Annex A (normative): RTP Payload Format and SDP Parameters

A.0 General

This Annex describes a generic RTP payload format and SDP parameters for the EVS codec. The EVS RTP payload format consists of the RTP header, the EVS payload header, and the EVS payload data.

The byte order used in this specification is the network byte order, i.e., the most significant byte is transmitted first. The bit order is most significant bit first. This practice is presented in all figures as having the most significant bit located left-most on each line and indicated with the lowest number.

A.1 RTP Header Usage

The format of the RTP header is specified in RFC 3550 [30]. This EVS RTP payload format uses the fields of the RTP header in a manner consistent with the usages in RFC 3550 [30].

The timestamp clock frequency for the EVS codec is 16 kHz, regardless of the audio bandwidth. The duration of one speech frame-block is 20 ms for both EVS Primary and EVS AMR-WB IO modes. Thus, the timestamp is increased by 320 for each consecutive frame-block.

The RTP header marker bit (M) shall be set to 1, if the first frame-block carried in the RTP packet contains a speech frame, which is the first in a talkspurt. For all other RTP packets the marker bit shall be set to zero (M=0).

A.2 EVS RTP Payload Format

The EVS RTP Payload Format includes a Compact format and a Header-Full format, which are used depending on the required functionalities within a session and whether only a single frame is transmitted. These two formats can be switched during a session by the media sender, if the EVS RTP Payload Format is not restricted to use only the Header-Full format, as described in Annex A.3 and TS 26.114 [13].

In addition to the EVS RTP Payload Format, RFC 4867 [15] format shall also be supported for the EVS AMR-WB IO modes to provide the backward interoperability with legacy AMR-WB terminals.

The media sender is the entity encoding the audio signal frames and sending the RTP packets including the encoded frames. The media receiver is the entity receiving the RTP packets and decoding the audio signal frames from the encoded frames.

The media receiver may send Codec Mode Requests (CMRs) in the Compact format (in the 3-bit CMR) or in the Header-Full format (in the CMR byte) to the media sender for adapting the bit rate, the audio bandwidth or the operational mode (EVS primary or EVS AMR-WB IO).

A.2.1 EVS codec Compact Format

In the Compact format, the RTP payload consists of exactly one coded frame for the EVS Primary mode, and one coded frame and one 3-bit CMR field for the EVS AMR-WB IO mode. The Compact format uses protected payload sizes that uniquely identify EVS codec modes (EVS Primary or EVS AMR-WB IO mode) and bit-rates. The protected payload sizes are used for determining the bit-rate of a received coded frame at the receiver.

Table A.1 shows the protected payload sizes and the corresponding bit-rates to be used for Compact RTP payload format.

Table A.1: Protected payload sizes

Mode	Payload Size (bits)	Bitrate (kbps)
EVS Primary	48	2.4 (EVS Primary SID)
Special case (see clause A.2.1.3)	56	2.8
EVS AMR-WB IO	136	6.6
EVS Primary	144	7.2
EVS Primary	160	8
EVS AMR-WB IO	184	8.85
EVS Primary	192	9.6
EVS AMR-WB IO	256	12.65
EVS Primary	264	13.2
EVS AMR-WB IO	288	14.25
EVS AMR-WB IO	320	15.85
EVS Primary	328	16.4
EVS AMR-WB IO	368	18.25
EVS AMR-WB IO	400	19.85
EVS AMR-WB IO	464	23.05
EVS AMR-WB IO	480	23.85
EVS Primary	488	24.4
EVS Primary	640	32
EVS Primary	960	48
EVS Primary	1280	64
EVS Primary	1920	96
EVS Primary	2560	128

A.2.1.1 Compact format for EVS Primary mode

In the Compact format for EVS Primary mode, the RTP payload consists of exactly one coded frame. Hence, the coded frame follows the RTP header without any additional EVS RTP payload header.

The payload represents a speech frame of 20 ms encoded with the EVS codec bit-rate identified by the payload size. The bits are in the same order as produced by the EVS encoder, where the first bit is placed left-most immediately following the RTP header.

A.2.1.2 Compact format for EVS AMR-WB IO mode (except SID)

In the Compact format for EVS AMR-WB IO mode, except SID, the RTP payload consists of one 3-bit CMR field, one coded frame, and zero-padding bits if necessary.

A.2.1.2.1 Representation of Codec Mode Request (CMR) in Compact format for EVS AMR-WB IO mode

The 3-bit CMR field carries the codec mode request information to signal to the media sender the requested AMR-WB [37] or EVS AMR-WB IO codec mode to be applied for encoding. The signalling of AMR-WB and EVS AMR-WB IO with the 3-bit CMR field is defined as shown in Table A.2. The 3-bit CMR field in Compact format for EVS AMR-WB IO mode comprises a 3-bit element [c(0), c(1), c(2)] for signalling codec mode requests for the following EVS AMR-WB IO or AMR-WB codec modes.

Table A.2: 3-bit signalling element and EVS AMR-WB IO/AMR-WB CMR

C(0)	C(1)	C(2)	Requested Mode
0	0	0	6.6
0	0	1	8.85
0	1	0	12.65
0	1	1	15.85
1	0	0	18.25
1	0	1	23.05
1	1	0	23.85
1	1	1	none

Due to the 3-bit limitation, there is not enough signalling space for all EVS AMR-WB IO codec modes. Consequently, CMRs in Compact format for EVS AMR-WB IO are limited to include the most frequently used set of EVS AMR-WB IO /AMR-WB modes as shown in Table A.2. CMRs for EVS AMR-WB IO / AMR-WB modes 14.25 and 19.85 are not supported in Compact format for EVS AMR-WB IO. In case a request needs to be transmitted for either mode, it should be re-mapped to the next lower mode (12.65 and 18.25, respectively). Alternatively, the CMR byte in the Header-Full format may be used to transmit CMRs to 14.25 and 19.85 modes.In case of restrictions in the allowed codec modes by the mode-set MIME parameter, the 3-bit CMR for a not supported mode may be re-mapped to the next lower mode in this mode-set.

Codec mode requests for EVS primary modes shall be made using the CMR byte in the Header-Full format.

The codec mode request indicated in the 3-bit-CMR shall comply with the media type parameters (the allowed bit-rates for EVS AMR-WB IO or AMR-WB) that are negotiated for the session. When a 3-bit-CMR is received, requesting a bit-rate that does not comply with the negotiated media parameters, it shall be ignored.

A 3-bit CMR indicates the highest EVS AMR-WB IO codec mode that the media receiver (CMR sender) wants to receive. When receiving a 3-bit CMR (except value "none") the media sender shall use the EVS AMR-WB IO operation mode. The media sender should use the EVS AMR-WB IO codec mode (bit rate) requested in the received 3-bit CMR and shall not use a higher codec mode (higher bit rate). The media sender may use a lower EVS AMR-WB IO codec mode within the negotiated mode-set.

CMR code-point "none" is specified as equivalent to no CMR-value being sent. The receiver of "none" shall ignore it.

NOTE: The meaning of "none" and "NO_REQ" (see A.2.2.1.1 below) for EVS is not equivalent to code-point "CMR=15" for AMR and AMR-WB, as specified according to TS 26.114 and RFC 4867 with its errata. MGWs in the path, repacking between the RTP format according to RFC 4867 and the RTP format according to the present document, translate between these code-points.

A.2.1.2.2 Payload structure of Compact EVS AMR-WB IO mode frame

In order to minimize the need for bit re-shuffling in media gateways in case of payload format conversion to or from AMR-WB bandwidth-efficient format according to [15], the speech data bits are inserted after CMR, starting with bit d(1). Speech data bit d(0) is appended after the last speech data bit.

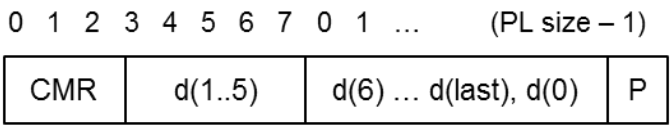


Figure A.1. Payload structure of Compact EVS AMR-WB IO.

The speech data payload represents a speech frame of 20 ms encoded with EVS AMR-WB IO bit-rate (mode) identified by the payload size. The order and numbering notation of the bits are as specified for Interface Format 1 (IF1) in Annex B of [36] for AMR-WB. The bits of the speech frames are arranged in the order of decreasing sensitivity, giving a re-ordered bit sequence {$d(0),d(1),...,d(K-1)$}.

If a total of three CMR bits and coded frame bits is not a multiple of 8, zero-padding bits are added so that the total becomes a multiple of 8. One zero-padding bit is required for EVS AMR-WB IO mode 6.6 and four zero-padding bits are required for EVS AMR-WB IO mode 8.85. In other mode no padding bits are inserted. With the exception of SID frames, the EVS AMR-WB IO Compact payload follows the RTP header without any additional EVS RTP payload header.

Note that no Compact frame format EVS AMR-WB IO SID frames is defined. For such frames the Header-Full format with CMR byte shall be used (see clause A.2.1.3).

NOTE: The Q bit defined in RFC 4867 [15] is not present in the Compact payload structure of EVS AMR-WB IO. Therefore it shall be ensured that the speech payload is not damaged. In case of a conversion of RFC 4867 formatted packets to Compact payload format, damaged frames (indicated by the Q bit) shall be discarded and not converted.

A.2.1.3 Special case for 56 bit payload size (EVS Primary or EVS AMR-WB IO SID)

The Compact format for EVS Primary 2.8 kbps frames (56 bits) has the same payload size (56 bits) as the Header-Full format for EVS AMR-WB IO SID frames with CMR byte.
Hence, two types of frames can be carried in the 56 bit payload case:

- EVS Primary 2.8 kbps frame in Compact format.
- EVS AMR-WB IO SID frame in Header-Full format (see clause A.2.2) with one CMR byte.
- The payload structure and bit ordering of EVS Primary 2.8 kbps frame in Compact format is defined in Figure A.2.

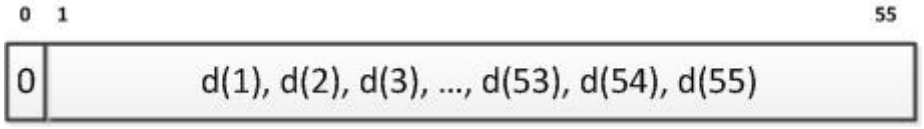


Figure A.2. Payload structure for EVS Primary 2.8 kbps (56-bit) payload

The resulting ambiguity between EVS Primary 2.8 kbps and EVS AMR-WB IO SID frames is resolved through the most significant bit (MSB) of the first byte of the payload. By definition, the first data bit d(0) of the EVS Primary 2.8 kbps is always set to '0'. Therefore, if the MSB of the first byte of the payload is set to '0' (see Figure A.2), then the payload is an EVS Primary 2.8 kbps frame in Compact format. Otherwise it is an EVS AMR-WB IO SID frame in Header-Full format with one CMR byte. The structure of EVS AMR-WB IO SID frame with Header-Full format is described in clause A.2.2.

A.2.2 EVS codec Header-Full format

In the Header-Full format, the payload consists of one or more coded frame(s) with EVS RTP payload header(s). There are two types of EVS RTP payload header: Table of Content (ToC) byte and Codec Mode Request (CMR) byte. The detailed header structure is described in clause A.2.2.1.

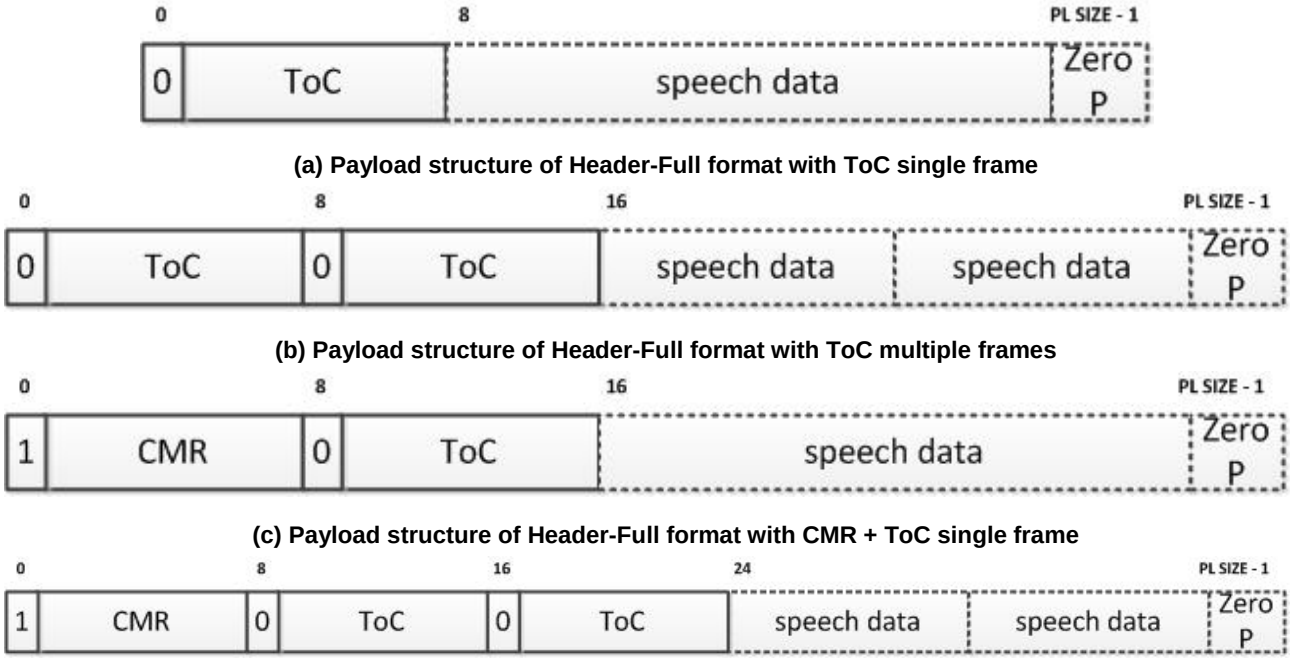
A.2.2.1 EVS RTP payload structure

The complete payload of Header-Full EVS frames comprises an optional CMR byte, followed by one or several ToC bytes, followed by speech data bits and possible zero-padding bits. Padding bits shall be discarded by the receiver. The purpose of padding is two-fold:

- In the case of EVS AMR-WB IO frames, payload data may need to be octet-aligned using zero-padding bits at the end of the payload. Note that EVS Primary frames are by definition octet-aligned (see clause A.2.2.1.4.1).
- When required, zero-padding bits are also used to increase the total payload size by byte increments such that conflicts with any of the protected sizes reserved for the Compact format are avoided (see clause A.2.2.1.4.2).

CMR and ToC bytes use MSB as Header Type identification bit (H) in order to identify the type of EVS RTP payload header. If the H bit is set to 0, the corresponding byte is a ToC byte, and if set to 1, the corresponding byte is a CMR byte. A CMR byte, if present, shall be located before ToC byte(s).

Figure A.3 shows the general structure of Header-Full payload format.



(a) Payload structure of Header-Full format with ToC single frame

(b) Payload structure of Header-Full format with ToC multiple frames

(c) Payload structure of Header-Full format with CMR + ToC single frame

(d) Payload structure of Header-Full format with CMR + ToC multiple frames

Figure A.3 Payload structure of Header-Full format

NOTE: The zero padding at the end of packet, indicated in Figure A.3 as “Zero P”, does not represent the octet-alignment for AMR-WB IO data described in clause A.2.2.1.4.1, but it represents the zero-padding for size collision avoidance described in clause A.2.2.1.4.2.

A.2.2.1.1 CMR byte

The Codec Mode Request (CMR) byte structure is shown in Figure A.4. This CMR byte shall be present for EVS AMR-WB IO speech and SID frames in Header-Full format. For EVS Primary mode, the CMR byte is only used when a CMR needs to be transmitted or if required by session negotiation. The request indicated in the CMR byte shall comply with the media type parameters (e.g. allowed bit-rates or audio bandwidths) that are negotiated in the session.

NOTE 1: There is no SDP MIME signalling parameter defined that can be used to disallow all CMRs with T-bits "001". However, the mode-set MIME parameter can be used to restrain the allowed EVS AMR-WB IO codec modes. If this mode-set parameter is not included in the media type parameters, then all 9 modes of the EVS AMR-WB IO codes modes are allowed.

The media receiver in the MTSI terminal shall be prepared to receive any speech frames within the negotiated media type parameter set as well as SID frames, irrespective of the CMR it sends or receives.

NOTE 2: The media receiver can receive such frames for various reasons. For instance, after a handover to AMR-WB, a MGW can send speech frames with an EVS AMR-WB IO codec mode even if it receives CMR byte of EVS Primary mode (T-bits not "001").

The bit-rate in the CMR byte of EVS Primary mode (T-bits not "001") indicates the highest bit-rate that the media receiver (CMR sender) wants to receive. The media sender should use the bit-rate requested in the received CMR and shall not use a higher bit-rate. The media sender may use a lower bit-rate than the requested bit-rate within the set of negotiated bit-rates.

If a single audio bandwidth is negotiated for EVS Primary mode, the CMR shall indicate this bandwidth in its T-bits, unless the mode of operation is switched by a received CMR from EVS Primary to EVS AMR-WB IO or is kept in EVS AMR-WB IO operation mode.

If a range of audio bandwidths is negotiated for EVS Primary mode, then the audio bandwidth in the CMR byte of EVS Primary mode indicates the highest audio bandwidth that the media receiver wants to receive. The media sender should use the audio bandwidth requested in the received CMR.

A CMR with T-bits "001" (i.e. a CMR for the EVS AMR-WB IO mode of operation) indicates the highest EVS AMR-WB IO codec mode that the media receiver wants to receive. When receiving a CMR with T-bits "001", the media sender shall use the EVS AMR-WB IO mode of operation. The media sender should use the EVS AMR-WB IO codec mode (bit rate) requested in the received CMR and shall not use a higher codec mode (higher bit rate). The media sender may use a lower EVS AMR-WB IO codec mode within the negotiated mode-set.

When a CMR is received, requesting a bit-rate and/or audio bandwidth that does not comply with the negotiated media parameters, it shall be ignored.

The request in the received CMR is valid until a new request is received.

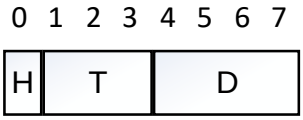


Figure A.4. CMR byte

H (1 bit): Header Type identification bit. For the CMR byte this bit is always set to 1.

T (3 bits): These bits indicate the Type of Request in order to distinguish EVS AMR-WB IO and EVS Primary bandwidths.

D (4 bits): These bits indicate the requested bit rate (in cases the T-bits are "000", "001", "010", "011" and "100") or the EVS Channel Aware offset and level (in cases the T-bits are "101" and "110") of the codec mode request.

The possible values of the CMR byte and corresponding CMRs are defined in Table A.3.

Table A.3: Structure of the CMR byte

Code		Definition		Code		Definition	
T	D			T	D		
000	0000	NB	5.9 (VBR)	010	0000	WB	5.9 (VBR)
	0001	NB	7.2		0001	WB	7.2
	0010	NB	8.0		0010	WB	8
	0011	NB	9.6		0011	WB	9.6
	0100	NB	13.2		0100	WB	13.2
	0101	NB	16.4		0101	WB	16.4
	0110	NB	24.4		0110	WB	24.4
	0111		Not used		0111	WB	32
	1000		Not used		1000	WB	48
	1001		Not used		1001	WB	64
	1010		Not used		1010	WB	96
	1011		Not used		1011	WB	128
	1100		Not used		1100		Not used
	1101		Not used		1101		Not used
	1110		Not used		1110		Not used
	1111		Not used		1111		Not used
001	0000	IO	6.6	011	0000		Not used
	0001	IO	8.85		0001		Not used
	0010	IO	12.65		0010		Not used
	0011	IO	14.25		0011	SWB	9.6
	0100	IO	15.85		0100	SWB	13.2
	0101	IO	18.25		0101	SWB	16.4
	0110	IO	19.85		0110	SWB	24.4
	0111	IO	23.05		0111	SWB	32
	1000	IO	23.85		1000	SWB	48
	1001		Not used		1001	SWB	64
	1010		Not used		1010	SWB	96
	1011		Not used		1011	SWB	128
	1100		Not used		1100		Not used
	1101		Not used		1101		Not used
	1110		Not used		1110		Not used
	1111		Not used		1111		Not used

Table A.3: Structure of the CMR byte (continued)

Code		Definition		Code		Definition	
T	D			T	D		
100	0000		Not used	110	0000	SWB	13.2 CA-L-O2
	0001		Not used		0001	SWB	13.2 CA-L-O3
	0010		Not used		0010	SWB	13.2 CA-L-O5
	0011		Not used		0011	SWB	13.2 CA-L-O7
	0100		Not used		0100	SWB	13.2 CA-H-O2
	0101	FB	16.4		0101	SWB	13.2 CA-H-O3
	0110	FB	24.4		0110	SWB	13.2 CA-H-O5
	0111	FB	32		0111	SWB	13.2 CA-H-O7
	1000	FB	48		1000		Not used
	1001	FB	64		1001		Not used
	1010	FB	96		1010		Not used
	1011	FB	128		1011		Not used
	1100		Not used		1100		Not used
	1101		Not used		1101		Not used
	1110		Not used		1110		Not used
	1111		Not used		1111		Not used
101	0000	WB	13.2 CA-L-O2	111	0000	Reserved	
	0001	WB	13.2 CA-L-O3		0001	Reserved	
	0010	WB	13.2 CA-L-O5		0010	Reserved	
	0011	WB	13.2 CA-L-O7		0011	Reserved	
	0100	WB	13.2 CA-H-O2		0100	Reserved	
	0101	WB	13.2 CA-H-O3		0101	Reserved	
	0110	WB	13.2 CA-H-O5		0110	Reserved	
	0111	WB	13.2 CA-H-O7		0111	Reserved	
	1000		Not used		1000	Reserved	
	1001		Not used		1001	Reserved	
	1010		Not used		1010	Reserved	
	1011		Not used		1011	Reserved	
	1100		Not used		1100	Reserved	
	1101		Not used		1101	Reserved	
	1110		Not used		1110	Reserved	
	1111		Not used		1111	NO_REQ	

CMR code-point "NO_REQ" is specified as equivalent to no CMR-value being sent. The receiver of "NO_REQ" shall ignore it.

NOTE: The meaning of "NO_REQ" and "none" (see A.2.1.2.1 above) for EVS is not equivalent to code-point "CMR=15" for AMR and AMR-WB, as specified according to TS 26.114 and RFC 4867 with its errata. MGWs in the path, repacking between the RTP format according to RFC 4867 and the RTP format according to the present document, translate between these code-points.

A.2.2.1.2 ToC byte

The Table of Content (ToC) byte structure is shown in Figure A.5.

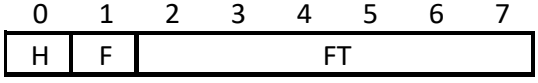


Figure A.5. ToC byte

H (1 bit): Header Type identification bit. For the ToC byte this bit is always set to 0.

F (1 bit): If set to 1, the bit indicates that the corresponding frame is followed by another speech frame in this payload, implying that another ToC byte follows this entry. If set to 0, the bit indicates that this frame is the last frame in this payload and no further header entry follows this entry.

FT (6 bits): Frame type index. These bits indicate whether the EVS Primary or EVS AMR-WB IO mode, or comfort noise (SID) mode of the corresponding frame is carried in this payload. FT is further divided into 3 fields: EVS mode (1 bit), Unused/Q bit (1 bit) depending on the value of EVS mode bit, and EVS bit-rate (4 bits). The value of FT is defined in Tables A.4 and A.5.

Table A.4: Frame Type index when EVS mode bit = 0

EVS mode bit (1 bit)	Unused (1 bit)	EVS bit rate	Indicated EVS mode and bit rate
0	0	0000	Primary 2.8 kbps
0	0	0001	Primary 7.2 kbps
0	0	0010	Primary 8.0 kbps
0	0	0011	Primary 9.6 kbps
0	0	0100	Primary 13.2 kbps
0	0	0101	Primary 16.4 kbps
0	0	0110	Primary 24.4 kbps
0	0	0111	Primary 32.0 kbps
0	0	1000	Primary 48.0 kbps
0	0	1001	Primary 64.0 kbps
0	0	1010	Primary 96.0 kbps
0	0	1011	Primary 128.0 kbps
0	0	1100	Primary 2.4kbps SID
0	0	1101	For future use
0	0	1110	SPEECH_LOST
0	0	1111	NO_DATA

Table A.5: Frame Type index when EVS mode bit = 1

EVS mode bit (1 bit)	AMR-WB Q bit (1 bit)	EVS bit rate (4 bits)	Indicated EVS mode and codec mode
1	Q	0000	AMR-WB IO 6.6 kbps
1	Q	0001	AMR-WB IO 8.85 kbps
1	Q	0010	AMR-WB IO 12.65 kbps
1	Q	0011	AMR-WB IO 14.25 kbps
1	Q	0100	AMR-WB IO 15.85 kbps
1	Q	0101	AMR-WB IO 18.25 kbps
1	Q	0110	AMR-WB IO 19.85 kbps
1	Q	0111	AMR-WB IO 23.05 kbps
1	Q	1000	AMR-WB IO 23.85 kbps
1	Q	1001	AMR-WB IO 2.0 kbps SID
1	Q	1010	For future use
1	Q	1011	For future use
1	Q	1100	For future use
1	Q	1101	For future use
1	Q	1110	SPEECH_LOST
1	Q	1111	NO_DATA

NOTE: The 4-bit EVS bit-rate index and the mapping to EVS AMR-WB IO codec mode in Table A.4 are the same as used for the Frame Type of AMR-WB. See Table 1a [36]. The Q bit for EVS AMR-WB IO has the same definition as in [15]. If Q bit is set to 0, this indicates that the corresponding frame is severely damaged. The receiver should handle such a severly damaged frame properly by applying bad frame processing according to [6].

Packets containing only NO_DATA frames should not be transmitted in any payload format configuration, except for situations, when CMR needs to be sent immediately. Frame-blocks containing only NO_DATA frames at the end of the packet should not be transmitted in any payload format configuration. In addition, frame blocks containing only NO_DATA frames in the beginning of the packet should not be included in the payload.

For sessions with multiple mono-channels, see clause A.2.5.

A.2.2.1.3 Speech Data

In Header-Full format, the RTP payload comprises, apart from headers and possible padding, one or several coded frames, the Speech Data.

In case the frame is coded EVS Primary mode data, the bits are in the same order as produced by the EVS encoder, where the first bit is placed left-most immediately following the EVS RTP payload header (CMR byte if present, and ToC bytes).

In case the frame is coded EVS AMR-WB IO mode data, the Speech Data field is constructed as described in RFC 4867 [15] for octet-aligned Mode, sub-clause 4.4.3. In accordance with this, in case multiple frames are included in the payload, the last octet of each frame shall be padded with zero bits at the end if some bits in the octet are not used. The padding bits shall be ignored on reception.

In case the frame is coded EVS AMR-WB IO SID data, the payload structure and bit-ordering are defined in Figure A.6. The bits *d*(0) to *d*(39) are as defined in TS 26.201 [36], sub-clause 4.2.3.

Figure A.6. Payload structure for EVS AMR-WB IO SID (56 bit) payload

The EVS AMR-WB IO SID frame payload is identified by MSB of the first byte of the payload set to '1'.

A.2.2.1.4 Zero padding

A.2.2.1.4.1 Zero padding for octet alignment of speech data (EVS AMR-WB IO)

In EVS AMR-WB IO mode, the payload length is always made an integral number of octets by padding with zero bits if necessary (see clause A.2.2.1.3).

Note that, by definition, EVS Primary speech data is octet-aligned.

A.2.2.1.4.2 Zero padding for size collision avoidance

When "hf-only=0" or "hf-only" is not present, the RTP payload formatting function of the sender shall control the size of Header-Full RTP payload so that the Header-Full format RTP payload size does not collide with any of the protected Compact format RTP payload sizes listed in Table A.1, except for the special case of the 56-bit payload. If a Header-Full format RTP payload size collides with one of the protected Compact format RTP payload sizes, the RTP payload formatting function of the sender shall append an appropriate number of zero-padding bytes to the end of the payload such that payload sizes do not collide.

The Header-Full format representing an EVS AMR-WB IO SID frame (with one CMR byte and one ToC byte) is allowed to have the same 56 bits as EVS Primary 2.8 kbps in Compact format. In this special case, no padding bits shall be appended to the EVS AMR-WB IO SID frame.

A.2.2.1.4.3 Additional zero padding

If additional padding is required to bring the payload length to a larger multiple of octets or for some other purposes, then the P bit in the RTP header may be set and padding bits are appended as specified in [30].

A.2.3 Header-Full/Compact format handling

There are two format handling modes: Default mode and Header-Full-only mode.

A.2.3.1 Default format handling

When “hf-only=0” is present or when the “hf-only” attribute is not present, the Compact format shall be used in the following cases:

- A single mono EVS Primary mode frame is carried in an RTP packet without sending CMR.
- A single mono EVS AMR-WB IO mode frame with 3-bit CMR is carried in an RTP packet.

Otherwise, the Header-Full format with size collision avoidance shall be used.

The only exception in this default format handling is as follows: the Header-Full format may be used to transmit a single EVS AMR-WB IO frame to request 14.25 or 19.85 kbps in EVS AMR-WB IO mode as these two bit-rates cannot be indicated with the 3-bit CMR defined for Compact format.

A.2.3.2 Header-Full-only format handling

When “hf-only=1” is present, only the Header-Full format shall be used during the session. In other words, the Compact format shall not be used. The size collision avoidance shall not be performed by the RTP payload formatting function of the sender. The RTP payload decoding function of the receiver shall use ToC byte(s) to obtain the mode (i.e., EVS Primary or EVS AMR-WB IO) and the bit-rate regardless of the RTP payload size.

A.2.4 AMR-WB backward compatible EVS AMR-WB IO mode format

In order to provide backward interoperability with AMR-WB, the payload format in [15] shall also be supported for EVS AMR-WB IO mode. This payload format shall be used to communicate with a terminal not supporting EVS but supporting AMR-WB.

A.2.5 Sessions with multiple mono channels

The Header-Full EVS payload format supports transmission of multiple mono channels in the same way as described in the AMR-WB payload format [15].

A.2.5.1 Encoding of multiple mono channels

The speech encoders for different channels are not synchronized, which means that they may use different codec modes and may result in different VAD decisions depending on the content in each channel.

A.2.5.2 RTP header usage

The RTP time stamp is derived from the media time of the first frame of the first channel in the packet, even if that frame is a NO_DATA frame.

If a frame in the packet is an onset frame, then the Marker bit in the RTP header is set to ‘1’. However, since the encoders are not synchronized, they may use different VAD decisions for different channels. Hence, it is not sufficient to only use the Marker bit to detect onset frames, and to for example reset the jitter buffers in the receiver. The receiver needs to monitor the content of the channels, e.g., the Frame Type identifier, to find the transition from DTX to active speech for each individual channel.

A.2.5.3 Construction of the RTP payload

The ToC bytes of all frames from a frame-block are placed in consecutive order as defined in Section 4.1 [38]. Therefore, with N channels and K speech frame-blocks in a packet, there shall be N*K ToC bytes in the EVS RTP payload header, and the first N ToC bytes will be from the first frame-block, the second N ToC bytes will be from the second frame-block, and so on.

The payload shall include frames from all channels for each media time that is included. If a frame is not available for a channel, e.g., when the encoder for that channel is currently in DTX mode, then a NO_DATA frame shall be included instead. Since the payload always contains two or more frames, the Header-Full payload format shall be used.

The payload may contain a CMR byte according to the same rules as defined for single-channel session. When a CMR is received, it is applied equally to all channels. It may still happen that different channels are encoded in different modes, especially if independent encoders are used.

A.2.6 Storage Format

The storage format is used for storing EVS Primary or EVS AMR-WB IO speech frames in a file or as an email attachment. Multiple channel content is supported.

For EVS AMR-WB IO, the storage format of [15] can be used.

For EVS, the storage format has the following structure:

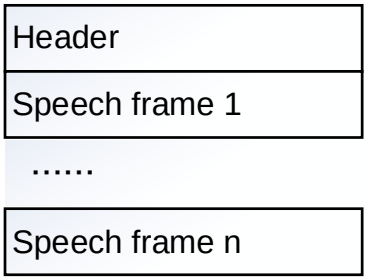


Figure A.7. Storage format for EVS

There is another storage format that is suitable for applications with more advanced demands on the storage format, like random access or synchronization with video. This format is the 3GPP-specified ISO-based multimedia file format specified in [40]. Its media type is specified in [41].

A.2.6.1 Header

The header consists of a magic number followed by a 32-bit channel description field, giving the header the following structure:

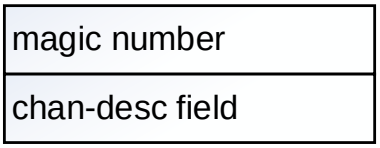


Figure A.8. Header for EVS

The magic number shall consist of the ASCII character string:

"#!EVS_MC1.0\n" or (0x23214556535f4d43312e30)

The version number in the magic number string refers to the version of the file format.

The 32-bit channel description field is defined as a 32-bit number (unsigned integer, MSB first). This number indicates the number of audio channels contained in this storage file starting from 1 for mono to N for a multi-mono signal with N channels.

A.2.6.2 Speech Frames

After the header, speech frame-blocks consecutive in time are stored in the file. Each frame-block contains a number of octet-aligned speech frames equal to the number of channels stored in the increasing order, starting with channel 1. Each stored speech frame starts with a ToC byte (see clause A.2.2.1.2). Note that no CMR byte is needed.

Non-received speech frames or frame-blocks between SID frames during non-speech periods shall be stored as NO_DATA frames. Frames or frame-blocks lost during transmission shall be stored as SPEECH_LOST frames in complete frame-blocks to keep synchronization with the original media.

A.3 Payload Format Parameters

A.3.1 EVS Media Type Registration

The media type for the EVS codec is to be allocated from the standards tree. This clause defines parameters of the EVS payload format. This media type registration covers real-time transfer via RTP and non-real-time transfers via stored files. All media type parameters defined in this Annex shall be supported. The receiver must ignore any unspecified parameter.

Media type name: audio

Media subtype name: EVS

Required parameters: none

Optional parameters:

The parameters defined below apply to RTP transfer only.

The following parameters are applicable to both EVS Primary mode and EVS AMR-WB IO mode:

ptime: see RFC 4566 [27].

maxptime: see RFC 4566 [27].

evs-mode-switch: Permissible values are 0 and 1. If evs-mode-switch is 0 or not present, EVS primary mode is used at the start or update of the session for the send and the receive directions. If evs-mode-switch is 1, EVS AMR-WB IO mode is used at the start or update of the session for the send and the receive directions.

hf-only: Permissible values are 0 and 1. If hf-only is 0 or not present, both Compact and Header-Full formats can be used in the session for the send and the receive directions. If hf-only is 1, only Header-Full format without zero padding for size collision avoidance is used.

NOTE 1: The hf-only parameter applies to both directions in the session, including when hf-only is 1.

dtx: Permissible values are 0 and 1. If dtx is 0, DTX is disabled in the session for the send and the receive directions. If dtx is 1 or not present, DTX is enabled. If dtx is included, dtx-recv is redundant but if dtx-recv is included, it shall be identical to dtx.

NOTE 2: If dtx is not present, DTX can still be disabled by the inclusion of dtx-recv=0 for the direction indicated by dtx-recv. See also clause A.3.3.1 and clause A.3.3.3.

dtx-recv: Permissible values are 0 and 1. If dtx-recv=0 is included for a payload type in the received SDP offer or the received SDP answer, and the payload type is accepted, the receiver shall disable DTX for the send direction. If dtx-recv=1 is included for a payload type in the received SDP offer or the received SDP answer, and this payload type is accepted, or if dtx-recv is not present for an accepted payload type, DTX is enabled.

NOTE 3: dtx-recv only applies for the media direction towards the SDP sender. If dtx-recv is not present, dtx determines if DTX is enabled or disabled. See also clause A.3.3.1 and clause A.3.3.3.

max-red: See RFC 4867 [15].

channels: The number of audio channels. See RFC 3551 [38]. If channels is not present, its default value is 1. If both ch-send and ch-recv are included in the SDP with different numbers of channels for sending and receiving directions, channels is set to the larger of the two parameters.

cmr: Permissible values are -1, 0, and 1. If cmr is -1 and the session is in the EVS primary mode, CMR on the RTP payload header is disabled in the session. If cmr is -1 and the session is in the EVS AMR-WB IO mode, CMR in the CMR byte is restricted to the values of EVS AMR-WB IO bit-rates and NO_REQ as specified in Table A.3. If cmr is 0 or not present, the values of CMR specified in Table A.3 are enabled. If cmr is 1, CMR shall be present in each packet. CMR shall be compliant with the negotiated bit-rate and bandwidth media type attributes for EVS primary and EVS AMR-WB IO modes.

The following parameters are applicable only to EVS Primary mode:

br: Specifies the range of source codec bit-rate for EVS Primary mode (see Table 1 [2]) in the session, in kilobits per second, for the send and the receive directions. The parameter can either have: a single bit-rate (br1); or a hyphen-separated pair of two bit-rates (br1-br2). If a single value is included, this bit-rate, br1, is used. If a hyphen-separated pair of two bit-rates is included, br1 and br2 are used as the minimum bit-rate and the maximum bit-rate respectively. br1 shall be smaller than br2. br1 and br2 have a value from the set: 5.9, 7.2, 8, 9.6, 13.2, 16.4, 24.4, 32, 48, 64, 96, and 128. 5.9 represents the average bit-rate of source controlled variable bit rate (SC-VBR) coding, and 7.2, …, 128 represent the bit-rates of constant bit-rate source coding. Only bit-rates supporting at least one of the allowed audio bandwidth(s) shall be used in the session (see clause A.3.3.1). If br is not present, all bit-rates consistent with the negotiated bandwidth(s) are allowed in the session unless br-send or br-recv is present. If br is included, br-send or br-recv is redundant but if either br-send or br-recv, or both are included, they shall be identical to br. If br-send and br-recv are not identical, br shall not be used.

br-send: Specifies the range of source codec bit-rate for EVS Primary mode (see Table 1 [2]) in the session, in kilobits per second, for the send direction. The parameter can either have: a single bit-rate (br1); or a hyphen-separated pair of two bit-rates (br1-br2). If a single value is included, this bit-rate, br1, is used. If a hyphen-separated pair of two bit-rates is included, br1 and br2 are used as the minimum bit-rate and the maximum bit-rate respectively. br1 shall be smaller than br2. br1 and br2 have a value from the set: 5.9, 7.2, 8, 9.6, 13.2, 16.4, 24.4, 32, 48, 64, 96, and 128. 5.9 represents the average bit-rate of source controlled variable bit-rate (SC-VBR) coding, and 7.2, …, 128 represent the bit-rates of constant bit-rate source coding. Only bit-rates supporting at least one of the allowed audio bandwidth(s) shall be used in the session (see clause A.3.3.1). If br-send is not present, all bit-rates consistent with the negotiated bandwidth(s) are allowed in the session unless br is present.

br-recv: Specifies the range of source codec bit-rate for EVS Primary mode (see Table 1 [2]) in the session, in kilobits per second, for the receive direction. The parameter can either have: a single bit-rate (br1); or a hyphen-separated pair of two bit-rates (br1-br2). If a single value is included, this bit-rate, br1, is used. If a hyphen-separated pair of two bit-rates is included, br1 and br2 are used as the minimum bit-rate and the maximum bit-rate respectively. br1 shall be smaller than br2. br1 and br2 have a value from the set: 5.9, 7.2, 8, 9.6, 13.2, 16.4, 24.4, 32, 48, 64, 96, and 128. 5.9 represents the average bit-rate of source controlled variable bit-rate (SC-VBR) coding, and 7.2, …, 128 represent the bit-rates of constant bit-rate source coding. Only bit-rates supporting at least one of the allowed audio bandwidth(s) shall be used in the session (see clause A.3.3.1). If br-recv is not present, all bit-rates consistent with the negotiated bandwidth(s) are allowed in the session unless br is present.

bw: Specifies the audio bandwidth for EVS Primary mode (see Table 1 [2]) to be used in the session for the send and the receive directions. bw has a value from the set: nb, wb, swb, fb, nb-wb, nb-swb, and nb-fb. nb, wb, swb, and fb represent narrowband, wideband, super-wideband, and fullband respectively, and nb-wb, nb-swb, and nb-fb represent all bandwidths from narrowband to wideband, super-wideband, and fullband respectively. If bw is not present, all bandwidths consistent with the negotiated bit-rate(s) are allowed in the session unless bw-send or bw-recv is present. If bw is included, bw-send or bw-recv is redundant but if either bw-send or bw-recv, or both are included, they shall be identical to bw. If bw-send and bw-recv are not identical, bw shall not be used.

bw-send: Specifies the bandwidth (see Table 1 [2]) to be used in the session for the send direction. bw-send has a value from the set: nb, wb, swb, fb, nb-wb, nb-swb, and nb-fb. nb, wb, swb, and fb represent narrowband, wideband, super-wideband, and fullband respectively, and nb-wb, nb-swb, and nb-fb represent all bandwidths from narrowband to wideband, super-wideband, and fullband respectively. If bw-send is not present, all bandwidths consistent with the negotiated bit-rate(s) are allowed in the session unless bw is present.

bw-recv: Specifies the bandwidth (see Table 1 [2]) to be used in the session for the receive direction. bw-recv has a value from the set: nb, wb, swb, fb, nb-wb, nb-swb, and nb-fb. nb, wb, swb, and fb represent narrowband, wideband, super-wideband, and fullband respectively, and nb-wb, nb-swb, and nb-fb represent all bandwidths from narrowband to wideband, super-wideband, and fullband respectively. If bw-recv is not present, all bandwidths consistent with the negotiated bit-rate(s) are allowed in the session unless bw is present.

ch-send: Specifies the number of audio channels to be used in the session for the send direction. ch-send has an integer value from 1 to the maximum number of audio channels (see also clause A.3.2). If ch-send is not present, ch-send=1, mono, is supported.

ch-recv: Specifies the number of audio channels to be used in the session for the receive direction. ch-recv has an integer value from 1 to the maximum number of audio channels (see also clause A.3.2). If ch-recv is not present, ch-recv=1, mono, is supported.

ch-aw-recv: Specifies how channel-aware mode is configured or used for the receive direction. Permissible values are -1, 0, 2, 3, 5, and 7. If ch-aw-recv is -1, channel-aware mode is disabled in the session for the receive direction. If ch-aw-recv is 0 or not present, partial redundancy (channel-aware mode) is not used at the start of the session for the receive direction. If ch-aw-recv is positive (2, 3, 5, or 7), partial redundancy (channel-aware mode) is used at the start of the session for the receive direction using the value as the offset (See NOTE below). Partial redundancy is supported only when the bit-rate is 13.2 kbps and the bandwidth is wb or swb.

NOTE 4: If a positive (2, 3, 5, or 7) value of ch-aw-recv is declared for a payload type and the payload type is accepted, the receiver of the parameter shall send partial redundancy (channel-aware mode) at the start of the session using the value as the offset. If ch-aw-recv=0 is declared or not present for a payload type and the payload type is accepted, the receiver of the parameter shall not send partial redundancy (channel-aware mode) at the start of the session. If ch-aw-recv=-1 is declared for a payload type and the payload type is accepted, the receiver of the parameter shall not send partial redundancy (channel-aware mode) in the session. If ch-aw-recv is not present or a non-negative (0, 2, 3, 5, or 7) value of ch-aw-recv is declared for a payload type and the payload type is accepted, partial redundancy (channel-aware mode) can be activated or deactivated during the session based on the expected or estimated channel condition through adaptation signaling, such as CMR (see Annex A.2) or RTCP based signaling (see clause 10.2 of [13]). If ch-aw-recv is not present or a non-negative (0, 2, 3, 5, or 7) value of ch-aw-recv is declared for a payload type and the payload type is accepted, the partial redundancy offset value can also be adjusted during the session based on the expected or estimated channel condition through adaptation signaling.

NOTE 5: The frame erasure rate indicator for the channel-aware mode has two permissible values (LO, HI) and this indicator has to be initialized to HI, as specified in clause 5.8.4.

The following parameters are applicable only to EVS AMR-WB IO mode:

mode-set: Restricts the active codec mode set to a subset of all modes when the EVS codec operates in AMR-WB IO, for example, to be able to support transport channels such as GSM or UMTS networks. Possible value is a comma-separated list of modes from the set: 0, …, 8 (see Table 1a [36]). If mode-set is specified, it must be abided, and frames encoded with AMR-WB IO outside of the subset must not be sent in any RTP payload or used in codec mode request signal. If not present, all codec modes of AMR-WB IO are allowed for the payload type.

mode-change-period: See RFC 4867 [15].

mode-change-capability: See RFC 4867 [15], except that the default and the only allowed value of mode-change-capability is 2 for EVS AMR-WB IO. As the default and the only allowed value of mode-

change-capibility is 2 in EVS AMR-WB IO, it is not required to include this parameter in the SDP.

mode-change-neighbor: See RFC 4867 [15].

Optional parameters of AMR-WB (see clause 8.2 of [15]) not defined above shall not be used in the EVS AMR-WB IO mode.

A.3.2 Mapping Media Type Parameters into SDP

The information carried in the media type specification has a specific mapping to fields in the Session Description Protocol (SDP) [27], which is commonly used to describe RTP sessions. When SDP is used to specify sessions employing the EVS codec, the mapping is as follows:

- The media type ("audio") goes in SDP "m=" as the media name.
- The media subtype (payload format name) goes in SDP "a=rtpmap" as the encoding name. The RTP clock rate in "a=rtpmap" shall be 16000, and the encoding parameters (number of channels) shall either be explicitly set to N or omitted, implying a default value of 1. The values of N that are allowed are specified in Section 4.1 in [38]. If ch-send and/or ch-recv paramaters are supplied, the number of channels N shall be the larger value given in those parameters.
- The parameters "ptime" and "maxptime" go in the SDP "a=ptime" and "a=maxptime" attributes, respectively.
- Any remaining parameters go in the SDP "a=fmtp" attribute by copying them directly from the media type parameter string as a semicolon-separated list of parameter=value pairs.

Mapping to fields in SDP is specified in clause 6 of [13].

A.3.3 Detailed Description of Usage of SDP Parameters

A.3.3.1 Offer-Answer Model Considerations

The following considerations apply when using SDP Offer-Answer procedures to negotiate the use of EVS payload in RTP:

dtx: When dtx is not offered, i.e., not included, for a payload type, the answerer may include dtx for the payload type in the SDP answer. When dtx is offered for a payload type and the payload type is accepted, the answerer shall not modify or remove dtx for the payload type in the SDP answer. When dtx-recv is offered and the answerer includes dtx, the value of dtx in the answer shall be identical to the value of dtx-recv in the offer.
When dtx is not present in the SDP answer (and thus was not present in the SDP offer), the following applies:
- If dtx-recv is not present in the SDP offer, DTX shall be enabled at least in the direction towards the offerer.
- If dtx-recv is present in the SDP offer, DTX shall be enabled or disabled towards the offerer depending on the value of dtx-recv in the offer.
- If dtx-recv is not present in the SDP answer, DTX shall be enabled at least in the direction towards the answerer.
- If dtx-recv is present in the SDP answer, DTX shall be enabled or disabled towards the answerer depending on the value of dtx-recv in the answer.

dtx-recv: The answerer may include dtx-recv for the payload type in the SDP answer irrespective of the presence and value of dtx-recv in the offer.

hf-only: When hf-only is not offered for a payload type, the answerer may include hf-only for the payload type in the SDP answer. When hf-only is offered for a payload type and the payload type is accepted, the answerer shall not modify or remove hf-only for the payload type in the SDP answer.

evs-mode-switch: When evs-mode-switch is not offered for a payload type, the answerer may include evs-mode-switch for the payload type in the SDP answer. When evs-mode-switch is offered for a payload

type and the payload type is accepted, the answerer shall not modify or remove evs-mode-switch for the payload type in the SDP answer.

br: When the same bit-rate or bit-rate range is defined for the send and the receive directions, br should be used but br-send and br-recv may also be used. br can be used even if the session is negotiated to be sendonly, recvonly, or inactive. For sendonly session, br and br-send can be interchangeably used. For recvonly session, br and br-recv can be interchangeably used. When br is not offered for a payload type, the answerer may include br for the payload type in the SDP answer. When br is offered for a payload type and the payload type is accepted, the answerer shall include br in the SDP answer which shall be identical to or a subset of br for the payload type in the SDP offer.

br-send: When br-send is not offered for a payload type, the answerer may include br-recv for the payload type in the SDP answer. When br-send is offered for a payload type and the payload type is accepted, the answerer shall include br-recv in the SDP answer, and the br-recv shall be identical to or a subset of br-send for the payload type in the SDP offer.

br-recv: When br-recv is not offered for a payload type, the answerer may include br-send for the payload type in the SDP answer. When br-recv is offered for a payload type and the payload type is accepted, the answerer shall include br-send in the SDP answer, and the br-send shall be identical to or a subset of br-recv for the payload type in the SDP offer.

bw: When the same bandwidth or bandwidth range is defined for the send and the receive directions, bw should be used but bw-send and bw-recv may also be used. bw can be used even if the session is negotiated to be sendonly, recvonly, or inactive. For sendonly session, bw and bw-send can be interchangeably used. For recvonly session, bw and bw-recv can be interchangeably used. When bw is not offered for a payload type, the answerer may include bw for the payload type in the SDP answer. When bw is offered for a payload type and the payload type is accepted, the answerer shall include bw in the SDP answer, which shall be identical to or a subset of bw for the payload type in the SDP offer.

bw-send: When bw-send is not offered for a payload type, the answerer may include bw-recv for the payload type in the SDP answer. When bw-send is offered for a payload type and the payload is accepted, the answerer shall include bw-recv in the SDP answer, and the bw-recv shall be identical to or a subset of bw-send for the payload type in the SDP offer.

bw-recv When bw-recv is not offered for a payload type, the answerer may include bw-send for the payload type in the SDP answer. When bw-recv is offered for a payload type and the payload is accepted, the answerer shall include bw-send in the SDP answer, and the bw-send shall be identical to or a subset of bw-recv for the payload type in the SDP offer.

cmr: When cmr is not offered for a payload type, the answerer may include cmr for the payload type in the SDP answer. When cmr is offered for a payload type and the payload type is accepted, the answerer shall not modify or remove cmr for the payload type in the SDP answer.

channels See <encoding parameters> of a=rtpmap attribute specified in RFC 4566 [27]. If ch-send and ch-recv are offered for a payload type with different numbers of channels for sending and receiving directions, channels is set to the larger of the two parameters.

ch-send: When ch-send is offered for a payload type and the payload type is accepted, the answerer shall include ch-recv in the SDP answer, and the ch-recv shall be identical to the ch-send parameter for the payload type in the SDP offer.

ch-recv When ch-recv is offered for a payload type and the payload type is accepted, the answerer shall include ch-send in the SDP answer, and the ch-send shall be identical to the ch-recv parameter for the payload type in the SDP offer.

When a single bit-rate is offered, the answerer may accept the offered bit-rate or reject the offered bit-rate. If the offered bit-rate is accepted, this bit-rate shall be used also in the SDP answer. If the offered bit-rate is accepted but the session is changed from sendrecv to sendrecv or recvonly, the offered bit-rate shall be used in the br, br-send or br-recv parameter included in the SDP answer. Otherwise, the RTP payload type shall be rejected.

When a bit-rate range is offered, the answerer: may accept the offered bit-rate range, modify the offered bit-rate range,

select a single bit-rate, or may reject the offered bit-rate range. Otherwise, the RTP payload type shall be rejected.

When an offered bit-rate range is modified for the answer, the following rules apply:

- The lower bit-rate limit 'br1' can be kept unchanged or can be increased up to 'br2', but cannot be decreased.
- The upper bit-rate limit 'br2' can be kept unchanged or can be decreased down to 'br1', but cannot be increased.

When an offered bit-rate range is answered with a single bit-rate, this bit-rate shall be one of the offered bit-rates.

Rejecting all RTP payload types may lead to rejecting the media type and possibly even the whole SIP INVITE.

The bit-rates and bandwidths indicated in the negotiated media type attributes shall be consistent with Table A.6. Each 'x' represents a bit-rate and bandwidth combination supported by the EVS codec.

Table A.6: Allowed bit-rates and audio bandwidths

	5.9	7.2	8	9.6	13.2	16.4	24.4	32	48	64	96	128
nb	x	x	x	x	x	x	x					
wb	x	x	x	x	x	x	x	x	x	x	x	x
swb				x	x	x	x	x	x	x	x	x
fb						x	x	x	x	x	x	x

If no bit rate parameter and no bandwidth parameter are specified, all bit-rates and bandwidths combinations as specified in Table A.6 are allowed in the session.

A.3.3.2 Examples

SDP offer/answer procedure examples for MTSI are in A.14 of [13].

Setting up a symmetric dual-mono session in both sending and receiving direction, can be done with SDP offer and SDP answer negotiating the same number of channels on the 'a=rtpmap' line in the SDP offer and SDP answer. An example SDP offer/answer negotiation for using the same number of channels for sending and receiving directions is included below:

Example SDP offer

```
m=audio 49152 RTP/AVP 96 97 98 99 100 101 102 103
a=rtpmap:96 EVS/16000/2
a=fmtp:96 br=16.4; bw=nb-swb; max-red=220
a=rtpmap:97 EVS/16000/1
a=fmtp:97 br=13.2-24.4; bw=nb-swb; max-red=220
a=rtpmap:98 AMR-WB/16000/2
a=fmtp:98 mode-change-capability=2; max-red=220
a=rtpmap:99 AMR-WB/16000/2
a=fmtp:99 mode-change-capability=2; max-red=220; octet-align=1
a=rtpmap:100 AMR-WB/16000/1
a=fmtp:100 mode-change-capability=2; max-red=220
a=rtpmap:101 AMR-WB/16000/1
a=fmtp:101 mode-change-capability=2; max-red=220; octet-align=1
a=rtpmap:102 AMR/8000/1
a=fmtp:102 mode-change-capability=2; max-red=220
a=rtpmap:103 AMR/8000/1
a=fmtp:103 mode-change-capability=2; max-red=220; octet-align=1
a=ptime:20
a=maxptime:240
```

Example SDP answer

```
m=audio 49152 RTP/AVP 96
a=rtpmap:96 EVS/16000/2
a=fmtp:96 br=16.4; bw=nb-swb; max-red=220
a=ptime:20
a=maxptime:240
```

It is possible to use one m= line when setting up a session with equal number of channels in both directions.

Setting up a session with asymmetric number of channels for different directions is possible by negotiating different number of channels using the 'ch-send=<#>' and the 'ch-recv=#' parameters.

A.3.3.3 Interactions of the dtx and dtx-recv parameters

Table A.7 lists all allowed combinations of the dtx and dtx-recv parameters in SDP offers and answers, and their meaning. Combinations of the dtx and dtx-recv parameters in SDP offers and answers not contained in Table A.7 shall not be used; the error handling if such combinations are encountered is left to the implementation.

Table A.7: Allowed combinations of the dtx and dtx-recv parameter in SDP offer and answer

Number	SDP offer		SDP answer		DTX towards offerer enabled?	DTX towards answerer enabled?
	dtx	dtx recv	dtx	dtx recv		
1	-	-	-	-	y	y
2	-	0	-	-	n	y
3	-	1	-	-	y	y
4	-	-	0	-	n	n
5	0	-	0	-	n	n
6	-	0	0	-	n	n
7	0	0	0	-	n	n
8	-	-	1	-	y	y
9	1	-	1	-	y	y
10	-	1	1	-	y	y
11	1	1	1	-	y	y
12	-	-	-	0	y	n
13	-	0	-	0	n	n
14	-	1	-	0	y	n
15	-	-	0	0	n	n
16	0	-	0	0	n	n
17	-	0	0	0	n	n
18	0	0	0	0	n	n
19	-	-	-	1	y	y
20	-	0	-	1	n	y
21	-	1	-	1	y	y
22	-	-	1	1	y	y
23	1	-	1	1	y	y
24	-	1	1	1	y	y
25	1	1	1	1	y	y