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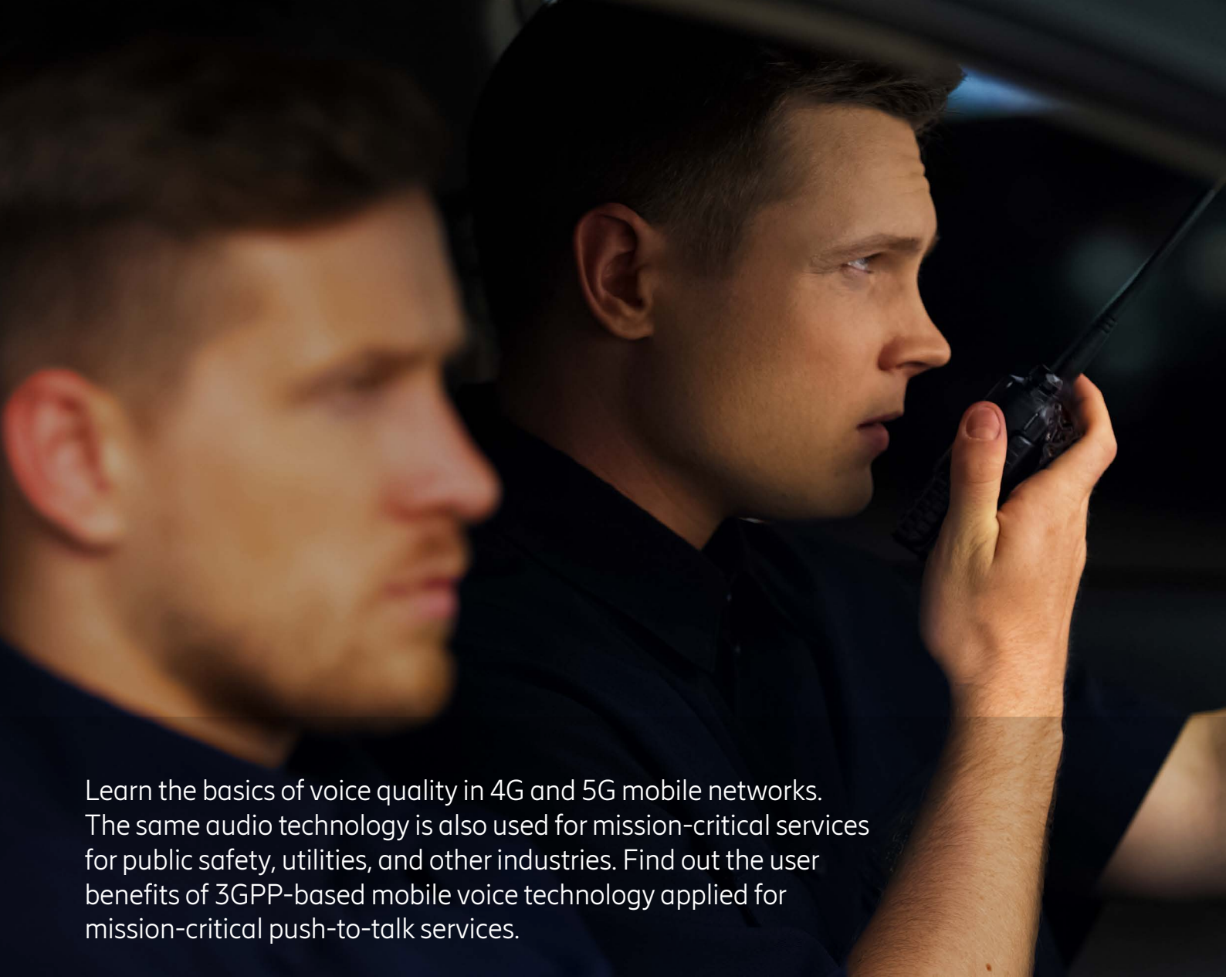
Voice quality in mission-critical 4G and 5G networks

Learn about the audio quality benefits for users of 3GPP-based push-to-talk



Learn the basics of voice quality in 4G and 5G mobile networks. The same audio technology is also used for mission-critical services for public safety, utilities, and other industries. Find out the user benefits of 3GPP-based mobile voice technology applied for mission-critical push-to-talk services.

Learn about:

Why you can be heard better over a mobile voice call when you are in a noisy work environment.

Why women are heard better with the latest voice technologies.

How mission-critical 4G and 5G 3GPP-based networks enable new audio quality benefits for push-to-talk services.

Voice quality in commercial and mission-critical 4G and 5G networks

The audio quality in mobile voice calls has evolved since the introduction of commercial 2G mobile networks, with improvements in voice coding technologies. All mobile voice codec, audio technologies, and commercial networks and devices are based on global telecommunications standards, as defined by 3GPP (the global telecommunications organization for the mobile broadband standard).

2G and 3G mobile networks first used narrowband voice quality (NB, usually 13.2 kbps). Then wideband HD voice (AMR-WB, usually 13.2 kbps) was introduced, mainly in 3G networks. With the coming of 4G networks, HD voice became the default voice codec in 4G smartphones. The latest 3GPP standards-based voice codec "HD Voice+" (EVS, Enhanced Voice Services) is default in 5G standalone networks, and it can also be optionally used in 4G smartphones.

The same audio technology is also used in 3GPP-based mission-critical applications, such as push-to-talk, which is used by public safety, utilities, and other industries. Current land mobile radio (LMR) networks use narrowband voice, usually 4-7 kbps, which provides lower voice quality than 3GPP-based narrowband 2G and 3G mobile voice codecs.

One of the challenges in the current LMR networks is that, due to poor audio quality, there is significant occupancy of the voice channel where the first responders ask for clarification and repeated information. Additionally, users are concerned that while, in most cases, they understand the message, legacy LMR codecs do not carry sufficient audio context to clearly identify which person they are talking to, causing confusion and delays in the sharing of time-critical information. These impairments are removed with the introduction of wideband state-of-the-art 3GPP voice technology.

Figure 1 shows an overview of the audio bandwidth for the different 3GPP-based telecommunications voice codecs used for commercial mobile voice calls. The purple area shows wideband voice quality (HD voice), which is also used for mission-critical push-to-talk services over 3GPP-based 4G mobile networks.

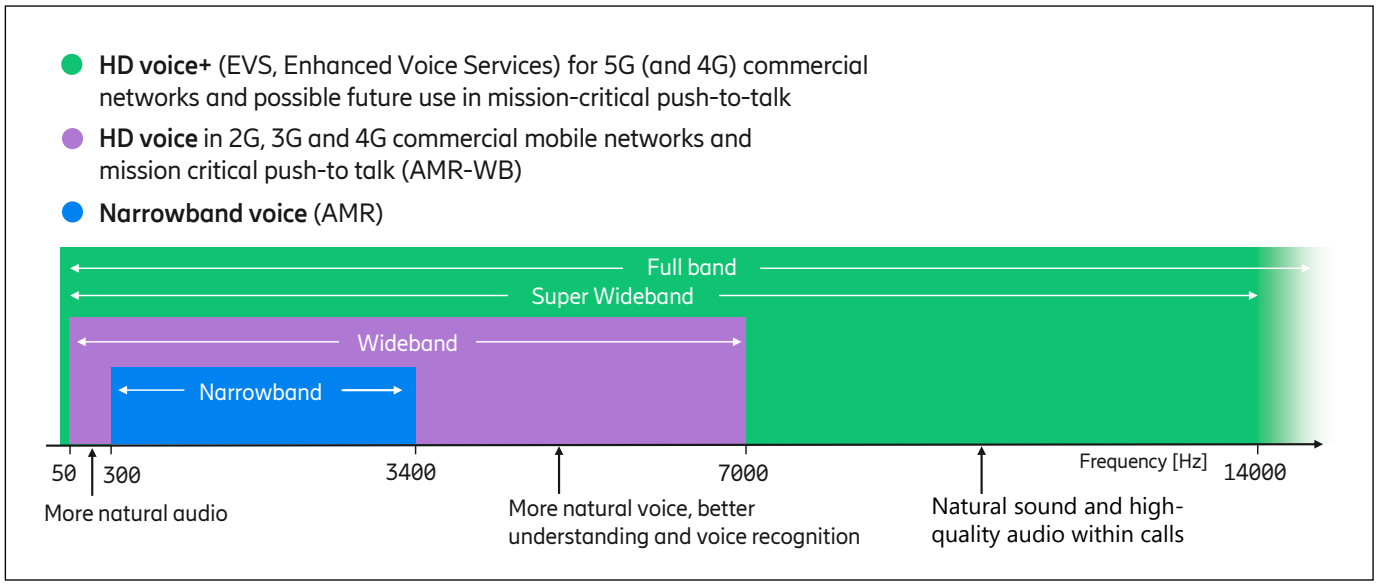


Fig 1: Audio bandwidth ranges for mobile voice services in 3GPP-based commercial and mission-critical 4G and 5G networks.

Women and people with a higher pitch voice are heard a lot better with wideband voice compared to narrowband voice, as higher frequencies are included. That's one of the key benefits of HD voice. Moreover, with HD voice+ (the green area) you will almost feel like you are standing next to the person you are talking to over the phone.

Normally: there are extra microphones integrated on commercial smartphones which are used to pick up and cancel out disturbing background sound, to provide better audio quality during a mobile voice call.

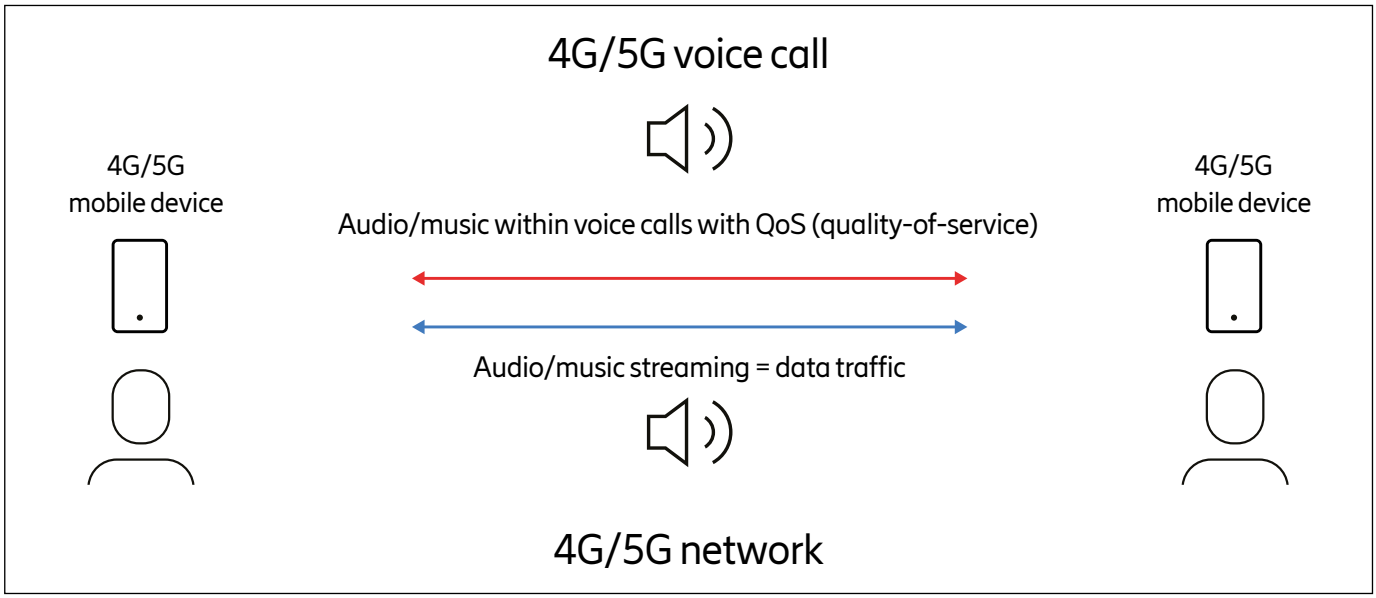
The audio quality user experience will differ between the different devices and smartphone brands and models, as it also depends on the quality of the microphones, loudspeakers, and other audio software implementations in devices. The bitrate can be set to vary between 7 kbps up to more than 24 kbps, but the most common commercial 3GPP network deployments use 13 or 24 kbps.

Audio quality within mobile voice calls

Different kinds of audio can also be transferred within a mobile voice call, with significantly higher quality using the latest audio codec HD voice+ (EVS). It may, for example, be music or other types of announcements in a call queue, or if you make a phone call when you are at a concert, the person you call may hear the music in the background a lot better than in narrowband voice calls.

Music is more of a consumer service, and is not likely to be used in mission critical push-to-talk services, but the same audio technology that can handle the technically challenging music use case, can be applied for other scenarios. For example the audio quality in pre-recorded announcements will be improved, to be used to inform first responders if they are entering a dangerous area. In the future, other applications can be developed, for example, ambient listening within a push-to-x call, where the command center staff can hear better what is happening in the background of a rescue operation. New device implementations would then have to be developed, to support these kinds of services and new types of devices may also be developed (helmets, smart speakers, special goggles, etc).

Fig 2 shows a high-level overview of the difference between audio within calls versus streaming audio services (data services). All voice calls are prioritized in the mobile network, over data traffic (streaming, browsing, etc.), to ensure high-quality real-time critical voice and push-to-talk services.



Example use cases with HD voice+ (EVS) within calls

- Music in call queue and pre-recorded announcements
- Personalized voice+music message for voice mailbox
- Other new services to be invented

Note the difference between

- Audio which takes place within a 4G/5G mobile voice call
  - It is benefitting from being prioritized vs mobile broadband data traffic by the network's quality-of-services merchanisms that mobile voice calls use
- Music streaming services (like consumer music smartphone apps) are run as regular mobile broadband data services (no network priority)

Fig 2. Voice calls are prioritized over data traffic in the mobile network to enable high-quality voice services.

Future evolution of audio quality in 4G and 5G networks

We have listed some examples in figure 3 of how the HD voice+ (EVS, Enhanced Voice Services) can be used to develop future services with a much better user experience for different use cases, for consumer and enterprise, as well as mission-critical push-to-talk services.

Voice
- Clearer voice quality in emergency situations
- Detect patterns in person's voice in stressful first responder situations, coluld be combined with other sensor data (body temperature, heartrate)
- Better live medical diagnosis over phone call
- Use your voice as digital fingerprint

Audio within calls
- Improved music and other types of audio in pre-recorded announcements and call queues
- Share ambient sound via phone call
- Other use cases and innovations to be further developed...

Fig 3. Innovation ideas how the HD voice+ technology can be used to improve different use cases with better audio quality.

Figure 4 illustrates the evolution of mobile voice services starting with fixed telephony networks and the first mobile networks, and then towards future networks, with new types of devices that support mobile voice services for different use case scenarios. Standardization in 3GPP is ongoing to develop new immersive voice and spatial audio services for 5G networks, and this technology can also be used and adapted for future mission-critical 5G applications. New types of services and applications for consumers, enterprises, and different industry use cases can be developed using 5G and future networks, to create greater communications experiences for different situations in private and business life.

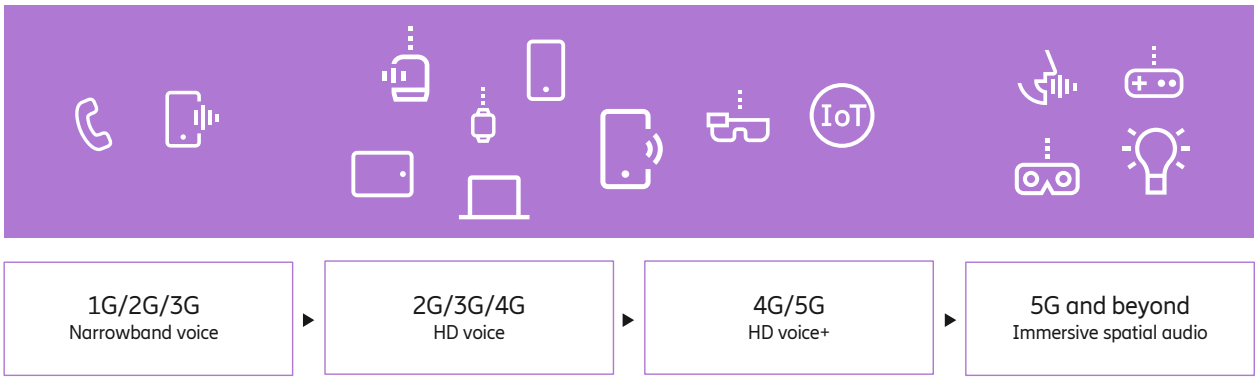


Fig 4: Voice quality evolution in 1G to 6G mobile 3GPP-based networks and devices.

Explore Ericsson's mission-critical communications offerings

Insights for communication service providers: Mission-critical communications

Explore how different industries can benefit from 4G and 5G mission-critical communications: Accelerate your industry transformation

Learn more about 3GPP-based mobile voice technologies in 4G/VoLTE networks and 5G voice network evolution aspects for communication services providers.

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