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AURACAST™ Whitepaper

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1 Introduction

The Auracast™ Broadcast functionality of Bluetooth 5.2 makes it possible to reach an unlimited amount of receivers simultaneously.

This new features allow a new fields of application.



2 Terms and und abbreviations

SIG	Special Interest Group
Transmitter	Bluetooth Sender
Receiver	Bluetooth Receiver
PA System	Public Audio System
BIS	Broadcast Isochronous Streams
BIG	Broadcast Isochronous Groups

3 Trademark

Auracast™ as well as Bluetooth® are protected trademarks owned by the Bluetooth SIG. For being allowed to use those trademarks you first need the have a membership at Bluetooth SIG and the products must have successfully passed the qualification process with a listing at the SIG.

4 Function

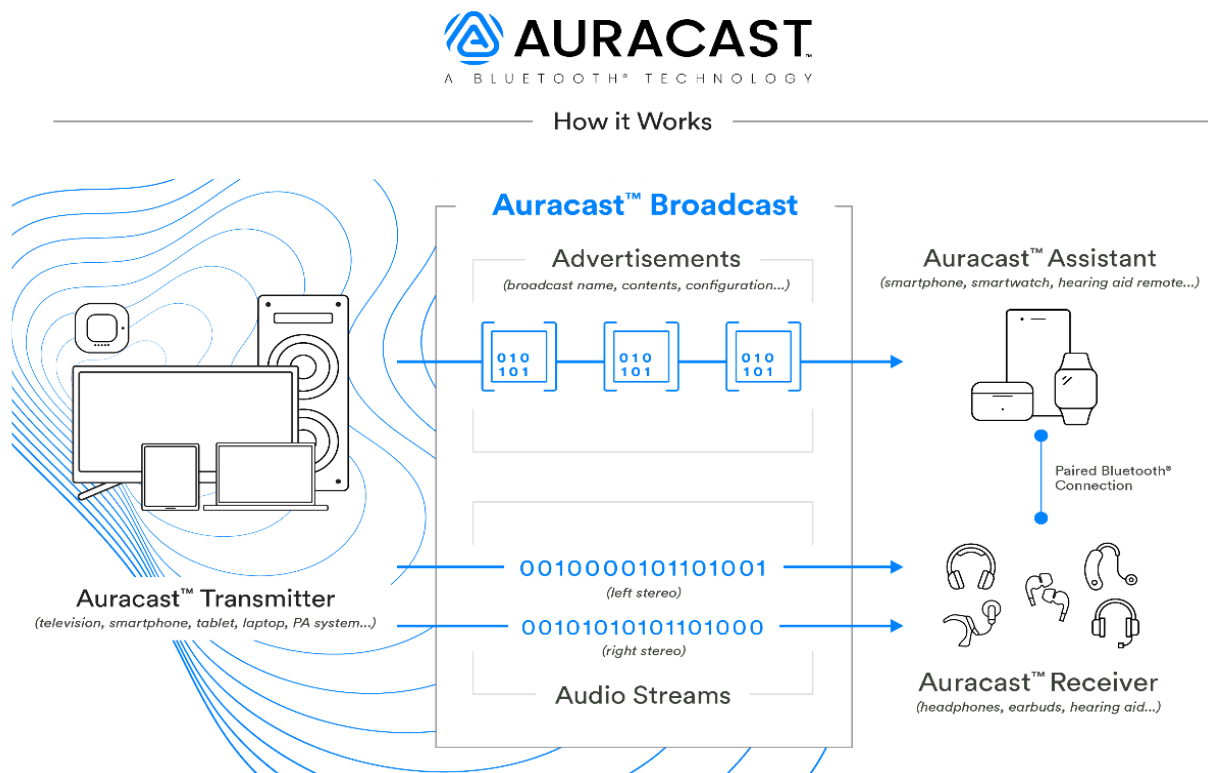


Figure 1: Auracast™ mode of operation, [<https://www.bluetooth.com/de/Auracast/how-it-works/>] visited 07.12.2023

Auracast™ Broadcast is part of the Bluetooth edition 5.2. A transmitter which can be integrated in existing audio players, provides a broadcast published by a Bluetooth advertising. The broadcast can be unencrypted for public information or encrypted to provide a private connection.

On the receiver side an Auracast™ Assistant is needed. The Auracast™ Assistant performs the broadcast subscription and requests the user confirmation. For encrypted broadcasts a key transfer to the receiver(s) will be performed as well. This functionality can be executed by a smartphone, a smartwatch or a smart charger case of a Bluetooth headset.

After the subscription the receiver will get the audio stream directly from the transmitter. The assistant is no more involved. The number of receivers is unlimited and has no influence on the streaming quality. This attribute makes a lot of new use cases possible. For applications where a big area needs to be covered, it is possible to synchronize stream transmitters. This makes it possible to stay connected with a stream even when moving through the area. At the moment however seamless roaming is not supported, resulting in short connection drops when switching to a next transmitter.

The missing seamless handover functionality is rising questions on how to handle the handover. But basically, the broadcast assistant can link the receiver with the strongest stream signal.

5 Benefits of Auracast™

For consumer electronics the transmitter integration depends on the big suppliers. Based on the current announcements and the fact that the integration is rather simple and possible at low costs, we can assume that all big players will participate. For example, all Samsung TVs of the latest generation are already supporting this functionality.

On the receiver side an Auracast™ Assistant is needed. This functionality can be executed by a smartphone, a smartwatch or a smart charger case of a Bluetooth headset. It is even possible to add this functionality with an app on existing devices as long as they support Bluetooth 5.2 and the so far only optional LE Audio features are also supported.

With the increasing connectivity in the every days life it was possible to perform a market analysis and to identify five future main application areas and to estimate their market potential [www.bluetooth.com/wp-content/uploads/2022/10/MRN-LE_Audio.pdf].

Main application areas:

- Assistive – and augmented listening on public venues
- Multi language support
- Tour guide systems
- Audio broadcast of TV screens in public areas
- Assistive listening at public counter / one to one

Based on those application areas, it is expected to reach more than 61 Million potential installations until 2030.

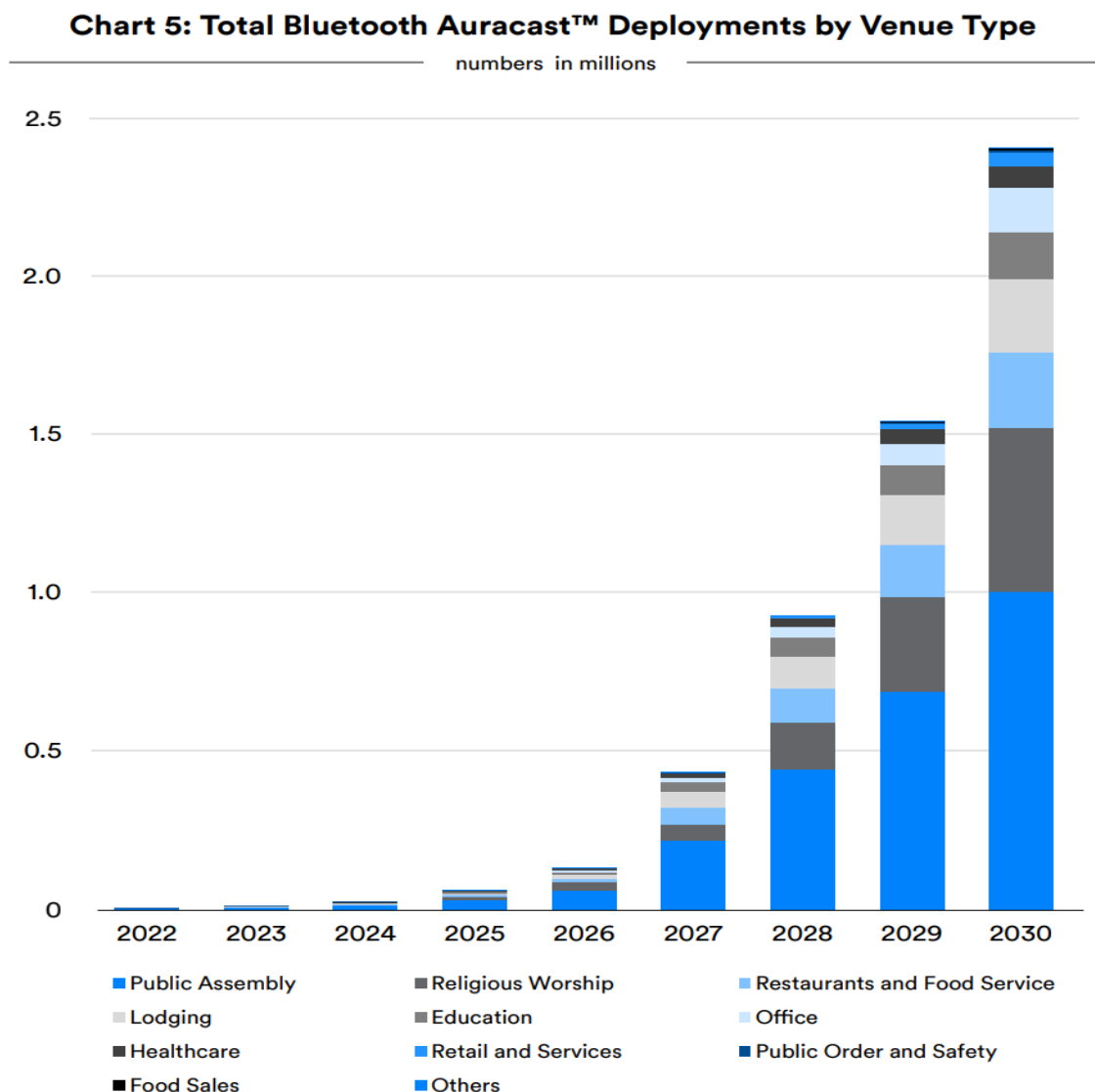


Figure 2: Market analysis for Auracast™ until 2030 [www.bluetooth.com/wp-content/uploads/2022/10/MRN-LE_Audio.pdf] visited 07.12.2023

Due to the new legal regulations in Switzerland as well as in Europe which request the equality for people with disabilities, a lot of catching up has to be done:

<https://www.edi.admin.ch/edi/de/home/themen/gleichstellung/gleichstellung-von-frau-und-mann.html> visited 07.12.2023.

Especially for people with visual or hearing impairments, there are numerous restrictions making the everyday life difficult. That's where Auracast™ opens new opportunities for a better integration in the everyday life. For example for people with visual or hearing impairments it is difficult to replan their public transport trip in case of delays or cancellations. With the Auracast™ Assistant App it will be possible to provide push notifications to promote available streams. After a subscription the user will receive the information through his hearing aid device listening to the Auracast™ Stream.

According to the Inclusion Handicap Association the following minimal standards for public transport shall be implemented:

- Complete and coherent information system for people with a visual impairment
e.g. audio orientation aid
- Use of ticket vending machines for all people, e.g. accessibility by tactile visual means or intercom
- Timetable information should be visually and acoustically available. This is crucial for people with visual or hearing impairments using public service.

6 Use Cases

Auracast™ can be used wherever a lot of people are present and shall be notified or only a certain group of them shall be addressed. A student with a hearing aid who needs an additional audio transmission directly into his hearing aid or a cinema show a film in multiple languages simultaneously are just some examples of the broad Auracast™ field of applications.

If you think about your everyday life, taking into account the fact that you have to live with impairments, numerous possible applications appear instantly. At the station, the timetable can be read out, delays and track changes can be notified and the audio signal from the emergency call stations on the train can also be transmitted. In the elevator, the floor can be announced with a short voice message and voice messages can make it easier to buy tickets too. The concept works in a similar way at airports and in shopping centers.

In the fitness centers, the TVs can provide the sound over Auracast™, whoever wants to hear the sound can listen to the stream while the others are not annoyed by the TV sound.

Traffic lights can report the current status for pedestrians and public services can communicate the waiting number and counter over Auracast™.

At major events such as concerts, folk festivals, open-air festivals and New Year's Eve fireworks, everything from the broadcasting of music to visitor guidance or police announcements could be communicated by Auracast™ and made available in various languages.

At a Drive-Thru, the announcements could be streamed directly into the car stereo or directly to headphones or hearing aids. Later in the parking garage of the shopping center, the number of free parking spaces on the current floor and in the current row could be announced in the car.

The uses cases can be grouped like this:

6.1 Public Places

- Emergency announcement at concerts / festivals
- Multilanguage tourist guide
- Multilanguage cinema
- Floor announcement in lifts
- Timetable information and delay announcements on trains and at Stations.

- Aid for directions at Stations
- Aid for ATMs / Ticket vending machines
- Flight information and aid for directions at airports
- Audio link with emergency call point
- Passenger information on trains (next stop, connections, cancellations, ...)
- Silent party/concert
- Silent TV in fitness centers

6.2 Hotels

- Floor announcement in lifts
- Multi language information at reception
- Announcement when a service is ready for pickup

6.3 Health Services

- Aid for directions in the building
- AI supported audio inputs during surgery
- Announcements for hospital staff

6.4 In shops

- Aid for directions
- Multi language support at self check out
- Announcements

6.5 Churches

- Multi language audio transmission

6.6 Schools and Universities

- Hearing aid
- Aid for directions
- Emergency announcements
- Multilanguage lectures

6.7 Retail and Services

- Announcement of free parking space directly in the car stereo

6.8 Restaurant and Catering

- Announcement of free parking space directly in the car stereo
- Direct stream into the car at Drive-thru

6.9 Office environment

- Aid for directions in the building

6.10 Public facilities

- Number announcement in queues for public service
- Multi language information at reception
- Aid for directions in the building

7 Technology

Auracast™ is part of the "LE Audio" enhancements included in the Bluetooth 5.2 edition. The "LE Audio" extensions include new profiles and services.

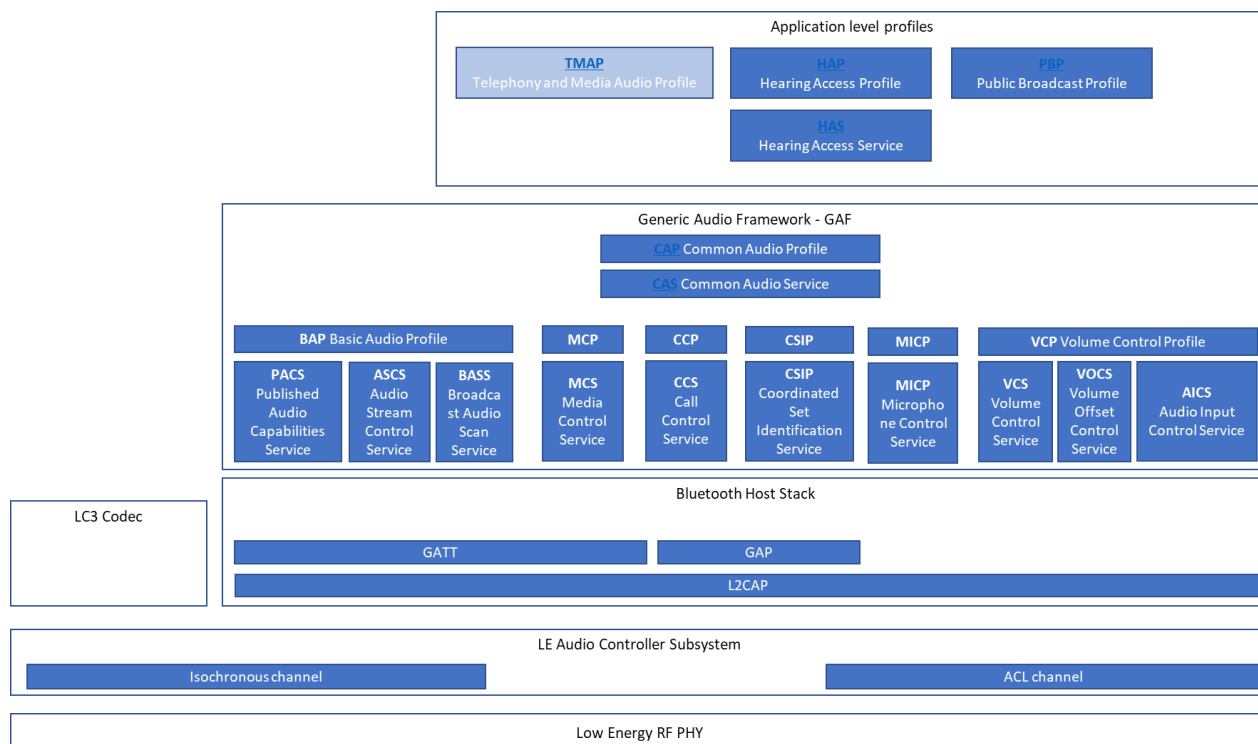


Figure 3 Simplified view of LE Audio Profiles and Service architecture (Source: Arendi AG)

Since Auracast™ only requires broadcast and no unicast connections, it only uses a fraction of the profiles and services listed above. The basis for Auracast™ broadcast streams are:

- Public Broadcast Profile (PBP)
- Basic Audio Profile (BAP) with the subprofiles
- New LC3 Codecs
- Isochronous channels
- Extended Advertising
- Periodic Advertising

Auracast™ supports streaming in different qualities. Typically, with 48kHz for high quality (e.g. for stereo hi-fi sound) and 24/16kHz which is predominately used for voice announcements or hearing aids. With Auracast™ it is also possible to transmit several audio streams simultaneously. Those streams are called BIS Broadcast

Isochronous Streams. They can be put into a group, which is then called a BIG Broadcast Isochronous Group. For example, you can send a group with 4 BIS channels for mono streams in 4 different languages or send a group with two stereo streams, one in high quality and the other in a reduced quality.

Since there is no connection to the receiving device during an Auracast™ stream session, the needed information required to receive the correct stream must always be sent along. This is done with the advertising addons Extended Advertising and Periodic Advertising. Both must be supported by both the sender and the receiver.

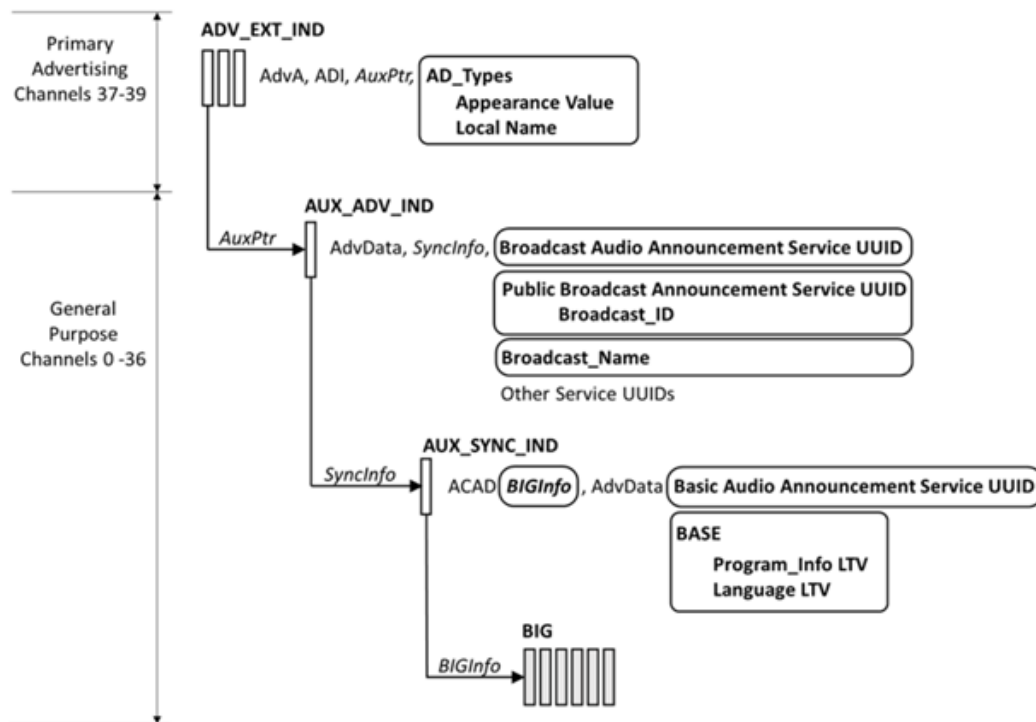


Figure 4: Structure of a broadcast stream in the advertising channels (Source: Bluetooth SIG)

The role of the Auracast™ Assistant was introduced so that a receiver knows which stream to listen to. The assistant makes the link between the sender and the receiver by searching for suitable transmitters for the receiver and telling the receiver which transmitter to listen to. As user interaction is required for this function, the role is normally performed by a smart phone where the functionality is already integrated in the OS or via a third-party app. If a broadcast stream is encrypted, it is also the task of the Auracast™ Assistant to securely obtain the key from the sender and pass it securely on to the receiver, so that the latter can decode the encrypted stream.

8 LE Audio Specification

To ease the access to the LE Audio specific profiles and services, you will find a table below with links to the specifications at the Bluetooth SIG:

Audio Input Control Service (AICS) v1.0	A service that exposes the gain of an audio input.	Volume Control
Audio Stream Control Service (ASCS) v1.0	A service that exposes an interface for Audio Stream Endpoints (ASEs), which enables clients to discover, configure, establish, and control the ASEs and their associated unicast Audio Streams.	Stream Management
Basic Audio Profile (BAP) v1.0.1	A profile that defines how devices can distribute and/or consume audio using Bluetooth Low Energy (LE) wireless communications.	Stream Management
Broadcast Audio Scan Service (BASS) v1.0	A service used by servers to expose their status with respect to synchronization to broadcast Audio Streams and associated data, including Broadcast_Codes used to decrypt encrypted broadcast Audio Streams. Clients can use the attributes exposed by servers to observe and/or request changes in server behavior.	Stream Management
Common Audio Profile (CAP) v1.0	A profile that specifies procedures to start, update, and stop unicast and broadcast Audio Streams on individual or groups of devices using procedures in the Basic Audio Profile (BAP). This profile specifies procedures to control volume and device input on groups of devices using procedures in the Volume Control Profile (VCP) and the Microphone Control Profile (MICP). This profile specification also refers to the Common Audio Service (CAS).	Common Audio
Common Audio Service (CAS) v1.0	A service used to identify a server supporting the Common Audio Profile (CAP) Acceptor role. If an instance of Coordinated Set	Common Audio

	<p>Identification Service (CSIS) is included in the CAS definition, CAS identifies that the device is part of a Coordinated Set.</p>	
<p>Call Control Profile (CCP) v1.0</p>	<p>A profile that defines the roles and procedures that are used to interact with a remote device that implements the Generic Telephone Bearer Service (GTBS), and optionally and additionally, the Telephone Bearer Service (TBS).</p>	<p>Call Control</p>
<p>Coordinated Set Identification Profile (CSIP) v1.0.1</p>	<p>A profile that specifies how to identify and treat devices as part of a Coordinated Set.</p>	<p>Coordinated Devices</p>
<p>Coordinated Set Identification Service (CSIS) v1.0.1</p>	<p>A service that specifies how devices can be identified and treated as part of a Coordinated Set.</p>	<p>Coordinated Devices</p>
<p>Hearing Access Profile (HAP) v1.0</p>	<p>A profile that defines the requirements for Bluetooth devices necessary for interoperability within the hearing aid ecosystem. It specifies behaviors related to audio streaming and remote control of the hearing aid using the Bluetooth Low Energy Audio (LE Audio) framework.</p>	<p>Use Case</p>
<p>Hearing Access Service (HAS) v1.0</p>	<p>A service that is used to identify hearing aids and to control hearing aid presets.</p>	<p>Use Case</p>
<p>Media Control Profile (MCP) v1.0</p>	<p>A profile that provides the ability for a client to control and interact with media players on a peer device.</p>	<p>Media Control</p>

Media Control Service (MCS) v1.0	A service that provides the client with the ability to control and interact with media players.	Media Control
Microphone Control Profile (MICP) v1.0	A profile that enables a microphone controller to adjust the state of microphones.	Microphone Control
Microphone Control Service (MICS) v1.0	A service that exposes a control interface and the status of a microphone mute control.	Microphone Control
Published Audio Capabilities Service (PACS) v1.0.1	A service that exposes server audio capabilities and audio availability, allowing discovery by clients.	Stream Management
Public Broadcast Profile (PBP) v1.0	A profile that defines how a Broadcast Source can use extended advertising data (AD) to signal that it is transmitting broadcast Audio Streams that can be discovered and rendered by Broadcast Sinks that support commonly used audio configurations.	Use Case
Telephone Bearer Service (TBS) v1.0	A service that exposes a telephone call control interface and telephone call control status for bearers on devices that can make and receive phone calls.	Call Control
Telephony and Media Audio Profile (TMAP) v1.0	A profile that defines the set of Bluetooth features collectively referred to as the Telephony and Media Audio Profile (TMAP). This profile enables these features by specifying interoperable configurations of the lower-level audio services and profiles.	Use Case

Volume Control Profile (VCP) v1.0	A profile that enables a device to adjust the volume of audio devices that expose the Volume Control Service.	Volume Control
Volume Control Service (VCS) v1.0	A service that exposes a control interface and volume state on an audio device.	Volume Control
Volume Offset Control Service (VOCS) v1.0	A service that exposes the volume offset of an audio output.	Volume Control