



## > CEVA-HD-Audio

### High-performance, single-core integrated audio solution

#### CEVA-HD-Audio Target Markets

- > Blu-ray Disc players
- > Digital TVs, HDTVs
- > Set-top boxes, PVRs, media centers
- > Other home A/V equipment
- > PMPs, Portable game consoles

The market for digital high definition audio (HD audio) solutions including Blu-ray Disc players, Digital TVs, Set-top boxes and home entertainment systems is dynamic and highly competitive. Digital HD audio devices are dramatically increasing in popularity, and there is a strong demand for lower cost and higher performance equipment. These market requirements translate into demand for integrated optimized platforms consuming smaller die size without compromising on audio performance.

Existing audio codecs are evolving relentlessly and new HD audio standards are constantly emerging. Consumers still

expect high quality sound reproduction, which necessitates even higher complexity audio standards. In addition, latest HD audio devices require sophisticated use-cases, including support for 2 HD audio decoders (supporting 7.1 and 5.1 channels), a 5.1 channel audio encoder and advanced

post-processing functions. Bit rates supported by some of the HD audio standards can reach as high as 24Mbps, as opposed to less than 1Mbps for previous generation home audio standards. The table below depicts the evolving requirements in today's home audio devices.

	Current Home Audio	Next Generation Home Audio
<b>Number of channels per stream</b>	5.1 channels	7.1 channels
<b>Number of simultaneous streams</b>	1 to 2	2 to 3
<b>Audio Codecs</b>	AC-3, MLP, DTS, HE-AAC, etc'	DD Plus, TrueHD, DTS-HD, lossless codecs Transcoding also required
<b>Bit Rates</b>	Up to 640Kbps	Up to 24Mbps Transcoding also required for backward compatability
<b>Post processing</b>	Up/down sampling, equalizer, spatial effects	Room correction, SRS WOW HD, Dolby Pro Logic II / IIx, Virtual Speaker, THX...
<b>Data Precision</b>	16-bit or 24-bit precision sufficient	32-bit data precision required for some HD Audio standards

#### Evolution of Home Audio - Increased Challenges

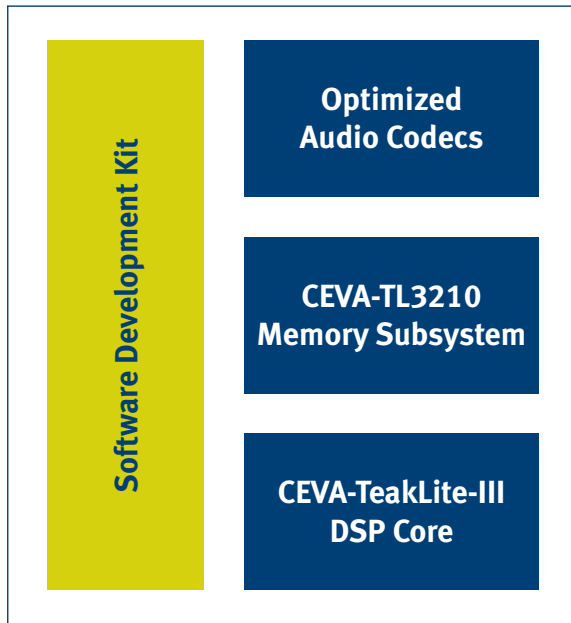
To meet these challenges, CEVA has developed CEVA-HD-Audio™, a DSP-based single-core audio platform targeting high-volume ICs for devices such as Blu-ray Disc players, DTVs and home entertainment systems.

CEVA-HD-Audio is a high-performance, low-cost platform that combines several CEVA-developed technologies including the CEVA-TeakLite-III™ DSP core, a configurable cached memory subsystem, a comprehensive set of optimized HD audio codecs, and complete software development kit, including software development tools, prototype boards, systems drivers and RTOS. This complete solution, fully developed and maintained by CEVA, ensures quick and easy development and integration into the customer's SoC.

The CEVA-TeakLite-III is a 32-bit DSP, designed specifically to deal with the demanding requirements of HD audio applications. It operates at 550MHz in 65nm G process, and incorporates a configurable memory subsystem, including cache memories, providing the best price/performance ratio in the market. Power consumption is 0.5mW for stereo MP3 decoding and the die size at 65nm process starts at 0.5 square millimeters.

CEVA-HD-Audio is further enhanced by the vast CEVAnet™ partner program, whereby partners provide additional audio software and tools to extend the CEVA-HD-Audio-based products.

## The CEVA-HD-Audio solution is comprised of **CEVA-HD-Audio DSP Engine** four key elements:



- › **Programmable DSP Engine**  
A 550MHz CEVA-TeakLite-III is a high performance, yet small die size and low-power DSP core
- › **Configurable Memory Subsystem**  
The CEVA-TL3210, a highly integrated, compact DSP subsystem, incorporating a CEVA-TeakLite-III core, a configurable cached memory architecture with a small memory footprint and an AMBA standard bridges for easy system integration
- › **Audio Software**  
CEVA's open, programmable platform contains a comprehensive set of industry standard audio, speech and voice codecs, optimized for the CEVA-TeakLite-III DSP
- › **Complete Software Development Kit (SDK)**  
A complete software development suite, including development tools, development boards, software system drivers and RTOS, for easy application development and system integration from initial design through final tape-out

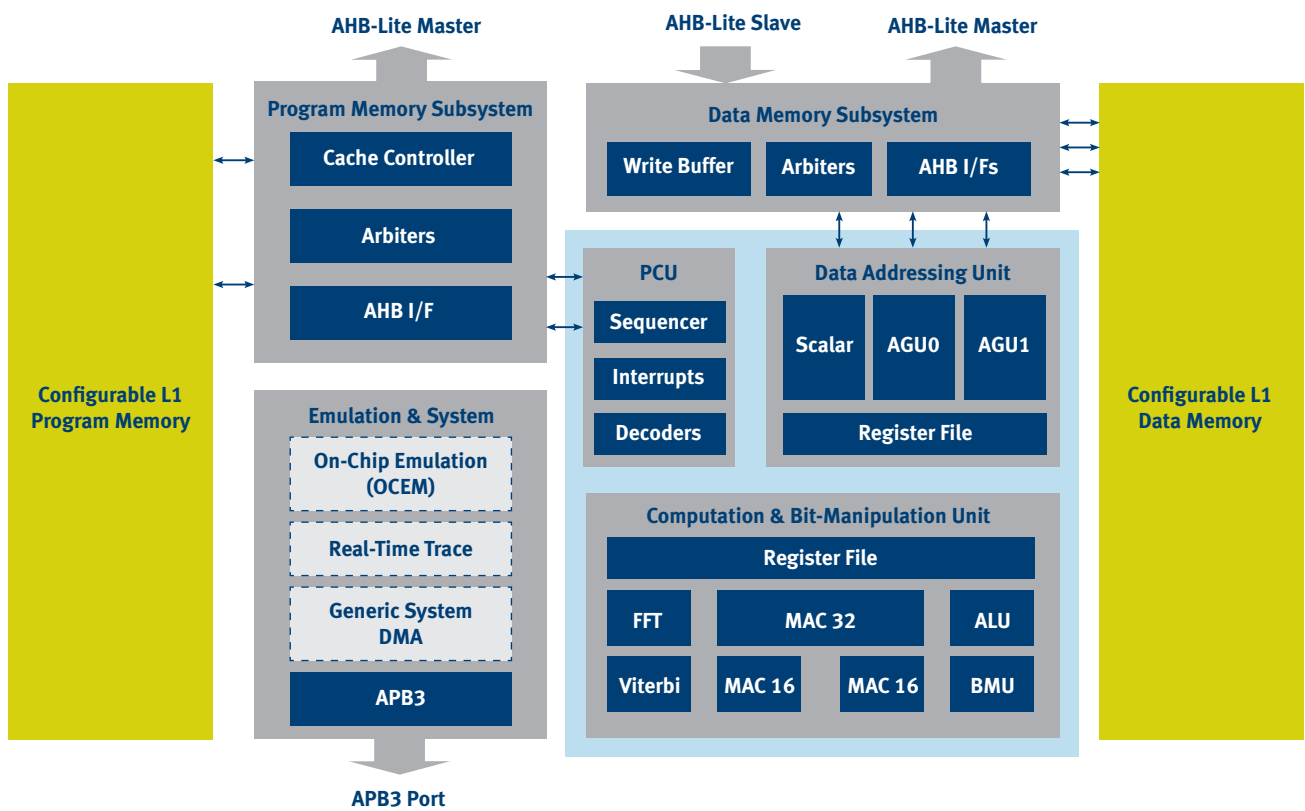
The CEVA-HD-Audio incorporates a very low-power, low-cost, fully synthesizable CEVA-TeakLite-III DSP core. Thanks to a small die size of 0.5mm<sup>2</sup> (at 65nm process) and the 16/32-bit instruction width, the DSP engine enables the production of low cost silicon and a small memory footprint.

The CEVA-TeakLite-III is a 32-bit DSP, incorporating various features that enable it to meet the most demanding HD audio requirements (see sidebar).

The core is assembly level-compatible to the CEVA-TeakLite-I/II DSP cores, allowing licensees of these cores to easily reuse their code on the CEVA-TeakLite-III.

### CEVA-TeakLite-III Designed for HD Audio

- › 32-bit native DSP
- › Single cycle 32x32-bit multiplier
- › 72-bit accumulation, for full precision in lossless codecs
- › 32-bit register file
- › 64-bit memory bandwidth
- › Strong bit-manipulation capabilities for stream processing
- › Up to 3 instructions running in parallel
- › Accelerated single-precision and double-precision FFT instructions
- › High-speed design, 550MHz in 65nm G process
- › CEVA-Quark™ ISA for reduced code memory and die size



CEVA-TeakLite-III Block Diagram

## CEVA-HD-Audio Audio Subsystem

CEVA-HD-Audio includes a configurable audio subsystem that is optimized for audio applications.

- › **Program Memory**
  - Configurable cache of 0-32K word
  - Optional Tightly Coupled Memory (TCM), up to 128K word
- › **Data memory**
  - Configurable 16-256K word TCM memory
- › **Standard interfaces and protocols**
  - AHB master port for easy integration to external memory resources
  - AHB slave port, allows internal memory access by external resources
  - APB bus enables integration with off the shelf APB peripherals
- › **Emulation capabilities**
  - On-chip emulation module (OCEM)
  - Real-Time Trace through ETM interface
  - Hardware profiler
- › **Optional DMA engine**
  - DMA is utilized by software codecs, to simultaneously control data/code traffic and reduce overall system speed requirements
  - Licensee can use his own SoC DMA engine, or can license a DMA engine from CEVA

## CEVA-HD-Audio Software

The CEVA-HD-Audio software library incorporates audio codecs that are widely adopted industry standards for DTV, STB and Blu-ray DVD. This improves time-to-market and eases the integration into customers' SoCs. Broad range of codecs include:

- › DTS-HD: High Resolution, Master Audio, Express, DTS Core decoder and encoder, Neo6
- › Dolby: Dolby Digital Decoder 5.1 / 7.1, Dolby Digital Plus, Dolby TrueHD, ProLogic-IIx, Dolby Digital Consumer Encoder
- › LC-AAC/HE-AAC stereo/5.1 V1 and V2
- › MPEG1/2/2.5 Layers 1/2/3
- › MP3, WMA, WMA Pro, RealAudio
- › PCM Mixing, Sample Rate Conversion

All the codecs are optimized for small internal Data RAM usage, and are utilizing a generic system DMA in order to reduce overall system speed requirements and shorten licensee's time-to-market.

## CEVA-HD-Audio Software Development Kit (SDK)

CEVA has developed a suite of advanced software and hardware development environments, allowing licensees a quick and easy software development and system integration. The GUI-based development environment allows the programmer to comfortably follow the various processes, allowing greater efficiency within programming, compiling and debugging processes.

Complete and integrated software development tools include:

- › Advanced user friendly IDE
- › Optimizing C Compiler
- › Assembler, linker & utilities
- › Advanced GUI debugger
  - Scripting support (CLI/TCL)
  - Multi core Support
  - Interface to Verilog simulators (DBGVerifier)
  - Built in extendible simulator
  - Emulator I/F (PP/USB/JTAG)
  - MATLAB connection
- › Application Profiler
  - Performance measurement
- › Mature and long-time field proven tools are available for PC/Windows, UNIX/Solaris and Linux operating systems

Development hardware boards include:

- › Support for audio-in, audio-out, SD/MMC card
- › Easy integration with ARM development board

Other SDK components

- › System software drivers
- › Generic DMA description
- › RTOS for easy software integration into complete application

## Platform Benefits

- › Integrated, programmable audio platform
    - DSP core and subsystem
    - Broad range of audio codecs
    - Shorter time to market
  - › Lower risks Robust performance Power efficiency
    - Low cost: 0.5mm<sup>2</sup> for the DSP at 65nm process
    - Low power: 0.5 mW for stereo MP3 decoder
  - › Strong technology heritage
    - Leverages on widely-deployed CEVA-TeakLite technology
    - Audio codecs deployed in key mobile and consumer devices
  - › Single source solution
    - Reduces risks and solution complexity
  - › Qualified IP
    - Stringent functional verification procedure
    - Simulation environment allows verification of customer SoC integration
    - Fully synthesizable RTL code
    - Robust RTL to GDSII design flow using mainstream, industry-standard EDA tools
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 [www.ceva-dsp.com](http://www.ceva-dsp.com)



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