LC3 plus

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LC3PLUS HIGH-RESOLUTION SERVICE SPECIFICATION FOR BLUETOOTH LE AUDIO

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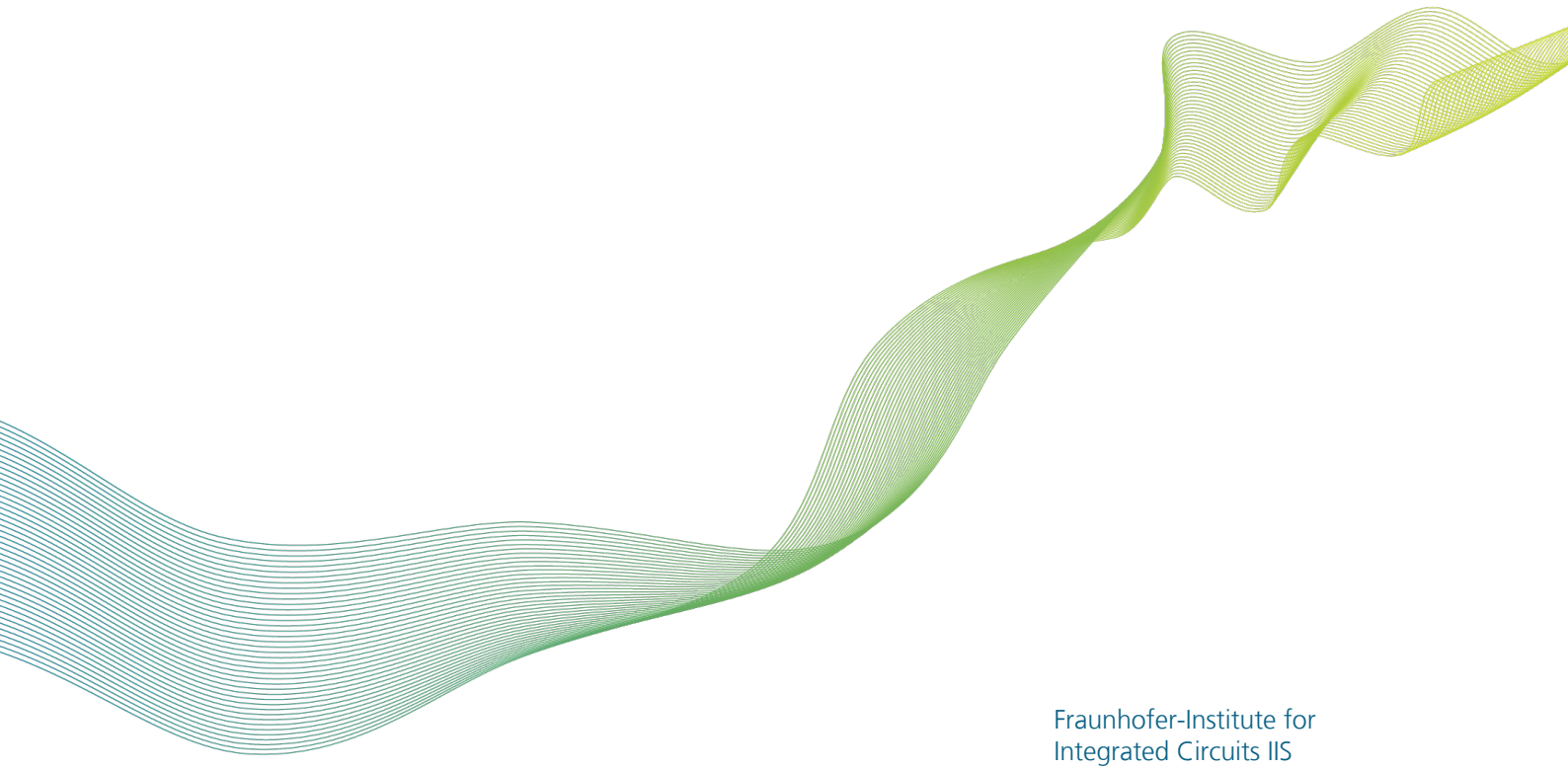
This document provides information on how to expose, negotiate and transport LC3plus High-Resolution as vendor-specific codec over Bluetooth LE Audio.



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The LC3plus High Resolution audio coding scheme is a development of Fraunhofer in cooperation with Ericsson AB, pursuant to the specification issued in clause 5.8 of the ETSI TS 103 634.

This document describes how to transmit LC3plus High Resolution bitstream via Bluetooth LE Audio by way of signaling a vendor specific codec. The LC3plus High Resolution transport over Bluetooth LE Audio described in this document is not part of any Bluetooth SIG specification. Implementations of the LC3plus High Resolution audio coding scheme are not compliant with any current Bluetooth specification and can not be qualified pursuant to the Bluetooth qualification process and the LC3plus High Resolution codec is not a compliant portion according to Bluetooth SIG PCLA.

For the purpose of clarity, the LC3plus High Resolution mode is a codec defined by ETSI. It is different from the low complexity communication codec (LC3) specified by Bluetooth. The LC3plus High Resolution mode is not compatible with LC3 specified by Bluetooth.

This documentation doesn’t grant any patent licence for the use of LC3plus patent licenses for necessary patent claims for the LC3plus High Resolution codec (including those of Fraunhofer) may be obtained from the respective patent owners.

For more information regarding licensing of LC3plus, please visit:
https://www.iis.fraunhofer.de/en/ff/amm/lizenz/patent.html

1. Changelog

V 0.1.0 2024-04 Initial Draft Release
V 0.2.0 2024-09 Reviewed by Codecoup
V 1.0.0 2025-07 Initial Release

2. LC3plus High Resolution

2.1 Definition

ETSI defines a dedicated high-resolution mode of LC3plus as defined in ETSI TS 103 634 V1.5.1 [1], clause 5.8, for the coding of audio data with very high precision. Note: the measurable distortion by means of Total Harmonic Distortion and Noise (THD+N) can be less than -130 dB measured on an AudioPrecision™ reference tool.
Reference implementation and test tools are available as electronic attachment of TS 103 634 [2].

2.2 Features

LC3plus High Resolution has the following configuration parameters:

Parameter	Value
Sample rate	48 kHz, 96 kHz
Frame duration	10 ms, 7.5 ms, 5 ms, 2.5 ms
Bit rate	Recommended rates: 156 to 625 bytes per frame at 48 kHz, 10 ms 187 to 625 bytes per frame at 96 kHz, 10 ms 117 to 475 bytes per frame at 48 kHz, 7.5 ms 141 to 475 bytes per frame at 96 kHz, 7.5 ms 93 to 375 bytes per frame at 48 kHz, 5 ms 109 to 375 bytes per frame at 96 kHz, 5 ms 54 to 210 bytes per frame at 48 kHz, 2,5 ms 62 to 210 bytes per frame at 96 kHz, 2,5 ms Fallback rates: Down to 50% of lowest recommended rate.
Sample depth	24 bit signed integer or 32 bit IEEE floating point

Table 1: LC3plus configuration parameters

3. LC3plus High Resolution Compliance

3.1 Codec requirements

3.1.1 Common requirements

An encoder and decoder implementation **shall** support:

Parameter	Value
Sample rate	48 kHz (optional), 96 kHz (mandatory)
Number of audio channels	1 (mono). Higher number of channels achieved through multi-mono.
Sample depth input/output	24 bit signed integer or 32 bit IEEE floating point
Rate switching	as defined in clause 5.7 of [1]
High-Resolution Audio	As defined in 5.8 of [1], including all required encoder and decoding functionalities of clause 5

Table 2: Encoder and decoder requirements

3.1.2 Encoder requirements

The encoder implementation **shall** be compliant to the definitions in TS 103 634, clause 5.8 and **shall** at least support the following configurations:

Parameter	Value
Frame duration	10 ms, and optionally 7.5 ms, 5 ms or 2.5ms
Payload sizes in bytes per frame and channel	Any number of bytes as defined in Table 5.2 of TS 103 634 [1]

Table 3: Encoder configuration parameters as specified in TS 103 634

3.1.3 Decoder requirements

The decoder implementation **shall** be compliant to the definitions in TS 103 634, clause 5.8 and **shall** at least support the following configurations:

Parameter	Value
Frame duration	10 ms, and optionally 7.5 ms, 5 ms or 2.5ms
Payload sizes in bytes per frame and channel	Any number of bytes as defined in Table 5.2 of TS 103 634 [1]
Packet Loss Concealment	Packet Loss Concealment as described in TS 103 634 clause 5.6 with changes for high-resolution mode mentioned in clause 5.8.

Table 4: Decoder configuration parameters as specified in TS 103 634

3.2 Conformance requirements

Encoder and decoder **shall** pass conformance requirements defined in TS 103 634 [1], clause 7.3.5.

Testscripts are available in the software package of TS 103 634 [2].

3.3 Precision Requirements

Encoder and decoder **shall** pass the requirements on implementation precision defined in TS 103 634 [1], clause 7.3.5.4.

The measured THD+N / SNR value **shall** be lower or equal to

- -120 dB / 120 dB at 1 kHz tone
- -110 dB / 110 dB as worst case value over all measured frequencies

Testscripts are available in the software package of TS 103 634 [2].

4. Signaling and Transport

4.1 Bluetooth Classic: A2DP

The specification on signal and transport over the A2DP is published as "SPECIFICATION FOR USE AS VENDOR SPECIFIC CODEC VIA BLUETOOTH A2DP" in [3].

4.2 LE Audio Variable Bitrate

Since support for variable bitrate is mandatory for LC3plus, this specification is not limited to constant bitrate but also supports variable bitrate. The maximum SDU size shall be allocated depending on the highest supported bitrate. The source may decide to use a single constant bitrate or change the bitrate during streaming operation. If bitrate is changed during streaming operation, the decoder shall accept the SDU with the new size.

4.2.1 Overview

This section defines signaling and transport of LC3plus High Resolution audio coding format over the Bluetooth Low Energy (LE) Basic Audio Profile (BAP), or any other application profiles depending on BAP, in constant bit rate (CBR) and variable bitrate (VBR) operation. The format is signaled as vendor specific coding format via Fraunhofer's company ID.

The following sections define the Codec_ID field and Length Type Value (LTV) structures to be used in Published Audio Capabilities (PAC) records as specified by the Published Audio Capabilities Service (PACS) [4], when exposing support for the LC3plus High Resolution VBR codec. This includes the corresponding parameter values to be used in the Config Codec operation, as defined in Audio Stream Control Service (ASCS) [5]. It also defines a set of mandatory and optional codec configurations to facilitate interoperability between integrators.

Where applicable, the LTV structures defined in the Generic Audio specification [6] are reused and referenced. In all other cases new vendor-specific LTV structures are specified in this document.

In case an LTV type is encountered which is unknown in this version of the specification, it **shall** be skipped.

All multibyte fields are in little endian.

4.2.2 Codec_ID field for LC3plus High Resolution VBR

The value of the Codec_ID field for LC3plus High Resolution for LE Audio VBR (LC3plusHR_VBR) is defined in **Table 5**

Codec_ID	Octet	Value	Meaning
	0	0xFF	Vendor Coding_Format
	1	0xA9	Fraunhofer IIS Company ID
	2	0x08	Fraunhofer IIS Company ID
	3	0x01	LC3plus High Resolution VBR ID
	4	RFU	RFU

Table 5: Codec_ID field for LC3plus High Resolution LE Audio VBR (LC3plusHR_VBR).

4.2.3 Codec_Specific_Capabilities LTV requirements

Devices exposing support for the LC3plus High Resolution VBR codec **shall** follow the requirements in this section when populating the Codec_Specific_Capabilities field in PAC records as defined in [4].

The **Supported_Sampling_Frequencies** LTV structure defined in Bluetooth Assigned Numbers [6] **shall** be present in the Codec_Specific_Capabilities field.

The **Supported_Audio_Channel_Counts** LTV structure defined in Bluetooth Assigned Numbers [6] **may** be present in the Codec_Specific_Capabilities field. The absence of the **Supported_Audio_Channel_Counts** LTV structure **shall** be interpreted as equivalent to a **Supported_Audio_Channel_Counts** value of 0x01 (one Audio Channel supported).

The **Supported_Max_Codec_Frames_Per_SDU** LTV structure defined in Bluetooth Assigned Numbers [6] **may** be present in the Codec_Specific_Capabilities field. The absence of the **Supported_Max_Codec_Frames_Per_SDU** LTV structure **shall** be interpreted as equivalent to a **Supported_Max_Codec_Frames_Per_SDU** value of 1 codec frame per Audio Channel per SDU maximum.

The **LC3plusHR_Supported_Frame_Durations** LTV structure defined in section 3.2.3.1 **shall** be present in the Codec_Specific_Capabilities field.

Dependent on the supported codec modes in the **LC3plusHR_Supported_Frame_Durations** (10 ms, 7.5 ms, 5 ms or 2.5 ms) one or more of the following LTV structures **shall** be present in the Codec_Specific_Capabilities field:

- As the 10 ms codec mode is mandatory the **LC3plusHR_Supported_Octets_Per_Codec_Frame_10ms** LTV structure defined in section 3.2.3.2 **shall** be present in the Codec_Specific_Capabilities field.
- If the 7.5 ms codec mode is supported the **LC3plusHR_Supported_Octets_Per_Codec_Frame_7_5ms** LTV structure defined in section 3.2.3.3 **shall** be present in the Codec_Specific_Capabilities field.
- If the 5 ms codec mode is supported the **LC3plusHR_Supported_Octets_Per_Codec_Frame_5ms** LTV structure defined in section 3.2.3.3 **shall** be present in the Codec_Specific_Capabilities field.
- If the 2.5 ms codec mode is supported the **LC3plusHR_Supported_Octets_Per_Codec_Frame_2_5ms** LTV structure defined in section 3.2.3.4 **shall** be present in the Codec_Specific_Capabilities.

4.2.4 LC3plusHR_Supported_Frame_Durations

The LC3plusHR_Supported_Frame_Durations LTV structure specifies the codec frame durations supported. The format of the LC3plusHR_Supported_Frame_Durations LTV structure is defined in **Table 6.**

Parameter	Size (Octets)	Value
Length	1	0x03
Type	1	0xF1
Value	2	Bitfield Bit 0: 10 ms frame duration. 0b1 = supported, 0b0 = not supported Bit 1: 7.5 ms frame duration. 0b1 = supported, 0b0 = not supported Bit 2: 5 ms frame duration. 0b1 = supported, 0b0 = not supported Bit 3: 2.5 ms frame duration. 0b1 = supported, 0b0 = not supported Bit 4 - 7: RFU Bit 8: 10 ms preferred. Bit 9: 7.5 ms preferred. Bit 10: 5 ms preferred. Bit 11: 2.5 ms preferred. Bit 12 - 15: RFU

Table 6: Format of the LC3plusHR_Supported_ Frame_Durations LTV structure.

Bits 8 – 11 **shall** only be set if at least two frame durations are supported (bits 0 – 3). Only one preference **shall** be set at a time.

4.2.4.1 LC3plusHR_Supported_Octets_Per_Codec_Frame_10ms

The LC3plusHR_Supported_Octets_Per_Codec_Frame_10ms LTV structure specifies the minimum and maximum octets per codec frame for 10 ms codec frames. The format of the LC3plusHR_ Octets_Per_Codec_Frame_10ms LTV structure is defined in **Table 7**.

Length	1	0x05
Type	1	0xF2
Value	4	Octet 0–1: Minimum number of octets supported per 10 ms codec frame Octet 2–3: Maximum number of octets supported per 10 ms codec frame

Table 7: Format of the LC3plusHR_Supported_ Octets_Per_Codec_Frame_ 10ms LTV structure.

4.2.4.2 LC3plusHR_Supported_Octets_Per_Codec_Frame_7_5ms

The LC3plusHR_Supported_Octets_Per_Codec_Frame_7_5ms LTV structure specifies the minimum and maximum octets per codec frame for 7.5 ms codec frames. The format of the LC3plusHR_ Octets_Per_Codec_Frame_7.5 ms LTV structure is defined in **Table 8.**

Length	1	0x05
Type	1	0xF3
Value	4	Octet 0–1: Minimum number of octets supported per 7.5 ms codec frame Octet 2–3: Maximum number of octets supported per 7.5 ms codec frame

Table 8: Format of the LC3plusHR_Supported_ Octets_Per_Codec_Frame_ 7_5ms LTV structure.

4.2.4.3 LC3plusHR_Supported_Octets_Per_Codec_Frame_5ms

The LC3plusHR_Supported_Octets_Per_Codec_Frame_5ms LTV structure specifies the minimum and maximum octets per codec frame for 5 ms codec frames. The format of the LC3plusHR_ Octets_Per_Codec_Frame_5ms LTV structure is defined in **Table 9.**

Parameter	**Size (Octets)**	**Value**
Length	1	0x05
Type	1	0xF4
Value	4	Octet 0–1: Minimum number of octets supported per 5 ms codec frame Octet 2–3: Maximum number of octets supported per 5 ms codec frame

Table 9: Format of the LC3plusHR_Supported_ Octets_Per_Codec_Frame_ 5ms LTV structure.

4.2.4.4 LC3plusHR_Supported_Octets_Per_Codec_Frame_2_5ms

The LC3plusHR_Supported_Octets_Per_Codec_Frame_2_5ms LTV structure specifies the minimum and maximum octets per codec frame for 2.5 ms codec frames. The format of the LC3plusHR_ Octets_Per_Codec_Frame_2_5ms LTV structure is defined in **Table 10**.

Parameter	**Size (Octets)**	**Value**
Length	1	0x05
Type	1	0xF5
Value	4	Octet 0–1: Minimum number of octets supported per 2.5 ms codec frame Octet 2–3: Maximum number of octets supported per 2.5 ms codec frame

Table 10: Format of the LC3plusHR_Supported_ Octets_Per_Codec_Frame_2_5ms LTV structure.

4.2.5 Codec Specific Configuration LTV requirements

Devices configuring an Audio Stream to use the LC3plus High Resolution VBR codec **shall** follow the requirements in this section when initiating the Config Codec operation as defined in Section 5.6.1 in BAP [7], or when configuring a broadcast Audio Stream, as defined in Section 6.3 in BAP [7].

The **LC3plusHR_Frame_Duration** LTV structure defined in section 4.2.5.1 **shall** be present in the Codec_Specific_Configuration field.

The **Sampling_Frequency** LTV structure defined in Bluetooth Assigned Numbers [6] **shall** be present in the Codec_Specific_Configuration field.

The **Audio_Channel_Allocation** LTV structure defined in Bluetooth Assigned Numbers [6] **may** be present in the Codec_Specific_Configuration field. The absence of the **Audio_Channel_Allocation** LTV structure **shall** be interpreted as a single channel with no specified Audio Location.

The **Octets_Per_Codec_Frame** LTV structure defined in Bluetooth Assigned Numbers [6] **shall** be present in the Codec_Specific_Configuration field. The Unicast Client and/or the Broadcast Source **shall** use a value for the **Octets_Per_Codec_Frame** LTV structure that lies within the value range of the corresponding **LC3plusHR_Supported_Octets_Per_Codec_Frame_Xms** LTV exposed within the Codec_Specific_Capabilities by the Unicast Server and/or the Broadcast Sink.

For instance, If **LC3plusHR_Frame_Duration** is set to 10 ms, the range exposed in **LC3plusHR_Supported_Octets_Per_Codec_Frame_10ms shall** be used.

If **LC3plusHR_Frame_Duration** is set to 7.5 ms, the range exposed in **LC3plusHR_Supported_Octets_Per_Codec_Frame_7_5ms shall** be used.

If **LC3plusHR_Frame_Duration** is set to 5 ms, the range exposed in **LC3plusHR_Supported_Octets_Per_Codec_Frame_5ms shall** be used.

If **LC3plusHR_Frame_Duration** is set to 2.5 ms, the range exposed in **LC3plusHR_Supported_Octets_Per_Codec_Frame_2_5ms shall** be used.

The Unicast Client and/or the Broadcast Source **should** use a value for the **Octets_per_Codec_Frame** LTV structure that is within the recommended range for the chosen Sampling Frequency and Frame Duration combination, as defined in Table 5.2. of the LC3plus specification [2].

The **Codec_Frame_Blocks_Per_SDU** LTV structure defined in Bluetooth Assigned Numbers [6] **may** be present in the Codec_Specific_Configuration field. The absence of the **Codec_Frame_Blocks_Per_SDU** LTV structure **shall** be interpreted as equivalent to a **Codec_Frame_Blocks_Per_SDU** value of 0x01.

4.2.5.1 LC3plusHR_Frame_Duration

The LC3plusHR_Frame_Duration LTV structure defines the LC3plus High Resolution frame duration selected for the codec. The format of the LC3plusHR_Frame_Duration LTV structure is defined in **Table 11**.

Parameter	Size (Octets)	Value
Length	1	0x02
Type	1	0xF1
Value	1	Selected codec frame duration 0x00: RFU 0x01: Use 10 ms codec frames 0x02: Use 7.5 ms codec frames 0x03: Use 5 ms codec frames 0x04: Use 2.5 ms codec frames All other values: RFU

Table 11: ***Format of the LC3plusHR_Frame_Duration LTV structure.***

4.2.6 Metadata LTV requirements

Section 4.3.3 in BAP [7] defines the Metadata LTV requirements for LC3. The same requirements **shall** be applied to LC3plusHR_VBR. LC3plusHR_VBR does not mandate any additional Metadata requirements.

4.2.7 Mandatory and Optional Codec Configurations and Capabilities

This section contains a set of required codec configurations, capabilities and QoS parameters.

4.2.7.1 Unicast Server Published Audio Capabilities Service requirements

Section 3.5.2 in BAP [7] defines Unicast Server audio capability configuration support settings for LC3. **Table 12** shows the additional Mandatory and Optional audio capability configuration support settings for LC3plusHR_VBR for a high-reliability configuration, and the optional capability configuration support setting for a low-latency configuration.

Codec Capability Setting	**Codec_ID**	**Codec_Specific_Capabilities (Defined in PACS [4])**			**Requirement**	
		Supported_Sampling_Frequencies (kHz) (Section 3.2.3)	**LC3plusHR_Supported_Frame_Durations (ms) (Section 3.2.3.1)**	**LC3plusHR_Supported_Octets_per_Codec_Frame (Octets) (Section 3.2.3.2)**		
					Audio Sink	**Audio Source**
48_1_LC3plusHR_VBR	LC3plusHR_VBR	48	10	160[1] (128 kbps[2])	C.1[3]	C.1[3]
48_2_LC3plusHR_VBR	LC3plusHR_VBR	48	10	310[1] (248 kbps[2])	O	O
96_1_LC3plusHR_VBR	LC3plusHR_VBR	96	10	190[1] (152 kbps[2])	M	M
96_2_LC3plusHR_VBR	LC3plusHR_VBR	96	10	310[1] (248 kbps[2])	O	O
48_3_LC3plusHR_VBR	LC3plusHR_VBR	48	7.5	117[1] (124.8 kbps[2])	C.1[3]	C.1[3]
48_4_LC3plusHR_VBR	LC3plusHR_VBR	48	7.5	180[1] (192 kbps[2])	O	O
96_3_LC3plusHR_VBR	LC3plusHR_VBR	96	7.5	141[1] (150.4 kbps[2])	C.1[3]	C.1[3]
96_4_LC3plusHR_VBR	LC3plusHR_VBR	96	7.5	225[1] (240 kbps[2])	O	O
48_5_LC3plusHR_VBR	LC3plusHR_VBR	48	5	120[1] (192 kbps[2])	O	O
96_5_LC3plusHR_VBR	LC3plusHR_VBR	96	5	120[1] (192 kbps[2])	O	O

[1] The supported range shall include this value.
[2] Bit rates are calculated according to Section 3.2.5 in [2].
[3] Mandatory to support if combination of frame duration and sample rate is supported.

Table 12: Unicast Server audio capability support requirements.

4.2.7.2 Unicast Client audio capability configuration support

Section 3.6.7 in BAP [7] defines Unicast Client audio capability configuration support settings for LC3. **Table 13** shows the additional Mandatory and Optional audio capability configuration support settings for LC3plusHR_VBR for a high-reliability configuration, and the optional capability configuration support setting for a low-latency configuration.

Codec Configuration Setting	**Codec_ID (Section 3.2.2)**	**Codec-Specific Configuration (Defined in ASCS [5])**			**Requirement**	
		Sampling_Frequency (kHz) (Section 3.2.4)	**LC3plusHR_Frame_Duration (ms) (Section 3.2.4.1)**	**Octets per_Codec_Frame (Octets) (Section 3.2.4)**	**Audio Sink**	**Audio Source**
48_1_LC3plusHR_VBR	LC3plusHR_VBR	48	10	160[1] (128 kbps[2])	C.1[2]	C.1[2]
48_2_LC3plusHR_VBR	LC3plusHR_VBR	48	10	310[1] (248 kbps[2])	O	O
48_3_LC3plusHR_VBR	LC3plusHR_VBR	48	7.5	117[1] (124.8 kbps[2])	C.1[2]	C.1[2]
48_4_LC3plusHR_VBR	LC3plusHR_VBR	48	7.5	180[1] (192 kbps[2])	O	O
48_5_LC3plusHR_VBR	LC3plusHR_VBR	48	5	120[1] (192 kbps[2])	O	O
96_1_LC3plusHR_VBR	LC3plusHR_VBR	96	10	190[1] (152 kbps[2])	M	M
96_2_LC3plusHR_VBR	LC3plusHR_VBR	96	10	310[1] (248 kbps[2])	O	O
96_3_LC3plusHR_VBR	LC3plusHR_VBR	96	7.5	141[1] (150.4 kbps[2])	C.1[2]	C.1[2]
96_4_LC3plusHR_VBR	LC3plusHR_VBR	96	7.5	225[1] (240 kbps[2])	O	O
96_5_LC3plusHR_VBR	LC3plusHR_VBR	96	5	120[1] (192 kbps[2])	O	O

[1] Bit rates are calculated according to Section 3.2.5 in [2].
[2] Mandatory to support if combination of frame duration and sample rate is supported.

Table 13: Unicast Client audio capability support requirements.

4.2.7.3 Broadcast Source audio capability configuration support

Section 3.7.1 in BAP [7] defines Broadcast Source audio capability configuration support settings for LC3**. Table 14** shows the additional Mandatory and Optional audio capability configuration support settings for LC3plusHR_VBR.

Codec Configuration Setting	**Codec_ID (Section 3.2.2)**	**Codec-Specific Configuration (see Table 3.16 in BAP [7])**			**Requirement**
		Sampling_Frequency (kHz) (Section 3.2.4)	**LC3plus HR_Frame_Duration (ms) (Section 3.2.4.1)**	**Octets per_Codec_Frame (Octets) (Section 3.2.4)**	
					Audio Source
48_1_LC3plusHR_VBR	LC3plusHR_VBR	48	10	160 (128[1] kbps)	M
96_1_LC3plusHR_VBR	LC3plusHR_VBR	96	10	190 (152[1] kbps)	O
[1] Bit rates are calculated according to Section 3.2.5 in [2].					

Table 14: Broadcast Source audio capability configuration support requirements.

4.2.7.4 Additional Published Audio Capabilities service requirements

Section 3.8.2 in BAP [7] defines Additional Published Audio capability configuration support settings for Broadcast Sinks for LC3**. Table 15** shows the additional Mandatory and Optional audio capability configuration support settings for LC3plusHR_VBR.

Codec Capability Setting	**Codec_ID**	**Codec_Specific_Capabilities (Defined in PACS [4])**			**Requirement**
		Supported_Sampling_Frequencies (kHz) (Section 3.2.3)	**LC3plusHR_Supported_Frame_Durations (ms) (Section 3.2.3.1)**	**LC3plusHR_Supported_Octets_per_Codec_Frame_10ms (Octets) (Section 3.2.3.2)**	
48_1_LC3plus HR_VBR	LC3plusHR_VBR	48	10	160[1] (128 kbps[2])	M
96_1_LC3plus HR_VBR	LC3plusHR_VBR	96	10	190[1] (152 kbps[2])	O

[1] The supported range shall include this value.
[2] Bit rates are calculated according to Section 3.2.5 in [2].

Table 15: Broadcast Sink audio capability support requirements.

4.2.7.5 QoS configuration for ASE Control operation

Section 5.6.2 in BAP [7] defines QoS settings for LC3**. Table 16** shows the additional Mandatory and Optional QoS configuration support settings for LC3plusHR_VBR. QoS configuration settings for Broadcast Server and Broadcast Client are shown in **Table 17.** The Unicast/Broadcast Client and the Unicast/Broadcast Server **may** support any other QoS configuration settings defined by an implementation or by a higher-layer specification.

Set Name	Codec Capability / Configuration Setting (Tables 8 and 10)	SDU_ Interval (µs)	Framing	Max_SDU (Octets)	RTN	Max_Transport_Latency (ms)	Presentation_Delay (µs)	Requirement	
								Unicast Client	Unicast Server
QoS Configuration settings for high-reliability audio data									
48_1_LC3plusHR_VBR_1	48_1_LC3plusHR_VBR	100001	unframed	1602 (128 kbps3)	13[5]	100	40000[4]	C.1	C.1
96_1_LC3plusHR_VBR_1	96_1_LC3plusHR_VBR	100001	unframed	1902 (152 kbps3)	13[5]	100	40000[4]	M	M
48_2_LC3plusHR_VBR_1	48_2_LC3plusHR_VBR	100001	unframed	3102 (248 kbps3)	13[5]	100	40000[4]	O	O
96_2_LC3plusHR_VBR_1	96_2_LC3plusHR_VBR	100001	unframed	3102 (248 kbps3)	13[5]	100	40000[4]	O	O
48_3_LC3plusHR_VBR_1	48_3_LC3plusHR_VBR	7500	unframed	1172 (124.8 kbps3)	13[5]	75	40000[4]	C.1	C.1
96_3_LC3plusHR_VBR_1	96_3_LC3plusHR_VBR	7500	unframed	1412 (150.4 kbps3)	13[5]	75	40000[4]	O	O
48_4_LC3plusHR_VBR_1	48_4_LC3plusHR_VBR	7500	unframed	1802 (192 kbps3)	13[5]	75	40000[4]	O	O
96_4_LC3plusHR_VBR_1	96_4_LC3plusHR_VBR	7500	unframed	2252 (240 kbps3)	13[5]	75	40000[4]	O	O
QoS Configuration settings for low-latency audio data									
48_5_LC3plusHR_VBR_LL	48_5_LC3plusHR_VBR_LL	5000	unframed	120[2] (192 kbps[3])	4[5]	5	40000[4]	O	O
96_5_LC3plusHR_VBR_LL	96_5_LC3plusHR_VBR_LL	5000	unframed	120[2] (192 kbps[3])	4[5]	5	40000[4]	O	O

[1] Nominal. May be adjusted to accommodate audio clock offset and drift.
[2] Settings are based on a Unicast Client communicating with two Unicast Servers, with each Unicast Server being configured for a single Audio Channel and single block of codec frames per SDU (Service Data Unit). Different Audio_Channel_Allocation values (see Section 3.2.4) and/or a greater number of blocks of codec frames per SDU (see Section 3.2.4) would require settings to be appropriately scaled.
[3] Bit rates are calculated according to Section 3.2.5 in [2].
[4] For the Unicast Server, the supported Presentation_Delay range in the Codec Configured state shall include this value when the ASE is a Sink ASE.
[5] Retransmission_Number values are recommendations to the Controller, which may use different values to match desired robustness and/or bandwidth. The Host shall be capable of requesting the values listed.

Table 16: QoS configuration support setting requirements for the Unicast Client and Unicast Server.

C.1: Optional if the Codec Configuration Setting is supported in **Table 12**, otherwise Excluded.

C.2: Optional if the Codec Capability Setting is supported in **Table 11**, otherwise Excluded.

Set Name	Codec Capability / Configuration Setting (Table 7 and Table 8)	SDU_ Interval (µs)	Framing	Max_SDU (Octets)	RTN	Max_Transport_Latency (ms)	Presentation_Delay (µs)	Requirement	
								Broadcast Source	Broadcast Sink
Broadcast Audio Stream configuration settings for high reliability audio data									
48_1_LC3plusHR_VBR_1	48_1_LC3plusHR_VBR	10000[1]	unframed	160[2] (128 kbps[3])	4[5]	65	40000[4]	M	M
96_1_LC3plusHR_VBR_1	96_1_LC3plusHR_VBR	10000[1]	unframed	190[2] (152 kbps[3])	4[5]	65	40000[4]	O	O

[1] Nominal. May be adjusted to accommodate audio clock offset and drift.
[2] Settings are based on a Broadcast Client communicating with two Broadcast Sources, with each Broadcast Sink being configured for a single Audio Channel and single block of codec frames per SDU (Service Data Unit). Different Audio_Channel_Allocation values (see Section 3.2.4) and/or a greater number of blocks of codec frames per SDU (see Section 3.2.4) would require settings to be appropriately scaled.
[3] Bit rates are calculated according to Section 3.2.5 in [2].
[4] For the Broadcast Sink, the supported Presentation_Delay range in the Codec Configured state shall include this value when the ASE is a Sink ASE.
[5] Retransmission_Number values are recommendations to the Controller, which may use different values to match desired robustness and/or bandwidth. The Host shall be capable of requesting the values listed.

Table 17: Broadcast Audio Stream configuration support requirements for the Broadcast Source and Broadcast Sink

4.2.8 LC3plusHR_VBR Media Payload Format

The Media Payload Format of LC3plusHR_VBR is identical to the one of LC3 as described in Section 4.2 LC3 Media Packet format in the Basic Audio Profile specification [7].

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Annex A Overview Codec ID

The following table lists the Codec ID for the Fraunhofer Company ID (0x08A9)

Codec ID	Description
0x0001	LC3plus High Resolution Frame duration: 10 ms, 7.5 ms, 5 ms, 2.5 ms Variable bit rate support

Table 18: Overview Fraunhofer Codec ID