

The Twenty-fourth Annual Interactive Audio Conference

PROJECT BAR-B-Q 2019



Group Report:
Developing a set of audio requirements
for the next evolution of Bluetooth

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Problem Statement

Bluetooth has been undeniably successful, featuring on the majority of smart phones, personal computers, smart speakers, smart watches and many more. There are however a number of use cases it cannot currently support, due to restrictions in data rates, latency, support for multi-channel audio or indeed the one-to-one nature of Bluetooth connections.

This report explores the requirements currently not satisfied by Bluetooth, as well as some of the acceptable trade-offs which could be made.

Solution

Having built upon previous year's work, that looked at available solutions and determined whether it did what they needed, the 2019 Bluetooth+ group has expanded the valuable audio use-cases for a RAN (Room Area Network) and developed the key features to meet these user needs. These features form the base of a new requirements document to replace Bluetooth for the consumer and professional audio market.

The five most valuable use-cases have been identified. These were determined based on approximate market size or relevance to the wider industry.

- Personal music playback (to headphones and wireless speakers)
- Network based communications (such as those using a host to connect to the internet - like a phone making a FaceTime call)
- Gaming (and explicitly looking beyond the casual gamer)
- Audio associated with video
- Pro Audio (for studio and live performance)

Taking input from the wider workshop group, other use-cases were identified including:

- Enhanced audio for event attendees (such as within a crowd at a concert)
- Local group communication (direct endpoint-to-endpoint)
- Personal audio for exhibits (such as tour guide audio or interactive audio)
- PSA (Public Service Announcements)

The following table is an extension of the previously reported capabilities of different wireless protocols. In this report the Bluetooth+ group has appended additional critical use-cases identified during the brainstorming session and assessed each of the previously recommended protocols against the complete list of capabilities.

A complete table of the needs of the key use-cases can be found in the Usecases section.

Requirements	WiFi	5G	BT	BLE	Bluetooth+Audio
Low Power	no	?	maybe	yes	yes
Reliable audio communication	?	?	no	?	yes
Controllable latency - for multiple transmit/receive devices	no	?	no	?	yes
Geometry/Location reporting	no	no	no	no	yes (part of general Bluetooth+spec)
Low cost	no	?	yes	yes	yes
Non-proprietary	yes	yes	yes	yes	yes
Discoverability	yes	yes	yes	yes	yes
Self configuring network	yes	?	no	no	yes
Nearfield inter-communication	yes	yes	yes	yes	yes
Hubless multi peer connectivity	yes	?	yes	yes	yes
Multi-bidirectional audio channels	yes	yes	?	?	yes
Scalable audio channel count	yes	yes	no	?	yes
Versatile audio formats	yes	yes	yes	?	yes
Command & Control	yes	yes	yes	yes	yes
Highly accurate synchronization	yes (debated in 2019)	?	no	?	yes
Low Latency (2ms has been mentioned)	no	no	no	no	yes
Spatial Audio (with meta data)	yes	yes	no	no	yes
Mix configuration (mix metadata)	yes	yes	no	no	yes
Multi-channel (any limit?)	yes	yes	stereo	no	yes
Uncompressed Audio	yes	yes	no	no	yes
Endpoint-Endpoint Communication	yes	?	no	no	yes
Broadcast (one-to-many audio)	yes	yes	no	yes	yes (part of general Bluetooth+spec)
Time Sensitive Control Data	no	no	no	?	yes
Stereo Playback + Mic	yes	yes	no	no	yes
Privacy	yes	yes	yes	yes	yes
Content protection	yes	yes	no	no	yes
Augmented (speakers + headphones)	yes	yes	no	no	yes
Configuration (e.g. Smart assistant wake word profile)	yes	yes	no	no	yes

Device profile information	no	no	no	no	yes
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The finding from the workgroup is that none of the existing wireless protocols are fully fit for the future needs of our primary use-cases. WiFi was most able to meet our identified needs however it is critically unable to meet the low power, low cost and low latency requirements.

This workgroup formed on the basis of assumed shortcomings of the existing Bluetooth specification. The conclusion of the brainstorming found that Bluetooth really does have many gaps to the needs of audio products thus reaffirming the need of new wireless standard for system level connectivity and interoperability.

In addition to the low power, low cost and low latency (2ms) requirements, the workgroup would particularly like to highlight the requirements to provide broadcast capabilities (one-to-many) and to enable direct endpoint-to-endpoint communication.

Usecases

The following matrix shows a list of feature requirements by usecase. Usecases on the left of the bold line are those which should be considered high-priority to resolve.

Features	Music Listening	Network Communications (e.g. Facetime)	Gaming (beyond the casual gamer)	Audio for Video	Pro Audio (not solved by BT)	Event Attendee	Live Performance	Local communication	Public Address System	Museum	Tour Guide
Stereo playback	X	X	X		X	X					
Multi-channel (any limit?)				X			X (for multi-ch stems)				
Mix configuration (mix metadata)				X			X				
Spatial audio (with metadata)	X		X	X							
Higher bitrate	X				X						
Endpoint-endpoint communication		X						X			
Broadcast	X			X	X	X					X
Head tracking			X	X		X					
Low Latency (2ms has been mentioned)		X	X		X		X	X			
Microphone replug/replace analogue FM					X						
Stereo playback + microphone		X									
Spatial capture (single device)		X									
Multi-speaker AEC		X									
Deterministic latency for multi device pickup		X			X						
Beamforming of connected microphones.		X									
Privacy		X			X	X	X	X			
Content protection	X		X	X	X	X	X				
Speaker time alignment	X				X				X		

Deterministic latency for multi-device playback	X				X			X	X		
Augmented (speakers + headphone)			X				X				
Localization/Positioning						X		X		X	
Configuration (e.g. Smart assistant wake word profile)	X			X							
Device profile information	X	X	X	X	X						

Considerations for Tradeoffs

There are a number of features which may not be required for every use case, which additionally may not be possible to implement together. For example, low latency may be a limiting factor when combined with other requirements.

With this in mind, it is recommended that Bluetooth+ considers Profiles which provide the correct combinations of features to satisfy the target use-cases.

Next Step

We urge the collective brain of BBQ to use their influence in the industry to provide this analysis to the appropriate parties.

Other reference material

Group Report: The Need for a New Wireless Audio Network Standard, Project Bar-B-Q 2016

<https://www.projectbarbq.com/reports/bbq16/bbq16r7.htm>

Group Report: Modes and Nodes, Project Bar-B-Q 2017

<https://www.projectbarbq.com/reports/bbq17/bbq17r7.htm>

Wikipedia: Sweyn Forkbeard

https://en.wikipedia.org/wiki/Sweyn_Forkbeard

Forkbeard Technology

<https://forkbeardtech.com>

Proposed definition of a Room Area Network

http://web.cs.ucla.edu/~ravi/publications/ran_hotnets15.pdf