SRNC functionality separately or to proxy the PS functionality. Different possibilities for relocating and/or for proxying may be described
10 in the different exemplary embodiments shown in figures Fig. 2 to Fig. 5. In other words, the Iur* interface may be adapted to relocate the SRNC PS functionality.

The communication system 100 uses an SRNS relocation message
15 for relocating the SRNC. The SRNS relocation message is a message used to control relocating of the SRNC and /or the SRNS. The SRNS relocation message is adapted such that an RNC, a SRNC or a DRNC which receive the SRNS relocation message are relocated to an external RNC. The SRNS relation mes-
20 sage can be exchanged via the Iu-PS interface 114, 111, 113, via the Iu-CS interface 105, 106, 109 or via the Iur* interface 115 ,116, 117. In particular, the relocation message may comprise information or parameter indicating the relocation type, e.g. CS only relocation, CS and PS relocation or PS
25 only relocation. The information can further comprise more detailed information, eg., on network related parameters like user or transport layer information. The information can also comprise more detailed instruction how the remaining SRNS should/will be moved, if needed.

30

The information can be transmitted by parameters added to an existing relocation messages and/or by adding new messages. Iur* interface can include new or modified information about resource sharing, e.g. Codes for HSDPA can be shared, infor-

mation about timing, when PS/CS bearer is not needed anymore. Therefore, the Iur* may allow exchanging such messages.

Thus, a message may be utilized to transport relocation or proxy/relaying information.

Fig. 2 shows a block diagram of an access network according to an exemplary embodiment of the present invention.

10 An iNB 107, 108 and a central RNC 101 can share information about the used resources and about the quality of the used resources. The information may be shared between iNB 107, 108 and RNC 101 via connection 211 or interface 211. Examples for the shared information are information about radio interface
15 parameters, radio interference quality, Uu parameters, RNC_ID, codes for HSDPA can be shared, information about timing or channel quality. The shared information can further include information about which RNC entity SRNC PS 206 or SRNC CS 210 is acting as main SRNC 210. In an example a main
20 SRNC 210 makes for example mobility decisions for that UE 200

The main RNC 210 can be a central RNC 210, since CS voice traffic has higher mobility requirements as PS data. iNB can also send some information about CRNC issues (e.g. cell management), if needed, towards central RNC 210.

A role of PS SRNC in iNB would be rather limited and central RNC would do the main part of SRNC functionalities.

The legacy UE 200 or the PS/CS UE 200 is connected via an air
30 interface 201 to the iNB 107, 108. In particular the UE connection to the iNB 107, 108 comprises a CS user plane connection 205 comprising a CS transport layer connection and a CS application layer connection. The UE connection may addition-

ally comprise a PS user plane connection 205 comprising a PS transport layer connection and a PS application layer connection.

5 Generally, in this document a feature may be described with regard to the user plane. This description may be valid for the PS user plane and/or for the CS user plane. Thus, also the term application connection may relate any of a CS application connection and/or a PS application connection. Furthermore, the general term transport connection may relate to
10 any of a CS transport connection and/or a PS transport connection.

This may also be valid for the control plane accordingly.

The control plane 203 or the signalling connection 203 comprise the transport layer connection for PS signalling traffic
15 and the transport layer connection for CS signalling traffic.

Even if in the figures the control plane is shown as a single connection between iNB 107, 108 and UE 200, this connection 203 may comprise a CS control plane and a PS control plane.
20 The CS control plane may comprise a CS control transport layer connection and a CS control application layer connection. Furthermore, the PS control plane may comprise a PS control transport layer connection and a PS control application layer connection. Different connections may be included
25 in a single connection for example as virtual connections, as virtual paths or as tunnels. Different connections may also be established on different layers, for example on a transport layer and/or on an application layer.

30 The UE connection 202, 205, 203 is connected to a Synchronization Device of CS and PS traffic 204 within the iNB 107, 108. The CS transport layer connection and the PS transport layer connection may be utilized to transport a data stream,

a payload or user data from the UE 200. The data may be differentiated dependent on the traffic type, i.e. CS or PS traffic or data.

5 As the routing of an application layer connection or of the user part may be determined by routing the transport layer connection, in this text, the same reference numerals 202, 205 may be used to show the way through the network, of a user plane, of an application connection and of a transport
10 connection, respectively.

The legacy UE 200 or the PS/CS UE 200 is connected via an air interface 201 to the iNB 107, 108. The UE connection comprises a CS user plane 205 and the CS/PS control plane 203. Furthermore, the UE connection comprises a PS user plane 202.
15 The CS/PS control plane 203 or the control plane 203 may comprise a CS control plane and/or a PS control plane and may be used for controlling the CS user plane and the PS user plane, respectively.

In particular the UE connection to the iNB 107, 108 comprises
20 a PS user plane 202, comprises a CS user plane 205 and a control plane 203 for CS and PS signalling. The UE connection 202, 205, 203 is connected to a Synchronization Device 204 of CS traffic and PS traffic within the iNB 107, 108.

The user plane 202, 205 of the UE connection 202, 205, 203
25 comprises a CS connection 205 and/or a PS connection 202. The PS connection 202 and the CS connection 205 and the control plane 203, which control plane 203 comprises a control plane for CS traffic and a control plane for PS traffic The CS control plane and the PS control plane are used for controlling
30 the same carrier for the CS traffic and the PS traffic or the same bearer, i.e. a shared carrier.

Fig. 2 shows a network scenario with an active CS call 205 on the CS application layer and a deactivated or not activated PS connection 202, 202'. Deactivated may mean that the transport layer connection of the PS user plane 202, 202', 202'' may be routed to the second interface 209 but the PS application layer may be deactivated, i.e. no user data may be sent via the routed PS transport layer connection.

The active CS call may use the active CS user plane connection 205, 205', 205'', 205''', wherein active may mean that the transport layer connection may be routed from the Synchronisation Device 204 to the MSS/MGW 103 and user traffic may be sent over this connection.

The Synchronization functionality 204 or the Synchronization Device 204 may be able to distinguish CS user traffic 205 and PS user traffic 202 and depending on the result of a distinguishing process the corresponding forwarding is issued. In other words, the Synchronisation Device 204 can separate the traffic based on the traffic type.

Thus, the iNB 107, 108 has a CS and PS traffic Synchronization functionality 204 which allows to forward CS traffic to MSC/MSS/MGW 103 and to forward PS user traffic 202 to the SGSN/GGSN (Gateway GPRS Support Node) 104.

Within the Synchronization functionality 204 or the Synchronization Device 204 the CS user traffic 205' and the PS user traffic 202' can be separated. In particular if at least one of a CS connection 205 and a PS connection 202 is inactive, the CS transport connection 205 and the PS transport connection 202 by the Synchronization Device can be routed to different outputs of the Synchronization Device.

The Synchronization Device 204 also separates the control plane traffic 203 associated with the PS traffic 202' and with the CS traffic 205'.

- 5 The PS traffic 202' or the PS connection 202' is routed to the PS Controlling Device 206. The CS traffic 205' or the CS connection 205' is routed to the CS Forwarding Device (DRNC CS) 207.
- 10 The CS Forwarding Device 207 and the PS Controlling Device 206 (SRNC PS) are coordinated using an iNB internal controlling interface 208. Via this controlling interface the SRNS relocation message for SRNS relocation may be exchanged. The SRNS relocation message may comprise, codes for HSDPA such
- 15 that codes for HSDPA can be shared, information about timing, wherein the timing may indicate when PS/CS bearer is not needed anymore, QoS and transport layer information.
- 20 Thus, the iNB 107, 108 comprises an SRNC PS functionality 206 in form of a PS Controlling Device 206, which functionality comprises forwarding of PS user data 202' between UE 200 and SGSN 104. In particular, the PS user data of a pure PS UE (not shown in Fig. 2), the PS user data of a legacy UE or the
- 25 PS user data of a legacy UE 200 with only an active PS connection 202 are forwarded by the SRNC PS 206.

Furthermore, the SRNC PS functionality 206 comprises forwarding of PS signalling 203a', 203a'' between UE 200 and SGSN

30 104. The SRNC PS functionality 206 or the PS controlling Device 206 comprising the SRNC PS functionality 206 furthermore comprises terminating of a RRC (Radio Resource Controller) signalling connection (not shown in Fig. 2) to the UE 200. The termination of CS related signalling, in particular the

termination of a CS transport layer control connection 203b', 203b'' is in the RNC 101.

The control plane connection 203 comprises CS signalling for
5 controlling the CS user plane and PS signalling for controlling PS user plane. The signalling information on an application layer is transported over a control plane transport connection. The signalling information may be separated in the Synchronisation Device 204 or in the RNC 101 which will provide the relevant signalling information to i-NB 107,108.
10

Furthermore, the SRNC PS functionality 206 comprises terminating of a core network connection, received via the Iu PS interface 209. Via the Iu PS interface 209 the PS signalling
15 203a'' or the PS signalling connection 203a' and the PS user data 202'' or the PS user data connection 202'' is transferred to the SGSN 104. The interface 209, the second interface 209 or the Iu PS interface 209 may comprise a connector for linking the iNB and the SGSN/GGSN 104. The PS user plane
20 202'' and/or the PS control plane 203a'' may be transported via the interface 209. In an example, the PS user plane 202'' and/or the PS control plane 203a'' may be transported via a common physical link.

25 The CS Forwarding Device 207 may comprise the DRNC CS functionality 207.

The UE connection 203, 202, 205, even if shown in Fig. 2 as different connections, may be a single connection on a single
30 shared carrier, the connection comprising a plurality of connections 202, 203, 205.

Therefore, in the iNB 107, 108 coordination of the parallel operation of the DRNC CS functionality 207 and the SRNC PS

functionality 206 is made by e.g. sharing of resources or splitting and combining of CS traffic and PS traffic.

The SRNC PS functionality 206 or the PS Controlling Device
5 206 triggers the Iu CS relocation to the RNC 101 by the Iu PS termination point 206, 209 remains in the iNB 107, 108.

In other words, the SRNC PS functionality 206 in the iNB 107,
108 decides when or under which conditions the PS SRNC func-
10 tionality 206 or the PS traffic 202', 202'' remains in the iNB 107, 108.

The SRNC PS 206 functionality also notifies the SRNC CS func-
tionality 210 in the RNC 101 if the SRNC PC functionality 206
15 decides to remain in the iNB and the SRNC PS 206 exchanges necessary parameters with the SRNC CS 210 via the Iur inter-
face 211. For exchanging parameters the SRNC PS 206 and the SRNC CS 210 may exchange messages of a predefined message
format via the Iur interface 211. For example the message is
20 an SRNS relocation message for SRNS relocation. Parameters to be exchanged are e.g., Codes for HSDPA can be shared, information about timing, when PS/CS bearer is not needed anymore, QoS and transport layer information.

25 Common parameters between the RNC functions are also exchanged via the Iur interface 211 using the RNSAP (Radio Network Subsystem Application Part) protocol.

Thus, the SRNC PS 206 or the PS Controlling Device 206 is
30 also coordinated with the SRNC CS 210 or the CS Controlling Device in the RNC 101. Thus, the PS Controlling Device 206 is adapted to exchange coordination information with the SRNC CS 210. The coordination may allow determining when the SRNC PS functionality may have to be relocated to the RNC 101.

The DRNC CS functionality 207 or the CS Forwarding Device 207 in the iNB 107, 108 comprise the functionality of forwarding of CS user data 205, 205', 205'', 205''' between UE 200 and MSC/MSS/MGW 103. Thus, the DRNC CS may allow providing the
5 first interface 212 or the Iur interface 212.

Furthermore the DRNC CS functionality 207 forwards CS signalling 203b', 203b'', 203b''' between UE 200 and MSC/MSS/MGW 103. Additionally the SRNC functionality SRNC CS 210 terminates
10 the RRC signalling connection from the UE 200 in the RNC 101, in particular in the SRNC CS 210. The connection from the UE 200 may be established via the Uu interface 201. The needed information about this RRC connection between UE 200 and SRNC CS 210 is transmitted and/or coordinated between different
15 SRNC functionalities 210, 206 over the Iur interface 211. PS signalling for example is forwarded to SRNC PS 206. The SRNC CS 210 receives substantially all RRC information and transfers, if required, information to the SRNC PS 206 so that UE sees a single RRC termination point, i.e. a collocated SRNC
20 CS 210 and SRNC PS 206.

The layer 2 connection of RRC signalling is terminated in the DRNC in the iNB 107, 108. It is also possible that the SRNC CS 210 communicates with SRNC PS 206 directly via interface
25 211 or indirectly via the DRNC CS 207, i.e. by using the first interface 212 and the internal coordination connection 208.

Furthermore the DRNC CS functionality 207 receives information about active SRNC PS functionality 206 via the internal
30 iNB interface 208 or the internal link 208 in the iNB 107, which SRNC PS functionality 206 relates to the UE 200, in order to allow coordination of SRNC PS functionality 206 and SRNC CS functionality 210.

In other words, Fig. 2 shows a User Equipment 200 connected to the iNB 107, 108 with an active CS call or an active CS connection 205, 205', 205'', 205''' or with a CS call but no active PS data transmission. Thus, Fig. 2 shows the situation
5 until PS user data will be sent via the PS connection 202, 202' and 202''. The PS connection 202, 202', 202'', in particular the PS transport connection, may be routed but no user data may be transported before the user data will be sent. For the active CS connection, no relocation may be re-
10 quired, since the SRNC CS functionality 210 is already located in the RNC 101.

As soon as a UE 200 connects to an iNB 107, 108 a CS connection 205, 205', 205'', 205''' and a PS connection 202, 202',
15 202'', in particular the transport layer connection, will be routed through the access network 107, 108, 101, which in Fig. 2 comprises iNB 107, 108 and RNC 101.

The PS transport connection 202, 202', 202'' is routed to the
20 second interface 209 of the iNB 107, 108 or of the Base Station Apparatus 107, 108 and the CS connection 205, 205', 205'' is routed to the first interface 212 (Iur)

The iNB 107, 108 in Fig. 2 acts also as a Serving RNC 206 for
25 a PS session 202', 202'' independently of the CS session 205, 205', 205'', 205'''. The PS session or the PS connection originates from the same UE 200 as the CS session and the CS session is handed over to the RNC 101.

30 Since the SRNC CS functionality 210 terminates the RRC connection of UE 200 and the SRNC PS functionality 206 communicates with the SRNC CS functionality 210 via connection 211 the RNC 101 knows about the session 202''. However, a PS connection from another UE than UE 200 (not shown in Fig. 2) can

simultaneously be active without influencing the SRNC CS functionality of RNC 101.

Since the PS session or the PS connection 202, 202', 202'' is
5 not simultaneously active with the CS connection from the same UE 200, no relocation to the PS domain is performed. In other words, the SRNC PS functionality 206 can be active inside the iNB and may have not to be transferred or relocated to the RNC 101.

10 Since the SRNC PS functionality or the PS Controlling Device 206 is located inside the iNB 107, 108, the iNB may be more intelligent than it must be. Furthermore, the Iu PS interface 209 may be provided directly at the iNB 107, 108.

15 The iNB 107, 108 may not have to handle a PS connection from the UE 200, where the CS connection 203b', 203b'', 203b''' originates from, since the PS connection may not be active. As however, in Fig. 2 the CS connection is active, in the iNB
20 the DRNC CS functionality forwards the CS session 205', 205'', 205''' to the RNC 101 and simultaneously with the SRNC PS functionality 206 the iNB 107, 108 can act as a PS Serving RNC 206 for PS only traffic or other PS traffic from another source than the source 200.

25 Even if the SRNC PS functionality 206 may be deactivated and the PS connection 202, in particular the PS user part, from the UE 200 may also be deactivated, the iNB 107, 108 can maintain the Iu connection or the Iu interface 209 between iNB 107, 108 and an SGSN 104 in the iNB 107, 108. However, no
30 relocation of the SRNC PS functionality 206 to the RNC 101, i.e. to the PS CN has to be performed, which could reduce the performance of the PS CN.

If UE 200 is connected to the SGSN 104, i.e. if a Radio Access bearer and Iu control connection 203a, 203a', 203a'' using the Iu interface 209 for the UE 200 exists, and if there is substantially no user data sent for a while via the PS user connection 202, 202', 202'', the UE 200 can fall to a URA_PCH state (UTRAN Registration Area Paging Channel) or to CELL_PCH state (Cell Paging Channel) from Cell_DCH/Cell_FACH state or mode (Cell Dedicated Channel State/Cell Forward Access Channel). During the UE 200 is in one of these modes, Iu connection to SGSN is kept. In particular, the transport connection of a PS user plane may be maintained.

If the UE 200 makes a CS call, the iNB 107, 108 can keep the SRNC PS functionality 206 in the iNB 107, 108 until the PS connection 202, 202', 202'' will become active, i.e. until PS user data may have to be sent from the UE 200 or received by the UE 200. Therefore, since a UE supporting CS and PS connections at the same time may not need to send PS data while a CS connection is active, in many cases a relocation of the SRNC PS functionality 206 may be prevented during a CS call is active. For supporting a CS call and for preventing relocating of SRNC functionality, an SRNC CS functionality 210 may substantially permanently be installed in the RNC 101 and a DRNC CS functionality 207 may be permanently installed in the iNB 107, 108.

Therefore, the Iu connection, in particular the Iu-PS connection 203a'', 202'' via the Iu-PS interface 209 can be maintained between iNB 107, 108 and SGSN 104. Thus, no relocation of the SRNC PS functionality to the PS CN has to be performed. An SRNC PS relocation may only have to be performed if a radio bearer needs to be created for PS calls, i.e. if a shared carrier for CS calls and PS calls originating from the

same source 200 or destined to the same destination 200 will appear.

Fig. 3 shows a block diagram of an access network with a simultaneously active CS call and PS call according to an exemplary embodiment of the present invention.

Fig. 3 shows the UE 200, the CS/PS UE 200 or the legacy UE 200 having the PS connection 302 and the CS connection 305 and the signalling connection for CS and PS traffic 303.

The situation shown in Fig. 3 is an active CS call or an active CS connection 305, 305', 305'' and 305''' and PS data which is intended to be sent.

When the PS data will be sent during the CS connection 305, 305', 305'', 305''' is active, a collocation of the SRNC PS functionality 206 to the RNC 101 has to be conducted. The SRNC CS&PS functionality 310 comprises the SRNC CS 210 and the SRNC PS functionality 206 which has been relocated.

Also the DRNC CS&PS 307 comprises the DRNC CS 207 and a DRNC PS functionality specific for PS traffic. The role of a drift RNS may be a role an RNS can take with respect to a specific connection between an UE 200 and UTRAN. The DRNC supports the Serving RNS 206, 310 with radio resources when the connection between the UTRAN and the UE 200 need to use a cell or a plurality of cells controlled by this RNS.

The remaining SRNC PS functionality 206 will be relocated to RNC 101. Thus, Fig. 3 shows the situation, after the SRNC PS have been relocated to the RNC 101. The SRNC PS 206 in Fig. 3 is shown in the iNB only for a better understanding of the relocation process. The SRNC PS 206 may be completely relo-

cated to the RNC 101 or the SRNC PS may be switched off during the SRNC CS&PS 310 is active.

Also CS related signalling which is included in the user
5 plane traffic 303, 303', 303'' is terminated in the RNC 101, in particular in the SRNC CS&PS functionality 310.

The remaining SRNC PS 206 further comprises terminating of a core network connection Iu PS 202'' When SRNC of CS/PS, i.e.
10 SRNC CS&PS 310 is located in the RNC 101 the connection 202'' to iNB 107 is not anymore active. Furthermore the SRNC PS functionality 206 receives information about active CS calls of UEs 200 in the iNB 107, 108 coverage, i.e. within the cell generated by the iNB or within the cell administered of the
15 iNB 107, 108.

Furthermore, the SRNC PS functionality 206 has the capability to detect when PS traffic needs to be transferred, e.g. the SRNC PS functionality 206 detects PS user data received from
20 the core network 104 via connection 202'' or on UE request 200, during a CS call 305, 305', 305'', 305'''.

The SRNC PS 206 detects a UE 200 request, for example the SRNC PS 206 detects that data needs to be sent and/or received or provided. A data transmission may also be detected
25 based on the amount of traffic that is sent via a PS user part. Furthermore the SRNC PS 206 is capable to trigger the Iu PS relocation of the Iu PS interface 209 to the corresponding RNC 101 to the Iu PS interface 209', without interrupting of the CS call 305, 305', 305'', 305''', when PS
30 traffic 302, 302', 302'', 302''' needs to be sent to/from UE 200 during an active CS call.

The CS connection is provided to the CS CN 103 via the Iu CS interface 213. Therefore, the MSS/MGW 103 may still be connected to the same interface 213.

5 Therefore, if a deactivated PS connection 202, 202', 202'' as of Fig. 2 will be activated and either the UE 200 or the network 104 intends to send PS data, 302, 302', 302'', 302''', the SRNC PS functionality 206 or the CS Controlling Device 207 is relocated to the RNC 101 to form the SRNC CS&PS func-
10 tionality 310 or the SRNC CS&PS Controlling Device 310 within the RNC 101. By doing this, the SRNC CS and the SRNC PS 310 are collocated during the time that simultaneously CS connection 305, 305', 305'', 305''' and a PS connection 302, 302', 302'' and 302''' are activated.

15

Fig. 4 shows a further block diagram of an access network for a mobile communication network according to an exemplary embodiment of the present invention.

20 Again, the UE 200 is connected to the iNB 107, 108 with an UE connection comprising the CS control plane 403 and PS control plane 403, the PS user plane 402 and the CS user plane 405. The UE connection 402, 403, 405 is connected to the Synchronization Device of CS traffic & PS traffic 204. The Synchronization Device 204 splits the CS and PS control plane 403 in
25 a separate CS and PS signalling connection 403', in the CS user plane 405' which is as well as the control plane 403' connected to the DRNC CS & PS 407. The CS and PS signalling connection 403' carries signalling traffic for the CS user
30 plane 405, 405', 405'', 405''' and for the PS user plane 402, 402'.

The PS user plane 402 is extracted from the UE connection 402, 403, 405 into a separate PS user plane 402' which leaves

the iNB 107, 108 at the Iu interface 209. The PS user traffic 402 leaves the iNB 107, 108 at Iu interfaces towards SGSN 104 and if a so called direct tunnel is used then the PS user traffic leaves the iNB 107, 108 via a Gn interface. The separate PS plane 402' is connected to the SGSN/GGSN 104 and bypasses the RNC 101. The Iu interface 209, in particular the Iu PS interface 209, may be substantially always provided for connecting the SGSN/GGSN 104.

The control plane 403' or the control stream 403' and the CS user plane 405' carrying the CS user traffic are connected via the DRNC CS&PS 407 to the SRNC CS&PS 410 in the RNC 101. The CS user traffic 405' is connected to the SRNC CS&PS functionality 410 as CS user data stream 405'', as CS traffic 405'' or as connection 405''.

The SRNC CS&PS 410 splits the control traffic such, that the CS control traffic of the CS control plane 403b''' can be connected to the MSS/MSC/MGW 103.

The PS control plane 403a''' associated with the PS user plane 402', is connected to the SGSN 104.

Thus, the control connection 403', 403, 403'', 403a''' can be seen as a Channel Associated Signalling (CAS) for the PS user connection 402', whereas the CS user connection 405, 405', 405'', 405''' and the CS signalling connection 403, 403', 403'' and 403b''' use the same path through the network which can be seen as a Common Channel Signalling (CCS).

In Fig. 4 the SRNC 410 is the signalling anchor to hide an enormous number of iNBs. The RNC 101 comprising the SRNC 410 thus may be used as a concentrator to collect a plurality of iNBs 107, 108 in order to support the CN 103, 104 such, that the CN 103, 104 may not have to administrate a large plural-

ity of iNBs 107, 108. However, the PS user data in particular for a PS only UE which is not shown in Fig. 4 may be directly connected to the SGSN 104.

- 5 The iNB 107, 108 has the functionality comprising CS&PS control of always passing the CS&PS control plane 403a''', 403b''' through the RNC 403, 403', 403'', 403b''', 403a'''. Furthermore inside the iNB 107, 108 the CS user traffic 405', 405'', 405''' and the PS user traffic 402' is split or separated.
- 10 Furthermore the iNB 107, 108 is adapted to configure the direct PS user pass 402' between the iNB 107, 108 and the SGSN/GGSN 104, thus providing the PS user traffic on the Iu PS interface 209.
- 15 Furthermore the iNB 107, 108 is adapted for forwarding the PS user data, the PS user traffic or the PS user stream of the PS user plane 402' between UE 200 and SGSN 104 bypassing the RNC 101. Furthermore the user data is forwarded by iNB 107, 108 during the UE 200 changes a cell or a handover of UE 200.
- 20 When user equipment 200 having a user data transport ongoing, i.e. having an active user connection, moves towards the edge of the cell border the UE 200 may request the iNB 107 and/or the RNC 101 to change to a better cell, i.e. UE based handover. A better cell may be a cell providing better conditions
- 25 for the UE 200. Alternatively, if the UE 200 moves towards the edge of the cell border, iNB 107 and/or RNC 101 decides that serving cell is changed from iNB to another iNB, i.e. network based handover.
- 30 If the iNB 107, 108 will be changed the Source iNB triggers a SRNS relocation procedure to CN in order to relocate UE to a cell having better coverage by sending relocation request to the CN.

The SRNC CS&PS 410 in the RNC 101 comprises the functionality of the CS&PS control plane 403', 403b''', 403a''' always passing the RNC 101. The SRNC 410 is further adapted to configure the direct PS user data path 402' between iNB 107, 108 and SGSN/GGSN 104. This means that in this use case the RNC 101 has the control plane connection 403'', but the user plane connection 402', e.g. a GTP-U tunnel (GPRS Tunnel Protocol), is established between the iNB 101 and SGSN/GGSN 104 directly. During the RAB establishment towards the UE 200 the RNC 101 is able to find out that a user is located in iNB and the RNC provides as a response to a request from the SGSN the IP address of the iNB user plane. SGSN 104 updates this IP address and a GTP tunnel is established directly from iNB to GGSN 104.

Furthermore the SRNC CS&PS 410 has a functionality of reconfiguring and/or updating the user plane IP address upon the iNB 107, 108 change of UE in SGSN. For reconfiguring and/or updating the user plane IP address the RANAP (Radio Access Network Application Part) procedure may be utilized. The RNC may not be able to modify an IP address when the iNB changes. Thus, a modified procedure may be needed.

A RANAP procedure may be utilised in the application layer of a control plane.

A new or modified RANAP procedure may be used. The RAB modification request message may be used for exchanging controlling information e.g., new transport layer parameters (eg., user plane address) to the core network when user moves from the coverage area of iNB 107 to coverage area of iNB 108. After relocation is performed from source iNB 107 to the destination iNB 108 the SRNC functionality 410 may update the transport layer parameters to the SGSN 104 by sending a new

or modified RAB modify request message including the changed user plane IP address and TEID among other information e.g., QoS parameters. During this relocation procedure suggested in this text the control plane address may be kept or maintained
5 as the SRNC functionality 210, 310, 410, 510 is not relocated, instead it may be anchored to 101 or 107 or 108. The request may be sent from the iNB 107,108 or from SRNC PS&CS 410 to the SGSN/GGSN 104 and can use connection oriented signalling. The RAB modification request comprises additional
10 user identifiers, network and/or transport layer parameters eg P-TMSI (Packet-Temporary Mobile Subscriber Identity), TEID (Tunnel Endpoint Identifier), transport address of the new i-NB, QoS related parameters. The TEID is used to multiplex different connections in the same GTP tunnel.

15 The SGSN/GGSN 104 will acknowledge the request with the RAB modification Acknowledge message comprising confirmed parameter values to be used in new i-NB.

Fig. 5 shows a further block diagram of the access network
20 comprising an iNB 107, 108 with proxying functionality and an RNC 101 according to an exemplary embodiment of the present invention.

The CS/PS UE 200 uses the UE connection 502, 503, 505 for
25 connecting to the iNB 107, 108. The UE connection comprises the CS and PS control plane 503, the PS user plane 502 and the CS user plane 505. The UE connection 502, 503, 505 is connected to the Synchronization Device 204 which is adapted to split the signalling connection 503 or control plane 503
30 and the user plane 502, 505 such, that the CS signalling connection 503b' and the CS user plane 505' can be connected to the DRNC CS 507 or to the CS Forwarding Device 507.

The UE connection 502, 503, 505 is furthermore separated by the Synchronization Device 204, such that the PS signalling connection 503a' or the PS control plane 503a' and the PS user plane 502' are separated and connected to the DRNC PS 506. Via an Iur interface the PS control plane 503a''' is connected to the SRNC PS CP 511 (control plane) or to the SRNC PS CP Device or the SRNC PS CP functionality. The PS control plane 503a''''' is connected to the SRNC PS Proxy 506 in the iNB 107, 108 via a further Iur interface. Via the second interface 209 or Iu PS interface 209 the PS control plane 503a'' is connected to the SGSN/GGSN 104.

The DRNC PS 506' or the PS Forwarding Device 506' and the SRNC PS Proxy 506 or the PS Controlling Device 506 are adapted to proxy the PS signalling connection 503a', 503a''', 503a''''', 503a'' to the SRNC PS CP 511. Thus, as indicated by the dotted line 503a''''' the PS signalling is proxied to the SRNC PS CP (Control Part) 511 and proxied back to the SRNC PS 506.

Proxying the signalling connection 503a''' may allow for virtually collocating SRNC CS 510 and SRNC PS CP 511 in the RNC 101. In other words, the PS control plane 503a''' may be proxied to the RNC where the PS control plane 503a''', 503a'''''' can be collocated with the SRNC CS 510 carrying the CS control plane 503b', 503b'''.

Proxying may include forwarding and address translating. Usually relaying may mean forwarding without modifying the information. In the context of this text relaying may also include address translation.

Contrary to the PS control plane, the PS user plane 502', 502''', 502'' is kept inside the iNB 107, 108. The PS user

plane 502' is routed from the Synchronisation Device 204 to the DRNC PS 506' and the PS user plane 502''' is routed from the DRNC PS 506' to the SRNC PS Proxy 506. Together with the PS control plane 503a'' the PS user plane 502'' is connected
5 to the SGSN/GGSN 104 via Iu PS interface 209.

Also in an example the PS user plane 502', 502''', 502'' is forwarded to the RNC 101 and then the PS user plane is forwarded back to the iNB 107, 108, in particular to the PS Relay 506 or back to the iNB 107, 108, in particular to the PS Proxy 506 for some reason. However, when heavy PS traffic exists forwarding the PS user plane to the RNC 101 and then back to the iNB may be prevented. In an example the CN may always prefer forwarding so that relocation may not be
15 needed.

From the SRNC PS Proxy 506 the PS signalling connection 503a'' carrying the signalling information is connected to the SGSN 104 and as well the PS user connection 502'' is connected to the SGSN 104. Thus, at the Base Station Apparatus 107, 108 or at the iNB 107, 108 the Iu PS interface 209 can be provided, e.g. as a second interface 209.
20

The CS signalling connection 503b'''' or the CS control plane 503b'''' is connected via the DRNC CS 507 and the CS signalling connection 503b'' to the SRNC CS functionality 510 or to the CS Controlling Device SRNC CS 510 in the RNC 101. Via the Iur interface 512 the SRNC CS 510 and the SRNC PS CP 511 are coordinated one with another.
25

30

Thus, by proxying the signalling connection 503a''' to the RNC 101 and reverse proxying the signalling connection 503a'''' to the SRNC PS Proxy 506, a coordination between SRNC CS 510 and SRNC PS CP 511 within or inside the RNC 101

can be reached without relocating the complete SRNC PS 506 into the RNC 101. In other words, by proxying the SRNC PS 506 into the RNC 101 a virtual relocation may be conducted and SRNC CS 510 and SRNC PS CP 511 are collocated in a case that
5 the UE 200 simultaneously sends PS traffic and CS traffic.

Proxying may also mean that the SRNC PS Relay 506 or the SRNC PS Proxy 506 work as a proxy.

10 At the RNC 101 the Iu CS interface 513 can be utilized to connect to the MSS/MSC/MGW 103, i.e. to the CS core network 103. In the iNB, the CS connection 505'' is provided at the first Iur interface 212. The CS user connection 503b''' or the user plane 503b''' is forwarded from the DRNC CS 507 as
15 user connection 505'' to the SRNC CS 510 and to the MSS 103 as the user connection 505'''.

The CS signalling connection 503a'''' is forwarded from the DRNC CS 507 as signalling connection 503b'' via the SRNC CS
20 510 and the signalling connection 503b''' to the CS core 103 or to the MSS/MSC/MGW 103.

Thus, the serving RNC functionality SRNC PS 511 is "virtually" handed over to the RNC 101 but the RNC 101 may allow
25 the iNB 107, 108 to keep the PS user plane (u-plane) 502', 502'', 502''' end point. A user plane endpoint is a GTP-U tunnel end point i.e. the IP address of the iNB GTP U tunnel endpoint. The iNB GTP-U tunnel endpoint may be defined during RAB establishment and may be needed to be able to transport
30 user data between iNB 107, 108 and CN 103, 104. Therefore, the u-plane end points may be fixed, which means that the u-plane end point may not need to be updated in the core network (in SGSN/GGSN).

Also the iNB 107, 108 may be able to forward any PS core related signalling 503a''''', 503, 503a', 503a'', 503a''', 503a'''''' between the RNC 101 and the SGSN 104. The SGSN 104 may not need to know that the serving RNC SRNC CP 506 has
5 changed. When a CS call is made and SRNC PS CP 511 is created to RNC, but SRNC PS CP 511 actually communicates with the SGSN 104 via the SRNC PS Proxy 506 in the iNB 107, 108. Therefore the SGSN sees the same endpoint the "SRNC PS proxy" via Iu PS interface 209 substantially all the time. Thus, the
10 SGSN 104 may believe that the iNB 107, 108 still act as the Serving RNC 511. However, the SRNC PS 506, 511 and/or the DRNC PS 506' is split in an SRNC PS Proxy portion 506 and in an SRNC PS CP (control plane) portion 511 wherein the SRNC PS CP 511 may conduct the control functionality of the SRNC 511.

15 The SRNC PS CP 511 provides SRNC PS CP functions and SRNC functions at the same time by the SRNC PS Proxy 506 just acting as proxy. For the PS control plane (C-plane) the DRNC PS 506' is added to the DRNC CS 507.

20 Thus, the SGSN 104 may believe that the iNB 107, 108 may be the Serving RNC 506, 511. The DRNC CS 507 or DRNC PS 506' may not be visible to SGSN/GGSN 104 at the same time the Serving RNC may be visible to SGSN/GGSN 104. In other words, by
25 proxying a signalling connection to the RNC a virtual relocation of the PS Controlling Device 506, 511 may be achieved which allows the iNB 107, 108 to act like an iNB having a complete SRNC PS functionality as for example shown in Fig. 2.

30 The SRNC PS Relay/Proxy 506 may work as a proxy. Thus, the RNC 101, in particular the SRNC PS C CP 511 in the direction to the SRNC PS Relay 506 sees a SGSN. In an example the SRNC PS Proxy 506 may appear as a SGSN.

The SGSN 104, in the direction of the SRNC PS Relay/Proxy 506 sees a RNC.

By amending addresses, the SRNC PS Relay 506 or the SRNC PS Proxy may be able to play the role of the peer of a network node, e.g. the RNC 101 and/or the SGSN 104, which the respective peer expects.

In an example the SRNC PS Proxy 506 may act as a GTP proxy hiding the change of the SRNC PS CP location from the SGSN/GGSN 104. Proxy may forward messages to from SGSN/GGSN 104 from/to SRNC PS CP 511. Proxy may modify source/destination addresses so that peer nodes discussing to each other or communicating with one another may not notice if other peer changes. Proxy may operate state full or stateless manner.

The Iu connection 502'' is maintained between the iNB 107, 108 and the SGSN 209. And substantially no relocation of the SRNC PS to the PS CN 104 may have to be performed.

Thus, the iNB 107, 108 has a CS&PS traffic Synchronization functionality or a Synchronization Device 204 which may be adapted to be able to distinguish between CS and PS user traffic. Furthermore the Synchronization Device 204 or the Synchronization functionality 204 may be adapted for forwarding a CS portion of the user equipment connection to the MSC/MGW/MSS 103 or a PS portion of the user equipment connection to the PS core SGSN/GGSN 104. The decision on the forwarding within the Synchronization Device 204 may depend on the result of the type of an active connection. In other words, an active CS connection, an active CS application layer or CS traffic on the CS connection 505, 505', 505'', 505''' may be routed to the CS core 103. A PS connection 502,

502', 502''', 502'' of the UE 200 may be directed or routed by the Synchronization Device 204 to the PS core 104.

By utilizing the SRNC PS proxy device 506 the iNB 107, 108
5 comprises a SRNC PS proxy functionality 506. The SRNC PS proxy functionality 506 may terminate a core network connection received via the Iu PS interface 209. A termination is the endpoint with which another end device communicates. The relevance for signalling termination may be that a core network or a CN may not see an SRNS relocation or SRNC relocation.
10 The core network continues to communicate with the original signalling termination point, such that the core network sees only this proxy functionality 506. Thus, the core or the SGSN/GGSN 104 has a fixed endpoint with the proxy
15 functionality 506.

Furthermore the iNB 107, 108 may be adapted to forward CS RRC signalling 503 from the UE 200 to the RNC 101 via control plane 503b', 503b'', 503b''', 503b''''.

20

The iNB 107 may further be adapted to forward a PS signalling 503a', 503a'', 503a''', 503a'''', 503a''''' to the RNC 101, when the PS signalling is received from the SGSN 104 or from the UE 200, wherein the RNC 101 may comprise the SRNC PS CP
25 (Control Plane) functionality 511. In particular the PS signalling may be forwarded or proxied to the RNC 101 when during a CS user connection 505', 505'', 505''' is active a PS user traffic 502', 502'' appears on the PS user plane.

30 Generally it may be the same situation if during a CS user plane is active a PS user plane is activate or if during a PS user plane is active a CS user plane is active. In both cases a shared carrier for the CS traffic and for the PS traffic has to be provided to the UE 200.

Furthermore the iNB 107, 108 may be adapted to forward PS signalling traffic 503a', 503a'', 503a''', 503a'''' from the RNC 101 to the UE 200 or to the SGSN 104.

- 5 The iNB may further be adapted to switch between an SRNC PS operation mode and an iNB proxy mode. In the proxy mode, the PS control plane is diverted or proxied to the SRNC PS CP 511 in the RNC 101.
- 10 In the SRNC PS operation mode the PS control plane is directly forwarded between DRNC PS 506' and SRNC PS Proxy 506 without diverting the PS control plane to the SRNC PS CP. In the SRNC PS operation mode the SRNC Proxy 506 is acting like a SRNC PS and not as SRNC PS proxy.

15

- The iNB may enter the iNB proxy mode, when PS traffic 502', 502'' needs to be exchanged between the UE 200 and the PS core 104 during a CS call 505', 505'', 505''' is active or during a CS call is established. Therefore, the iNB proxy
- 20 mode is a mode, in which the SRNC PS 506 decisions are outsourced to the RNC 101, in particular to the SRNC PS CP 511, and wherein the decisions are executed in the iNB 107, 108. In other words, the SRNC PS 506, 506', 511 may be distributed to the iNB 107, 108 and to the RNC 101 or a portion of the
- 25 SRNC PS 506, 511 may be located inside the iNB 107, 108 and another portion (management portion) which manages the interworking between both parts, i.e. between the SRNC PS 506 and SRNC PS CP 511. This management portion is not shown in
- Fig.5. In the mode (proxy mode), shown in Fig. 5 the proxy
- 30 506 is exchanging or translating the source address and the target addresses of the signalling messages forwarded to the SRNC PS CP 511 or to SGSN 104 to hide the actual SRNC PS location for the RNC 101 and for the SGSN/GGSN 104. SGSN should keep current PS connection, i.e. the connection via interface

209 can be maintained. In other words, a PS Controlling Device may be split into a SRNC PS Proxying Device 506, DRNC PS Device 506' and into a SRNC PS control plane device 511.

- 5 Functionality can be further improved in Proxy mode by allowing SRNC PS (in RNC 101) to send user data directly to SGSN/GGSN 104. This may be possible if receiving GTP entity trust source node. Receiving entity may just identify TEID and allow data transfer.
- 10 Also downlink direction (from SGSN 104 to RNC 101 or iNB 107, 108) can be improved so that user data is not sent via SRNC PS Proxy 506, but it is sent directly to SRNC PS 511 in RNC 101. This can be done by updating GTP-U address to the CN 104 for example by using the RAB Modify Request message when SRNC
- 15 PS 511 functionality is established in RNC 101. When RNC 101 GTP-U address and TEID is updated to SGSN/GGSN 104 the downlink user plane traffic is routed directly to RNC 101 without passing the iNB 107, 108 prior to passing the RNC. Necessary functionalities such as proxying may then be done
- 20 to the user plane or to the user plane traffic and it can be sent to UE 200 via iNB 107, 108 or BTS 107, 108.

One alternative is to send DL (downlink) the user plane or user plane traffic to SRNC PS 506 (in 107 or 108), but not to

25 transfer it via RNC 101 to UE. In this alternative iNB 107 or 108 may be responsible to prepare user plane to a format in which it may be transmitted to the UE.

When the iNB 107, 108 is in the iNB proxy mode, the iNB 107,

30 108 requests the RNC 101 to set up a PS data path 502, 502', 502'', 502''' via the iNB 107, 108 PS user plane 503a', 503a'', 503a''', 503a''''', 503a'''. In particular the SRNC PS functionality 506 requests a SRNC PS CP functionality 511 to set up a PS data path 502', 502, 502'', 502''' or a PS user plane

502, 502', 502'', 502'''. The DRNC PS 506' may terminates layer 2 signalling connection towards UE 200.

In the iNB proxy mode the iNB 107, 108 set up a PS data path
5 502, 502', 502'' between the UE 200 and the SGSN 104 based on a reply from the RNC 101. In other words, that means when RAB is established and/or modified the RNC 101 informs the iNB 107, 108 and the RNC 101 prepares a GTP-U tunnel to be able to send and receive data to/from SGSN/GGSN 104. The idea may
10 be again that the proxy 506 may cancel the need to relocate and reduces core load. In the iNB 107, 108 proxy mode, PS user data 502, 502', 502'' may be forwarded between UE 200 and SGSN 104.

15 The iNB 107, 108 leaves the iNB proxy mode for PS user traffic, when an allocated CS resource is released by the RNC 101, then the control of the PS serving functionality 206 is relocated back to the iNB. Another reason to leave the PS proxying mode may be when PS application layer connection is
20 removed, e.g. due inactivity or user removes the PS attachment to the core network.

In other words, when a CS application layer connection 505, 505', 505'', 505''' is deactivated also proxying of PS signalling 503a'''' to the RNC may be deactivated. The SRNC PS
25 CP functionality 511 may only be activated in order to provide a shared carrier to the UE connection for UE 200 when CS traffic and PS traffic has to be transferred simultaneously. In a case where only CS traffic or only PS traffic has to be
30 transferred between UE and SGSN 104 and/or UE and MSS 103, the SRNC PS CP functionality 511 within the RNC 101 may be deactivated and SRNC PS proxy functionality 506 in the iNB 107, 108 may be deactivated and complete SRNC PS functionality 506 may be activated within the iNB 107, 108 by leaving

the proxy mode. Thus, also in this example of Fig. 5 a CS Controlling Device 510 and a PS Controlling Device 511 are collocated during simultaneously a CS connection 503b'''' and a PS connection 503a'''' from a common UE 200 is active.

5

In another example, if the UE 200 has an Iu connection to the SGSN 104 but no RAB is established, this means, that only a transport connection between the UE 200 to the SGSN 104 is established (e.g. a PDP context) or routed but substantially
10 no user data is transferred via this connection.

Another alternative is that RAB is established, but user data transfer is not active. Thus, when substantially no data is sent for a while or for a predefined duration over the connection, the UE 200 may be moved to a URA_PCH mode or to a CELL_PCH mode. During at least one of the URA_PCH mode and the CELL_PCH mode the Iu connection or a PS connection to the SGSN 104 is kept, maintained or routed, however no user data is sent via this connection.

20

If the UE 200 makes a CS call on application layer, the Iu connection 502''', 502'', 502', 502 to the SGSN 104 could be released to avoid SRNC relocation. This means that if iNB determines that a user having a RAB is inactive there may not
25 be a need to relocate the PS connection to the RNC. Instead Iu connection can simply be released on the source side. When SRNS relocation for CS due to CS call of a UE 200 to the RNC 101 is conducted the RNC 101 can perform simpler location update of the CN (Routing Area update (RAU) to the SGSN) Or
30 else if RAU is not changed (i.e. UE located in same URA (UTRAN Routing Area) no procedure to the SGSN is required as SGSN knows that the UE is located in URA. If RA Update (RAU) is not performed the SRNC PS proxy functionality in 107 or 108 may be able to receive paging request from CN 104 and is

able to deliver the paging request to UE 200. When UE 200 responds to paging the connection may be established between iNB (107 or 108) and CN 104. GTP-U tunnel may be established between RNC 101 and SGSN/GGSN 104 as well if CS call was active as described above.

Thus, a CS call 505, 505', 505'', 505''' may substantially not affect the PS core 104 since relocation may be prevented. SGSN 104 CPU power could be saved for other processing or a processing load may be reduced.

A user plane may substantially not be affected and an end user may realize a quicker handover or a quicker establishing of a connection since no relocation or reduced number of relocation may be needed. In other words if the UE 200 is inactive and if the UE 200 is not sending/receiving any data, there was no effect since there was no data, the UE can be moved to IDLE mode a bit earlier. In an aspect of the invention the PS domain is released before relocation, i.e. the PS part is released if UE has been PS inactive (no PS traffic was sent on application layer) already e.g. 67% of the inactivity timer value. It means that if a user has not been sending and/or receiving data for some time (e.g. user stopped a browsing application on the application layer), the data bearer or PS bearer can be removed. The inactivity timer may be a timer after whose expiration the UE 200 enters the IDLE mode. Thus, the inactivity timer value may be reduced. This may reduce the probability that the CS traffic of the UE 200 becomes active during the UE may not be IDLE.

30

The RNC 101 functionality may be adapted such that the RNC 101 or the iNB 107, 108 may handover to the SGSN 104 or to the UE 200 that there may exist two logical entities 506, 511 (RNC and SRNC PS) by splitting the PS Controlling Device 506, 511.

In other words, one PS Controlling Device 506, 511 may be split into two logical entities 506, 511.

5 The Base Station Apparatus or the Controlling Apparatus may be realized as an I-HSPA adapter, i.e. as an RNC functionality inside a BTS. The carrier sharing may be used in the evolved UTRAN.

10 Fig. 6 shows a block diagram of a Base Station Apparatus according to an exemplary embodiment of the present invention.

The Base Station Apparatus 107, 108 comprises the Synchronisation Device 204, the CS Forwarding Device 207 and the PS Controlling device 206. The Synchronisation Device 107, 108
15 comprises the input interface 600, which can be an air interface, for connecting a UE (not shown in Fig. 6) to the Base Station Apparatus 107, 108.

The Synchronisation Device 204 is adapted to receive, to send
20 or to provide a User Equipment connection comprising a CS user plane and a PS user plane via the input interface 600.

During a PS connection, in particular a transport connection of the PS user plane, of the UE connection is deactivated,
25 the Synchronisation Device 204 is able to route the CS user plane to the first interface 212 and the Synchronisation Device 204 is able to route the PS user plane to the second interface 209.

30 The CS user plane is routed via the CS Forwarding Device 207, which is connected to the Synchronisation Device 204 and the first interface 212.

The PS user plane is routed via the PS Controlling Device 206, which is connected to the Synchronisation Device 204 and the second interface 209.

- 5 Fig. 7 shows a block diagram of a Controlling Apparatus according to an exemplary embodiment of the present invention.

The Controlling Apparatus 101 comprises the CS Controlling Device 701 and the PS Controlling Device 702.

10

The CS Controlling Device 701 is connected to the CS input interface 703 and to the CS output interface 705. The CS output interface 705 is adapted for connecting a CS CN (core network), which is not shown in Fig. 7.

15

The PS Controlling Device 702 is connected to the PS input interface 704 and the PS output interface 706. The PS output interface 706 is adapted for connecting a PS CN (core network), which is not shown in Fig. 7.

20

The CS Controlling Device 701 and the PS Controlling Device 702 can be coordinated using the coordination connection 700. The CS Controlling Device and the PS Controlling Device 702 can be included in a single device or can be combined in a
25 single device.

- Fig. 8 shows a flow diagram for a method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus according to an exemplary embodiment of the present invention.
30

The method starts in starting point S 800.

In step S801 a User Equipment connection comprising a CS connection and a PS connection is received in the Base Station Apparatus.

- 5 Step S802 comprises routing the CS connection to the first interface during the PS connection is deactivated and step S803 comprises routing the PS connection, in particular a transport layer connection of a PS user part, to the second interface during the PS connection is deactivated.

10

In step S804 an idle state is reached.

Fig. 9 shows a flow diagram of a method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus according to an exemplary embodiment of the present invention.

15

The method starts in starting state S900.

- 20 Step S901 comprises separating a CS Controlling Device and a PS Controlling Device in the Controlling Apparatus and step S902 comprises deactivating at least one portion of the PS Controlling Device in the Controlling Device during the PS connection in the Base Station Apparatus is deactivated.

25

In step S903, an idle state is reached.

Fig. 10 shows a flow diagram of a further method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus according to an exemplary embodiment of the present invention.

30

The method starts in the starting state S1000.

The step S1001 comprises controlling the CS connection of the Base Station Apparatus with a CS Controlling Device.

5 The step S 1002 comprises controlling the PS connection of the Base Station Apparatus with a PS Controlling Device, wherein the PS connection is bypassing the Controlling Apparatus.

In step S 1003 an idle state is reached.

10

It should be noted that the term "comprising" does not exclude other elements or steps and the "a" or "an" does not exclude a plurality. Also elements described in association with different embodiments may be combined.

15

It should also be noted that reference signs in the claims shall not be construed as limiting the scope of the claims.

20

25

30

Acronyms and Terminology

	3GPP -	Third Generation Partnership Project
	CN -	core network
5	CS -	circuit switched
	HSDPA -	High-Speed Downlink Packet Access
	HSUPA -	High-Speed Downlink Packet Access
	IE -	Information Element
	I-HSPA -	Internet High Speed Packet Access
10	PDU -	Protocol Data Unit
	PS -	packet switched
	RANAP -	Radio Access Network Application Part
	RNC -	Radio Network Controller
	RRC -	Radio Resource Control
15	SRNS -	Serving Radio Network Subsystem
	RNS -	Radio Network Subsystem
	WCDMA -	Wideband Code Division Multiple Access
	UE -	User Equipment

Patent claims

1. A Base Station Apparatus (107, 108), comprising:

a Synchronisation Device (204);

5 a first interface (212);

a second interface (209);

wherein the Synchronisation Device (204) is adapted to receive a User Equipment connection (202, 203, 205) comprising a CS connection (205, 305, 405, 505) and a PS connection
10 (202, 302, 402, 502);

wherein, during the PS connection (202, 202', 202'') is deactivated, the Synchronisation Device (204) is able to route the CS connection (205) to the first interface (212); and

15 wherein, during the PS connection (202, 202', 202'') is deactivated, the Synchronisation Device (204) is able to route the PS connection (202) to the second interface (209).

20 2. The Base Station Apparatus (107, 108) of claim 1, further comprising:

a CS Forwarding Device (207);

wherein the CS Forwarding Device (207) is adapted to forward CS information of the CS connection to the first interface (212).
25

3. The Base Station Apparatus (107, 108) of claim 1 or 2, further comprising:

30 a PS Controlling Device (206);

wherein the PS Controlling Device (206) is adapted to detect the activation of the PS connection (202, 202', 202'');

wherein the PS Controlling Device (206) is adapted to collocate at least a portion of the PS Controlling Device (206) to a CS Controlling Device (210) during the PS connection (202, 202', 202'') is active.

5

4. The Base Station Apparatus (107, 108) of claim 3, wherein the PS Controlling Device (206) is adapted to request a relocation of PS Controlling Device (206).

10

5. The Base Station Apparatus (107, 108) of claim 3 or 4, wherein the PS Controlling Device (206) is adapted to exchange coordination information with a Controlling Apparatus.

15

6. The Base Station Apparatus (107, 108) of one of claims 3 to 5, wherein the PS Controlling Device (206) is adapted to request a Controlling Apparatus to establish a PS connection of a User Equipment via the Base Station Apparatus (107, 108).

20

7. The Base Station Apparatus (107, 108) of one of claims 3 to 6, wherein the PS Controlling Device (206) is adapted to receive a request from a user equipment (200) for setting-up a PS connection between the user equipment (200) and a core network (104) in accordance with the parameters from the user equipment.

25

30

8. The Base Station Apparatus (107, 108) of one of claims 3 to 7, wherein the PS Controlling Device (206) is adapted to receive a signalling message from a user equipment (200) and/or from a core network (104); and

wherein the PS Controlling Device (206) is further adapted to send at least the received signalling message to a Controlling Apparatus (101) to indicate that the Base Station Apparatus (107, 108) maintains the PS connection and/or a
5 user equipment connection.

9. The Base Station Apparatus (107, 108) of one of claims 3 to 8, wherein the PS Controlling Device (206) is adapted to
10 receive a PS signalling message from a Controlling Apparatus (101) to differentiate a destination of the message and to send the received PS signalling message toward the indicated destination; and

wherein the PS Controlling Device is further adapted for
15 indicating that the PS connection is terminated in at least one of the group consisting of the Base Station Apparatus, the SRNC PS proxy and the PS controlling device.

20 10. The Base Station Apparatus (107, 108) of one of claims 3 to 9, wherein the CS Controlling Device (210) is an external apparatus (101) to the Base Station Apparatus (107, 108).

25 11. The Base Station Apparatus (107, 108) of claim 10, wherein the external apparatus (101) is a Radio Network Controller.

30 12. Base Station Apparatus (107, 108) of one of claims 3 to 11, wherein collocating comprises at least one collocation method of the group of
Relocating; Relaying; and Proxying.

13. The Base Station Apparatus (107, 108) of claim 1 or 2, wherein the Synchronisation Device (204) is further adapted to continue routing the PS connection (202, 202', 202'') to the second interface (209) during the PS connection
5 (202, 202', 202'') is active.

14. The Base Station Apparatus (107, 108) of one of claims 1 to 13, wherein at least one Device of
10 the CS Forwarding Device (207);
the PS Controlling Device (206); and
the CS Controlling Device (210)
is at least one device selected from the group of Devices consisting of:
15 a Serving Radio Network Controller;
a Controlling Radio Network Controller;
a Drift Radio Network Controller.

20 15. A Controlling Apparatus (101), comprising:
A CS Controlling Device (210);
A PS Controlling Device (206, 310, 506, 511);
wherein the CS Controlling Device (210) is adapted for controlling a CS connection in a Base Station Apparatus (107,
25 108);
wherein the PS Controlling Device (310, 506, 511) is adapted for controlling a PS connection in the Base Station Apparatus (107, 108);
wherein the CS Controlling Device (210) and the PS Controlling Device (206) are separated such that at least one
30 portion of the PS Controlling Device (206) can be deactivated during the PS connection in the Base Station Apparatus (107, 108) is deactivated.

16. The Controlling Apparatus (101) of claim 15,
wherein the CS Controlling Device (210) and the PS Control-
ling Device (206) are adapted to coordinate one another such
that if the CS connection and the PS connection in the Base
5 Station Apparatus are simultaneously activated, a shared car-
rier access to the Base Station Apparatus (107, 108) can be
provided for a User Equipment (200).

10 17. The Controlling Apparatus (101) of claim 15 or 16,
wherein for deactivating the at least one portion of the PS
Controlling Device, the at least one portion of the PS Con-
trolling Device can be reverse relocated from or relayed
and/or proxied from the Controlling Apparatus.

15 18. A Controlling Apparatus (101), comprising:
A CS Controlling Device (410);
A PS Controlling Device (410);
20 wherein the CS Controlling Device (410) is adapted for
controlling a CS connection (405, 405', 405'', 405''') in a
Base Station Apparatus (107, 108);
wherein the PS Controlling Device (410) is adapted for
controlling a PS connection (402, 402') in the Base Station
25 Apparatus (107, 108);
wherein the PS connection (402, 402') is bypassing the
Controlling Apparatus (101).

30 19. A Method for routing a CS connection to a first in-
terface of a Base Station Apparatus and a PS connection to a
second interface of a Base Station Apparatus, comprising:
providing a User Equipment connection comprising a CS
connection and a PS connection;

routing the CS connection to the first interface during the PS connection is deactivated; and

routing the PS connection to the second interface during the PS connection is deactivated.

5

20. A Method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus, comprising:

10 separating a CS Controlling Device and a PS Controlling Device in the Controlling Apparatus;

deactivating at least one portion of the PS Controlling Device in the Controlling Device during the PS connection in the Base Station Apparatus is deactivated.

15

21. A Method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus, comprising:

20 controlling the CS connection of the Base Station Apparatus with a CS Controlling Device;

controlling the PS connection of the Base Station Apparatus with a PS Controlling Device;

wherein the PS connection is bypassing the Controlling Apparatus.

25

22. A method for relocating a PS Controlling Device comprising:

requesting a relocation of the PS Controlling Device between a Base Station Apparatus and a Controlling Apparatus;

30 relocating a CS connection independently from a PS connection.

23. A program element, which when being executed by a processor is adapted to carry out at least one of the methods selected from the group of methods consisting of:

the method for routing a CS connection to a first interface of a Base Station Apparatus and a PS connection to a second interface of a Base Station Apparatus of claim 19;

the method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus of claim 20;

the method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus of claim 21; and

the method for relocating a PS Controlling Device of claim 22.

24. A computer-readable medium comprising program code, which when being executed by a processor is adapted to carry out at least one of the methods selected from the group of methods consisting of:

the method for routing a CS connection to a first interface of a Base Station Apparatus and a PS connection to a second interface of a Base Station Apparatus of claim 19;

the method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus of claim 20;

the method for controlling a CS connection and a PS connection of a Base Station Apparatus with a Controlling Apparatus of claim 21; and

the method for relocating a PS Controlling Device of claim 22.

25. A System for controlling a PS connection and a CS connection of a User Equipment connection, the system comprising:

a Base Station Apparatus (107, 108) of one of claims 1 to 14;

a Controlling Apparatus (101) of one of claims 15 to 17 or of claim 18;

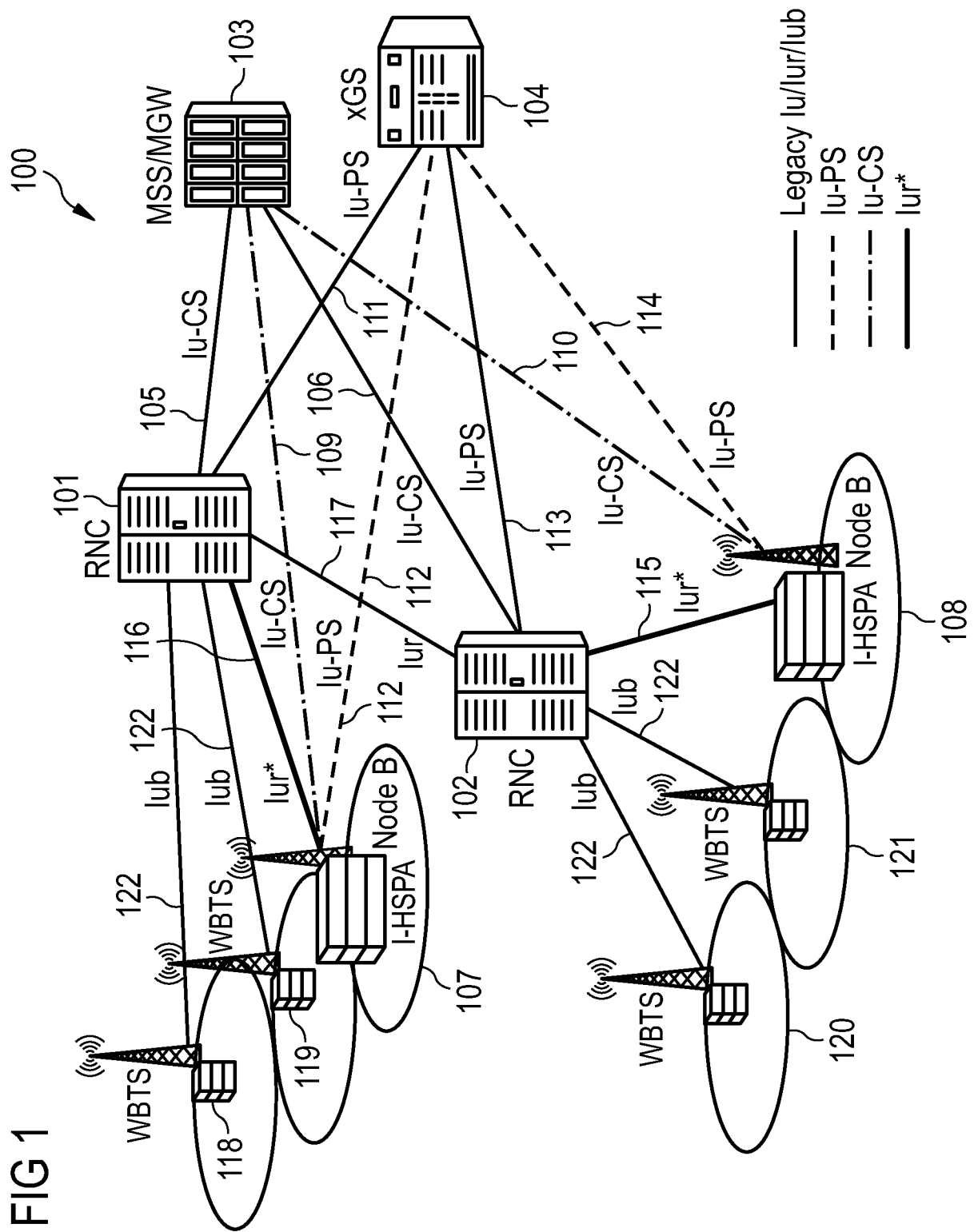
5 wherein, during the PS connection (202', 202'') is deactivated in the Base Station Apparatus (107, 108), the PS Controlling Device (310, 410, 511) of the Controlling Apparatus (101) can be deactivated; and

10 wherein during the PS connection is deactivated in the Base Station Apparatus, the Synchronisation Device (204) of the Base Station Apparatus (107, 108) is able to route the CS connection to the first interface; and

15 wherein, during the PS connection is deactivated in the Base Station Apparatus, the Synchronisation Device is able to route the PS connection to the second interface.

26. A use of a Drift Radio Network Controller function for providing a connection from a Base Station Apparatus to a Controlling Apparatus.

27. A message for signalling relocation parameter, wherein the message is adapted to inform a core network about relocation of an interface (209).



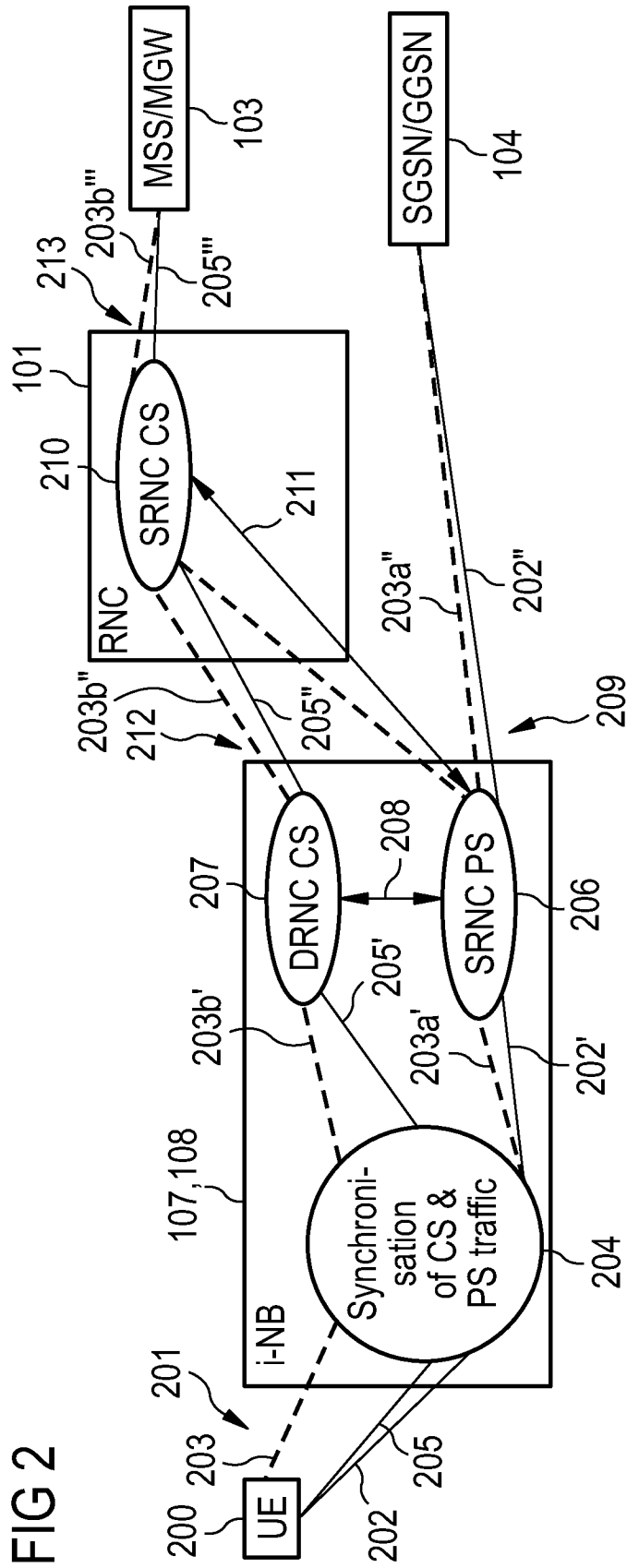


FIG 2

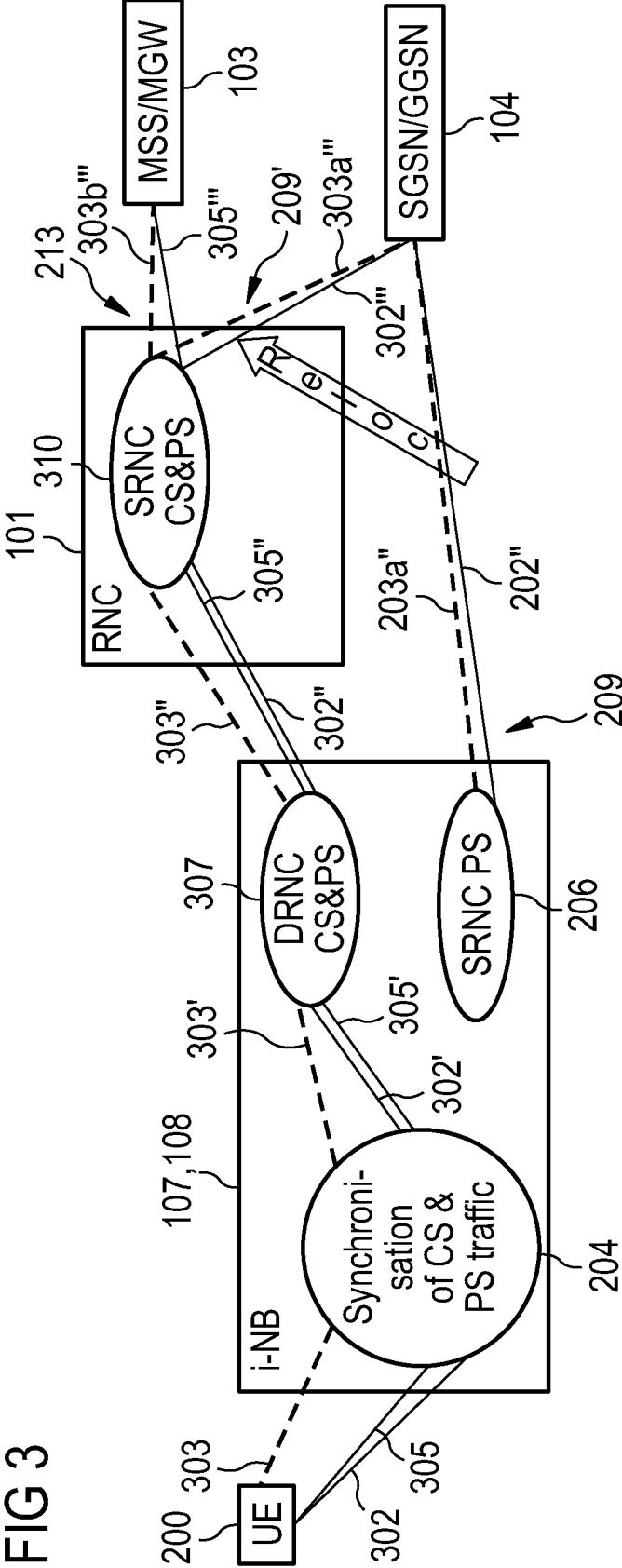


FIG 3

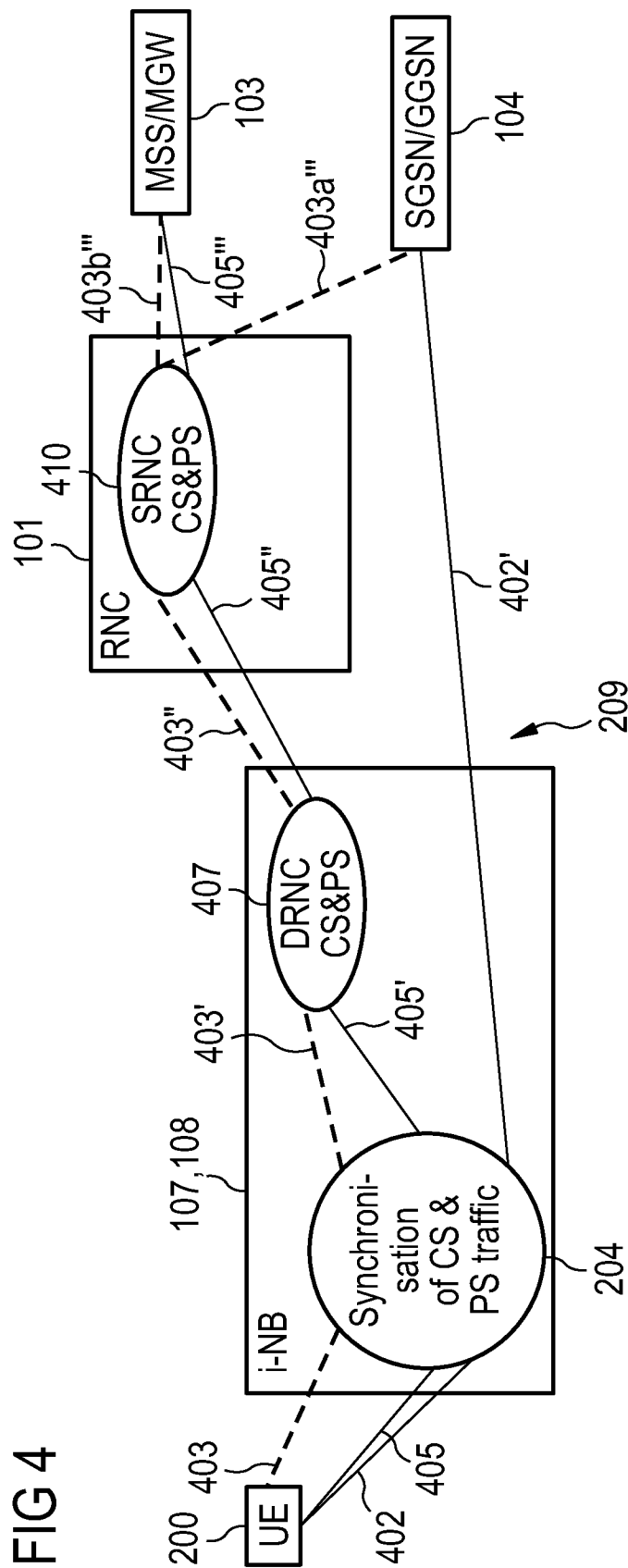
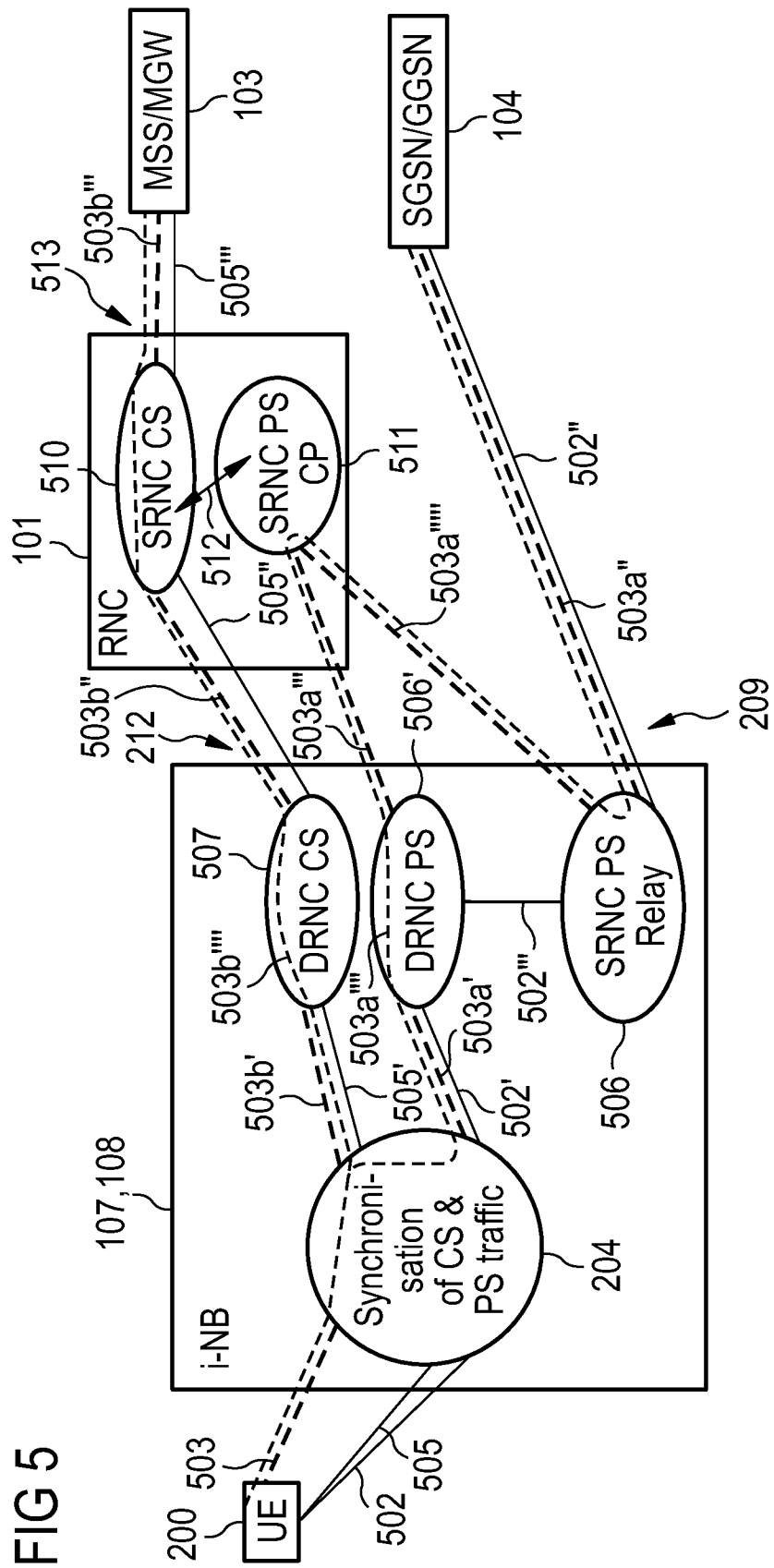


FIG 4



6/6

FIG 6

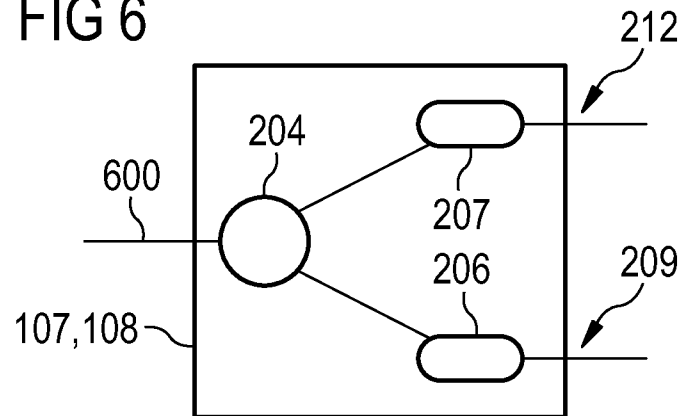


FIG 7

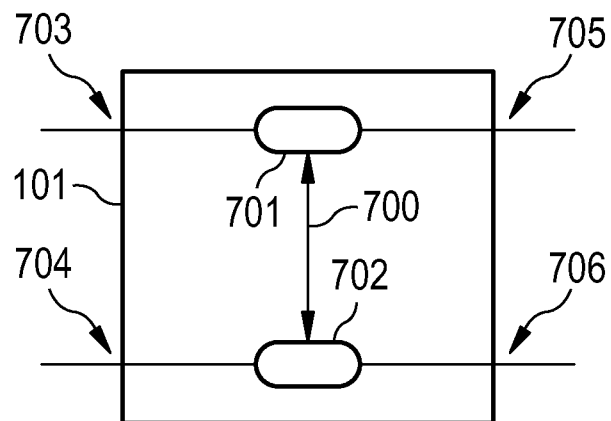


FIG 8

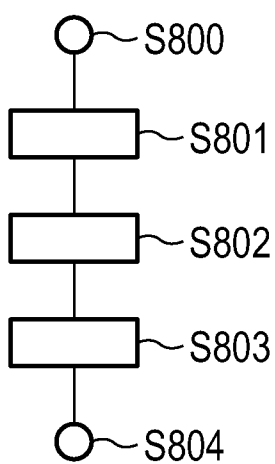


FIG 9

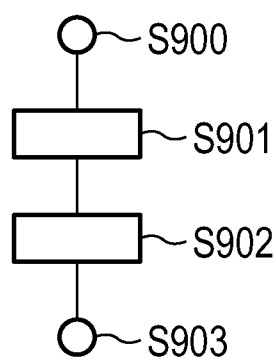
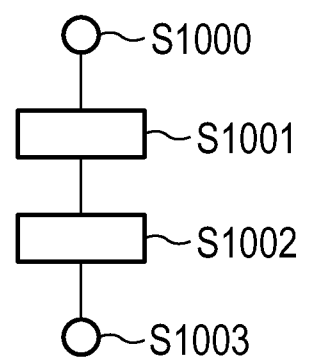


FIG 10



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/068372

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W36/14 H04W40/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W

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 practical, search terms used)

EPO-Internal, COMPENDEX, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008/002997 A2 (QUALCOMM INC [US]; GRILLI FRANCESCO [US]; GUPTA KIRTI [US]; MAHENDRAN) 3 January 2008 (2008-01-03) paragraph [0008] - paragraph [0009] paragraph [0020] - paragraph [0059]	1-25
A	WO 2008/131682 A1 (HUAWEI TECH CO LTD [CN]; XUE XIJUN [CN]; LIN BO [CN]) 6 November 2008 (2008-11-06) abstract	1-25
A	US 2003/003919 A1 (BEMING PER [SE]; VAN LIESHOUT GERT-JAN [NL]) 2 January 2003 (2003-01-02) the whole document	1-25
A	GB 2 443 467 A (VODAFONE PLC [GB]) 7 May 2008 (2008-05-07) the whole document	1-25

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

☒ See patent family annex.

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- *Z* document member of the same patent family

Date of the actual completion of the international search

6 October 2009

Date of mailing of the international search report

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Frantzeskakis, D

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2008/068372

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 26-27
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search reportcovers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 26-27

Claims 26 and 27 are extremely broad and unclear (Article 6 PCT)

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2008/068372

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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			CA 2650492 A1	03-01-2008
			CN 101480083 A	08-07-2009
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			WO 03003783 A1	09-01-2003
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