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LTE;
5G;
Mission Critical Push To Talk (MCPTT);
Media, codecs and Multimedia Broadcast/Multicast Service (MBMS) enhancements for MCPTT over LTE
(3GPP TR 26.989 version 17.0.0 Release 17)

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Contents

Foreword

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1 Scope

The present document covers the enhancement required to support MCPTT.

2 References

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

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

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 22.179: "Mission Critical Push To Talk (MCPTT) over LTE; Stage 1"

[3] 3GPP TR 26.952: "Codec for Enhanced Voice Services (EVS);Performance Characterization".

[4] 3GPP TS 26.114: "IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".

[5] ITU-T Technical Paper - GSTP-GVBR, Performance of ITU-T G.718 (http://www.itu.int/pub/T-TUT) (http://www.itu.int/pub/publications.aspx-lang=en&parent=T-TUT-ASC-2010).

[6] ETSI EN 300 395-2: "Terrestrial Trunked Radio (TETRA) Speech codec for full-rate traffic channel Part 2: TETRA codec", version 1.3.1 (25 January 2005).

[7] 3GPP TR 26 975: "Performance characterization of the Adaptive Multi-Rate (AMR) speech codec".

[8] 3GPP TR 46.055: "Performance characterization of the GSM Enhanced Full Rate (EFR) speech codec".

[9] (void)

[10] IETF RFC 3550: "RTP: A Transport Protocol for Real-Time Applications".

[11] 3GPP TS 26.346: "Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs".

[12] 3GPP TS 23.468: "Group Communication System Enablers for LTE (GCSE_LTE); Stage 2".

[13] 3GPP TR 26 976: "Performance characterization of the Adaptive Multi-Rate Wideband (AMR-WB) speech codec".

[14] 3GPP TS 22.076: "Noise suppression for the AMR codec; Service description; Stage 1".

[15] 3GPP TS 26.131: "Terminal acoustic characteristics for telephony; Requirements".

[16] NTIA Report 15-520: "Speech Codec Intelligibility Testing in Support of Mission-Critical Voice Applications for LTE", S.D. Voran & A.A. Catellier September 2015.

[17] (void)

[18] (void)

[19] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[20] 3GPP TR 26.947: "Multimedia Broadcast/Multicast Service (MBMS); Selection and characterisation of application layer Forward Error Correction (FEC)".

[21] (void)

[22] (void)

[23] (void)

[24] ITU-T Recommendation P.800 (08/1996): "Methods for subjective determination of transmission quality".

[25] 3GPP TS 26.442: "Codec for Enhanced Voice Services (EVS); ANSI C code (fixed-point)".

[26] 3GPP TS 26.448: "Codec for Enhanced Voice Services (EVS); Jitter buffer management".

[27] ITU-T Recommendation P.807 (02/2016): "Subjective test methodology for assessing speech intelligibility".

3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

ADP Associated Delivery Procedures
AS Application Server
BC Broadcast
BM-SC Broadcast-Multicast - Service Centre
GCS Group Communication Service
MCPTT Mission Critical Push-To-Talk
MBMS Multimedia Broadcast/Multicast Service
MBSFN Multimedia Broadcast Single Frequency Network
MOS Mean Opinion Score
NTIA National Telecommunications & Information Administration
TETRA TErrestrial Trunked Radio
SC-PTM Single Cell-Point To Multipoint
SWB Super Wide Band
UC Unicast

4 Reference Model

Figure 1 shows a reference model of MCPTT support over UC and BC. The GCS AS interacts with UE over GC1 interface for application signalling. The GCS AS determines whether to deliver the audio over UC or BC. GCS AS interacts with BM-SC over MB2 interface to deliver audio to BM-SC. The BM-SC delivers the audio over broadcast channel to the UE via SGi-mb interface. The GCS AS interacts with P-GW over SGi interface to deliver audio to the UE. The **red** line represents the audio delivered over UC channel. The **green** line represents the audio delivered over BC channel.

NOTE: The UE interacts with the BM-SC using HTTP method via SGi interface for MBMS Associated Delivery Procedure. Whether the ADP procedure applies to the MCPTT is TBD.

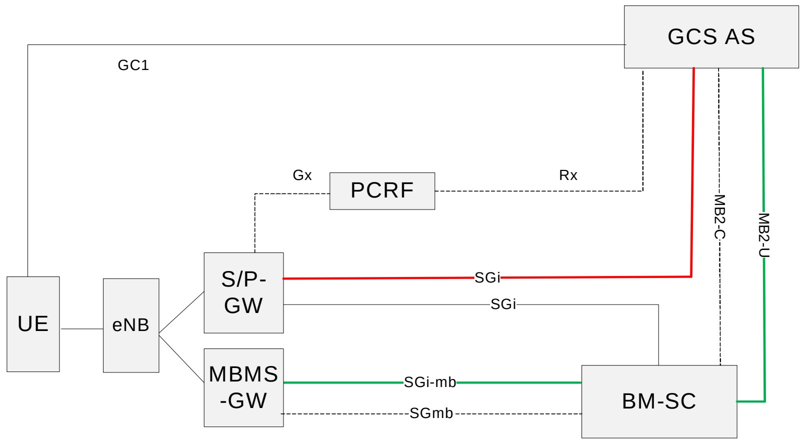


Figure 1: MCPTT support Reference Model

5 Key Issues for Supporting MCPTT

5.1 Key Issue#1: Codec for MCPTT

5.1.1 Review of Codec Alternatives and their Relative Perceptual Performance

5.1.1.1 Overview of the 3GPP Codec Comparison

The EVS Selection and Characterization Phase Test Results provided in the main body and Annex D of TR 26.952 [3] give a detailed assessment of the performance of the EVS Codec in realistic scenarios compared to both AMR and AMR-WB. A summary of this comparison is provided in the next two subclauses.

In the fourth subclause the relative performance of different audio bandwidths coded with AMR, AMR-WB and EVS is provided showing that the SWB modes of EVS outperform the WB and NB Primary modes of EVS, AMR-WB and AMR.

In the fifth subclause, a review of the TETRA codec performance in comparison to the 3GPP Codecs is provided.

This version of the document includes a review of codec alternatives and their relative intelligibility in high noise conditions, e.g., at SNRs in the range of -30 dB to 5 dB. The NTIA report [16] covered six noise types for an intelligibility study that included a range of public safety and civilian environments. Results of intelligibility testing for additional public safety specific high noise background conditions are not included in this document.

5.1.1.2 Narrowband Comparison vs AMR

For Narrowband (NB) signals, four experiments were conducted in the EVS Selection and four in the EVS Characterization. Taken together, these results provide a complete picture of the performance of EVS with respect to AMR but the highlights are provided in Figures 2 to 6 below.

It can be seen that EVS always significantly out-performs AMR in terms of intrinsic audio quality for both speech and Mixed/Music signals. EVS is also significantly more robust to frame erasures; both randomly distributed or according to the Delay and Error profiles from TS 26.114 [4] using the EVS JBM.

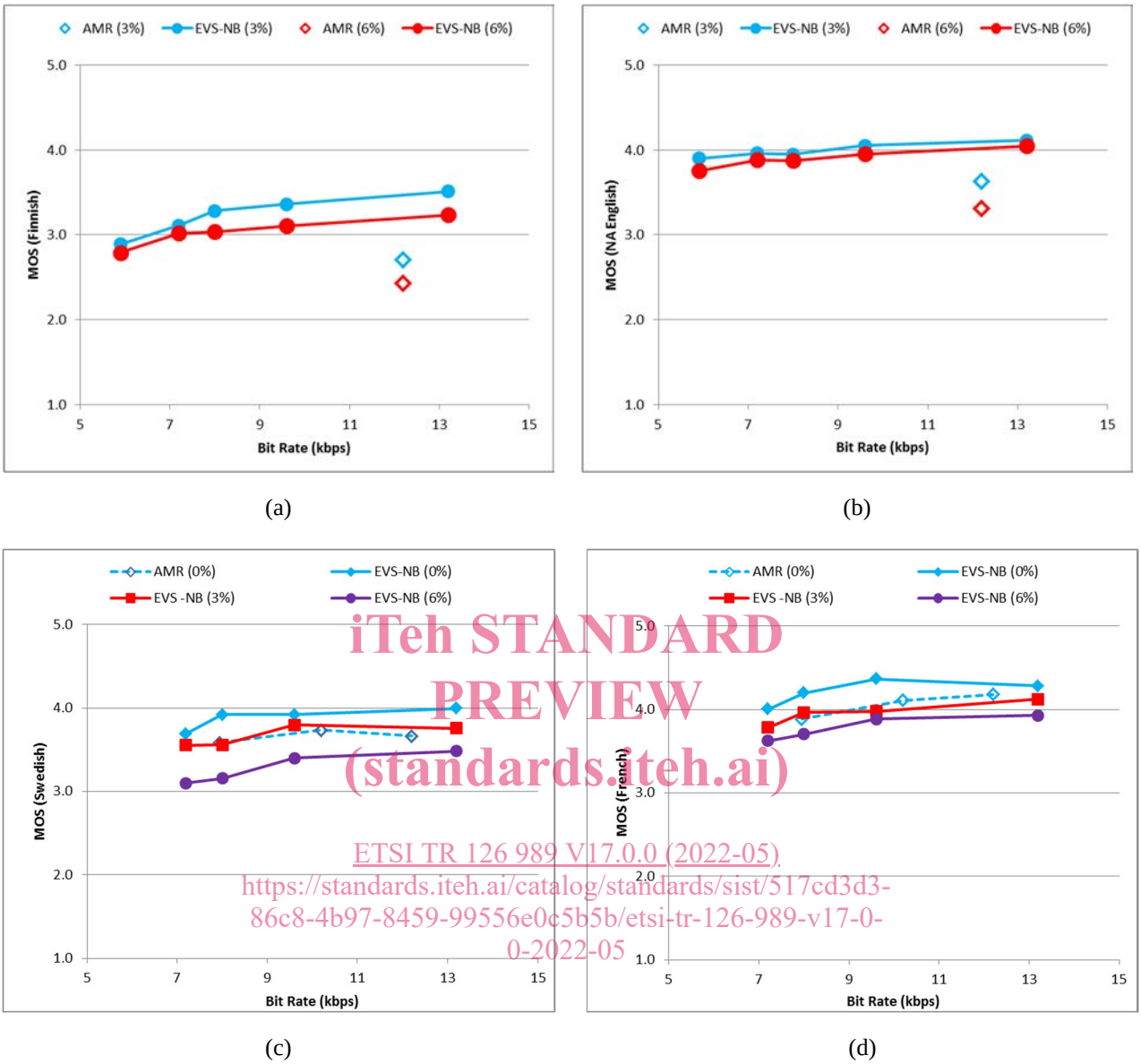
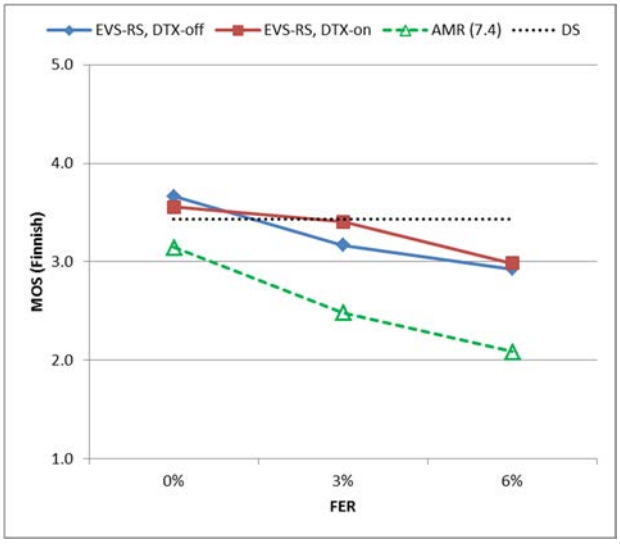
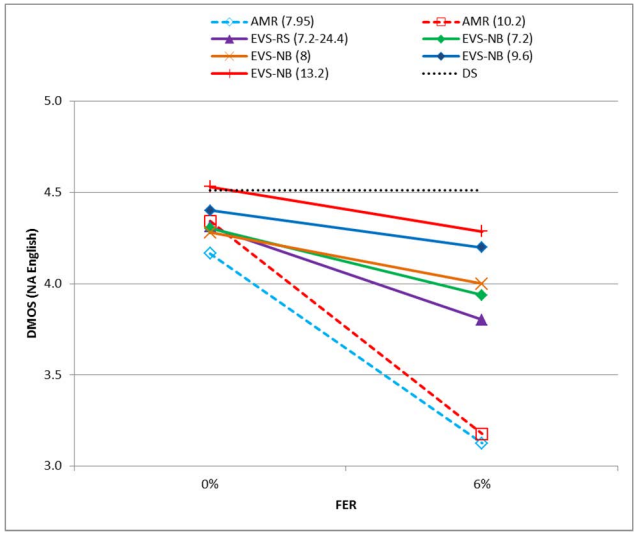


Figure 2: EVS NB vs AMR – Speech - Random Frame Erasures - Selection



(a)



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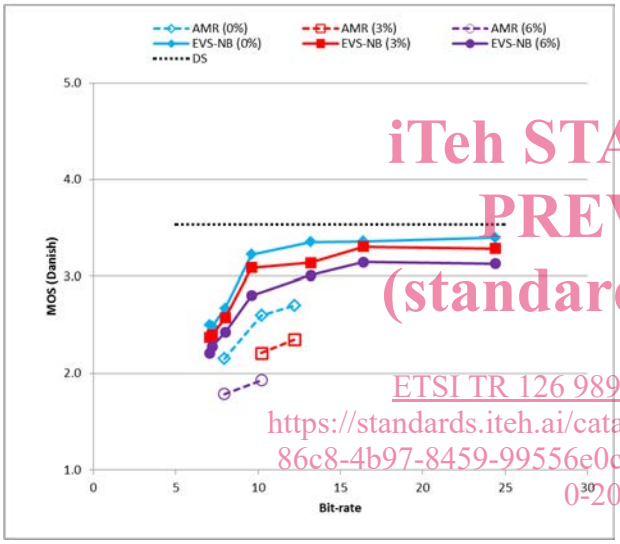

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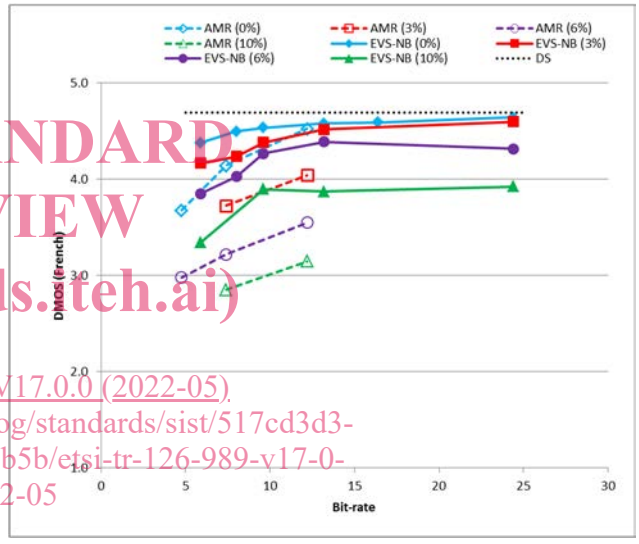
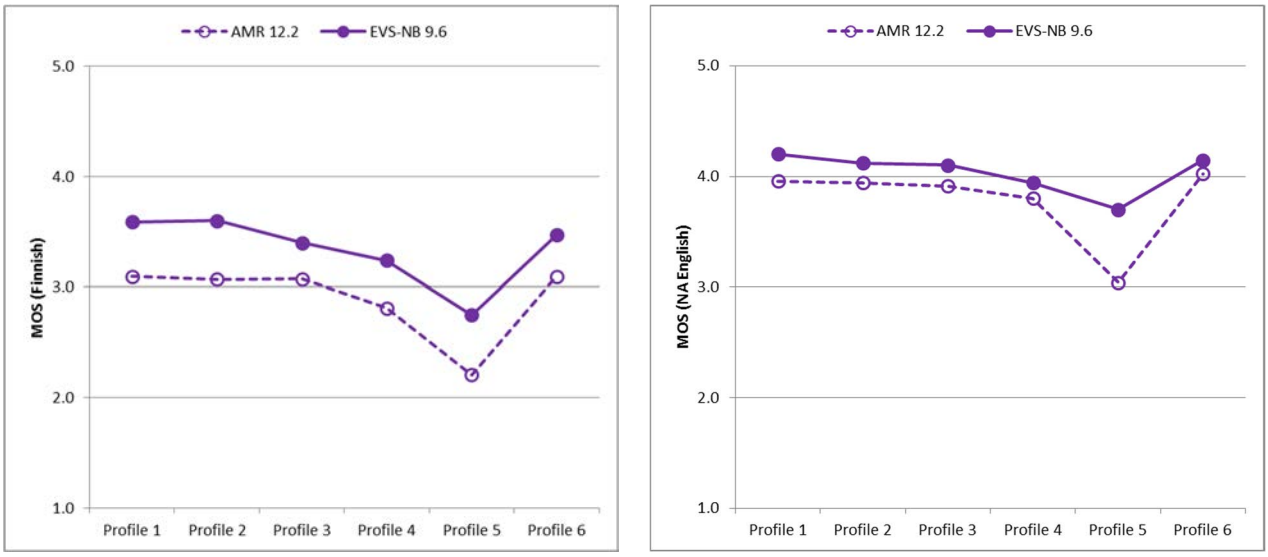


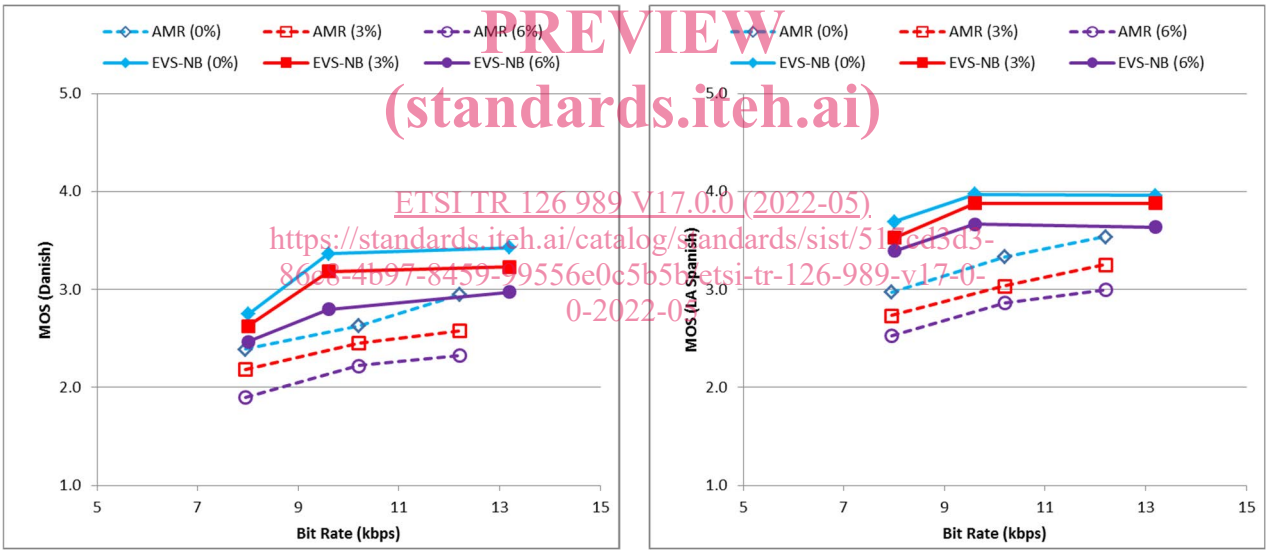
(d)

Figure 3: EVS NB vs AMR – Speech - Random Frame Erasures - Characterization



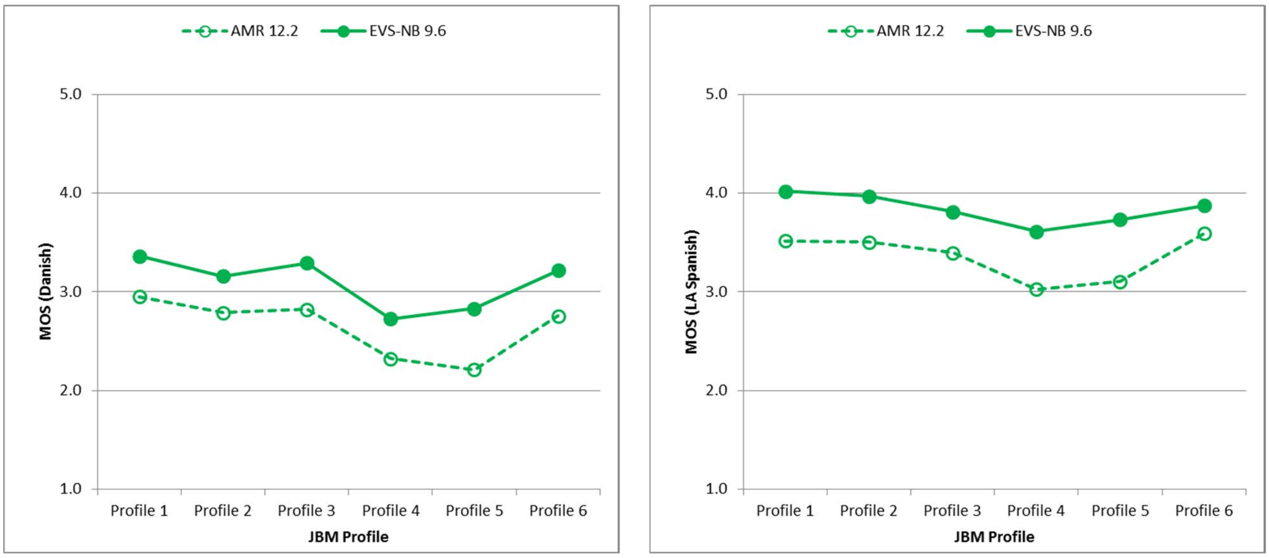
(a) (b)

Figure 4: EVS NB vs AMR – Speech - TS 26.114 Delay & Error Profiles



(a) (b)

Figure 5: EVS NB vs AMR – Music & Mixed Content - Random Frame Erasures



(a) (b)

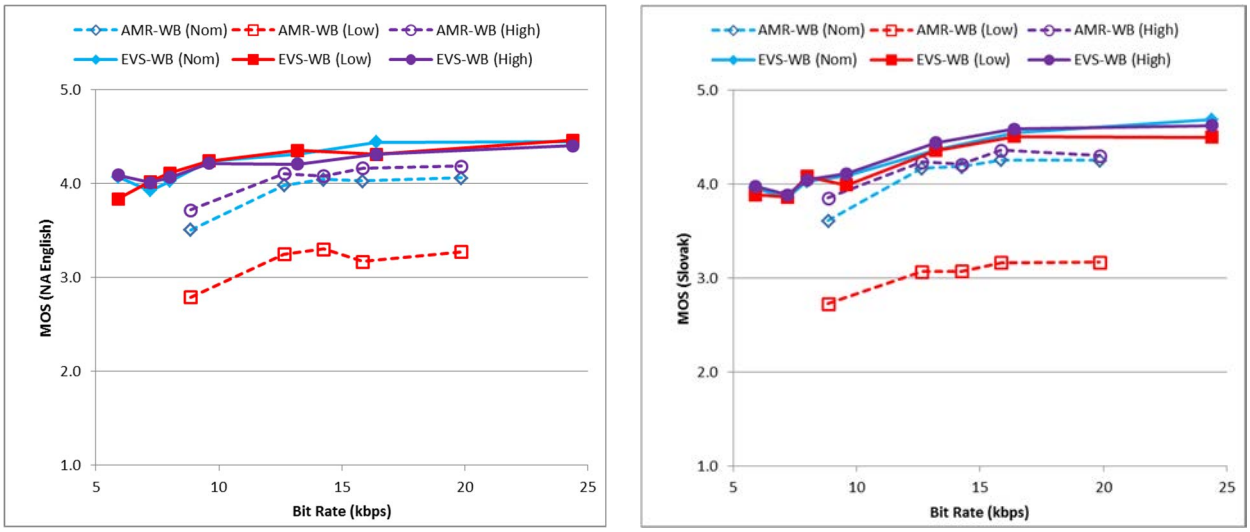
Figure 6: EVS NB vs AMR – Music & Mixed Content - TS 26.114 Delay & Error Profiles

5.1.1.3 Wideband Comparison vs AMR-WB

For Wideband (WB) signals, seven experiments were conducted during the EVS Selection and five experiments during Characterization; focused on determining the performance of the EVS Wideband Primary Modes of operation. Taken together these experiments provide unique information about the performance of EVS with respect to AMR-WB but the highlights are provided below in Figures 7 to 10.

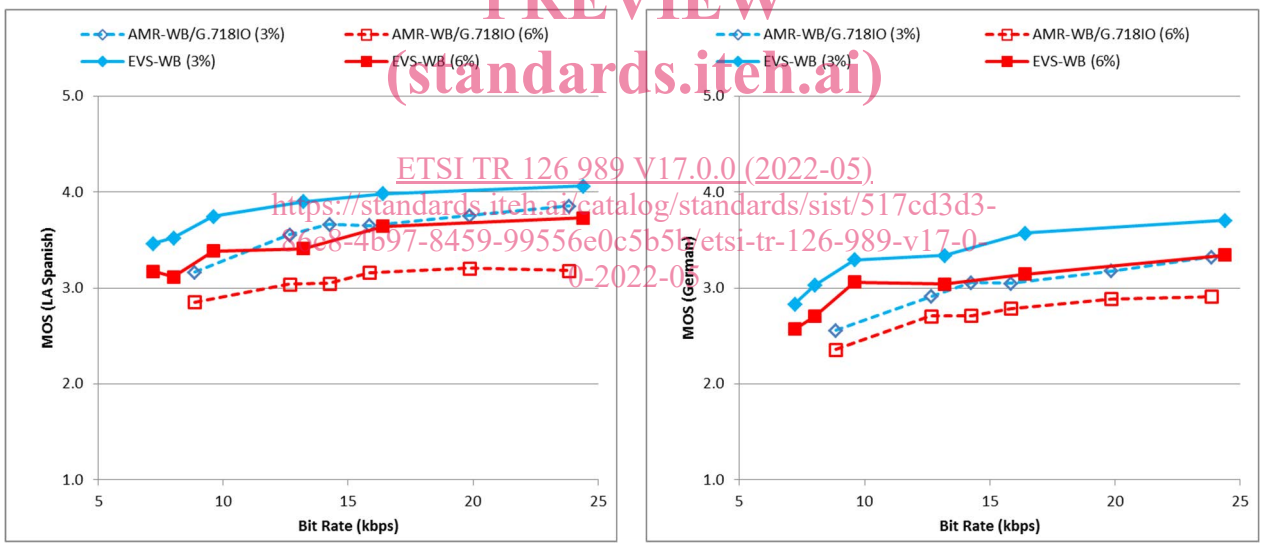
As in the case of AMR and NB, it can be seen that EVS always significantly out-performs AMR-WB or AMR-WB/G.718IO in terms of intrinsic audio quality for both speech and Mixed/Music signals. EVS is also significantly more robust to input level and frame erasures; both randomly distributed or using the EVS JBM in conjunction with the packet delay and error profiles taken from either TS 26.114 or the new profiles defined for LTE.

What is less clear from the frame erasure plots is that AMR-WB, in its basic form, performs significantly less well than these curves would suggest. Work in ITU-T as part of the G.718 exercise led to significant improvements to the packet loss concealment of AMR-WB (G.722.2) and these improvements are shown in Figures 11 & 12 (FER and BFER); taken from the Characterization Report of Recommendation ITU-T G.718 [5]. The enhancements achieved during the development of G.718 formed part of the justification of the EVS work item and thus it can be assumed that EVS will perform even better than suggested by Figures 8, 9 and 10.



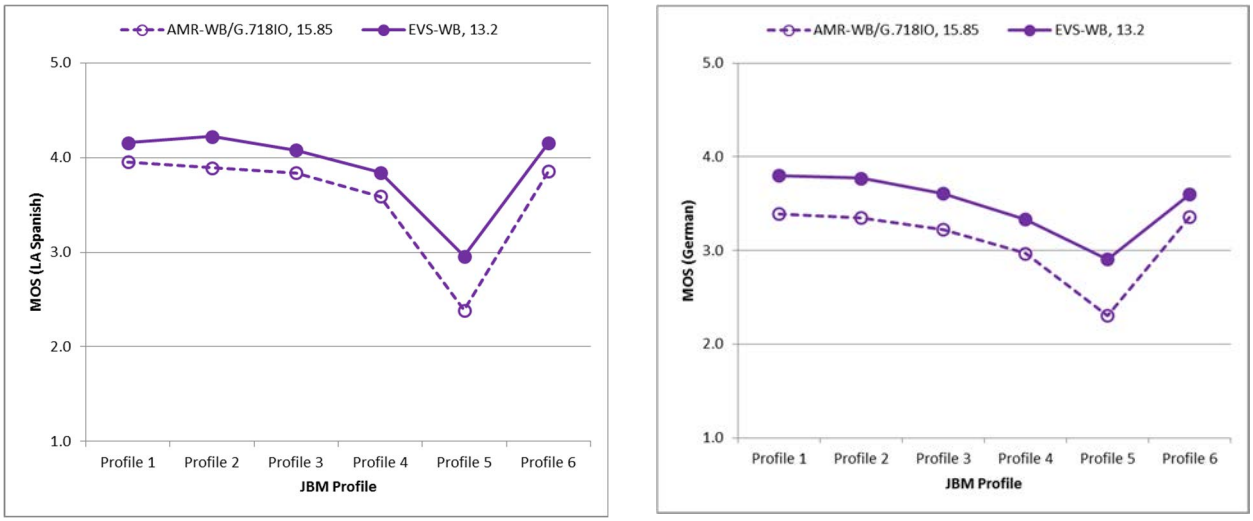
(a) (b)

Figure 7: EVS WB vs AMR-WB – Speech – Clean Channel & Levels



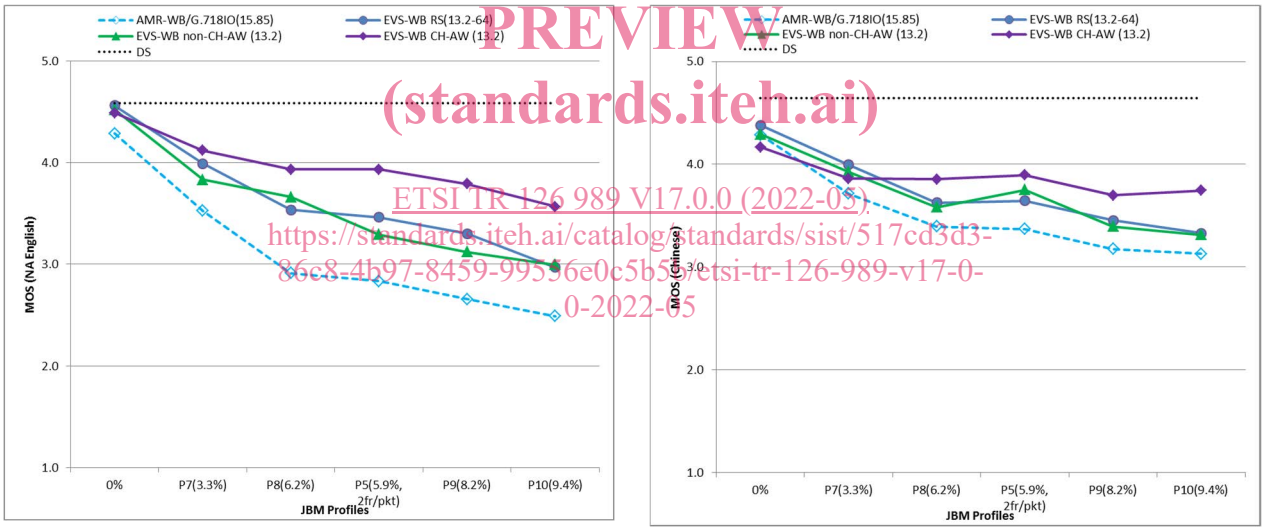
(a) (b)

Figure 8: EVS WB vs AMR-WB – Speech - Random Frame Erasures



(a) (b)

Figure 9: EVS WB vs AMR-WB – Speech - TS 26.114 Delay & Error Profiles



(a) (b)

Figure 10: EVS WB vs AMR-WB – Speech – New EVS JBM Delay & Error Profiles