NORDICTECH
WEBINARS

# Introduction to Bluetooth LE Audio

# Today's hosts

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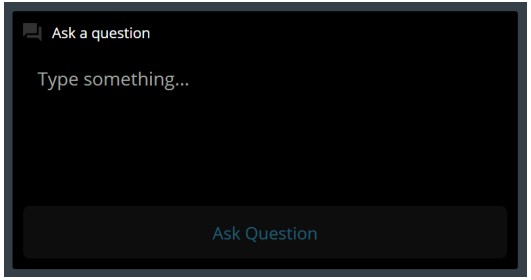
PMT

NORDIC SEMICONDUCTOR

# Practicalities

- Duration: about 60 minutes
- Questions are encouraged!
  - Please type questions in the top of the right sidebar
  - All questions are anonymous
  - Try to keep them relevant to the topic
  - We will answer towards the end
- The chat is not anonymous, and do not use for questions
- Go to DevZone if you have more questions
- A recording of the webinar will be available together with the presentation at webinars.nordicsemi.com





{ DevZone

# Introduction to Bluetooth LE Audio

Nordic Semiconductor

*Eirik Midttun*

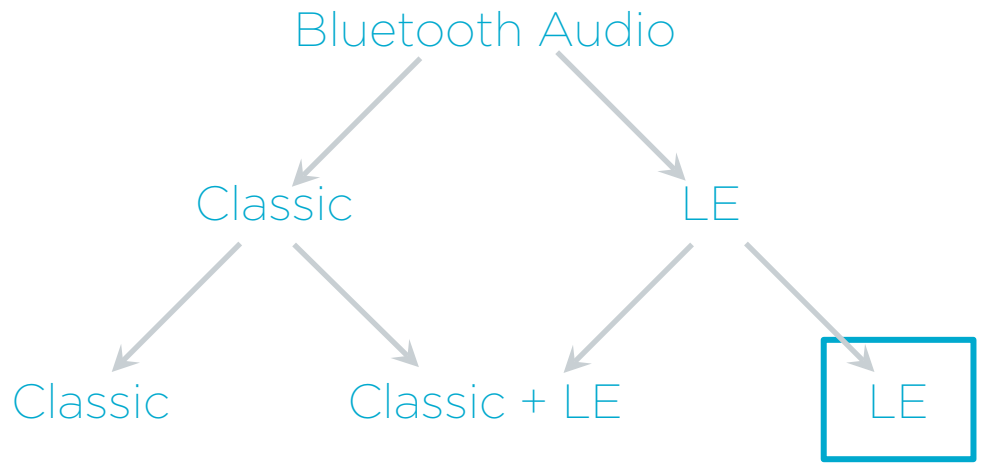
*May 2022*

# “LE Audio” solutions

The next generation of Bluetooth Audio

Specifications

Solutions



# Bluetooth Classic Audio solutions

## A2DP

Advanced Audio Distribution Profile

Stereo audio streaming

## HFP

Handsfree Profile

Two-way mono audio

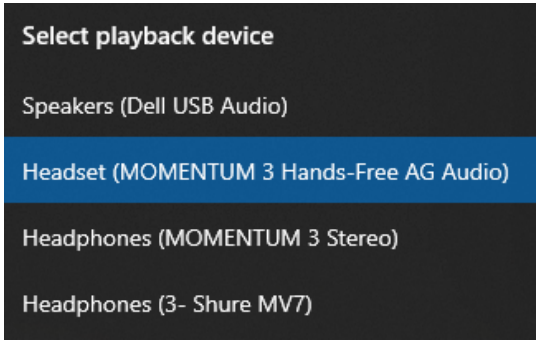
## AVRCP

Audio/Video Remote Control Profile

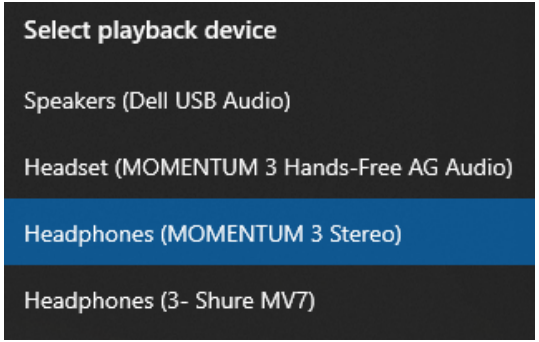
Audio remote control

(Play/pause, volume)

# Hands-Free and Stereo

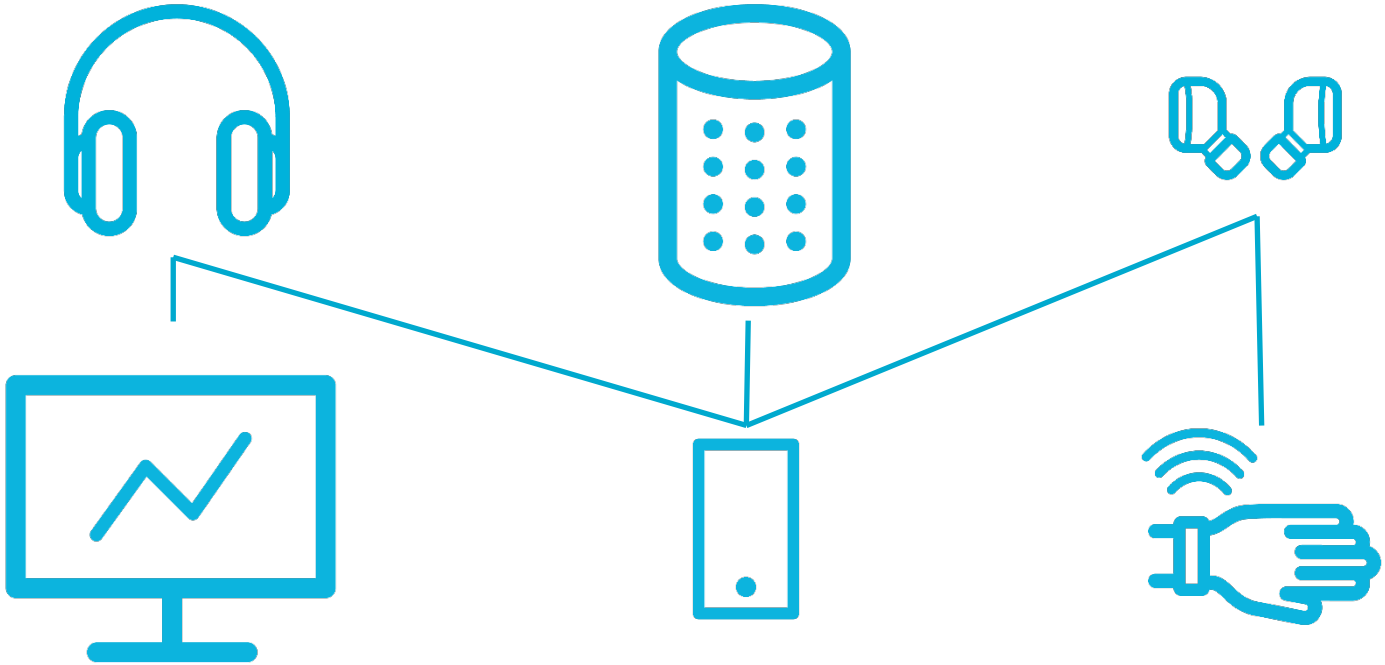



Hands-Free is bidirectional but has worse quality




Stereo is good quality and only one directional

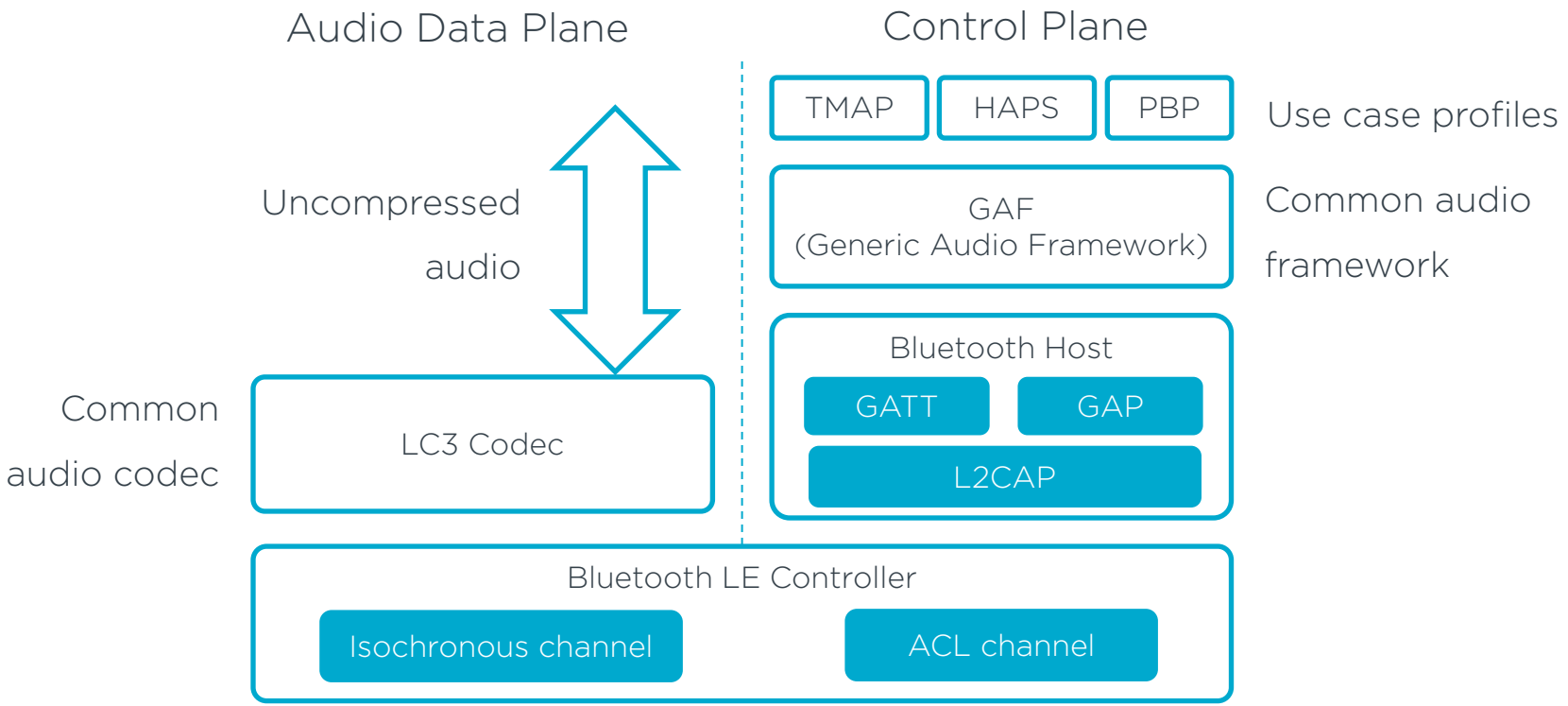
# Personal use of audio - today



# LE Audio overview

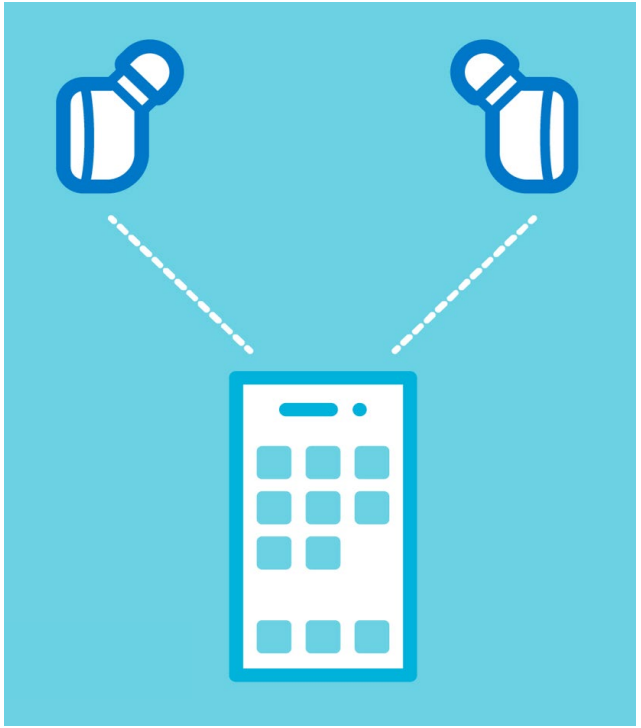
## Technology and enhancements

# LE Audio architecture

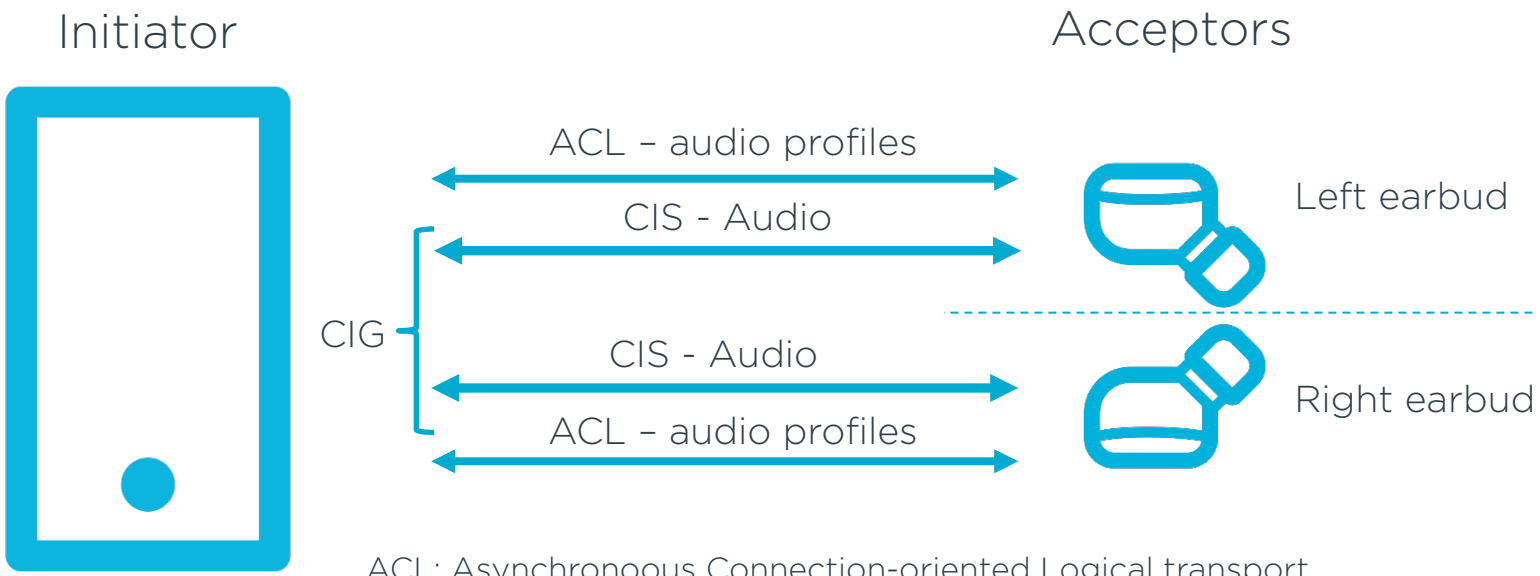


# Isochronous Channels

- Used to transmit time-bound data
- … needing synchronized processing
- Connected and connectionless modes are supported
- Retransmissions allowed until data is said to expire



# LE Audio earbuds example



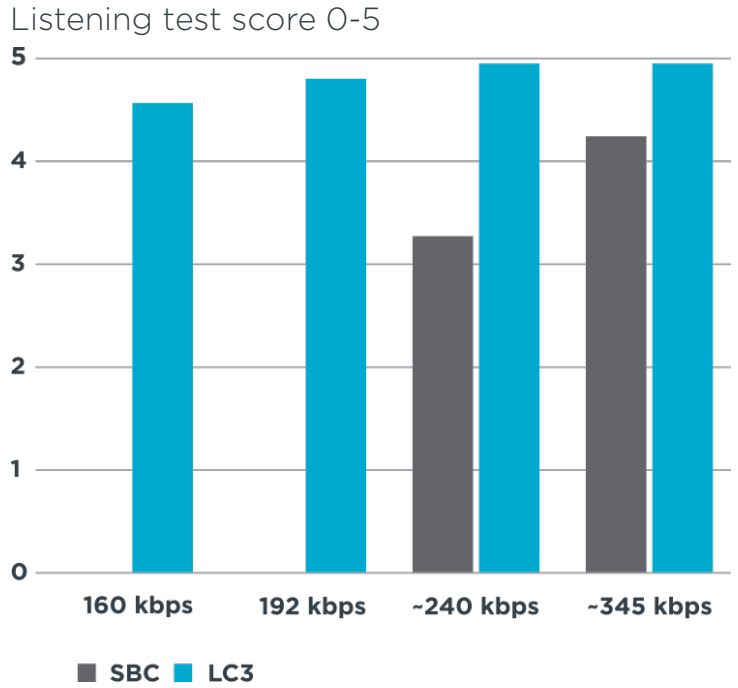

ACL: Asynchronoous Connection-oriented Logical transport

(AKA «Normal Bluetooth LE connetion»)

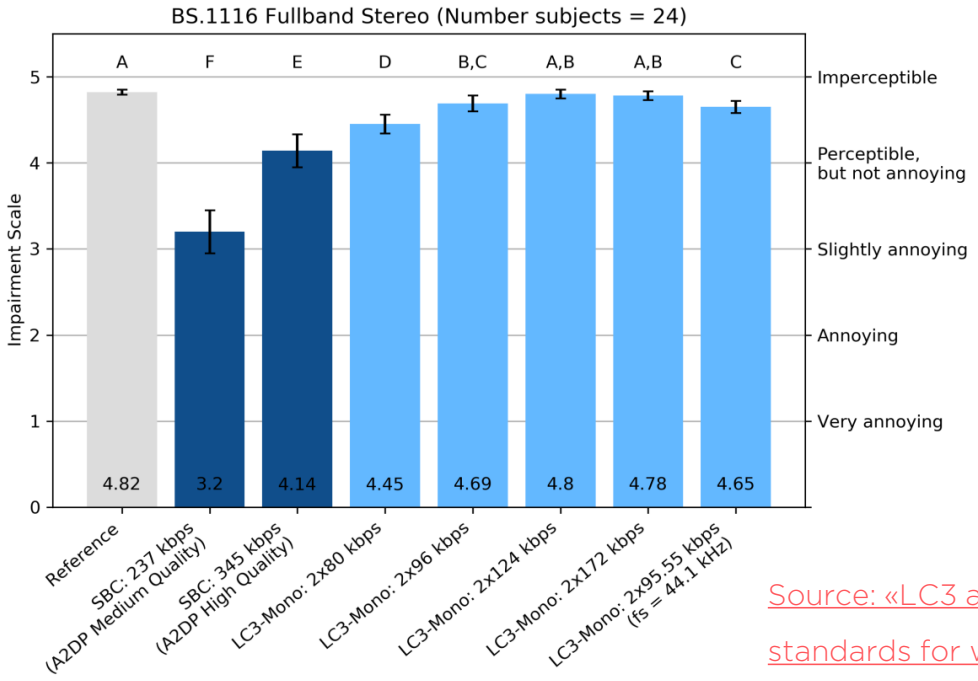
CIS/G: Connected Isochronous Stream/Group

# LC3 – Low Complexity Communication Codec

- LC3 is the required codec for LE Audio
  - Other codecs are allowed
- Better perceived audio quality than SBC
- Less data sent than SBC
- Sample rate from 8kHz to 48kHz
- Data rate from 16 to 320kbps / channel



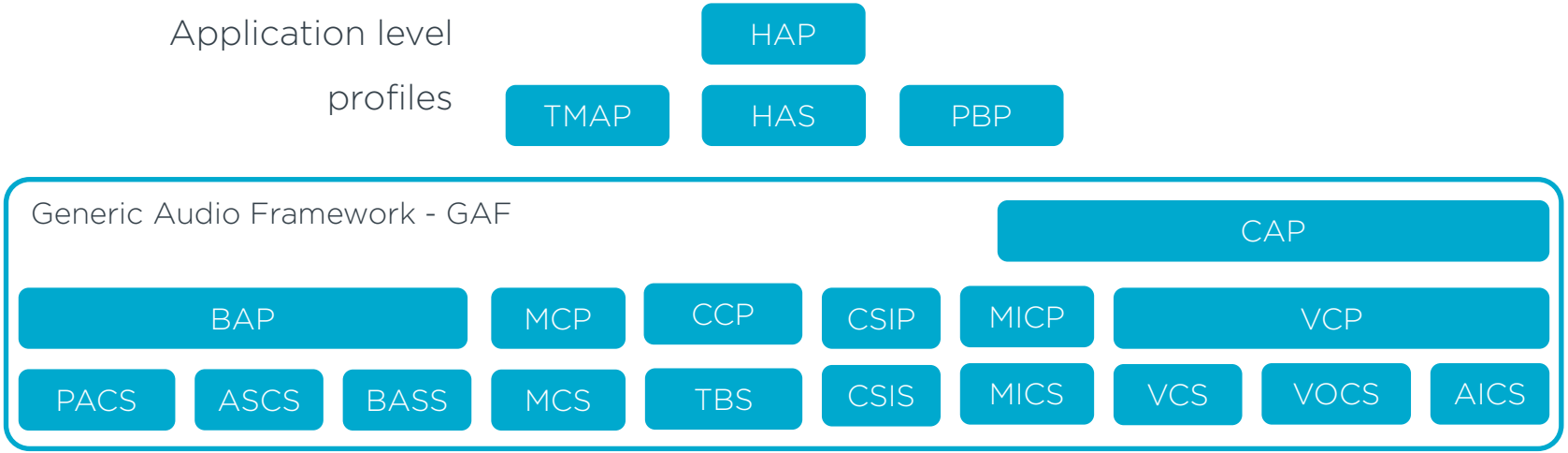
# Audio quality test scores



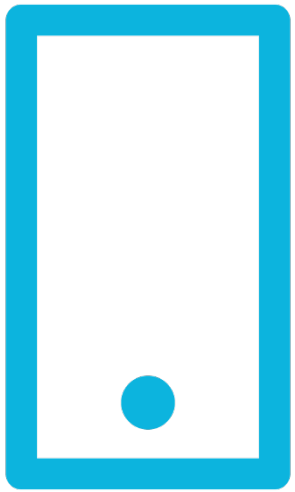

- Subjective listening test
- LC3 is be nearly imperceptible
- Uncompressed audio do not get a ‘5’ score
- Are alternative codecs a thing of the past?

Source: «LC3 and LC3plus: The new audio transmission standards for wireless communication», Schnell, M. et al.

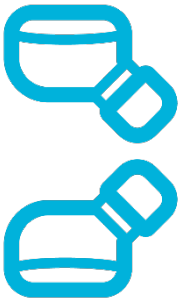
# Bluetooth LE Audio profiles



# LE Audio Basic Audio Profile (BAP)

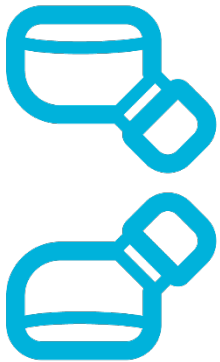


- BAP:
  - Config Codec
  - Config QoS
  - Control Streaming



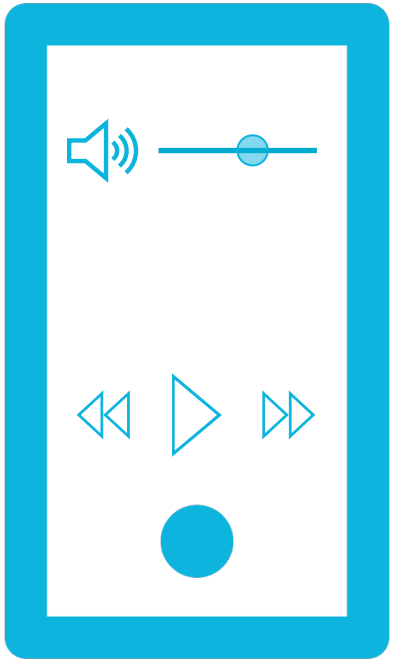
- PACS:
  - Supported audio configurations
  - Audio context
  - Audio location
- ASCS:
  - Audio Stream Endpoints
    - Sink/Source
    - Config
    - State

# Coordinated Set Identification Profile/Service



- Identifies members of a coordinated set:
  - Example: Left and right earbud.
- Ensures mute and volume control apply to all devices in the set.
- Ensures all devices use the same audio source.
  - Relevant for changing use case, music to phone call.
- Lock access from other devices when in use.

# Profiles for listening to music



- Basic Audio Profile (BAP)
- Volume Control Service/Profile (VCS/P)
- Media Control Service/Profile (MCS/P)

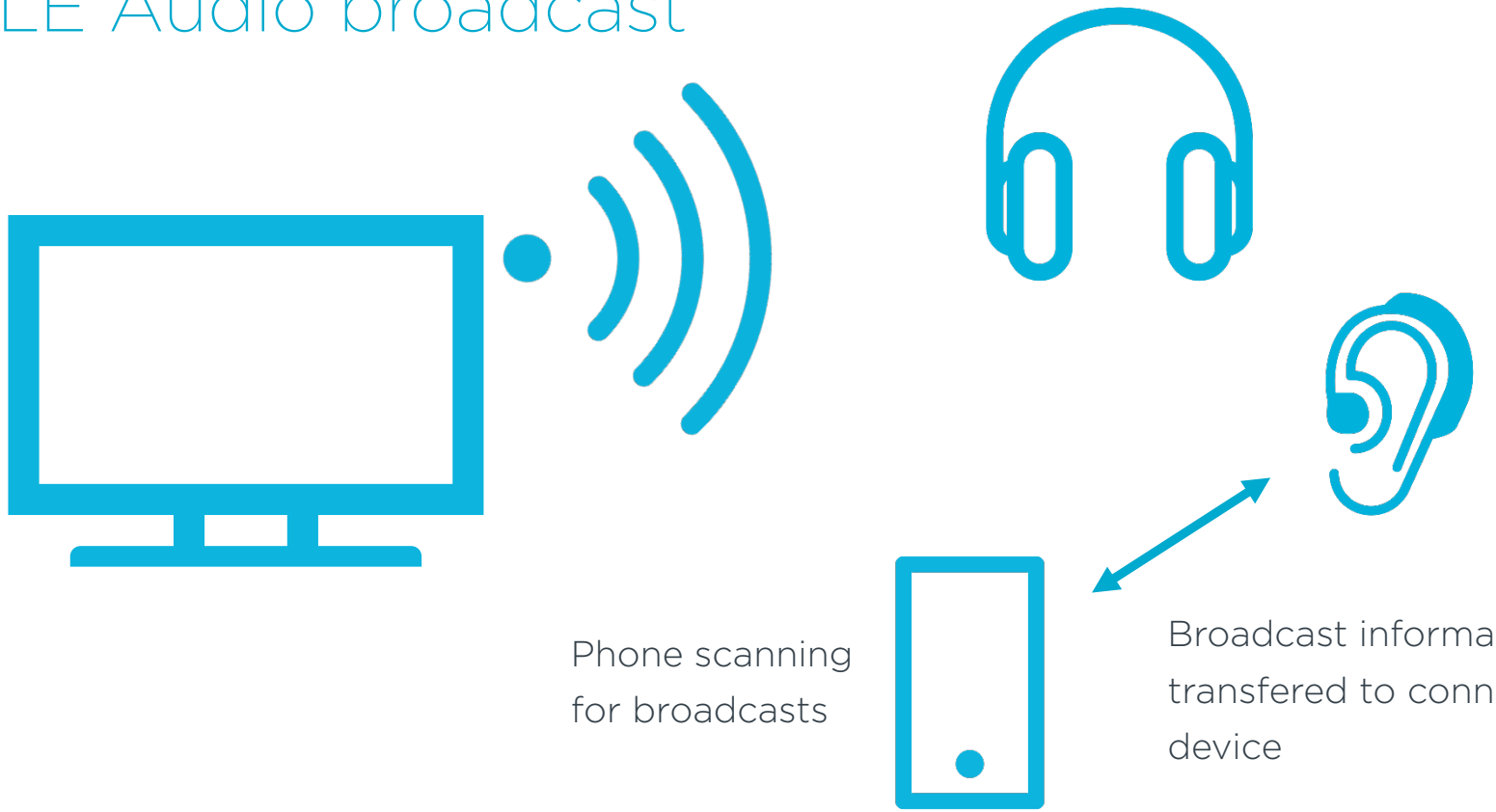
# Profiles for phone calls

- Basic Audio Profile (BAP)
- Volume Control Service/Profile (VCS/P)
- Audio Input Control Service (AICS)
- Microphone Control Service/Profile (MICS/MICP)
- Telephony Bearer Service (TBS)
- Call Control Profile (CCP)

# Broadcast Audio

- Extended advertising
- Broadcast audio to unlimited number of devices
- Location based audio sharing
- Audio induction loop replacement

# LE Audio broadcast



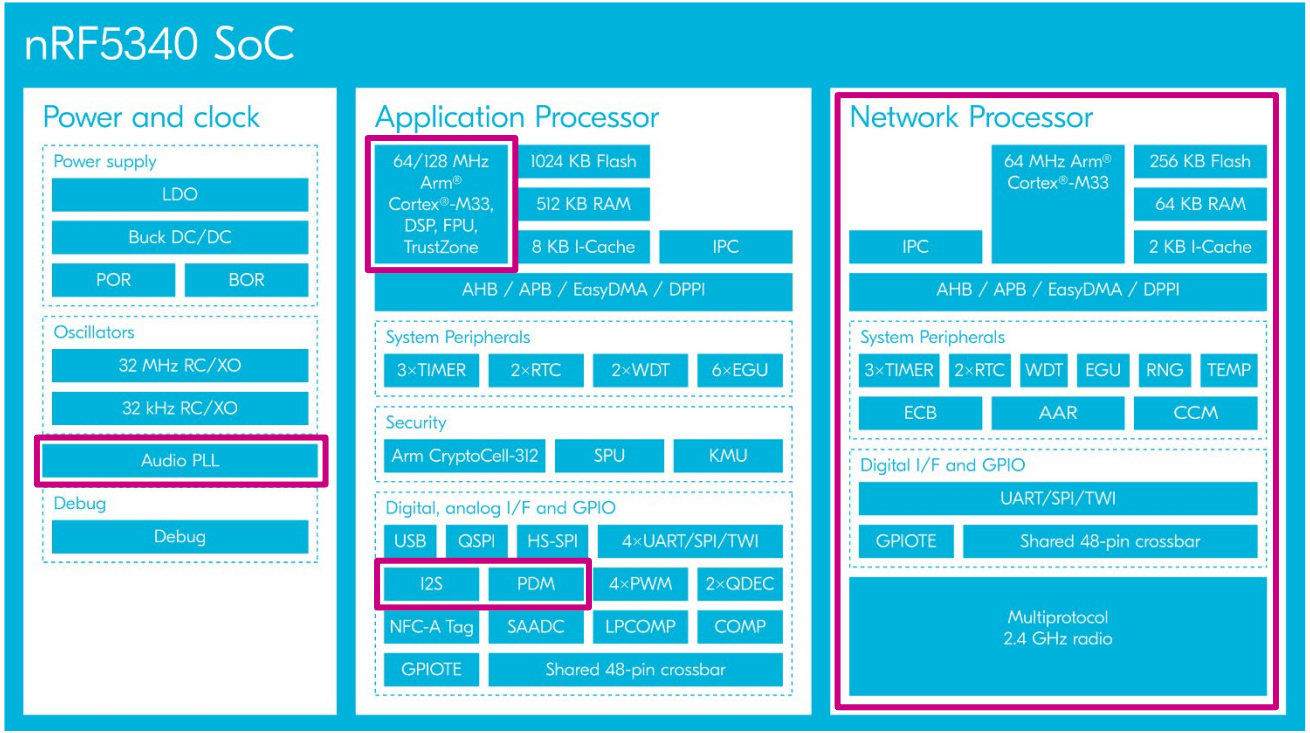
Phone scanning for broadcasts

Broadcast information transfered to connected device

# nRF5340

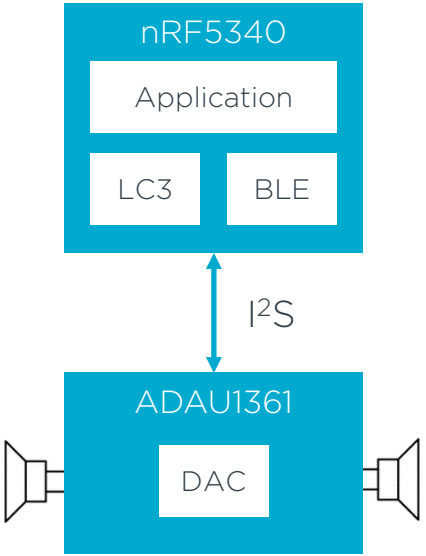
## Nordics Flagship SoC for your LE Audio Application

# Unique features in nRF5340



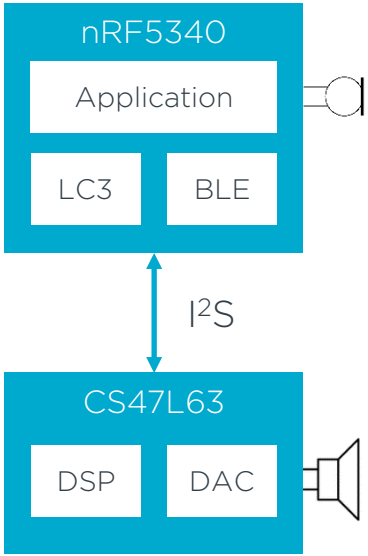
# nRF5340 based audio system

Speaker



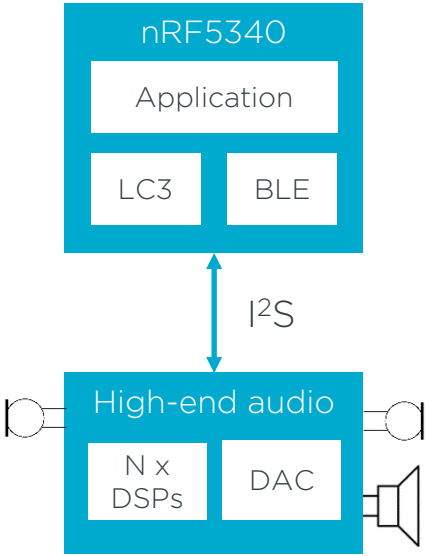

Earbud

(nRF5340 Audio DK)

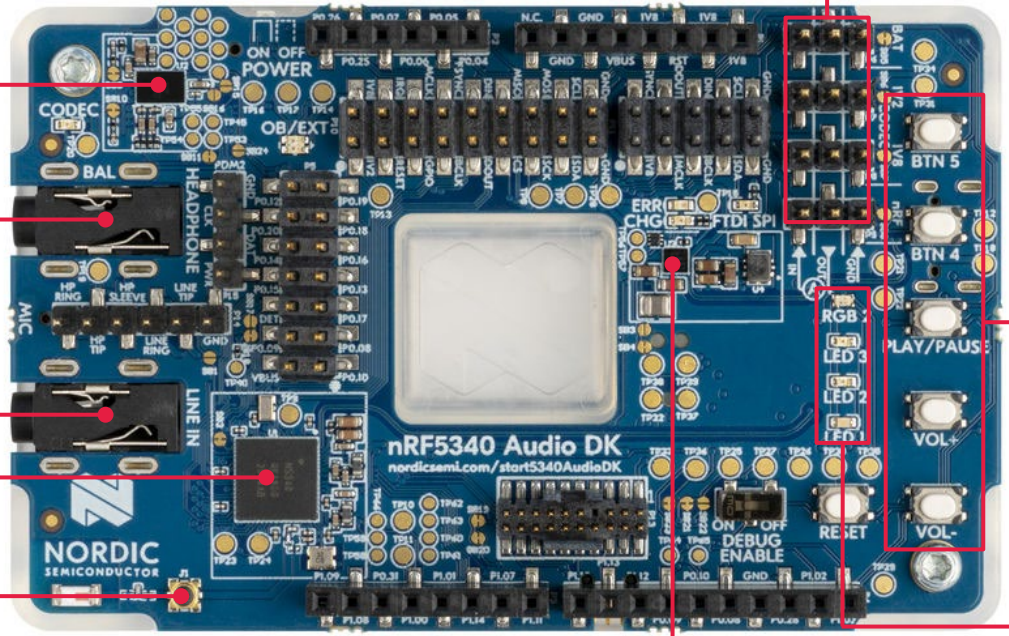



Earbud

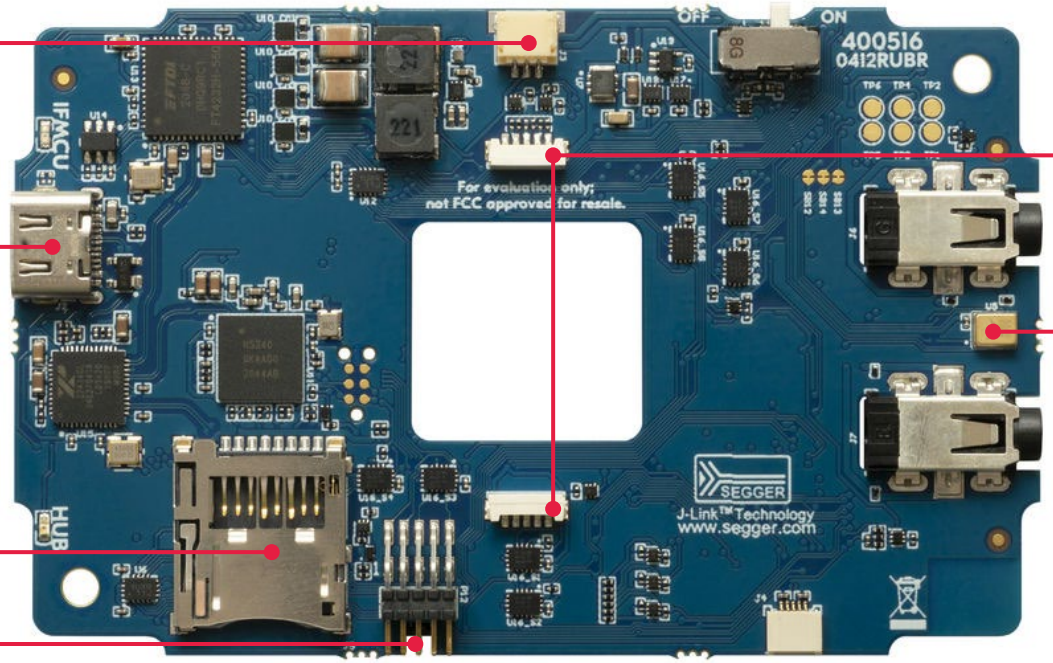
w/ advanced ANC



# nRF5340 Audio DK - front



# nRF5340 Audio DK - … and back




Battery connector

USB C

SD card holder

Serial wire Debug

SWD

RGB LEDs for

Illuminated logo

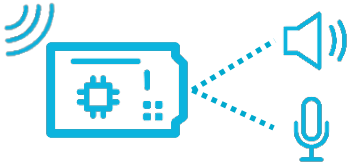
Digital microphone

nPM1100 PMIC

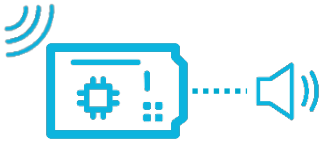
# Configurations / topologies

Dongle

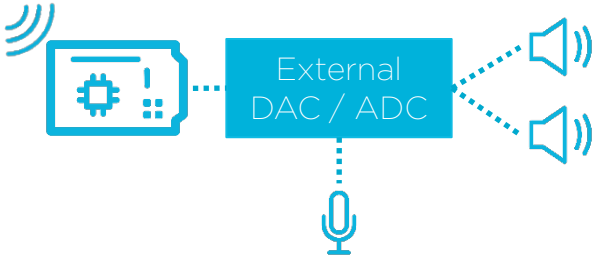
TWS Earbud



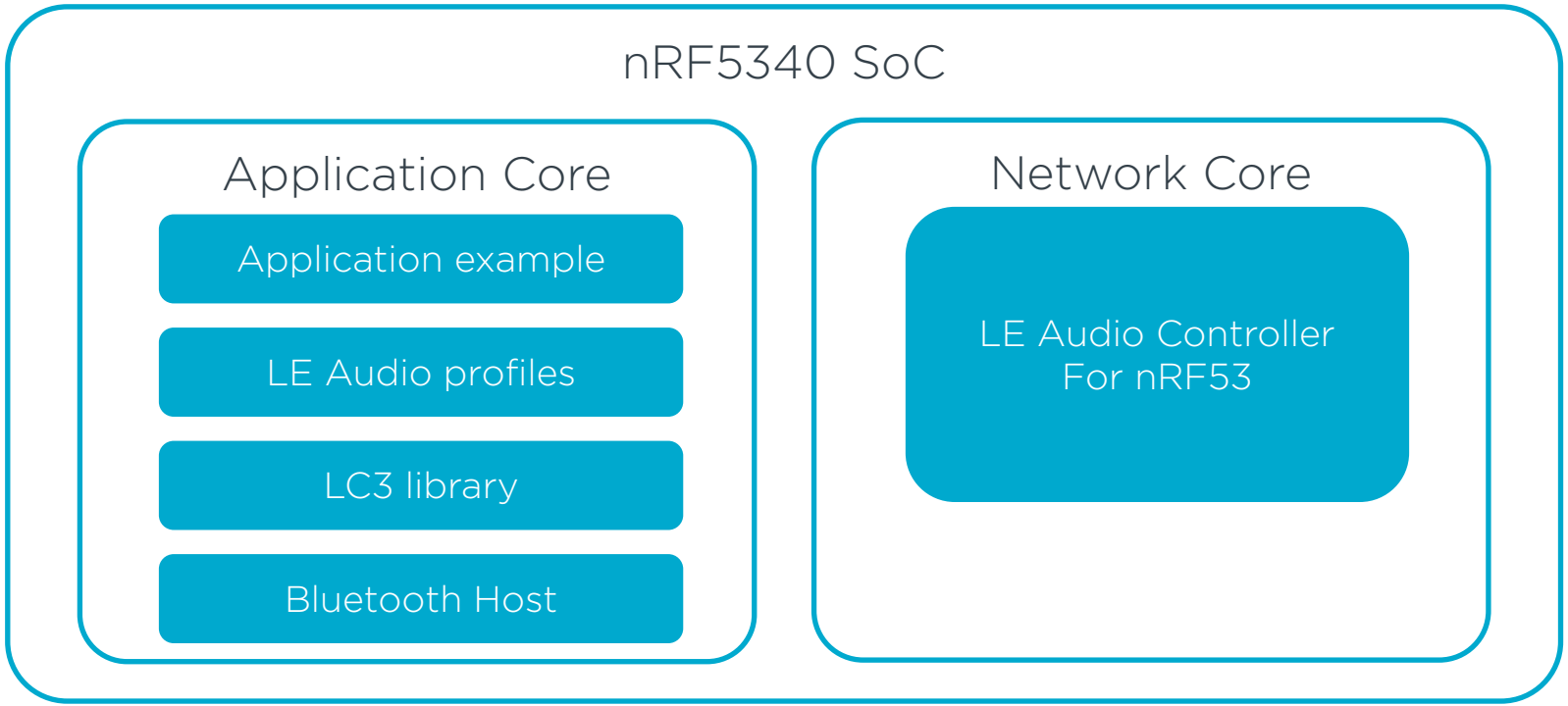
Broadcast reciever



Headset

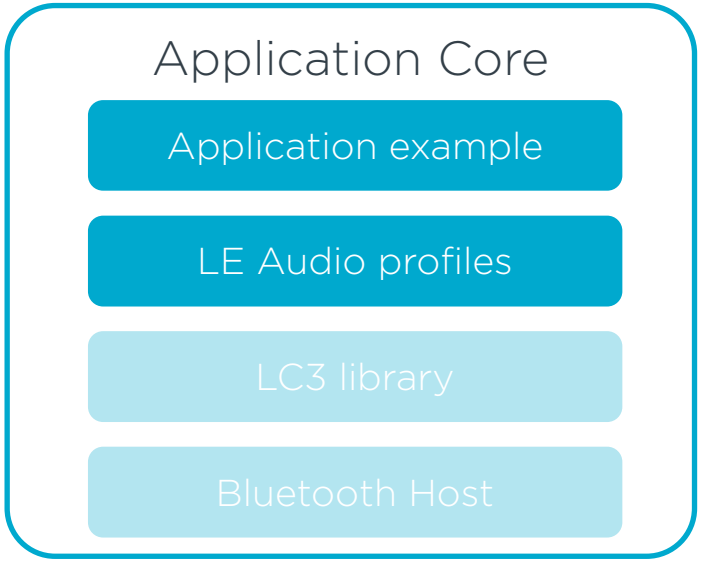


# LE Audio software solution



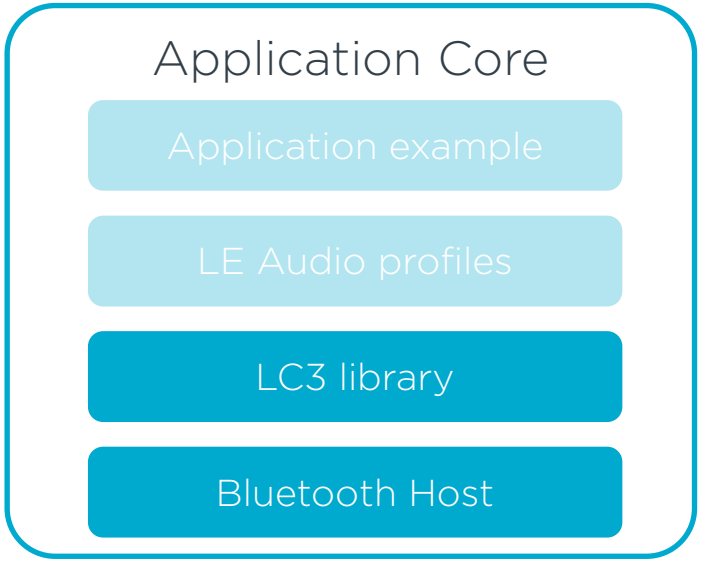
# LE Audio software components

- Application example :
  - nrf5340_audio for nRF5340 Audio DK
  - All relevant use cases and topologies
    - USB Dongle (Broadcaster or receiver)
    - Headset
    - Earbud
    - Broadcast receiver
- LE Audio profiles:
  - Profiles as specified by the Bluetooth SIG



# LE Audio software components

- LC3 Codec:
  - Bluetooth qualified component with QDID.
  - SBC available as alternative for easier software access.
  - Distributed via GitHub repository with credential control
  - License agreement needed!
- Bluetooth Host: Zephyr Host
  - Like all nRF Connect SDK Bluetooth solutions



# LE Audio software components

- Bluetooth LE Controller:
  - Runs on the nRF5340 network core.
  - Available as HEX file
  - Licensed solution with **perpetual** license for the binary file

# Bluetooth LE Audio summary

- Bluetooth LE Audio addresses many limitations in Classic Audio
- LE Audio comprises a number of updates in Bluetooth:
  - Isochronous channels for multi-stream audio transfer
  - Broadcast mode for audio
  - A new high performing audio coded - LC3
  - Profiles designed for new and existing use cases, with flexibility in mind
- nRF5340 is the SoC of choice for audio applications
- nRF5340 Audio DK and nRF Connect SDK is here to get you started!

# Q&A

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