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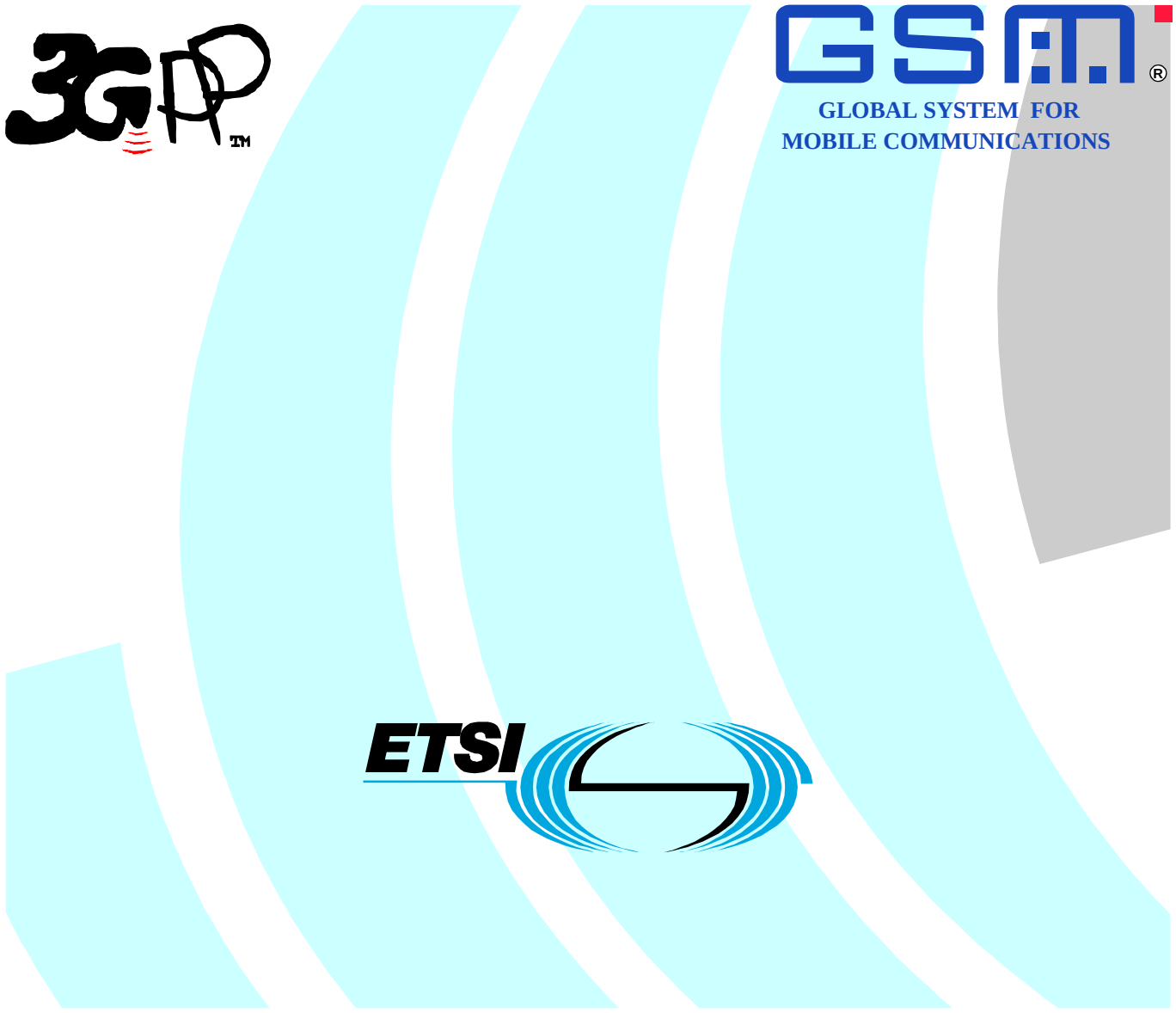
Technical Specification

**Digital cellular telecommunications system (Phase 2+);
Universal Mobile Telecommunications System (UMTS);
Speech codec list for GSM and UMTS
(3GPP TS 26.103 version 6.2.0 Release 6)**



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Foreword

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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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1 Scope

The present Technical Specification outlines the Codec Lists in 3GPP including both systems, GSM and UMTS, to be used by the Out of Band Transcoder Control (OoBTC) protocol to set up a call or modify a call in **Tr**anscoder **F**ree **O**peration (TrFO) and in "transcoder at the edge" scenarios.

The TS further specifies the coding of the Supported Codec List Information Elements for the UMTS radio access technology.

The Supported Codec List IE includes Codec_Types from the TDMA and PDC systems, to support TFO or TrFO between UMTS and TDMA, or UMTS and PDC.

2 Normative 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 26.090 : 'AMR Speech Codec; Speech Transcoding Functions".

[2] 3GPP TS 26.093 : 'AMR Speech Codec; Source Controlled Rate Operation".

[3] 3GPP TS 26.101 : 'Mandatory Speech Codec Speech Processing Functions; AMR Speech Codec Frame Structure".

[4] 3GPP 46.0xx: 'Enhanced Full Rate Codec Recommendations".

[5] 3GPP 26.0xx: 'Adaptive Multi-Rate Codec Recommendations".

[6] 'ITU Q.765.5: 'Use of Application Transport Mechanism for Bearer Independent Call Control'

[7] 3GPP TS 28.062: "In-band Tandem Free Operation (TFO) of Speech Codecs, Stage 3 - Service Description".

[8] 3GPP TS 23.153: "Out of Band Transcoder Control - Stage 2".

[9] 3GPP TS 24.008: "Mobile radio interface layer 3 specifications, Core Network Protocols"

[10] 3GPP TS 26.190: 'AMR Wideband Speech Codec; Speech Transcoding Functions".

[11] 3GPP TS 26.193: 'AMR Wideband Speech Codec; Source Controlled Rate Operation".

[12] 3GPP TS 26.201: 'Mandatory Speech Codec Speech Processing Functions; AMR Wideband Speech Codec Frame Structure".

[13] 3GPP TS 23.172: 'CS multimedia service UDI/RDI fallback and service modification; Stage 2'.

3 Definitions and Abbreviations

3.1 Definitions

Codec Type: defines a specific type of a speech Coding algorithm, applied on a specific radio access technology (e.g. GSM FR, (GSM) FR AMR).

Codec Mode:defines a specific mode of a Codec Type (e.g. 12,2 kBit/s Mode of the (GSM) FR AMR).

Codec Configuration: defines a specific set of attributes to a certain Codec Type (e.g. the combination of ACS and DTX='on' for (GSM) FR AMR).

Organisation Identifier (OID): Identifies the standard organisation (e.g. 3GPP) producing a specification for a Codec List. ITU-T is responsible for maintaining the list of Organisation Identifiers.

System Identifier (SysID): Identifies the radio access technology (e.g. GSM or UMTS) for which the supported Codec List is defined.

Other definitions are given in TS 23.153 [8].

3.2 Abbreviations

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

ACS	Active Codec (mode) Set
BWM	BandWidth Multiplier
CoID	Codec IDentifier
DTX	Discontinuous Transmission
GSM	Global System for Mobile communication
MuMe	Multi-Media
OID	Organisation IDentifier (e.g. ITU-T, 3GPP)
OoBTC	Out of Band Transcoder Control
PDC	Personal Digital Communication (synonym for ...)
RX	Receive
SCR	Source Controlled Rate operation (synonym to DTX)
SID	Silence Descriptor
SysID	System Identifier
TDMA	Time Division Multiple Access (synonym for ...)
TFO	**T**andem **F**ree **O**peration (also sometimes called 'Transcoder-Through' or 'Codec-Bypass')
TrFO	**Tr**anscoder **F**ree **O**peration
TX	Transmit
UMTS	Universal Mobile Telecommunications System

4 General

The present Technical Specification outlines the 3GPP internal Codec Lists for both, GSM and UMTS, to be used by the Out of Band Transcoder Control (OoBTC) protocol to set up a call or modify a call in Transcoder Free Operation (TrFO).

It further specifies the coding of the Supported Codec List Information Elements as defined in 3GPP TS 24.008 for the UMTS radio access technology.

Transcoder Free Operation allows the transport of speech signals in the coded domain from one user equipment (UE) to the other user equipment through the radio access network (RAN) and core network (CN), possibly through a transit network (TN). This enables high speech quality, low transmission costs and high flexibility.

The necessary Codec Type selection and resource allocation are negotiated out of band before and after call setup. Possible Codec (re-)configuration, Rate Control and DTX signalling may be performed after call setup by additional inband signalling or a combination of inband and out-of-band signalling.

Up to release ´99 GSM does not support Transcoder Free Operation, but specifies the Tandem Free Operation (TFO). Tandem Free Operation enables similar advantages, but is based on pure inband signalling after call setup.
The parameters defined in this Technical Specification allow interaction between TrFO and TFO. They further provide an evolutionary path for GSM towards Transcoder Free Operation.

The GERAN and UTRAN standards define fourteen different Codec Types, see table 4.1.

Table 4.1: Support of Codec Types in Radio Access Technologies

	TDMA EFR	**UMTS AMR 2**	**UMTS AMR**	**(GSM) HR AMR**	**(GSM) FR AMR**	**GSM EFR**	**GSM HR**	**GSM FR**
CoID	**0x07**	**0x06**	**0x05**	**0x04**	**0x03**	**0x02**	**0x01**	**0x00**
GERAN GMSK	not defined	not possible	not possible	yes, 1..4 modi	yes, 1..4 modi	yes	yes	yes
GERAN 8PSK	not defined	not possible	not possible	not defined	not defined	not defined	not defined	not defined
UTRAN	not defined	yes, 1..8 modi 1..4 modi recomm.	R99, UTRAN-only UEs	not defined	not defined	not defined	not defined	not defined

			OHR AMR-WB	**OFR AMR-WB**	**OHR AMR**	**UMTS AMR-WB**	**FR AMR-WB**	**PDC EFR**
CoID	**0x0F**	**0x0E**	**0X0D**	**0x0C**	**0x0B**	**0x0A**	**0x09**	**0x08**
GERAN GMSK			not defined	not defined	not defined	not possible	yes3 modi	not defined
GERAN 8PSK			yes, 3 modi	yes, 3 modi	yes, 1..4 modi	not possible	not defined	not defined
UTRAN			not defined	not defined	not defined	yes 3..4 modi	not defined	not defined

CoID is reprinted here in hexadecinmal notation. It is defined in section 5.

5 3GPP Codec List for OoBTC

The definition of the common Codec List for Out of Band Transcoder Control (3GPP TS 23.153, [8]) in 3GPP for GSM and UMTS follows the specifications given in ITU Q.765.5: The most preferred Codec Type is listed first, followed by the second preferred one, and so on. An informative example for a codec list for UMTS can be found in Annex A.

5.1 GSM Full Rate Codec Type (GSM FR)

The Codec IDentification (CoID) code is defined to be: FR_CoID := 0x0000.0000.

The GSM Full Rate Codec Type has no additional parameters.

For information (for exact details see GSM Recommendations):

The GSM Full Rate Codec Type supports one fixed Codec Mode with 13.0 kBit/s.

DTX may be enabled in uplink and in downlink independently of each other. DTX on or off is defined by the network on a cell basis and can not be negotiated at call setup or during the call. The DTX scheme uses one SID frame to mark the end of a speech burst and to start Comfort Noise Generation. Identical SID frames for comfort noise updates are sent in speech pauses about every 480 ms, aligned with the cell´s TDMA frame structure. The defined Tandem Free Operation allows the reception of GSM FR DTX information for the downlink direction in all cases. The TFO respectively TrFO partner is prepared to receive DTX information as well.

5.2 GSM Half Rate Codec Type (GSM HR)

The Codec IDentification (CoID) code is defined to be: HR_CoID := 0x0000.0001.

The GSM Half Rate Codec Type has no additional parameters.

For information (for exact details see GSM Recommendations):

The GSM Half Rate Codec Type supports one fixed Codec Mode with 5.60 kBit/s.

DTX may be enabled in uplink and in downlink independently of each other. DTX on or off is defined by the network on a cell basis and can not be negotiated at call setup or during the call. The DTX scheme uses one SID frame to mark the end of a speech burst and to start Comfort Noise Generation. Identical SID frames for comfort noise updates are sent in speech pauses about every 480 ms, aligned with the cell´s TDMA frame structure. The defined Tandem Free Operation allows the reception of GSM HR DTX information for the downlink direction in all cases. The TFO respectively TrFO partner shall be prepared to receive DTX information as well.

5.3 GSM Enhanced Full Rate Codec Type (GSM EFR)

The Codec IDentification (CoID) code is defined to be: EFR_CoID := 0x0000.0010.

The GSM Enhanced Full Rate Codec Type has no additional parameters.

For information (for exact details see GSM Recommendations):

The GSM Enhanced Full Rate Codec Type supports one fixed Codec Mode with 12.2 kBit/s.

DTX may be enabled in uplink and in downlink independently of each other. DTX on or off is defined by the network on a cell basis and can not be negotiated at call setup or during the call. The DTX scheme uses one SID frame to mark the end of a speech burst and to start Comfort Noise Generation. It is important to note that the Comfort Noise parameters for this start of the comfort noise generation are calculated at transmitter side from the previous eight speech frames. A DTX hangover period needs to be applied therefore at transmitter side before sending the first SID frame. SID frames with incremental information for comfort noise updates are sent in speech pauses about every 480 ms, aligned with the cell´s TDMA frame structure. The defined Tandem Free Operation allows the reception of GSM EFR DTX information for the downlink direction in all cases. The TFO respectively TrFO partner shall be prepared to receive DTX information as well.

5.4 Five Adaptive Multi-Rate Codec Types (FR AMR, HR AMR, UMTS AMR, UMTS AMR2, OHR AMR)

The Adaptive Multi-Rate Codec algorithm is applied in GERAN-GMSK, GERAN-8PSK and UTRAN in five different Codec Types.
The Codec IDentification (CoID) codes are defined to be:
FR_AMR_CoID := 0x0000.0011.
HR_AMR_CoID := 0x0000.0100.
UMTS_AMR_CoID := 0x0000.0101.
UMTS_AMR_2_CoID := 0x0000.0110.
OHR_AMR_CoID := 0x0000.1011.

The AMR Codec Types can be used in conversational speech telephony services in a number of different configurations. The set of preferred configurations is defined in TS 28.062, Table 7.11.3.1.3-2. One of these preferred configurations, Config-NB-Code 1, is recommended for TFO-TrFO harmonisation between GSM and UMTS networks.

The Single Codec Information Element for AMR Codec Types may have several additional parameters. These parameters are optional in the Supported Codec List (BICC) and in the Available Codec List (BICC), but these parameters shall specify exactly one AMR Configuration for the Selected Codec (BICC), see [8].

Active Codec Set, ACS: eight bits.
Each bit corresponds to one AMR Mode. Setting the bit to '1' means the mode is included, setting the bit to '0' means the mode is not included in the ACS.
Note: Except for HR_AMR all eight AMR modes may be selected, for the HR_AMR only the six lower modes.

Supported Codec Set, SCS: eight bits.
Each bit corresponds to one AMR Mode, as in the ACS. Setting the bit to '1' means the mode is supported, setting the bit to '0' means the mode is not supported. The SCS shall at least contain all modes of the ACS.

Maximal number of codec modes in the ACS, MACS: three bits.
MACS shall be used in the Supported Codec List (BICC) and the Available Codec List (BICC), when it is necessary to restrict the maximum number of modes for the (future) Selected Codec (BICC).
For FR AMR, HR AMR and OHR AMR one up to four, for the UMTS AMR and UMTS AMR2 one up to eight Codec Modes are allowed.
Coding: '001': one, '010': two, … '111': seven, '000': eight Codec Modes allowed.

Optimisation Mode for ACS, OM: one bit.
OM indicates, whether the sending side supports the modification (optimisation) of its offered ACS for the needs of the distant side.
Coding: "0": Optimisation of the ACS not supported, "1": Optimisation of the ACS supported.
If OM is specified as 'Optimisation of the ACS not supported', then SCS and MACS have no meaning for this Single Codec Information Element; then the SCS shall at least contain all modes of the offered ACS; MACS shall be equal to or larger than the number of modes in the offered ACS.

Usage of this Single Codec Information Element in OoBTC.
In the Single Codec Information Element for the Selected Codec (BICC) the ACS shall be specified exactly.
For FR AMR, HR_AMR and OHR AMR at least one, but not more than four modes shall be included.
For UMTS AMR and UMTS AMR2 at least one, but not more than four modes should be included.
OM shall be set to 'Optimisation of the ACS not supported'.

In the Single Codec Information Element for the Supported Codec List (BICC) and the Available Codec List (BICC) one of the following codings shall be used

- either all parameters (ACS, SCS, MACS and OM) are omitted.
  Then per default all possible AMR modes shall be treated as included in ACS and SCS, MACS shall be treated as set to its allowed maximum and OM shall be treated as set to 'Optimisation of the ACS supported'.

- or only the ACS is specified:
  Then per default all possible AMR modes shall be treated as included in the SCS, MACS shall be treated as set to its allowed maximum and OM shall be treated as set to 'Optimisation of the ACS supported'.

- or ACS and SCS are specified.
  Then per default MACS shall be treated as set to its allowed maximum and OM shall be treated as set to 'Optimisation of the ACS supported'.

- or all parameters (ACS, SCS, MACS and OM) are specified.

Procedures in OoBTC
The procedures for handling of these Single Codec Information Element in the originating, intermediate and terminating nodes are specified in TS 23.153 [8].

The 'Single Codec' information element consists of 5 to 8 octets in case of the AMR Codec Types (table 5.4):

Table 5.4: Coding of 'Single Codec' for the Adaptive Multi-Rate Codec Types

Octet	Parameter	MSB 8	7	6	5	4	3	2	1 LSB
1 m	Single Codec	Single Codec (see ITU-T Q.765.5)							
2 m	Length Indication	3, 4, 5, 6							
3 m	Compat. Info	Compatibility Information							
4 m	OID	ETSI OID (See ITU-T Q.765.5 [6])							
5 m	CoID	FR_AMR_CoID, HR_AMR_CoID, UMTS_AMR_CoID, UMTS_AMR_2_CoID, OHR_AMR-CoID							
6 o	ACS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
7 o	SCS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
8 o	OM, MACS	(spare)	(spare)	(spare)	(spare)	OM	MACS		

with 'm' = mandatory and 'o' = optional

For information on GSM procedures (for exact details see GSM Recommendations):

The GSM AMR Codec Types comprise eight (Full Rate), respectively six (Half Rate) different Codec Modes:
12,2 … 4,75 kBit/s.

The active Codec Mode is selected from the Active Codec Set (ACS) by the network (Codec Mode Command) with assistance by the mobile station (Codec Mode Request). This Codec Mode Adaptation, also termed Rate Control, can be performed every 40 ms by going one Codec Mode up or down within the ACS. The Codec Modes in uplink and downlink at one radio leg may be different. In Tandem Free Operation both radio legs (A and B) are considered for the optimal selection of the active Codec Mode in each direction (uplink A and then downlink B, respectively vice versa) by the 'Distributed Rate Decision' algorithm. The worst of both radio legs determines the highest allowed Codec Mode, respectively the maximally allowed rate ("Maximum Rate Control"). All rate control commands are transmitted inband: on the radio interface, the BTS-TRAU interface and the TRAU-TRAU interface.

The Active Codec Set is configured at call setup or reconfigured during the call. It consists of one up to maximally four Codec Modes (MACS) at a given time, selected from the Supported Codec Set. The maximal number of Codec Modes and the Supported Codec Set may be constrained by the network to consider resources and radio conditions.
The Active Codec Sets in uplink and downlink are identical.
First, at start up of Tandem Free Operation, Active Codec Sets, the Supported Codec Sets, the MACSs and the OMs are taken into account to determine the optimal common Active Codec Set. In a later phase the Codec Lists of both radio legs may be taken into account to find the optimum configuration. For exact details see 3GPP TS 28.062. All configuration data and update protocols are transmitted inband.

The DTX scheme of the Adaptive Multi-Rate Codec Type marks with a specific SID_FIRST frame the end of a speech burst. SID_FIRST does not contain Comfort Noise parameters. This SID_FIRST starts the comfort noise generation with parameters that are calculated at receiver side (!) from the latest received seven speech frames. A DTX hangover period needs to be applied therefore at transmitter side before sending of this SID_FIRST.

Absolutely coded SID_UPDATE frames follow about every eighth frame (160 ms) in speech pauses. SID_UPDATE frames are sent independently of the cell´s TDMA frame structure and are related only to the source signal.
An ONSET frame (typically) precedes in uplink direction the beginning of a new speech burst. DTX on or off is defined by the network on a cell basis. The defined Tandem Free Operation allows the reception of GSM-AMR DTX information for the downlink direction in all cases.

Note: The DTX scheme of the Enhanced Full Rate Codec Type is not compatible with the DTX scheme of the Adaptive Multi-Rate Codec Type in Codec Mode 12.2 kBit/s, although the speech modes of these two Codec Types are bit exact identical.

Informative for terminals of R99 that support only UTRAN access ("UTRAN-only" terminals):
UTRAN-only terminals of R99 may either use UMTS AMR or UMTS AMR2 as default speech version in UTRAN access.

Normative for terminals that support GSM and UTRAN radio access ("dual-mode" terminals):
Dual-mode terminals of R99 and onwards shall use the UMTS AMR2 as the default speech version in UTRAN access. They need not to support the UMTS AMR, because the UMTS AMR2 in terminals is a fully compatible replacement.

Normative for all UMTS terminals of REL-4 and onwards: The UMTS AMR2 shall be the default speech version in UTRAN access in all terminals, UTRAN-only and dual-mode (GSM and UTRAN) of REL-4 and onwards.

For information on UMTS procedures (for exact details see 3GPP TS 28.062 (TFO) and 3GPP TS 23.153 (TrFO)):

The active Codec Mode is selected from the Active Codec Set (ACS) by the network. This Codec Mode Adaptation, also termed Rate Control, can be performed for the UMTS AMR every 20 ms by going to another Codec Mode within the ACS. For the UMTS AMR 2 this Codec Mode Adaptation can be performed every 20ms for the downlink traffic channel, but only every 40ms for the uplink radio channel. The UE selects at call setup one of the two possible phases for Codec Mode Adaptation (odd or even frames). During the call changes of the Codec Mode in uplink direction are only allowed in this selected phase. Rate Control commands received in downlink direction are considered at the next possible phase.

By this definition the UMTS AMR 2 Codec Type is TFO and TrFO compatible to the FR AMR, HR AMR, OHR AMR and UMTS AMR 2 Codec Types. In any multi-mode configuration the UMTS_AMR shall be regarded as only 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 compatible, when both codec types use the same single rate ACS.

The Codec Modes in uplink and downlink at one radio leg may be different. In Tandem Free Operation or Transcoder Free Operation both radio legs (A and B) are considered for the optimal selection of the active Codec Mode in each direction (uplink A and then downlink B, respectively vice versa) by a 'Distributed Rate Decision' algorithm. The worst of both radio legs determine the highest allowed Codec Mode, respectively the maximally allowed rate. All rate control commands are transmitted inband on the Iu and Nb interfaces and out of band on the radio interface.

The Active Codec Set is configured at call setup or reconfigured during the call. It consists of one up to maximally eight Codec Modes (MACS) at a given time, selected from the Supported Codec Set. The maximal number of Codec Modes and the Supported Codec Set may be constrained by the network to consider resources and radio conditions.
The Active Codec Sets in uplink and downlink are typically identical.
At call setup the Originating Side sends the AMR parameter set (included in the Codec List). The Terminating side then selects a suitable ACS from the given information and sends it back. In case the terminating side does not support TrFO a transcoder is allocated in the path at a suitable position, preferably as close as possible to the terminating side. This transcoder may by inband signalling install a Tandem Free Operation after call setup. Then, at start up of Tandem Free Operation, both Active Codec Sets, the Supported Codec Sets, the MACSs and the OMs are taken into account to determine the optimal common Active Codec Set. In a later phase the Codec Lists of both radio legs may be taken into account to find the optimum configuration. All configuration data and update protocols are transmitted inband on the TFO interface, but out of band within the UMTS network. For information on Tandem Free Operation see 3GPP TS 28.062 and on Transcoder Free Operation see 3GPP TS 23.153.

The SCR scheme of the Adaptive Multi-Rate Codec Types mark with a specific SID_FIRST frame the end of a speech burst. SID_FIRST does not contain Comfort Noise parameters. This SID_FIRST starts the comfort noise generation with parameters that are calculated at receiver side (!) from the latest received seven speech frames. A DTX hangover period needs to be applied therefore at transmitter side before sending of this SID_FIRST.
Absolutely coded SID_UPDATE frames follow about every eighth frame (160 ms) in speech pauses. SID_UPDATE frames are sent independently of the cell´s timing structure and are related only to the source signal.
An ONSET frame does (typically) not exist in UMTS networks, but may be received in TFO from the distant partner. It

marks the beginning of a speech burst. The uplink SCR operation is always activated for UMTS AMR and UMTS AMR2 codec types. The defined Tandem Free Operation and Transcoder Free Operation allows the reception of AMR SCR information for the downlink direction in all cases.

The SCR scheme of the UMTS AMR2 Codec Type is fully compatible to the SCR scheme of the UMTS AMR in UMTS and the DTX schemes of the FR AMR, HR AMR and OHR AMR Codec Types.

5.5 TDMA Enhanced Full Rate Codec Type (TDMA EFR)

The Codec IDentification (CoID) code is defined to be: TDMA_EFR_CoID := 0x0000.0111.

The TDMA Enhanced Full Rate Codec Type has no additional parameters.

For information (for exact details see TDMA Recommendations):

The TDMA Enhanced Full Rate Codec Type supports one fixed Codec Mode with 7.4 kBit/s. This codec mode is bit exact identical with AMR codec mode at 7.4 kBit/s.

In a TDMA system DTX may be enabled in uplink, but not in downlink. The DTX scheme uses one SID frame to mark the end of a speech burst and to start or continue Comfort Noise Generation.

The defined Tandem Free Operation allows the reception of TDMA EFR DTX information for the downlink direction in all cases. In TDMA systems the transcoder has to generate comfort noise in speech like frames to be sent downlink. In UMTS the downlink DTX shall always be supported and the transcoder can therefore stay transparently in TFO.

5.6 PDC Enhanced Full Rate Codec Type (PDC_EFR)

The Codec IDentification (CoID) code is defined to be: TDMA_EFR_CoID := 0x0000.1000.

The PDC Enhanced Full Rate Codec Type has no additional parameters.

For information (for exact details see PDC Recommendations):

The PDC Enhanced Full Rate Codec Type supports one fixed Codec Mode with 6.7 kBit/s. This codec mode is bit exact identical with AMR codec mode at 6.7 kBit/s.

In a PDC system DTX may be enabled in uplink, but not in downlink. The DTX scheme uses one SID frame to mark the end of a speech burst and to start or continue Comfort Noise Generation.

The Tandem Free Operation allows the reception of PDC EFR DTX information for the downlink direction in all cases. In PDC systems the transcoder has to generate comfort noise in speech like frames to be sent downlink.
In UMTS the downlink DTX shall always be supported and the transcoder can therefore stay transparently in TFO.

5.7 Four Adaptive Multi-Rate Wideband Codec Types (FR AMR-WB, UMTS AMR-WB, OFR AMR-WB, OHR AMR-WB)

The Adaptive Multi-Rate - WideBand Codec algorithm is applied in GERAN-GMSK, GERAN-8PSK and UTRAN in four different Codec Types.
The Codec IDentification (CoID) codes are defined to be:
FR_AMR-WB_CoID := 0x0000.1001.
UMTS_AMR-WB_CoID := 0x0000.1010.
OFR_AMR-WB_CoID := 0x0000.1100.
OHR_AMR-WB_CoID := 0x0000.1101.

The AMR-WB Codec Types can be used in conversational speech telephony services in a number of different configurations. The set of allowed configurations is defined in Table 5.7-1.

Table 5.7-1: Allowed Configurations for the Adaptive Multi-Rate – Wideband Codec Types

Configuration → (Config-WB-Code) ↓ **Codec Mode**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
23,85					**1**	**1**										
15,85			**1**	**1**												
12,65	**1**	**1**	**1**	**1**	**1**	**1**										
8,85	**1**	**1**	**1**	**1**	**1**	**1**										
6,60	**1**	**1**	**1**	**1**	**1**	**1**										
OM	**F**	**A**	**F**	**A**	**F**	**A**										
FR_AMR-WB, OHR_AMR-WB	**Y**															
OFR_AMR-WB, UMTS_AMR-WB	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**										

The '1' in the table indicates that the Codec Mode is included in the Active Codec Set of the Configuration.

The parameters 'OM' (Optimisation Mode) define whether the indicated Configuration can be changed to any of the other Allowed ones (OM == A) or if the change is Forbiden (OM == F).

The 'Y' in the table indicates, which Configuration is defined for which Codec Type.

Please note that Configurations 0 to 5 are immediately fully compatible with respect to TFO/TrFO due to the specification of Maximum Rate Control.

Table 5.7-2 defines the Coding of the 'Single Codec' information element for the AMR-WB Codec Types.

Table 5.7-2: Coding of 'Single Codec' for the Adaptive Multi-Rate - WideBand Codec Types

Octet	Parameter	MSB 8	7	6	5	4	3	2	1 LSB
1 m	Single Codec	Single Codec (see ITU-T Q.765.5)							
2 m	Length Indication	4							
3 m	Compat. Info	Compatibility Information							
4 m	OID	ETSI OID (See ITU-T Q.765.5 [6])							
5 m	CoID	FR_AMR-WB_CoID or UMTS_AMR-WB_CoID or OHR_AMR-WB_CoID or OFR_AMR-WB_CoID							
6 m	Config-WB	(spare)	(spare)	(spare)	(spare)	Config-WB-Code			

with 'm' = mandatory

An AMR-WB speech telephony service is only possible when the whole path allows a digitally transparent transport of the AMR-WB speech parameters end to end.

Normative for GERAN terminals for FR_AMR-WB, OHR_AMR-WB and OFR_AMR-WB.
If a GERAN terminal offers one of these Codec Types in the capability list, then all AMR-WB Configurations that are defined for the offered Codec Type shall be supported by this terminal.

Normative for GERAN infrastructure for FR_AMR-WB, OHR_AMR-WB and OFR_AMR-WB.
If a GERAN infrastructure supports one of these Codec Types, then at least AMR-WB Configuration 0 shall be supported. The other AMR-WB Configurations are not normative, but optional for OFR_AMR-WB.

For information on GERAN A/Gb mode procedures for FR_AMR-WB, OHR_AMR-WB and OFR_AMR-WB (for exact details see GSM Recommendations):

The active Codec Mode is selected from the Active Codec Set (ACS) by the network (Codec Mode Command) with assistance by the mobile station (Codec Mode Request). This Codec Mode Adaptation, also termed Rate Control, can be performed every 40 ms by going one Codec Mode up or down within the ACS. The Codec Modes in uplink and downlink at one radio leg may be different. In Tandem Free Operation both radio legs (A and B) are considered for the optimal selection of the active Codec Mode in each direction (uplink A and then downlink B, respectively vice versa) by the 'Distributed Rate Decision' algorithm. The worst of both radio legs determines the highest allowed Codec Mode, respectively the maximally allowed rate ("Maximum Rate Control"). All rate control commands are transmitted inband: on the radio interface, the BTS-TRAU interface and the TRAU-TRAU interface.

The Active Codec Set is configured at call setup or reconfigured during the call. It consists of three or four Codec Modes at a given time, selected from the set of allowed Configurations. The selection of the Configuration may be constrained by the network to consider resources and radio conditions.
The configurations (Active Codec Sets) in uplink and downlink are identical.

First, at start up of Tandem Free Operation both Active Codec Sets are taken into account to determine the common Active Codec Set. The set of allowed AMR-WB configurations guarantees that WB-TFO is always possible. In a later phase the Codec Lists of both radio legs may be taken into account to find the optimum configuration. For exact details see 3GPP TS 28.062. All configuration data and update protocols are transmitted inband.

The DTX scheme of the Adaptive Multi-Rate Wideband Codec Type marks with a specific SID_FIRST frame the end of a speech burst. SID_FIRST does not contain Comfort Noise parameters. This SID_FIRST starts the comfort noise generation with parameters that are calculated at receiver side from the latest received seven speech frames. A DTX hangover period needs to be applied therefore at transmitter side before sending of this SID_FIRST.
Absolutely coded SID_UPDATE frames follow about every eighth frame (160 ms) in speech pauses. SID_UPDATE frames are sent independently of the cell´s TDMA frame structure and are related only to the source signal.
An ONSET frame (typically) precedes in uplink direction the beginning of a new speech burst. DTX on or off is defined by the network on a cell basis. The defined Tandem Free Operation allows the reception of FR AMR-WB DTX information for the downlink direction in all cases.

Normative for UTRAN terminals for UMTS_AMR-WB.
If an UTRAN terminal offers Codec Type UMTS_AMR-WB in the capability list, then all allowed AMR-WB Configurations shall be supported by this terminal.

Normative for UTRAN infrastructures for UMTS_AMR-WB.
If an UTRAN infrastructure supports Codec Type UMTS_AMR-WB, then at least AMR-WB Configuration 0 shall be supported. The other AMR-WB Configurations are not normative, but optional.

For information on UMTS procedures for UMTS_AMR-WB (for exact details see 3GPP TS 28.062 (TFO) and 3GPP TS 23.153 (TrFO):

The active Codec Mode is selected from the Active Codec Set (ACS) by the network. This Codec Mode Adaptation, also termed Rate Control, can be performed for the UMTS AMR-WB every 20 ms for the downlink traffic channel, but only every 40ms for the uplink traffic channel by going to another Codec Mode within the ACS. The UE selects at call setup one of the two possible phases for Codec Mode Adaptation (odd or even frames). During the call changes of the Codec Mode in uplink direction are only allowed in this selected phase. Rate Control commands received in downlink direction are considered at the next possible phase. By this definition the UMTS AMR-WB Codec Type is TFO and TrFO compatible to the FR AMR-WB, the OHR_AMR-WB and OFR AMR-WB and the UMTS AMR-WB Codec Types.

The Codec Modes in uplink and downlink at one radio leg may be different. In Tandem Free Operation or Transcoder Free Operation both radio legs (A and B) are considered for the optimal selection of the active Codec Mode in each direction (uplink A and then downlink B, respectively vice versa) by a 'Distributed Rate Decision' algorithm. The worst of both radio legs determine the highest allowed Codec Mode, respectively the maximally allowed rate. All rate control commands are transmitted inband on the Iu and Nb interfaces and out of band on the radio interface.

The Active Codec Set is selected at call setup or reselected during the call. It consists of three or four Codec Modes at a given time, selected from the allowed configurations. The selection of the configuration may be constrained by the network to consider resources and radio conditions.
The Active Codec Sets in uplink and downlink are typically identical.

At call setup with TrFO negotiation the Originating Side sends its preferred AMR-WB configuration and indicates whether it allows a change of this preferred configuration or not (included in the Codec List). The Terminating side then selects a suitable configuration from the given information and sends it back. In case the terminating side does not support TrFO a transcoder is allocated in the path at a suitable position, preferably as close as possible to the terminating side. This transcoder may by inband signalling install a Tandem Free Operation after call setup. The set of allowed AMR-WB configurations guarantees that WB-TFO is always possible. In a later phase the Codec Lists of both radio legs may be taken into account to find the optimum configuration. All configuration data and update protocols are transmitted inband on the TFO interface, but out of band within the UMTS network. For information on Tandem Free Operation see 3GPP TS 28.062 and on Transcoder Free Operation see 3GPP TS 23.153.

The SCR scheme of the Adaptive Multi-Rate WideBand Codec Types mark with a specific SID_FIRST frame the end of a speech burst. SID_FIRST does not contain Comfort Noise parameters. This SID_FIRST starts the comfort noise generation with parameters that are calculated at receiver side from the latest received seven speech frames. A DTX hangover period needs to be applied therefore at transmitter side before sending of this SID_FIRST.
Absolutely coded SID_UPDATE frames follow about every eighth frame (160 ms) in speech pauses. SID_UPDATE frames are sent independently of the cell´s timing structure and are related only to the source signal.
An ONSET frame does (typically) not exist in UMTS networks, but may be received in TFO from the distant partner. It marks the beginning of a speech burst. "SCR on" is always defined by the network. The defined Tandem Free Operation and Transcoder Free Operation allows the reception of AMR-WB SCR information for the downlink direction in all cases.

The SCR scheme of the UMTS AMR-WB Codec Type is fully compatible to the DTX schemes of FR AMR-WB, OHR AMR-WB and OFR AMR-WB.

The exact details of these Codec Types and their related procedures (DTX, Rate Control, etc) are described in the respective standard documentation.

5.8 MuMe Dummy Codec (3G.324M)

The Codec Identification (CoID) code is defined to be: MuMe_CoID:= 0x1111.1111.

The MuMe codec has one additional mandatory parameter:

B/W Multiplier, BWM: eight bits.

This defines the required bandwidth for the bearer; the value is a factor of 64K b/s when not equal to 0. When equal to zero then a 32k b/s.

The 'Single Codec' information element consists of 6 octets in case of the MuMe Dummy Codec (table 5.8):

Table 5.8: Coding of 'Single Codec' for the MuMe Dummy Codec Type

Octet	Parameter	MSB 8	7	6	5	4	3	2	1 LSB
1 m	Single Codec	Single Codec (see ITU-T Q.765.5)							
2 m	Length Indication	4							
3 m	Compat. Info	Compatibility Information							
4 m	OID	ETSI OID (See ITU-T Q.765.5 [6])							
5 m	CoID	MuMe_CoID							
6 m	BWM	BandWidth Multiplier – see note1							

with 'm' = mandatory

Note 1:

BWM == 0 => 32Kb/s

BWM == 1-255 => factor n (multiplier of 64Kb/s)

The procedures for use of this codec are defined in TS 23.172 [13].

This MuMe Dummy codec type is only for use in Core Network OoBTC procedures it shall NOT be used across the radio interface.

The MuMe Dummy codec indicates that an Unrestricted multimedia path (UDI) is required, subsequent codec negotiation may occur within this path using MuMe protocols, e.g H.324M. There are no encoding properties or codec specifications associated to this codec type; it is purely an indication for a MuMe pipe.

5.9 MuMe2 Dummy Codec (3G.324M2)

The Codec Identification (CoID) code is defined to be: MuMe2_CoID:= 0x1111.1110. Otherwise, the Coding is identical to the MuME Dummy Codec described in Clause 5.8.

The Procedural description provided for MuME Dummy Codec in Clause 5.8 is also applicable for the MuMe2 Dummy Codec. The MuMe2 Dummy Codec is used in core network procedures to indicate that a service change to multimedia was indicated by the network. The procedures for use of this codec are defined in TS 23.172 [13].

6 Codec List for the Call Control Protocol

For call control on the air interface the Codec Lists need to be specified for each radio access technology separately, because it can not be expected that an UE supports the same Codec Types in different radio access technologies.

3GPP TS 24.008 [9] *defines the call control signalling and how to use the "Supported Codec List* Information Element" (IE). It contains Codec Lists (in form of Codec Bitmaps) for each supported radio access technology (identified by a SysID).

The coding of this is IE is given here. It is also used for TFO in 3GPP TS 28.062 [7].

6.1 System Identifiers for GSM and UMTS

The system identifiers for the radio access technologies supported by this specification are:

SysID for GSM: 0x0000.0000 (bit 8 .. bit 1)

SysID for UMTS: 0x0000.0100 (bit 8 .. bit 1)

These values are selected in accordance with [7] (3GPP TS 28.062).

6.2 Codec Bitmap

The Codec Types are coded in the first and second octet of the Codec List Bitmap as follows:

8	7	6	5	4	3	2	bit 1	
TDMA EFR	UMTS AMR 2	UMTS AMR	HR AMR	FR AMR	GSM EFR	GSM HR	GSM FR	Octet 1

bit 16	15	14	13	12	11	10	bit 9	
(reserved)	(reserved)	OHR AMR-WB	OFR AMR-WB	OHR AMR	UMTS AMR-WB	FR AMR-WB	PDC EFR	Octet 2

A Codec Type is supported, if the corresponding bit is set to '1'. All reserved bits shall be set to '0'.

6.3 Selected Codec Type

The Selected Codec Type is coded as shown in Table 6.3-1. The same coding is used also in 3GPP TS 28.062 [7].

Table 6.3-1: Coding of the selected Codec_Type (long form)

Bit 8…Bit 1 CoID	Codec_Type	Name
0000.0000	GSM Full Rate (13.0 kBit/s)	GSM FR
0000.0001	GSM Half Rate (5.6 kBit/s)	GSM HR
0000.0010	GSM Enhanced Full Rate (12.2 kBit/s)	GSM EFR
0000.0011	Full Rate Adaptive Multi-Rate	FR AMR
0000.0100	Half Rate Adaptive Multi-Rate	HR AMR
0000.0101	UMTS Adaptive Multi-Rate	UMTS AMR
0000.0110	UMTS Adaptive Multi-Rate 2	UMTS AMR 2
0000.0111	TDMA Enhanced Full Rate (7.4 kBit/s)	TDMA EFR
0000.1000	PDC Enhanced Full Rate (6.7 kBit/s)	PDC EFR
0000.1001	Full Rate Adaptive Multi-Rate WideBand	FR AMR-WB
0000.1010	UMTS Adaptive Multi-Rate WideBand	UMTS AMR-WB
0000.1011	8PSK Half Rate Adaptive Multi-Rate	OHR AMR
0000.1100	8PSK Full Rate Adaptive Multi-Rate WideBand	OFR AMR-WB
0000.1101	8PSK Half Rate Adaptive Multi-Rate WideBand	OHR AMR-WB
Up to 1111.1101	reserved for future use	
1111.1110	Reserved forMuMe2 dummy Codec Type NOTE: codec not to be used across radio interface.	MuMe2
1111.1111	Reserved forMuMe dummy Codec Type NOTE: codec not to be used across radio interface.	MuMe

Annex A (informative): Example Codec List for UMTS

This Annex gives some informative examples how the Codec List for UMTS may look like for the OoBTC protocol. UMTS does support: UMTS AMR, FR AMR and HR AMR. It may support also GSM EFR, TDMA EFR and PDC EFR.
One list (with arbitrarily selected Codec Type preference) could look at Originating side like:

Octet	Parameter	MSB 8	7	6	5	4	3	2	1 LSB
1	Codec List	Codec List (see ITU-T Q.765.5)							
2	Length Indication (LI)	30							
3	Compat. Info	Compatibility Information							
4	Single Codec	Single Codec (see ITU-T Q.765.5)							
5	LI	6							
6	Compat. Info	Compatibility Information							
7	OID	ETSI OID (See ITU-T Q.765.5 [6])							
8	CoID	UMTS_AMR_CoID							
9 o	ACS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
10 o	SCS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
11 o	MACS	(spare)	(spare)	(spare)	(spare)	OM	MACS		
12	Single Codec	Single Codec (see ITU-T Q.765.5)							
13	LI	6							
14	Compat. Info	Compatibility Information							
15	OID	ETSI OID (See ITU-T Q.765.5 [6])							
16	CoID	FR_AMR_CoID							
17 o	ACS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
18 o	SCS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
19 o	MACS	(spare)	(spare)	(spare)	(spare)	OM	MACS		
20	Single Codec	Single Codec (see ITU-T Q.765.5)							
21	LI	6							
22	Compat. Info	Compatibility Information							
23	OID	ETSI OID (See ITU-T Q.765.5 [6])							
24	CoID	HR_AMR_CoID							
25 o	ACS	(spare)	(spare)	7.95	7.40	6.70	5.90	5.15	4.75
26 o	SCS	(spare)	(spare)	7.95	7.40	6.70	5.90	5.15	4.75
27 o	MACS	(spare)	(spare)	(spare)	(spare)	OM	MACS		
28	Single Codec	Single Codec (see ITU-T Q.765.5)							
29	LI	3							
30	Compat. Info	Compatibility Information							
31	OID	ETSI OID (See ITU-T Q.765.5 [6])							
32	CoID	EFR_CoID							

with 'o' = optional octet

The Terminating Side selects one of the Codec Types and returns it, together with the selected codec attributes.

The AMR Codec Types may have very similar, if not identical codec attributes at Originating side. The UMTS as Originating side can, however, already decide, which configuration would be preferred in case the Terminating side is UMTS, or GSM FR or GSM HR. A GSM as Originating side can not offer UMTS AMR and the Codec attributes for FR AMR and HR AMR may be quite different.

Annex A (informative): Change history

Change history							
Date	**TSG SA#**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
12-2000	10	SP-000576	004		Introduction of Codec Type Bit-Map for Codec Negotiation	3.0.0	4.0.0
12-2000	10	SP-000576	005		Introduction of Selected Codec Type for Codec Negotiation	3.0.0	4.0.0
12-2000	10	SP-000576	006		Clarification for the use of the Codec List Information Element	3.0.0	4.0.0
03-2001	11	SP-010104	007		Simplification of the Optimisation Mode Field	4.0.0	4.1.0
03-2001	11	SP-010199	008	3	Introduction of UMTS_AMR_2	4.0.0	4.1.0
03-2001	11	SP-010199	009		Introduction of AMR Wideband	4.1.0	5.0.0
03-2002	15	SP-020078	015		Introduction of GERAN-8PSK Codec Types into Codec List	5.0.0	5.1.0
03-2002	15	SP-020078	017		Introduction of codepoint for Dummy Codec for CS Multi Media (3G 324M)	5.0.0	5.1.0
06-2002	16	SP-020223	014	2	UMTS_AMR2 is default Codec Type in all terminals of Rel-4 and onwards	5.1.0	5.2.0
09-2002	17	SP-020437	020	1	TrFO-Signalling for allowed AMR-WB Configurations	5.2.0	5.3.0
12-2002	18	SP-020690	021	1	Correction of uplink SCR activation for UMTS AMR	5.3.0	5.4.0
12-2002	18	SP-020690	022		Correction to the Codec ID Table	5.3.0	5.4.0
09-2004	25	SP-040646	028	1	Correction of Size and Reference of MuMe Codec	5.4.0	5.5.0
09-2004	25	SP-040646	023	2	Harmonisation of AMR Configurations	5.5.0	6.0.0
09-2004	25	SP-040646	025	1	Error Fixes	5.5.0	6.0.0
09-2004	25	SP-040646	029	1	Correction of Size and Reference of MuMe Codec	5.5.0	6.0.0
12-2004	26	SP-040845	032		TFO/TrFO Compatibility of UMTS_AMR and UMTS_AMR2	6.0.0	6.1.0
12-2004	26	SP-040847	036	1	Clarifications for AMR	6.0.0	6.1.0
03-2006	31	SP-060008	0037		3G-324.M2 Codec for Indication of Network-Initiated Service Change	6.1.0	6.2.0

History

Document history		
V6.1.0	December 2004	Publication
V6.2.0	March 2006	Publication