3GPP TSG CN Plenary Meeting #26 **NP-040520**
8th – 10th December 2004 Athens, Greece.

Source: TSG CN WG4

Title: Corrections on OoBTC

Agenda item: 7.7

Document for: APPROVAL

Spec	CR	Rev	Doc-2nd-Level N4-040	Phase	Subject	Cat	Ver_C
23.153	075		1301	Rel-4	TFO/TrFO compatibility of UMTS_AMR and UMTS_AMR2	F	4.10.0
23.153	076		1302	Rel-5	TFO/TrFO compatibility of UMTS_AMR and UMTS_AMR2	A	5.8.0
23.153	77	1	1518	Rel-4	Detailed description of the handling of codec negotiation parameters	F	4.10.0
23.153	78	1	1519	Rel-5	Detailed description of the handling of codec negotiation parameters	A	5.8.0
23.153	79	3	1701	Rel-4	Addition of missing condition for transcoder free operation in the MGW	F	4.10.0
23.153	80	3	1702	Rel-5	Addition of missing condition for transcoder free operation in the MGW	A	5.8.0

3GPP TSG-CN WG4 Meeting #25 ***N4-041301***

Seoul, KOREA. 15th to 19th November 2004.

CR-Form-v7.1

CHANGE REQUEST

⌘ **23.153** **CR** **075** ⌘ **rev** **-** ⌘ Current version: **4.10.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ ☐ ME ☐ Radio Access Network ☐ Core Network ☒

Title:	⌘	TFO/TrFO compatibility of UMTS_AMR and UMTS_AMR2
Source:	⌘	CN4
Work item code:	⌘	OoBTC
Date:	⌘	29/10/2004
Category:	⌘	**F**
Release:	⌘	Rel-4

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
Ph2 *(GSM Phase 2)*
R96 *(Release 1996)*
R97 *(Release 1997)*
R98 *(Release 1998)*
R99 *(Release 1999)*
Rel-4 *(Release 4)*
Rel-5 *(Release 5)*
Rel-6 *(Release 6)*
Rel-7 *(Release 7)*

Reason for change: ⌘ **Essential correction**

TS 26.103 (4.3.0, 5.4.0, 6.0.0) states:

"For the UMTS AMR2 this Codec Mode Adaptation can be performed every 20ms for the downlink traffic channel, but only every 40ms for the uplink radio channel. …
By this definition the UMTS AMR2 Codec Type is TFO and TrFO compatible to the FR AMR, HR AMR, UMTS AMR and UMTS AMR2 Codec Types."

TS 28.062 (4.5.0, 5.4.0, 6.0.0) states:

Table 11-1: Compatibility of AMR Codec Types

distant → ↓ local	UMTS_AMR_2	UMTS_AMR	FR_AMR	HR_AMR	OHR_AMR
UMTS_AMR_2	compatible	compatible	compatible	compatible	compatible
UMTS_AMR	compatible	compatible	-	-	-
FR_AMR	compatible	-	compatible	compatible	compatible
HR_AMR	compatible	-	compatible	compatible	compatible
OHR_AMR	compatible	-	compatible	compatible	compatible

The UMTS_AMR_2 is the preferred Codec Type for 3G systems.

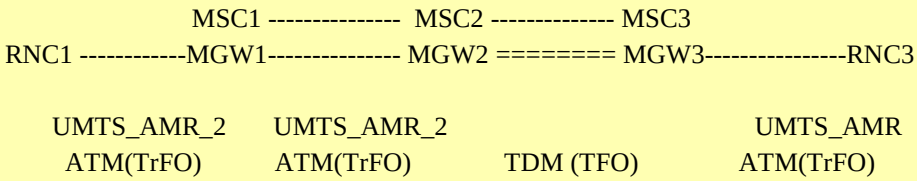
TS 23.153 (4.10.0 and 5.8.0) states:

"The UMTS_AMR_2 is a superset of the UMTS_AMR. It behaves as a FR_AMR codec in the UL and as a UMTS_AMR codec in the DL. This allows UMTS terminals to operate in TFO with GSM terminals. The UMTS_AMR_2 is fully compatible with UMTS_AMR in TFO and TrFO and fully compatible with R99 CN nodes (TC in MGW)."

In other words: UMTS_AMR_2 is TFO/TrFO compatible to UMTS_AMR and FR_AMR; but UMTS_AMR and FR_AMR (indeed all GERAN versions) are not compatible.

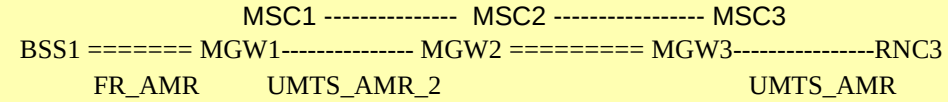
These statements are true for end-to-end TFO scenarios and end-to-end TrFO scenarios with these two Codec Types. But this may cause problems in a more complex network supporting TFO/TrFO interworking, as explained in the following:

Let us assume that a call is set up from an UE1 served by RNC1 towards an UE3 served by RNC3. UE1 supports UMTS_AMR_2, UE3 only UMTS_AMR. For the first part of the connection, UMTS_AMR_2 is negotiated via BICC OoBTC. MSC2/MGW2 and MSC3/MGW3 are connected via a TDM link and may belong to different PLMNs. Nevertheless, all the MSCs are configured so that the same active codec mode set (ACS) is selected both for UMTS_AMR_2 and UMTS_AMR.



When the TFO peer entities in MGW2 and MGW3 exchange the locally used codec types and codec configurations via TFO in-band signalling, they will come to the conclusion that immediate TFO operation is possible, since UMTS_AMR and UMTS_AMR_2 are termed “TFO compatible”. The result will be an concatenation of tandem free and transcoder free links: it will be end-to-end transcoding free.
(Note that according to TS 29.232, MSC2 and MSC3 will not be informed that TFO operation was actually successfully established. Furthermore, MSC2 will not be informed that MGW3 is actually using UMTS_AMR, unless MSC2 explicitly asked MGW2 for a list of all distant codecs.).
So far so good.

But now:
Subsequently, UE1 performs an inter-system handover to GERAN. The new codec assigned by BSS1 is FR_AMR, again with the same ACS. Now, the TFO peer entities in BSS1 and MGW1 start TFO in-band signalling and go to immediate TFO operation, since FR_AMR and UMTS_AMR_2 are TFO compatible. So we end up with a **concatenation of links using FR_AMR, UMTS_AMR_2 and UMTS_AMR**. With the information locally available at MSC1/MGW1 and MSC2/MGW2, both nodes come to the conclusion that TFO/TrFO is possible, but **end-to-end, FR_AMR and UMTS_AMR are not compatible**. Since the UMTS_AMR codec does not comply with the rate control rules of the FR_AMR codec, the result will be a higher frequency of bad speech frames in downlink direction towards UE1. This can seriously **deteriorate the speech quality**.



TDM (TFO) ATM(TrFO) TDM (TFO) ATM(TrFO)

For a solution to avoid this kind of path configuration it should be taken into account that

a) apart from R99 'UMTS only' UEs, all other UTRAN capable UEs support the UMTS_AMR_2. And it can be expected that R99 'UMTS only' UEs will soon become a small minority. Therefore, calls without involvement of an UMTS_AMR codec should be affected by the solution as little as possible.

   For this reason we do not want to require MSC1 to perform a codec modification or mid-call codec negotiation on the link between MGW1 and MGW2 after each inter-system handover of UE1, since such a requirement would apply to any call using AMR codecs. But codec changes in the core network should be avoided, if possible, since each re-initialization of the user plane will cause a short interruption of the speech transmission. Furthermore, such a requirement would create an unnecessarily high signalling load between MSC1 and MSC2 and their associated MGWs. And, most important to note: a transcoder would have to be inserted somewhere in the path.

b) Nowadays, many operating UMTS networks use the UMTS_AMR codec only in 12.2 kbit/s single mode configuration. For AMR codecs in single mode configuration, the difference in the rate control becomes meaningless.

c) Since MSC3/MGW3 can be located in a different PLMN, anywhere in the world, it cannot be excluded that in this foreign PLMN the UMTS_AMR codec is used in a multi-mode configuration with TFO.

For these reasons we propose the following solution:

i) UMTS_AMR and UMTS_AMR_2 shall only be considered as TFO- and TrFO- compatible, when used in a single mode configuration.

In the scenario above, this would mean that for an UMTS_AMR in multimode configuration immediate TFO between MGW2 and MGW3 would not be possible. MGW2 (using the new compatibility rule, for example) would terminate the TFO-negotiation. Provided that MSC2 asked MGW2 for a list of all distant codecs , MSC2 would be informed by MGW2 that UMTS_AMR was the codec used by the distant TFO partner. It would then be up to MSC2 to take appropriate measures. (Note that a codec modification from UMTS_AMR_2 to UMTS_AMR on the link between MGW1 and MGW2 would not improve this situation, because then the FR_AMR in BSS1 and the UMTS_AMR in MGW1 are not TFO-compatible. Only the point, where the transcoder is inserted, would be shifted from MGW2 to MGW1.)

ii) Since UMTS_AMR and UMTS_AMR_2 are no longer considered as TFO/TrFO-compatible in all cases, it shall be possible to discriminate clearly between the two codecs in the BICC OoBTC signalling. I.e. the UMTS_AMR_2 codec in the Supported Codecs List or Available Codecs List shall not include also the UMTS_AMR codec.

E.g. the originating MSC might want to offer in the Supported Codecs List the preferred (multimode) configuration 1 only for UMTS_AMR_2, but not for UMTS_AMR. Then the terminating MSC should not be allowed to reply with UMTS_AMR in preferred configuration 1 (which would currently be allowed according to subclause TS 23.153, 5.6).
(Note: in order to allow TrFO connections with R99 UMTS only UEs, the originating MSC can additionally include UMTS_AMR in preferred (single) mode configuration 7 to the Supported Codecs List. Or it can include UMTS_AMR in configuration 1, then the terminating MSC may select between all offers.)

Summary of change:	⌘	i) UMTS_AMR and UMTS_AMR_2 shall only be considered as TFO- and TrFO-compatible, when used in a single mode configuration with the same mode. ii) UMTS_AMR and UMTS_AMR_2 are treated as fully separate codec types in BICC OoBTC signalling. I.e. the UMTS_AMR_2 codec in the Supported Codecs List or Available Codecs List no longer includes also the UMTS_AMR codec.
Consequences if not approved:	⌘	Without the change (i), the network may set up a connection consisting of links using different codecs (FR_AMR, UMTS_AMR_2, and UMTS_AMR) that cannot be combined in TFO/TrFO end-to-end (FR_AMR and UMTS_AMR), although locally, at each node, the used codecs (FR_AMR and UMTS_AMR_2, or UMTS_AMR_2 and UMTS_AMR, respectively) are TFO/TrFO compatible. Since the UMTS_AMR codec does not comply with the rate control rules of the FR_AMR codec, the result will be a higher frequency of bad speech frames in downlink direction towards the UE using the FR_AMR codec. This can **seriously deteriorate the speech quality**. Without the change (ii), it is not possible for the originating MSC to restrict the use of UMTS_AMR to single mode configurations: if the originating MSC offers UMTS_AMR_2 in a multi mode configuration the terminating MSC could select the UMTS_AMR in the same multi mode configuration as Selected Codec.

Clauses affected:	⌘	5.6			
Other specs affected:	⌘	**Y** / **N** **X** / ☐ Other core specifications ☐ / **X** Test specifications ☐ / **X** O&M Specifications	⌘	TS 28.062, TS 26.103	
Other comments:	⌘				

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Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.6 CN Node handling of Codec Types & Codec Modes

The supported codec list received by the MSC in DTAP protocol [2] has no priority, whereas the list sent in the OoBTC procedures is sent with a level of preference.

The default Codec Type for "R99 UMTS only" terminals is UMTS_AMR, the default Codec Type for all terminals supporting GSM and UMTS radio access is UMTS_AMR_2, see [5] for the detailed description. The UMTS_AMR_2 is a superset of the UMTS_AMR. It behaves as a FR_AMR codec in the UL and as a UMTS_AMR codec in the DL. This allows all UMTS terminals, except R99 UMTS only terminals, to operate in TFO with GSM terminals. The UMTS_AMR_2 is fully compatible ~~with UMTS_AMR in TFO and TrFO and fully compatible~~ with R99 CN nodes (TC in MGW). In any multi-mode configuration the UMTS_AMR shall be treated as only TFO and TrFO compatible to itself, not to any other AMR codec Type, to avoid incompatibilities in TFO-TrFO-TFO interworking scenarios. In single mode configuration, UMTS_AMR and UMTS_AMR_2 are TFO and TrFO compatible, when both codec types use the same single rate ACS, (see [10]).

~~If the UE supports both Codec Types (UMTS_AMR and UMTS_AMR_2), then the MSC shall indicate only the UMTS_AMR_2 in the OoBTC codec negotiation.~~ If no Codec List IE is received from the UE and the UE is "UMTS only", then the MSC shall assume UMTS_AMR as supported Codec Type. If no Codec List IE is received, but the UE is "dual system", then the MSC shall assume UMTS_AMR_2 as the supported codec type. The MSC shall assume "dual system" support only if the UE indicates at least one GSM speech version in Octet 3a etc. of the Bearer Capability.

~~When a codec list contains UMTS_AMR_2 and a node in the network participating in the codec negotiation only supports UMTS_AMR then it shall indicate UMTS_AMR back although the codepoints as defined in [5] are different and only the UMTS_AMR_2 codepoint is included in the codec list it shall be allowed to signal back the codepoint for UMTS_AMR as this is a subset of the UMTS_AMR_2 codec and thus its support is implied. Similarly, if a node receives only UMTS_AMR in the codec list but it supports UMTS_AMR_2 it shall reply with the codepoint for UMTS_AMR as this is the subset that is compatible.~~

The MSC may include more than one "Single codec" element indicating the same codec type, but different configurations, in the codec list (see [5]).

NOTE: This may be necessary if the RNC supports for an adaptive multi-rate codec different sets of codec modes, e.g., (a, b, c, d) and (e, f, g), which are not subsets of each other, and the RNC does not support combinations of these sets, e.g. (a, b, c, d, e, f, g).

The MSC Server shall know the codec mode configurations supported by the RNC. These configurations shall be considered during the speech codec negotiation and the RAB Assignment.

In order to support interworking with 2G systems it is recommended that MGWs support 2G EFR codecs (GSM_EFR, PDC_EFR, TDMA_EFR). In order to avoid modifications during handover between 2G and 3G systems the MSC nodes may give preference to a suitable 2G codec.

The originating CN node, while performing speech service negotiation with a terminating CN node, shall indicate the maximum number of codec modes that shall be selected during speech codec negotiation. This maximum number of supported codec modes may depend on optimisation strategies applied by the originating CN node. The recommended value is "four" (see [10]).

The terminating CN node receiving this information compares the maximum number of codec modes received by the originating CN with its own one and shall decide on the minimum of both numbers to be applied as result of the negotiation.

The decision about the actual codec modes to be selected as the Active Codec Set (ACS) shall be left to the terminating CN node. In order to provide harmonisation of out of band codec negotiation (TrFO) and inband codec negotiation (TFO) very similar codec selection mechanisms as those being defined for TFO shall be applied for TrFO, see [10]. These rules shall be taken into account when forwarding a codec list from the originating node to proceeding node, both for TrFO and TFO.

Whenever one or several TrFO links have been already established and initialised, the CN node (e.g. the serving CN in case of Call Hold scenarios, the visited CN node in case of Call Forwarding scenarios, etc.) initiating a subsequent codec negotiation, shall give the already negotiated codec type, including its ACS, highest preference to reduce the possibility of performing bearer re-establishment or UP re-initialisation of the already established and initialised TrFO links.

When the MSC node requests a RAB assignment the Subflow Combinations provided shall either all be initialised by the RNC or all rejected with appropriate cause code.

The MSC shall always assume "Discontinuous Transmission (DTX)" as mandatory and shall define “SID” SDUs in addition to the negotiated speech codec modes. This is because for TrFO the RAB requested by one RNC must match that requested by the peer RNC – they are effectively the same RAB. If one MSC requires DTX support then the RAB requested by the far end MSC must also support DTX (even if it is not desired by that MSC). As no Out Of Band negotiation for DTX is supported nor DTX control to the UE, DTX shall be mandatory for TrFO connections.

Once the common ACS has been selected the MSCs shall indicate in the RAB Assignment parameters [3] for the Guaranteed Bitrate the lowest speech mode in the ACS (assuming any SID frames are smaller than the SDU for lowest speech mode, otherwise the Guaranteed Bitrate shall be set to the largest SID frame). The Maximum bitrate shall correspond to the highest mode in the ACS.

3GPP TSG-CN WG4 Meeting #25 ***N4-041302***

Seoul, KOREA. 15th to 19th November 2004.

CR-Form-v7.1

CHANGE REQUEST

⌘ **23.153** **CR** **076** ⌘ **rev** **-** ⌘ Current version: **5.8.0** ⌘

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Proposed change affects: UICC apps⌘ ☐ ME ☐ Radio Access Network ☐ Core Network ☒

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Source:	⌘	CN4
Work item code:	⌘	OoBTC
Date:	⌘	29/10/2004
Category:	⌘	**A**
Release:	⌘	Rel-5

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Reason for change: ⌘ **Essential correction**

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By this definition the UMTS AMR2 Codec Type is TFO and TrFO compatible to the FR AMR, HR AMR, UMTS AMR and UMTS AMR2 Codec Types."

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Table 11-1: Compatibility of AMR Codec Types

distant → ↓ local	UMTS_AMR_2	UMTS_AMR	FR_AMR	HR_AMR	OHR_AMR
UMTS_AMR_2	compatible	compatible	compatible	compatible	compatible
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The UMTS_AMR_2 is the preferred Codec Type for 3G systems.

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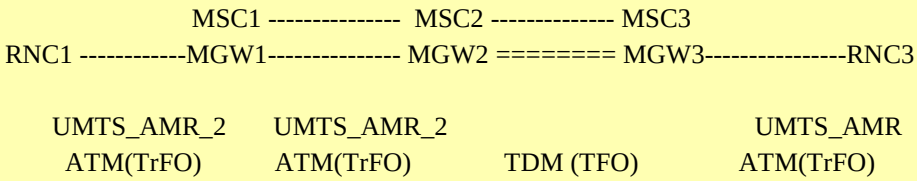
These statements are true for end-to-end TFO scenarios and end-to-end TrFO scenarios with these two Codec Types. But this may cause problems in a more complex network supporting TFO/TrFO interworking, as explained in the following:

Let us assume that a call is set up from an UE1 served by RNC1 towards an UE3 served by RNC3. UE1 supports UMTS_AMR_2, UE3 only UMTS_AMR. For the first part of the connection, UMTS_AMR_2 is negotiated via BICC OoBTC. MSC2/MGW2 and MSC3/MGW3 are connected via a TDM link and may belong to different PLMNs. Nevertheless, all the MSCs are configured so that the same active codec mode set (ACS) is selected both for UMTS_AMR_2 and UMTS_AMR.



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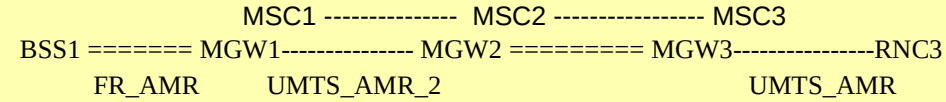

TDM (TFO) ATM(TrFO) TDM (TFO) ATM(TrFO)

For a solution to avoid this kind of path configuration it should be taken into account that

a) apart from R99 'UMTS only' UEs, all other UTRAN capable UEs support the UMTS_AMR_2. And it can be expected that R99 'UMTS only' UEs will soon become a small minority. Therefore, calls without involvement of an UMTS_AMR codec should be affected by the solution as little as possible.

   For this reason we do not want to require MSC1 to perform a codec modification or mid-call codec negotiation on the link between MGW1 and MGW2 after each inter-system handover of UE1, since such a requirement would apply to any call using AMR codecs. But codec changes in the core network should be avoided, if possible, since each re-initialization of the user plane will cause a short interruption of the speech transmission. Furthermore, such a requirement would create an unnecessarily high signalling load between MSC1 and MSC2 and their associated MGWs. And, most important to note: a transcoder would have to be inserted somewhere in the path.

b) Nowadays, many operating UMTS networks use the UMTS_AMR codec only in 12.2 kbit/s single mode configuration. For AMR codecs in single mode configuration, the difference in the rate control becomes meaningless.

c) Since MSC3/MGW3 can be located in a different PLMN, anywhere in the world, it cannot be excluded that in this foreign PLMN the UMTS_AMR codec is used in a multi-mode configuration with TFO.

For these reasons we propose the following solution:

i) UMTS_AMR and UMTS_AMR_2 shall only be considered as TFO- and TrFO- compatible, when used in a single mode configuration.

In the scenario above, this would mean that for an UMTS_AMR in multimode configuration immediate TFO between MGW2 and MGW3 would not be possible. MGW2 (using the new compatibility rule, for example) would terminate the TFO-negotiation. Provided that MSC2 asked MGW2 for a list of all distant codecs , MSC2 would be informed by MGW2 that UMTS_AMR was the codec used by the distant TFO partner. It would then be up to MSC2 to take appropriate measures. (Note that a codec modification from UMTS_AMR_2 to UMTS_AMR on the link between MGW1 and MGW2 would not improve this situation, because then the FR_AMR in BSS1 and the UMTS_AMR in MGW1 are not TFO-compatible. Only the point, where the transcoder is inserted, would be shifted from MGW2 to MGW1.)

ii) Since UMTS_AMR and UMTS_AMR_2 are no longer considered as TFO/TrFO-compatible in all cases, it shall be possible to discriminate clearly between the two codecs in the BICC OoBTC signalling. I.e. the UMTS_AMR_2 codec in the Supported Codecs List or Available Codecs List shall not include also the UMTS_AMR codec.

E.g. the originating MSC might want to offer in the Supported Codecs List the preferred (multimode) configuration 1 only for UMTS_AMR_2, but not for UMTS_AMR. Then the terminating MSC should not be allowed to reply with UMTS_AMR in preferred configuration 1 (which would currently be allowed according to subclause TS 23.153, 5.6).
(Note: in order to allow TrFO connections with R99 UMTS only UEs, the originating MSC can additionally include UMTS_AMR in preferred (single) mode configuration 7 to the Supported Codecs List. Or it can include UMTS_AMR in configuration 1, then the terminating MSC may select between all offers.)

Summary of change:	⌘	i) UMTS_AMR and UMTS_AMR_2 shall only be considered as TFO- and TrFO-compatible, when used in a single mode configuration with the same mode. ii) UMTS_AMR and UMTS_AMR_2 are treated as fully separate codec types in BICC OoBTC signalling. I.e. the UMTS_AMR_2 codec in the Supported Codecs List or Available Codecs List no longer includes also the UMTS_AMR codec.
Consequences if not approved:	⌘	Without the change (i), the network may set up a connection consisting of links using different codecs (FR_AMR, UMTS_AMR_2, and UMTS_AMR) that cannot be combined in TFO/TrFO end-to-end (FR_AMR and UMTS_AMR), although locally, at each node, the used codecs (FR_AMR and UMTS_AMR_2, or UMTS_AMR_2 and UMTS_AMR, respectively) are TFO/TrFO compatible. Since the UMTS_AMR codec does not comply with the rate control rules of the FR_AMR codec, the result will be a higher frequency of bad speech frames in downlink direction towards the UE using the FR_AMR codec. This can **seriously deteriorate the speech quality**. Without the change (ii), it is not possible for the originating MSC to restrict the use of UMTS_AMR to single mode configurations: if the originating MSC offers UMTS_AMR_2 in a multi mode configuration the terminating MSC could select the UMTS_AMR in the same multi mode configuration as Selected Codec.

Clauses affected:	⌘	5.6			
Other specs affected:	⌘	**Y** / **N** **X** / ☐ Other core specifications ☐ / **X** Test specifications ☐ / **X** O&M Specifications	⌘	TS 28.062, TS 26.103	
Other comments:	⌘				

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.6 CN Node handling of Codec Types & Codec Modes

The supported codec list received by the MSC in DTAP protocol [2] has no priority, whereas the list sent in the OoBTC procedures is sent with a level of preference.

The default Codec Type for "R99 UMTS only" terminals is UMTS_AMR, the default Codec Type for all terminals supporting GSM and UMTS radio access is UMTS_AMR_2, see [5] for the detailed description. The UMTS_AMR_2 is a superset of the UMTS_AMR. It behaves as a FR_AMR codec in the UL and as a UMTS_AMR codec in the DL. This allows all UMTS terminals, except R99 UMTS only terminals, to operate in TFO with GSM terminals. The UMTS_AMR_2 is fully compatible ~~with UMTS_AMR in TFO and TrFO and fully compatible~~ with R99 CN nodes (TC in MGW). In any multi-mode configuration the UMTS_AMR shall be treated as only TFO and TrFO compatible to itself, not to any other AMR codec Type, to avoid incompatibilities in TFO-TrFO-TFO interworking scenarios. In single mode configuration, UMTS_AMR and UMTS_AMR_2 are TFO and TrFO compatible, when both codec types use the same single rate ACS, (see [10]).

~~If the UE supports both Codec Types (UMTS_AMR and UMTS_AMR_2), then the MSC shall indicate only the UMTS_AMR_2 in the OoBTC codec negotiation.~~ If no Codec List IE is received from the UE and the UE is"UMTS only", then the MSC shall assume UMTS_AMR as supported Codec Type. If no Codec List IE is received, but the UE is "dual system", then the MSC shall assume UMTS_AMR_2 as the supported codec type. The MSC shall assume "dual system" support only if the UE indicates at least one GSM speech version in Octet 3a etc. of the Bearer Capability.

~~When a codec list contains UMTS_AMR_2 and a node in the network participating in the codec negotiation only supports UMTS_AMR then it shall indicate UMTS_AMR back, although the codepoints as defined in [5] are different and only the UMTS_AMR_2 codepoint is included in the codec list it shall be allowed to signal back the codepoint for UMTS_AMR as this is a subset of the UMTS_AMR_2 codec and thus its support is implied. Similarly, if a node receives only UMTS_AMR in the codec list but it supports UMTS_AMR_2 it shall reply with the codepoint for UMTS_AMR as this is the subset that is compatible.~~

The MSC may include more than one "Single codec" element indicating the same codec type, but different configurations, in the codec list (see [5]).

NOTE: This may be necessary if the RNC supports for an adaptive multi-rate codec different sets of codec modes, e.g., (a, b, c, d) and (e, f, g), which are not subsets of each other, and the RNC does not support combinations of these sets, e.g. (a, b, c, d, e, f, g).

The MSC Server shall know the codec mode configurations supported by the RNC. These configurations shall be considered during the speech codec negotiation and the RAB Assignment.

In order to support interworking with 2G systems it is recommended that MGWs support 2G EFR codecs (GSM_EFR, PDC_EFR, TDMA_EFR). In order to avoid modifications during handover between 2G and 3G systems the MSC nodes may give preference to a suitable 2G codec.

For GERAN Iu-mode the MSC Server receives a list of codec types (for definition see [15]) as well as the supported codec modes (for an adaptive multi-rate codec type) within the RANAP INITIAL UE MESSAGE, indicating the GERAN capabilities, which will be available at the RAB establishment procedure. With this information the MSC Server shall puncture out (i.e. delete) those codec types and codec modes (for an adaptive multi-rate codec type) from the supported codec list (for definition see [5]) taking into account the GERAN classmark and the MS capabilities which are not supported by the GERAN. This possibly reduced list shall be used by the MSC Server during the negotiation procedure as described in clause 5.1. The value of the maximum number of supported codec modes shall be set to "four" (see [10]).

The originating CN node, while performing speech service negotiation with a terminating CN node, shall indicate the maximum number of codec modes that shall be selected during speech codec negotiation. This maximum number of supported codec modes may depend on optimisation strategies applied by the originating CN node. The recommended value is "four" (see [10]).

The terminating CN node receiving this information compares the maximum number of codec modes received by the originating CN with its own one and shall decide on the minimum of both numbers to be applied as result of the negotiation.

The decision about the actual codec modes to be selected as the Active Codec Set (ACS) shall be left to the terminating CN node. In order to provide harmonisation of out of band codec negotiation (TrFO) and inband codec negotiation

(TFO) very similar codec selection mechanisms as those being defined for TFO shall be applied for TrFO, see [10]. These rules shall be taken into account when forwarding a codec list from the originating node to proceeding node, both for TrFO and TFO.

Whenever one or several TrFO links have been already established and initialised, the CN node (e.g. the serving CN in case of Call Hold scenarios, the visited CN node in case of Call Forwarding scenarios, etc.) initiating a subsequent codec negotiation, shall give the already negotiated codec type, including its ACS, highest preference to reduce the possibility of performing bearer re-establishment or UP re-initialisation of the already established and initialised TrFO links.

When the MSC node requests a RAB assignment the Subflow Combinations provided shall either all be initialised by the RNC or all rejected with appropriate cause code.

The MSC shall always assume "Discontinuous Transmission (DTX)" as mandatory and shall define “SID” SDUs in addition to the negotiated speech codec modes. This is because for TrFO the RAB requested by one RNC must match that requested by the peer RNC – they are effectively the same RAB. If one MSC requires DTX support then the RAB requested by the far end MSC must also support DTX (even if it is not desired by that MSC). As no Out Of Band negotiation for DTX is supported nor DTX control to the UE, DTX shall be mandatory for TrFO connections.

Once the common ACS has been selected the MSCs shall indicate in the RAB Assignment parameters [3] for the Guaranteed Bitrate the lowest speech mode in the ACS (assuming any SID frames are smaller than the SDU for lowest speech mode, otherwise the Guaranteed Bitrate shall be set to the largest SID frame). The Maximum bitrate shall correspond to the highest mode in the ACS.

3GPP TSG-CN WG4 Meeting #25 ***N4-041518***

Seoul, KOREA. 15th to 19th November 2004. (rev of N4-041397)

CR-Form-v7.1

CHANGE REQUEST

⌘ **23.153** **CR** **077** ⌘ **rev** **1** ⌘ Current version: **4.10.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ ☐ ME ☐ Radio Access Network ☐ Core Network ☒

Title:	⌘	Detailed description of the handling of codec negotiation parameters
Source:	⌘	CN4
Work item code:	⌘	OoBTC
Date:	⌘	2/11/2004
Category:	⌘	**F**
Release:	⌘	Rel-4

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
Ph2 *(GSM Phase 2)*
R96 *(Release 1996)*
R97 *(Release 1997)*
R98 *(Release 1998)*
R99 *(Release 1999)*
Rel-4 *(Release 4)*
Rel-5 *(Release 5)*
Rel-6 *(Release 6)*
Rel-7 *(Release 7)*

Reason for change: ⌘ **Essential correction**

1) The use of the "Optimization Mode" (OM) parameter during OoBTC procedures is not clearly defined:

TS 26.103, subclause 5.4, refers to TS 23.153:

> Optimisation Mode for ACS , OM: one bit.
> Coding: "0": Optimisation of the ACS not supported, "1": Optimisation of the ACS supported.
> The Optimisation Mode indicates in TFO, whether the sending side supports the modification (optimisation) of its ACS for the needs of the distant side. This parameter is necessary in UMTS OoBTC to support TFO in "transcoders at the edge" scenarios. In case the OM is set to "not supported" the offered ACS cannot be altered.
> Only Rate Control can then be used to restrict the modes within the ACS.
> The use of the Optimisation Mode parameter for TrFO is defined in 3GPP TS 23.153 [9].

TS 23.153 mentions this parameter in the context of TrFO/TFO interworking ("Codec Negotiation Harmonisation"):

> The TFO package allows the Server to request the MGW to initiate TFO protocol towards a far end transcoder. The package includes a property to turn off the TFO (TFO_Active); this may be required prior to TrFO break situations such as handover. The control of the level of negotiation is performed by the "Optimisation Mode" parameter in the Codec List IE see [5]. This allows a node to indicate if the ACS may be punctured or not and this is mapped to the appropriate parameter in the TFO protocol

	by the MGW. but it remains unclear whether the puncturing of the ACS refers to the TFO or TrFO procedures or both. There is, however, also an important application of the "Optimization Mode" parameter for pure TrFO scenarios (without any involvement of TFO): real-world UTRAN implementations may support only a limited number of codec configurations. This means: - only certain codec configurations are supported; - subsets of the ACS of these codec configurations may not be supported - codec modes supported within a codec configuration are not necessarily supported as single mode configurations. For such a UTRAN implementation the MSC Server must be able to indicate to the other nodes that the offered ACS must not be modified during the OoBTC procedure, but either accepted or rejected as offered. 2) Inter-vendor discussions related to the standardization of SIP/BICC interworking have shown that the handling of the Supported Codecs List, Available Codecs List and Selected Codec in the BICC protocol needs to be specified in more detail, especially for the 3GPP specific case that AMR or AMR-WB codecs are involved in the signalling.
Summary of change: ⌘	1) The use of the "Optimsiation mode" parameter is described in the generic context of the handling of codec types and codec configurations. 2) Handling of the Supported Codecs List, Available Codecs List and Selected Codec in the BICC protocol is specified in detail.
Consequences if not approved: ⌘	1) Without clear description the "Optimization Mode" parameter cannot be implemented in OoBTC and consequently certain real-word UTRAN implementations which support only a limited number of codec configurations cannot be supported. (These UTRAN implementations can be expected especially for the introduction phase of UMTS.) 2) Without clear description of the parameter handling, interoperability problems between CN equipment from different vendors can be expected. If codec negotiation parameters are sent in an unexpected format or are changed in an unexpected way, dependent on the implemented error handling, in the worst case this can cause the release of a call.

Clauses affected:	⌘	2, 3.1, 3.2, 5.5, 5.6, 5.8.1, 5.8.2, 5.8.3			
		Y	**N**		
Other specs affected:	⌘		X	Other core specifications	⌘
			X	Test specifications	
			X	O&M Specifications	
Other comments:	⌘				

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 23.107: "QoS Concept and Architecture".

[2] 3GPP TS 24.008: "Mobile radio interface layer 3 specification Core Network Protocols –Stage 3".

[3] 3GPP TS 25.413: "UTRAN Iu Interface RANAP Signalling".

[4] 3GPP TS 25.415: "UTRAN Iu Interface User Plane Protocols".

[5] 3GPP TS 26.103: "Speech codec list for GSM and UMTS".

[6] 3GPP TS 29.205: "3rd Generation Partnership Project; Technical Specification Group CoreNetwork; Application of Q.1900 series to Bearer Independent circuit-switched core Network architecture; Stage 3".

[7] ITU-T Recommendation Q.765.5: "Signalling system No. 7; Application transport mechanism: Bearer Independent Call Control (BICC)".

[8] 3GPP TS 23.205: "Bearer-independent CS Core Network.".

[9] 3GPP TS 33.106: "3GPP Security; Lawful Interception Requirements".

[10] 3GPP TS 28.062: "Inband Tandem Free Operation (TFO) of Speech Codecs; Service Description; Stage 3".

[11] 3GPP TS 23.009: "Handover Procedures".

[12] 3GPP TS 29.232: "Media Gateway Controller (MGC) – Media Gateway (MGW) interface; Stage 3".

[13] ITU-T H.248: "Gateway Control Protocol".

[14] 3GPP TS 29.415: "Customised Applications for Mobile network Enhanced Logic (CAMEL) Phase 3; CAMEL Application Part (CAP) specification".

[15] 3GPP TS 34.108: "Common test environments for User Equipment (UE) conformance testing".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following definitions apply:

Codec: device to encode information from its original representation into an encoded form and to decode encoded information into its original representation

Codec Lists, Selected Codecs: The OoBTC procedures pass a number of codec lists created by comparing the capabilities of the different nodes or equipment involved. For the different interfaces involved during call setup, handover, and relocation, the following codec lists and selected codecs need to be distinguished:

i) Supported Codecs List (DTAP) – this is the list of codecs supported by the UE. It is subdivided into codecs supported for the currently used radio access and codecs that can be used for other radio accesses supported by the UE. The list contains only the codec types, but not the individual configuration, as the UE is mandated to support all configurations for a given codec type.

ii) Supported Codecs List (BICC) – this list is used on NNI (BICC) OoBTC signalling. At call setup it is sent forward by the node originating the OoBTC signalling and contains the default PCM codec and a set of codecs that is common to the nodes and the equipment involved in setting up the call. For a mobile originating call, these are the UE and the MGWs involved in the connection and, for UTRAN and GERAN Iu-mode, also the originating radio access. At inter-MSC relocation and inter-MSC handover, the Supported Codecs List (BICC) is sent forward by the anchor MSC towards the target MSC and contains the default PCM codec and a set of codecs that is common to the anchor MSC and the nodes involved in setting up the new call leg towards the target MSC. For UDI/RDI multimedia calls with fallback and service change according to 3GPP TS 23.172 [17], the multimedia dummy codec will be included (see 3GPP TS 26.103 [5]).

iii) Available Codecs List (BICC) – this is the list of codecs available for the NNI connection. It is returned in the backward signalling to the node that originated the OoBTC and is a subset of the Supported Codecs List (BICC) sent forward. At call setup the Available Codecs List (BICC) contains the default PCM codec and a common set of codecs that can be supported by all nodes and, if Transcoder Free Operation has been achieved end-to-end, also by the UEs and the radio access networks that are involved in the call. At inter-MSC relocation and inter-MSC handover to UMTS, the Available Codecs List (BICC) contains the default PCM codec and a set of codecs that can be supported by all nodes involved in setting up the new call leg towards the target MSC and, if Transcoder Free Operation can be maintained end-to-end after the handover or relocation, also by the UE and the target radio access network.

iv) Selected Codec (BICC) – this is the codec selected to be used on the NNI connection. It is one of the codecs contained in the Available Codecs List (BICC) and may be different from the codec that is used on the radio interface, but if end-to-end Transcoder Free Operation has been achieved, this will be the common codec for all nodes, the UEs, and the radio accesses.

v) Iu-Supported Codecs List (MAP) – this list is used for MAP signalling from the anchor MSC to the target MSC. It is subdivided into lists for UTRAN and GERAN Iu-mode and contains the codecs common to the UE and to the anchor MGW for each radio access supported by the UE. The codec capabilities of the serving radio access, i.e. the radio access used prior to the inter-MSC handover or relocation, are not taken into account. Codecs that are only applicable to the NNI, e.g. the default PCM codec or the multimedia dummy codec (see 3GPP TS 26.103 [5]), are not included.

vi) Iu-Available Codecs List (MAP) – this is the list of codecs available for the target Iu interface. When returned by the target MSC to the anchor MSC in response to an initial Prepare Handover message it is the Iu-Supported Codecs List (MAP) reduced according to the capabilites of the target MGW and the target radio access. After a subsequent intra-MSC handover or relocation, the target MSC may update the Iu-Available Codecs List (MAP) according to the capabilites of its associated MGW and the new target radio access, if necessary.

vii) Iu-Selected Codec (MAP) – this is the codec selected for the target Iu interface. It is one of the codecs contained in the Iu-Available Codecs List (MAP). In response to a Prepare Handover request message this is the codec selected by the target MSC and indicated back to the anchor MSC. When sent from the anchor MSC in a Forward Access Signalling request message during a codec modification, it contains the codec type and configuration chosen by the anchor MSC.

viii) Iu-Currently Used Codec (MAP) – this is the codec in use on the serving Iu interface prior to an inter-MSC handover.

ix) TFO Codec List (H.248) – this is the list of codecs for use by the MGW during TFO in-band negotiations with a distant node. The list is passed via the Mc interface from the server to the MGW. The first entry of the TFO Codec List (H.248) is to be used by the MGW as the 'local used codec' (see [10]).

x) Distant Codec List (H.248) – this is the list of codecs received by the MGW from a distant node during TFO in-band negotiations. The list is passed via the Mc interface from the MGW to the server. The first entry of the Distant Codec List (H.248) is the 'distant used codec' received by the MGW (see [10]).

xi) Codec (H.248) – this is the codec for use on a certain MGW termination. It is passed via the Mc interface from the server to the MGW.

For the codecs in the Supported Codecs List (DTAP), no order of priority is defined. Within the lists ii and v, the codecs are ordered in decreasing order of priority, the first entry in the list being the highest priority codec (preferred codec).

Tandem Free Operation: configuration of a connection with two transcoders that support TFO protocol and whose external coding schemes are compatible, thus enabling compressed speech to pass between them

NOTE 1: When the TFO protocol is not supported by both transcoders or the coding schemes are not compatible then normal "Tandem" operation occurs and PCM encoded speech is passed between them.

Transcoder: device to change the encoding of information from one particular encoding scheme to a different one, most commonly to/from a compressed speech algorithm from/to PCM.

Transcoder Free Operation: configuration of a speech or multimedia call for which no transcoder device is physically present in the communication path and hence no control or conversion or other functions can be associated with it

Out of Band Transcoder Control: capability of a system to negotiate the types of codecs and codec modes on a call per call basis through out-of-band signalling, required to establish Transcoder Free Operation.

Default PCM Codec: network default 64kb/s codec for speech in PCM domain

NOTE 2: For example ITU G.711 A-law.

-**Transcoding free link (TrFL)**: bearer link, where compressed voice is being carried between bearer endpoints

NOTE 3: Within the UMTS network, the compressed voice is transmitted in Iu/ Nb User Plane format, depending on the related interface.

Tandem free link (TFOL): bearer link between transcoders that are operating in Tandem Free Operation mode, i.e. bypassing the transcoding functions

NOTE 4: The involved transcoders can be a UMTS transcoder or a GSM TRAU with TFO functionality.

Transcoder free operation (TrFO): calls that have no transcoders involved in the connection between the source codecs

NOTE 5: For mobile to mobile calls this is UE to UE, although the connection could be UE to another type of terminal. TrFO operation is considered a concatenation of TrFLs between RNCs.

NOTE 6: In case of mobile to fixed network calls the term "Transcoder free operation" is applicable for the TrFLs carrying compressed speech. The TrFO usually ends at the Gateway to the PSTN where the speech is transcoded e.g. to G.711.

Tandem free and Transcoding free operation (TaTrFO): concatenation of "transcoding free links" and "tandem free links"

Iu Framing: framing protocol used for the speech packets on both the Iu User Plane interface and the Nb User Plane interface

NOTE 7: The Iu framing protocol is specified by [4].

In addition, the definitions of **ACS, SCS, OM,** and **MACS** provided in [5] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations defined in 3GPP TS 21.905 and the following apply:

ACS	Active Codec mode Set
APM	Application Transport Mechanism
BC	Bearer Control
BICC	Bearer Independent Call Control
CC	Call Control
CCD	Conference Call Device
CFNRc	Call Forward Not Reachable
CFNRy	Call Forward on No Reply
IN	Intelligent Network
IuFP	Iu Framing Protocol
MACS	Maximal number of codec modes in the ACS
OM	Optimization Mode
OoBTC	Out-of-Band Transcoder Control
QoS	Quality of Service
RAB	Radio Access Bearer
SCS	Supported Codec mode Set
TFO	Tandem Free Operation
TICC	Transport Independent Call Control
TrFO	Transcoder Free Operation
UP	User Plane

********** NEXT MODIFIED SECTION **********

5.5 TrFO/TFO Codec Negotiation Harmonisation

When OoBTC procedures are initiated to a node where compressed voice cannot be supported (either at the node or to the preceding node) then a transcoder is inserted. This can be due to the transport technology (e.g. TDM) or due to the access technology (e.g. GSM). The OoBTC procedures can result in the following call scenarios:

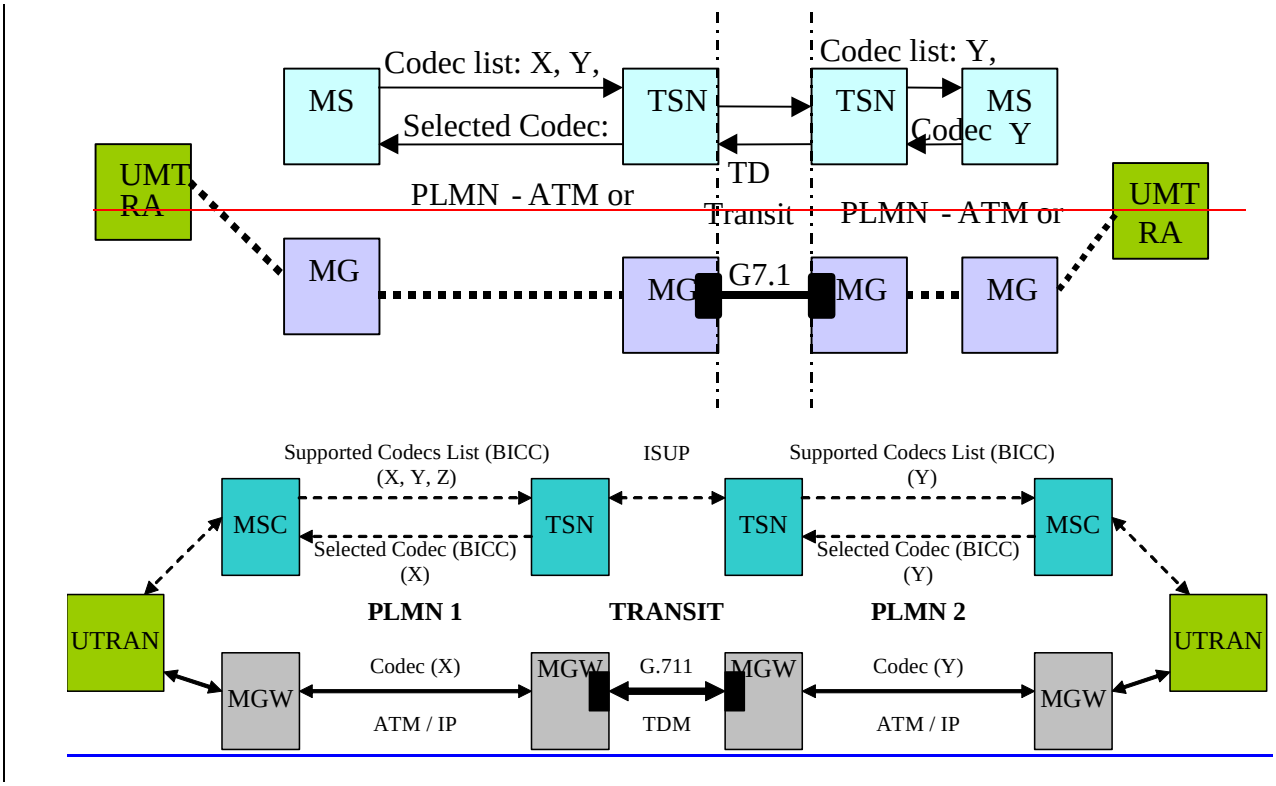

Figure 5.5/1: Cascaded TrFO & Transcoding

In Figure 5.5/ 1 the OoBTC cannot proceed as the call crosses a transit network that does not support compressed voice. The same could occur if the transit network did not support out of band codec negotiation (Support in BICC is optional).

In Figure 5.5/2 the OoBTC procedures result in the call terminating to a GSM access. As the GSM radio access transcodes to default PCM codec, the OoBTC results in default PCM being the only codec that can be selected. The reply is passed back to the originating network, which then inserts a transcoder from default PCM to AMR for the UMTS radio access.

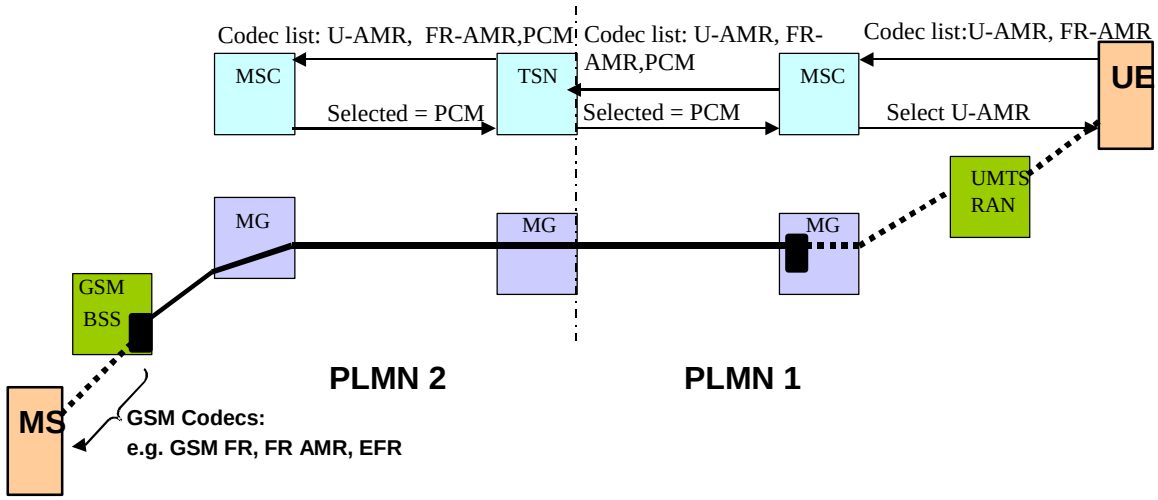

Figure 5.5/2: UMTS to GSM interworking

For TFO to establish between the transcoders in the above scenarios, each TRAU must send a codec list inband after the call has been established. If a common codec type is available (determined by pre-defined rules, described in TFO specification [10]) then the OoBTC procedures need to be informed so that a codec modification can be performed. This is shown in Figure 5.5/3. Note – a modification could also be required when a common codec type has been selected but the ACS is not common.

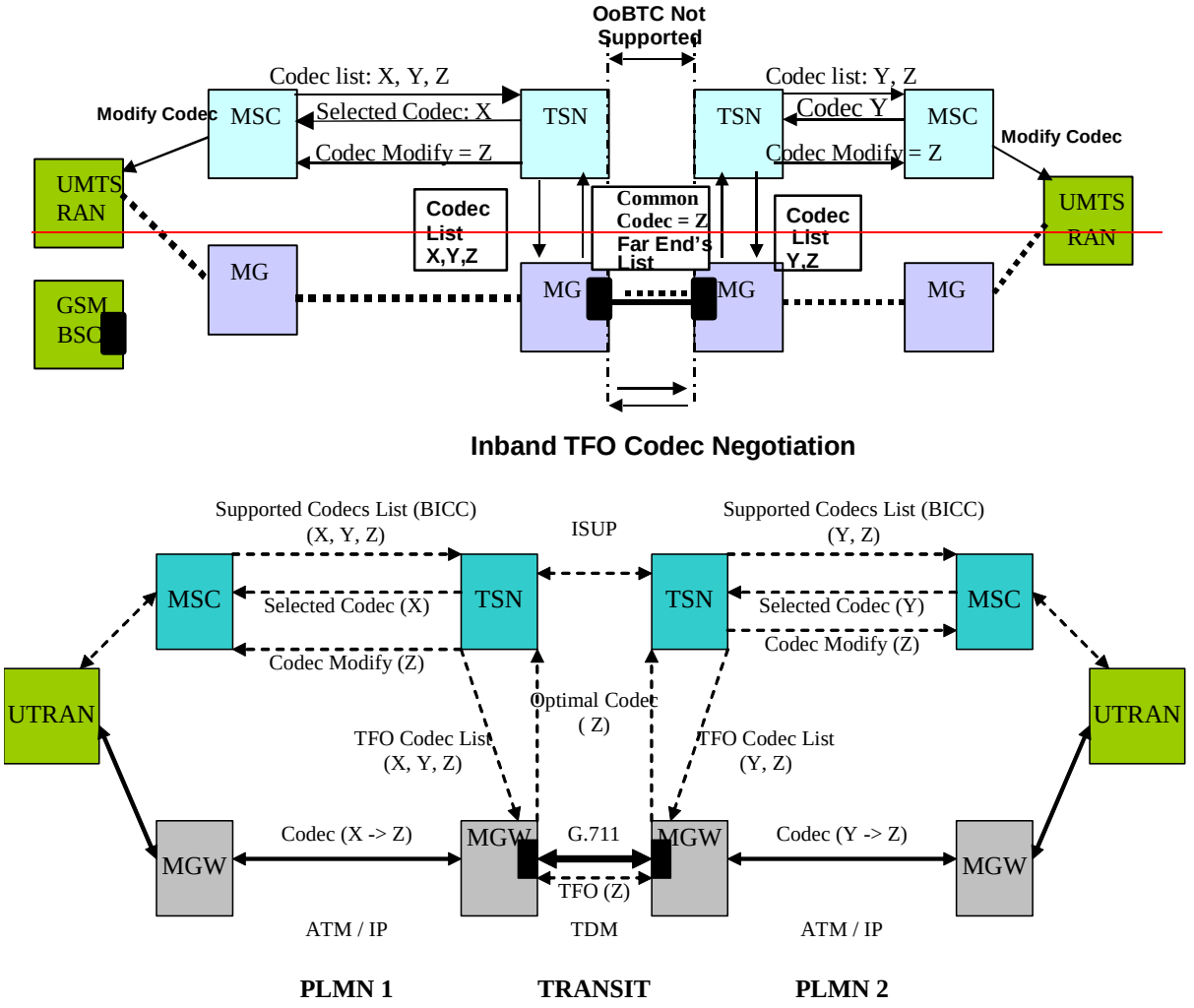

Figure 5.5/3: TFO support by OoBTC signalling

In H.248, the vertical MG control protocol, the coding types are specified by Media Stream Property, as defined by Annex C of H.248 specification. A specific package is used for TFO (see [12]).

The basic requirements are listed below:

i) Property for TFO Codec List (same format as for [5])

ii) Event for ~~common~~Optimal ~~c~~Codec, as determined by TFO in-band protocol

iii) Event for ~~Far End's~~Distant Codec List sent by the distant TFO partner

iv) Procedures to define and enable TFO

The TFO package allows the Server to request the MGW to initiate the TFO in-band protocol towards a far end transcoder. The package includes a property to turn on/off the TFO (tfoenable~~TFO_Active~~); this may be required prior to TrFO break situations such as handover.

The TFO Codec List (H.248) is passed via the Mc interface from the Server to the MGW. The first entry of the TFO Codec List (H.248) shall be used by the MGW as the 'Local Used Codec'. The other entries of the TFO Codec List (H.248) shall be used by the MGW as '(Local) Codec List' in the TFO in-band negotiation (see [10]). For adaptive multi-rate codecs (AMR codecs) ~~The~~some control of the level of negotiation is performed by the "Optimiz~~s~~ation Mode"

parameter in the respective Single Codec information element in the TFO Codec List (H.248)~~IE~~ (see [5]and [12]). This allows a node to indicate if the offered ACS may be modified~~punctured~~ or not during TFO procedures, and this is mapped to the appropriate parameter in the TFO protocol by the MGW. If for a Single Codec information element in the TFO Package from the Server to the MGW the OM is set to "Optimization of the ACS not supported", then the TFO Negotiation shall not change the offered ACS of the respective Single Codec information element.

The MGW returns Notification Events for the ~~Far End's~~ Distant Codec List sent by the far end and the Optimal ~~Common~~ Codec Type as selected by the Codec Selection mechanism in TFO. The first entry of the Distant Codec List (H.248) is the 'Distant Used Codec' as received by the MGW during TFO in-band negotiations. The other entries of the Distant Codec List (H.248) are the entries of the '(Distant) Codec List' as received by the MGW from the distant TFO Partner (see [10]).The Server then compares the ~~"Far End~~Distant Codec List~~"~~ (H.248) with its previously negotiated Available Codec List (BICC). If the lists are not the same then an OoBTC Codec List Modification or Mid-call Codec Negotiation ~~is also~~may be performed. If for a Single Codec information element in the TFO Package from the MGW to the Server the OM is set to "Optimization of the ACS not supported", then the offered ACS of the respective Single Codec information element shall not be changed during OoBTC procedures.

5.6 CN Node handling of Codec Types & Codec Modes

5.6.1 Signalling between UE and MSC

~~The supported codec list received by the MSC in DTAP protocol [2] has no priority, whereas the list sent in the OoBTC procedures is sent with a level of preference.~~

The default Codec Type for “R99 UMTS only” terminals is UMTS_AMR, the default Codec Type for all terminals supporting GSM and UMTS radio access is UMTS_AMR_2~~,~~ (see [5] for the detailed description). The UMTS_AMR_2 is a superset of the UMTS_AMR. It behaves as a FR_AMR codec in the UL and as a UMTS_AMR codec in the DL. This allows UMTS terminals to operate in TFO with GSM terminals. The UMTS_AMR_2 is fully compatible with UMTS_AMR in TFO and TrFO and fully compatible with R99 CN nodes (TC in MGW). *[Editor's note: the previous sentence will be modified by CR 076.]*

During call setup, a UE supporting Rel-4 or later releases will indicate to the MSC the codecs supported by the UE in the Supported Codecs List (DTAP) (see [2]). For the codecs in this Supported Codecs List (DTAP), no order of priority is defined.

If the UE supports both Codec Types (UMTS_AMR and UMTS_AMR_2), then the MSC shall indicate only the UMTS_AMR_2 in the OoBTC codec negotiation. *[Editor's note: the previous sentence will be removed by CR 075.]* If no Supported Codecs List (DTAP)~~IE~~ is received and the UE is “UMTS only”, then the MSC shall assume UMTS_AMR as supported Codec Type. If no Supported Codecs List (DTAP)~~IE~~ is received, but the UE is “dual system”, then the MSC shall assume UMTS_AMR_2 as the supported codec type. The MSC shall assume “dual system” support only if the UE indicates at least one GSM speech version in Octet 3a etc. of the Bearer Capability.

5.6.2 Node originating the OoBTC codec negotiation

When a codec list contains UMTS_AMR_2 and a node in the network participating in the codec negotiation only supports UMTS_AMR then it shall indicate UMTS_AMR back although the codepoints as defined in [5] are different and only the UMTS_AMR_2 codepoint is included in the codec list it shall be allowed to signal back the codepoint for UMTS_AMR as this is a subset of the UMTS_AMR_2 codec and thus its support is implied. Similarly, if a node receives only UMTS_AMR in the codec list but it supports UMTS_AMR_2 it shall reply with the codepoint for UMTS_AMR as this is the subset that is compatible. *[Editor's note: the previous paragraph will be removed by CR 076.]*

The node originating the OoBTC codec negotiation shall implement the procedures described in Q.1902.4, subclause 8.3.1 [6]. Additionally, the following applies:

In UTRAN, when constructing the codec configurations for AMR codecs in the Supported Codecs List (BICC), the MSC Server should take the codec types and codec configurations supported by the RNC or BSC into account (see subclause 5.6.6). The MSC may include more than one ~~"~~Single codec~~"~~ element indicating the same codec type, but different configurations, in the Supported Codecs List (BICC)~~codec list~~ (see [5]).

NOTE: This may be necessary if the RNC supports for an ~~adaptive multi-rate~~AMR codec different sets of codec modes, e.g., (a, b, c, d) and (e, f, g), which are not subsets of each other, and the RNC does not support combinations of these sets, e.g. (a, b, c, d, e, f, g).

~~The MSC Server shall know the codec mode configurations supported by the RNC. These configurations shall be considered during the speech codec negotiation and the RAB Assignment.~~ *[Editor's note: moved to subclause 5.6.6.]*

For AMR codecs the originating CN node shall use the "Optimization Mode" parameter in the Single Codec information element in the Supported Codec List (BICC) (see [5]) to indicate whether or not other nodes may change the offered ACS.

EXAMPLE: An RNC implementing only the prioritised RABs for interoperability testing specified in [15] will support for the UMTS_AMR_2 codec e.g. the set of codec modes (12.2, 7.4, 5.9, 4.75), but none of its subsets containing 2 or 3 codec modes. If the MSC Server connected to this RNC includes the codec configuration (12.2, 7.4, 5.9, 4.75) in the Supported Codecs List (BICC), it will therefore set the OM parameter of the respective Single Codec information element to "Optimization of the ACS not supported".

For AMR codecs, if the OM is set to "Optimization of the ACS supported", the originating CN node shall indicate the maximum number of codec modes (MACS) that may be selected for the ACS during speech codec negotiation. This maximum number of codec modes may depend on optimization strategies applied by the originating CN node. The recommended value is 4 (see [10]).

In order to support interworking with 2G systems it is recommended that MGWs support 2G EFR codecs (GSM_EFR, PDC_EFR, TDMA_EFR). In order to avoid modifications during handover between 2G and 3G systems the MSC nodes may give preference to a suitable 2G codec.

~~The originating CN node, while performing speech service negotiation with a terminating CN node, shall indicate the maximum number of codec modes that shall be selected during speech codec negotiation. This maximum number of supported codec modes may depend on optimisation strategies applied by the originating CN node. The recommended value is "four" (see [10]).~~ *[Editor's note: moved up 1 paragraph, with small modifications.]*

Whenever one or several TrFO links have been already established and initialised, the CN node (e.g. the serving CN in case of Call Hold scenarios, the visited CN node in case of Call Forwarding scenarios, etc.) initiating a subsequent codec negotiation on a new call leg or a mid-call codec negotiation on an established and initialised TrFO link, should give the already negotiated Selected Codec (BICC), including its ACS, highest preference to reduce the probability of having to perform a bearer re-establishment or UP re-initialisation of the already established and initialised TrFO links.

5.6.3 Intermediate node

An intermediate node taking part in an OoBTC codec negotiation shall implement the procedures described in Q.1902.4, subclause 8.3.2 [6]. Additionally, the following applies:

If a Single Codec information element for an AMR codec is included in the Supported Codecs List (BICC), with the OM set to "Optimization of the ACS not supported", the intermediate node shall delete the Single Codec information element

i) if the codec type is not supported; or

ii) if one or more codec modes of the offered ACS are not supported.

If a Single Codec information element for an AMR codec is included in the Supported Codecs List (BICC), with the OM set to "Optimization of the ACS supported", the intermediate node

i) shall delete the Single Codec information element, if the codec type is not supported;

ii) shall delete codec modes from the offered SCS and ACS, if they are not supported. If the last codec mode is deleted from the offered SCS, the Single Codec information element shall be deleted from the Supported Codecs List (BICC);

iii) shall reduce MACS to a locally supported value, if necessary;

iv) may change the ACS to a different ACS within the offered SCS; and

v) shall change the OM parameter from "Optimization of the ACS supported" to "not supported", if necessary.

NOTE: In interworking scenarios with TFO, step (iv) may prevent the establishment of an end-to-end tandem free and transcoder free connection; therefore, the intermediate node should not do this without a good reason.

During the processing of a Single Codec information element of an AMR codec with the OM set to "Optimization of the ACS supported", the intermediate node may replace the original Single Codec information element by two or more new Single Codec information elements, which can be derived from the original Single Codec information element by the steps (i) to (v) listed above.

5.6.4 Node terminating the OoBTC codec negotiation

The node terminating the OoBTC codec negotiation shall implement the procedures described in Q.1902.4, subclause 8.3.3 [6]. Additionally, the following procedures apply:

The terminating node shall process the Supported Codecs List (BICC) as described for the intermediate note in subclause 5.6.3.

In UTRAN, when processing the codec configurations for AMR codecs in the Supported Codecs List (BICC), the terminating MSC Server should take the codec types and codec configurations supported by the terminating RNC into account (see subclause 5.6.6).

~~The terminating CN node receiving this information compares the maximum number of codec modes received by the originating CN with its own one and shall decide on the minimum of both numbers to be applied as result of the negotiation.~~

For the selection of the Selected Codec (BICC) from the Supported Codecs List (BICC), the following additional procedures apply:

If an adaptive multi-rate codec is selected, ~~T~~then the decision about the actual codec modes to be included in~~selected as~~ the selected ~~Active Codec Set (~~ACS~~)~~ shall also be made by~~left to~~ the terminating CN node. If the OM of the offered configuration is set to "Optimization of the ACS supported", the selected ACS may be different from the offered ACS, but it shall be a subset of the offered SCS and be consistent with MACS.

In order to provide harmonisation of out of band codec negotiation (for TrFO) and inband codec negotiation (for TFO) ~~very~~ similar codec type and codec configuration selection mechanisms as those being defined for TFO should~~all~~ be applied for TrFO~~,~~ (see [10]). ~~These rules shall be taken into account when forwarding a codec list from the originating node to proceeding node, both for TrFO and TFO.~~

NOTE: For TrFO codec negotiation, besides the speech quality additional aspects may be considered which are not applicable to TFO, e.g. the location of the transcoder that may need to be inserted or possible bandwidth savings in the core network.

If an adaptive multi-rate codec is selected, the terminating MSC Server shall exactly specify the ACS in the Selected Codec (BICC) and set the OM to "Optimization of the ACS not supported".

In the Available Codecs List (BICC), sent back to the originating node, the terminating MSC server may include more than one Single Codec information element indicating the same codec type, but different configurations. Single Codec information elements for adaptive multi-rate codecs may also be included with the OM set to "Optimization of the ACS supported" and the ACS being a subset of the SCS.

According to Q.1902.4, subclause 8.3.3 [6], the terminating node shall include the Selected Codec (BICC) in the Available Codecs List (BICC). For AMR codecs, the following applies:

If the Selected Codec (BICC) is an AMR codec, it shall be considered as included in the Available Codecs List (BICC), if the Available Codecs List (BICC) contains a Single Codec information element with the same codec type and

- exactly the same configuration, i.e. the same ACS and the OM set to "Optimization of the ACS not supported"; or
- the Selected Codec (BICC) is consistent with the Single Codec information element, i.e. the selected ACS is a subset of the SCS of the Single Codec information element, the Number of codec modes in the selected ACS is less or equal to the MACS parameter of the Single Codec information element, and the OM of the Single Codec information element is set to "Optimization of the ACS supported".

~~Whenever one or several TrFO links have been already established and initialised, the CN node (e.g. the serving CN in case of Call Hold scenarios, the visited CN node in case of Call Forwarding scenarios, etc.) initiating a subsequent codec negotiation, shall give the already negotiated codec type, including its ACS, highest preference to reduce the possibility of performing bearer re-establishment or UP re-initialisation of the already established and initialised TrFO links.~~ *[Editor's note: moved to subclause 5.6.2.]*

5.6.5 Signalling between server and MGW

According to Q.1902.4, subclause 8.3 [6], during the OoBTC codec negotiation a server can provide its associated MGW with the preferred codec from the Supported Codecs List (BICC), and as a result of the negotiation the server will provide its associated MGW with the Selected Codec (BICC). The information is sent via the Mc interface as Codec (H.248).

If the Codec (H.248) is an adaptive multi-rate codec, the server shall exactly specify the ACS in the respective Single Codec information element and set the OM to "Optimization of the ACS not supported", both for the preferred codec and the Selected Codec (BICC).

For the Single Codec information elements of adaptive multi-rate codecs in the TFO Codec List (H.248), the OM may be set to "Optimization of the ACS supported", and the ACS may be a subset of the SCS. This applies also to the first entry in the TFO Codec List (H.248), the Local Used Codec.

NOTE: In some scenarios the flexible configuration of the Local Used Codec may be used for a faster TFO establishment (see [10]).

5.6.6 Signalling between MSC and UTRAN

The MSC Server shall know the codec types and codec mode configurations supported by the RNC. The MSC Server shall select only from these configurations for the RAB assignment.

When the MSC node requests a RAB assignment the Subflow Combinations provided shall either all be initialised by the RNC or all rejected with appropriate cause code.

The MSC shall always assume "Discontinuous Transmission (DTX)" as mandatory and shall define “SID” SDUs in addition to the negotiated speech codec modes. This is because for TrFO the RAB requested by one RNC must match that requested by the peer RNC – they are effectively the same RAB. If one MSC requires DTX support then the RAB requested by the far end MSC must also support DTX (even if it is not desired by that MSC). As no Out Of Band negotiation for DTX is supported nor DTX control to the UE, DTX shall be mandatory for TrFO connections.

Once an adaptive multi-rate codec with an~~the common~~ ACS has been selected as Selected Codec (BICC), the MSCs shall indicate in the RAB Assignment parameters [3] for the Guaranteed Bitrate the lowest speech mode in the ACS (assuming any SID frames are smaller than the SDU for lowest speech mode, otherwise the Guaranteed Bitrate shall be set to the largest SID frame). The Maximum bitrate shall correspond to the highest mode in the ACS.

5.7 Inband Rate Control

Inband rate control shall only allow the RNCs to set the maximum codec mode (maximum bitrate) from the set of codec modes that have been negotiated out of band. This procedure is called Maximum Rate Control. The final maximum mode selected results from a rate control request from one side and the maximum rate supported at the receiving side; the lower rate of these is selected. This is known as Distributed Rate Decision. In TrFO maximum rate control shall be supported through the Iu Framing protocol and through transit networks supporting compressed voice. The maximum rate control procedures are further defined within the Iu Framing protocol [4].

When the MSC requests for a RAB to be assigned, it shall always define 1 speech mode SDU (lowest rate), and DTX SDU as non-rate controllable. Other SDU formats for higher rates shall be defined as rate controllable. The first subflow combination in the IuUP initialisation shall be treated as an initial maximum rate control. Where a node is in TrFO break (e.g. the terminating MGW) this initial maximum rate control received at a given MGW/IuUP termination shall be signalled to the other TrFO link using the IuUP Rate Control PDU unless the IuUP Initialisation frame is to be sent on to the next link as in RFCI Value Correction (see clause 5.4.3).

At SRNS relocation the new RNC shall send a rate control frame at Relocation Detect indicating its current maximum rate, it will receive in the acknowledgement the current maximum rate from the far end. This procedure is called Immediate Rate Control. Again the distributed rate decision means both RNCs will operate within a common limit.

5.8 Modification Procedures

The OoBTC procedures shall support the following modification mechanisms:

i) Modification of Selected Codec.
(The codec type of the Selected Codec (BICC) may be switched to another type within the Available Codecs List (BICC), and/or the Active Codec mode Set of the Selected Codec (BICC) may be modified, and/or the Supported Codec mode Set of the Selected Codec (BICC) may be reduced.)

ii) Modification of Available Codecs List
(The Available Codecs List (BICC) may be reduced by removing codec types and modes)

iii) Mid-call Codec Negotiation
(The Available Codecs List (BICC) is re-negotiated, allowing the addition and removal of codec types and modes compared to the previous Available Codecs List (BICC), and a new Selected Codec (BICC) is chosen out of the new Available Codecs List (BICC))

The specific call flows when such procedures may be required are detailed in Clause 6. Further information on the Available Codecs List (BICC) and the Selected Codec (BICC) is provided in Section 5.2. Further information on codec types, codec modes, a Supported Codec mode Set and an Active Codec mode Set is provided in TS 26.103 [5]. The basic codec negotiation principles are defined by the BICC Call Control Procedures (see [6]) but the explicit Mc interface procedures are added.

5.8.1 Modification of Selected Codec

The codec modification procedures shall support the following changes:

i) change of the~~to currently selected~~ codec type or codec configuration of the current Selected Codec (BICC) to another codec type or codec configuration within the Available Codecs List (BICC);

~~ii)reduction of the currently selected codec type's available codec set (ACS)~~

~~iii)reduction of the currently selected codec type's supported codec set (SCS)~~

ii) modification of the Available Codecs List (BICC) according to subclause 5.8.2, (i) to (v), in combination with any change of the codec type or codec configuration of the current Selected Codec (BICC) to another codec type or codec configuration within the new Available Codecs List (BICC). The modification of the Available Codecs List (BICC) may include removal of the current Selected Codec (BICC) from the list.

~~iv)reduction of the ACS of any codec in the Supported Codecs List (in addition to any change of the selected codec).~~

~~v)reduction of the SCS of any codec in the Supported Codecs List(in addition to any change of the selected codec).~~

~~vi)reduction of the codec types in the Supported Codecs List (in addition to any change of the selected codec).~~

The procedures described in Q.1902.4, clauses 10.4.1 to 10.4.3 [6] shall apply.

The new codec type and codec configuration may be selected freely from the Available Codecs List (BICC). For an AMR codec, a codec configuration may be selected if it is considered to be included in the Available Codecs List (BICC) according to the criteria specified at the end of subclause 5.6.4.

For the coding of the new Selected Codec (BICC), the new Available Codecs List (BICC), and the new Codec (H.248), the same rules apply as specified in subclauses 5.6.4 and 5.6.5.

In Figure 5.8.1/1 and 5.8.1/2 the basic codec modification procedure is shown. This Figure is an example; the codec modification procedure may be initiated by any node within the call.

Upon Reception of a Modify Codec message (action 5 and 9 in Figure 5.8.1/1), a server node shall check if the Selected Codec is altered according to the criteria above. If the Selected Codec is not altered, the procedures in Section 5.8.2 (Modification of the Available Codec List) apply, otherwise the server node shall send a “Reserve Characteristics” procedure to the attached MGW for the corresponding termination (action 6 and 10 in Figure 5.8.1/1

To perform a modification of the selected codec at an Iu interface, the MSC server shall send a “Modify Bearer Characteristics” procedure to the attached MGW (action 1 and 12 in Figure 5.8.1/1). Upon completion of the “Modify Bearer Characteristics” procedure, the server node shall send a “RAB Assignment Request” to the radio access network (action 2 and 13 in Figure 5.8.1/1). The MSC server shall then wait to receive a corresponding “RAB Assignment Response” message from the radio access network (action 3 and 14 in Figures 5.8.1/2 and 5.8.1/3) before continuing the modification procedure.

An MSC server shall use the “Reserve Characteristic” procedure for the termination towards the preceeding node (with respect to the Modify Codec message) to perform the necessary bearer level modification. The MGW shall respond for that termination with the “Bearer Modified” procedure to indicate that the possible bearer modification to increase bandwidth was successful. The MGW shall not wait until the Iu UP initialisation is complete before replying with the “Bearer Modified” procedure. Each server shall not send forward the modify request to the succeeding node until the indication from its MGW that any necessary bearer level modification has been completed (BNC_Modified notification). The MSC server shall use the “Confirm Characteristics” procedure to confirm the modification at that termination.

An MSC server shall use the “Modify Characteristic” procedure for the termination towards the succeeding node (with respect to the Modify Codec message) to confirm the codec modification.

The specific handling of the Iu UP initialisation is described in Section 5.8.4.

Error Cases are described in Section 5.8.5.

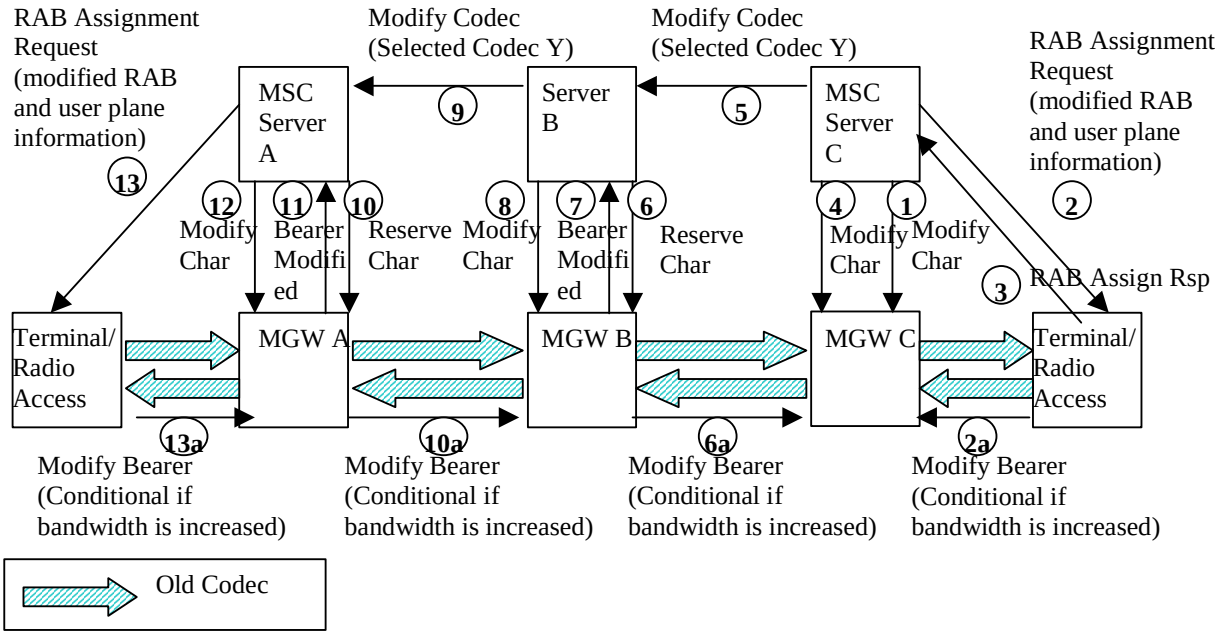

Figure 5.8.1/1: Codec Modification Control Procedures

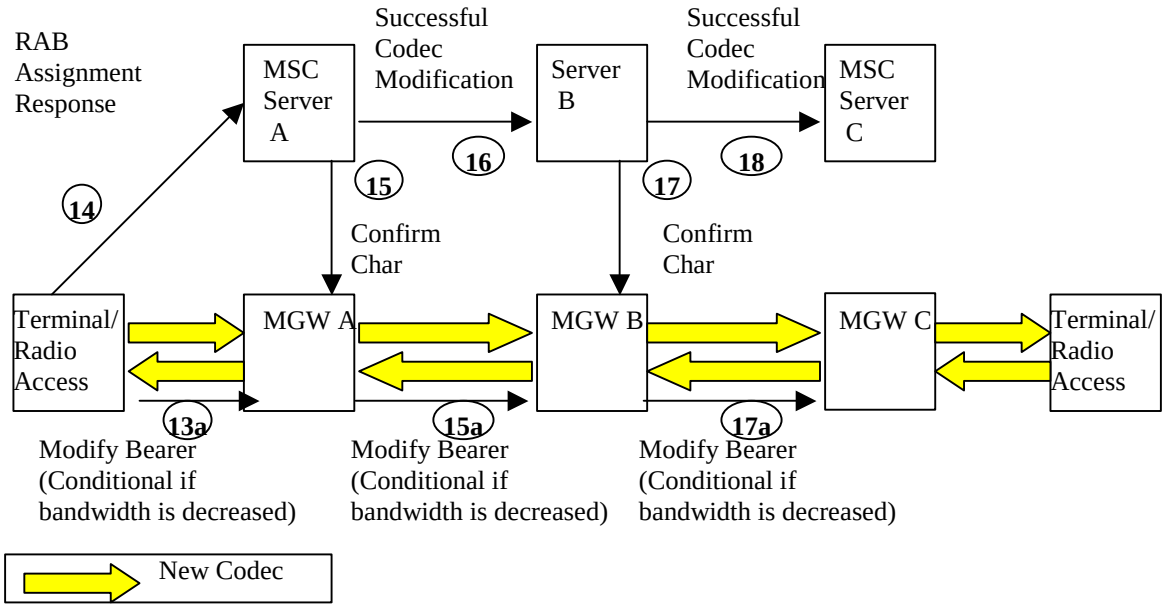

Figure 5.8.1/2: Codec Modification acknowledgement

5.8.2 Modification of Available Codecs List

The modification of the Available Codecs List (BICC) shall support the following changes:

i) reduction of the ACS of any Single ~~e~~Codec information element in the Available~~Supported~~ Codecs List (BICC) for which OM is set to "Optimisation of the ACS supported";

ii) reduction of the SCS of any Single ~~e~~Codec information element in the Available~~Supported~~ Codecs List (BICC) for which OM is set to "Optimisation of the ACS supported";

iii) reduction of the MACS of any Single Codec information element in the Available Codecs List (BICC) for which OM is set to "Optimisation of the ACS supported";

iv) change of the OM of any Single Codec information element in the Available Codecs List (BICC) from "Optimisation of the ACS supported" to "not supported"; and

~~iii)~~v) deletion~~reduction~~ of one or more ~~the~~ Single ~~c~~Codec information elements from~~types in~~ the Available~~Supported~~ Codecs List (BICC).

This shall not include the removal of the Selected Codec (BICC) or of modes from the ACS of the ~~s~~Selected ~~c~~Codec (BICC), as this would require a Modification of Selected Codec ~~modification~~ as described in 5.8.1.

The procedures described in Q.1902.4, clauses 10.4.1 to 10.4.3 [6] shall apply.

For the coding of the new Available Codecs List (BICC), the same rules apply as specified in subclause 5.6.4.

No modification of the user plane and signalling towards the MGWs and radio access network is required.~~,~~

In Figure 5.8.2/1 the basic “modification of available codec list” procedure is shown. This Figure is an example; the codec modification procedure may be initiated by any node within the call.

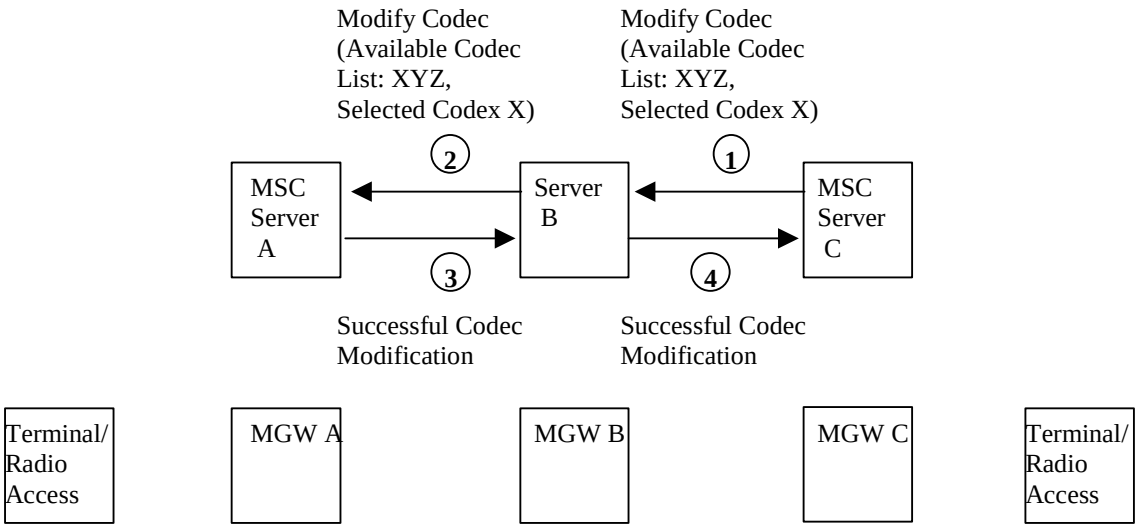

Figure 5.8.2/1: Modification of Available Codec List

5.8.3 Mid-call Codec negotiation

The Selected Codec (BICC) and the Available Codecs List (BICC) can be (re-) negotiated during the call using the “Mid Call Codec Negotiation” mechanism. The Mid-Call Codec Negotiation mechanism results in a new Available Codecs List (BICC), where new codec types or modes not within the previous Available Codecs List (BICC) may be included. The codec negotiation procedure is performed as for call set-up.

The procedures described in Q.1902.4, clauses 10.4.4 to 10.4.6 [6] shall apply.

The sequence is shown in Figure 5.8.3/1. Starting with the Modify to Selected Codec message, the remaining sequence is the same as for the Codec Modification in Section 5.8.1 except that the message name for the modify request is “Modify To Selected Codec” (instead of “Modify Codec”) in order to allow collisions between the two procedures to be resolved. Everything stated in Section 5.8.1 shall also apply for the Mid-Call Codec Negotiation procedure.

The node initiating the “Mid Call Codec Negotiation” mechanism (MSC Server A in Figure 5.8.3/1) shall select a Preferred Codec and a Supported Codecs List (BICC), which may contain new codecs and also may not contain codecs from the previous Available Codecs List (BICC). If the list no longer contains the previous Selected Codec (BICC), then a new codec shall be selected as Preferred Codec. If the previous Selected Codec (BICC) exists within the Supported Codecs List (BICC), this codec should be selected as the Preferred Codec.

If a server node removes the Preferred Codec, from the Supported Codecs List (BICC), the node shall select a new Preferred Codec.

3GPP TSG-CN WG4 Meeting #25 ***N4-041519***

Seoul, KOREA. 15th to 19th November 2004. (rev of N4-041398)

CR-Form-v7.1

CHANGE REQUEST

⌘ **23.153** **CR** **078** ⌘ **rev** **1** ⌘ Current version: **5.8.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ ☐ ME ☐ Radio Access Network ☐ Core Network ☒

Title:	⌘	Detailed description of the handling of codec negotiation parameters
Source:	⌘	CN4
Work item code:	⌘	OoBTC
Date:	⌘	2/11/2004
Category:	⌘	**A**
Release:	⌘	Rel-5

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
Ph2 *(GSM Phase 2)*
R96 *(Release 1996)*
R97 *(Release 1997)*
R98 *(Release 1998)*
R99 *(Release 1999)*
Rel-4 *(Release 4)*
Rel-5 *(Release 5)*
Rel-6 *(Release 6)*
Rel-7 *(Release 7)*

Reason for change: ⌘ **Essential correction**

1) The use of the "Optimization Mode" (OM) parameter during OoBTC procedures is not clearly defined:

TS 26.103, subclause 5.4, refers to TS 23.153:

> Optimisation Mode for ACS , OM: one bit.
> Coding: "0": Optimisation of the ACS not supported, "1": Optimisation of the ACS supported.
> The Optimisation Mode indicates in TFO, whether the sending side supports the modification (optimisation) of its ACS for the needs of the distant side. This parameter is necessary in UMTS OoBTC to support TFO in "transcoders at the edge" scenarios. In case the OM is set to "not supported" the offered ACS cannot be altered.
> Only Rate Control can then be used to restrict the modes within the ACS.
> The use of the Optimisation Mode parameter for TrFO is defined in 3GPP TS 23.153 [9].

TS 23.153 mentions this parameter in the context of TrFO/TFO interworking ("Codec Negotiation Harmonisation"):

> The TFO package allows the Server to request the MGW to initiate TFO protocol towards a far end transcoder. The package includes a property to turn off the TFO (TFO_Active); this may be required prior to TrFO break situations such as handover. The control of the level of negotiation is performed by the "Optimisation Mode" parameter in the Codec List IE see [5]. This allows a node to indicate if the ACS may be punctured or not and this is mapped to the appropriate parameter in the TFO protocol

	by the MGW. but it remains unclear whether the puncturing of the ACS refers to the TFO or TrFO procedures or both. There is, however, also an important application of the "Optimization Mode" parameter for pure TrFO scenarios (without any involvement of TFO): real-world UTRAN implementations may support only a limited number of codec configurations. This means: - only certain codec configurations are supported; - subsets of the ACS of these codec configurations may not be supported - codec modes supported within a codec configuration are not necessarily supported as single mode configurations. For such a UTRAN implementation the MSC Server must be able to indicate to the other nodes that the offered ACS must not be modified during the OoBTC procedure, but either accepted or rejected as offered. 2) Inter-vendor discussions related to the standardization of SIP/BICC interworking have shown that the handling of the Supported Codecs List, Available Codecs List and Selected Codec in the BICC protocol needs to be specified in more detail, especially for the 3GPP specific case that AMR or AMR-WB codecs are involved in the signalling.
Summary of change: ⌘	1) The use of the "Optimsiation mode" parameter is described in the generic context of the handling of codec types and codec configurations. 2) Handling of the Supported Codecs List, Available Codecs List and Selected Codec in the BICC protocol is specified in detail.
Consequences if not approved: ⌘	1) Without clear description the "Optimization Mode" parameter cannot be implemented in OoBTC and consequently certain real-word UTRAN implementations which support only a limited number of codec configurations cannot be supported. (These UTRAN implementations can be expected especially for the introduction phase of UMTS.) 2) Without clear description of the parameter handling, interoperability problems between CN equipment from different vendors can be expected. If codec negotiation parameters are sent in an unexpected format or are changed in an unexpected way, dependent on the implemented error handling, in the worst case this can cause the release of a call.

Clauses affected:	⌘	2, 3.1, 3.2, 5.5, 5.6, 5.8.1, 5.8.2, 5.8.3			
		Y	**N**		
Other specs affected:	⌘		X	Other core specifications	⌘
			X	Test specifications	
			X	O&M Specifications	
Other comments:	⌘				

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 23.107: "QoS Concept and Architecture".

[2] 3GPP TS 24.008: "Mobile radio interface layer 3 specification Core Network Protocols –Stage 3".

[3] 3GPP TS 25.413: "UTRAN Iu Interface RANAP Signalling".

[4] 3GPP TS 25.415: "UTRAN Iu Interface User Plane Protocols".

[5] 3GPP TS 26.103: "Speech codec list for GSM and UMTS".

[6] 3GPP TS 29.205: "3rd Generation Partnership Project; Technical Specification Group CoreNetwork; Application of Q.1900 series to Bearer Independent circuit-switched core Network architecture; Stage 3".

[7] ITU-T Rec~~e~~ommendation Q.765.5: "Signalling system No. 7; Application transport mechanism: Bearer Independent Call Control (BICC)".

[8] 3GPP TS 23.205: "Bearer-independent CS Core Network.".

[9] 3GPP TS 33.106: "3GPP Security; Lawful Interception Requirements".

[10] 3GPP TS 28.062: "Inband Tandem Free Operation (TFO) of Speech Codecs; Service Description; Stage 3".

[11] 3GPP TS 23.009: "Handover Procedures".

[12] 3GPP TS 29.232: "Media Gateway Controller (MGC) – Media Gateway (MGW) interface; Stage 3".

[13] ITU-T H.248: "Gateway Control Protocol".

[14] 3GPP TS 29.415: "Customised Applications for Mobile network Enhanced Logic (CAMEL) Phase 3; CAMEL Application Part (CAP) specification".

[15] 3GPP TS 48.008: "Mobile-services Switching Centre – Base Station System (MSC – BSS) interface; layer 3 specification"

[16] 3GPP TS 43.051: "Technical Specification Group GSM/EDGE; Radio Access Network; Overall description - Stage 2; "

[17] 3GPP TS 23.172: "Technical realization of Circuit Switched (CS) multimedia service; UDI/RDI fallback and service modification - Stage 2".

[18] 3GPP TS 34.108: "Common test environments for User Equipment (UE) conformance testing".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following definitions apply:

Codec: device to encode information from its original representation into an encoded form and to decode encoded information into its original representation

Codec Lists, Selected Codecs: The OoBTC procedures pass a number of codec lists created by comparing the capabilities of the different nodes or equipment involved. For the different interfaces involved during call setup, handover, and relocation, the following codec lists and selected codecs need to be distinguished: *[Editor's note: change format of the paragraph from B1 to Standard.]*

i) Supported Codecs List (DTAP) – this is the list of codecs supported by the UE. It is subdivided into codecs supported for the currently used radio access and codecs that can be used for other radio accesses supported by the UE. The list contains only the codec types, but not the individual configuration, as the UE is mandated to support all configurations for a given codec type.

ii) Supported Codecs List (BICC) – this list is used on NNI (BICC) OoBTC signalling. At call setup it is sent forward by the node originating the OoBTC signalling and contains the default PCM codec and a set of codecs that is common to the nodes and the equipment involved in setting up the call. For a mobile originating call, these are the UE and the MGWs involved in the connection and, for UTRAN and GERAN Iu-mode, also the originating radio access. At inter-MSC relocation and inter-MSC handover, the Supported Codecs List (BICC) is sent forward by the anchor MSC towards the target MSC and contains the default PCM codec and a set of codecs that is common to the anchor MSC and the nodes involved in setting up the new call leg towards the target MSC. For UDI/RDI multimedia calls with fallback and service change according to 3GPP TS 23.172 [17], the multimedia dummy codec will be included (see 3GPP TS 26.103 [5]).

iii) Available Codecs Lists (BICC) – this is the list of codecs available for the NNI connection. It is returned in the backward signalling to the node that originated the OoBTC and is a subset of the Supported Codecs List (BICC) sent forward. At call setup the Available Codecs Lists (BICC) contains the default PCM codec and a common set of codecs that can be supported by all nodes and, if Transcoder Free Operation has been achieved end-to-end, also by the UEs and the radio access networks that are involved in the call. At inter-MSC relocation and inter-MSC handover to UMTS, the Available Codecs List (BICC) contains the default PCM codec and a set of codecs that can be supported by all nodes involved in setting up the new call leg towards the target MSC and, if Transcoder Free Operation can be maintained end-to-end after the handover or relocation, also by the UE and the target radio access network.

iv) Selected Codec (BICC) – this is the codec selected to be used on the NNI connection. It is one of the codecs contained in the Available Codecs Lists (BICC) and may be different from the codec that is used on the radio interface, but if end-to-end Transcoder Free Operation has been achieved, this will be the common codec for all nodes, the UEs, and the radio accesses.

v) Iu-Supported Codecs List (MAP) – this list is used for MAP signalling from the anchor MSC to the target MSC. It is subdivided into lists for UTRAN and GERAN Iu-mode and contains the codecs common to the UE and to the anchor MGW for each radio access supported by the UE. The codec capabilities of the serving radio access, i.e. the radio access used prior to the inter-MSC handover or relocation, are not taken into account. Codecs that are only applicable to the NNI, e.g. the default PCM codec or the multimedia dummy codec (see 3GPP TS 26.103 [5]), are not included.

vi) Iu-Available Codecs List (MAP) – this is the list of codecs available for the target Iu interface. When returned by the target MSC to the anchor MSC in response to an initial Prepare Handover message it is the Iu-Supported Codecs List (MAP) reduced according to the capabilites of the target MGW and the target radio access. After a subsequent intra-MSC handover or relocation, the target MSC may update the Iu-Available Codecs List (MAP) according to the capabilites of its associated MGW and the new target radio access, if necessary.

vii) Iu-Selected Codec (MAP) – this is the codec selected for the target Iu interface. It is one of the codecs contained in the Iu-Available Codecs Lists (MAP). In response to a Prepare Handover request message this is the codec selected by the target MSC and indicated back to the anchor MSC. When sent from the anchor MSC in a

Forward Access Signalling request message during a codec modification, it contains the codec type and configuration chosen by the anchor MSC.

viii) Iu-Currently Used Codec (MAP) – this is the codec in use on the serving Iu interface prior to an inter-MSC handover.

ix) TFO Codec List (H.248) – this is the list of codecs for use by the MGW during TFO in-band negotiations with a distant node. The list is passed via the Mc interface from the server to the MGW. The first entry of the TFO Codec List (H.248) is to be used by the MGW as the 'Local Used Codec' (see [10]).

x) Distant Codec List (H.248) – this is the list of codecs received by the MGW from a distant node during TFO in-band negotiations. The list is passed via the Mc interface from the MGW to the server. The first entry of the Distant Codec List (H.248) is the 'Distant Used Codec' received by the MGW (see [10]).

xi) Codec (H.248) – this is the codec for use on a certain MGW termination. It is passed via the Mc interface from the server to the MGW.

For the codecs in the Supported Codecs List (DTAP), no order of priority is defined. Within ~~each of~~ the ~~other~~ lists ii and v, the codecs are ordered in decreasing order of priority, the first entry in the list being the highest priority codec (preferred codec).

Tandem Free Operation: configuration of a connection with two transcoders that support TFO protocol and whose external coding schemes are compatible, thus enabling compressed speech to pass between them

NOTE 1: When the TFO protocol is not supported by both transcoders or the coding schemes are not compatible then normal "Tandem" operation occurs and PCM encoded speech is passed between them.

Transcoder: device to change the encoding of information from one particular encoding scheme to a different one, most commonly to/from a compressed speech algorithm from/to PCM.

Transcoder Free Operation: configuration of a speech or multimedia call for which no transcoder device is physically present in the communication path and hence no control or conversion or other functions can be associated with it

Out of Band Transcoder Control: capability of a system to negotiate the types of codecs and codec modes on a call per call basis through out-of-band signalling, required to establish Transcoder Free Operation.

Default PCM Codec: network default 64kb/s codec for speech in PCM domain

NOTE 2: For example ITU G.711 A-law.

Transcoding free link (TrFL): bearer link, where compressed voice is being carried between bearer endpoints

NOTE 3: Within the UMTS network, the compressed voice is transmitted in Iu/ Nb User Plane format, depending on the related interface.

Tandem free link (TFOL): bearer link between transcoders that are operating in Tandem Free Operation mode, i.e. bypassing the transcoding functions

NOTE 4: The involved transcoders can be a UMTS transcoder or a GSM TRAU with TFO functionality.

Transcoder free operation (TrFO): calls that have no transcoders involved in the connection between the source codecs

NOTE 5: For mobile to mobile calls this is UE to UE, although the connection could be UE to another type of terminal. TrFO operation is considered a concatenation of TrFLs between RNCs.

NOTE 6: In case of mobile to fixed network calls the term "Transcoder free operation" is applicable for the TrFLs carrying compressed speech. The TrFO usually ends at the Gateway to the PSTN where the speech is transcoded e.g. to G.711.

Tandem free and Transcoding free operation (TaTrFO): concatenation of "transcoding free links" and "tandem free links"

Iu Framing: framing protocol used for the speech packets on both the Iu User Plane interface and the Nb User Plane interface

NOTE 7: The Iu framing protocol is specified by [4].

In addition, the definitions of **ACS, SCS, OM,** and **MACS** provided in [5] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations defined in GSM 01.04 and the following apply:

ACS	Active Codec mode Set
APM	Application Transport Mechanism
BC	Bearer Control
BICC	Bearer Independent Call Control
CC	Call Control
CCD	Conference Call Device
CFNRc	Call Forward Not Reachable
CFNRy	Call Forward on No Reply
IN	Intelligent Network
IuFP	Iu Framing Protocol
MACS	Maximal number of codec modes in the ACS
OM	Optimization Mode
OoBTC	Out-of-Band Transcoder Control
QoS	Quality of Service
RAB	Radio Access Bearer
SCS	Supported Codec mode Set
TFO	Tandem Free Operation
TICC	Transport Independent Call Control
TrFO	Transcoder Free Operation
UP	User Plane

********** NEXT MODIFIED SECTION **********

5.5 TrFO/TFO Codec Negotiation Harmonisation

When OoBTC procedures are initiated to a node where compressed voice cannot be supported (either at the node or to the preceding node) then a transcoder is inserted. This can be due to the transport technology (e.g. TDM) or due to the access technology (e.g. GSM). The OoBTC procedures can result in the following call scenarios:

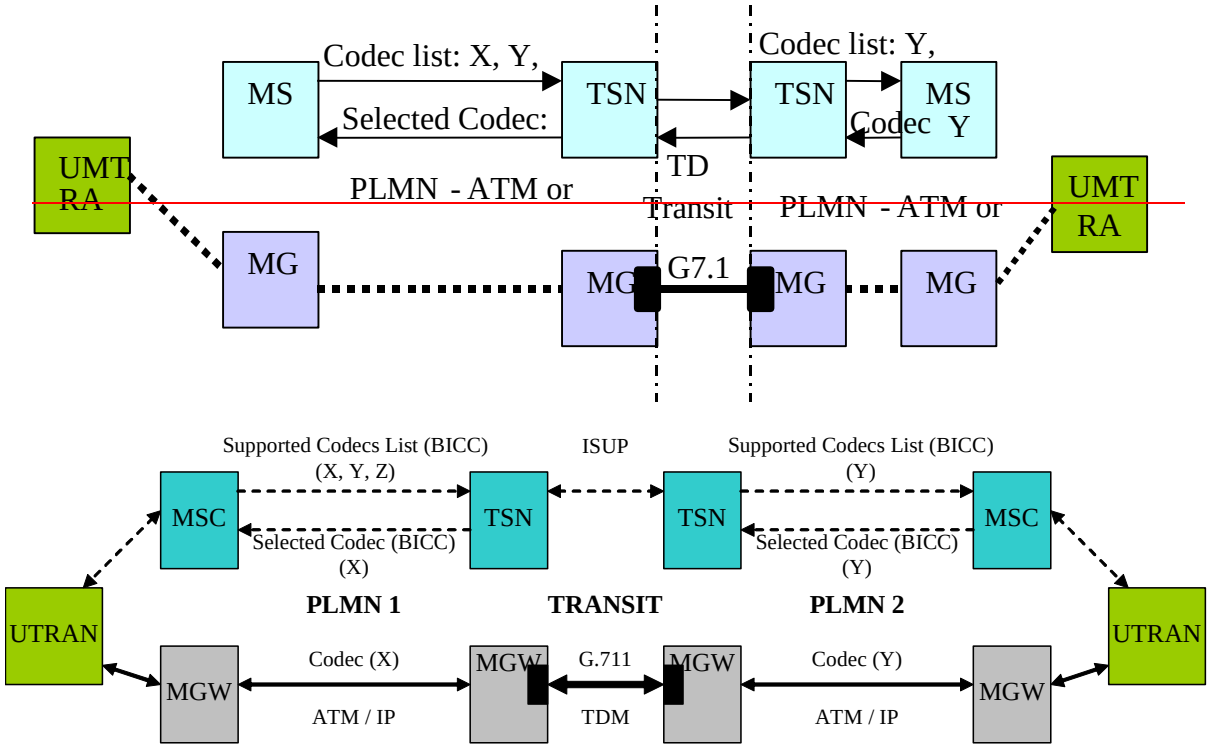

Figure 5.5/1: Cascaded TrFO & Transcoding

In Figure 5.5/ 1 the OoBTC cannot proceed as the call crosses a transit network that does not support compressed voice. The same could occur if the transit network did not support out of band codec negotiation (Support in BICC is optional).

In Figure 5.5/2 the OoBTC procedures result in the call terminating to a GSM access. As the GSM radio access transcodes to default PCM codec, the OoBTC results in default PCM being the only codec that can be selected. The reply is passed back to the originating network, which then inserts a transcoder from default PCM to AMR for the UMTS radio access.

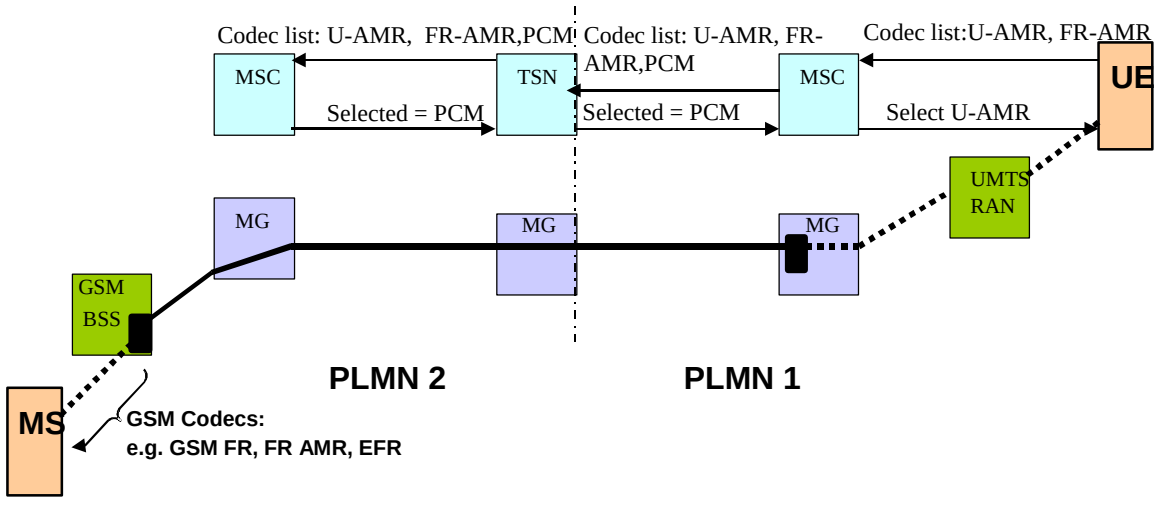

Figure 5.5/2: UMTS to GSM interworking

For TFO to establish between the transcoders in the above scenarios, each TRAU must send a codec list inband after the call has been established. If a common codec type is available (determined by pre-defined rules, described in TFO specification [10]) then the OoBTC procedures need to be informed so that a codec modification can be performed. This is shown in Figure 5.5/3. Note – a modification could also be required when a common codec type has been selected but the ACS is not common.

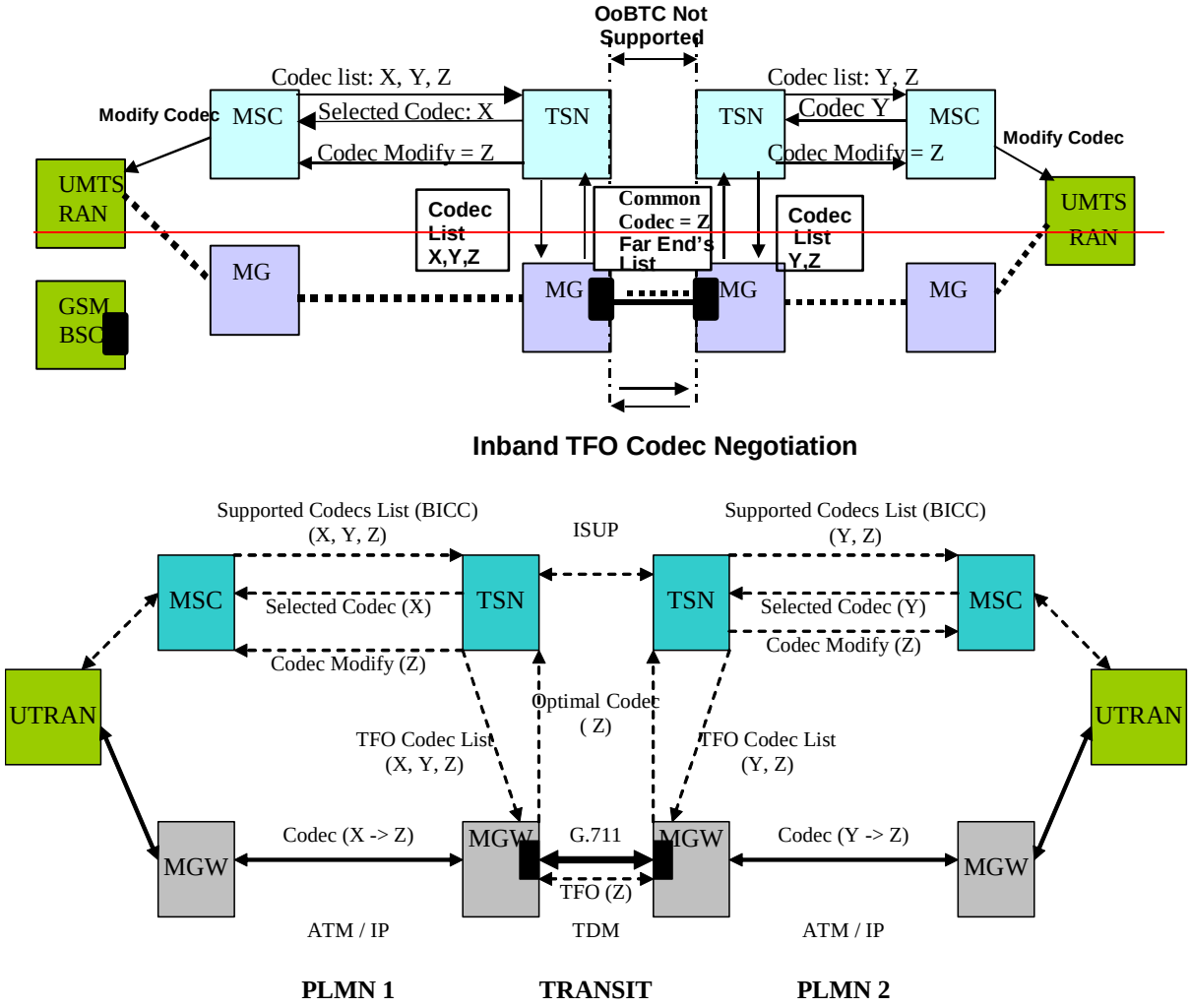

Figure 5.5/3: TFO support by OoBTC signalling

In H.248, the vertical MG control protocol, the coding types are specified by Media Stream Property, as defined by Annex C of H.248 specification. A specific package is used for TFO (see [12]).

The basic requirements are listed below:

i) Property for TFO Codec List (same format as for [5])

ii) Event for ~~common~~Optimal ~~c~~Codec, as determined by TFO in-band protocol

iii) Event for ~~Far End's~~Distant Codec List sent by the distant TFO partner

iv) Procedures to define and enable TFO

The TFO package allows the Server to request the MGW to initiate the TFO in-band protocol towards a far end transcoder. The package includes a property to turn on/off the TFO (tfoenable~~TFO_Active~~); this may be required prior to TrFO break situations such as handover.

The TFO Codec List (H.248) is passed via the Mc interface from the Server to the MGW. The first entry of the TFO Codec List (H.248) shall be used by the MGW as the 'Local Used Codec'. The other entries of the TFO Codec List (H.248) shall be used by the MGW as Local Codec List in the TFO in-band negotiation (see [10]). For adaptive multi-rate codecs (AMR and AMR-WB codecs) ~~The~~some control of the level of negotiation is performed by the

"Optimiz~~s~~ation Mode" parameter in the respective Single Codec information element in the TFO Codec List (H.248)~~IE~~ (see [5] and [12]). This allows a node to indicate if the offered ACS may be modified~~punctured~~ or not during TFO procedures, and this is mapped to the appropriate parameter in the TFO protocol by the MGW. If for a Single Codec information element in the TFO Package from the Server to the MGW the OM is set to "Optimization of the ACS not supported", then the TFO Negotiation shall not change the offered ACS of the respective Single Codec information element.

The MGW returns Notification Events for the ~~Far End's~~ Distant Codec List sent by the far end and the Optimal ~~Common~~ Codec Type as selected by the Codec Selection mechanism in TFO. The first entry of the Distant Codec List (H.248) is the 'Distant Used Codec' as received by the MGW during TFO in-band negotiations. The other entries of the Distant Codec List (H.248) are the entries of the Distant Codec List as received by the MGW from the distant TFO Partner (see [10]). The Server then compares the ~~"Far End~~Distant Codec List~~"~~ (H.248) with its previously negotiated Available Codec List (BICC). If the lists are not the same then an OoBTC ~~-~~Codec List Modification or Mid-call Codec Negotiation ~~is also~~may be performed. If for a Single Codec information element in the TFO Package from the MGW to the Server the OM is set to "Optimization of the ACS not supported", then the offered ACS of the respective Single Codec information element shall not be changed during OoBTC procedures.

5.6 CN Node handling of Codec Types & Codec Modes

5.6.1 Signalling between UE and MSC

~~The supported codec list received by the MSC in DTAP protocol [2] has no priority, whereas the list sent in the OoBTC procedures is sent with a level of preference.~~

The default Codec Type for “R99 UMTS only” terminals is UMTS_AMR, the default Codec Type for all terminals supporting GSM and UMTS radio access is UMTS_AMR_2~~,~~ (see [5] for the detailed description). The UMTS_AMR_2 is a superset of the UMTS_AMR. It behaves as a FR_AMR codec in the UL and as a UMTS_AMR codec in the DL. This allows UMTS terminals to operate in TFO with GSM terminals. The UMTS_AMR_2 is fully compatible with UMTS_AMR in TFO and TrFO and fully compatible with R99 CN nodes (TC in MGW). *[Editor's note: the previous sentence will be modified by CR 076.]*

During call setup, a UE supporting Rel-4 or later releases will indicate to the MSC the codecs supported by the UE in the Supported Codecs List (DTAP) (see [2]). For the codecs in this Supported Codecs List (DTAP), no order of priority is defined.

If the UE supports both Codec Types (UMTS_AMR and UMTS_AMR_2), then the MSC shall indicate only the UMTS_AMR_2 in the OoBTC codec negotiation. *[Editor's note: the previous sentence will be removed by CR 076.]* If no Supported Codecs List (DTAP)~~IE~~ is received and the UE is “UMTS only”, then the MSC shall assume UMTS_AMR as supported Codec Type. If no Supported Codecs List (DTAP)~~IE~~ is received, but the UE is “dual system”, then the MSC shall assume UMTS_AMR_2 as the supported codec type. The MSC shall assume “dual system” support only if the UE indicates at least one GSM speech version in Octet 3a etc. of the Bearer Capability.

5.6.2 Node originating the OoBTC codec negotiation

When a codec list contains UMTS_AMR_2 and a node in the network participating in the codec negotiation only supports UMTS_AMR then it shall indicate UMTS_AMR back. although the codepoints as defined in [5] are different and only the UMTS_AMR_2 codepoint is included in the codec list it shall be allowed to signal back the codepoint for UMTS_AMR as this is a subset of the UMTS_AMR_2 codec and thus its support is implied. Similarly, if a node receives only UMTS_AMR in the codec list but it supports UMTS_AMR_2 it shall reply with the codepoint for UMTS_AMR as this is the subset that is compatible. *[Editor's note: the previous paragraph will be removed by CR 076.]*

The node originating the OoBTC codec negotiation shall implement the procedures described in Q.1902.4, subclause 8.3.1 [6]. Additionally, the following applies:

In UTRAN or GERAN Iu mode, when constructing the codec configurations for AMR or AMR-WB codecs in the Supported Codecs List (BICC), the MSC Server should take the codec types and codec configurations supported by the RNC or BSC into account (see subclause 5.6.6). The MSC may include more than one ~~"~~Single codec~~"~~ element indicating the same codec type, but different configurations, in the Supported Codecs List (BICC)~~codec list~~ (see [5]).

NOTE: This may be necessary if the RNC supports for an ~~adaptive multi-rate~~AMR codec different sets of codec modes, e.g., (a, b, c, d) and (e, f, g), which are not subsets of each other, and the RNC does not support combinations of these sets, e.g. (a, b, c, d, e, f, g).

~~The MSC Server shall know the codec mode configurations supported by the RNC. These configurations shall be considered during the speech codec negotiation and the RAB Assignment.~~ *[Editor's note: moved to subclause 5.6.6.]*

For AMR codecs the originating CN node shall use the "Optimization Mode" parameter in the Single Codec information element in the Supported Codec List (BICC) (see [5]) to indicate whether or not other nodes may change the offered ACS.

EXAMPLE: An RNC implementing only the prioritised RABs for interoperability testing specified in [18] will support for the UMTS_AMR_2 codec e.g. the set of codec modes (12.2, 7.4, 5.9, 4.75), but none of its subsets containing 2 or 3 codec modes. If the MSC Server connected to this RNC includes the codec configuration (12.2, 7.4, 5.9, 4.75) in the Supported Codecs List (BICC), it will therefore set the OM parameter of the respective Single Codec information element to "Optimization of the ACS not supported".

For AMR codecs, if the OM is set to "Optimization of the ACS supported", the originating CN node shall indicate the maximum number of codec modes (MACS) that may be selected for the ACS during speech codec negotiation. This maximum number of codec modes may depend on optimization strategies applied by the originating CN node. The recommended value is 4 (see [10]).

For AMR-WB codecs the "Optimization Mode" is defined implicitly by the configuration parameter "Config-WB-Codec" in the Single Codec information element (see [5]). If for a configuration the OM is set to "Optimization of the ACS supported", then the configuration may be changed to any other allowed configuration specified in [5].

In order to support interworking with 2G systems it is recommended that MGWs support 2G EFR codecs (GSM_EFR, PDC_EFR, TDMA_EFR). In order to avoid modifications during handover between 2G and 3G systems the MSC nodes may give preference to a suitable 2G codec.

~~For GERAN Iu-mode the MSC Server receives a list of codec types (for definition see [15]) as well as the supported codec modes (for an adaptive multi-rate codec type) within the RANAP INITIAL UE MESSAGE, indicating the GERAN capabilities, which will be available at the RAB establishment procedure. With this information the MSC Server shall puncture out (i.e. delete) those codec types and codec modes (for an adaptive multi-rate codec type) from the supported codec list (for definition see [5]) taking into account the GERAN classmark and the MS capabilities which are not supported by the GERAN. This possibly reduced list shall be used by the MSC Server during the negotiation procedure as described in clause 5.1. The value of the maximum number of supported codec modes shall be set to "four" (see [10]).~~ *[Editor's note: moved to subclause 5.6.6.]*

~~The originating CN node, while performing speech service negotiation with a terminating CN node, shall indicate the maximum number of codec modes that shall be selected during speech codec negotiation. This maximum number of supported codec modes may depend on optimisation strategies applied by the originating CN node. The recommended value is "four" (see [10]).~~ *[Editor's note: moved up 3 paragraphs, with small modifications.]*

Whenever one or several TrFO links have been already established and initialised, the CN node (e.g. the serving CN in case of Call Hold scenarios, the visited CN node in case of Call Forwarding scenarios, etc.) initiating a subsequent codec negotiation on a new call leg or a mid-call codec negotiation on an established and initialised TrFO link, should give the already negotiated Selected Codec (BICC), including its ACS, highest preference to reduce the probability of having to perform a bearer re-establishment or UP re-initialisation of the already established and initialised TrFO links.

5.6.3 Intermediate node

An intermediate node taking part in an OoBTC codec negotiation shall implement the procedures described in Q.1902.4, subclause 8.3.2 [6]. Additionally, the following applies:

If a Single Codec information element for an AMR codec is included in the Supported Codecs List (BICC), with the OM set to "Optimization of the ACS not supported", the intermediate node shall delete the Single Codec information element

i) if the codec type is not supported; or

ii) if one or more codec modes of the offered ACS are not supported.

If a Single Codec information element for an AMR codec is included in the Supported Codecs List (BICC), with the OM set to "Optimization of the ACS supported", the intermediate node

i) shall delete the Single Codec information element, if the codec type is not supported;

ii) shall delete codec modes from the offered SCS and ACS, if they are not supported. If the last codec mode is deleted from the offered SCS, the Single Codec information element shall be deleted from the Supported Codecs List (BICC);

iii) shall reduce MACS to a locally supported value, if necessary;

iv) may change the ACS to a different ACS within the offered SCS; and

v) shall change the OM parameter from "Optimization of the ACS supported" to "not supported", if necessary.

NOTE: In interworking scenarios with TFO, step (iv) may prevent the establishment of an end-to-end tandem free and transcoder free connection; therefore, the intermediate node should not do this without a good reason.

During the processing of a Single Codec information element of an AMR codec with the OM set to "Optimization of the ACS supported", the intermediate node may replace the original Single Codec information element by two or more new Single Codec information elements, which can be derived from the original Single Codec information element by the steps (i) to (v) listed above.

If a Single Codec information element for an AMR-WB codec is included in the Supported Codecs List (BICC), the intermediate node shall

i) delete the Single Codec information element, if the codec type or codec configuration is not supported; or

ii) replace a Single Codec information element with configuration 1, 3, or 5 (see [5], table 5.7-1) by a Single Codec information element with configuration 0 and, optionally, another Single Codec information element with configuration 2 or 4, if configuration 3 or 5 is not supported.

5.6.4 Node terminating the OoBTC codec negotiation

The node terminating the OoBTC codec negotiation shall implement the procedures described in Q.1902.4, subclause 8.3.3 [6]. Additionally, the following procedures apply:

The terminating node shall process the Supported Codecs List (BICC) as described for the intermediate note in subclause 5.6.3.

In UTRAN or GERAN Iu mode, when processing the codec configurations for AMR or AMR-WB codecs in the Supported Codecs List (BICC), the terminating MSC Server should take the codec types and codec configurations supported by the terminating RNC or BSC into account (see subclause 5.6.6).

~~The terminating CN node receiving this information compares the maximum number of codec modes received by the originating CN with its own one and shall decide on the minimum of both numbers to be applied as result of the negotiation.~~

For the selection of the Selected Codec (BICC) from the Supported Codecs List (BICC), the following additional procedures apply:

If an adaptive multi-rate codec is selected, ~~T~~then the decision about the actual codec modes to be included in~~selected as~~ the selected ~~Active Codec Set (~~ACS~~)~~ shall also be made by~~left to~~ the terminating CN node. If the OM of the offered configuration is set to "Optimization of the ACS supported", the selected ACS may be different from the offered ACS, but it shall be a subset of the offered SCS and be consistent with MACS.

In order to provide harmonisation of out of band codec negotiation (for TrFO) and inband codec negotiation (for TFO) ~~very~~ similar codec type and codec configuration selection mechanisms as those being defined for TFO should~~all~~ be applied for TrFO~~,~~ (see [10]). ~~These rules shall be taken into account when forwarding a codec list from the originating node to proceeding node, both for TrFO and TFO.~~

NOTE: For TrFO codec negotiation, besides the speech quality additional aspects may be considered which are not applicable to TFO, e.g. the location of the transcoder that may need to be inserted or possible bandwidth savings in the core network.

If an adaptive multi-rate codec is selected, the terminating MSC Server shall exactly specify the ACS in the Selected Codec (BICC) and set the OM to "Optimization of the ACS not supported".

In the Available Codecs List (BICC), sent back to the originating node, the terminating MSC server may include more than one Single Codec information element indicating the same codec type, but different configurations. Single Codec information elements for adaptive multi-rate codecs may also be included with the OM set to "Optimization of the ACS supported" and the ACS being a subset of the SCS.

According to Q.1902.4, subclause 8.3.3 [6], the terminating node shall include the Selected Codec (BICC) in the Available Codecs List (BICC). For AMR and AMR-WB codecs, the following applies:

If the Selected Codec (BICC) is an AMR codec, it shall be considered as included in the Available Codecs List (BICC), if the Available Codecs List (BICC) contains a Single Codec information element with the same codec type and

- exactly the same configuration, i.e. the same ACS and the OM set to "Optimization of the ACS not supported"; or
- the Selected Codec (BICC) is consistent with the Single Codec information element, i.e. the selected ACS is a subset of the SCS of the Single Codec information element, the Number of codec modes in the selected ACS is less or equal to the MACS parameter of the Single Codec information element, and the OM of the Single Codec information element is set to "Optimization of the ACS supported".

If the Selected Codec (BICC) is an AMR-WB codec, it shall be considered as included in the Available Codecs List (BICC), if the Available Codecs List (BICC) contains a Single Codec information element with the same codec type and

- exactly the same configuration, i.e. the same the configuration parameter "Config-WB-Codec"; or
- any configuration for which the OM is set to "Optimization of the ACS supported".

~~Whenever one or several TrFO links have been already established and initialised, the CN node (e.g. the serving CN in case of Call Hold scenarios, the visited CN node in case of Call Forwarding scenarios, etc.) initiating a subsequent codec negotiation, shall give the already negotiated codec type, including its ACS, highest preference to reduce the possibility of performing bearer re-establishment or UP re-initialisation of the already established and initialised TrFO links.~~ *[Editor's note: moved to subclause 5.6.2 with small modifications.]*

5.6.5 Signalling between server and MGW

According to Q.1902.4, subclause 8.3 [6], during the OoBTC codec negotiation a server can provide its associated MGW with the preferred codec from the Supported Codecs List (BICC), and as a result of the negotiation the server will provide its associated MGW with the Selected Codec (BICC). The information is sent via the Mc interface as Codec (H.248).

If the Codec (H.248) is an adaptive multi-rate codec, the server shall exactly specify the ACS in the respective Single Codec information element and set the OM to "Optimization of the ACS not supported", both for the preferred codec and the Selected Codec (BICC).

For the Single Codec information elements of adaptive multi-rate codecs in the TFO Codec List (H.248), the OM may be set to "Optimization of the ACS supported", and the ACS may be a subset of the SCS. This applies also to the first entry in the TFO Codec List (H.248), the Local Used Codec.

NOTE: In some scenarios the flexible configuration of the Local Used Codec may be used for a faster TFO establishment (see [10]).

5.6.6 Signalling between MSC and UTRAN or GERAN Iu-mode

The MSC Server shall know the codec types and codec configurations supported by the RNC. The MSC Server shall select only from these configurations for the RAB assignment.

For GERAN Iu-mode the MSC Server receives a list of codec types (for definition see [15]) as well as the supported codec modes (for an adaptive multi-rate codec type) within the RANAP INITIAL UE MESSAGE, indicating the GERAN capabilities, which will be available at the RAB establishment procedure. With this information the MSC

Server shall delete those codec types and codec modes (for an adaptive multi-rate codec type) from the Supported Codecs List (BICC) which are not supported by the GERAN, taking into account the GERAN classmark and the MS capabilities. This possibly reduced list shall be used by the MSC Server during the codec negotiation procedure. The value of the maximum number of supported codec modes shall be set to 4 (see [10]).

When the MSC node requests a RAB assignment the Subflow Combinations provided shall either all be initialised by the RNC or all rejected with appropriate cause code.

The MSC shall always assume "Discontinuous Transmission (DTX)" as mandatory and shall define “SID” SDUs in addition to the negotiated speech codec modes. This is because for TrFO the RAB requested by one RNC must match that requested by the peer RNC – they are effectively the same RAB. If one MSC requires DTX support then the RAB requested by the far end MSC must also support DTX (even if it is not desired by that MSC). As no Out Of Band negotiation for DTX is supported nor DTX control to the UE, DTX shall be mandatory for TrFO connections.

Once an adaptive multi-rate codec with an~~the common~~ ACS has been selected as Selected Codec (BICC), the MSCs shall indicate in the RAB Assignment parameters [3] for the Guaranteed Bitrate the lowest speech mode in the ACS (assuming any SID frames are smaller than the SDU for lowest speech mode, otherwise the Guaranteed Bitrate shall be set to the largest SID frame). The Maximum bitrate shall correspond to the highest mode in the ACS.

5.7 Inband Rate Control

Inband rate control shall only allow the RNCs to set the maximum codec mode (maximum bitrate) from the set of codec modes that have been negotiated out of band. This procedure is called Maximum Rate Control. The final maximum mode selected results from a rate control request from one side and the maximum rate supported at the receiving side; the lower rate of these is selected. This is known as Distributed Rate Decision. In TrFO maximum rate control shall be supported through the Iu Framing protocol and through transit networks supporting compressed voice. The maximum rate control procedures are further defined within the Iu Framing protocol [4].

When the MSC requests for a RAB to be assigned, it shall always define 1 speech mode SDU (lowest rate), and DTX SDU as non-rate controllable. Other SDU formats for higher rates shall be defined as rate controllable. The first subflow combination in the IuUP initialisation shall be treated as an initial maximum rate control. Where a node is in TrFO break (e.g. the terminating MGW) this initial maximum rate control received at a given MGW/IuUP termination shall be signalled to the other TrFO link using the IuUP Rate Control PDU unless the IuUP Initialisation frame is to be sent on to the next link as in RFCI Value Correction (see clause 5.4.3).

At SRNS relocation the new RNC shall send a rate control frame at Relocation Detect indicating its current maximum rate, it will receive in the acknowledgement the current maximum rate from the far end. This procedure is called Immediate Rate Control. Again the distributed rate decision means both RNCs will operate within a common limit.

5.8 Modification Procedures

The OoBTC procedures shall support the following modification mechanisms:

i) Modification of Selected Codec.
(The codec type of the Selected Codec (BICC) may be switched to another type within the Available Codecs List (BICC), and/or the Active Codec mode Set of the Selected Codec (BICC) may be modified, and/or the Supported Codec mode Set of the Selected Codec (BICC) may be reduced.)

ii) Modification of Available Codecs List
(The Available Codecs List (BICC) may be reduced by removing codec types and modes)

iii) Mid-call Codec Negotiation
(The Available Codec List (BICC) is re-negotiated, allowing the addition and removal of codec types and modes compared to the previous Available Codec List (BICC), and a new Selected Codec (BICC) is chosen out of the new Available Codec List (BICC))

The specific call flows when such procedures may be required are detailed in Clause 6. Further information on the Available Codecs List (BICC) and the Selected Codec (BICC) is provided in Section 5.2. Further information on codec types, codec modes, a Supported Codec mode Set and an Active Codec mode Set is provided in TS 26.103 [5]. The basic codec negotiation principles are defined by the BICC Call Control Procedures (see [6]) but the explicit Mc interface procedures are added.

5.8.1 Modification of Selected Codec

The codec modification procedures shall support the following changes:

i) change of the~~to currently selected~~ codec type or codec configuration of the current Selected Codec (BICC) to another codec type or codec configuration within the Available Codecs List (BICC);

~~ii)reduction of the currently selected codec type's available codec set (ACS)~~

~~iii)reduction of the currently selected codec type's supported codec set (SCS)~~

ii) modification of the Available Codecs List (BICC) according to subclause 5.8.2, (i) to (v), in combination with any change of the codec type or codec configuration of the current Selected Codec (BICC) to another codec type or codec configuration within the new Available Codecs List (BICC). The modification of the Available Codecs List (BICC) may include removal of the current Selected Codec (BICC) from the list.

~~iv)reduction of the ACS of any codec in the Supported Codecs List (in addition to any change of the selected codec).~~

~~vi)reduction of the SCS of any codec in the Supported Codecs List(in addition to any change of the selected codec)Reduction of the codec types in the Supported Codecs List (in addition to any change of the selected codec).~~

The procedures described in Q.1902.4, clauses 10.4.1 to 10.4.3 [6] shall apply.

The new codec type and codec configuration may be selected freely from the Available Codecs List (BICC). For an AMR codec or AMR-WB codec, a codec configuration may be selected if it is considered to be included in the Available Codecs List (BICC) according to the criteria specified at the end of subclause 5.6.4.

For the coding of the new Selected Codec (BICC), the new Available Codecs List (BICC), and the new Codec (H.248), the same rules apply as specified in subclauses 5.6.4 and 5.6.5.

In Figure 5.8.1/1 and 5.8.1/2 the basic codec modification procedure is shown. This Figure is an example; the codec modification procedure may be initiated by any node within the call.

Upon Reception of a Modify Codec message (action 5 and 9 in Figure 5.8.1/1), a server node shall check if the Selected Codec is altered according to the criteria above. If the Selected Codec is not altered, the procedures in Section 5.8.2 (Modification of the Available Codec List) apply, otherwise the server node shall send a "Reserve Characteristics" procedure to the attached MGW for the corresponding termination (action 6 and 10 in Figure 5.8.1/1

To perform a modification of the selected codec at an Iu interface, the MSC server shall send a "Modify Bearer Characteristics" procedure to the attached MGW (action 1 and 12 in Figure 5.8.1/1). Upon completion of the "Modify Bearer Characteristics" procedure, the server node shall send a "RAB Assignment Request" to the radio access network (action 2 and 13 in Figure 5.8.1/1). The MSC server shall then wait to receive a corresponding "RAB Assignment Response" message from the radio access network (action 3 and 14 in Figures 5.8.1/2 and 5.8.1/3) before continuing the modification procedure.

An MSC server shall use the "Reserve Characteristic" procedure for the termination towards the preceeding node (with respect to the Modify Codec message) to perform the necessary bearer level modification. The MGW shall respond for that termination with the "Bearer Modified" procedure to indicate that the possible bearer modification to increase bandwidth was successful. The MGW shall not wait until the Iu UP initialisation is complete before replying with the "Bearer Modified" procedure. Each server shall not send forward the modify request to the succeeding node until the indication from its MGW that any necessary bearer level modification has been completed (BNC_Modified notification). The MSC server shall use the "Confirm Characteristics" procedure to confirm the modification at that termination.

An MSC server shall use the "Modify Characteristic" procedure for the termination towards the succeeding node (with respect to the Modify Codec message) to confirm the codec modification.

The specific handling of the Iu UP initialisation is described in Section 5.8.4.

Error Cases are described in Section 5.8.5.

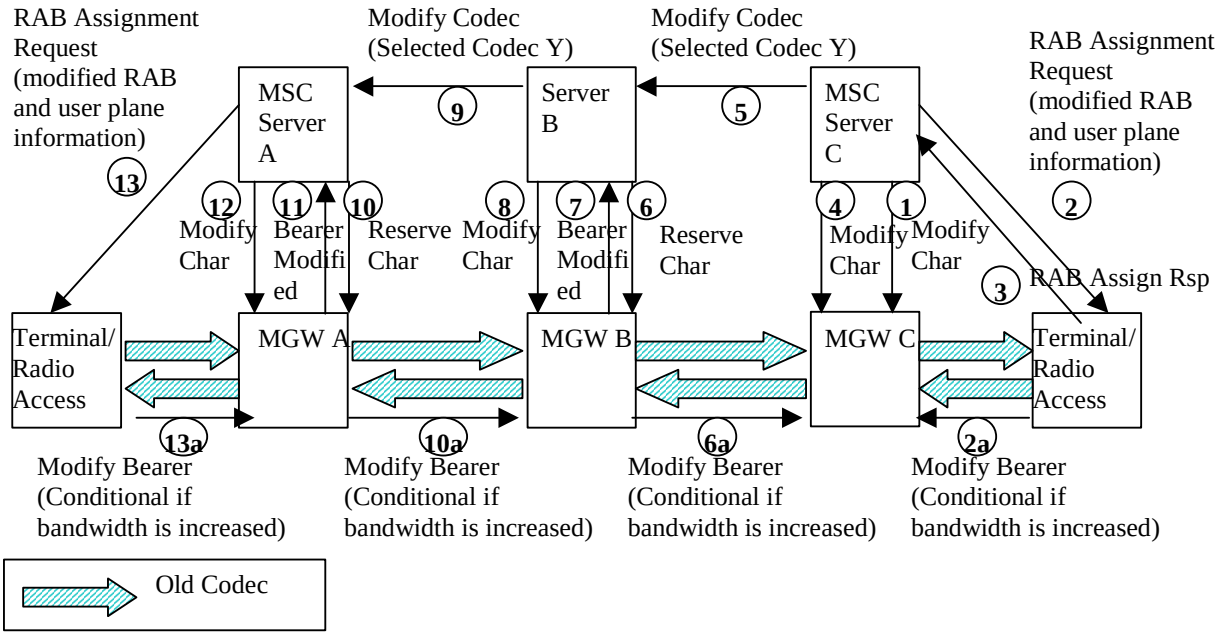

Figure 5.8.1/1: Codec Modification Control Procedures

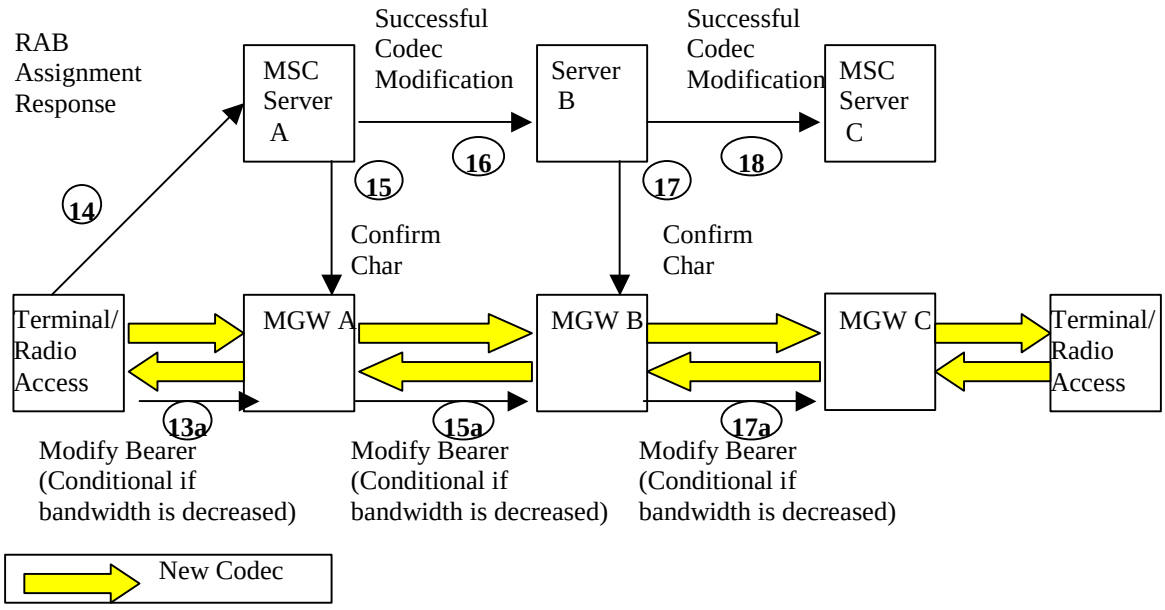

Figure 5.8.1/2: Codec Modification acknowledgement

5.8.2 Modification of Available Codecs List

The modification of the Available Codecs List (BICC) shall support the following changes:

i) reduction of the ACS of any Single ~~c~~Codec information element in the Available~~Supported~~ Codecs List (BICC) for which OM is set to "Optimization of the ACS supported";

ii) reduction of the SCS of any Single ~~c~~Codec information element in the Available~~Supported~~ Codecs List (BICC) for which OM is set to "Optimization of the ACS supported";

iii) reduction of the MACS of any Single Codec information element in the Available Codecs List (BICC) for which OM is set to "Optimization of the ACS supported";

iv) change of the OM of any Single Codec information element in the Available Codecs List (BICC) from "Optimization of the ACS supported" to "not supported"; and

~~iii)~~v) deletion~~reduction~~ of one or more ~~the~~ Single ~~c~~Codec information elements from~~types in~~ the Available~~Supported~~ Codecs List (BICC).

This shall not include the removal of the Selected Codec (BICC) or of modes from the ACS of the ~~s~~Selected ~~c~~Codec (BICC), as this would require a Modification of Selected Codec ~~modification~~ as described in 5.8.1.

The procedures described in Q.1902.4, clauses 10.4.1 to 10.4.3 [6] shall apply.

For the coding of the new Available Codecs List (BICC), the same rules apply as specified in subclause 5.6.4.

No modification of the user plane and signalling towards the MGWs and radio access network is required.~~,~~

In Figure 5.8.2/1 the basic “modification of available codec list” procedure is shown. This Figure is an example; the codec modification procedure may be initiated by any node within the call.

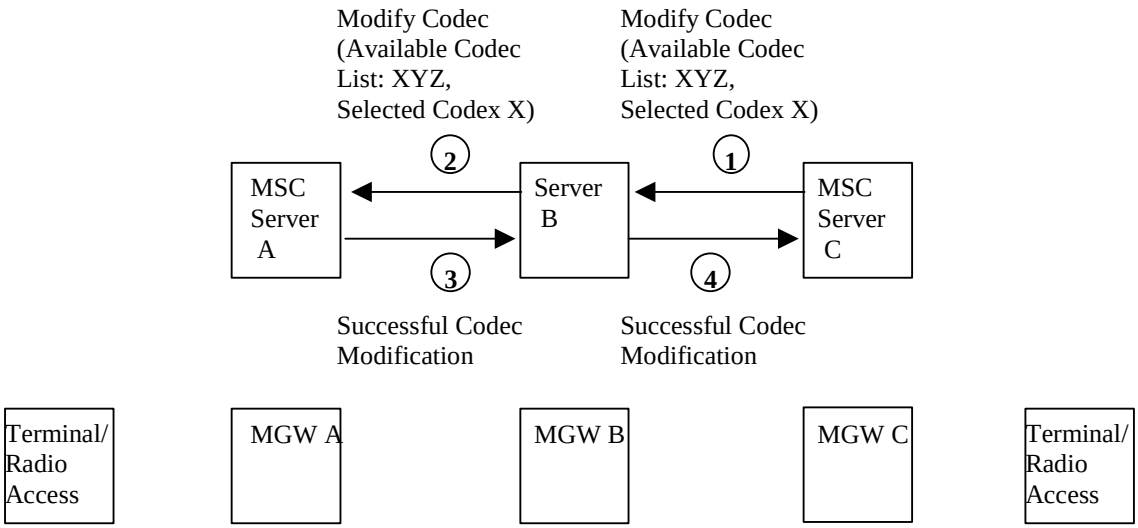

Figure 5.8.2/1: Modification of Available Codec List

5.8.3 Mid-call Codec negotiation

The Selected Codec (BICC) and the Available Codecs List (BICC) can be (re-) negotiated during the call using the “Mid Call Codec Negotiation” mechanism. The Mid-Call Codec Negotiation mechanism results in a new Available Codecs List (BICC), where new codec types or modes not within the previous Available Codecs List (BICC) may be included. The codec negotiation procedure is performed as for call set-up.

The procedures described in Q.1902.4, clauses 10.4.4 to 10.4.6 [6] shall apply.

The sequence is shown in Figure 5.8.3/1. Starting with the Modify to Selected Codec message, the remaining sequence is the same as for the Codec Modification in Section 5.8.1 except that the message name for the modify request is “Modify To Selected Codec” (instead of “Modify Codec”) in order to allow collisions between the two procedures to be resolved. Everything stated in Section 5.8.1 shall also apply for the Mid-Call Codec Negotiation procedure.

The node initiating the “Mid Call Codec Negotiation” mechanism (MSC Server A in Figure 5.8.3/1) shall select a Preferred Codec and a Supported Codecs List (BICC), which may contain new codecs and also may not contain codecs from the previous Available Codecs List (BICC). If the list no longer contains the previous Selected Codec (BICC), then a new codec shall be selected as Preferred Codec. If the previous Selected Codec (BICC) exists within the Supported Codecs List (BICC), this codec should be selected as the Preferred Codec.

If a server node removes the Preferred Codec, from the Supported Codecs List (BICC), the node shall select a new Preferred Codec.

3GPP TSG-CN WG4 Meeting #25 ***N4-041701***

Seoul, KOREA. 15th to 19th November 2004. **(rev of N4-041624)**

(rev of N4-041520)

CR-Form-v7.1

CHANGE REQUEST

⌘ **23.153** **CR** **079** ⌘ **rev** **3** ⌘ Current version: **4.10.0** ⌘

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Proposed change affects: UICC apps⌘ ☐ ME ☐ Radio Access Network ☐ Core Network ☒

Title:	⌘	Addition of missing condition for transcoder free operation in the MGW
Source:	⌘	CN4
Work item code:	⌘	OoBTC
Date:	⌘	19/11/2004
Category:	⌘	**F**
Release:	⌘	Rel-4

Use one of the following categories:
- ***F*** *(correction)*
- ***A*** *(corresponds to a correction in an earlier release)*
- ***B*** *(addition of feature),*
- ***C*** *(functional modification of feature)*
- ***D*** *(editorial modification)*

Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

Ph2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
Rel-4	*(Release 4)*
Rel-5	*(Release 5)*
Rel-6	*(Release 6)*
Rel-7	*(Release 7)*

Reason for change:	⌘	**Essential correction** The condition when the MGW needs to insert a transcoder between two terminations with different AMR or AMR-WB codecs is missing.
Summary of change:	⌘	A corresponding condition is added to subclause 5.3
Consequences if not approved:	⌘	Without clear specification there is a risk that a MGW implementation will not insert a transcoder although it is needed. Dependent on the codecs, this may result in a **serious deteroriation of speech quality** (e.g. if FR_AMR and UMTS_AMR are connected without transcoder) or even an **unusable connection** (if the codecs are 'absolutely' incompatible).

Clauses affected:	⌘	5.3			
Other specs affected:	⌘	**Y** / **N**		⌘	
		X /	Other core specifications		28.062 042
		/ **X**	Test specifications		
		/ **X**	O&M Specifications		
Other comments:	⌘	.			

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1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.3 Media Gateway Control for Codec Handling

The general handling of MGW control procedures are detailed in [8]. Specific handling related to the control of the speech encoding is detailed in Figure. 5.3/1. The terms context, termination, streams and stream properties are described in the ITU-T H.248 "Media Gateway Control Protocol" [13].

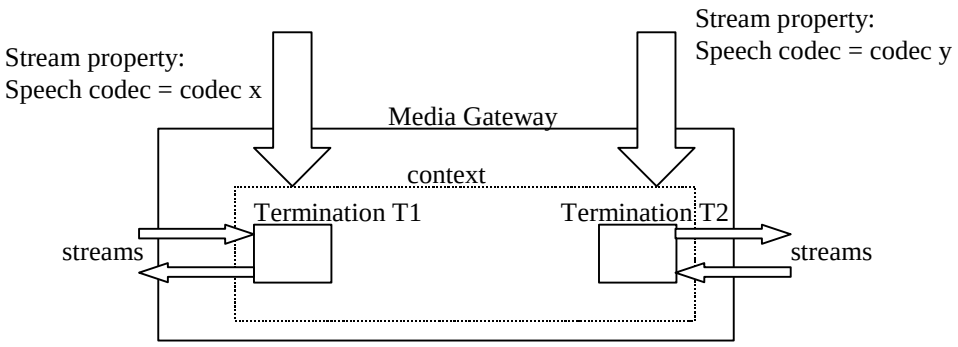

Figure 5.3/1. MGW control for speech codec

The handling of transcoding between one codec type (media stream property applied at one termination) and another codec type (media stream property at other termination) is a function of the MGW. The media stream property for Audio Codec Type is defined in Annex C of the ITU-T MGW control protocol, H.248.

If TFO-incompatible codec types are applied at different terminations of the same context, the MGW shall insert a transcoder. For the definition of TFO-compatibility between 3GPP codec types and codec configurations see [10], clauses 11 and 12.

Between codecs of the AMR codec family, the MGW need not insert a transcoder, if the codec types are TFO-compatible according to [10], table 11-1, and

- the codecs use the same ACS; or
- the ACSs are compatible and the use of codec modes is restricted to a common subset of the ACSs by means of maximum rate control. In this case the MGW should coordinate the rate control request.

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Seoul, KOREA. 15th to 19th November 2004. **(rev of N4-041625)**

(rev of N4-041521)

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CHANGE REQUEST

⌘ **23.153** **CR** **080** ⌘ **rev** **3** ⌘ Current version: **5.8.0** ⌘

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Source:	⌘	CN4
Work item code:	⌘	OoBTC
Date:	⌘	19/11/2004
Category:	⌘	**A**
Release:	⌘	Rel-5

Use one of the following categories:
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- ***A*** *(corresponds to a correction in an earlier release)*
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Rel-7	*(Release 7)*

Reason for change:	⌘	**Essential correction** The condition when the MGW needs to insert a transcoder between two terminations with different AMR or AMR-WB codecs is missing.
Summary of change:	⌘	A corresponding condition is added to subclause 5.3
Consequences if not approved:	⌘	Without clear specification there is a risk that a MGW implementation will not insert a transcoder although it is needed. Dependent on the codecs, this may result in a **serious deteroriation of speech quality** (e.g. if FR_AMR and UMTS_AMR are connected without transcoder) or even an **unusable connection** (if the codecs are 'absolutely' incompatible).

Clauses affected:	⌘	5.3			
Other specs affected:	⌘	**Y** / **N**	Other core specifications	⌘	28.062 043
		N	Test specifications		
		N	O&M Specifications		
Other comments:	⌘				

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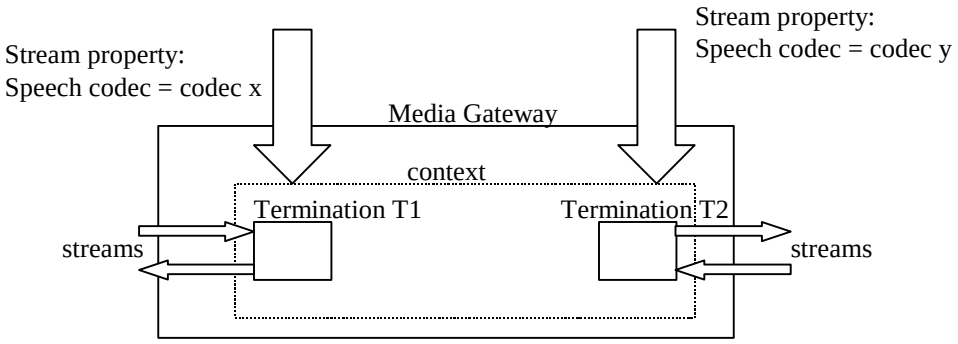

Figure 5.3/1. MGW control for speech codec

The handling of transcoding between one codec type (media stream property applied at one termination) and another codec type (media stream property at other termination) is a function of the MGW. The media stream property for Audio Codec Type is defined in Annex C of the ITU-T MGW control protocol, H.248.

If TFO-incompatible codec types are applied at different terminations of the same context, the MGW shall insert a transcoder. For the definition of TFO-compatibility between 3GPP codec types and codec configurations see [10], clauses 11 and 12.

Between codecs of the AMR codec family, the MGW need not insert a transcoder, if the codec types are TFO-compatible according to [10], table 11-1, and

- the codecs use the same ACS; or
- the ACSs are TFO-compatible and the use of codec modes is restricted to a common subset of the ACSs by means of maximum rate control. In this case the MGW should coordinate the rate control request.

Between codecs of the AMR-WB codec family, the MGW need not insert a transcoder, if

- the codecs use the same ACS; or
- the use of codec modes is restricted to a common subset of the ACSs by means of maximum rate control. In this case should coordinate the rate control request.