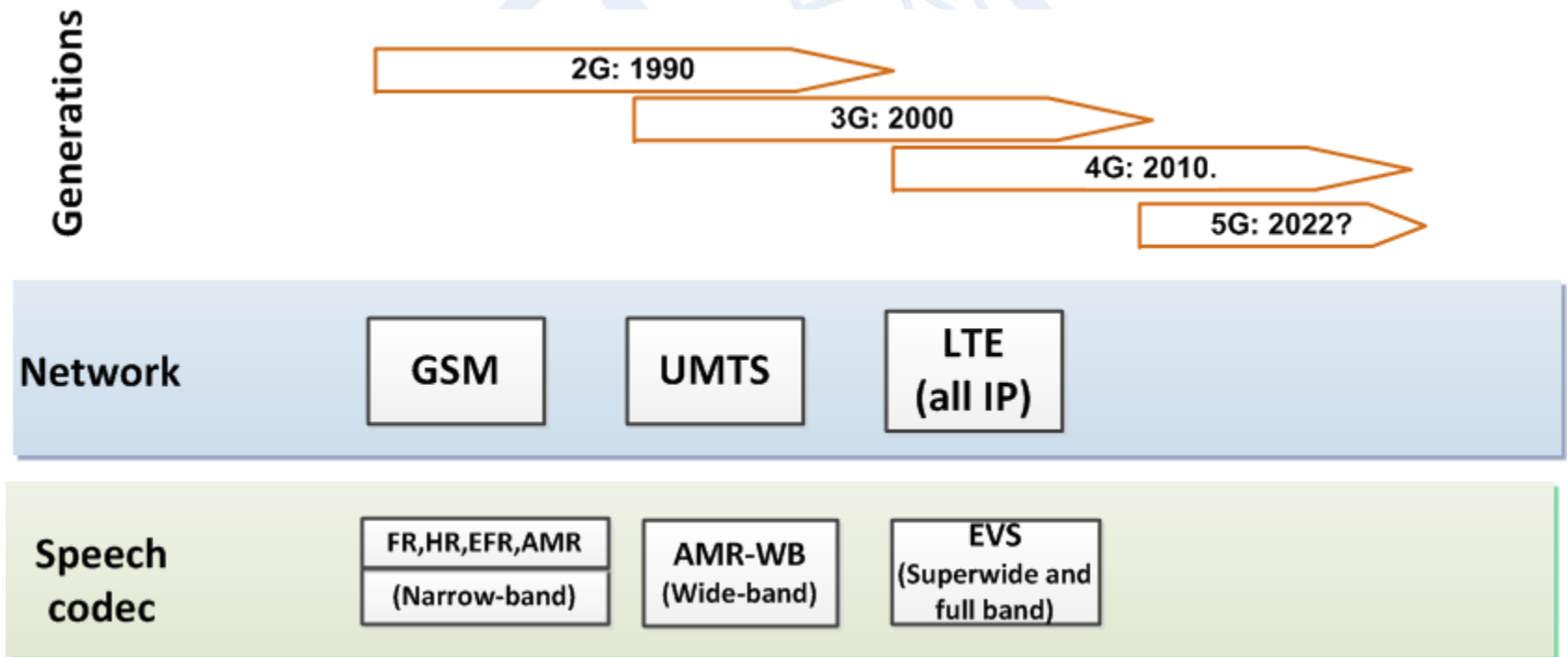# ITU Workshop on "Voice and Video over LTE"
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Enhanced Voice Services (EVS) - Latest state-of-the-art speech and audio communication codec and related interoperability aspects

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Speech Codec evolution in mobile phones

Introduction

- What is EVS?
  - EVS = Enhanced Voice Services
  - The next generation 3GPP communication codec (after AMR-WB, 2001)
  - Substantially improved with respect to
    - Speech quality and compression efficiency
    - Quality for non-speech content (mixed content, music)
    - Audio bandwidth (superwideband, fullband)
    - Error robustness
  - Integrated AMR-WB for seamless switching from/to EVS
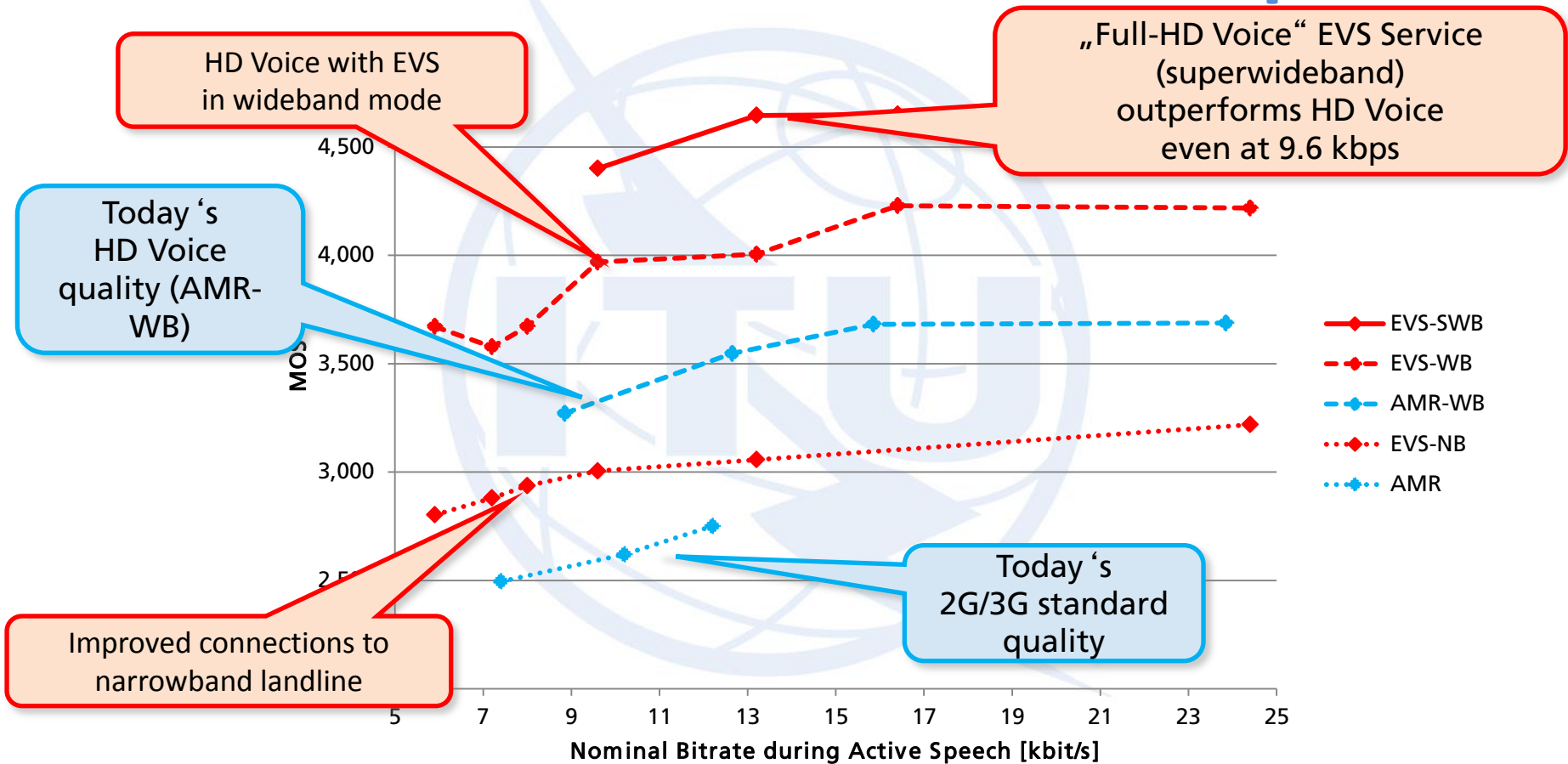 - Result of a cooperation of 12 companies:

EVS Status

- 3GPP

  - EVS for packet switched (4G) standardized in September 2014

    Primary use case is VoLTE, but also fit for VoWiFi, fixed VoIP

  - Extensive performance data available in 3GPP TR 26.952

  - Ongoing work on specifications to enable the use of EVS in Circuit Switched 3G (UTRAN)

- GSMA

  - EVS integrated into VoLTE Specification IR.92 in March 2015

    EVS Mandatory for SWB, optional for WB and NB services

EVS Performance

EVS Performance Gain – Clean Speech

HD Voice with EVS in wideband mode

„Full-HD Voice" EVS Service (superwideband) outperforms HD Voice even at 9.6 kbps

Today's HD Voice quality (AMR-WB)

Improved connections to narrowband landline

Today's 2G/3G standard quality

MOS

4,500

4,000

3,500

3,000

2,5

5   7   9   11   13   15   17   19   21   23   25

Nominal Bitrate during Active Speech [kbit/s]

- EVS-SWB
- EVS-WB
- AMR-WB
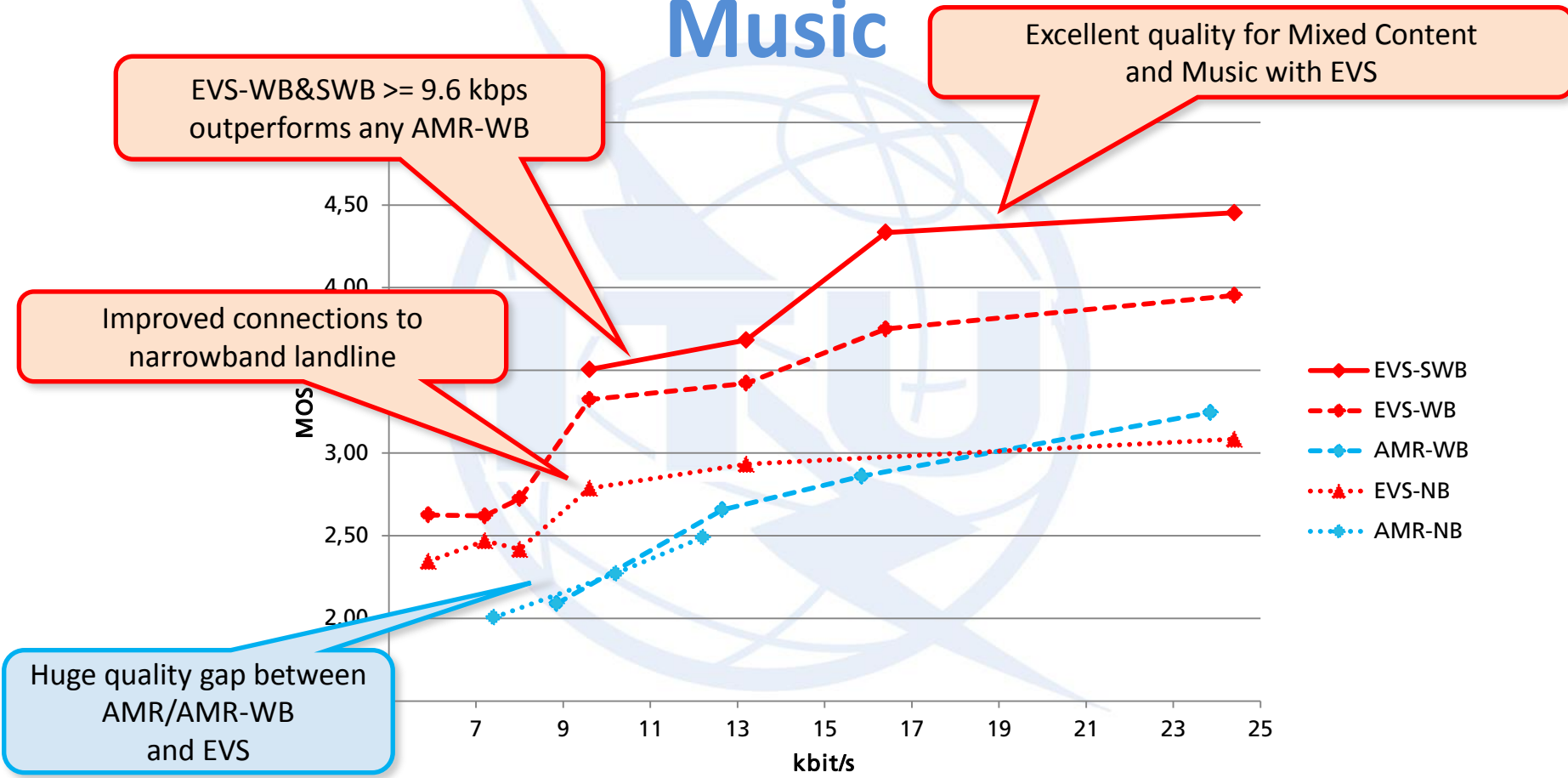- EVS-NB
- AMR

Source: 3GPP TR 26.952, Experiment M1 (mixed bandwidth), Clean Speech, DTX on, North American English
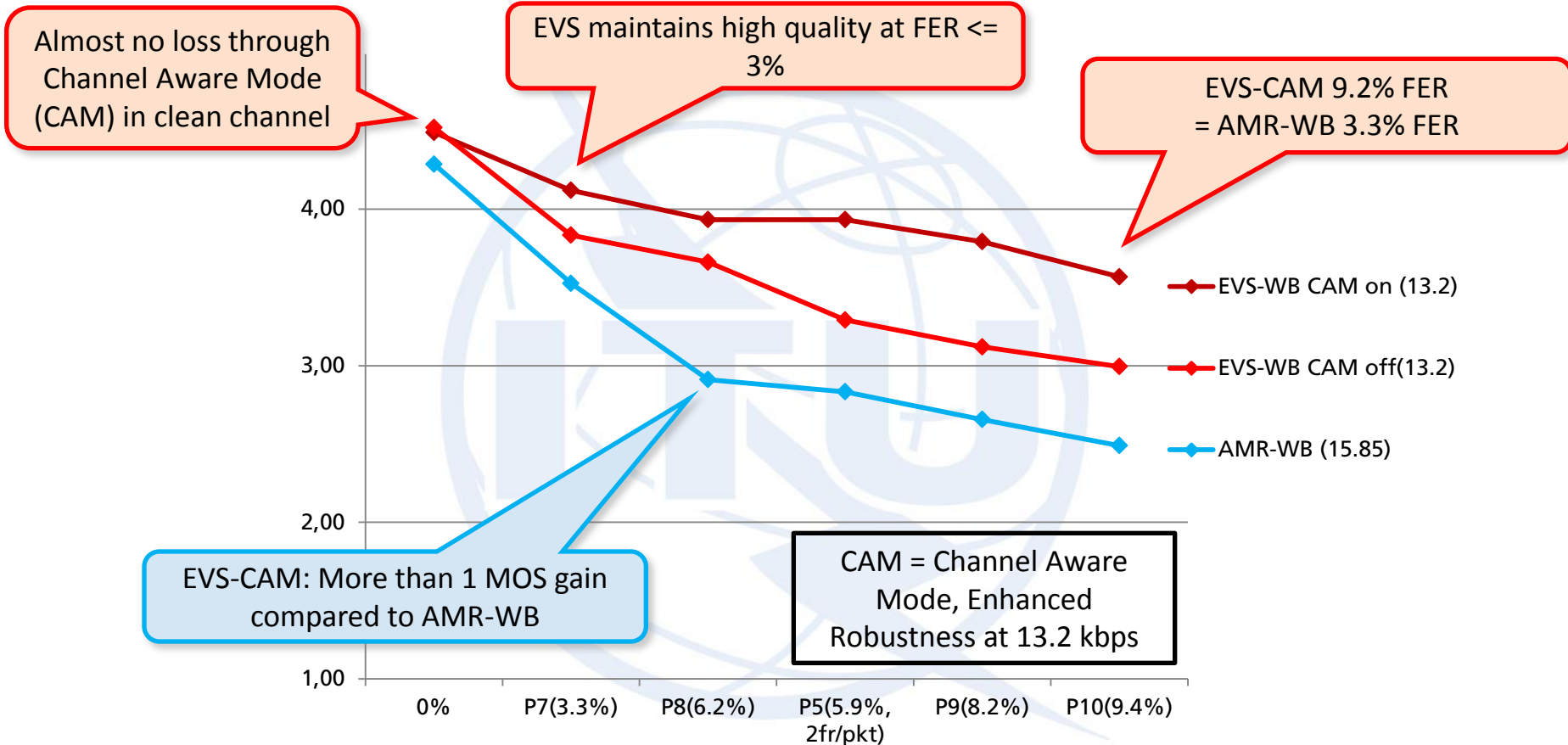
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EVS Performance Gain – Noisy Speech
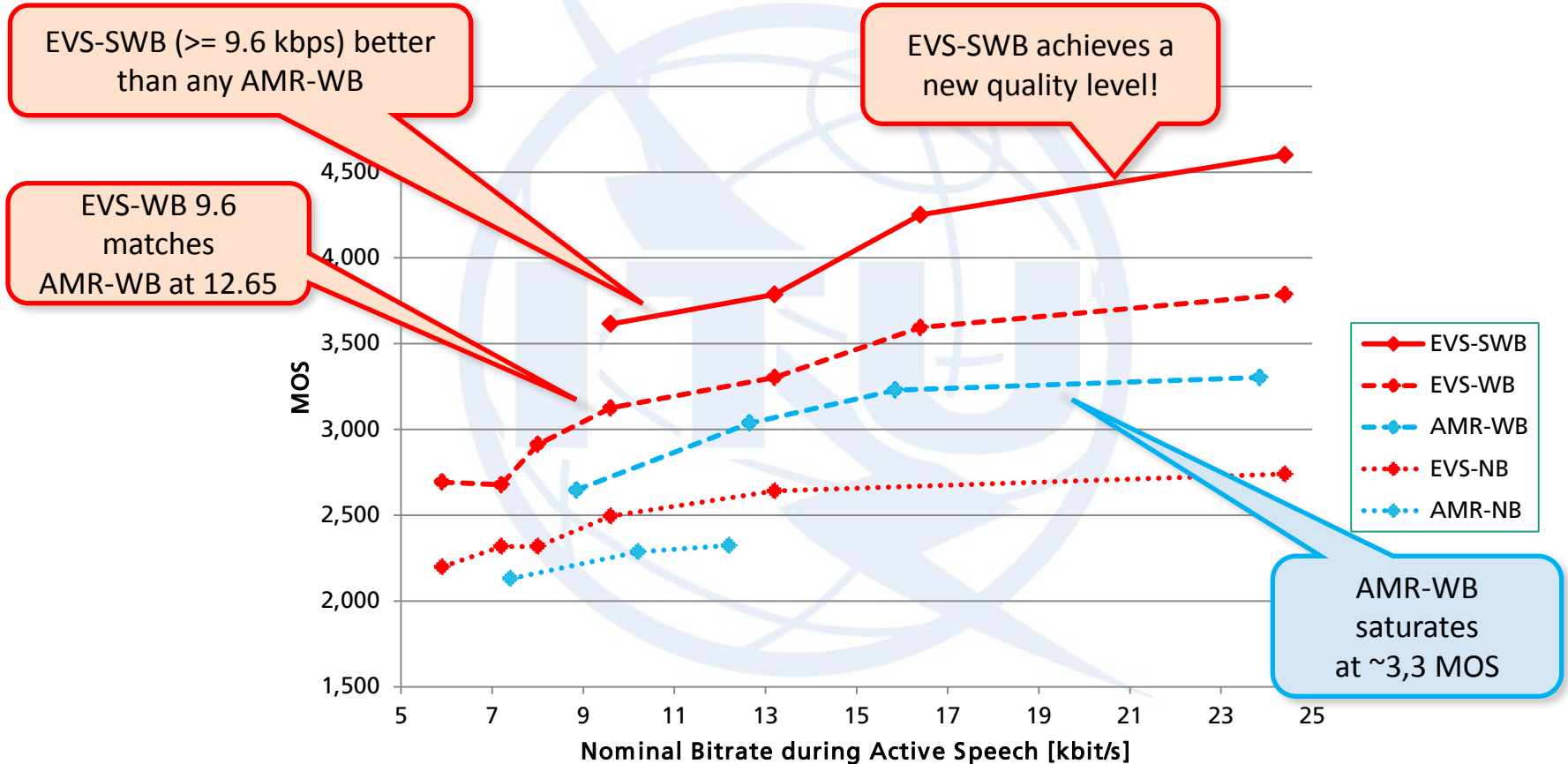
Source: 3GPP TR 26.952, Experiment M2 (mixed bandwidth), Noisy Speech (Car Noise 20dB), DTX on, Finnish

EVS Performance Gain – Mixed and Music

Excellent quality for Mixed Content and Music with EVS

EVS-WB&SWB >= 9.6 kbps outperforms any AMR-WB

Improved connections to narrowband landline

Huge quality gap between AMR/AMR-WB and EVS

MOS

— EVS-SWB	
- - EVS-WB	
- - AMR-WB	
... EVS-NB	
... AMR-NB	

4,50
4,00
3,00
2,50
2,00

7   9   11   13   15   17   19   21   23   25

kbit/s

Source: 3GPP TR 26.952, Experiment M3b (mixed bandwidth), Mixed and Music, DTX on, North American English

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EVS Performance Gain – Error

Almost no loss through Channel Aware Mode (CAM) in clean channel

EVS maintains high quality at FER <= 3%

EVS-CAM 9.2% FER = AMR-WB 3.3% FER

EVS-CAM: More than 1 MOS gain compared to AMR-WB

CAM = Channel Aware Mode, Enhanced Robustness at 13.2 kbps

- EVS-WB CAM on (13.2)
- EVS-WB CAM off(13.2)
- AMR-WB (15.85)

X-axis: 0%, P7(3.3%), P8(6.2%), P5(5.9%, 2fr/pkt), P9(8.2%), P10(9.4%)

Y-axis: 1,00 2,00 3,00 4,00

Wideband Clean Speech, North American English
FER=Frame Error Rate, CAM = Channel Aware Mode

Source: 3GPP TR 26.952, Characterization Experiment W1

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EVS Performance Summary

- Higher efficiency and transparent quality for wideband and narrowband services

  - Up to transparent wideband speech (at 24 kbps)

  - Up to transparent wideband mixed content and music (at 24 kbps)

  - Substantially improved compression efficiency at all rates

  - High robustness against packet loss – fit for Voice over WLAN

- Unprecedented quality through „Full HD Voice" superwideband audio at mobile bitrates

  - 14-16 kHz audio bandwidth from as low as 9.6 kbps

  - Highest quality speech, mixed content and music

  - Outperforms wideband at any operation point

- Integrated AMR-WB interoperable mode

  - Improved quality and robustness while 100% compatible with AMR-WB

EVS Interoperability aspects
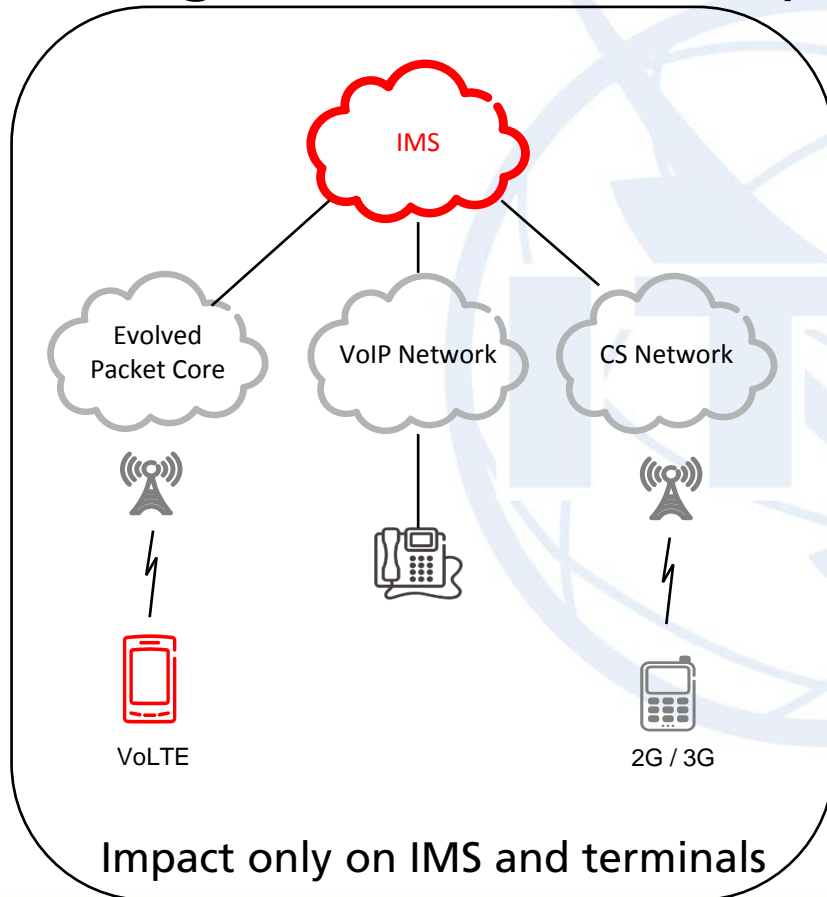
EVS Interoperability aspects (1)

- EVS supports narrow-band, wide-band, super-wideband, and full-band

  - -> Bandwidths for all device classes

- EVS supports bitrates from 5.9VBR to 128kbps

  - -> Rates for a large variety of mobile and fixed networks

- EVS includes fully interoperable AMR-WB encoder and decoder

  - TS 26.114 and IR.92: EVS is alternative implementation for AMR-WB

  -> single codec for AMR-WB and EVS

  - Mode can be changed from EVS to AMR-WB and back within the codec

    -> Handover without transcoding/re-negotiation for SRVCC
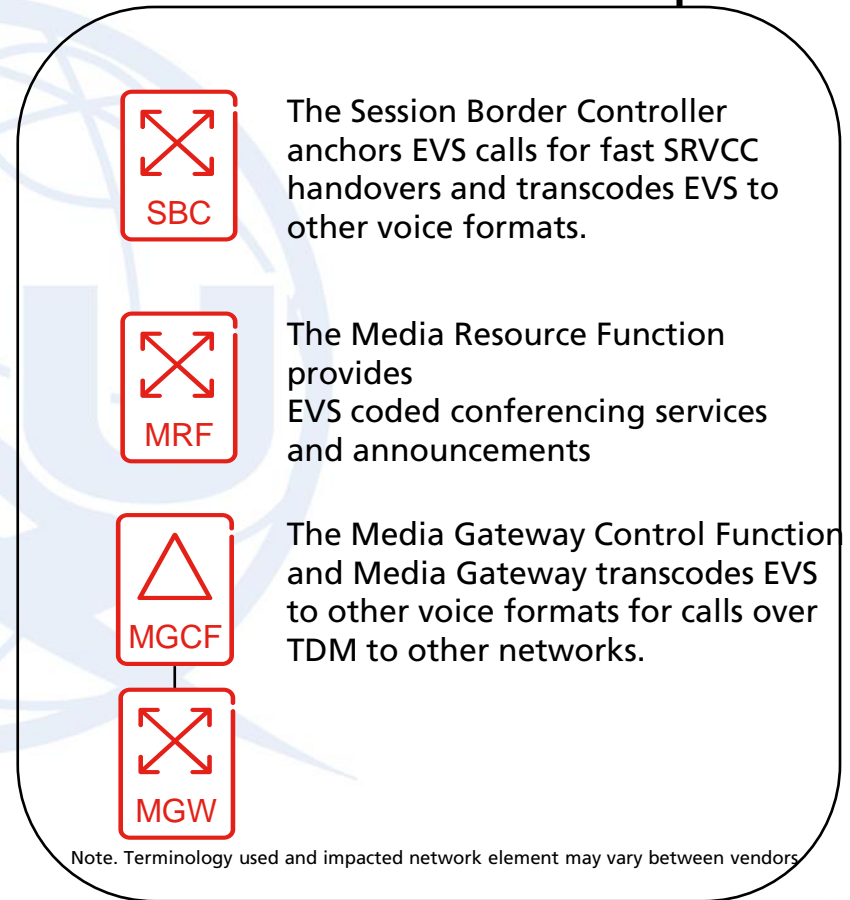
EVS Interoperability aspects (2)

- EVS transport has been designed for LTE, interoperable to AMR-WB

    - Same RTP packet sizes as AMR-WB

    - Constant bitrate

    - VAD/DTX/CNG operation

    -> Facilitates easy transition from AMR-WB in VoLTE networks

EVS – VOLTE NETWORK IMPACT

High-level network impact

IMS

Evolved Packet Core

VoIP Network

CS Network

VoLTE

2G / 3G

Impact only on IMS and terminals

Detailed IMS impact

SBC
The Session Border Controller anchors EVS calls for fast SRVCC handovers and transcodes EVS to other voice formats.

MRF
The Media Resource Function provides EVS coded conferencing services and announcements

MGCF
MGW
The Media Gateway Control Function and Media Gateway transcodes EVS to other voice formats for calls over TDM to other networks.

Note. Terminology used and impacted network element may vary between vendors

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Conclusions

- EVS enables operators to offer superior voice services compared to legacy, especially in super wide band mode

- easy integration into AMR-wb optimized VoLTE networks

- Due to its flexibility, EVS can become the „single codec" for mobile as well as fixed services, including VoWiFi