LC3 plus

LOSSLESS AUDIO

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LC3PLUS LOSSLESS PRODUCT SHEET

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LC3plus is standardized by ETSI as TS 103 634 as a highly flexible audio codec suitable for speech and music content, providing high quality, low delay and low complexity at medium compression. The LC3plus codec is a superset of LC3 as specified by Bluetooth (LC3BT).

LC3plus Lossless is an extension to LC3plus, making it an all-in-one solution for wireless audio streaming. The new Lossless mode of LC3plus allows perfect reconstruction of the original audio signal at the receiver side with sample rates up to 192 kHz. If bandwidth requirements get tough, the codec's operation bitrate can be reduced while switching from Lossless coding to High-Resolution coding, still preserving excellent performance in SNR and THD+N. The LC3plus Lossless thus automatically includes transmission of content in High-Resolution as well and checks all marks of the LC3plus toolbox like support for low delay frame durations and Advanced Packetloss Concealment.

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1. LC3plus Lossless – Overview

LC3plus Lossless is an extension of the LC3plus toolbox which supports both Lossless and High-Resolution audio coding.
The codec supports the following configurations:

- Sample Rates: 44.1 kHz, 48 kHz, 96 kHz and 192 kHz
- Frame durations: 10 ms, 7.5 ms, 5 ms, 2.5 ms and 1.25 ms
- Bit depths: 16-bit and 24-bit
- Packet Loss Concealment: Advanced as in LC3plus Advanced PLC
- Support for High-Resolution available as fallback to Lossless

NOTE: One single library can cover LC3, LC3plus, LC3plus High-Resolution and LC3plus Lossless use-cases while being efficient in terms of memory usage.

The main control parameter of LC3plus Lossless is the codec bitrate. The LC3plus Lossless Encoder will determine whether the codec bitrate is sufficient to code the frame lossless. If it is, the encoder uses the lossless operation mode – if not, it uses a High-Resolution (lossy) coding mode to code with as much precision as possible. Thus, LC3plus Lossless internally consists of two coding modes: Lossless and High-Resolution (lossy).
The High-Resolution (lossy) coding mode performs identical to LC3plus High-Resolution in terms of SNR and THD+N metrics. LC3plus Lossless thus combines Lossless and High-Resolution coding into one single operation mode.

The switch between Lossless and High-Resolution (lossy) coding mode, and the adaptation of the codec's bitrate can happen seamlessly on a frame-by-frame basis. The required bitrate for lossless coding depends on the frame content and can vary. Some example average bitrate requirements for Lossless coding (i.e., to achieve bit-exact output for 100% of all frames) with LC3plus Lossless are shown in Table 1.

NOTE: The High-Resolution (lossy) operation of LC3plus Lossless is also certified for the Japan Audio Society High-Res Audio Wireless Logo.

Sample Rate [kHz]	Bit Depth	Avg. Bitrate [kbit/s per channel]
44.1	16-bit	315
44.1	24-bit	655
48	16-bit	418
48	24-bit	870
96	24-bit	1.706

Table 1: Average bitrate requirements for LC3plus Lossless

LC3plus Lossless software is available in binary format and soon as source code.

For Bluetooth A2DP, Fraunhofer can provide a patch set to enable transmission of LC3plus Lossless over A2DP. The patch set has been verified in real-life environments and can enable Lossless transmission of 44.1 kHz, 48 kHz and 96 kHz with 16-bit bit depth with the 2M Bluetooth Classic A2DP wireless link. LC3plus Lossless uses 500 kbit/s per channel in the A2DP configuration, i.e., 1 Mbit/s total bandwidth.