NORDIC SEMICONDUCTOR

LE Audio – spec and Zephyr implementation

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Intro and background

Why is LE Audio important – to Zephyr?

- Bluetooth (TM) LE Audio is coming - final specs June 2022
- LE Audio has the potential to have a significant impact [1]
- Indications: A number of these LE Audio devices will be running Zephyr [2]
- Zephyr has large parts of an LE Audio implementation in place.

=> A new and important range of audio use cases and products is coming and Zephyr is well placed to play a role in this.

[1] https://www.bluetooth.com/blog/analysts-predict-le-audio-will-drive-new-growth-for-bluetooth-audio-devices/

[2] https://www.nordicsemi.com/News/2022/02/Sennheiser-chooses-Nordic-Semiconductor-Bluetooth-LE-Audio-technology

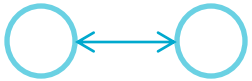
Overview

- What is LE Audio? Features and use cases
- LE Audio specifications - overview
- Zephyr LE Audio implementation – overview and example

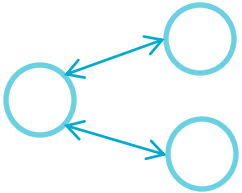
LE Audio
features and use cases

Flexible topology

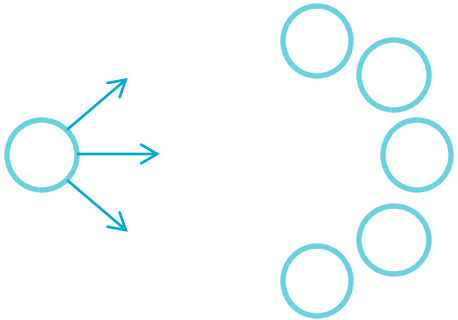
- Point to point
  - (Also in Bluetooth «Classic Audio»)



- Synchronized point to multi-point
  - «True Wireless Stereo»

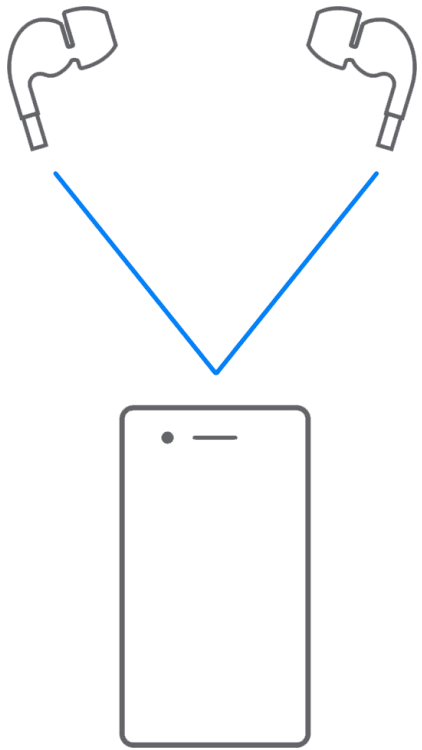


- Point to many
  - Broadcasting
  - Audio sharing



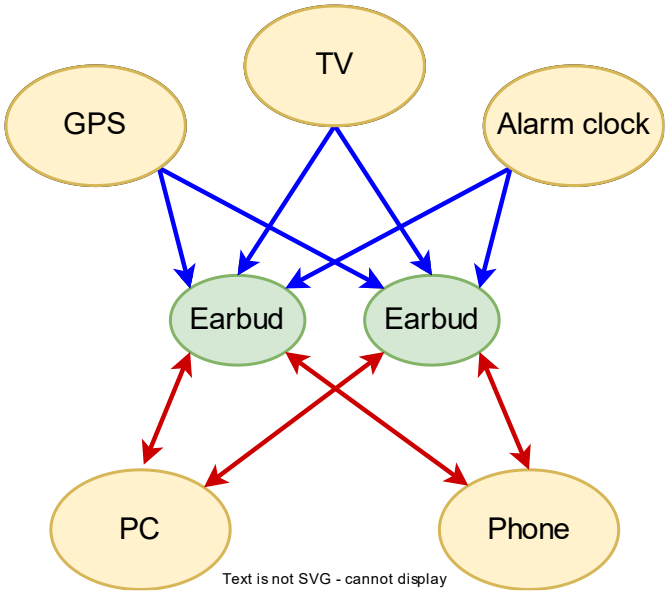
Fully synchronous multi-stream audio

- Several simultaneous streams/channels
  - To separate/independent devices
  - In practice limited only by capacity
- Same latency for all receivers
  - Accurate enough for binaural audio
  - Alse between different brands



Hearing-device centered dynamic topology

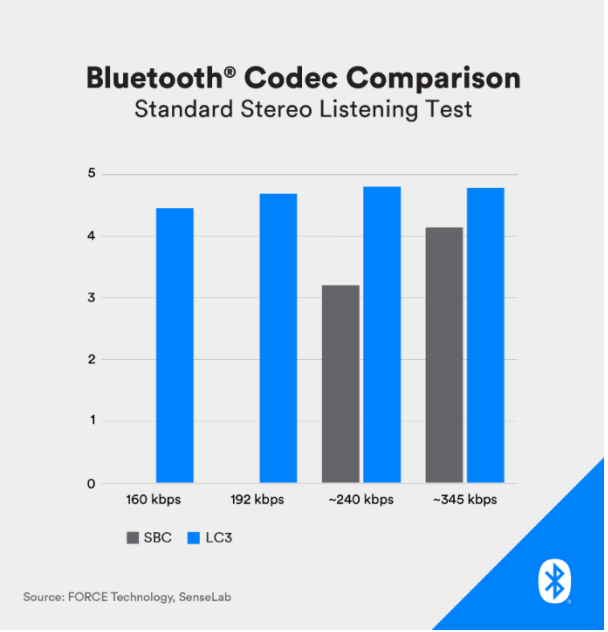
- Many sources, many sinks
  - Devices announcing their existence
- The hearing device in center
  - Dynamic connections
  - Discover new sources
  - Be connected to several sources
  - Switch between sources
  - Automatic prioritization



LC3 – new codec

- «Low Complexity Communications Codec»
- Higher quality
- Lower bitrate

- Specs:
  - Single channel
  - 8, 16, 24, 32, 44.1 or 48 kHz fs
  - 16, 24 or 32 bit samples
  - 10 or 7.5 ms frame length
  - 16 – 320 kbps bitrate



LE Audio specs

Bluetooth core spec 5.2 additions

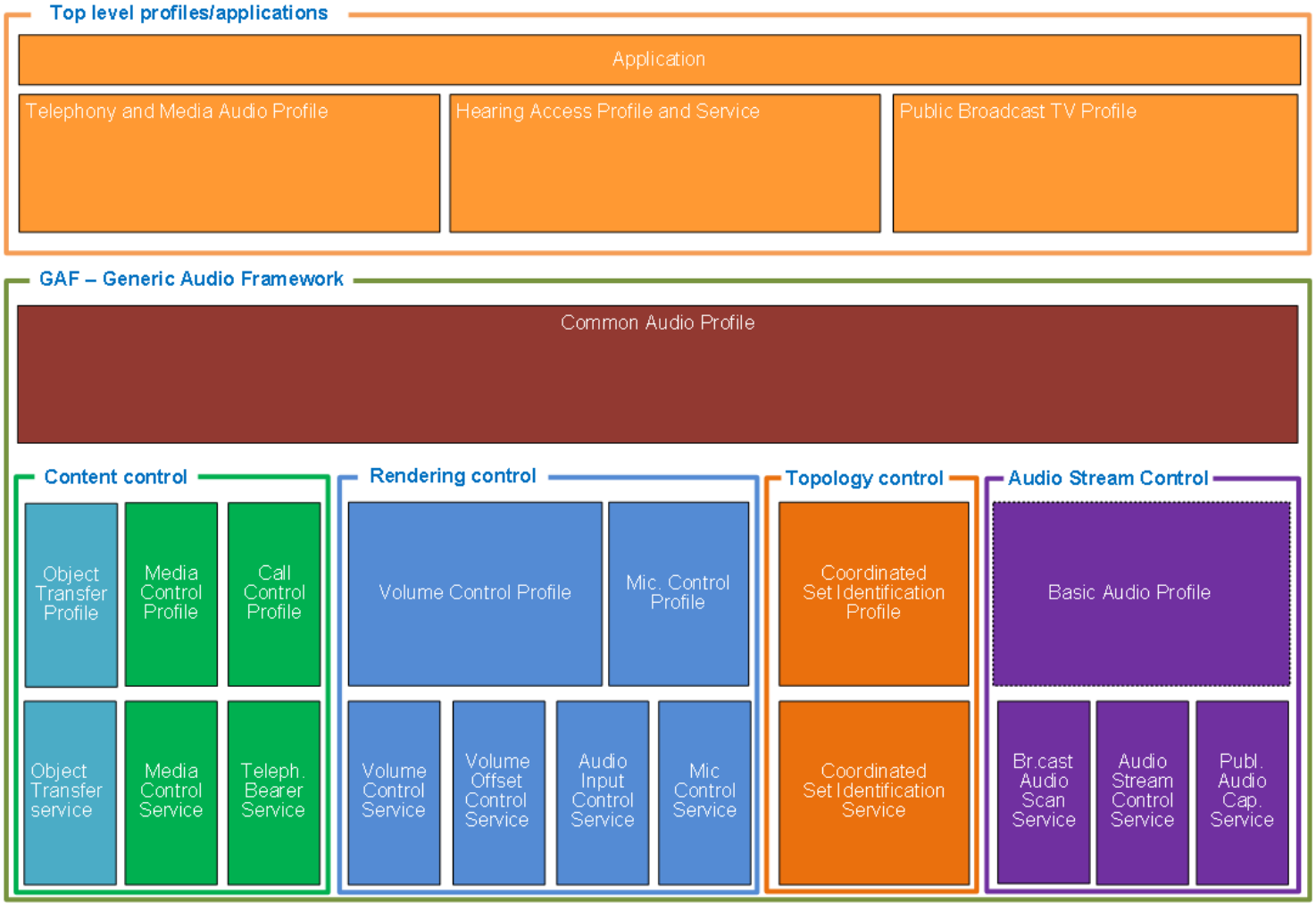
- Isochronous channels
  - Connected isochronous streams and groups (CIS, CIG)
  - Broadcast isochronous streams and groups (BIS, BIG)
  - Time-out, limited number of retransmissions, data flushing
- ISOAL – ISO Adaptation Layer
- EATT – Extended ATT
  - Multiple bearers, for parallel ATT procedures

LC3 codec

- Separate specification

Control plane and use case specs

- Generic Audio Framework
  - Audio control profiles and services
- Use case profiles



Zephyr LE Audio implementation

Zephyr implementation history

- Developed over several years by a set of cooperating partners
  - **Nordic**, **Demant**, **Intel**, **Bose** and others
- Private repo while specs were not public
- All is now upstream, or in PRs to upstream
- Development in the open, PRs to the main branch

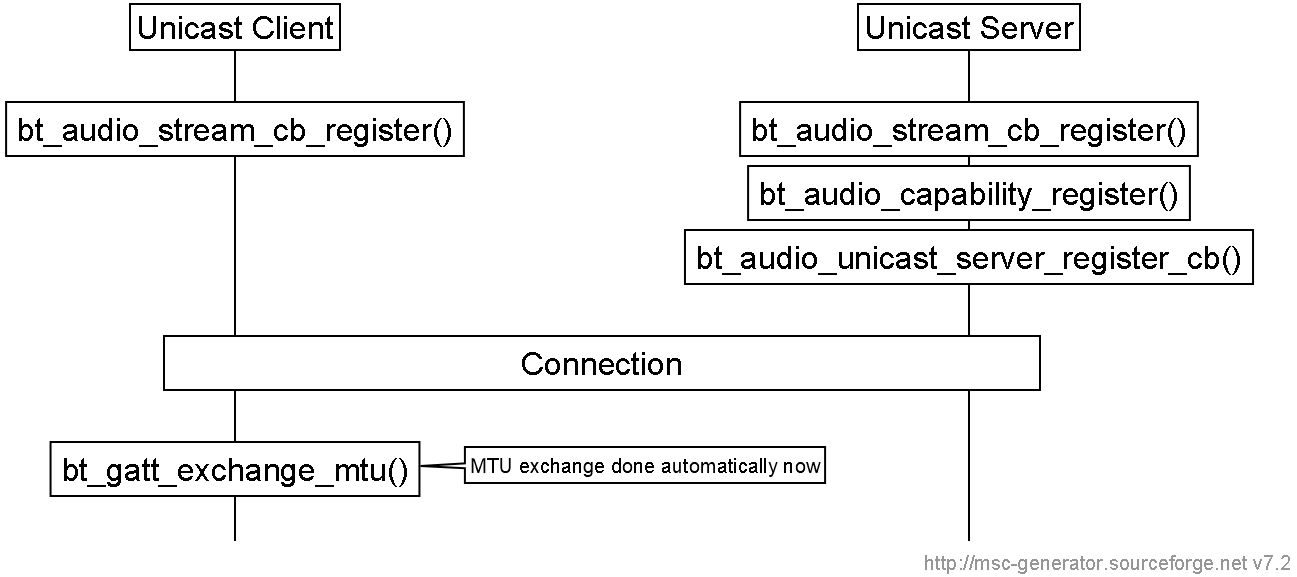
- Host status: Mostly in place, up until CAP and HAS.
- Controller status: Roughly three quarters in place.
  Connected ISO missing, but in the works.

The host profile and service code + LC3

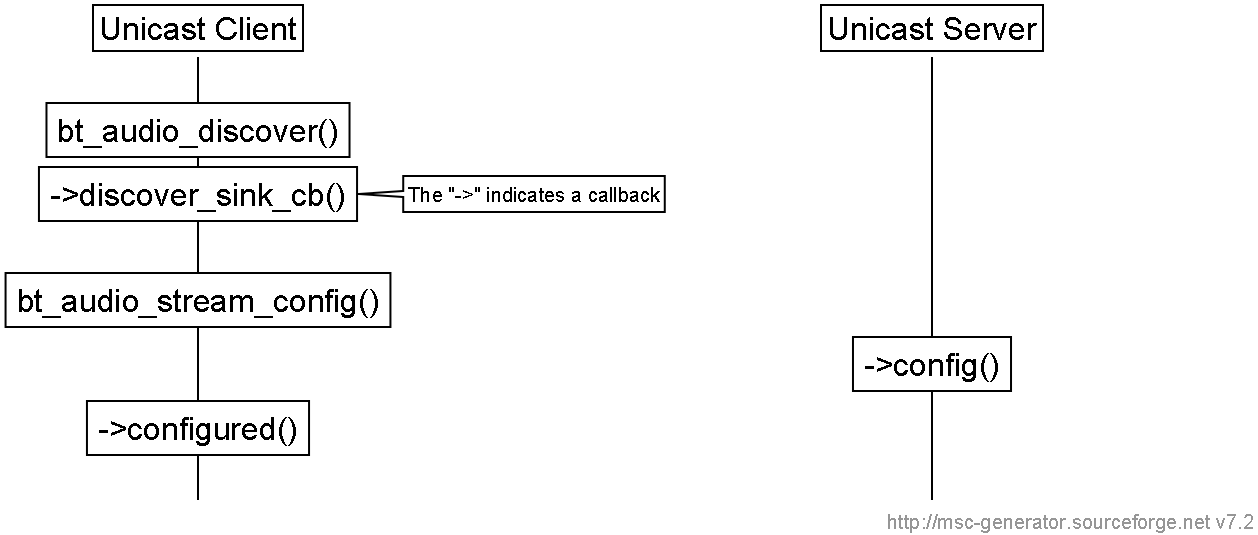
- header files: include/zephyr/bluetooth/audio/
- modules: subsys/bluetooth/audio/
- Babblesim tests: tests/bluetooth/bsim_bt/bsim_test_audio/
- shell app: subsys/bluetooth/shell/ tests/bluetooth/shell/
- samples: samples/bluetooth/
- docs: doc/connectivity/bluetooth/ , doc/connectivity/bluetooth/api/

- LC3: https://github.com/zephyrproject-rtos/liblc3codec

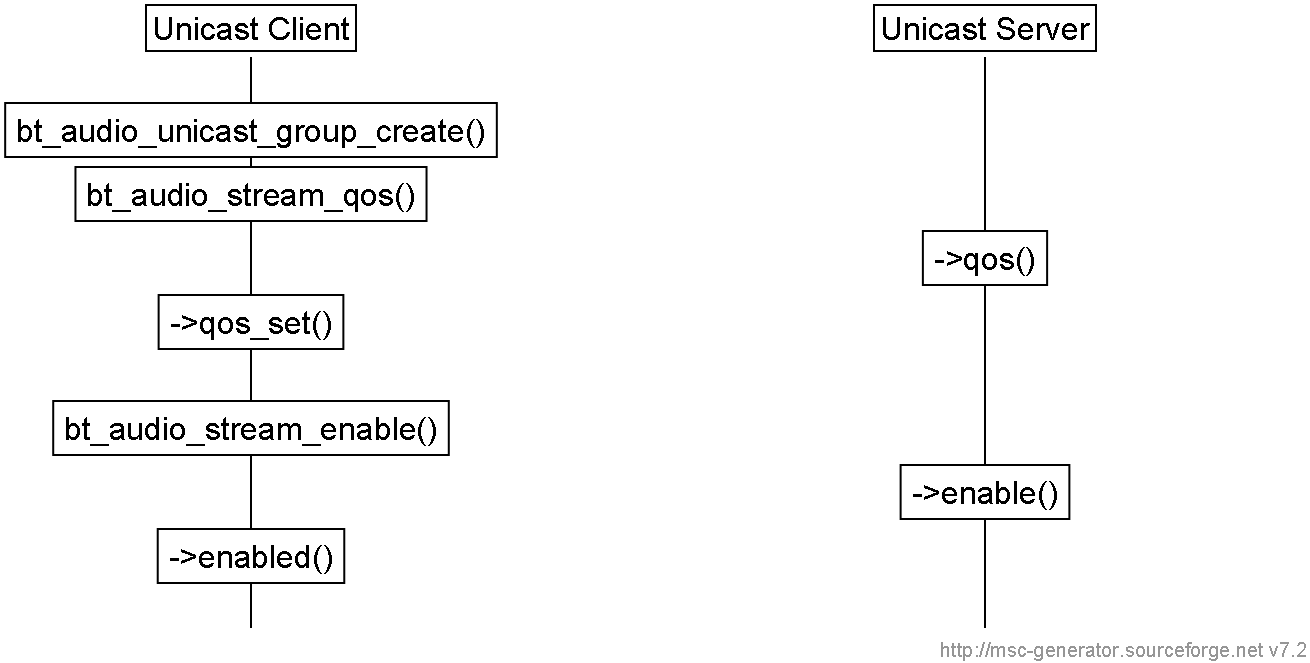
Setup and connection



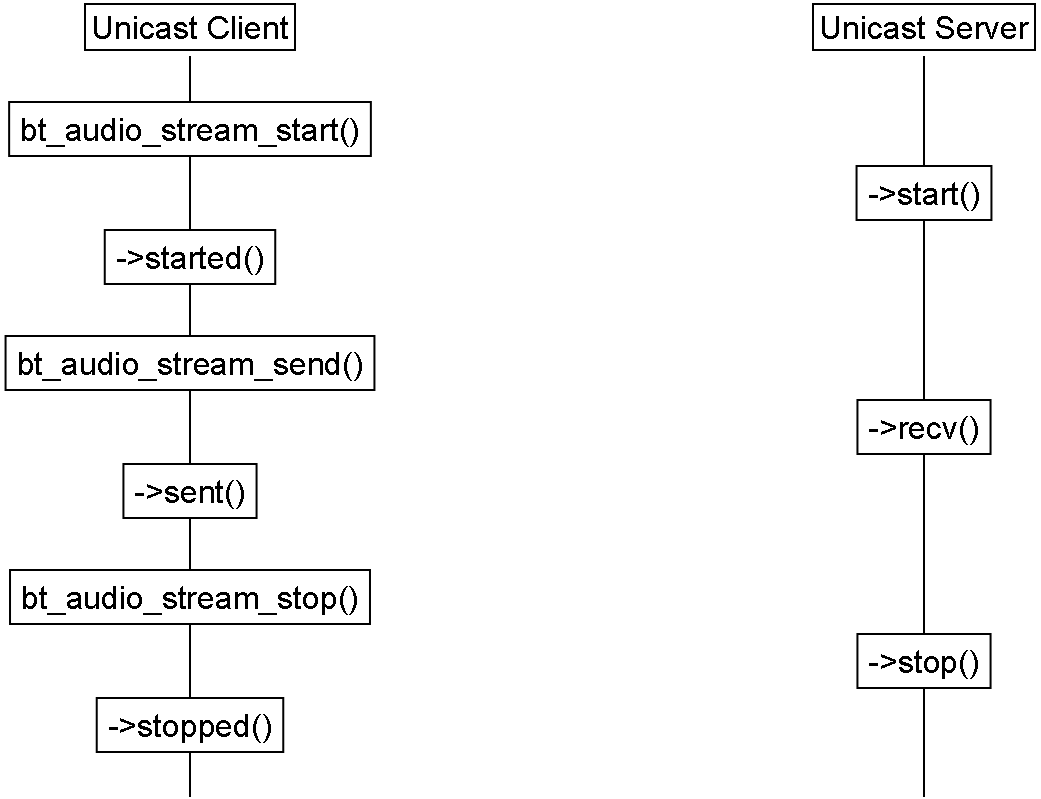
Discovery and configuration



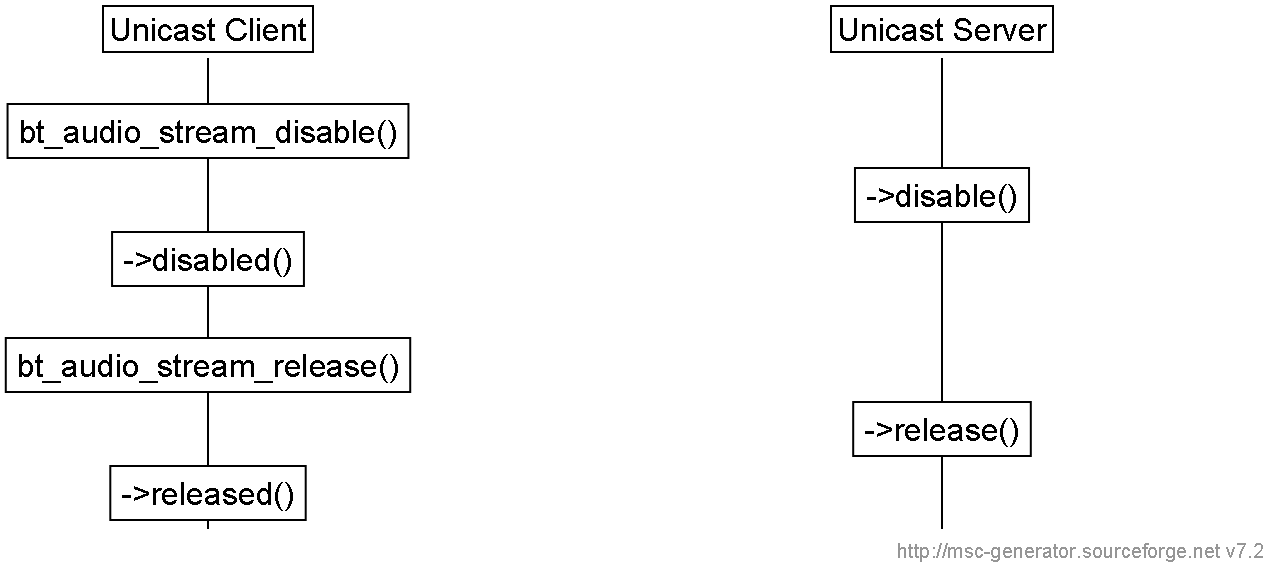
QoS configuration and enabling



Streaming



Disabling and releasing



Thank you!