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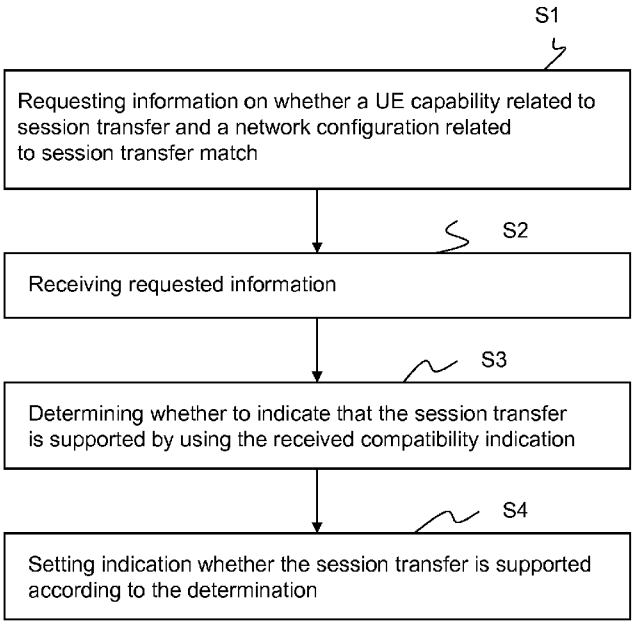

Fig. 2

(57) Abstract: The invention relates to methods and nodes for supporting a session transfer, for a user equipment, from a circuit switched network to a packets witched network. According to one aspect a method for operating a control node of a core network is provided. The method comprises the steps: requesting from a radio access network of the circuit switched network information on whether a capability of the user equipment related to the session transfer are compatible with a network configuration related to the session transfer; receiving from the radio access network an indication whether the capability of the user equipment and the network configuration are compatible; determining whether to indicate that the session transfer is supported by using the received compatibility indication; and setting an indication whether the session transfer is supported according to the determination.

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SESSION TRANSFER FROM A CIRCUIT SWITCHED NETWORK TO A PACKET SWITCHED NETWORK

TECHNICAL FIELD

The invention relates to methods and nodes for supporting a session transfer, such as a voice session, from a circuit switched network to a packet switched network. In particular it is focused on the support of transfer of a session from UTRAN/GERAN to E-UTRAN/HSPA.

BACKGROUND

Single Radio Voice Call Continuity (SRVCC) is a functionality that allows a VoIP (Voice over IP) or an IMS (IP Multimedia Subsystem) call in the packet domain, such as an LTE domain to be moved to a legacy circuit switched voice domain, such as GSM/ UMTS or CDMA 1x.

As an example, SRVCC may function as follows: A user equipment (UE) that is SRVCC capable and that accesses an LTE network is engaged in a voice call. When the UE leaves the LTE coverage area it may be determined that the voice call is to be handed over to a legacy circuit switched domain and the voice call is then transferred from LTE to the circuit switched network.

According to 3GPP TS 23.216 V11.4.0 Single Radio Voice Call Continuity (SRVCC) may relate to voice call continuity between IMS (IP Multimedia Subsystem) over PS (Packet Switched) access and CS (Circuit Switched) access for calls that are anchored in IMS when the UE (User Equipment) is capable of transmitting/receiving on only one of those access networks at a given time.

Single Radio Video Call Continuity (vSRVCC) relates to video call continuity from E-UTRAN (evolved UMTS Terrestrial Radio Access Network) to UTRAN-CS for calls that are anchored in the IMS when the UE is capable of transmitting/receiving on only one of

those access networks at a given time. The term vSRVCC refers to Single Radio Video Call Continuity.

Single Radio Voice Call Continuity (SRVCC) is discussed and specified in 3GPP TS 23.216 V11.4.0, entitled Single Radio Voice Call Continuity (SRVCC) and in 3GPP TS 23.237 V11.4.0, entitled IP Multimedia Subsystem (IMS) Service Continuity. IMS SIP (Session Initiation Protocol) signaling is discussed in 3GPP TS 23.228 V11.4.0, entitled IP Multimedia Subsystem. User Equipment Radio Capability Match procedures are discussed in 3GPP TS 23.401 V11.1.0 entitled General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access and in 3GPP TS 23.060 V11.1.0 entitled General Packet Radio Service (GPRS), Service description.

While SRVCC often refers to the handover of a session from the packet switched domain to the circuit switched domain, in this application the opposite direction of a session transfer is considered, i.e. session transfer from the circuit switched domain to the packet switched domain will be the main focus. The concept of SRVCC from circuit switched to packet switched will thus also be referred to as rSRVCC, meaning return SRVCC or reverse SRVCC.

The current 3GPP specification TS23.216 V11.4.0 discusses in Section 5.3.2b an MSC (Mobile Switching Centre) enhanced for UTRAN/GERAN to E-UTRAN/UTRAN (HSPA) SRVCC; (UTRAN: UMTS Terrestrial Radio Access Network, GERAN: GSM EDGE Radio Access Network, E-UTRAN: evolved UTRAN, HSPA: High Speed Packed Access). According to this section, the MSC may inform the RAN (Radio Access Network) about the possibility to perform CS (Circuit Switched) to PS (Packet Switched) SRVCC by sending a “CS to PS SRVCC operation possible” to the RNC (Radio Network Controller) or alternatively to the BSC (Base Station Controller) only for normal TS 11 call (i.e. not an emergency call – TS 12, 3GPP TS 22.003). The MSC Server determines the possibility of performing CS to PS SRVCC based on: the CS to PS SRVCC capability

of the UE, the presence of the CS to PS SRVCC allowed indication in the subscription data of the user, and the IMS registration status of the UE.

According to existing specification, the MSC Server indicates to the RAN that rSRVCC (SRVCC from CS to PS) is supported even if the UE does not support the actually required capabilities. For example, the network supports rSRVCC from UTRAN to LTE but the UE may only supports rSRVCC from GERAN to LTE. In such cases a handover or session transfer from the CS domain to the PS may fail or the call may even be lost or need to be recovered.

SUMMARY

Accordingly it is an object of the invention to obviate at least some of the above disadvantages and to provide improved methods and nodes for a session transfer from the circuit switched to the packet switched domain. The session transfer shall be reliable. Signaling overhead shall be minimized.

According to an embodiment of the invention, a method for operating a control node of a core network and for supporting, for a user equipment, a session transfer from a circuit switched network to a packet switched network is provided. The control node requests from a radio access network of the circuit switched network information on whether a capability of the user equipment related to the session transfer are compatible with a network configuration related to the session transfer. The control node receives from the radio access network an indication whether the capability of the user equipment and the network configuration are compatible. The control node determines whether to indicate that the session transfer is supported by using the received compatibility indication. The control node sets an indication whether the session transfer is supported according to the determination.

According to an embodiment of the invention, a method for operating a node of a radio access network for supporting, for a user equipment, a session transfer from a circuit switched network to a packet switched network is provided. The node receives from a

control node of a core network a request of information on whether a capability of the user equipment related to the session transfer is compatible with a network configuration. The node checks whether the user equipment capability and the network configuration are compatible. The node indicates to the control node whether the user capability and the network configuration are compatible.

According to an embodiment of the invention, a control node for a core network and for supporting, for a user equipment, a session transfer from a circuit switched network to a packet switched network is provided. The control node comprises a network interface to request from a radio access network of the circuit switched network information on whether a capability of the user equipment related to the session transfer is compatible with a network configuration related to the session transfer and to receive from the radio access network an indication whether the capability of the user equipment and the network configuration are compatible. The control node further comprises a processor configured to determine whether to indicate that the session transfer is supported by using the received compatibility indication, and configured to set an indication whether the session transfer is supported according to the determination.

According to an embodiment of the invention, a node of a radio access network for supporting, for a user equipment, a session transfer from a circuit switched network to a packet switched network is provided. The node comprises a network interface for receiving, from a control node of a core network, a request of information on whether a capability of the user equipment related to the session transfer is compatible with a network configuration, and for indicating to the control node whether the user equipment capability and the network configuration are compatible. The node comprises further a processor configured to check whether the user equipment capability and the network configuration are compatible.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 schematically illustrates an exemplary network architecture according to the state of the art.

Fig. 2 shows a flowchart for illustrating a method in a control node of a core network according to one embodiment of the invention.

Fig. 3 shows a flowchart for illustrating a method in a radio access network according to one embodiment of the invention.

Fig. 4 shows a signaling diagram for illustrating signaling in an embodiment of the invention.

Fig. 5 schematically illustrates a control node of a core network according to one embodiment of the invention.

Fig. 6 schematically illustrates a node of a radio access network according to one embodiment of the invention.

Fig. 7 shows a flowchart for illustrating a method in a control node of a core network according to an embodiment of the invention.

Fig. 8 shows a flowchart for illustrating a method in a user equipment according to one embodiment of the invention.

Fig. 9 schematically illustrates a control node of a core network according to one embodiment of the invention.

Fig. 10 schematically illustrates a user equipment according to one embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

In the following, the invention will be explained in more detail by referring to exemplary embodiments and to the accompanying drawings. The illustrated embodiments relate to

concepts for a session transfer from a circuit switched network to a packet switched network, e.g. from UTRAN or GERAN to E-UTRAN or HSPA. This direction of session transfer is also referred to as return or reverse direction. As far as a voice session is concerned the return or reverse direction is referred to as rSRVCC (return/reverse SRVCC), or simply a CS to PS SRVCC.

Fig. 1 schematically illustrates an exemplary network architecture in which a session transfer from a circuit switched network to a packet switched network can be performed. A similar structure is also presented in 3GPP TS 23.216 V11.4.0, Section 5.2.4.

In the example according to Fig. 1, a user equipment 1 is at first served by the circuit switched access network 2, e.g. UTRAN or GERAN. The access network 2 is connected to an MSC server 3 which is connected to an IMS 4. A session of the UE 1 is to be transferred from the circuit switched network 2 to a packet switched network 5, e.g. a Target-E-UTRAN. This example shows a bearer path 6 before the session transfer and a bearer path 7 and a signaling path 8 after the session transfer. After the session transfer, the bearer path 7 runs from the UE 1 via the packet switched network 5 (Target E-UTRAN) and a Serving / PDN Gateway 9 to the IMS 4. A Serving GPRS Support Node (SGSN) 12, a Mobility Management Entity (MME) 10 and a Home Subscriber Server (HSS) 11 may also be involved in signaling relevant for the session transfer. A core network in this example can be seen as the part of the architecture that resides between the circuit switched access network 2, the packet switched access network 5 and the IMS. The core network may generally be or comprise at least one of a circuit switched core network, a packet switched core network or an evolved packet core network. A network, in general, may comprise, depending on the context, at least one of a circuit switched access network, a packet switched access network, a circuit switched core network, and a packet switched core network.

Fig. 2 shows a flowchart for illustrating a method in a control node of a core network according to one embodiment. The method supports a session transfer from a circuit

switched to a packet switched network. A user equipment which is served by a radio access network of the circuit switched network uses the session.

Examples of circuit switched networks are GSM based networks and UMTS based networks. Each of which comprises an access network, e.g. GERAN type or UTRAN type, and a core network comprising several nodes such as an MSC server. An MSC server is an example of a control node of a core network.

Examples of packet switched networks are LTE based networks (E-UTRAN) and HSPA. The mentioned access networks are connected to a corresponding core network.

Session transfer comprises that a session is transferred or handed over from one access network or technology to another access network or technology. A session to be transferred can in particularly be a voice session or a video session. In this sense, the session transfer allows mobility of the user equipment between different access networks or technologies, including circuit switched access networks and packet switched access networks. A voice call is a session that can be transferred between the mentioned access networks or technologies.

In a step S1, the control node requests from a radio access network of the circuit switched network information whether a capability of the user equipment related to the session transfer are compatible with a network configuration related to the session transfer. A network configuration may be an operator configuration or a configuration set by an operator of the network. The network may comprise radio access network(s) and core network(s). The network configuration may concern a network capability of a network operator. In one example, the network comprises a circuit switched access network, a packet switched access network and a core network. For example, the control node may direct the request to a radio network controller (RNC) of a UTRAN or to a base station controller (BSC) of a GERAN.

The capability of the user equipment may be an rSRVCC capability of the UE, which indicates that a UE is capable to be transferred from a circuit switched to a packet switched network. Examples are the capability to be transferred from UTRAN to E-UTRAN, from GERAN to E-UTRAN, or from GERAN to HSPA. As several types of such access networks exist, e.g. TDD LTE or FDD LTE, the capability may also define whether the UE is capable to be transferred from a particular type of UTRAN/GERAN to a particular type of E-UTRAN/HSPA. The capability of the UE may also be that the UE is capable for Voice over a PS network such as UTRAN/E-UTRAN.

The capability of the user equipment may also or alternatively comprise the information whether the UE is capable for an FDD mode or a TDD mode or both of GERAN, UTRAN or E-UTRAN.

The capability of the user equipment may also or alternatively comprise at least one piece of information of the following group of pieces of information: the UE supports or does not support a certain frequency band of the GERAN/UTRAN and/or E-UTRAN, FDD and/or TDD for UTRAN, FDD and/or TDD for E-UTRAN, rSRVCC for GERAN to FDD and/or TDD HSPA, rSRVCC from FDD and/or TDD UTRAN to FDD/TDD HSPA, rSRVCC for GERAN to FDD and/or TDD E-UTRAN, and rSRVCC from FDD and/or TDD UTRAN to FDD/TDD E-UTRAN.

It is noted that not all possible information are mentioned that define the UE capability, however the skilled person will understand from the examples given above that the capability of the UE may comprise any kind of information that is related to a session transfer capability. The capability information may answers the question whether a certain mobility feature is supported, i.e. the transfer of a session from one network to another.

If the UE shows a certain capability and the network is also configured to support the capability or the network indicates support of the certain capability or mobility feature,

than the network configuration related to session transfer and the capability of UE related to the session transfer match or are compatible.

For example, if the network is configured to support a particular rSRVCC for the UE or indicates that the particular rSRVCC of the UE is supported and if also the capability of the UE indicates that the particular rSRVCC is supported, than the UE capability and the network configuration match or are compatible. If the UE is not capable to support the particular rSRVCC than the UE capability and the rSRVCC do not match.

The control node may select a certain capability and indicate it to the radio access network. For example, the control node may be configured to support several types of session transfer, such as from GERAN to HSPA, from UTRAN to TDD-LTE and from UTRAN to FDD-LTE. When due to certain circumstances the control node is only interested whether a UE supports UTRAN to TDD-LTE than the control node may indicate that selected capability to the RAN. In this case not the entire capability information needs to be checked and signaled but only the selected capability is checked and signaled.

In step S2, the control node receives from the radio access network an indication whether the capabilities of the user equipment and the network configuration are compatible. This information can be a simple “yes” or “no.”

In step S3, the control node determines whether to indicate that the session transfer is supported by using the received compatibility indication. Besides the received compatibility information the control node may take further information into account, e.g. information on network load, cell load, rSRVCC capability indicated by the HSS, priority or other information. The further information may be obtained from the network. Typically, the control node determines that session transfer is supported only if the compatibility indication is indicating that rSRVCC is supported and if none of the other information prevents the use of rSRVCC.

The control node can thus e.g. determine that the session transfer is not supported although the control node received the indication from the radio access network that the capabilities related to the session transfer of the UE are compatible with the network configuration.

In step S4, the control node sets an indication whether the session transfer is supported according to the determination. The control node may send the set indication to the radio access network.

The above described method can be seen as a match procedure between the control node of the core network and the RAN (radio access network) to match the capability of a UE served by the RAN and the network in view of a possible session transfer. Whether the control node finally indicates that the session transfer is supported depends on the outcome of the match procedure and may also depend on further information available at the control node.

The actual session transfer will only be performed if the control node has set the indication that the session transfer is supported. In this way it can be assured that the session transfer can only be performed if the user equipment and the network have matching capabilities related to the session transfer.

Fig. 3 shows a flowchart for illustrating a method in a radio access network according to one embodiment. The method may run in a node of a radio access network, such as an RNC (Radio Network Controller) in UTRAN or a BSC (Base Station Controller) in GERAN.

The method supports, for a user equipment, a session transfer from a circuit switched network to a packet switched network. In a step S11, a node in the radio access network receives from a control node of a core network a request of information on whether capabilities of the user equipment related to the session transfer are compatible with a network configuration.

Upon receiving the request, the node checks in a step S14 whether the user equipment capability and the network configuration are compatible. Essentially, the RAN needs to check whether a mobility feature is supported by the user equipment. For example, the RAN checks whether the UE capability indicates that the UE supports rSRVCC or a particular type of rSRVCC.

When the RAN receives an indication, e.g. from the control node of the core network, that the check shall only be performed for a particular capability such as a particular rSRVCC capability, then the RAN performs only the check(s) necessary for this capability. By indicating a certain capability, the number of checks to be preformed is reduced and only the checks required by the network and requested by the control node are performed.

The RAN may already know the UE capabilities and can thus perform the requested checks right away. In case the RAN has not already received the capabilities of the UE, the RAN, in an optional step S12, requests the UE to upload or provide its capability information. With the request, the RAN may indicate to the UE at least one particular capability, the RAN is interested in. For example the RAN may indicate that it is interested in the rSRVCC capability of the UE or a certain type of SRVCC capability. The UE than provides the indicated capability information only. In this way the number of capability checks is reduced to the number which is of importance to the network and the amount of data to be uploaded from the UE is correspondingly reduced.

The capability information uploaded by the UE may comprise various types of information relating to the UE capability in general. They may comprise all capability information related to session transfer or to at least one particular capability as explicitly requested by the RAN.

In a step S13, the radio access network receives the requested capability information of the UE. Steps S12 and S13 are optional as the required capability information may

already be available at the RAN. The steps may be performed if it is determined that the information requires an update. Steps S12 and S12 are performed in case the capability information is not already available at the RAN or the capability information needs to be updated. Thus the RAN may check first whether the information is available or whether the information requires an update before performing steps S12 and S13.

In a step S15, the RAN indicates to the control node whether the UE capability and the network configuration are compatible. For example, the RAN may indicate for rSRVCC to TDD-LTE “yes” whereas it indicates for rSRVCC to FDD-LTE “no”, meaning that the session transfer from the current circuit switched network to TDD-LTE is supported and to FDD-LTE is not supported.

Fig. 4 shows a signaling diagram for illustrating signaling in one embodiment. An MSC 31 of a core network is connected to a RAN 32. Messages between the MSC 31 and the RAN 32 may be exchanged via a respective interface such as the A-interface or the Iu interface. A UE 33 is served by the RAN 32. It may be assumed that the UE is registered in IMS before rSRVCC takes place. The UE may be registered for a voice session. If the UE is registered for another service a re-registration may be necessary when the UE is handed over to the packet switched network. A function T-ADS which is a Terminating Access Domain Selection may be used to ensure that terminated calls are routed correctly, even if camping on a circuit switched network (e.g. a 2G or 3G network). Such a function can ensure terminating on the packet switched networks only if the packet switched access supports IMS voice service.

If the MSC 31 requires more information on the UE capability to be able to set the rSRVCC Indication(s), the MSC 31 may send a “UE Radio Capability Match Request” to the RAN 32.

This procedure is typically used during the Initial Attach procedure, during Location Area Update (LAU) procedure for the "first LAU following GERAN Attach" or for "UE Capability update" (e.g. during an active CS call) or when MSC has not received the

Voice Support Match Indicator from the MME (e.g. during SRVCC), SGSN (e.g. during SRVCC) or other MSC (e.g. during MTRF procedure, Mobile Terminating Roaming Forwarding).

In step 35, the MSC 31 indicates whether the MSC 31 wants to receive a "Voice Support Match Indicator". The MSC 31 may indicate whether the RAN 32 should only check for rSRVCC.

In step 36, upon receiving a "UE Radio Capability Match Request" from the MSC 31, if the RAN 32 has not already received the UE capabilities from the UE 33 the RAN 32 requests the UE 33 to upload the UE Capability information by sending the "RRC UE Capability Enquiry".

In step 37, the UE 33 provides the RAN 32 with its UE capabilities sending the "RRC UE Capability Information".

In step 38, upon receiving the "UE Radio Capability Match Request from the MSC" of step 35, the RAN 32 checks whether the UE capabilities are compatible with the network configuration. If requested by the MSC 31, or if configured to do so, the RAN 32 only checks for the rSRVCC capabilities.

In step 39, the RAN 32 provides a "Voice Support Match Indicator" to the MSC 31 to indicate whether the UE capabilities and networks configuration are compatible.

For determining the appropriate "UE Radio Capability Match Response", the RAN 32 is configured, e.g., by an operator to check whether the UE 33 supports certain capabilities required for IMS PS Voice continuity. In a shared network, the RAN 32 keeps a configuration separately per PLMN (Public Land Mobile Network).

The checks which are to be performed depend on network configuration. In the following some examples of UE capabilities are given: the SRVCC/rSRVCC, and UTRAN/E-

UTRAN Voice over PS capabilities; the Radio capabilities for GERAN/UTRAN/E-UTRAN FDD and/or TDD; and/or the support of GERAN/UTRAN/E-UTRAN frequency bands.

The MSC 31 stores the received Voice support match indicator in the MM Context (MM: Mobility Management) and uses it as an input for setting the rSRVCC Indication.

The above example can be analogous done for the case of LTE, where the MME makes a query on the capability match of the UE. The rSRVCC capability indication would be provided by the UE to the MME as response to the query of the capability match and then it would be provided by the MME to the MSC Server during SRVCC from LTE to 2G/3G.

Fig. 5 schematically illustrates exemplary structures for implementing the above-described concepts in a control node 41 for a core network. The control node 41 for a core network supports, for a user equipment, a session transfer from a circuit switched network to a packet switched network. The control node 41 comprises a network interface 42 to request from a radio access network of the circuit switched network information whether a capability of the user equipment related to the session transfer are compatible with a network configuration related to the session transfer and to receive from the radio access network an indication whether the capability of the user equipment and the network configuration are compatible. Examples of the interface 42 are the A interface or the Iu-CS interface. Examples of the control node 41 are an MSC or an MME.

Further, the control node 41 includes a processor 44 coupled to the network interface 42 and a memory 45 coupled to the processor 44.

The memory 45 may include a read-only memory (ROM), e.g., a flash ROM, a random-access memory (RAM), e.g., a Dynamic RAM (DRAM) or a static RAM (SRAM), a mass storage, e.g., a hard disc drive or a solid state disk, or the like. The memory 45

includes suitably configured program code to be executed by the processor 44 so as to implement the above-described functionalities of the control node 41.

It is to be understood that the structure as illustrated in Fig. 5 is merely schematic and that the control node 41 may actually include further components which, for the sake of clarity, have not been illustrated, e.g., further interfaces. Also, it is to be understood that the memory 45 may include further types of program code modules, which have not been illustrated. For example, the memory 45 may include program code modules for implementing typical functionalities of a respective control node.

Fig. 6 schematically illustrates exemplary structures for implementing the above-described concepts in a node of a radio 51 access network, e.g. a BSC or an RNC.

The node 51 of a radio access network is adapted to support, for a user equipment, a session transfer from a circuit switched network to a packet switched network. In the illustrated structure, the node 51 comprise a network interface 52 for receiving, from a control node of a core network, a request of information on whether a UE capability related to the session transfer are compatible with a network configuration, and for indicating to the control node whether the user capability and the network configuration are compatible.

Further, the node 51 comprises a processor 54 configured to check whether the user equipment capability and the network configuration are compatible; The processor 54 is coupled to the network interface 52, to a radio interface 53 for requesting the user equipment to provide its capability information and for receiving the capability information of the UE and to a memory 55. The memory 55 may include a read-only memory (ROM), e.g., a flash ROM, a random-access memory (RAM), e.g., a Dynamic RAM (DRAM) or static RAM (SRAM), a mass storage, e.g., a hard disk or solid state disk, or the like. The memory 55 includes suitably configured program code to be executed by the processor 54 so as to implement the above-described functionalities of the node 51.

It is to be understood that the structure as illustrated in Fig. 5 is merely schematic and that the node 51 of a radio access network may actually include further components which, for the sake of clarity, have not been illustrated, e.g., further interfaces. Also, it is to be understood that the memory 55 may include further types of program code modules, which have not been illustrated. For example, the memory 55 may include program code modules for implementing typical functionalities of a respective control node.

According to some embodiments, also a computer program product may be provided for implementing concepts according to embodiments of the invention, e.g., a computer-readable medium storing the program code and/or other data to be stored in the memory 45 or the memory 55.

With the above described concepts it can be assured that a session transfer from a circuit switched to a packet switched network is only performed when the UE and the network have matching capabilities. The concepts relate, e.g., to a procedure between a control node of a core network and a RAN to match capabilities regarding session transfer, to a RAN that determines session transfer capability from a circuit switched to a packet switched network upon request of the control node, and to a control node determining whether to indicate that session transfer is supported.

It is to be understood that the examples and embodiments as explained above are merely illustrative and susceptible to various modifications. For example, the concepts could be used in other types of mobile communication networks, not explicitly mentioned so far. Further, it is to be understood that the above concepts may be implemented by using correspondingly designed software in existing nodes, or by using dedicated hardware in the respective nodes.

Figures 7 to 10 concern a registration of a user equipment in an IMS in the context of rSRVCC as described so far. Embodiments related to user equipment registration

described in the following sections can be considered independently of the already discussed embodiments and also in combination with previously described embodiments.

The technical standard specification 3GPP TS 23.237 V11.4.0, entitled IP Multimedia Subsystem (IMS) Service Continuity, discusses IMS registration and a session transfer from circuit switched to packet switched networks from various perspectives.
In Section 6.1.3 of 3GPP it is stated that as a prerequisite for CS to PS SRVCC to be applied, the UE shall be IMS registered over PS. Consequently, the UE needs to be IMS registered before rSRVCC can take place.

The user equipment should be registered for voice, otherwise it would have to re-register when being handed over to e.g. LTE. A Terminating Access Domain Selection (T-ADS) ensures to terminate the IMS voice session on a PS access if the PS access supports IMS voice.

Currently, the user equipment has to register into IMS on e.g. via 2G/3G networks, e.g. GERAN or UTRAN, even if that access does not support IMS Voice over the PS domain. It is an object to improve existing IMS registration concepts and nodes in the context of rSRVCC.

According to one embodiment a method in a control node of a core network for supporting registration of a user equipment in an Internet Protocol Multimedia Subsystem, IMS, is provided. The method comprises the steps: checking whether a session transfer from a circuit switched network to a packet switched network is supported; and if the session transfer is supported, indicating to the user equipment that the session transfer is supported.

According to one embodiment a method in a user equipment for registration of the user equipment in an Internet Protocol Multimedia Subsystem, IMS, is provided. The method comprises the steps: receiving, from a control node of a core network, an indication that a session transfer from a circuit switched network to a packet switched network is

supported; checking the received indication; and, if the session transfer is supported, the user equipment registering in the IMS or maintaining its IMS registration.

According to one embodiment a control node of a core network for supporting registration of a user equipment in an Internet Protocol Multimedia Subsystem, IMS, is provided. The control node comprises a processor for checking whether a session transfer from a circuit switched network to a packet switched network is supported and a network interface for indicating to the user equipment that the session transfer is supported, if the session transfer is supported.

According to one embodiment a user equipment for registration of the user equipment in an Internet Protocol Multimedia Subsystem, IMS, is provided. The user equipment comprises a radio interface for receiving an indication that a session transfer from a circuit switched network to a packet switched network is supported and a processor configured to check the received indication and to initiating registration of the user equipment in the IMS or to maintain the IMS registration of the user equipment.

Fig. 7 shows a flowchart of a method in a control node of a core network according to one embodiment. The node may be a Mobile Switching Center (MSC) or a Mobility Management Entity (MME), or in general a function in the core network. The core network is connected with a radio access network that serves a user equipment. The method supports the registration of user equipment in an Internet Protocol Multimedia Subsystem, IMS, by providing relevant information to the user equipment.

In a step S71, the control node checks whether a session transfer from a circuit switched network to a packet switched network is supported. An example network is composed of a circuit switched access network, a circuit switched core network, a packet switched access network, and a packet switched core network. The core network(s) connects the access network(s) with an IMS. An example of a circuit switched networks are GERAN or UTRAN, which are circuit switched access networks. An example of a packet switched network is an E-UTRAN (evolved UTRAN). It is checked whether the support

of a session transfer is supported within a network, at least comprising the circuit switched and the packet switched network and a core network. A session supported to be transferred can, for example, be a voice call or video call.

Examples of a session transfer from a circuit switched to packet switched network are: rSRVCC from GERAN to FDD and/or TDD HSPA, rSRVCC from FDD and/or TDD UTRAN to FDD/TDD HSPA, rSRVCC for GERAN to FDD and/or TDD E-UTRAN, and rSRVCC from FDD and/or TDD UTRAN to FDD/TDD E-UTRAN.

In a step S72, the control node indicating to the user equipment that the session transfer is supported, if the check revealed that the session transfer is supported by the network. The control node may send this information to a radio access network which forwards the information to the user equipment. The indication may be sent in a response to an Attach Request Message sent by the user equipment.

In this way the information whether the network supports session transfer is made available to the user equipment.

Fig. 8 shows a flowchart of a method in a user equipment according to one embodiment. The method registers the user equipment in an Internet Protocol Multimedia Subsystem.

In a step S81, the user equipment receives from a control node of a core network, an indication that a session transfer from a circuit switched network to a packet switched network is supported. The received indication in step S81 corresponds to the indication of step S72 in Fig. 7.

In step S82, the received indication is checked by the user equipment and when the check reveals that the session transfer is supported, the user equipment will in a step S83 register in the IMS or maintain its IMS registration in case the registration is already in existence.

Typically the IMS registration is done via the packet switched network. The registration can in particularly be made for a voice session. The registration is also made if there is no indication that the session, such as a voice session, is supported in the packet switched network or if an indication explicitly states that the session is not supported by the packet switched access network.

With respect to Fig. 7 embodiments from a control node perspective are described, whereas with respect to Fig. 8 embodiments from a user equipment perspective are described.

The following example further illustrates various embodiments. A user equipment is currently camping on a 2G or 3G network, e.g. GERAN or UTRAN. The user equipment receives the indication that session transfer from circuit switched network to a packet switched network (rSRVCC) is supported from a MSC Server. The indication is received from the MSC in response to an Attach Request message previously send by the user equipment. The user equipment registers in the IMS. The registration is done even if there is no indication saying that IMS Voice is supported from the packet switched network or if there is an indication stating that IMS voice is not supported. Alternatively, the user equipment maintains its IMS registration that was initiated on an IMS Voice capable access or on 2G/3G. For this example it is important to note, that T-ADS (Terminating Access Domain Selection) in the IMS ensures that terminated calls are not routed to PS access if the PS access does not support IMS voice over PS. Embodiments suggest that the MSC Server informs the UE that rSRVCC is possible and that a user equipment performs IMS registration for voice also when currently used PS access does not support IMS Voice over PS. With it the UE is registered in the IMS on 2G/3G for voice also when the currently used access does not support IMS voice.

Fig. 9 schematically shows exemplary structures for implementing the above-described concepts in a control node 91 for a core network. The control 91 is configured to support a registration of a user equipment in an Internet Protocol Multimedia Subsystem, IMS. The control node 91 comprises a processor 94 for checking whether a session transfer

from a circuit switched network to a packet switched network is supported, and a network interface 92 for indicating to the user equipment that the session transfer is supported, if the session transfer is supported. Further the control node includes a memory 45 coupled to the processor.

The memory 95 may include a read-only memory (ROM), e.g., a flash ROM, a random-access memory (RAM), e.g., a Dynamic RAM (DRAM) or a static RAM (SRAM), a mass storage, e.g., a hard disc drive or a solid state disk, or the like. The memory 95 includes suitably configured program code to be executed by the processor 94 so as to implement the above-described functionalities of the control node 91.

It is to be understood that the structure as illustrated in Fig. 9 is merely schematic and that the control node 91 may actually include further components which, for the sake of clarity, have not been illustrated, e.g., further interfaces. Also, it is to be understood that the memory 95 may include further types of program code modules, which have not been illustrated. For example, the memory 95 may include program code modules for implementing typical functionalities of a respective control node.

Fig. 10 schematically shows exemplary structures for implementing the above-described concepts in a user equipment 101. The user equipment is configured for registration in an Internet Protocol Multimedia Subsystem, IMS. The user equipment 101 comprises a radio interface 103 for receiving an indication that a session transfer from a circuit switched network to a packet switched network is supported; and a processor 104 configured to check the received indication and to initiating registration of the user equipment in the IMS or to maintain the IMS registration of the user equipment. The processor 104 is coupled to a memory 105.

The memory 105 may include a read-only memory (ROM), e.g., a flash ROM, a random-access memory (RAM), e.g., a Dynamic RAM (DRAM) or static RAM (SRAM), a mass storage, e.g., a hard disk or solid state disk, or the like. The memory 105 includes suitably

configured program code to be executed by the processor 104 so as to implement the above-described functionalities of the node user equipment 101

It is to be understood that the structure as illustrated in Fig. 10 is merely schematic and that the user equipment 101 may actually include further components which, for the sake of clarity, have not been illustrated, e.g., further interfaces. Also, it is to be understood that the memory 105 may include further types of program code modules, which have not been illustrated. For example, the memory 105 may include program code modules for implementing typical functionalities of the user equipment 101.

According to some embodiments, also a computer program product may be provided for implementing concepts according to embodiments of the invention, e.g., a computer-readable medium storing the program code and/or other data to be stored in the memory 95 or the memory 105.

It is to be understood that the examples and embodiments as explained above are merely illustrative and susceptible to various modifications. For example, the concepts could be used in other types of mobile communication networks, not explicitly mentioned so far. Further, it is to be understood that the above concepts may be implemented by using correspondingly designed software in existing nodes, or by using dedicated hardware in the respective nodes.

CLAIMS

1. A method for operating a control node (41) of a core network for supporting, for a user equipment, a session transfer from a circuit switched network to a packet switched network, comprising the steps:

the control node (41) requesting (S1) from a radio access network of the circuit switched network information whether a capability of the user equipment related to the session transfer are compatible with a network configuration related to the session transfer;

the control node (41) receiving (S2) from the radio access network an indication whether the capability of the user equipment and the network configuration are compatible;

the control node (41) determining (S3) whether to indicate that the session transfer is supported by using the received compatibility indication; and

the control node (41) setting (S4) an indication whether the session transfer is supported according to the determination.

2. The method according to claim 1, wherein determining whether to indicate that the session transfer is supported is further based on further information available at the control node (41).

3. A method for operating a node (51) of a radio access network for supporting, for a user equipment, a session transfer from a circuit switched network to a packet switched network, comprising the steps:

the node (51) receiving (S11) from a control node of a core network a request of information on whether a capability of the user equipment related to the session transfer is compatible with a network configuration;

the node (51) checking (S13) whether the user equipment capability and the network configuration are compatible;

the node (51) indicating (S15) to the control node whether the user equipment capability and the network configuration are compatible.

4. The method according to claim 3, the method further comprising the steps:

the node (51) of the radio access network requesting (S12) the user equipment to provide its capability information;

the node (51) receiving (S13) the capability information of the user equipment.

5. The method according to claim 4, the method further comprising the step:

the node (51) of the radio access network indicating a selected capability of the user equipment related to the session transfer to the user equipment.

6. The method according to any one of claims 1 to 5, wherein the circuit switched network comprises a UTRAN or a GERAN.

7. The method according to any one of claims 1 to 6, wherein the packet switched network comprises an E-UTRAN or a HSPA network.

8. The method according to any one of claims 1 to 7, wherein the capability of the user equipment comprises a return Single Radio Voice Call Continuity, rSRVCC, capability.

9. The method according to any one of claims 1 to 8, wherein the capability of the user equipment comprises a capability of the user equipment to support a frequency division duplex, FDD, mode, or a time division duplex, TDD, mode or both of the circuit switched network and/or the packet switched network.

10. The method according to any one of claims 1 to 9, wherein the capability of the user equipment comprises a capability of the user equipment to support a certain frequency band of the circuit switched network and/or the packet switched network.

11. The method according to any one of claims 1 to 10, wherein the request indicates a selected capability of the user equipment.

12. A control node (41) for a core network and for supporting, for a user equipment, a session transfer from a circuit switched network to a packet switched network, the control node (41) comprising:

a network interface (42) to request from a radio access network of the circuit switched network information on whether a capability of the user equipment related to the session transfer are compatible with a network configuration related to the session transfer and to receive from the radio access network an indication whether the capability of the user equipment and the network configuration are compatible; and

a processor (44) configured to determine whether to indicate that the session transfer is supported by using the received compatibility indication, and further configured to set an indication whether the session transfer is supported according to the determination.

13. The control node (41) according to claim 12, wherein the processor is further configured to determine whether to indicate that the session transfer is supported by additionally using further information available at the control node (41).

14. The control node (41) according to claim 12 or 13, wherein the circuit switched network comprises an UTRAN or a GERAN.

15. The control node (41) according to any one of claims 12 to 14, wherein the packet switched network comprises an E-UTRAN or a HSPA network.

16. The control node (41) according to any one of claims 12 to 15, wherein the capability of the user equipment comprises a return Single Radio Voice Call Continuity, rSRVCC, capability.

17. The control node (41) according to any one of claims 12 to 16, wherein the capability of the user equipment comprises a capability of the user equipment to support a

frequency division duplex, FDD, mode, or a time division duplex, TDD, mode or both of the circuit switched network and/or the packet switched network.

18. The control node (41) according to any one of claims 12 to 17, wherein the capability of the user equipment comprises a capability of the user equipment to support a certain frequency band of the circuit switched network and/or the packet switched network.

19. The control node (41) according to any one of claims 12 to 18, wherein the request indicates a selected capability of the user equipment.

20. A node (51) of a radio access network for supporting, for a user equipment, a session transfer from a circuit switched network to a packet switched network, the node comprising:

a network interface (51) for receiving, from a control node of a core network, a request of information on whether a capability of the user equipment related to the session transfer is compatible with a network configuration, and for indicating to the control node whether the user capability and the network configuration are compatible; and

a processor (54) configured to check whether the user equipment capability and the network configuration are compatible;

21. The node (51) according to claim 20, wherein the node (51) further comprising:

a radio interface (53) for requesting the user equipment to provide its capability information and for receiving the capability information of the UE.

22. The node (51) according to claim 21, wherein the node (51) is further adapted to indicate a selected capability of the user equipment related to the session transfer to the user equipment.

23. The node (51) according to any one of claims 20 to 22, wherein the circuit switched network comprises an UTRAN or a GERAN.

24. The node (51) according to any one of claims 20 to 23, wherein the packet switched network comprises an E-UTRAN or a HSPA network.

25. The node (51) according to any one of claims 20 to 24, wherein the capability of the user equipment comprises a return Single Radio Voice Call Continuity, rSRVCC, capability.

26. The node (51) according to any one of claims 20 to 25, wherein the capability of the user equipment comprises a capability of the user equipment to support a frequency division duplex, FDD, mode, or a time division duplex, TDD, mode or both of the circuit switched network and/or the packet switched network.

27. The node (51) according to any one of claims 20 to 26, wherein the capability of the user equipment comprises a capability of the user equipment to support a certain frequency band of the circuit switched network and/or the packet switched network.

28. The node (51) according to any one of claims 20 to 26, wherein the request indicates a selected capability of the user equipment.

29. A control node (41) for a core network adapted to perform a method as defined by any one of claims 1 to 2 and 6 to 11.

30. A node (51) of a radio access network adapted to perform a method as defined by any one of claims 3 to 11.

31. A computer program product comprising program code to be executed by at least one processor (44) of a control node (41), thereby causing the control node (41) to perform steps of a method according to any one of claims 1 to 2 and 6 to 11.

31. A computer program product comprising program code to be executed by at least one processor (54) of a node (51) of a radio access network, thereby causing the node (51) to perform steps of a method according to any one of claims 3 to 11.

32. A method in a control node (91) of a core network for supporting registration of a user equipment in an Internet Protocol Multimedia Subsystem, IMS, the method comprising the steps:

checking (S71) whether a session transfer from a circuit switched network to a packet switched network is supported; and

if the session transfer is supported, indicating (S72) to the user equipment that the session transfer is supported.

33. A method in a user equipment (101) for registration of the user equipment in an Internet Protocol Multimedia Subsystem, IMS, the method comprising the steps:

receiving (S81), from a control node of a core network, an indication that a session transfer from a circuit switched network to a packet switched network is supported;

checking (S82) the received indication; and,

if the session transfer is supported, the user equipment registering (S83) in the IMS or maintaining its IMS registration.

34. A control node (91) of a core network for supporting registration of a user equipment in an Internet Protocol Multimedia Subsystem, IMS, the control node (91) comprising:

a processor (94) for checking whether a session transfer from a circuit switched network to a packet switched network is supported and

a network interface (92) for indicating to the user equipment that the session transfer is supported, if the session transfer is supported.

35. A user equipment (101) for registration of the user equipment (101) in an Internet Protocol Multimedia Subsystem, IMS, the user equipment (101) comprising:

a radio interface (103) for receiving an indication that a session transfer from a circuit switched network to a packet switched network is supported; and

a processor (104) configured to check the received indication and to initiating registration of the user equipment in the IMS or to maintain the IMS registration of the user equipment.

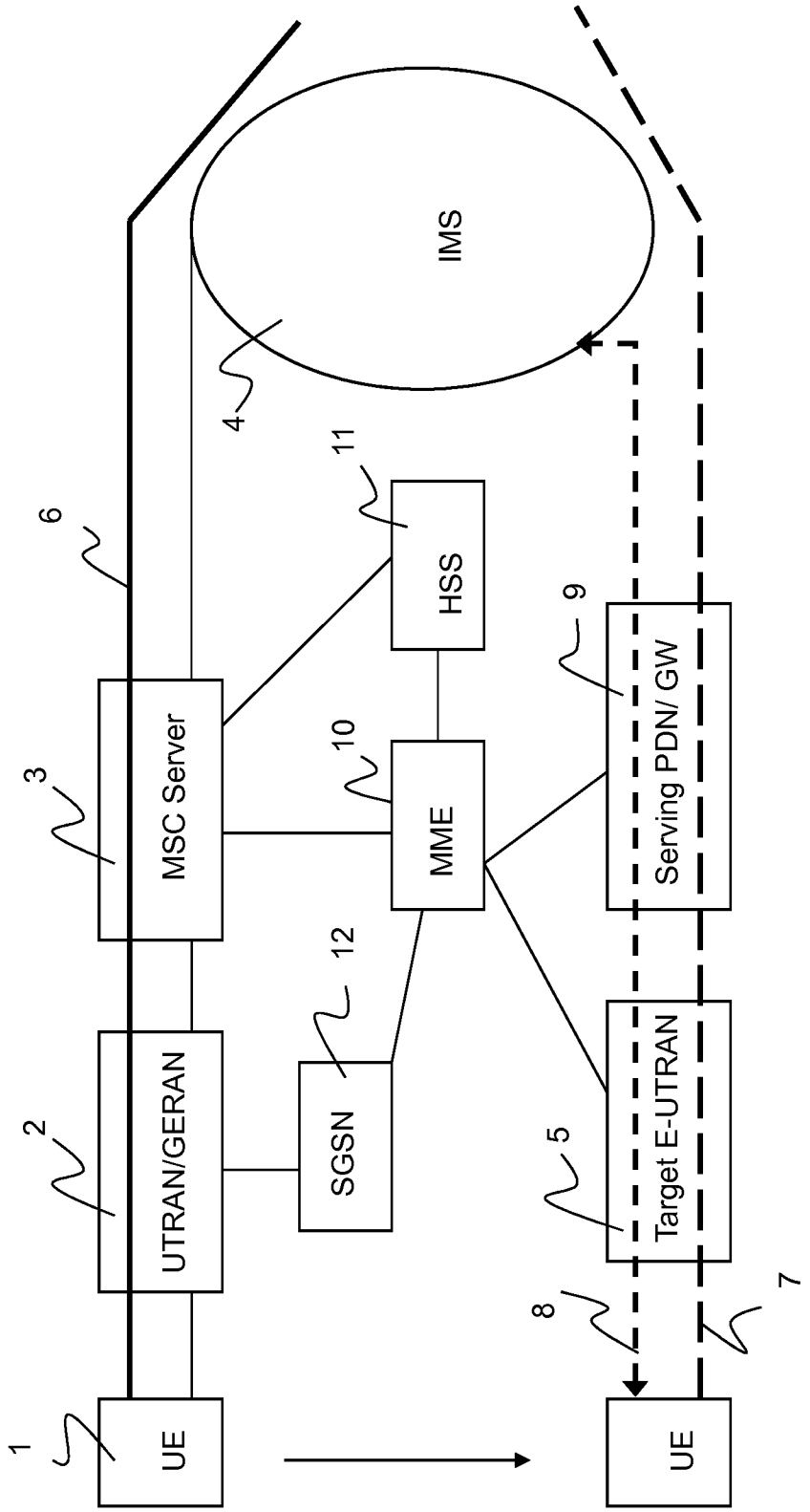
IMS
4
11
HSS
6
9
Serving PDN/ GW
MSC Server
3
10
MME
12
SGSN
2
UTRAN/GERAN
5
Target E-UTRAN
8
7
1
UE
UE

Fig. 1

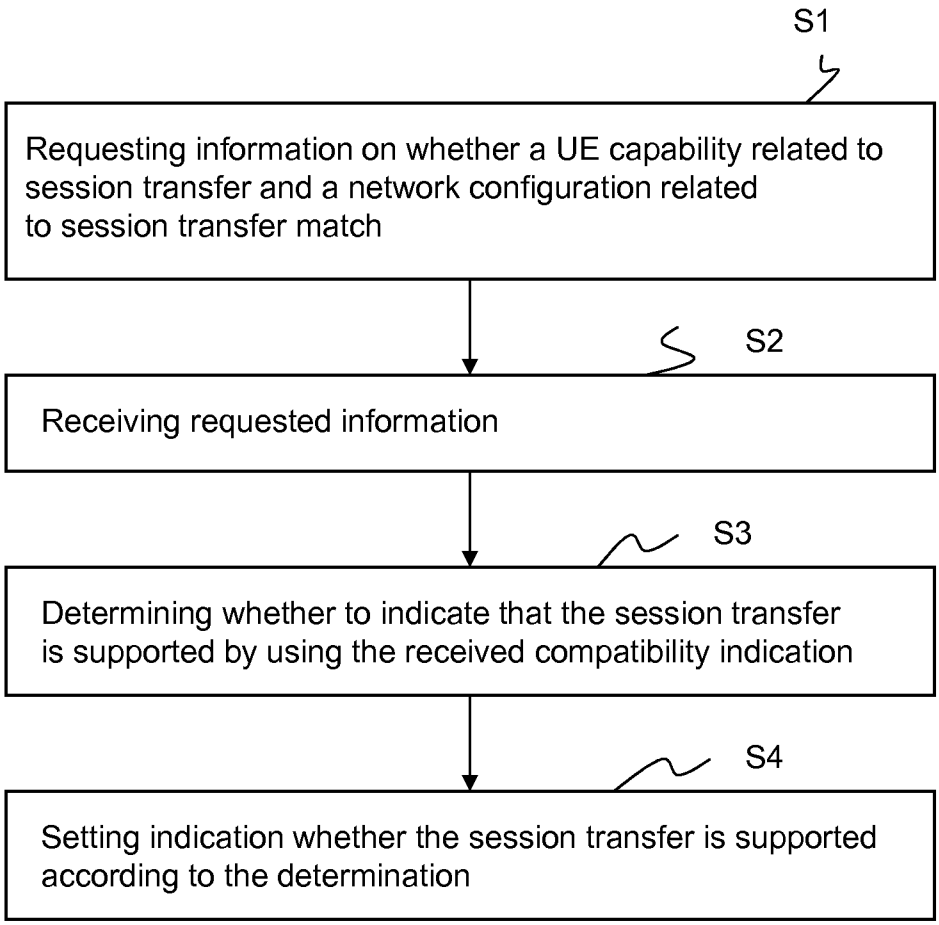
S1
Requesting information on whether a UE capability related to session transfer and a network configuration related to session transfer match
S2
Receiving requested information
S3
Determining whether to indicate that the session transfer is supported by using the received compatibility indication
S4
Setting indication whether the session transfer is supported according to the determination

Fig. 2

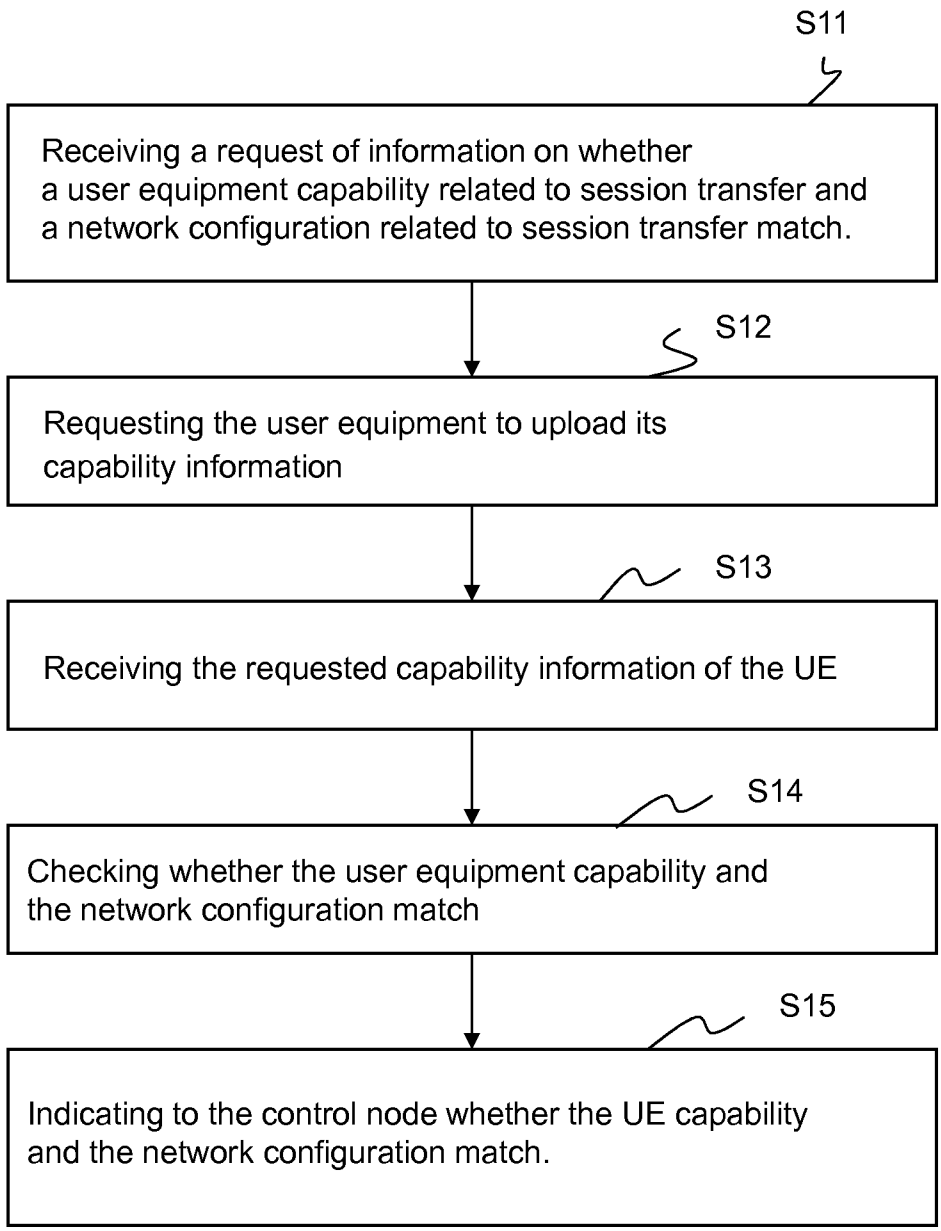
S11
Receiving a request of information on whether a user equipment capability related to session transfer and a network configuration related to session transfer match.
S12
Requesting the user equipment to upload its capability information
S13
Receiving the requested capability information of the UE
S14
Checking whether the user equipment capability and the network configuration match
S15
Indicating to the control node whether the UE capability and the network configuration match.

Fig. 3

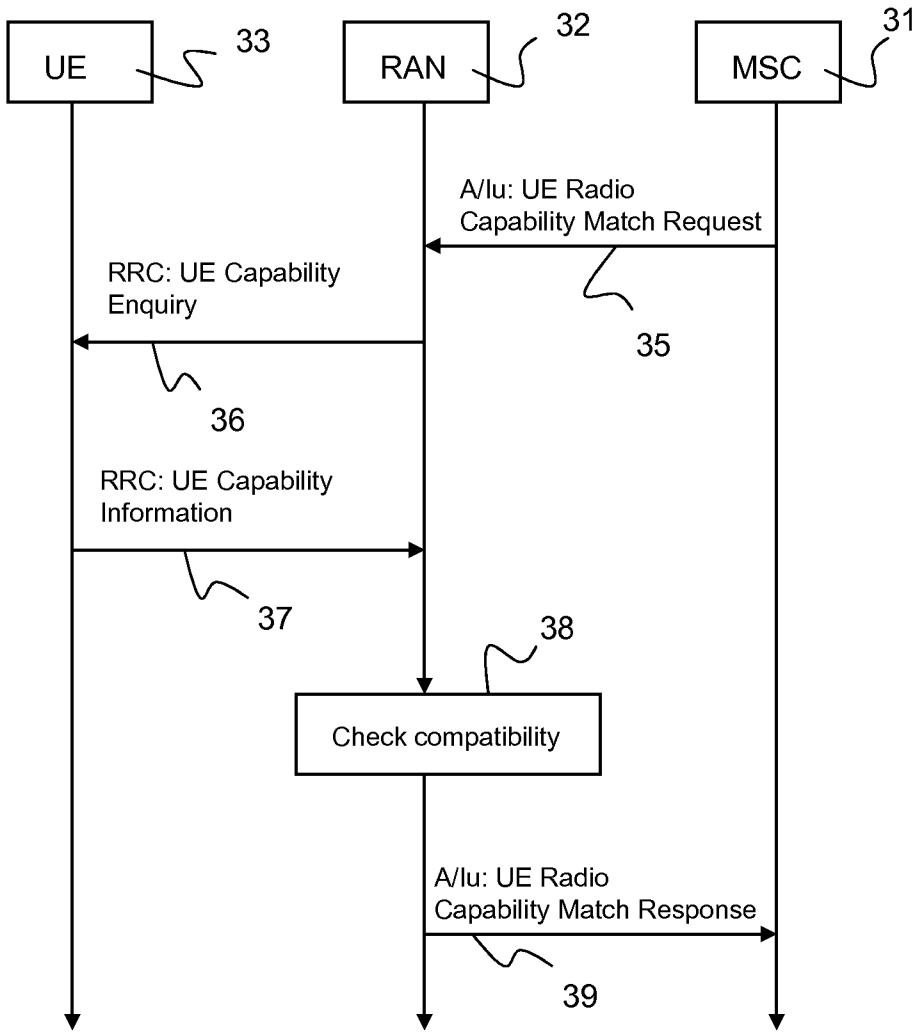
UE
33
RAN
32
MSC
31
A/Iu: UE Radio
Capability Match Request
35
RRC: UE Capability
Enquiry
36
RRC: UE Capability
Information
37
38
Check compatibility
A/Iu: UE Radio
Capability Match Response
39

Fig. 4

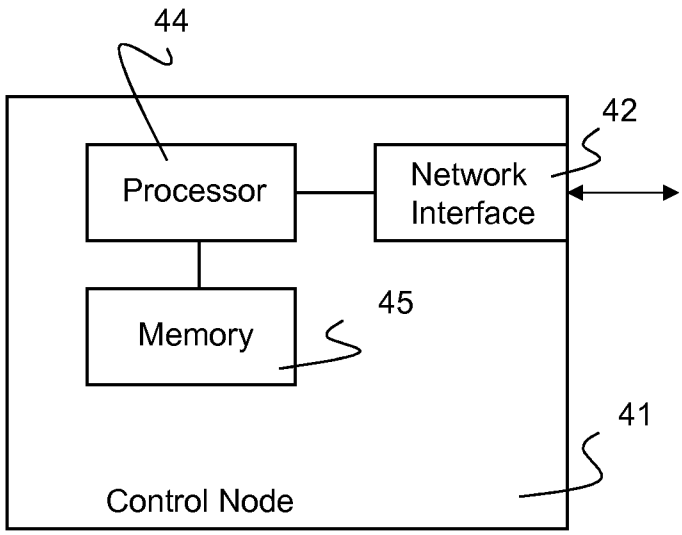
44
42
Processor
Network Interface
Memory
45
41
Control Node

Fig. 5

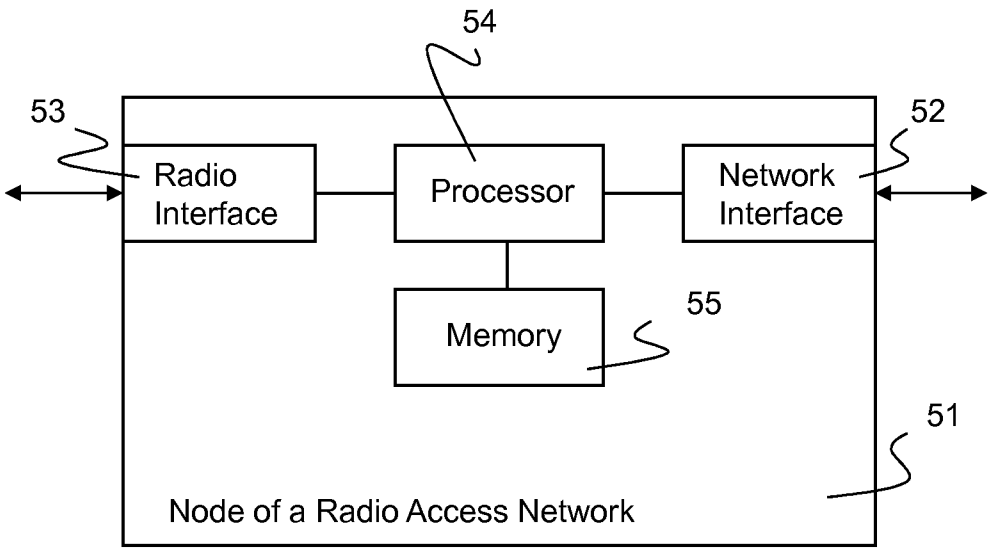
54
53
52
Radio Interface
Processor
Network Interface
Memory
55
51
Node of a Radio Access Network

Fig. 6

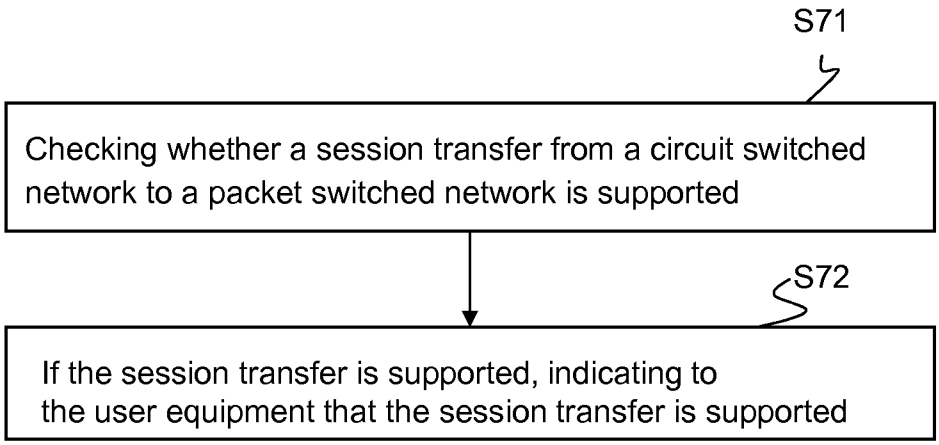
S71
Checking whether a session transfer from a circuit switched network to a packet switched network is supported
S72
If the session transfer is supported, indicating to the user equipment that the session transfer is supported

Fig. 7

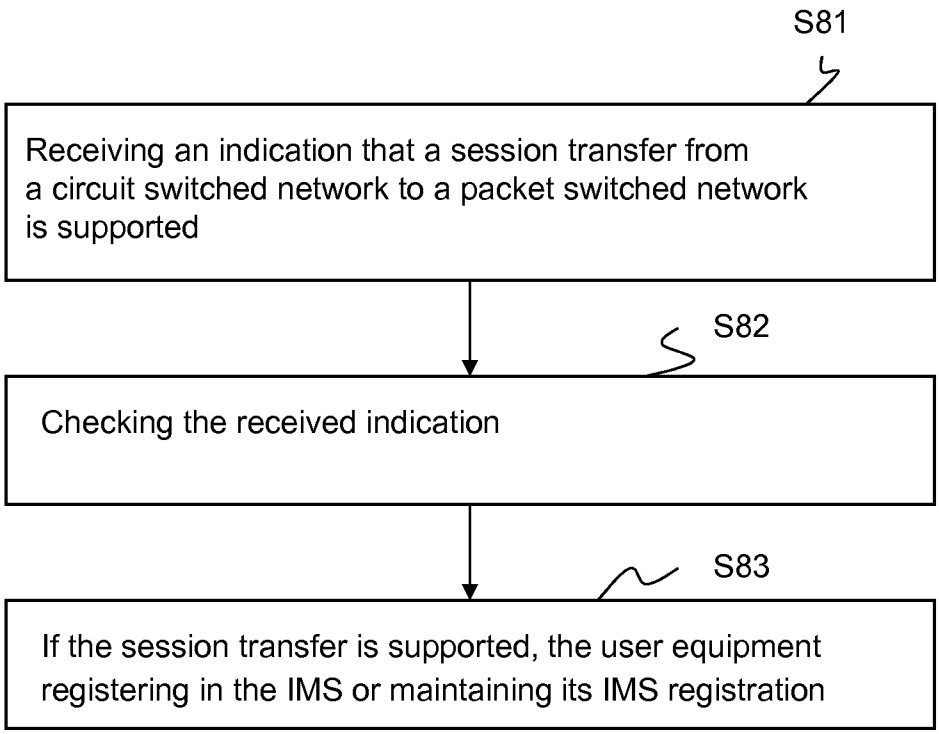
S81
Receiving an indication that a session transfer from a circuit switched network to a packet switched network is supported
S82
Checking the received indication
S83
If the session transfer is supported, the user equipment registering in the IMS or maintaining its IMS registration

Fig. 8

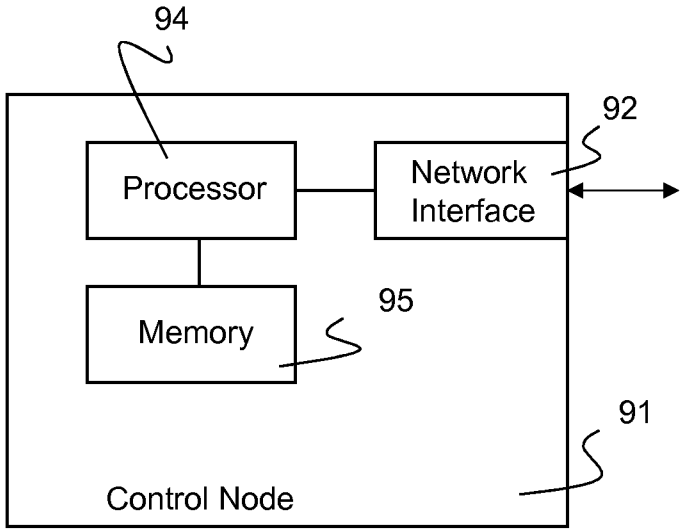
94
92
Processor
Network Interface
Memory
95
91
Control Node

Fig. 9

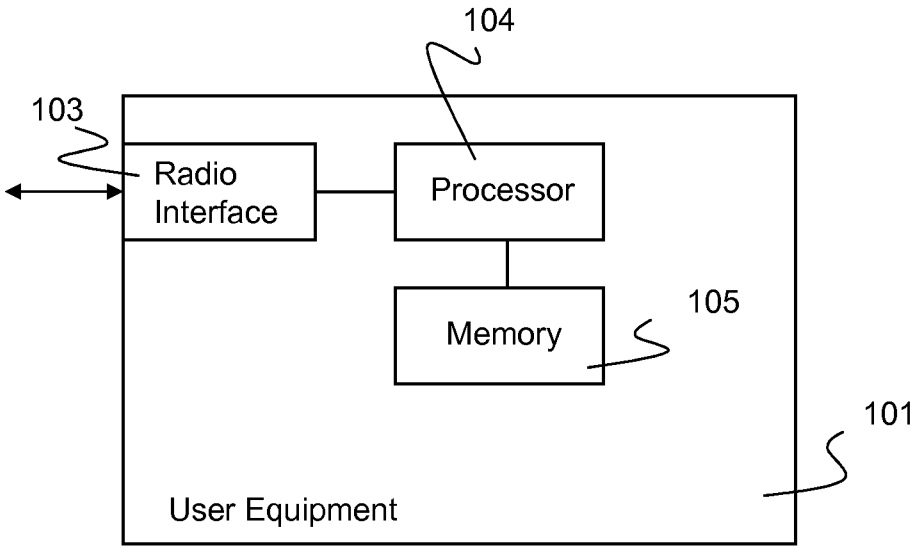
104
103
Radio Interface
Processor
Memory
105
101
User Equipment

Fig. 10