Technical Specification Group Services and System Aspects ***TSGS#17(02)0437***
Meeting #17, Biarritz, France, 9-12 September 2002

Source: **TSG-SA WG4**

Title: CRs to TSs 26.103, 26.202 and 28.062 on Simplified TFO decision for AMR-WB and TFO/TrFO Signalling for allowed AMR-WB Configurations (Release 5)

Document for: **Approval (conditional)**

Agenda Item: **7.4.3**

The following CRs, agreed at the TSG-SA WG4 meeting #22, are presented to TSG SA #17 for approval (conditionally to the decision on the LS on Allowed AMR-WB Configurations).

Spec	CR	Rev	Phase	Subject	Cat	Vers	WG	Meeting	S4 doc
26.103	020	1	Rel-5	TrFO Signalling for allowed AMR-WB Configurations	F	5.2.0	S4	TSG-SA WG4#22	S4-020450
26.202	001	2	Rel-5	Consideration of allowed Configurations for AMR-WB	F	5.0.0	S4	TSG-SA WG4#22	S4-020487
28.062	030	1	Rel-5	TFO Signalling for allowed AMR-WB Configurations	F	5.1.0	S4	TSG-SA WG4#22	S4-020451
28.062	031	2	Rel-5	Simplified TFO decision for AMR-WB	F	5.1.0	S4	TSG-SA WG4#22	S4-020488

3GPP TSG-SA4 Meeting #22
Tampere, Finland, 22-26 July 2002

Tdoc ⌘S4-020450

CR-Form-v7

CHANGE REQUEST

⌘ **26103** **CR** **020** ⌘ **rev** **1** ⌘ Current version: **5.2.0** ⌘

*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 [X] Radio Access Network [X] Core Network [X]

Title:	⌘	TrFO-Signalling for Allowed AMR-WB Configurations
Source:	⌘	TSG-SA WG4
Work item code:	⌘	AMRWB
Date:	⌘	12/Sept/2002
Category:	⌘	**F**
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:

2	*(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)*

Reason for change:	⌘	The reduction of the number of AMR-WB modes from 9 to 5 and the proposed limitation of Allowed Configurations for AMR-WB for conversational speech telephony services.
Summary of change:	⌘	Substantial Simplification of signalling for TrFO, to achieve best compatibility with TFO and simplest handling within the Core Network. Declaration what is normative and optional for mobiles and networks
Consequences if not approved:	⌘	The decision on allowed configurations for AMR-WB would not be obeyed. Signalling more complex than necessary, In-Call-Modifications not avoidable, higher network signalling load than necessary, higher risc of incompatibilities.

Clauses affected:	⌘	5.7

Other specs affected:	⌘	Y	N		⌘	
		X		Other core specifications		TS 28.062, TS 23.153, 26.202
				Test specifications		
				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.

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). ~~Note: A change via Maximum Rate Control is always be possible (e.g. from configuration 2 to configuration 0).~~

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

~~The AMR-WB may have several additional parameters. These parameters are optional at originating side, but mandatory for the terminating side:~~

~~**Active Codec Set, ACS0 & ACS1:** nine bits.~~

~~For the FR AMR-WB up to four modes from the seven lowest modes and for the OHR_AMR-WB and the OFR AMR-WB up to four modes from all nine modes may be selected by setting the corresponding bits to "1";~~

~~For the UMTS AMR-WB up to eight from all nine modes may be selected.~~

~~If the ACS is not specified at originating side, then all modes are supported there.~~

~~If ACS is not provided, then SCS and MACS cannot be provided as well.~~

~~**Supported Codec Set, SCS0 & SCS1:** nine bits.~~

~~In FR AMR-WB up to seven lowest modes may be selected by setting the corresponding bits to "1".~~

~~In UMTS AMR-WB and OHR_AMR-WB and OFR AMR-WB up to nine modes may be selected by setting the corresponding bits to "1".~~

~~If the SCS is not specified at originating side, then all modes are supported there.~~

~~If SCS is not provided, then MACS can not be provided as well.~~

~~**Maximal number of Codec Modes, MACS:** three bits.~~

~~For the FR AMR-WB, OHR_AMR-WB and OFR AMR-WB one to four Codec Modes are allowed within the ACS.~~

~~Coding: "001: one, "010": two, "011": three, "100": four Codec modes allowed.~~

~~For the UMTS AMR-WB one up to eight Codec Modes are allowed within the ACS.~~

~~Coding: "001: one, "010": two, … "111": seven, "000": eight Codec modes allowed.~~

~~If MACS is not specified at originating side, then the maximum of modes is supported there.~~

~~**Optimisation Mode for ACS , OM:** one bit.~~

~~Coding: "0": Optimisation of the ACS not supported, "1": Optimisation of the ACS supported (see 3GPP TS 28.062, [7]).~~

~~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 can not 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].~~

~~The Length Indicator field (LI) is set to 3, 5, 7 or 8 at originating side, depending on how many parameters are specified. The terminating side shall return the selected Codec with a full set of parameters. Hence LI shall be set to 8 always by the terminating side. If any node in the path from originating side to terminating side does not support the parameter set offered by the originating side, it may restrict it. If necessary the missing, optional parameter octets may have to be inserted then.~~

~~The "Single Codec" information element consists of 5 to 10 octets in case of the AMR-WB Codec Types (table 5.7):~~

Table 5.7: 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	8							
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							
6 o	ACS0	23.05	19.85	18.25	15.85	14.25	12.65	8.85	6.60
7 o	ACS1	(spare)	(spare)	(spare)	(spare)	(spare)	(spare)	(spare)	23.85
8 o	SCS0	23.05	19.85	18.25	15.85	14.25	12.65	8.85	6.60
9 o	SCS1	(spare)	(spare)	(spare)	(spare)	(spare)	(spare)	(spare)	23.85
10 o	OM, MACS	(spare)	(spare)	(spare)	(spare)	OM	MACS		

with "m" = mandatory and "o" = optional

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. In GERAN this is only possible with TFO, in UMTS this is possible with TFO or TrFO or a combination of both.

Normative for GERAN terminals for FR_AMR-WB, OHR_AMR-WB and OFR_AMR-WB.
If a GERAN terminal offers one or more 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 or more 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 FR AMR-WB Codec Type comprises seven different Codec Modes: 19,85 … 6,60 kbit/s.
The OHR_AMR-WB and OFR AMR-WB Codec Type comprise nine different Codec Modes: 23,85 … 6,60 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 three or four Codec Modes (MACS) at a given time, selected from the set of allowed ConfigurationsSupported Codec Set. The selection of the Configurationmaximal number of Codec Modes and the Supported Codec Set 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, the Supported Codec Sets, the MACSs and the OMs are taken into account to determine the optimal 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 UMTS-AMR-WB Codec Type comprises nine different Codec Modes: 23.85 … 6.60 kbit/s.~~
~~If an UE supports AMR-WB it shall supported the UMTS-AMR-WB Codec Type. There is no need to support the FR AMR-WB Codec Type.~~

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 ~~configured~~ selected at call setup or ~~reconfigured~~ reselected during the call. It consists of ~~one up~~three or four ~~to maximally nine~~ Codec Modes ~~(MACS)~~ at a given time, selected from the ~~Supported Codec Set~~allowed configurations. The ~~maximal number of Codec Modes and the Supported Codec Set~~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 ~~the~~ its preferred AMR-WB ~~parameter set~~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 ~~ACS~~ 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. ~~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.~~ 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.

3GPP TSG-SA4 Meeting #22
Tampere, Finland, 22-26 July 2002

Tdoc ⌘S4-020487

CR-Form-v7

CHANGE REQUEST

⌘ **26.202** **CR** **001** ⌘ **rev** **2** ⌘ Current version: **5.0.0** ⌘

*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 [X] Radio Access Network [X] Core Network [X]

Title:	⌘	Consideration of Allowed Configurations for UMTS_AMR-WB
Source:	⌘	TSG-SA WG4
Work item code:	⌘	AMRWB
Date:	⌘	12/Sept/2002
Category:	⌘	**F**
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:

2	*(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)*

Reason for change:	⌘	The number of modes for the AMR-WB in Speech telephony services has been reduced from 9 to 5 and the number of allowed Configurations is now proposed to be only three. This change is still not reflected in this TS. Additionally and independent of that first reason: Some errors are corrected in clause 6 regarding Blind Rate Detection.
Summary of change:	⌘	Deletion of the not longer included modes, corrections of class division
Consequences if not approved:	⌘	Decision on AMR-WB Simplification is not incorporated. Signalling more complex than necessary, In-Call-Modifications not avoidable, higher network signalling load than necessary, higher risc of incompatibilities. Inconsistent AMR-WB standard. Blind Rate Detection not ensured.

Clauses affected:	⌘	5 and 6

Other specs affected:	⌘	Y	N		⌘	
		X		Other core specifications		28.062, 26.103
				Test specifications		
				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:

5 RAB aspects

During the RAB Assignment procedure initiated by the CN to establish the RAB for UMTS_AMR-WB, the RAB parameters are defined. The UMTS_AMR-WB RAB is established with one or more RAB co-ordinated sub-flows with predefined sizes and QoS parameters. In this way, each Transport Format Combination between sub-flows corresponds to one UMTS_AMR-WB frame type. On the Iu interface, these RAB parameters define the corresponding parameters regarding the transport of UMTS_AMR-WB frames.

Some of the QoS parameters in the RAB assignment procedure are determined from the Bearer Capability Information Element used at call set up. These QoS parameters as defined in [3], can be set as follows:

Table 5-1: Example of mapping of BC IE into QoS parameters for UMTS_AMR-WB

RAB service attribute	RAB service attribute value		Comments
Traffic Class	Conversational		
RAB Asymmetry Indicator	Symmetric, bidirectional		Symmetric RABs are used for uplink and downlink
~~Maximum bit rate~~	~~23.85 / 23.05 / 19.85 / 18.25 / 15.85 / 14.25 / 12.65 / 8.85 / 6.6 kbit/s~~		~~This value depends on the highest mode rate in the RFCS (note 2)~~
Maximum bit rate	12,65 kbit/s in configurations 0 and 1 15,85 kbit/s in configurations 2 and 3 23,85 kbit/s in configurations 4 and 5		This value depends on the highest mode rate in the RFCS (note 2):
Guaranteed bit rate	~~23.85 / 23.05 / 19.85 / 18.25 / 15.85 / 14.25 / 12.65 / 8.85 / 6.6~~ 6,60 kbit/s		One of the values is chosen, depending on the lowest rate controllable SDU format (note 2)
Delivery Order	Yes		(note 1)
~~Maximum SDU size~~	~~477 / 461 / 397 / 365 / 317 / 285 / 253 / 177 / 132 bits~~		~~Maximum size of payload field in Iu UP, according to the highest mode rate in the RFCS (note 2)~~
Maximum SDU size	253 in configurations 0 and 1 317 in configurations 2 and 3 477 in configurations 4 and 5		Maximum size of payload field in Iu UP, according to the highest mode rate in the RFCS (note 2)
Traffic Handling Priority	Not applicable		Parameter not applicable for the conversational traffic class. (note 1)
Source statistics descriptor	Speech		(note 1)
SDU Parameters	RAB subflow 1 (Class A bits)	RAB subflow 2 (Class B bits)	The number of SDU, their number of RAB subflow is subject to operator tuning (note 3)
SDU error ratio	$7 * 10^{-3}$	-	(note 3)
Residual bit error ratio	10^{-6}	10^{-3}	(note 3 – applicable for every subflow)
Delivery of erroneous SDUs	yes	-	Class A bits are delivered with error indication; Class B bits are delivered without any error indication.
SDU format information 1-5~~9~~			(note 4)
sub-flow SDU size 1-5~~9~~	(note 5)	(note 5)	

NOTE 1: These parameters apply to all UMTS speech codec types.
NOTE 2: The guaranteed bit rate depends on the periodicity and the lowest rate controllable SDU size. All UMTS_AMR-WB configurations as defined in TS 26.103 contain the 6~~.~~,60 kbps codec mode as lowest and therefore "guaranteed bit rate". The "maximum bit rate" and the "maximum SDU size" depend on the selected UMTS_AMR-WB configuration.
NOTE 3: These parameters are subject to operator tuning.
NOTE 4: SDU format information has to be specified for each AMR-WB_core frame type (i.e. with speech bits and comfort noise bits) included in the RFCS as defined in [2].
NOTE 5: The subflow SDU size corresponding to an AMR-WB_core frame type indicates the number of bits in the class A, class B fields.

The conversational traffic class shall be used for the speech service, which is identified by the ITC parameter of the bearer capability information element in the SETUP message. This shall apply for all UMTS speech codec types.
The parameters traffic class, transfer delay, traffic handling priority and source statistics descriptor shall be the same for all speech codec types applicable for UMTS.

6 Iu Interface User Plane (RAN)

The data structures exchanged on the Iu interface are symmetrical, i.e. the structure of the uplink data frames is identical to that of the downlink data frames. This facilitates Tandem Free Operation and Transcoder Free Operation.

6.1 Frame structure on the Iu UP transport protocol

6.1.1 Initialisation

At the initialisation of the SMpSDU mode of operation, several parameters are set by the CN. The initialisation procedure is described in 3GPP TS 25.415 [1].

- RFCS:

  In the case of UMTS_AMR-WB, the RFCS corresponds to the Active Codec Set (ACS) plus ~~potentially~~ SCR authorised in the communication. *Annex A of [1] gives an illustration of the usage of RFCI for UMTS_AMR-WB speech RAB. RFCS used in downlink may differ from that in uplink.* [Editor's note: 25.415 may need to be updated to cover UMTS_AMR-WB]

- Delivery of erroneous SDUs:

  This parameter shall be set to YES. Erroneous speech frames may be used to assist the error concealment procedures.

[Editor's note: This might need to be specified in another specifications] PDU type.

The PDU type 0 shall be used for the transport of AMR-WB_data.

[Editor's note: This might need to be specified in another specifications].

6.1.2 Time Alignment Procedure

The TC should adjust the timing of the speech data transmission in downlink direction according to the time alignment frame sent by the RNC.

Time alignment procedure shall be dismissed in case of TFO and TrFO.

6.2 Mapping of the bits

The mapping of the bits between the generic AMR-WB frames and the PDU is the same for both uplink and downlink frames.

The following table gives the correspondence of the bit fields between the generic AMR-WB frames at the TC interface and the PDU exchanged with the Iu transport layer.

Table 6-1: Mapping of generic AMR-WB frames onto Iu PDUs

PDU field	**Corresponding field within the generic AMR-WB frame**	**Comment**
PDU Type	N/A	Type 0
Frame Number	N/A	
FQC	Frame Quality Indicator	
RFCI	Frame Type	
Payload CRC	N/A	
Header CRC	N/A	
Payload Fields (N sub-flows)	Class A or SID payload Class B	
SDU #1	Most important speech bits come first	Mandatory
SDU #2	Next bits follow	Optional
…	…	Optional
SDU #N	Least important speech bits	Optional

The number of RAB sub-flows, their corresponding sizes, and their attributes such as "Delivery of erroneous SDUs" shall be defined at the RAB establishment and signalled in the RANAP RAB establishment request, as proposed in clause 5. The number of RAB sub-flows are corresponding to the desired bit protection classes. The total number of bits in all sub-flows for one RFC shall correspond to the total number given in 3GPP TS 26.201, generic AMR-WB frame, format IF1, -for the corresponding Codec Mode respectively Frame Type.

Guidance for setting the number of bits in each RAB sub-flow according to their relative subjective importance is given in 3GPP TS 26.201.

~~The following two tables are examples of mapping of RAB sub-flows.~~

Table 6-2 gives three examples of sub-flow mapping, one for each allowed configuration.
The RFCI definition is given in order of increasing SDU sizes.

In all examples, the sub-flow mapping follows the class division guidance of TS 26.201, with some slight modification: in order to support Blind Transport Format Detection the number of bits in class A is sometimes increased slightly by taking the next bits from class B into class A.

- ~~–~~Example 1 describes Codec Type UMTS_AMR~~-~~–WB, with ~~all nine~~ the three lowest codec modes foreseen in the Active Codec Set (ACS) and provision for Source Controlled Rate operation (SCR). ~~In this example, Blind Transport Format Detection is supported and the sub-flow mapping follows the 3GPP TS 26.201 class division guidance.~~

- Example 2 describes Codec Type UMTS_AMR-WB as in example 1, with codec mode 15.85 in addition.

- Example 3 describes Codec Type UMTS_AMR-WB as in example 1, with codec mode 23.85 in addition.

Table 6-2: Example~~s~~ for UMTS_AMR-WB with SCR and ~~three~~ two sub-flows, according to subjective class division indication of 3GPP TS 26.201

~~UMTS_AMR_WB RFCI Example 1~~	~~RAB sub-flows~~		~~Total size of bits/RAB sub-flows combination (Mandatory)~~	~~Source rate~~
	~~RAB sub-flow 1 (Optional)~~	~~RAB sub-flow 2 (Optional)~~		
~~2~~	~~54~~	~~78~~	~~132~~	~~AMR-WB 6.6 kbps~~
~~3~~	~~64~~	~~113~~	~~177~~	~~AMR-WB 8.85 kbps~~
~~4~~	~~72~~	~~181~~	~~253~~	~~AMR-WB 12.65 kbps~~
~~5~~	~~72~~	~~213~~	~~285~~	~~AMR-WB 14.25 kbps~~
~~6~~	~~72~~	~~245~~	~~317~~	~~AMR-WB 15.85 kbps~~
~~7~~	~~72~~	~~293~~	~~365~~	~~AMR-WB 18.25 kbps~~
~~8~~	~~72~~	~~325~~	~~397~~	~~AMR-WB 19.85 kbps~~
~~9~~	~~72~~	~~389~~	~~461~~	~~AMR-WB 23.05 kbps~~
~~10~~	~~72~~	~~405~~	~~477~~	~~AMR-WB 23.85 kbps~~
~~1~~	~~40~~	~~0~~	~~40~~	~~AMR-WB SID~~

UMTS_AMR-WB RFCI	RAB sub-flows		Total number of bits per RAB sub-flow combination (Mandatory)	Source rate
	RAB sub-flow 1 (Optional)	RAB sub-flow 2 (Optional)		
Example 1				
1	40	0	40	AMR-WB SID
2	54	78	132	AMR-WB 6.6 kbps
3	64	113	177	AMR-WB 8.85 kbps
4	72	181	253	AMR-WB 12.65 kbps
Example 2				
1	40	0	40	AMR-WB SID
2	54	78	132	AMR-WB 6.6 kbps
3	64	113	177	AMR-WB 8.85 kbps
4	72	181	253	AMR-WB 12.65 kbps
5	73	244	317	AMR-WB 15.85 kbps
Example 3				
1	40	0	40	AMR-WB SID
2	54	78	132	AMR-WB 6.6 kbps
3	64	113	177	AMR-WB 8.85 kbps
4	72	181	253	AMR-WB 12.65 kbps
5	74	403	477	AMR-WB 23.85 kbps

3GPP TSG-SA4 Meeting #22
Tampere, Finland, 22-26 July 2002

Tdoc ⌘S4-020451

CR-Form-v7

CHANGE REQUEST

⌘ **28062** **CR** **030** ⌘ **rev** **1** ⌘ Current version: **5.1.0** ⌘

*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-Signalling for allowed AMR-WB Configurations
Source:	⌘	TSG-SA WG4
Work item code:	⌘	AMRWB / TFO
Date:	⌘	12/Sept/2002
Category:	⌘	**F**
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:

2	*(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)*

Reason for change:	⌘	The number of modes and allowed configurations for AMR-WB has been reduced. This CR reflects these changes in the TFO Signalling
Summary of change:	⌘	Addition of AMR-WB TFO message element
Consequences if not approved:	⌘	Decision on AMR-WB Simplification is not incorporated. Signalling more complex than necessary, In-Call-Modifications not avoidable, higher network signalling load than necessary, higher risc of incompatibilities.
Clauses affected:	⌘	7

	Y	N			
Other specs affected: ⌘	X		Other core specifications	⌘	TS 26.103, TS 23.153, 26.202
			Test specifications		
			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.

7.11.3.1.1 AMR Active_Codec_Set Attributes

One AMR_ACS ~~(AMR-WB_ACS)~~ Extension_Block shall be added in the TFO_REQ and TFO_ACK messages after the SIG_LUC Extension_Block if an AMR ~~(AMR-WB)~~ Codec_Type is used as the Local_Used_Codec_Type.

Table 7.11.3.1.1-1: AMR_ACS Extension_Block

Bit	Description	Comment
Bit 1	"**0**"	Normal IS-Message Sync Bit, constant.
Bit 2..9	**Active Codec Set (NB_ACS)**	Active Codec Set: For each Codec_Mode of the AMR one bit is reserved. If the bit is set to "0" then the specific Codec_Mode is not in the ACS, otherwise it is in and may be used by the adaptation algorithm. Bit 2: AMR_Mode 12,2 kbit/s (undefined for HR_AMR) Bit 3: AMR_Mode 10,2 kbit/s (undefined for HR_AMR) Bit 4: AMR_Mode 7,95 kbit/s Bit 5: AMR_Mode 7,40 kbit/s Bit 6: AMR_Mode 6,70 kbit/s Bit 7: AMR_Mode 5,90 kbit/s Bit 8: AMR_Mode 5,15 kbit/s Bit 9: AMR_Mode 4,75 kbit/s
Bit 10	**Full_Sub (NB_F/S)**	0: **F**ull Set supported, NB_SCS is not following 1: **S**ubset only supported, NB_SCS is following immediately
Bit 11	"**0**"	Normal IS-Message Sync Bit, constant
Bit 12	spare	set to "1"
Bit 13	**Optimisation Mode (NB_OM)**	ACS Optimisation Mode 0 No ACS Change supported 1 ACS change supported
Bit 14 & 15	**NB_Ver**	**Ver**sion Number of the AMR-NB TFO Scheme Bit 15 is equivalent to the ATVN in Configuration Frames, see Annex C
Bit 16..18	**CRC**	3 CRC bits protecting Bits 2 to 10 and 12 to 15
Bit 19..20:	**EX**	The normal 2 bits for IS_Message Extension: 00: No other extension block follows 11: An other extension block follows (i.e. SCS)

~~**Table 7.11.3.1.1-2: AMR-WB_ACS Extension_Block**~~

~~**Bit**~~	~~**Description**~~	~~**Comment**~~
~~Bit 1~~	~~"**0**"~~	~~Normal IS-Message Sync Bit, constant.~~
~~Bit 2..10~~	~~**Active Codec Set (WB_ACS)**~~	~~Active Codec Set: For each Codec_Mode of the AMR-WB one bit is reserved. If the bit is set to "0" then the specific Codec_Mode is not in the ACS, otherwise it is in and may be used by the adaptation algorithm.~~ ~~Bit 2: AMR-WB_Mode 23.85 kbit/s~~ ~~Bit 3: AMR-WB_Mode 23.05 kbit/s~~ ~~Bit 4: AMR-WB_Mode 19.85 kbit/s~~ ~~Bit 5: AMR-WB_Mode 18.25 kbit/s~~ ~~Bit 6: AMR-WB_Mode 15.85 kbit/s~~ ~~Bit 7: AMR-WB_Mode 14.25 kbit/s~~ ~~Bit 8: AMR-WB_Mode 12.65 kbit/s~~ ~~Bit 9: AMR-WB_Mode 8.85 kbit/s~~ ~~Bit 10: AMR-WB_Mode 6.60 kbit/s~~
~~Bit 11~~	~~"**0**"~~	~~Normal IS-Message Sync Bit, constant~~
~~Bit 12~~	~~**Full_Sub (WB_F/S)**~~	~~0: **F**ull Set supported, WB_SCS is not following.~~ ~~1: **S**ubset only supported, WB_SCS is following immediately~~
~~Bit 13~~	~~**Optimisation Mode (WB_OM)**~~	~~ACS Optimisation Mode~~ ~~0: No ACS Change supported~~ ~~1: ACS Change supported~~
~~Bit 14~~	~~spare~~	~~set to "1"~~
~~Bit 15~~	~~spare~~	~~set to "1"~~
~~Bit 16..18~~	~~**CRC**~~	~~3 CRC bits protecting Bits 2 to 10 and 12 to 15~~
~~Bit 19..20:~~	~~**EX**~~	~~The normal 2 bits for IS_Message Extension:~~ ~~00: No other extension block follows~~ ~~11: An other extension block follows (i.e. SCS)~~

7.11.3.1.2 AMR Supported_Codec_Set Attributes

The AMR_SCS ~~(AMR-WB_SCS)~~ Extension_Block contains the information on the AMR ~~(AMR-WB)~~ Supported Codec Set. It shall be omitted, if the full set is supported. Table 7.11.3.1.2-1 gives the description of the SCS Extension_Block.

For the Local_Used_Codec_Type the SCS Extension_Block shall follow immediately after the corresponding ACS Extension_Block. In that case the Full_Sub flag shall be set within the ACS Extension_Block. For alternative Codec_Types, as flagged in the Local_Codec_List, the SCS shall follow immediately after the corresponding Attribute_Head Extension_Block.

NOTE: The VERsion numbers in ACS and SCS Extension_Blocks shall be identical for one Codec_Type, but may be different for different Codec_Types (e.g. FR_AMR and HR_AMR~~ or FR_AMR-WB~~).

Table 7.11.3.1.2-1: AMR_SCS Extension_Block

Bit	Description	Comment
Bit 1	"**0**"	Normal IS-Message Sync Bit, constant.
Bit 2…9	**Supported Codec Set (NB_SCS)**	Supported Codec Set: For each Codec_Mode of the AMR one bit is reserved. If the bit is set to "0" then the specific Codec_Mode is not supported; if the bit is set to "1" then the specific Codec_Mode is supported and may be considered for the optimisation of the common ACS. Bit 2: AMR_Mode 12,2 kbit/s (undefined in SCS(H)) Bit 3: AMR_Mode 10,2 kbit/s (undefined in SCS(H)) Bit 4: AMR_Mode 7,95 kbit/s Bit 5: AMR_Mode 7,4 kbit/s Bit 6: AMR_Mode 6,7 kbit/s Bit 7: AMR_Mode 5,9 kbit/s Bit 8: AMR_Mode 5,15 kbit/s Bit 9: AMR_Mode 4,75 kbit/s
Bit 10	**NB_MACS MSB**	See comment for Bit 12…13
Bit 11	"**0**"	normal IS-Message Sync Bit, constant
Bit 12…13	**NB_MACS LSBs**	The maximally supported number of Codec_Modes in this radio leg. Coding for bits 10.12.13: "0.0.1" 1 Mode "0.1.0" 2 Modes "0.1.1" 3 Modes "1.0.0" 4 Modes "1.0.1" 5 Modes "1.1.0" 6 Modes "1.1.1" 7 Modes "0.0.0" 8 Modes
Bit 14…15	**NB_Ver**	Version Number of the AMR TFO Scheme for that Codec_Type Bit 15 is equivalent to the ATVN in Configuration Frames, see Annex C
Bit 16..18	**CRC**	3 CRC bits protecting Bits 2 to 10 and 12 to 15
Bit 19 20	**EX**	The normal 2 bits for IS_Message Extension: 00: No other extension block follows 11: An other extension block follows

~~**Table 7.11.3.1.2-2: AMR-WB_SCS Extension_Block**~~

~~**Bit**~~	~~**Description**~~	~~**Comment**~~
~~Bit 1~~	~~"**0**"~~	~~Normal IS-Message Sync Bit, constant.~~
~~Bit 2…10~~	~~**Supported Codec Set (WB_SCS)**~~	~~Supported Codec Set: For each Codec_Mode of the AMR-WB one bit is reserved. If the bit is set to "0" then the specific Codec_Mode is not supported; if the bit is set to "1" then the specific Codec_Mode is supported and may be considered for the optimisation of the common WB_ACS.~~ ~~Bit 2: AMR-WB_Mode 23.85 kbit/s~~ ~~Bit 3: AMR-WB_Mode 23.05 kbit/s~~ ~~Bit 4: AMR-WB_Mode 19.85 kbit/s~~ ~~Bit 5: AMR-WB_Mode 18.25 kbit/s~~ ~~Bit 6: AMR-WB_Mode 15.85 kbit/s~~ ~~Bit 7: AMR-WB_Mode 14.25 kbit/s~~ ~~Bit 8: AMR-WB_Mode 12.65 kbit/s~~ ~~Bit 9: AMR-WB_Mode 8.85 kbit/s~~ ~~Bit 10: AMR-WB_Mode 6.60 kbit/s~~
~~Bit 11~~	~~"**0**"~~	~~normal IS-Message Sync Bit, constant~~
~~Bit 12…14~~	~~**WB_MACS**~~	~~The maximally supported number of Codec_Modes in this radio leg. Coding:~~ ~~"0.0.1" 1 Mode~~ ~~"0.1.0" 2 Modes~~ ~~"0.1.1" 3 Modes~~ ~~"1.0.0" 4 Modes~~ ~~"1.0.1" 5 Modes~~ ~~"1.1.0" 6 Modes~~ ~~"1.1.1" 7 Modes~~ ~~"0.0.0" 8 Modes~~
~~Bit 15~~	~~spare~~	~~set to "1"~~
~~Bit 16..18~~	~~**CRC**~~	~~3 CRC bits protecting Bits 2 to 10 and 12 to 15~~
~~Bit 19 20~~	~~**EX**~~	~~The normal 2 bits for IS_Message Extension:~~ ~~00: No other extension block follows~~ ~~11: An other extension block follows~~

7.11.3.1.3 AMR specific Codec_Attribute_Head Extension_Block

The AMR specific Codec_Attribute_Head Extension_Block (Table 7.11.3.1.3-1) shall precede the Codec Attribute Extension_Blocks of any AMR Codec_Type.

Table 7.11.3.1.3-1: AMR specific Codec_Attribute_Head Extension_Block

Bit	**Description**	**Comment**
Bit 1	"**0**"	normal IS-Message Sync Bit, constant.
Bit 2	**PAR_Sel**	Differentiates this Extension_Block **0:** Parameters included in **PAR** field: Simple Codec_List_Extension **1:** Length Indicator (**LI**) included: Parameters follow in subsequent Extension_Blocks
Bit 3..10	**CoID = HR_AMR or FR_AMR or UMTS_AMR or UMTS_AMR2 or OHR_AMR**	This field identifies the AMR Codec_Type for which the subsequent attributes are valid. The same coding as in the Codec_x Extension_Block is used (long form)
Bit 11	"**0**"	normal IS-Message Sync Bit, constant
Bit 12.. 15:	**LI / PAR**	If Par_Sel==1: LI: Length Indicator: 0000: reserved; 0001: one other Extension_Block follows, etc. If Par_Sel==0: PAR: Codec specific definition of these four bits
Bit 16..18:	**CRC**	3 CRC bits protecting Bits 2 to 10 and 12 to 15
Bit 19..20:	**EX**	The normal 2 bits for IS_Message Extension: 00: No other extension block follows 11: An other extension block follows

If PAR_Sel is set to "1" then the AMR_ACS and potentially AMR_SCS is/are following.

If PAR_Sel is set to "0", then one of 16 possible AMR Configurations is indicated in the
PAR field and no additional Codec Attribute Extension_Blocks do follow.
Coding for PAR (bits 12.13.14.15):
0000: to

1111: for further study.

The option" Par_Sel=0" and the corresponding configuration codes can only be used in TFO Version 5 and onwards. A Pre-REL-5 implementation does not understand it and ignores it.

7.11.3.1.4 AMR-WB specific Codec_Attribute_Head Extension_Block

The AMR-WB specific Codec_Attribute_Head Extension_Block ~~(is defined in~~ Table 7.11.3.1.4-1~~,) shall precede the Codec Attribute Extension_Blocks of any AMR-WB Codec_Type.~~

Table 7.11.3.1.4-1: AMR-WB specific Codec_Attribute_Head Extension_Block

Bit	Description	Comment
Bit 1	"**0**"	normal IS-Message Sync Bit, constant.
Bit 2	**PAR_Sel**	Differentiates this Extension_Block **0:** Parameters included in **PAR** field: Simple Codec_List_Extension **1:** undefined ~~Length Indicator (**LI**) included: Parameters follow in subsequent Extension_Blocks~~
Bit 3..10	**CoID = FR_AMR-WB or UMTS_AMR-WB or OHR_AMR-WB or OFR_AMR-WB**	This field identifies the AMR-WB Codec_Type for which the subsequent attributes are valid. The same coding as in the Codec_x Extension_Block is used (long form)
Bit 11	"**0**"	normal IS-Message Sync Bit, constant
Bit 12.. 15:	~~**LI /**~~ **PAR**	AMR-WB configuration as defined in TS 26.103, table 5.7-1 (Config-WB-Code) ~~If Par_Sel==1: LI: Length Indicator:~~ ~~0000: reserved;~~ ~~0001: one other Extension_Block follows, etc.~~ ~~If Par_Sel==0: PAR: Codec specific definition of these four bits~~
Bit 16..18:	**CRC**	3 CRC bits protecting Bits 2 to 10 and 12 to 15
Bit 19..20:	**EX**	The normal 2 bits for IS_Message Extension: 00: No other extension block follows 11: An other extension block follows

~~If PAR_Sel is set to "1" then the AMR-WB_ACS and potentially AMR-WB_SCS is/are following.~~

~~If PAR_Sel is set to "0" then one of 16 possible AMR-WB Configurations is indicated in the PAR field and no additional Codec Attribute Extension_Blocks do follow.~~
~~Coding for PAR (bits 12.13.14.15):~~
~~0000: to~~

~~1111: for further study.~~

3GPP TSG-S4 Meeting #22
Tampere, Finland, 22-26 July

Tdoc ⌘S4-020488

CR-Form-v7

CHANGE REQUEST

⌘ **28.062** **CR** **031** ⌘ **rev** **2** ⌘ Current version: **5.1.0** ⌘

*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:	⌘	Simplified TFO Decision for AMR-WB
Source:	⌘	TSG-SA WG4
Work item code:	⌘	AMRWB
Date:	⌘	12/Sept/2002
Category:	⌘	**F**
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:

2	*(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)*

Reason for change:	⌘	TFO Decision Algorithm for AMR-WB is much more complex and general than necessary. It can be simplified dramatically without reducing performance.
Summary of change:	⌘	1) The TFO Decision for AMR-WB is described in 12.8 using a table. This table replaces the "voting" algorithm for general OACS determination, which is removed (12.3.2). In addition two flow charts are updated. 2) MaMiMo removed since always included in mandatory SCS 3) Some AMR-WB specific text needed more general formulation to also comply with description of Immediate Codec Type Optimisation 4) Incorrect refferences fixed 5) Several typos removed and formatting improved Additionally, the reference C-code implementation was adapted.
Consequences if not approved:	⌘	The TFO Decision Algorithm for AMR-WB is more complex than required. The result is less obvious and hinders implementation.

Clauses affected:	⌘	11, 12, Annex E, Annex F, C-Code

Other specs affected:	⌘	Y	N		⌘	
		X		Other core specifications		TS 26.103, TS 23.153, 26.202
			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.

11 TFO Decision Algorithm

The TFO decision algorithm defines the processes invoked in both transcoders in order to examine the possibility for TFO establishment. Codec Types are in general only compatible to itself. For the AMR Codec Type family the following tables 11-1 and 11-2 illustrate the compatible combinations (Table 11-1 for AMR-NB codec types, table 11-2 for AMR-WB codec types):

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

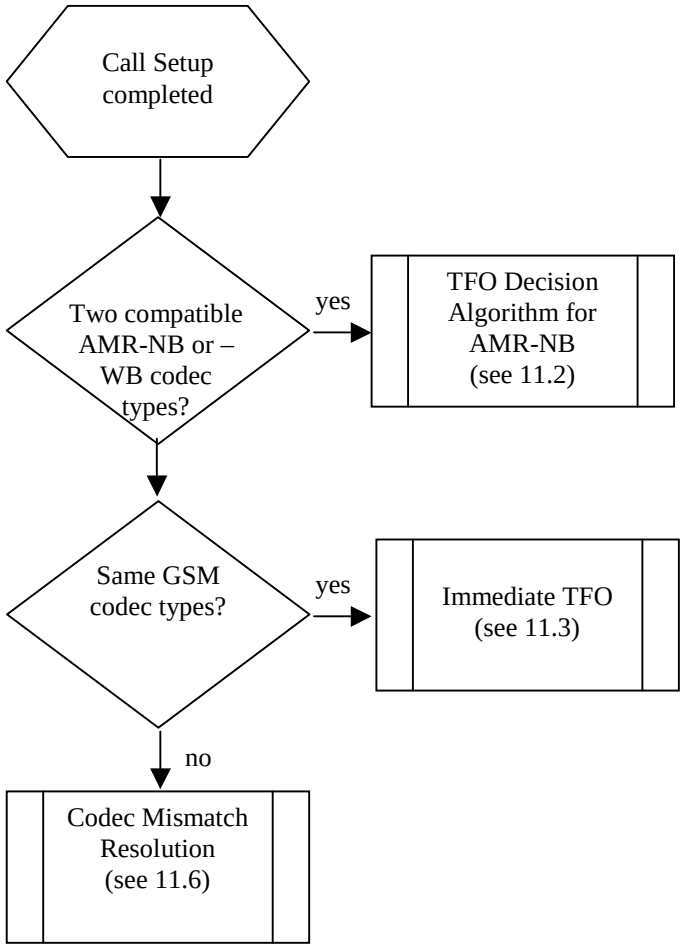
The UMTS_AMR_2 is the preferred Codec Type for 3G systems.

Table 11-2 Compatibility of AMR-WB Codec Types

distant → ↓ local	**FR_AMR-WB**	**UMTS_AMR-WB**	**OFR_AMR-WB**	**OHR_AMR-WB**
FR_AMR-WB	compatible	compatible	compatible	compatible
UMTS_AMR-WB	compatible	compatible	compatible	compatible
OFR_AMR-WB	compatible	compatible	compatible	compatible
OHR_AMR-WB	compatible	compatible	compatible	compatible

11.1 Main TFO Decision Procedure

The main TFO decision procedure is depicted in figure 11.1-1.



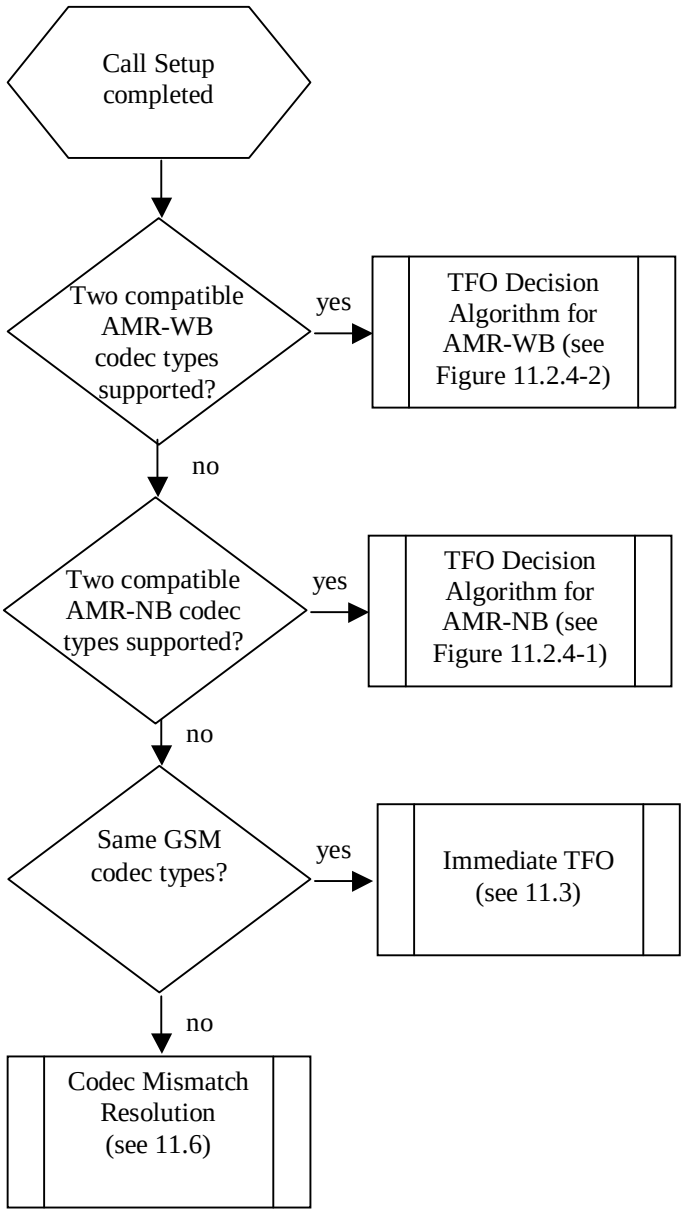


Figure 11.1-1: Main TFO Decision Algorithm

11.2 TFO Decision Algorithm for AMR codec types

The TFO Decision Algorithm for AMR codec types defines the processes that are invoked in order to examine the possibility for a TFO establishment if both radio legs use compatible AMR codec types.

11.2.1 Principles

In order to yield high speech quality the following items are underlying principles of the TFO decision algorithm for AMR codec types:

- Avoid immediate TFO establishment with a following codec optimisation that has to interrupt the TFO connection.
- Go into immediate TFO if this is possible with a good configuration, otherwise do codec optimisation.
- Only do codec mode optimisation if the ongoing TFO connection is established on a contiguous subset of the ACS and if this ongoing TFO connection need not be interrupted.

11.2.2 Available Information at Call Set-up

After the exchange of TFO_REQ and TFO_ACK messages the following information is available at the transcoders on both sides:

- Local / distant codec type (FR_AMR, HR_AMR, UMTS_AMR, UMTS_AMR_2, OHR_AMR, FR_AMR-WB, UMTS_AMR-WB, OHR_AMR-WB, OFR_AMR-WB)
- Local / distant supported codec set (LSCS / DSCS)
- Local / distant ACS (LACS / DACS)
- Local / distant MACS
- Local / distant ACS optimisation mode (OM)
- Local / distant version number (Ver)

With this information the following can be calculated:

- Common ACS (CACS)
- Common supported codec set (CSCS)
- Common MACS (CMACS)
- Optimised ACS (OACS)

~~The codec lists are not available.~~

~~The version number is not regarded.~~

Furthermore, additional information on supported codecs may become available when the Codec List is received. There are several possibilities for receiving this information: 1) by TFO_REQ and TFO_ACK messages including optional Extension_Blocks, 2) by TFO_REQ_L and TFO_ACK_L messages, and 3) by Configuration Frames (Con_Req, Con_Ack). In any case, the following information is available for each supported codec in the Codec List:

~~If the AMR-WB is not currently used, but supported, then after exchange of TFO_REQ_L and TFO_ACK_L messages the following information is available:~~

- Local / distant supported ~~AMR-WB~~ codec type~~(s)~~
- Local / distant supported codec set (LSCS / DSCS)
- Local / distant MACS
- ~~Local / distant ACS optimisation mode (OM)~~
- ~~Local / distant version number (Ver)~~

In the case that Generic Configuration Frames are used to transmit the Codec List the following information is also available for each codec in the Codec List:

- Local / distant intended ACS (LACS/ DACS)
- Local / distant ACS optimisation mode (OM)

In all other cases (no Generic Configuration Frames are used) the OM bit shall be assumed to be set ("ACS optimisation allowed").

With this information the following can be calculated for each compatible codec combination in the local and distant Codec List:

- Common supported codec set (CSCS)
- Common MACS (CMACS)
- Optimised ACS (OACS)

~~In this case, if for AMR-WB Con_Req and Con_Ack are exchanged, then additionally the following information is available:~~

~~□Local / distant intended ACS (LACS / DACS)~~

~~and the~~

~~□Common intended ACS (CACS)~~

~~can be calculated.~~

~~The version number is not regarded.~~

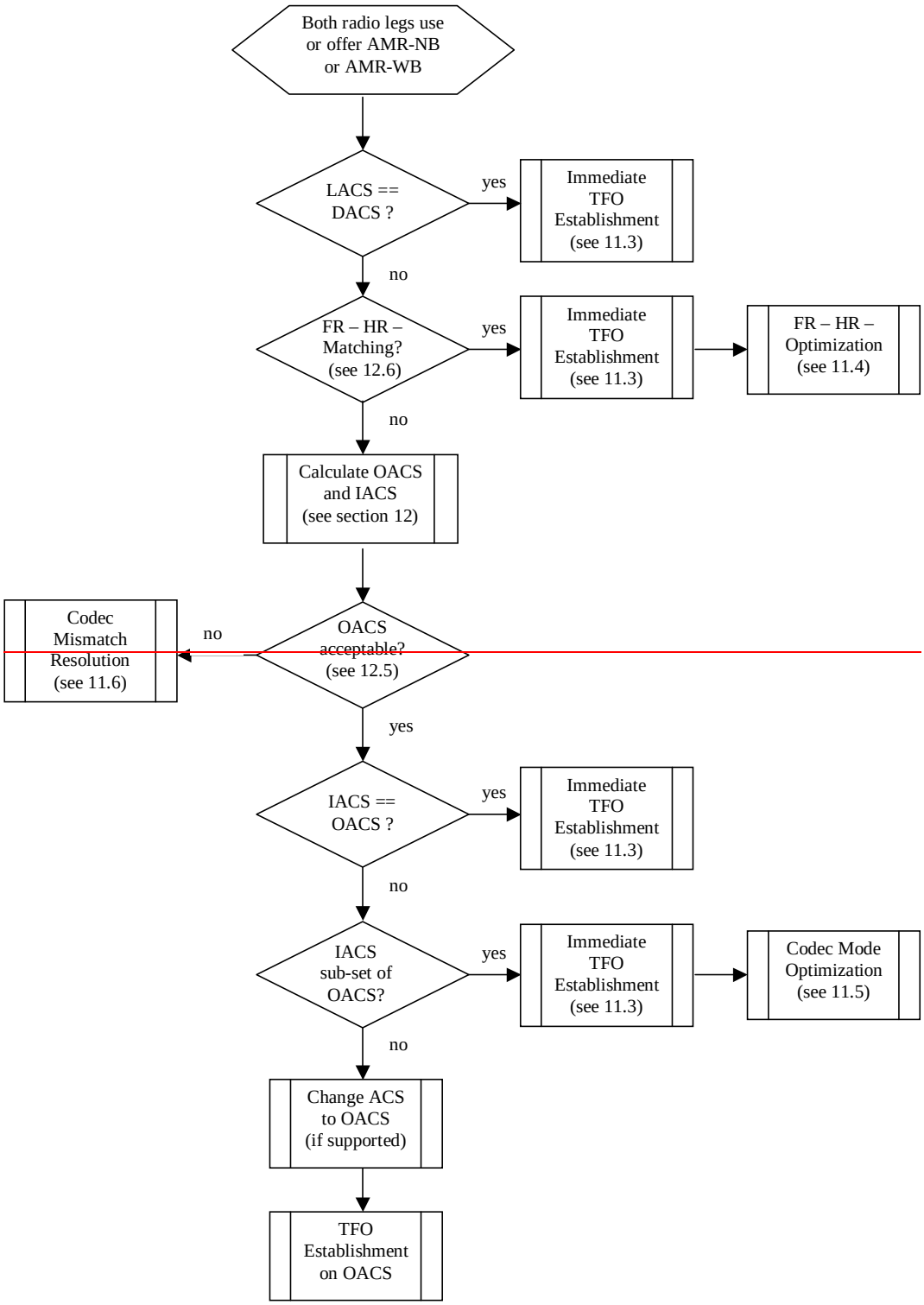
11.2.3 [deleted]~~Mandatory Minimum set of Modes (MaMiMo) for AMR-WB TFO~~

~~If for one or both sides of a possible TFO connection an AMR-WB codec type offers a Supported Codec Set which is not a superset or is not equal to the Mandatory Minimum set of Modes, then no AMR-WB TFO shall be done involving this AMR-WB codec type.~~

~~The MaMiMo for AMR-WB TFO comprises the AMR-WB modes 8,85 and 12,65 (kbit/s).~~

Editor's note: Clause kept to maintain section numbering.

11.2.4 Flowchart for AMR-NB TFO Decision



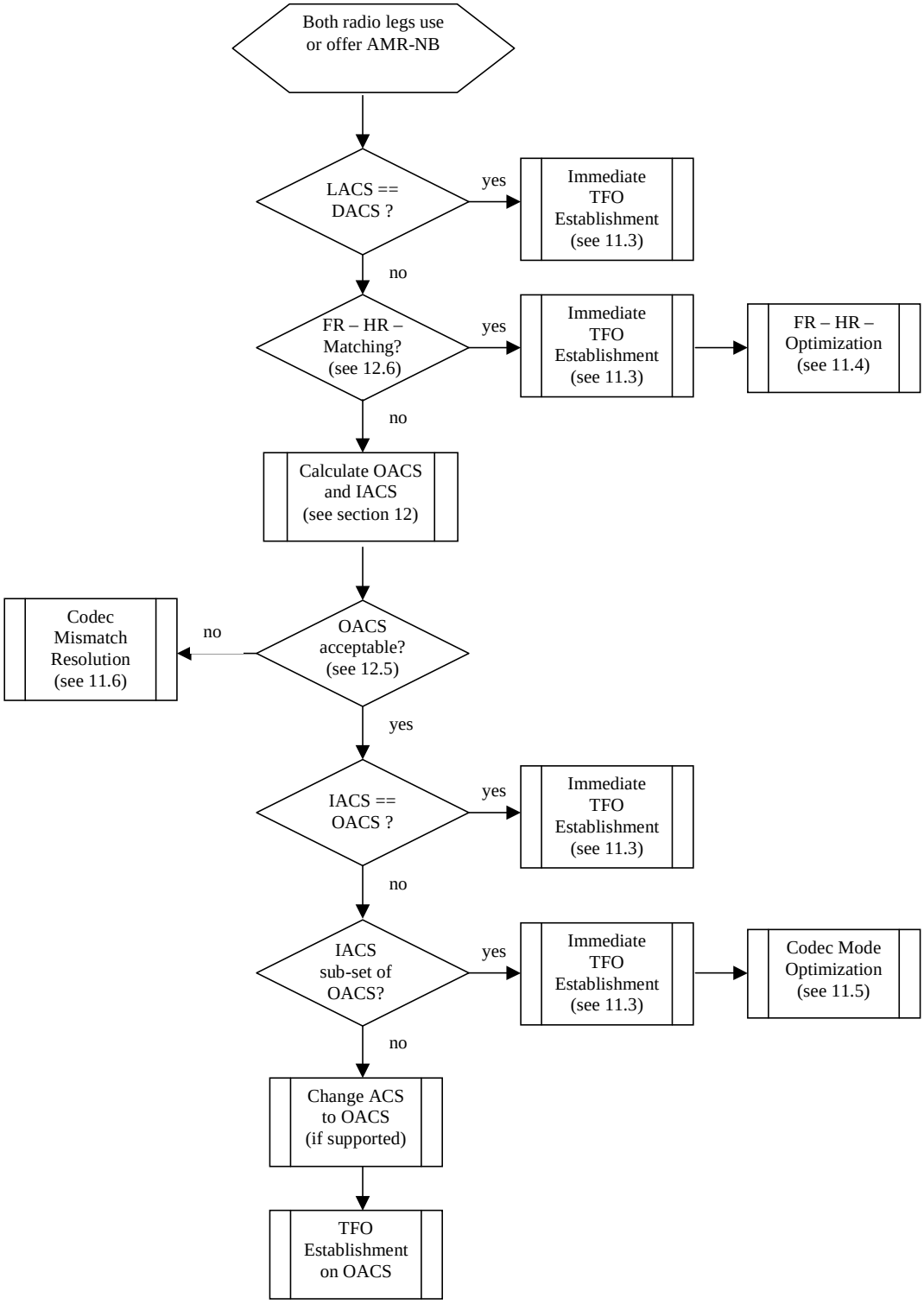


Figure 11.2.4-1: Flowchart for AMR-NB TFO Establishment at Call Set-Up

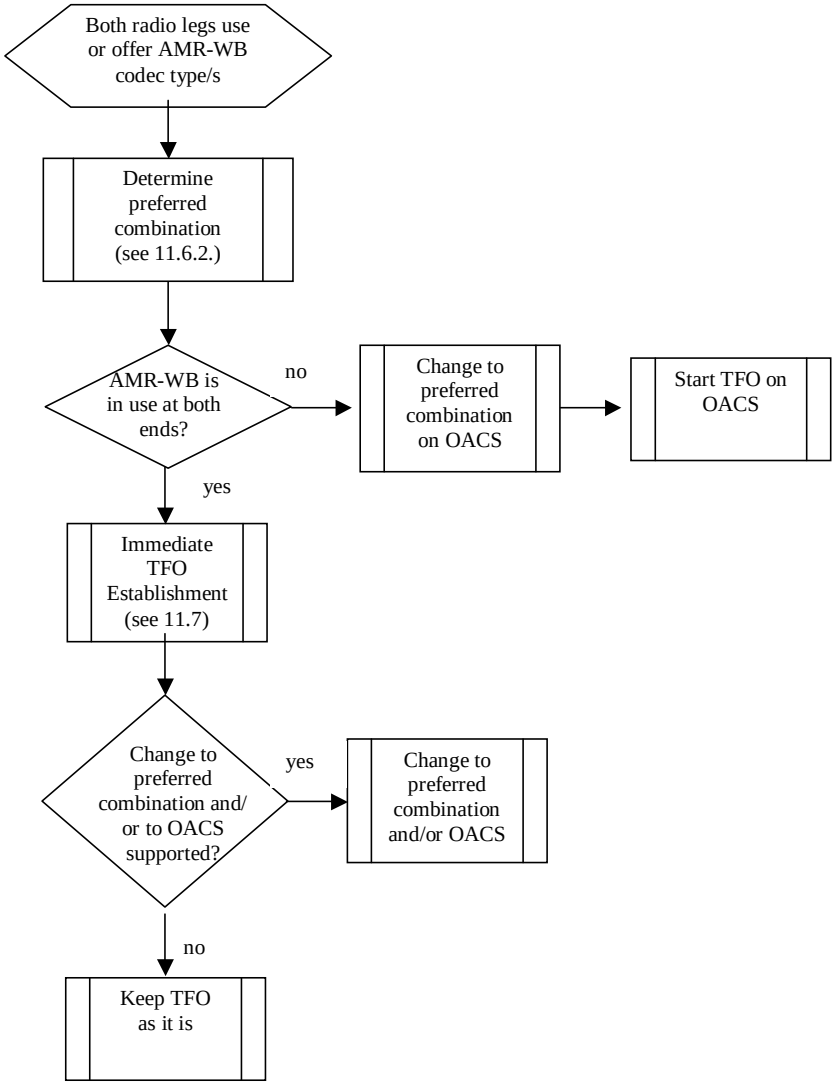


Figure 11.2.4-2: Flowchart for AMR-WB TFO Establishment at Call Set-Up

11.2.5 Annotations to the Flowcharts

- LACS == DACS:
  Establish immediate TFO if the local and distant ACS are identical.
  Example: Enable immediate TFO establishment within one operator's homogenous network. The operator's choice is always acceptable and needs no optimisation.

- FR – HR Matching
  The rules for FR – HR – Matching are stated in clause 12.6.
  Goal: Enable immediate TFO between 3G channels and 2G FR and 2G HR channels.

- FR – HR – Optimisation
  The rules for FR – HR – Optimisation are stated in clause 11.4.

- Calculate OACS and IACS:
  The calculation of the OACS is described in clause 12.
  The Immediate ACS (IACS) is given by the common ACS (CACS) if it is contiguous.

- OACS acceptable:
  The acceptability rules for the OACS are stated in clause 12.5.

- IACS == OACS
  If the immediate ACS is already optimal, establish immediate TFO.

- IACS subset of OACS:
  Immediate TFO is established on a contiguous subset of the OACS. Afterwards, a codec mode optimisation is performed without interrupting the TFO connection.

- Change ACS to OACS
  If immediate TFO cannot be established, both sides must change their ACS to the OACS in order to enable TFO. If one side doesn't support an ACS change (ACS Optimisation Mode), the OACS determination rules ensure that the OACS is a contiguous subset of the fix ACS. So a TFO connection can be established without the need for an ACS change on that side.

- Codec Mismatch Resolution
  A TFO connection with the currently ~~actual~~ used AMR codec types will not be possible, but the remaining codec types have to be investigated.

11.3 Immediate TFO Establishment

Immediate TFO establishment shall take place if

- both radio legs use the same codec type that is different from an AMR codec type; or
- the local ACS is equal to the distant ACS in the case of two compatible AMR codec types; or
- the CACS is equal to the OACS and the CACS fulfils the contiguity rule in the case of two compatible AMR codec types; or
- the rules for FR – HR – matching are fulfilled in the case of two compatible AMR-NB codec types; or
- the CACS is a contiguous subset of the OACS in the case of two compatible AMR codec types and Codec Mode Optimisation is supported and will be done after immediate TFO establishment.

If both radio legs use the same codec type that is different from an AMR codec type, immediate TFO shall be established on this common codec type. If both radio legs use compatible AMR codec types and immediate TFO can be established, each side keeps its own AMR codec type (e. g. FR_AMR, HR_AMR, UMTS_AMR, UMTS_AMR_2) and Active Codec Set (ACS).

If immediate TFO is possible on a currently used codec type, but also on a supported ~~AMR-WB~~ codec type with a higher preverence level (see 11.6.2), then TFO shall not be started on the used codec type, but only after switching to the preferred codec. For details on this Immediate Codec Type Optimisation see 11.7)~~AMR-WB~~.

11.4 FR – HR – Optimisation (only for AMR-NB)

FR – HR – Optimisation takes place after immediate TFO establishment in the case of FR – HR – Matching. The FR_AMR-side adopts the ACS of the HR_AMR-side, if this ACS is supported and the optimisation mode allows an ACS change.

This ACS change can be done without interrupting the TFO connection that is established on a contiguous subset.

11.5 Codec Mode Optimisation

After an immediate TFO establishment with compatible AMR codec types, a codec mode optimisation shall be invoked if the optimisation can be done without interrupting the TFO connection, i.e. without degradation of speech quality. Codec Mode Optimisation takes place in the following situations:

- After immediate TFO establishment on a I~~C~~ACS that is a contiguous subset of the OACS.

11.6 Codec Type Optimisation and Codec Mismatch Resolution

The objective of the Codec Mismatch Resolution and the Codec Type Optimisation is to find the optimised TFO codec type and configuration for a TFO connection. Codec Mismatch Resolution is invoked if a TFO establishment is not possible on the currently~~actually~~ used codec types. Codec Type Optimisation may happen while a TFO connection is ongoing and the capabilities of one radio leg have changed (e. g. after a hand-over, other reasons).

Codec Mismatch Resolution and Codec Type Optimisation are optional features. If one radio leg doesn't support these features, the codec list sent in the TFO_REQ_L and TFO_ACK_L messages (or Con_Req and Con_Ack frames) shall be restricted to the local used codec. If supported, the Codec Type Mismatch Resolution or the Codec Type Optimisation shall be performed every time a new codec list is sent or received by TFO_REQ_L or TFO_ACK_L (or Con_Req and Con_Ack frames) messages.

The determination of the local codec list (list of all codec types supported by the local radio leg, consisting of the local UE and the local RAN) is outside the scope of the present document. Similarly, the determination of the attributes of all locally supported codec types (e.g. LSCS for AMR codec types) is also outside the scope of the present document. Only codec types that are real alternatives, considering all resources (UE, RAN, TC, radio interface, cell capacity, interference), shall be reported within the local codec list. Only codec type Attributes that can be considered shall be indicated with the codec list as well. This means that if a TFO configuration is not desirable, it should not be listed in the TFO_REQ_L or TFO_ACK_L messages (or Con_Req and Con_Ack frames).

11.6.1 Procedure

1. The transcoders shall exchange their lists of supported codec types (codec list) and their associated attributes. This is done either by the exchange of TFO_REQ_L and/or TFO_ACK_L messages or Con_Req and Con_Ack frames.
2. Each side shall identify all candidate TFO configurations involving compatible codec types supported by both radio legs.
3. Each side shall calculate the OACS in the case of an AMR TFO candidate. If the OACS is not acceptable, this candidate shall be removed from the list of candidate TFO configurations.
4. The candidate TFO configuration with the highest preference level shall define the optimised codec type and the optimised codec configuration.
5. Each side shall switch its operation to the optimised codec type and the optimised codec configuration. If no acceptable TFO candidate was found, TFO is not possible.

11.6.2 Preference List of TFO candidates

The preference list of TFO candidates orders all possible TFO configurations according to the speech quality they provide.

Table 11.6.2-1: Codec Type Combination Preference List, Part 1

distant → ↓ local	OFR_AMR-WB	UMTS_AMR-WB	FR_AMR-WB	OHR_AMR-WB
OFR_AMR-WB	**1** ~~*)~~	**2** ~~*)~~	**4** ~~*)~~	**7**
UMTS_AMR-WB	symmetric	**3** ~~*)~~	**5** ~~*)~~	**8**
FR_AMR-WB	symmetric	symmetric	**6** ~~*)~~	**9**
OHR_AMR-WB	symmetric	symmetric	symmetric	**10**

~~*) For the AMR-WB codec type combinations with preference 1 to 6 the OACS is additionally evaluated. For details see §12.3.2.3 .~~

For AMR-WB the preference is determined by the OACS: A combination with the highest mode in the OACS has preference. If the highest mode in OACSs for at least two combinations is identical, then the preference level as given in Table 11.6.2-1 shall decide.

Examples:
The configuration (OFR_AMR-WB, UMTS_AMR-WB, OACS={6,60, 8,85, 12,65, 23,85}) is preferred to (OFR_AMR-WB, OFR_AMR-WB, OACS={6,60, 8,85, 12,65, 15,85}).
The configuration (OFR_AMR-WB, OFR_AMR-WB, OACS={6,60, 8,85, 12,65}) is preferred to (OFR_AMR-WB, UMTS_AMR-WB, OACS={6,60, 8,85, 12,65}).

Table 11.6.2-2 Codec Type Combination Preference List, Part 2

distant → ↓ local	UMTS_AMR_2	FR_AMR	UMTS_AMR	OHR_AMR	HR_AMR
UMTS_AMR_2	**11**	**12**	**14**	**17**	**20**
FR_AMR	symmetric	**13**	Not compatible	**18**	**21**
UMTS_AMR	symmetric	Not compatible	**15**	Not compatible	Not compatible
OHR_AMR	symmetric	symmetric	Not compatible	**19**	**22**
HR_AMR	symmetric	symmetric	Not compatible	symmetric	**23**

Table 11.6.2-3 Codec Type Combination Preference List, Part 3

distant → ↓ local	GSM_EFR	GSM_FR	GSM_HR
GSM_EFR	**16**	Not compatible	Not compatible
GSM_FR	Not compatible	**24**	Not compatible
GSM_HR	Not compatible	Not compatible	**25**

All other possible codec type combinations not listed in these table 11.6.2.3-1/2/3 are not compatible.

The codec type FR_AMR-WB is preferred to the AMR-NB codec types, because it still provides significantly better speech quality.

The two equivalent combinations FR_AMR-WB ⇔ UMTS_AMR-WB and UMTS_AMR-WB ⇔ FR_AMR-WB should not exist in parallel, because these two AMR-WB codec types are not offered by one side simultaneously.

The codec type UMTS_AMR_2 is the most preferred AMR-NB codec type, because it is compatible with all other AMR codec types. Note: Whenever UMTS_AMR_2 is available, then the UMTS_AMR and FR_AMR shall not be included in the Codec_List, see Annex F (Operator´s Guide).

The codec type FR_AMR is preferred to UMTS_AMR because UMTS_AMR is not compatible with FR_AMR and HR_AMR.

If the two equivalent AMR-NB combinations like FR_AMR ⇔ HR_AMR and HR_AMR ⇔ FR_AMR or UMTS_AMR_2 ⇔ HR_AMR and HR_AMR ⇔ UMTS_AMR_2 etc. exist in parallel, then they shall be ranked according to the following rules:

1. The combination with the highest number of modes shall be selected.
2. If they have the same number of modes, then the combination with the widest spread shall be selected. The spread is the difference between the highest and the lowest mode indexes.
3. If the spreads are identical, then the combination with the highest mode in the OACS shall be selected.
4. If the highest modes are identical, repeat 3 with the second highest mode. If the second highest are identical, then repeat 3 with the third highest, etc.

11.7 Immediate Codec Type Optimisation

The Codec Type Optimisation described in the previous section is performed after the exchange of TFO_REQ_L and TFO_ACK_L messages. Because these messages are exchanged in a late phase of the protocol and may require significant time for transmission, the optimisation may be delayed by a significant amount of time. Furthermore, if TFO was already established before optimisation, a switch to the preferred codec type may disturb the ongoing speech call. To avoid these drawbacks, the codec type optimisation can also be performed immediately during TFO establishment, i.e., in a very early stage of the TFO protocol. This option for TFO establishment is termed “Immediate Codec Type Optimisation” and is explained in the following.

The objective of the Immediate Codec Type Optimisation is to switch the codec type at the local and/or the distant side if this results in a preferred TFO configuration. The required information to decide if Immediate Codec Type Optimization shall be performed is included in the TFO_REQ and TFO_ACK messages by means of the TFO_Version Extension_Block (see Clause 7.4.5). This information is equivalent to the Codec_List included in TFO_REQ_L and TFO_ACK_L messages, however, signalled in a different way. If a preferred TFO configuration becomes possible by changing the local and/or the distant codec type, both sides remain in the Contact state as long as the Immediate Codec Type Optimisation is being performed, i.e., until the local and/or the distant side has/have changed the codec type. After the switch, the TFO protocol continues as usual.

Immediate Codec Type Optimisation becomes only effective in TFO version 5 or higher. If either the local or the distant side is using a lower version, no Immediate Codec Type Optimisation is used. Hence, the protocol is compatible with older versions that do not include Immediate Codec Type Optimisation. Note that a switch to a different codec type is always possible using the normal Codec Type Optimisation in the Mismatch state.

The procedure and preference list used for finding the optimal configuration is exactly identical to Clause 11.6. The only difference is that the required information (active codec, codec list, attributes, …) is obtained from TFO_REQ and TFO_ACK messages instead of TFO_REQ_L and TFO_ACK_L messages. Furthermore, the change of codec type is performed in the Contact state instead of the Mismatch or Operation state.

11.8 TFO Decision ~~Algorithm~~Table for AMR-WB

For AMR-WB only a limited set of configurations is allowed. Table 12.8-1.gives the effective ACS for all combinations of these allowed configurations.

Local scenario Distant scenario	**0**: **ACS:=A**=SCS 12,65 8,85 6,60 OM=F MACS=3	**1**: ACS:=A, SCS:=D 23,85 15,85 12,65 12,65 8,85 8,85 6,60 6,60 OM=A MACS=4	**2**: **ACS:=B**=SCS 15,85 12,65 8,85 6,60 OM=F MACS=4	**3**: ACS:=A, SCS=D 15,85 12,65 8,85 6,60 OM=A MACS=4	**4**: **ACS:=C**=SCS 23,85 12,65 8, 85 6,60 OM=F MACS=4	**5**: ACS=C, SCS=D 23,85 12,65 8,85 6,60 OM=A MACS=4
0	A	A	A	A	A	A
1	Symmetrical	A	B (config. 1 changes to 3)	B (config. 1 changes to 3)	C (config. 1 changes to 5)	C (config. 1 changes to 5)
2	Symmetrical	Symmetrical	B	B	A	B (config. 5 changes to 3)
3	Symmetrical	Symmetrical	Symmetrical	B	C (config. 3 changes to 5)	C (config. 3 changes to 5)
4	Symmetrical	Symmetrical	Symmetrical	Symmetrical	C	C
5	Symmetrical	Symmetrical	Symmetrical	Symmetrical	Symmetrical	C

Table 11.8-1: Effective ACS for AMR-WB TFO

Immediate TFO (see 11.3) is always possible for each combination of the allowed configurations. In some cases a Codec Mode Optimisation (see 11.5) is invoked after TFO establishment. For these cases the changing configuration is also specified in the table 12.8-1. Remark: For all combinations where one side changes the configuration, immediate TFO is established on ACS A.

All final (and immediate) ACSs as listed in table 12.8-1 are contiguous and acceptable, by design. No check – as for an AMR-NB OACS (see clause 12.4, 12.5 and 12.7) – is needed.

12 Determination of the OACS for AMR-NB

In case of inconsistencies between the TFO decision C-Code in Annex E and this clause the C-Code shall take precedence.

12.1 Principles

The determination of the OACS shall be done considering the available information (see 11.2.2).

The common MACS is defined as the minimum value of the local and distant MACS.

The determination of the OACS shall depend on the local and distant optimisation mode (LOM / DOM).

12.2 Algorithm for OACS Determination

12.2.1 Case 1: No side supports ACS change

If neither the local side nor the distant side supports an ACS change, the OACS is equal to the CACS if it fulfils the contiguity rule. Otherwise, the rules for contiguous subset selection are applied to the CACS in order to obtain the OACS.

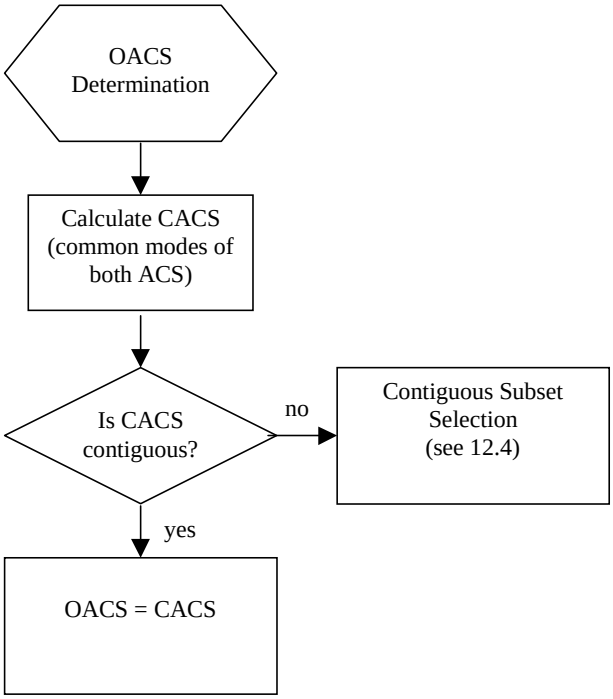


Figure 12.2.1-1: OACS Determination when No side supports ACS Change

12.2.2 Case 2: Only one side supports ACS change

If only one side supports an ACS change, the CSCS is built with the common modes of the SCS of the flexible side and the unchangeable ACS.

If the CSCS doesn't fulfil the contiguity rule or the common MACS is lower than the number of modes in the CSCS, the OACS is obtained by applying the rules for contiguous subset selection. Otherwise, the OACS is equal to the CSCS.

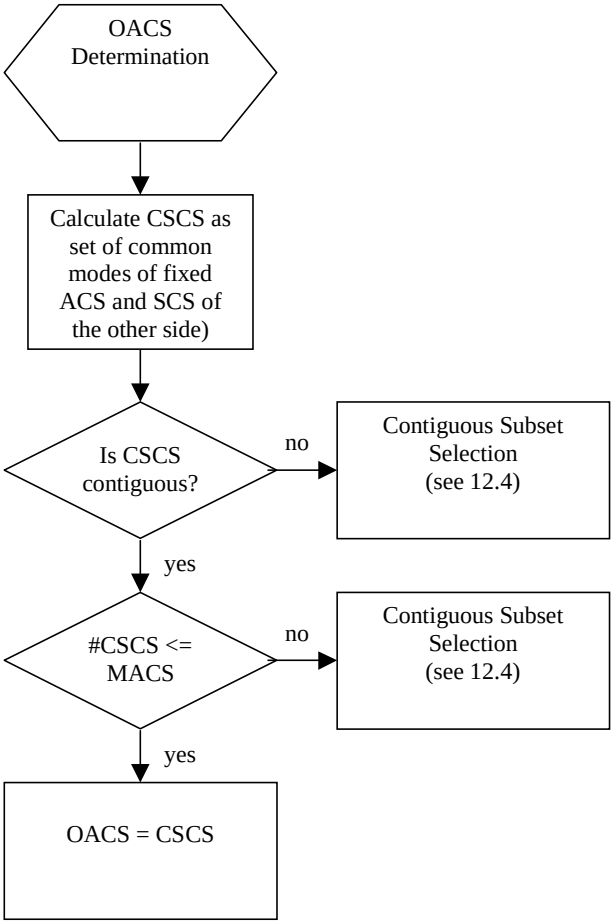


Figure 12.2.2-1: OACS Determination when only one side supports ACS Change

12.2.3 Case 3: Both sides support ACS change

If both sides support ACS change, the CSCS is built with the common modes of both SCS.

The Optimised Active Codec Set (OACS) is equal to the Common Supported Codec Set (CSCS) if the number of modes in the CSCS is equal or lower than the common MACS.

If the number of modes in the CSCS is higher than the common MACS, the OACS shall be defined as a subset of the CSCS using the OACS selection rules.

If the CSCS is not empty, then a Optimised Active Codec Set (OACS) exists.

The existence of an OACS doesn't mean the OACS is acceptable. To check this, the acceptability rules for the OACS have to be applied.

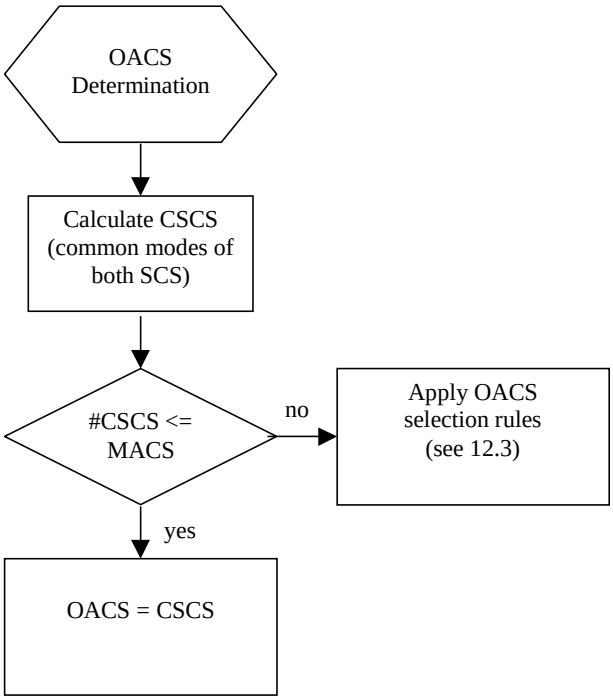


Figure 12.2.3-1: OACS Determination when both sides support ACS Change

12.3 OACS Selection Rules

If both radio legs support ACS change and if the number of modes contained in the CSCS is greater than the common MACS, the OACS is determined by the following rules. These rules are skipped as soon as an OACS containing CMACS modes is found.

The reference C-Code also implements the OACS rules (see Annex E). In case of inconsistencies between this clause and the C-code, the C-code takes precedence.

~~12.3.1 OACS selection for AMR-NB~~

12.3.1~~.1~~ Case 1: No Half Rate Channel is involved

Case MACS == 1

1. Select mode according to preference list {6,7, 7,4, 5,9, 5,15, 4,75, 7,95, 10,2, 12,2}.

Case MACS == 2

1. If mode 10,2 is supported, do not include mode 12,2.
2. Select highest mode.
3. If mode 12,2 or mode 10,2 is selected, select mode according to preference list {6,7, 7,4, 5,9, 5,15, 4,75, 7,95, 10,2, 12,2}.
4. Select lowest mode.

Case MACS > 2

1. If mode 10,2 is supported, do not include mode 12,2.
2. If mode 4,75 is supported, do not include mode 5,15.
3. If mode 5,15 is supported, do not include mode 5,9.
4. If mode 5,9 is supported and mode 4,75 is not supported, do not include mode 6,7.

5. If mode (12,2 or 10,2) and 7,4 is supported, do not include mode 7,95.
6. If mode 7,95 is supported, do not include 7,4.
7. Select lowest mode.
8. Select highest mode.
9. Select mode 6,7.
10. Select mode 5,9.

12.3.~~1.~~2 Case 2: A Half Rate Channel is involved

Case MACS == 1

1. Select mode according to preference list {5,9, 5,15, 4,75, 6,7, 7,4, 7,95}.

Case MACS == 2

1. Select highest mode.
2. Select lowest mode.

Case MACS > 2

The same rules apply as in clause 12.3.1 for the case MACS>2.

~~12.3.2 OACS for AMR-WB~~

~~12.3.2.1 Selection of AMR-WB OACS~~

~~For each AMR-WB mode a weight factor is defined. For the modes one side is offering in its ACS the weight factors are summed. The total sums of both sides are compared and the "right" for the selection of the first mode for the Common ACS (CACS) is assigned to the side with the bigger sum. Further selection rights are exerted until the maximum number (CMACS) of modes in the CACS is reached or all modes of the Common Supported Codec Set (CSCS) were selected.~~

~~The selection order for the second, third etc. mode of the CACS is determined by a calculation where the total sums are divided by 1, 3, 5, 7… and the results are ranked in order of their size. This order determines the sequence of rights to select the next and following mode/s.~~

~~Of course the selection must take place out of the CSCS.~~

~~12.3.2.1.1 Both sides offer AMR-WB ACS information~~

~~The selecting size chooses the mode with the highest weight factor out of intersection of the CSCS and its own ACS (if that mode is not already part of the CACS).~~

~~The following rules apply:~~

~~If both sides have the equal sum of weights, then the side that offered the highest-ranking mode has the first choice. If both sides took the same highest-ranking mode, then the side with the second highest-ranking mode will win and so on. For the second, third … selection right the same principle applies analoguously, if division results are identical.~~

~~If no mode of the intersection of its ACS and the CSCS is available anymore, the side with the selection right selects the mode with the highest weight factor out of the intersection of CSCS and the ACS of the other side. If also such a mode is not available, then the not yet selected mode out of the CSCS with the highest weight factor is selected.~~

~~Remark:~~
~~For these rules the relevant weights for the modes have to be selected as described in 13.3.2.2.~~

12.3.2.1.2 Only one sides offers AMR-WB ACS information

This ACS or a contiguous subset (if ACS is no subset of CSCS) of it shall be chosen, if a Handover can be avoided this way. Otherwise the selection is performed as described above, with all selection rights going to the side where the ACS information is present.

12.3.2.1.3 No sides offers AMR-WB ACS information

If no information about any of the ACSs of both sides is available, then the highest ranking modes out of the CSCS are selected. [This automatically leads to the Default ACS or a subset of it].

12.3.2.2 Weight of AMR-WB modes

The weights of the modes are as follows:

12.3.2.2.1 Weight of AMR-WB modes involving OHR_AMR-WB or FR_AMR-WB

For AMR-WB codec combinations involving OHR_AMR-WB or FR_AMR-WB the following weights apply:

Table 12.3.2.2-1: Weight factors for OHR_AMR-WB / FR_AMR-WB

AMR-WB mode	Weight factor for GMSK/8PSK-HR
6,60	17
8,85	18
12,65	19
14,25	4
15,85	16
18,25	3
19,85	2
23,05	1
23,85	15

Remark: Value for modes not required for AMR-WB speech service or not supported by the radio access technology are only needed for algorithm (which is capable of 9 modes).

12.3.2.2.2 Weight of AMR-WB modes, other cases

For all other AMR-WB codec combinations the following weights apply:

Table 12.3.2.2-1: Weight factors for UTRAN / 8PSK-FR

AMR-WB mode	*Weight factor for UTRAN / 8PSK-FR*
6,60	*15*
8,85	*18*
12,65	*19*
14,25	*4*
15,85	*16*
18,25	*3*
19,85	*2*
23,05	*1*
23,85	*17*

Remark: Value for modes not required for AMR-WB speech service or not supported by the radio access technology are only needed for algorithm (which is capable of 9 modes).

12.3.2.3 Evaluation of AMR-WB OACS

If AMR-WB codec type combinations of OHR_AMR-WB, FR_AMR-WB, UMTS_AMR-WB – which have equivalent speech quality – are possible, the OACS of these combinations must be evaluated (see Table 11.6.2-1). The combination with the highest evaluation is chosen for TFO.

~~The evaluation is done as follows:~~

- ~~Step 1: The ratio~~
  ~~(sum of weights of modes in the OACS) /~~
  ~~(sum of weights of modes in the Default ACS with the same number of modes as the OACS)~~
  ~~[higher value => higher preference]~~
  ~~This ratio determines how close the OACS is to the Default ACS.~~

~~If Step1 leads to the same values, then by~~

- ~~Step 2: The ratio~~
  ~~(sum of weights of intersections of Local ACS with OACS and Distant ACS with OACS) /~~
  ~~(sum of weights of modes in the Default ACS with the same number of modes as the OACS)~~
  ~~[higher value => higher preference]~~
  ~~This ratio determines how close the OACS is to the local and distant ACS.~~

~~If Step2 leads to the same values, then by~~

- ~~Step 3: The order of preference as in Codec Type Preference List Part 1 (Table 11.6.2-1)~~

12.4 Rules for Contiguous Subset Selection

The rules for contiguous subset selection are necessary if one or both radio legs don't support ACS change. If TFO should be established in these cases, the resulting OACS must fulfil the contiguity rule considering the fixed ACS.

If the CSCS doesn't fulfil the contiguity rule, a contiguous subset with a maximum number of modes shall be selected as the new CSCS. This subset must contain the lowest mode of the fixed ACS, otherwise there is no OACS.

If the common MACS is lower than the number of modes in the CSCS, the highest modes shall be removed from the CSCS until the number of modes in the CSCS is equal to the common MACS. This new codec set defines the OACS.

12.5 Acceptability Rule for the OACS

~~12.5.1 Acceptability Rule for AMR-NB OACS~~

An optimised ACS (OACS) is acceptable for AMR-NB TFO if

1. the Highest-Mode-Rule is fulfilled and
2. the Lowest-Mode-Rule is fulfilled.

High Mode Rule (don't give up tandem with high quality modes)
The highest mode in the OACS is not lower than one mode below the minimum of the highest modes of both ACS.

Low Mode Rule (tandem AMR with robust low modes performs better)
Either the lowest mode of the OACS is not higher than a specific maximum mode or both ACS don't contain lower modes than the lowest mode in the OACS. The specific maximum mode is 5,9 for TFO connections involving a half rate channel and 7,4 otherwise.

~~12.5.2 Acceptability Rule for AMR-WB OACS~~

~~An optimised ACS (OACS) is NOT acceptable for AMR-WB TFO if~~

1. ~~only mode 6,60 is present~~
2. ~~only modes 15,85 or higher are present, if FR_AMR-WB or OHR_AMR-WB is involved.~~

12.6 FR – HR – Matching

A common ACS (CACS) is acceptable for immediate TFO establishment without consideration of the OACS if all of the following conditions are fulfilled:

- the one radio leg uses FR_AMR or UMTS_AMR_2 or HR_AMR, the other uses HR_AMR [for AMR-NB TFO];
- the CACS is contiguous;
- the CACS fulfils the acceptability rule.

12.7 Contiguity Rule

The Contiguity Rule states that the codec modes of the CACS must be contiguous modes in the local ACS (LACS) and the distant ACS (DACS). Additionally, the CACS must contain the lowest mode of both ACS. The Contiguity Rule is used to enable TFO establishment on a CACS different from the ACS. In a GSM system this is necessary because link adaptation is only possible using maximum rate control with adjacent modes of the ACS.

Example A:	LACS:	12,2	10,2	7,95	5,9	
	DACS:		10,2	7,95	5,9	
	CACS:		10,2	7,95	5,9	Contiguity Rule is fulfilled
Example B:	LACS:	12,2	10,2		4,75	
	DACS:		10,2	7,4	4,75	
	CACS:		10,2		4,75	Contiguity Rule is not fulfilled for the DACS

12.8 Examples of OACS Computation

12.8.1 TFO between a full rate channel and a half rate channel

	SCS	ACS	CACS	OACS	CSCS	ACS	SCS
12,2	x						
10,2	x	x					
7,95	x						
7,4	x			x	x	x	x
6,7	x	x	x	x	x	x	x
5,9	x	x	x	x	x	x	x
5,15	x				x		x
4,75	x	x	x	x	x	x	x

This is an example for FR – HR – Matching.
Immediate TFO is possible using the CACS.
Afterwards, a codec mode optimisation is performed without interrupting the ongoing TFO connection.

12.8.2 TFO between two full rate channels with different ACS

	SCS	ACS	CACS	OACS	CSCS	ACS	SCS
12,2	x				x	x	x
10,2	x	x		x	x		x
7,95	x				x		x
7,4	x				x		x
6,7	x	x	x	x	x	x	x
5,9	x	x	x	x	x	x	x
5,15	x				x		x
4,75	x	x	x	x	x	x	x

The CACS is a contiguous subset if the OACS.
Immediate TFO and subsequent codec mode optimisation without interrupting TFO is performed.

12.8.3 Full Rate Channel with restricted capabilities

	SCS	ACS	CACS	OACS	CSCS	ACS	SCS
12,2	x						
10,2	x	x					
7,95	x						
7,4	x			x	x	x	x
6,7	x	x	x	x	x	x	x
5,9	x	x					
5,15	x						
4,75	x	x	x	x	x	x	x

Immediate TFO is not possible because the CACS is not contiguous.
TFO on the OACS is acceptable since a tandem connection would not provide a better speech quality.
The OACS is acceptable since both the High Mode Rule and the Low Mode Rule are fulfilled.

12.8.4 Scenario: Full Rate Channel with MACS == 2

	SCS	ACS	CACS	OACS	CSCS	ACS	SCS
12,2							
10,2							
7,95							
7,4	x	x		x	x		x
6,7						x	x
5,9	x			x	x		x
5,15	x	x					
4,75						x	x

The OACS is acceptable for a TFO connection. A tandem connection would not provide better speech quality. Both High Mode Rule and Low Mode Rule are fulfilled. For good radio channels a tandem between 7,4 and 6,7 is worse than a 7,4 TFO connection. For poor radio channels a 5,9 TFO connection is considered to be robust enough.

12.8.5 Scenario: AMR codec type with only one supported mode

	SCS	ACS	CACS	OACS	CSCS	ACS	SCS
12,2	x			x	x	x	x
10,2	x	x					
7,95	x						
7,4	x						
6,7	x	x					
5,9	x	x					
5,15	x						
4,75	x	x					

One side offers an FR_AMR codec type with only the 12,2 mode in the supported codec set.

The OACS is not acceptable, TFO should not be established. A tandem connection would provide better overall speech quality. If the only supported mode is lower or equal to the 7,4 mode, TFO shall be established on this single mode. The 7,4 mode is considered to be robust enough in the case of poor radio channels. On the other hand, a tandem connection between 7,4 and 12,2 would be worse than a 7,4 TFO connection for good radio channels.

Annex E (normative):
TFO Decision Algorithm C-Code

E.1 Brief Description of the Program 'tfo_decision'

The program 'tfo_decision' implements the TFO decision algorithm for AMR-NB described in clauses 11 and 12. With the help of this program, the TFO decision algorithm can be run for different codec configurations in order to check and illustrate the TFO decision algorithm.

To perform the whole TFO decision algorithm it is needed to run the C-Code for all combinations of local and distant supported codec types. The output of the programm tells if TFO would be possible for a single combination and in which way. The ranking of the TFO candidates is not done by this C-Code. For that, it has to be checked the preference list in §11.6.2 (and for AMR-WB in some cases the OACS evaluation in §12.3.2.3).

The necessary files for compiling the program 'tfo_decision' are: tfo.cpp, tfo_decision.cpp, extensionsForAMRWB.cpp, tfo_decision.h, oacs.cpp, oacs.h, extensionsForAMRWB.h.

The files oacs.h, oacs.cpp, tfo_decision.h, tfo_decision.cpp, extensionsForAMRWB.cpp and extensionsForAMRWB.h serve as reference implementation of the TFO decision algorithm.

The C-Code is available in a separate file AMR_TFO_C-Code(version_number of 28.062).zip.

In case of inconsistencies between the TFO decision C-Code and clauses 11 and 12 the C-Code shall take precedence.

E.1.1 Input

The program tfo_decision reads from stdin. Each line is separated by spaces into 10 fields that contain the input data for a TFO decision. For example:

```
XXXXXXXX -X--XX-X 4 FR_AMR y --XXXXXX ---X-X-X 3 HR_AMR y
```

1. field:	LSCS	XXXXXXXX	all modes supported
2. field:	LACS	-X--XX-X	modes 10,2, 6,7, 5,9, 4,75
3. field:	LMACS	4	local MACS 4
4. field:	LUC	FR_AMR	local used codec type FR_AMR
5. field:	LOM	y	('y' or 'n') local optimization mode yes
6. field:	DSCS	--XXXXXX	modes 7,95, 7,4, 6,7, 5,9, 5,15, 4,75
7. field:	DACS	---X-X-X	modes 7,4, 6,7, 5,9, 4,75
8. field:	DMACS	3	distant MACS 3
9. field:	DUC	HR_AMR	distant used codec type HR_AMR
10. field:	DOM	y	('y' or 'n') distant optimization mode yes

The fields LSCS, LACS, DSCS, DACS must consist of 8 characters ‘x’ or 'X' or '-' ~~in case of AMR-NB codec types or of 9 characters for AMR-WB types.~~ They are indicating the 8 AMR-NB ~~or the 9 AMR-WB~~ modes. An ‘x’ or ‘X’ stands for ‘mode is present’.

The LMACS and DMACS field must be numbers. LUC and DUC may be FR_AMR, HR_AMR, UMTS_AMR, UMTS_AMR_2, GSM_EFR, GSM_FR, GSM_HR, OHR_AMR~~, FR_AMR-WB, UMTS_AMR-WB, OHR_AMR-WB, OFR_AMR-WB~~. The LOM and DOM fields must be 'y' or 'n'.

E.1.2 Output

The program tfo_decision prints directly to stdout. The output is self-explaining, e.g.:

~~E.1.2.1 Output for AMR-NB~~

```
    FR_AMR                          HR_AMR
   MACS = 4                        MACS = 3
   OM = yes                        OM = yes


      SCS     ACS     IACS    OACS    CSCS    ACS     SCS
12,2  X       -       -       -       -       -       -
10,2  X       X       -       -       -       -       -
7,95  X       -       -       X       X       -       X
7,40  X       -       -       -       X       X       X
6,70  X       X       -       X       X       -       X
5,90  X       X       X       -       X       X       X
5,15  X       -       -       -       X       -       X
4,75  X       X       X       X       X       X       X


Change ACS to OACS and establish TFO.
```

OACS: In this example the IACS consists of the modes 5,9 and 4,75. The OACS consists of three modes (7,95, 6,7, 4,75). The TFO Decision Algorithm states that the ACSs on both sides have to be changed to the OACS in order to establish TFO. Immediate TFO is not possible in this example.

~~E.1.2.2 Output for AMR-WB~~

~~UMTS_AMR_WB UMTS _AMR_WB~~
~~MACS = 4 MACS = 4~~
~~OM = yes OM = yes~~

	SCS	ACS	IACS	OACS	DefACS	CSCS	ACS	SCS
23.85	X	X	-	X	X	X	-	X
23.05	-	-	-	-	-	-	-	-
19.85	-	-	-	-	-	-	-	-
18.25	-	-	-	-	-	-	-	-
15.85	X	X	-	X	X	X	X	X
14.25	-	-	-	-	-	-	-	-
12.65	X	X	-	X	X	X	X	X

~~8.85 X X - X X X X X~~

~~6.60 X - - - - X X X~~

~~Change ACS to OACS and establish TFO on OACS.~~

~~OACS evaluation step 1 (*1000): 1000~~

~~OACS evaluation step 2 (*1000): 878.571~~

~~Preference value: 3~~

~~In this example the IACS is empty, because immediate TFO is not possible (reason: the contiguity rule). The TFO Decision Algorithm states that the ACSs on both sides would have to be changed to the OACS in order to establish TFO. The OACS is identical to the Default ACS : 23.85, 15.85, 12.65 and 8.80.~~
~~The values of the OACS evaluation steps and the preference value are given to allow a comparison with possibly present alternative AMR-WB TFO candidate configurations.~~

~~Remark: The reference C-Code is capable of handling all 9 modes of AMR-WB, not only those 5 (6,60, 8,85, 12,65m 15,85, 23,85) for speech telephony service. Reason is, that the C-Code was designed before the reduction of AMR-WB modes.~~

F.2.1 Avoidance of Codec Mode Optimisation

Guideline 2:

If the operator wants to avoid Codec Mode Optimisation after TFO establishment with AMR, then he shall set the "Optimisation Mode" to "No_Change".

Guideline 3:

The operator should configure AMR so that MACS = 4 and the ACS e.g. corresponds to the default sets (10,20, 6,70, 5,90, 4,75 for FR_AMR, UMTS_AMR, UMTS_AMR_2 and OHR_AMR and 7,40, 6,70, 5,90, 4,75 for HR_AMR). By this the chance for Inter-PLNM TFO is enhanced.
Other ACSs for FR_AMR, UMTS_AMR, UMTS_AMR_2, OHR_AMR and HR_AMR are possible. They should include as many as possible common Codec Modes in the lower, contiguous subsets. In that case Inter-PLNM TFO is not as obvious and may need inter-operator agreements.

NOTE: The default sets correspond to the ACSs determined by the TFO Decision algorithm, when all Codec Modes of the ACSs are included in the corresponding SCS.

Guideline 4:

The operator should configure AMR so that the ACSs are homogeneous within the whole PLMN (same ACS used in all BSS of a given PLMN for a given Codec Type: UMTS_AMR, UMTS_AMR_2, FR_AMR, OHR_AMR, HR_AMR). The ACSs of different Codec Types of the AMR Family should contain as many as possible Codec Modes within the common, lower, contiguous subset.

Guideline 5:

If the network is heterogeneous, the operator should choose ACSs so that all resulting Common ACSs are acceptable (see clause 12), with as many as possible Codec Modes within the common, lower, contiguous subset.

Guideline 6:

If for AMR-WB an optimisation shall be restricted to certain configurations, this can be acchieved by choosing a suitable configuration with OM=F(orbidden) in a combination with Maximum Rate Control.
Example: If configuration 4 and 5 shall not be possible, then configuration 2 shall be indicated. Then the effective ACS A and B (see Table 12.8-1) are possible, but not ACS C.