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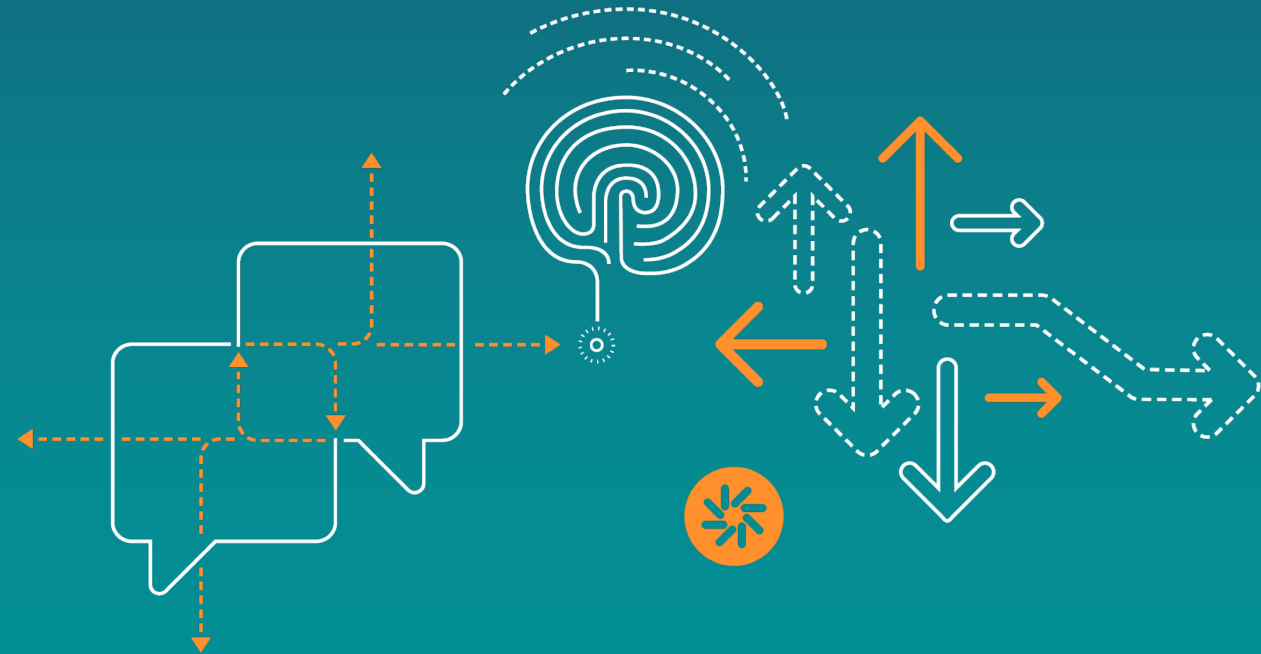
Qualcomm Technologies, Inc.

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# Voice Quality with VoLTE

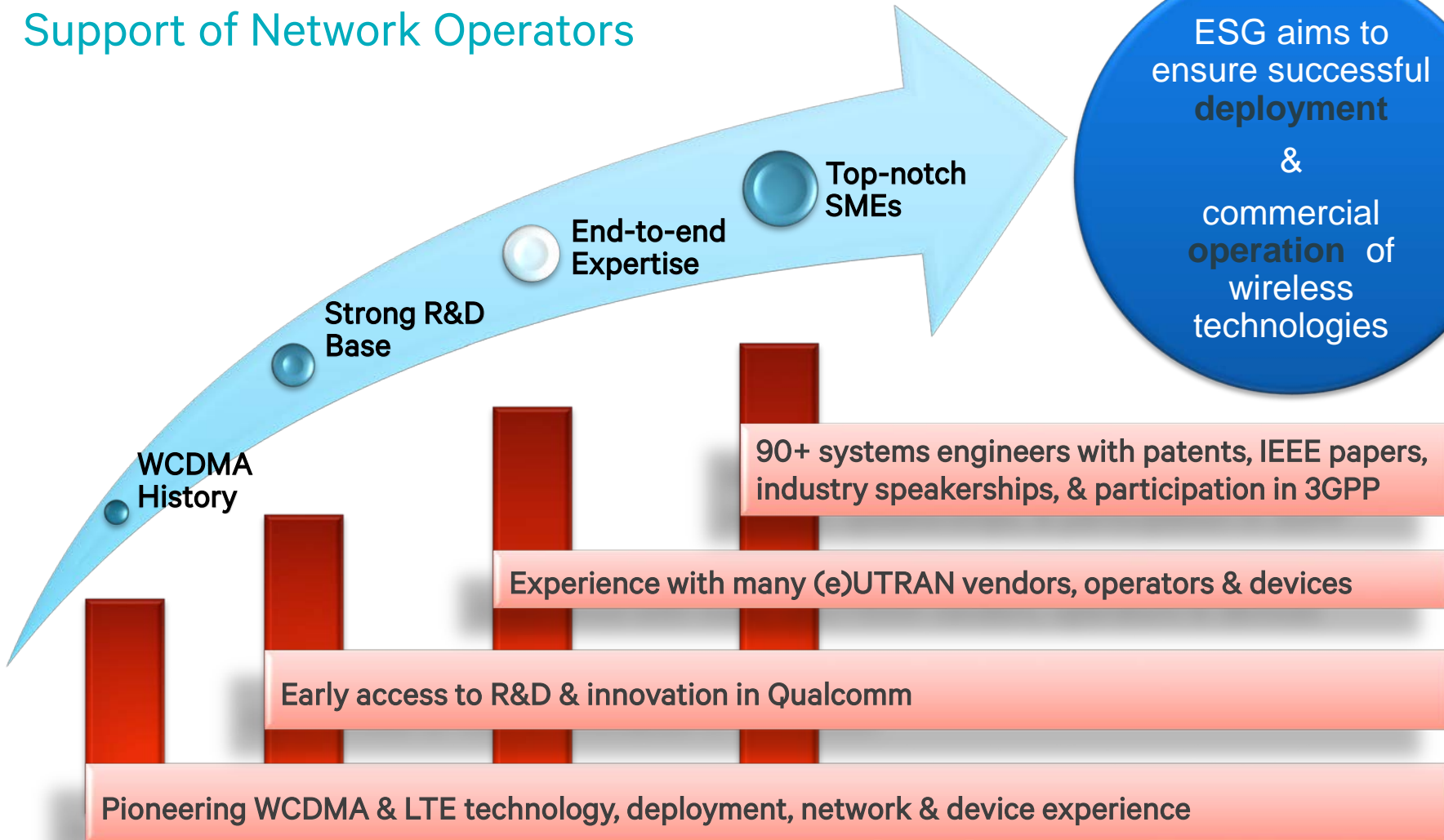
20. ITG Tagung Mobilkommunikation 2015

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# Qualcomm Engineering Services

## Support of Network Operators



ESG aims to ensure successful **deployment** & **commercial operation** of wireless technologies

- By offering **Operators**
- Advanced engineering services
  - Systems engineering & technical consultation
  - Training & workshops



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# Outline

1. Qualcomm Engineering Services
2. LTE Eco System
  - a) Voice Support in LTE
  - b) IMS & VoLTE
3. VoLTE Voice Quality
  - a) Testing
  - b) Voice Quality vs. Speech Codec
  - c) Voice Quality vs. Isolation
  - d) Voice Quality in Mobility
  - e) Mouth-to-Ear Delay
4. Conclusions

# Voice Support in LTE

## E-UTRAN Is An All-IP Network

Three options are available to support **Voice Services**

- **VoIP over LTE (VoLTE)**

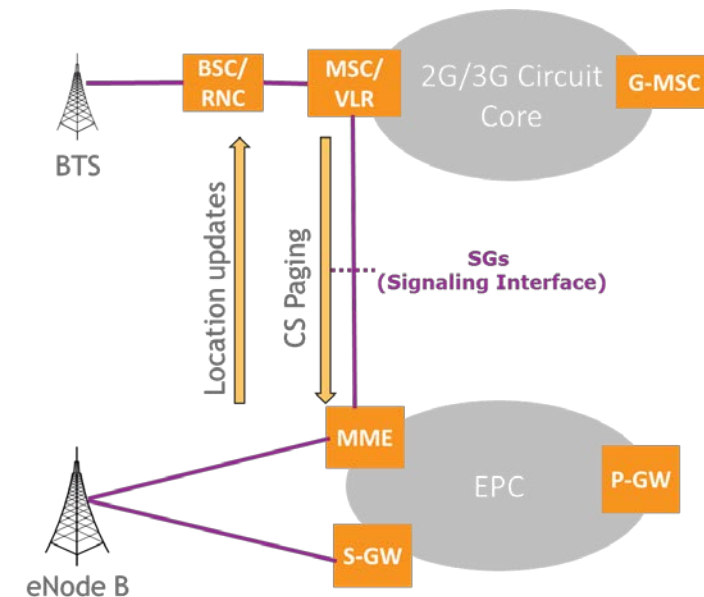
- VoIP services supported by LTE through an IMS (IP Multimedia Service) framework
- Supplemented by Single Radio Voice Call Continuity (SRVCC)

- **Circuit Switched Fallback (CSFB)**

- No VoIP support required
- Voice services are supported by falling back onto an existing 2G or 3G CS network

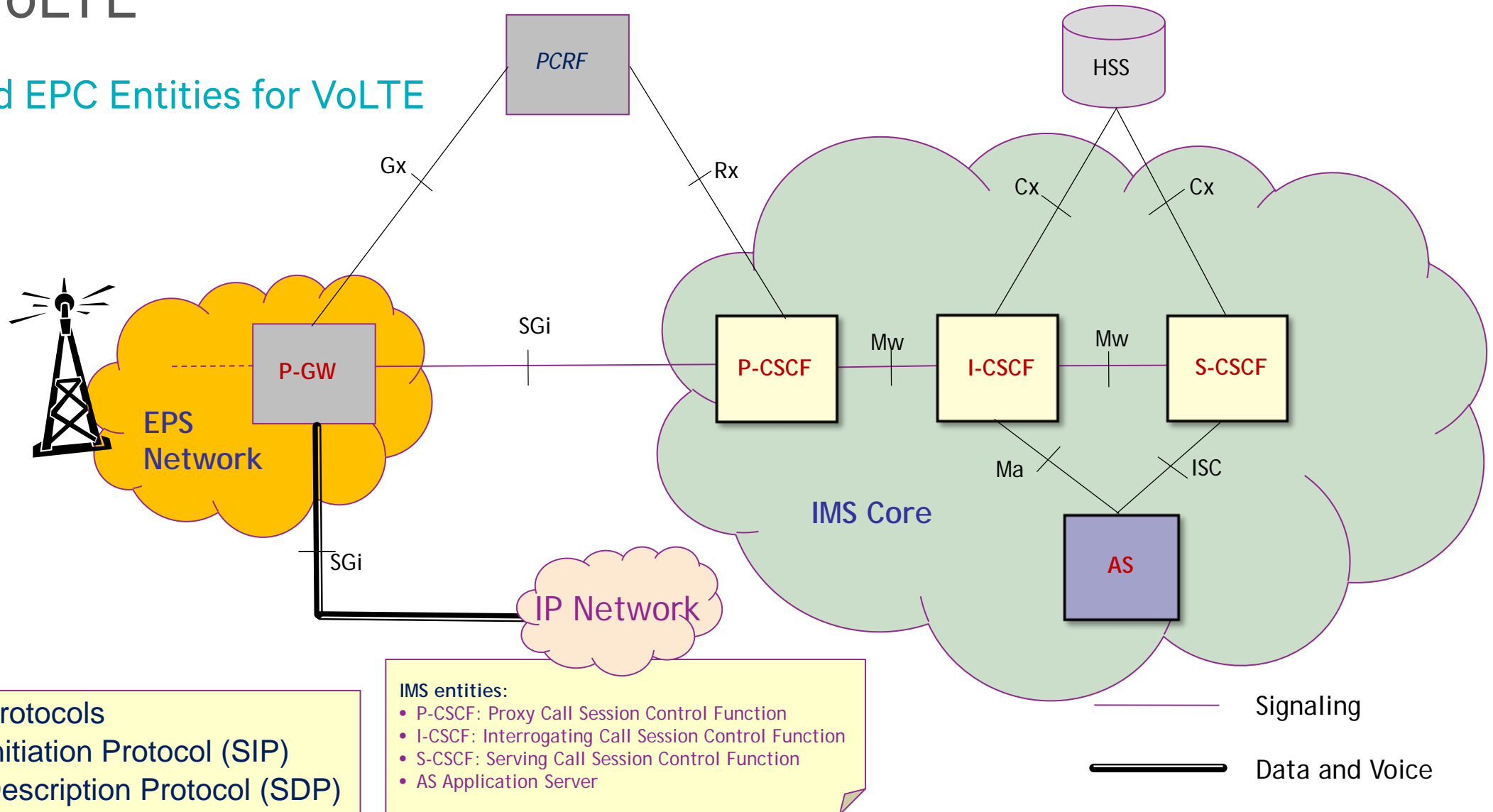
- **SVLTE (Simultaneous Voice and LTE Data)**

- Device-based solution requiring dual radio UEs
- Simultaneous communication with a legacy network for voice services and E-UTRAN network for data services



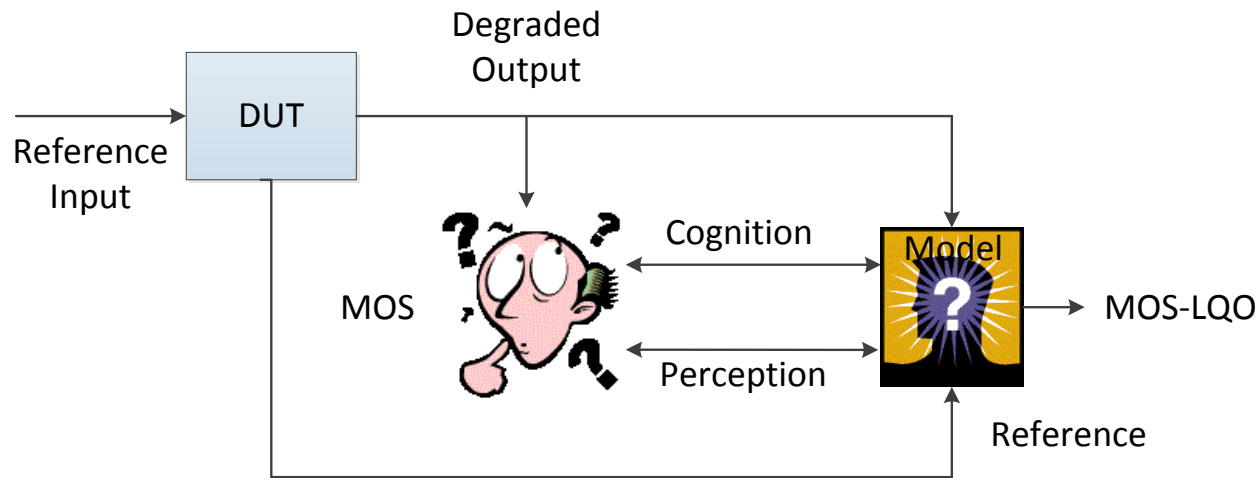
# IMS & VoLTE

## Key IMS and EPC Entities for VoLTE



# VoLTE Voice Quality

## Testing



MOS Score	Quality Level
5	Very Good
4	Good
3	Fair
2	Poor
1	Bad

- MOS – Mean Opinion Score
- POLQA (Perceptual Objective Listening Quality Assessment)
  - An objective method for predicting overall listening speech quality for the IP-based network technology
  - Based on ITU T P.863

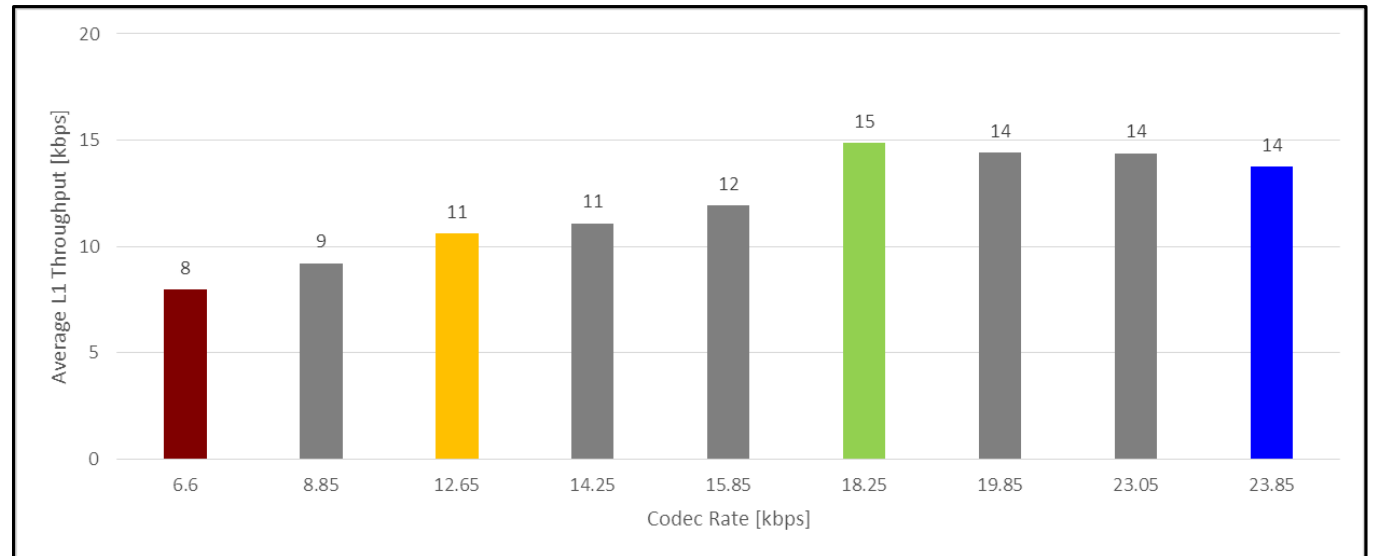
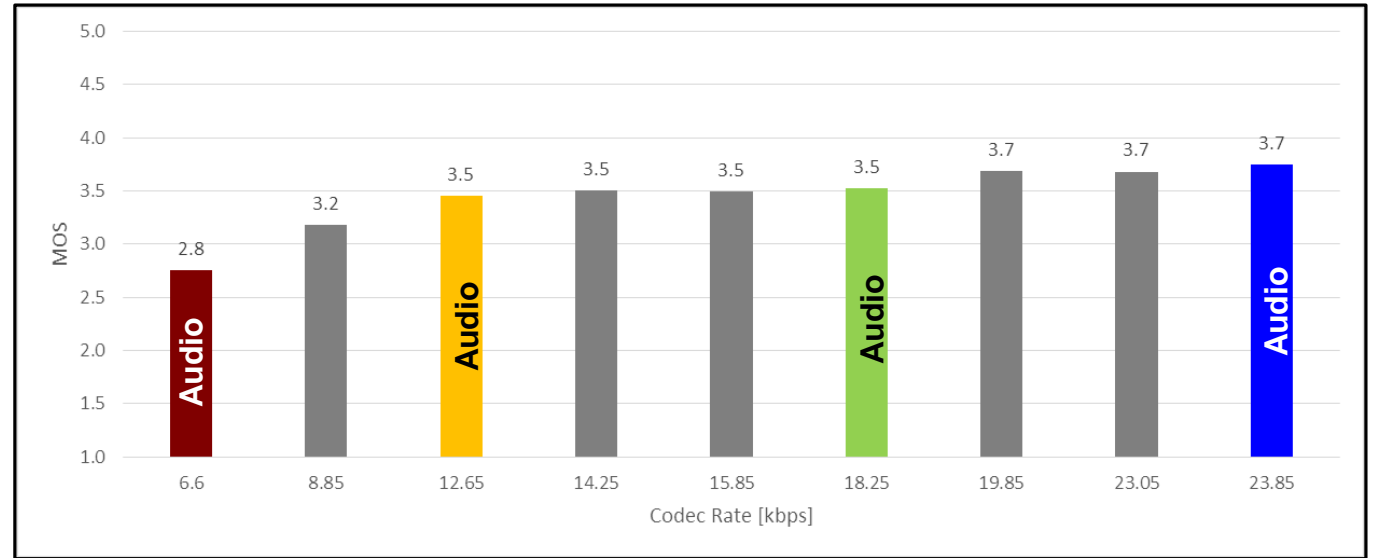


# Voice Quality vs. Codec

## AMR Wideband

Codec Rate [kbps]	SIP Negotiated RTP Rate [kbps]
6.6	24
8.85	26
12.65	30
14.25	31
15.85	33
18.25	35
19.85	37
23.05	40
23.85	41

Reference Audio



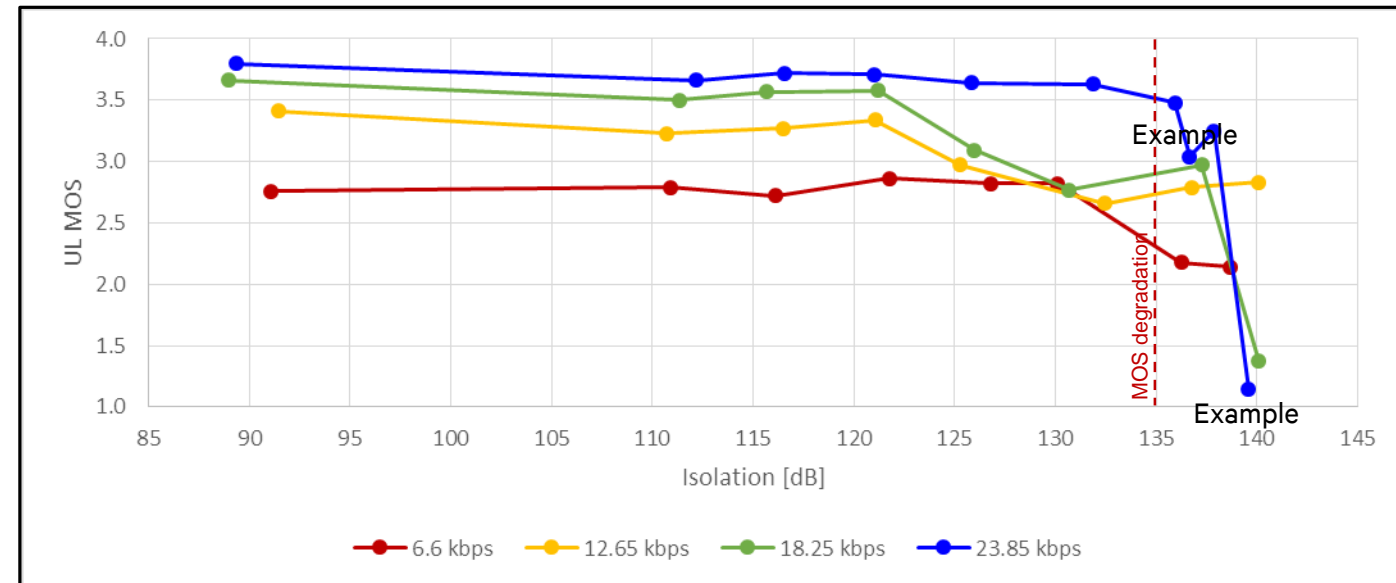
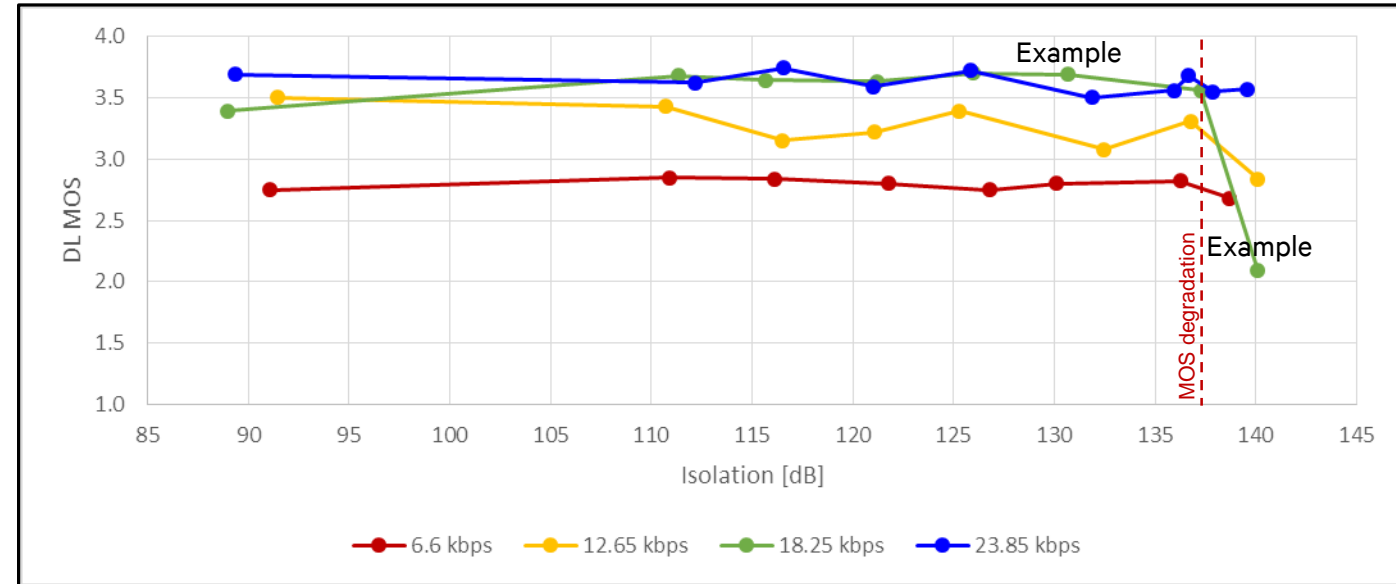


# Voice Quality vs. Isolation

## Link Budget & Network Planning

- LTE link budget is typically UL limited
- DL MOS
  - Maintained almost until maximum isolation
  - MOS degradation not depending on codec type
- UL MOS
  - Degrades earlier than DL MOS
  - Radio link is (typically) UL limited

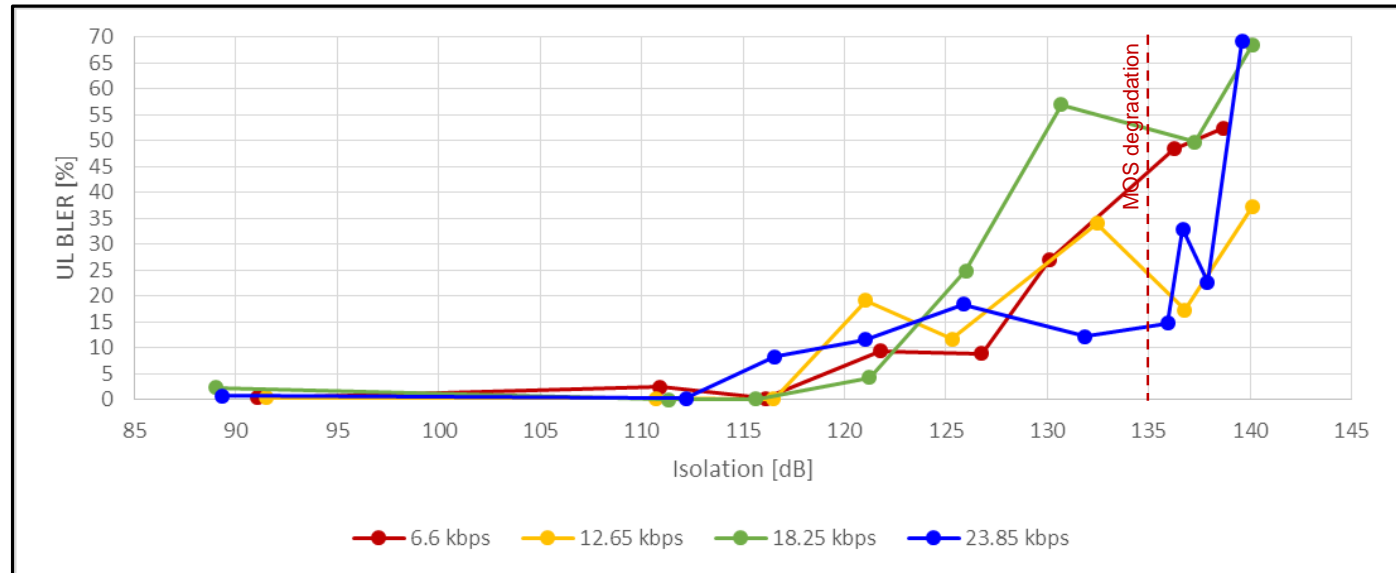
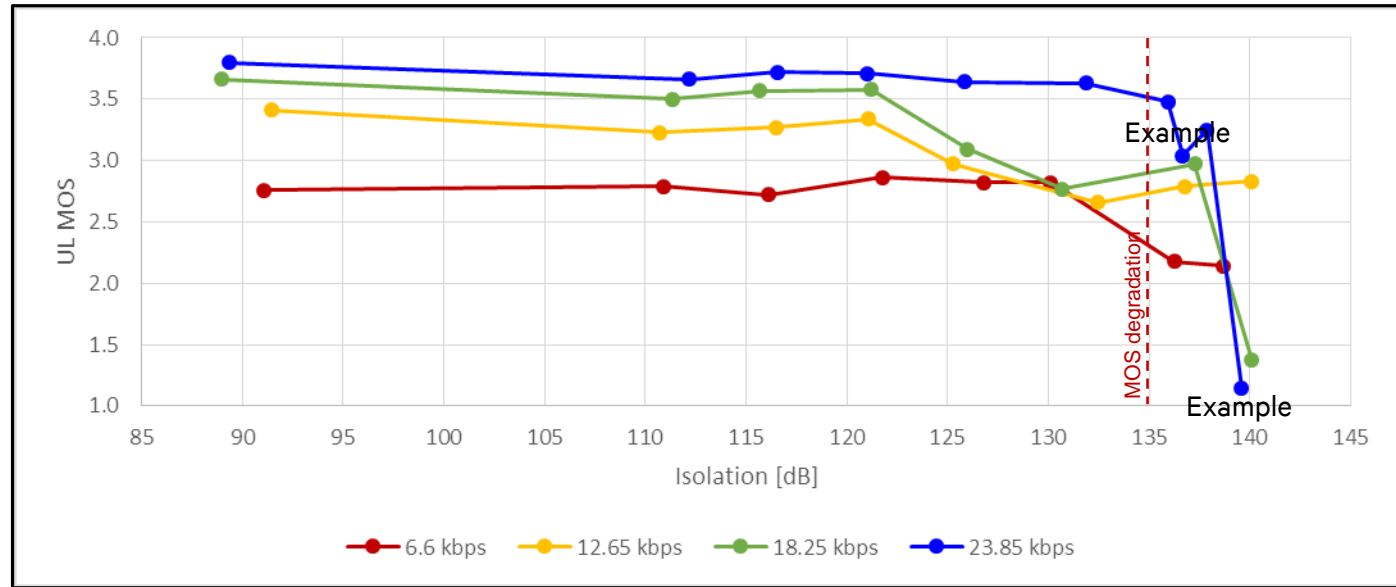
Isolation [dB] = RS\_power – RSRP  
(= total attenuation between eNodeB and UE)



# Voice Quality vs. Isolation

## Correlation of MOS and BLER - UL

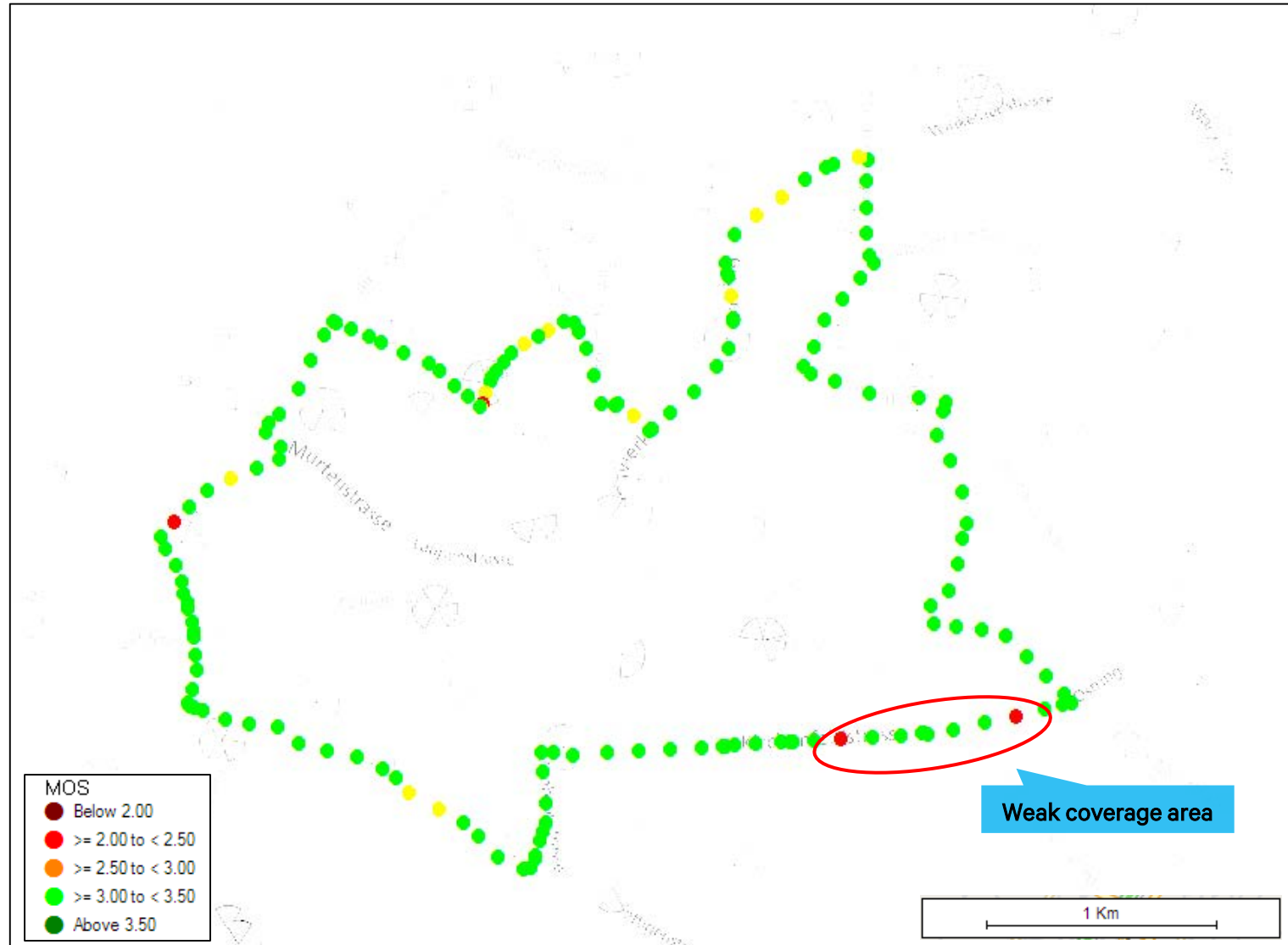
- UL BLER starts to rise from ~120 dB isolation
  - Radio link is UL limited
  - No significant difference between codecs
  - BLER is already increased RSRP ~ -121 dBm
- MOS degradation is visible when BLER > ~15%
- Voice Samples
  - 23.85 kbps: Isolation = 137 dB: UL MOS = 3.1
  - 23.85 kbps: Isolation = 140 dB: UL MOS = 1.1



# Voice Quality in Mobility

## Typically Impaired by RF

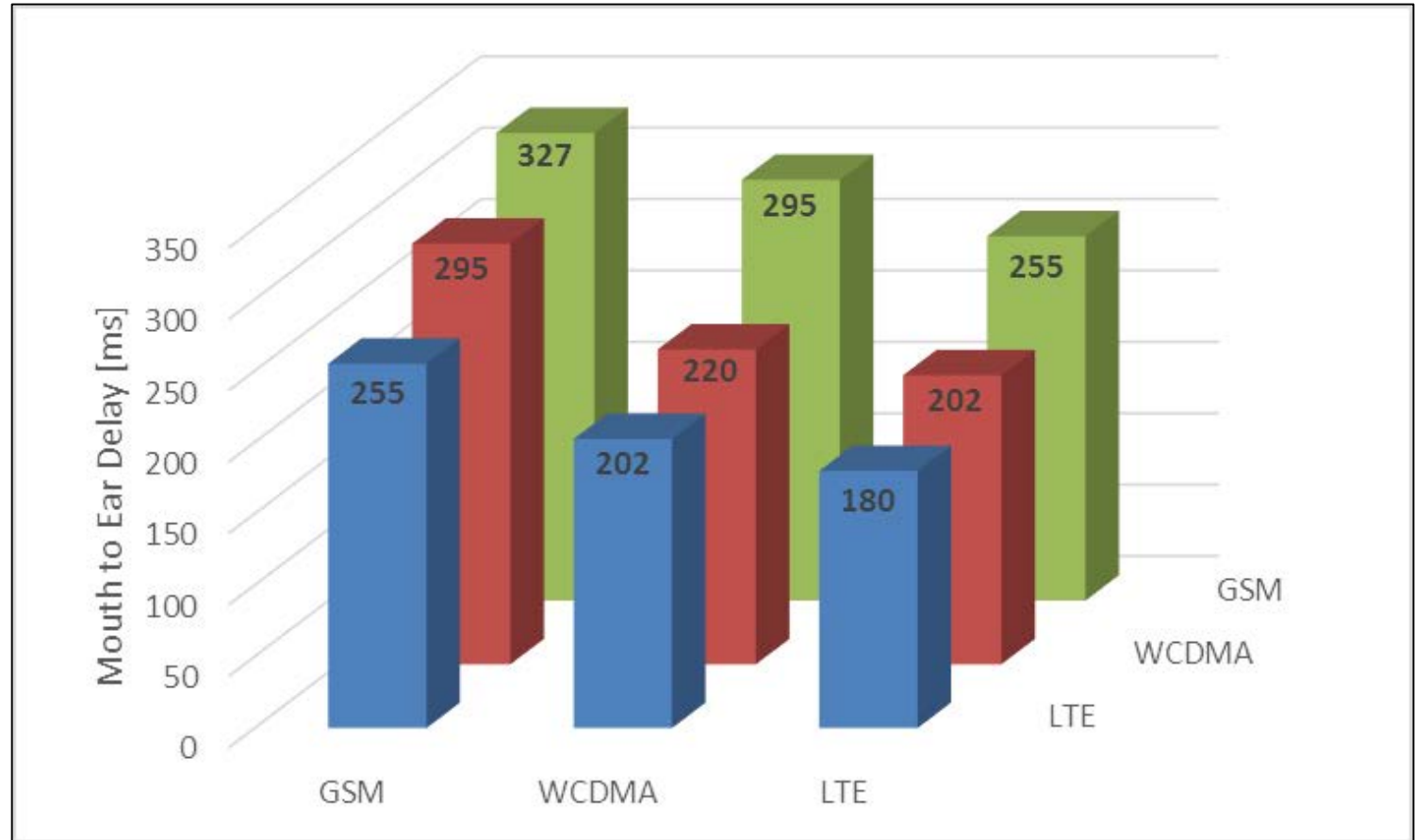
- Voice quality in mobility
  - Interruptions due to handovers
  - Hard handover in LTE
  - SRVCC (IRAT)
  - Impairments from weak coverage
    - Radio link failures
    - RTP packet loss
    - Jitter



# Mouth-to-Ear Delay

## Results of a Technology Check

- Test was performed to measure audio channel delay between pairs of different technologies
  - Single cell, good RF stationary location on all technologies
  - Average of UL and DL values is shown in the diagram
- Results scale with technology
  - LTE to LTE with lowest delay
  - GSM to GSM with highest delay
- Acceptance limit: ~300 ms



# Conclusions

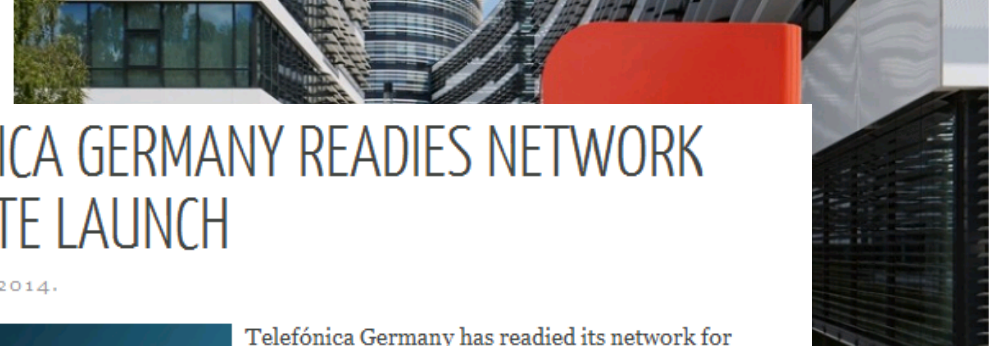
## VoLTE Voice Solution

- All IP approach based on IMS, SIP/SDP
  - Solid LTE networks
  - Complex setup but maturing fast
  - Integrated solutions (mobile & fixed networks)
- Voice quality in LTE
  - Interworking with LTE network
  - QoS support
  - AMR wideband codec family
  - Codec and RF (radio isolation) impact
- Excellent user experience
  - Speech quality
  - Call setup durations

## Vodafone Germany claims country's first commercial VoLTE service



Written by [Auri Aittokallio](#) | 16 March 2015 @ 11:05



## TELEFÓNICA GERMANY READIES NETWORK FOR VOLTE LAUNCH

ON 22 OCTOBER 2014.



Telefónica Germany has readied its network for VoLTE, becoming one of the first operators to offer converged wireless and wireline services on a common IMS core network.

As announced **yesterday**, Ericsson is the main supplier and has deployed a range of products from its IMS portfolio, such as call session control

re-over-LTE (VoLTE)  
re first live VoLTE call

services produc

4G

16.03.2015 19:21

## Voice over LTE: Auch Telekom und o2 stehen in den Startlöchern

*Auch die Deutsche Telekom und o2 wollen in Kürze Voice over LTE anbieten. In unserer Meldung erfahren Sie mehr zum aktuellen Planungsstand zum Start der Telefonie im LTE-Netz der Vodafone-Konkurrenten.*

*Von Markus Weidner*

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# Thank you

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