**Title: Multi-Microphone Capture on UE**

**Source: Panasonic Holdings Corporation**

**Document for: Discussion & Agreement**

**Agenda item: 7.8.**

1. Background

Inbuilt microphones in modern-day smartphones equipped with MEMS microphones supporting more than one microphone. Source has investigated the latest smartphone devices by physically inspecting various mobile brands devices, surveyed the technical specification, and analyzed the hardware diagrams available on the internet. The survey result is presented for discussion and for inclusion in the TR 26.933[6].

2. Discussion

The following content is proposed for inclusion in the clause 6.1.4 of TR 26.933.

4.1.2 Microphones

Modern smartphone devices come with inbuilt MEMS microphones supporting more than one microphone, while the top end devices have inbuilt microphones between 3 to 4; mid-range devices support dual microphones. With multi-microphones as a feature, they offer several advantages over devices with mono including improved audio quality, better spatial awareness, more accurate noise cancellation, better sound localization.

The spacing between the multi-array microphones, its polar pattern and the number of microphones varies from device to device. However, generally the spacing ranges from 3cm – 17cm. The following table covers the specifications of these microphones in smartphones.

Table 1: MEMS Microphone example characteristics for Multi-array microphones in Smartphone.

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of Microphones** | **Placement of Microphones** | **Spacing** | **Polar Pattern** |
| Dual Microphone array | Top and Bottom of Bezel | 12 to 17 cm | Omni-directional or Cardioid |
| Bottom of Bezel and rear facing | 10 to 15 cm |
| Triple Microphone array | Top, Bottom of Bezel and Rear Facing | 5 to 17 cm | Omni-direction, Cardiod, directional |
| Quad Microphone array | Top, Dual Bottom of Bezel and Rear Facing | 5 to 17 cm | Omni-direction, Cardiod, directional |

Microphones with 3cm stereo spacing are usually located at the bottom of the bezel (left and right side of USB C-Port), while the larger spacing is achieved with a combination of top, bottom bezel microphone and/or rear facing microphone. Because the user can operate and hold the device in a variety of ways, a combination of these microphones can be activated for stereo voice communication and efficient capturing configuration is possible with advancements in audio processing by means of fine-tune of audio signals through pre-processing which offers great potential for enhancing stereo performance for different user end consumption scenarios such as loudspeaker and/or headphones.

3. Conclusion

Source proposes to agree the inclusion of clause 6.1.4.5 into the TR 26.933[6]

4 References

[1] <https://seektogeek.com/where-is-microphone-in-samsung-s22-ultra-s22-s22-plus/?utm_content=cmp-true>

[2] <https://support.google.com/pixelphone/answer/7157629?hl=en#zippy=%2Cpixel>

[3] [Pixel phone hardware diagram - Pixel Phone Help (google.com)](https://support.google.com/pixelphone/answer/7157629?hl=en#zippy=%2Cpixel-pro%2Cpixel) [Pixel phone hardware diagram - Pixel Phone Help (google.com)](https://support.google.com/pixelphone/answer/7157629?hl=en#zippy=%2Cpixel-pro%2Cpixel)

[4] [iPhone 15 Pro Max - Technical Specifications (apple.com)](https://support.apple.com/kb/SP904?locale=en_US)

[5] [Where is the Microphone on iPhone 14 Series? 14 Pro, 14 Pro Max, Plus (howtoisolve.com)](https://www.howtoisolve.com/where-is-the-microphone-on-iphone/#Where_is_iPhone_mic)

[6] S4-231944, TR 26.933 v0.3.0, Oct 2023