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(54) Title: CODEC CHANGE ON IP-BASED A INTERFACE

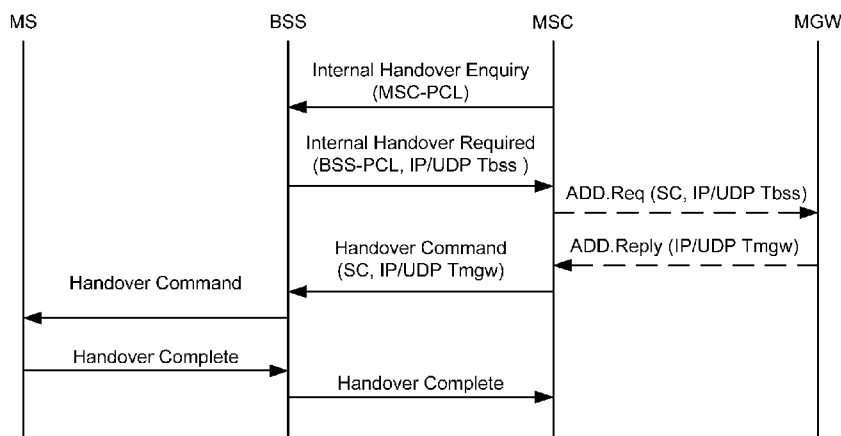


Figure 1: Codec change triggered by the Core Network

(57) Abstract: A method to perform codec changes for ongoing calls on an IP- based A interface between a base station subsystem and a mobile switching center, where the transcoding functionality is removed from the base station subsystem, the method being based on a handover procedure, and where a preparation and an execution phase are controlled via signalling messages between the base station subsystem and the mobile switching center.

Codec change on IP-based A interface

One of the main goals of the definition of an IP-based A
5 interface is the possibility to avoid using the G.711 codec
on the A interface and more in general to avoid any
transcoding in a mobile to mobile call. In other words the
goal is to allow end-to-end Transcoding-Free Operation (TrFO)
in GERAN networks.

10 In order to achieve this, an end-to-end codec negotiation is
needed when the call is first established: the two BSSs
serving the two users communicate their codec capabilities
(for that call, in that specific cell) to the Core Network at
call setup. Then the Core Network finally decides to use -
15 for that specific call - one of the codecs jointly supported
by both the BSSs.

However, when handover needs to be performed to a cell not
supporting the codec negotiated at call setup (e.g. codec x),
the MGW connected to the target BSS (the BSS including the
20 cell where the mobile station is moved to) needs to insert a
transcoding resource to perform transcoding between the codec
x (negotiated at call setup and used on one leg of the call)
and codec y (used in the other leg of the call in the target
cell after handover). When this happens Transcoder-Free
25 Operation is interrupted and voice quality might be degraded.
To re-establish TrFO, a codec re-negotiation has to be
started. For instance the Core Network could trigger a codec
change (from x to y) on the leg of the call where codec x is
still in use, to align to the other leg of the call where the
30 codec y is used. If this were possible, the MGW could remove
the transcoding resource from the path and re-establish
Transcoder-Free Operation.

The problem is that - although codec re-negotiations are
currently possible within the Core Network - there is
35 currently no defined procedure to trigger a codec change from
the Core Network to the BSS.

One of the related issues is to provide a mechanism whereby
the BSS informs the Core Network about the codecs it can
support for the ongoing call, before the Core Network

triggers a codec change towards a specific codec (i.e. codec y in the example above). Note that although the BSS communicates its codec capabilities at call setup, this is a dynamic information related to a specific time instant in a specific cell and might change in time, e.g. due to overload conditions (when only half-rate codecs can be used). Therefore a mechanism is needed to update this information for an ongoing call.

10 The proposal to solve this problem consists in:

1. The definition of a signalling message sent by the MSC to the BSS to trigger a feedback from the BSS about its current codec capabilities regarding a specific ongoing call

15 2. The definition of a signalling message sent by the BSS to the MSC containing the current codec capabilities (i.e. a BSS-PCL, BSS-Preferred Codec List) and the IP/UDP termination at the BSS to be used by the Core Network (in particular by the MGW) as a destination point for user data sent with the new codec.

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Then the idea is to reuse existing messages on the A interface: "Handover Command" from the MSC to the BSS (to finally trigger the codec change) and "Handover Complete" from the BSS to the MSC (to confirm the handover/codec change to the MSC).

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The message issued by the MSC to receive the current BSS codec capabilities could be named something like "Codec Change Request". But considering that on the radio interface a (possibly intra-cell) "Handover Command" would be finally used to modify the codec, to minimize the needed changes it makes sense to name the probe message from the MSC as "Internal Handover Request" or "Internal Handover Enquiry". This message is different from a legacy "Handover Request" sent to the target BSS during the preparation phase of an inter-BSS handover: its goal is to get back the updated BSS codec capabilities to handle a specific call and no specific

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target cell is indicated in the message (the primary goal is to change the codec, not necessarily the cell, and typically an intra-cell handover would be finally triggered in this case). On the other hand a MSC-PCL, MSC-Preferred Codec List
5 could be included in the "Internal Handover Enquiry" message to inform the BSS about the MSC codec preferences. The BSS might then use this information to decide a possible target cell that meets such requirements.

10 When receiving the "Internal Handover Enquiry" message from the MSC, the BSS responds with an "Internal Handover Required" containing:

- 15 o A target cell. This shall be a cell controlled by the same BSS and could be the same cell where the call is currently ongoing. Alternatively this could also be a cell where the BSS could better satisfy the MSC codec preferences expressed in the MSC-PCL contained in the "Internal Handover Enquiry" message
- 20 o A list with the current codec capabilities, i.e. the BSS-PCL, in the cell where the BSS intends to handle the call after the handover
- o An IP/UDP termination at the BSS (IP/UDP Tbss) to be used as a destination point for user data sent by the MGW with the finally MSC selected codec

25 This message is different from a legacy "Handover Required" sent to the MSC during the preparation phase of an inter-BSS handover: by sending this message the BSS already acknowledges the possibility to support the call in the
30 target cell (which is controlled by the same BSS) together with the information of the supported codec and IP/UDP termination to be used, so that no subsequent "Handover Request"/"Handover Request Acknowledge" message exchange is needed in the preparation phase.

35 When receiving the "Internal Handover Required" message from the BSS, the MSC selects a new codec (SC, Selected Codec)

taking into account the BSS-PCL and the need to re-establish TrFO.

The Selected Codec and the new IP/UDP Tbss termination at the BSS are communicated to the MGW so that it can add another
5 termination towards the BSS. The MGW acknowledges this request by sending back to the MSC the new IP/UDP termination at the MGW (IP/UDP Tmgw).

At this point in time existing messages are used on the A
10 interface to trigger the handover execution phase. In particular, to trigger the codec change (and possibly a cell change, if required by the BSS) the "Handover Command" message is sent by the MSC to the BSS, including the Selected Codec together with the new IP/UDP Tmgw termination. A legacy
15 handover procedure is performed on the radio interface and then the BSS finally confirms the handover/codec change to the MSC with the "Handover Complete" message.

The overall procedure is described in Figure 1.

20 The described approach for a codec change triggered by the Core Network can be reused also in case of an intra-BSS handover to an "incompatible cell", i.e. a target cell where a codec has to be used which is incompatible with respect to
25 the codec used in the source cell. For instance, this could be the case of a congested cell where only half rate codecs can be used (and the codec in use before the handover is incompatible with half rate codecs).

In this scenario the handover cannot be handled internally in
30 the BSS by informing the MSC only at the end of the procedure with the "Handover Performed" message. In fact, before performing the handover, the BSS needs to ask the Core Network to select a codec that can be supported in the target cell.

35 This can be done by issuing an unsolicited "Internal Handover Required" message, not triggered by an "Internal Handover Enquiry" message, but by the actual need to perform an internal handover and change the codec at the same time. Then

the procedure would continue exactly as in the case of a codec change triggered by the Core Network.

5 The procedure for an intra-BSS handover to an incompatible cell is described in Figure 2.

Note: the fact that codec has to be changed during an intra-BSS handover to an incompatible cell also means that the MGW connected to the BSS needs to insert a transcoding resource to perform transcoding between the codec used in the source cell (and likely used on the other leg of the call) and the codec used in the target cell after handover. This breaks Transcoder-Free Operation so that further codec re-
10 negotiations might be triggered to re-establish end-to-end TrFO.
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List of acronyms

BSS	Base Station Subsystem
20 BSC	Base Station Controller
BTS	Base Transceiver Station
GERAN	GSM/EDGE Radio Access Network
IP	Internet Protocol
MS	Mobile Station
25 MSC	Mobile Switching Centre
MGW	Media GateWay
PCL	Preferred Codec List
SC	Selected Codec
TrFO	Transcoder Free Operation
30 UDP	User Datagram Protocol

List of references

[1] 3GPP TR 43.903 v0.0.4

Claims

1. A method to perform codec changes for ongoing calls on an IP-based A interface between a base station subsystem and a mobile switching center, where the transcoding functionality is removed from the base station subsystem, the method being based on a handover procedure, and where a preparation and an execution phase are controlled via signalling messages between the base station subsystem and the mobile switching center.
2. A method according to claim 1 where during said preparation phase a signalling message, the so-called internal handover enquiry message, is sent by said mobile switching center to said base station subsystem to trigger a feedback from said base station subsystem about its current codec capabilities regarding a specific ongoing call, and wherein said signalling message includes an MSC-Preferred Codec List.
3. A method according to claim 1 or 2 where during said preparation phase a further signalling message, the so-called internal handover required message, is sent by the base station subsystem to the mobile switching center, and wherein said signalling message contains a target cell, a list containing current codec capabilities in said target cell and a target address for speech data sent with a new codec, wherein said target address comprises an IP/UDP termination at said base station subsystem.
4. A method according to claim 1 to 3, where said further signalling message, the so-called internal handover required message, is sent by the base station subsystem to the mobile switching center as a response to said signalling message, the so-called internal handover enquiry message.
5. 4. A method according to any of the claims 1 to 4 where the execution phase reuses on said IP-based A

interface a legacy messages, the so-called handover command, from the mobile switching center to the base station subsystem and a legacy message, the so-called handover complete, from the base station subsystem to the mobile switching center.

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6. A base station subsystem (BSS) comprising means arranged for performing a codec change for ongoing calls on an IP-based A interface (removed transcoder aufführen?) with a preparation phase and an execution phase wherein the means are further arranged for transmitting, during said preparation phase, a further signalling message, the so-called internal handover required message to a mobile switching center, said further signalling message containing a target cell, a list containing current codec capabilities in said target cell and a IP/UDP termination at said base station subsystem.

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7. A base station subsystem (BSS) according to claim 1 further comprising means arranged for receiving, during said preparation phase, a signalling message, the so-called internal handover enquiry message, from a mobile switching center and means for transmitting said further signalling message as a response to said signalling message.

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8. A mobile switching center (MSC) comprising means arranged for performing a codec change for ongoing calls on an IP-based A interface with a preparation phase and an execution phase wherein the means are further arranged for transmitting, during said preparation phase, a signalling message, the so-called internal handover enquiry message, to a base station subsystem and wherein said signalling message includes an MSC-Preferred Codec List and wherein the means are further arranged for receiving a further signalling message, the so-called internal handover required message, from said base station subsystem containing a target cell, a list containing current

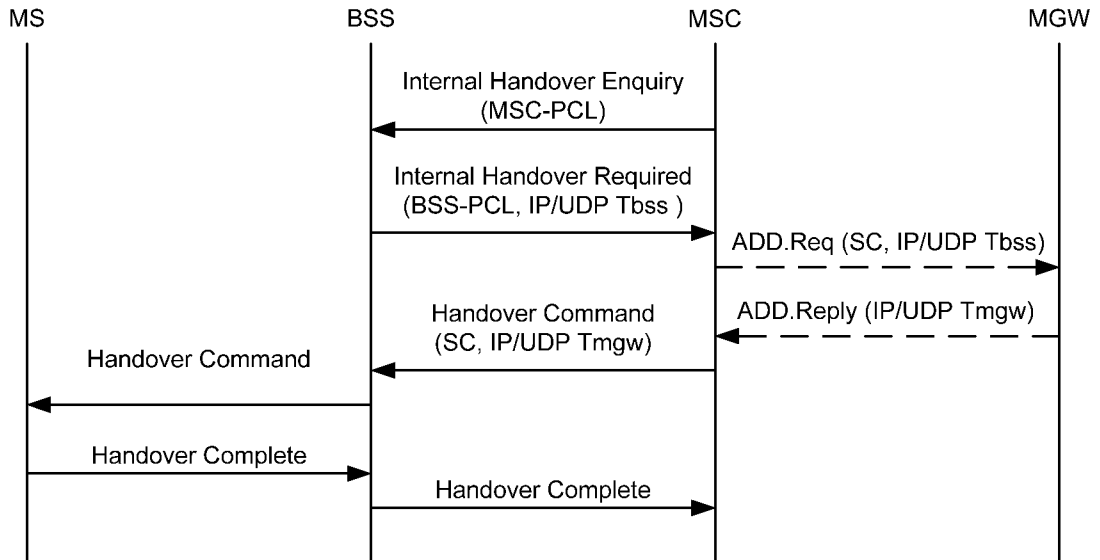
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codec capabilities in said target cell and a IP/UDP termination at said base station subsystem.

Figures



5 Figure 1: Codec change triggered by the Core Network

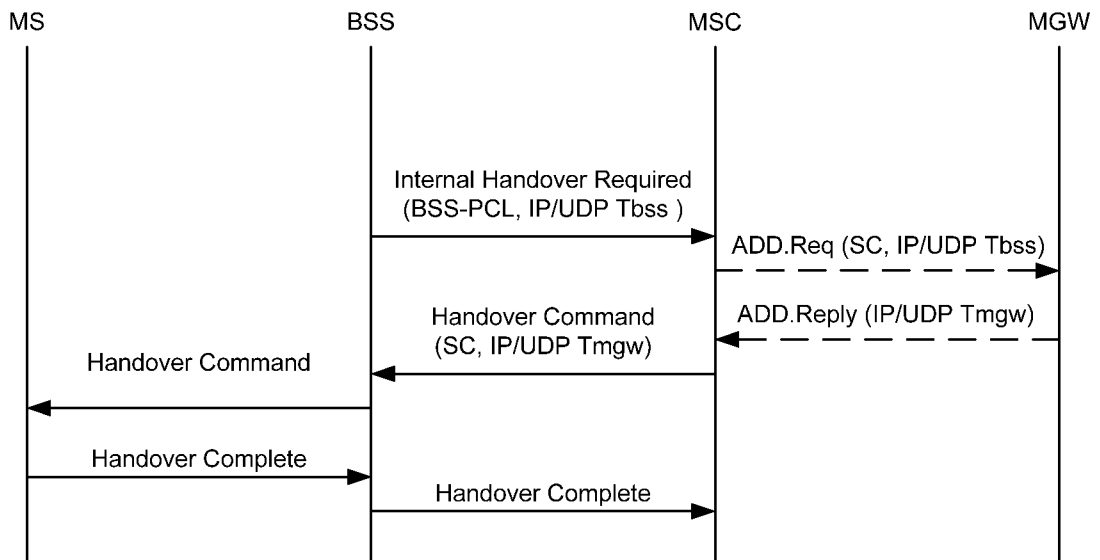


Figure 2: Codec change triggered by the BSS (intra-BSS Handover to an incompatible cell)