**Source:** TSG_SA WG4

**Title:** AMR-WB speech codec; interface to Iu and Uu (Release 4)

**Document for:** Approval

# Presentation of Specification to TSG-SA

| | |
|---|---|
| **Presentation to:** | **TSG SA Meeting #11** |
| **Document for presentation:** | **TS 26.202 Version 2.0.0** |
| **Presented for:** | **Approval** |

**Abstract of document:**

The present document specifies the mapping of the AMR wideband generic frame format (3GPP TS 26.201) to the Iu Interface (3GPP TS 25.415), the Uu Interface and the Nb Interface (3GPP TS 29.415). It further specifies the mapping of PCM 64 kBit/s (ITU-T G.711) coded speech to the Nb Interface.

**Changes since last presentation to TSG Meeting #10:**

Editorial changes and mapping to the Nb interface.

**Outstanding Issues:**

None.

**Contentious Issues:**

None.

# 3GPP TS 26.202 V2.0.0 (2001-03)

*Technical Specification*

# 3rd Generation Partnership Project;
# Technical Specification Group Services and System Aspects;
# AMR wideband speech codec; Interface to Iu, Uu and Nb
# (Release 4)

**GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS**

Keywords

AMR, CODEC, Adaptive Multi-Rate, Wideband
speech coder

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# Contents

# Foreword

This Technical Specification (TS) has been produced by the 3$^{rd}$ Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document specifies the mapping of the AMR wideband generic frame format (3GPP TS 26.201) to the Iu Interface (3GPP TS 25.415), the Uu Interface and the Nb Interface (3GPP TS 29.415). It further specifies the mapping of PCM 64 kBit/s (ITU-T G.711) coded speech to the Nb Interface.

# 2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies.

[1]          3GPP TS 25.415: "Iu Interface CN-UTRAN User plane Protocols".

[2]          3GPP TS 26.201: "AMR Wideband Speech Codec, Frame structure".

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

[5]          3GPP TS 28.062: " In-band Tandem Free Operation (TFO) of Speech Codecs, Stage 3".

[6]          3GPP TS 23.153: "Out of band transcoder control, Stage 2".

[6]          3GPP TS 29.415: "Core Network Nb Interface User Plane Protocols".

[7]          ITU-T  I.366.2: "AAL type 2 service specific convergence sublayer for trunking".

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document the following terms and definitions apply:

**AMR Wideband Generic Frame Interface**: this interface transports the AMR-WB IF1 generic frame as defined in 3GPP TS 26.201.

## 3.2 Abbreviations

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

| | |
|---|---|
| AAL2 | ATM Adaptation Layer 2 |
| ACS | Active Codec Set |
| AMR | Adaptive Multi-Rate |
| AS | Access Stratum |
| ATM | Asynchronous Transfer Mode |
| BFH | Bad Frame Handling |
| CMR/CMC | Codec Mode Request or Codec Mode Command |
| CMI | Codec Mode Indication |
| CN | Core Network |
| CDMA | Code Division Multiple Access |

| DRC | Downlink Rate Command |
| --- | --- |
| FDD | Frequency Duplex Division |
| FQC | Frame Quality Classification (Iu Interface) |
| FQI | Frame Quality Indication (AMR-WBIF1) |
| GSM | Global System for Mobile communications |
| ITU-T | International Telecommunication Union – Telecommunication standardisation sector (former CCITT) |
| MAC | Media Access Control |
| MGW | Media GateWay |
| PCM | Pulse Code Modulation, synonym for 64 kBit/s coded speech (see ITU-T G.711) |
| PLMN | Public Land Mobile Network |
| QoS | Quality of Service |
| RAN | Radio Access Network |
| RAB | Radio Access Bearer |
| RF | Radio Frequency |
| RFC | RAB sub-flow Combination |
| RFCI | RFC Indicator |
| RFCS | RFC Set |
| RX | Receive |
| SCR | Source Controlled Rate |
| SDU | Source Data Unit |
| SID | Silence Insertion Descriptor |
| SMpSDU | Support Mode for Predefined SDU sizes |
| SPD | SPeech Decoder |
| SPE | SPeech Encoder |
| TC | Transcoder |
| TDD | Time Duplex Division |
| TDMA | Time Division Multiple Access |
| TFO | Tandem Free Operation |
| TrFO | Transcoder Free Operation |
| TX | Transmit |
| UE | User Equipment (terminal) |
| URC | Uplink Rate Command |

# 4 General

The mapping of the AMR-WB Speech Codec parameters to the Iu interface specifies the frame structure of the speech data exchanged between the RNC and the TC in case of normal operation and Tandem Free Operation, respectively between RNC 1 and RNC 2 in case of Transcoder Free Operation. This mapping is independent from the radio interface in the sense that it has the same structure for both FDD and TDD modes of the UTRAN.

The mapping between the Speech Codec and the Radio Access Network within the UE is not an open interface and need not to be detailed.

The mapping on the Nb Interface is identical to the one on the Iu Interface in case of Transcoder Free Operation, with the MGW relaying the SDUs unaltered between Iu and Nb Interfaces.
In case of transcoding within the MGW the PCM coded speech is mapped onto the Nb Interface in packets of 40 octets.

# 5 RAB aspects

During the RAB Assignment procedure initiated by the CN to establish the RAB for AMR-WB, the RAB parameters are defined. The 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 AMR-WB frame type. On the Iu interface, these RAB parameters define the corresponding parameters regarding the transport of 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**

| 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 |
| Guaranteed bit rate | 23.85 / 23.05 / 19.85 / 18.25 / 15.85 / 14.25 / 12.65 / 8.85 / 6.6 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 |
| 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 1-9 | | | (note 4) |
| sub-flow SDU size 1-9 | (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.
NOTE 3: These parameters are subject to operator tuning.
NOTE 4: SDU format information has to be specified for each AMR-WBcore 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-WBcore 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 structure 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 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 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 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-WBdata.

  [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<br>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.
The RFCI definition is given in order of increasing SDU sizes.

- Example 1 describes Codec Type UMTS_AMR_WB, with all nine 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.

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

| UMTS_AMR_WB | RAB sub-flows | | Total size of bits/RAB sub-flows combination (Mandatory) | Source rate |
|---|---|---|---|---|
| RFCI Example 1 | 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 |
| | | | | |

# 6.3 Frame handlers

Iu PDU Frame handling functions are described in 3GPP TS 25.415. This sections describes the mandatory frame handling functions at the AMR-WB Generic frame interface. [Editor's note: 25.415 may need to be updated to cover AMR-WB]

## 6.3.1 Handling of frames from TC to Iu interface (downlink)

The frames from the TC in generic AMR-WB frame format IF1 are mapped onto the Iu PDU as follows.

### 6.3.1.1 Frame Quality Indicator

The Frame Quality Indicator (FQI) from the TC, respectively from the distant TFO partner, is directly mapped to the Frame Quality Classification (FQC) of the Iu frame according to Table 6-3.

**Table 6-3: FQI AMR-WBto FQC Iu PDU mapping**

| FQI AMR | FQI value (1 bit) | FQC PDU | FQC value (2 bit) |
|---------|-------------------|---------|-------------------|
| GOOD | 1 | GOOD | 00 |
| BAD | 0 | BAD | 01 |

### 6.3.1.2 Frame Type

The received Frame Type Index l is mapped onto the RFCI j thanks to the assigned RFCS table: the correspondence between Codec Mode, Frame Type Index l and RFCI j is defined at RAB assignment.

### 6.3.1.3 Codec Mode Indication

The Codec Mode Indication is not used.

### 6.3.1.4 Codec Mode Request

Codec Mode Request (CMR) in downlink direction is forwarded to the rate control procedure when it changes, or when it is commanded so by the TC in case of TFO, see 3G TS 28.062.

### 6.3.1.5 Optional internal 8 bits CRC

The internal AMR-WB codec CRC is not used on the Iu interface.

### 6.3.1.6 Mapping of Speech or Comfort Noise parameter bits

Let us define the N payload fields of the N sub-flows for RFCI j as follow :

$U_i(k)$   shall be the bits in sub-flow i, for  k =1 to Mi

$M_i$   shall be the size of sub-flow i, for i = 1 to N

d(k)   shall be the bits of the speech or comfort noise parameters of the corresponding Frame Type 1 in decreasing subjective importance, as defined in the generic AMR-WB frame format IF1, see TS 26.201.

Then the following mapping in pseudo code applies:

$U_1(k)$   $=$   $d(k-1)$   with k = 1,   … $M_1$

$U_2(k)$   $=$   $d(k-1 + M_1)$   with k = 1,   … $M_2$

$U_3(k)$   $=$   $d(k-1 + M_2)$   with k = 1,   … $M_3$

…

$U_N(k)$   $=$   $d(k-1 + M_{N-1})$   with k = 1   … $M_N$

## 6.3.2 Handling of frames from Iu interface to TC (uplink)

The uplink Iu frames are mapped onto generic AMR-WB frames, format IF1, as follows.

### 6.3.2.1 Frame Quality Indicator

At reception of Iu PDU the Iu frame handler function set the Frame Quality Classification according to the received FQC, Header-CRC check, and Payload-CRC check (see 25.415). AMR-WB Frame Type and Frame Quality Indicator are determined according to the following table:

**Table 6-4: FQC Iu PDU type 0 to AMR-WB FQI and AMR-WB Frame Type mapping**

| FQC | FQC value (2 bits) | Resulting FQI | FQI value (1 bit) | Resulting Frame Type |
|---|---|---|---|---|
| GOOD | 00 | GOOD | 1 | from RFCI |
| BAD | 01 | BAD | 0 | NO_DATA |
| BAD Radio | 10 | BAD | 0 | from RFCI |
| Reserved | 11 | BAD | 0 | Reserved |

### 6.3.2.2 Frame Type

The received RFCI j is mapped onto the Frame Type Index l thanks to the RFCS table.

### 6.3.2.3 Codec Mode Indication

The Codec Mode Indication is not used.

### 6.3.2.4 Codec Mode Request

The received Downlink Rate Control (DRC) command is mapped onto the Codec Mode Request (CMR) towards the AMR-WB Codec. In case a new DRC is received it is mapped into the corresponding CMR of the generic AMR-WB frame format. It is remembered by the TC until the next DRC is received. In each new frame that is sent to the AMR-WB Codec, the stored CMR is resent, in order to control the Codec Mode for the downlink direction.

### 6.3.2.5 Optional internal 8 bits CRC

The internal AMR-WB Codec CRC is not used on the Iu interface.

### 6.3.2.6 Speech and Comfort noise parameter bits

The speech and Comfort noise parameter bits are mapped from the sub-flows to the payload of the generic AMR-WB frames with the reverse function of subclause 6.3.1.6.

# 7 Uu Interface User Plane (UE)

The interface between the UE AMR-WB speech codec (see 3GPP TS 26.201) and the Radio Access Network is an internal UE interface and is not detailed. The mapping is corresponding to the mapping described in clause 6 for the Iu interface.

# 8 Nb Interface User Plane (CN)

The data structures exchanged on the Nb interface are symmetrical, i.e. the structures of the sent and received data frames are identical.

## 8.1 Frame structure on the Nb UP transport protocol

Delivery of erroneous SDUs for AMR-WB data and PCM coded speech on the Nb interface shall be set to: "YES".

Erroneous speech frames may be used to assist the error concealment procedures. Therefore, according to [1] and [6], PDU Type 0 (with payload CRC) shall be used for the transport of AMR-WB coded speech on the Nb interface. PDU Type 0 (with payload CRC) shall be used for the transport of PCM coded speech on the Nb interface, too.

### 8.1.1 Initialisation

The initialisation procedure is used for support mode. At the initialisation several parameters are set by the CN. The initialisation procedure for the Nb Interface is described in [6].

### 8.1.2 Time Alignment Procedure

The handling of Time Alignment on the Nb Interface is described in [6].

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

## 8.2 Mapping of the bits

### 8.2.1 Mapping for AMR-WB frames

The mapping of the bits between the generic AMR-WB frames and the PDU for the Nb Interface is identical to the mapping on the Iu Interface. In case of TrFO the MGW relays the AMR-WB frames from the Iu Interface unaltered to the Nb Interface and vice versa, as described in [6].

### 8.2.2 Mapping for PCM Coded Speech

In case of transcoding within the MGW from PCM coded speech to AMR-WB frames and vice versa the mapping for the PCM coded speech on the Nb Interface shall be as defined in Table 8-1.

**Table 8-1: Mapping of PCM Coded Speech onto Nb PDU, Type 0**

| PDU field | Comment |
|---|---|
| PDU Type | Type 0 (with Payload CRC) |
| Frame Number | as defined in [6] |
| FQC | set to "good" |
| RFCI | initialise by MGW, see [6], one value required |
| Header CRC | as defined in [6] |
| Payload CRC | as defined in [6] |
|  |  |
| Payload Field | 40 octets of PCM coded speech, in accordance with [7]. |

## 8.3 Frame handlers

Nb PDU Frame handling functions are described in [6].

# Annex A (informative):
# Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | TSG # | TSG Doc. | CR | Rev | Subject/Comment | Old | New |
| | | | | | | | |
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