CEVA®
The DSP Powerhouse

CEVA MM2000

MM2000 Target Markets

- Multimedia phones and smartphones
- Mobile Internet Devices
- Portable Media Players
- Video Phones
- Digital Still Cameras
- Digital Camcorders

The demand for mobile infotainment applications such as mobile TV, streaming video-on-demand, video clip messages, video-conferencing and imaging is growing at a relentless pace. Handset vendors and other consumer device manufacturers are introducing new devices to the consumer electronics market on a weekly basis, including multimedia phones, wireless PDAs, digital still cameras and camcorders. With applications, usage scenarios and standards changing on a constant basis, ASIC and ASSP developers need to ensure that their products incorporate the latest advances in technology, while reducing their Bill-of-Material and maximizing battery life.

To meet these challenges, CEVA has developed MM2000, a comprehensive and fully programmable solution for mobile multimedia applications.

MM2000 is a scalable, flexible, powerful and efficient solution, combining audio, video, voice and imaging functions with extremely low power consumption all in a small die size. It is accompanied by an application development environment allowing customers to extend the package with other features such as 2.5G/3G modems, Wi-Fi, GPS and Bluetooth. CEVA MM2000 is programmable solution for a wide range of multimedia standards, resolutions and frame rates, allowing licensees to retarget a single silicon platform for any multimedia processing requirements, thereby eliminating the need for costly, time-consuming silicon re-spins.

MM2000 is the second generation mobile multimedia solution from CEVA, following its successful predecessor, the MM1000. MM2000 is capable of encoding and decoding of the most complex standards today. For example, MM2000 is capable of encoding and decoding H.264 streams at up to full D1 resolution, at 30 frame-per-second, without any hardwired acceleration.

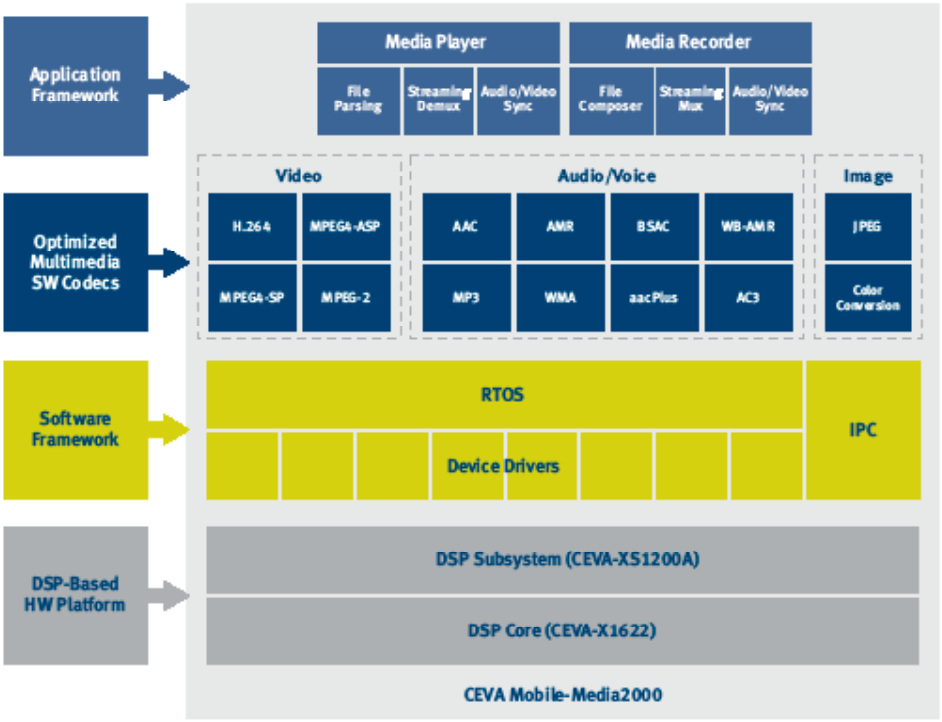
The MM2000 solution incorporates four integrated layers, forming the most comprehensive solution in the market today: DSP-based hardware platform, platform-related software framework, optimized multimedia software codecs, and complete application frameworks.

MM2000 Scalability

MM2000 is a scalable solution designed to custom-fit specific applications and customer requirements. At its entry-level, the MM2000 platform offers an optimized feature set for low-cost products like MobileTV-enabled devices, low-cost MP4 players and feature phones supporting H.264 decode and encode up to CIF resolution. At its top of the scale, the MM2000 platform offers feature set for the most demanding mobile multimedia products like high-end PMPs, Smartphones, Digital Still Cameras and Camcorders. At all scales, MM2000 offers the customer a complete set of HW and SW layers to choose from and best fit the product to its time-to-market.

MM2000 DSP-Based Hardware Platform

MM2000 pre-verified and silicon-proven hardware platform is based on the CEVA-X1622 DSP core and the CEVA-XS1200A DSP subsystem. The CEVA-X1622 DSP core is a dual-MAC VLIW/SIMD processor, capable of executing up to 8 instructions in parallel. It has four 40-bit arithmetic units and sixteen 40-bit accumulators, also used as a unified register file. A separate



MM2000 Solution Layers

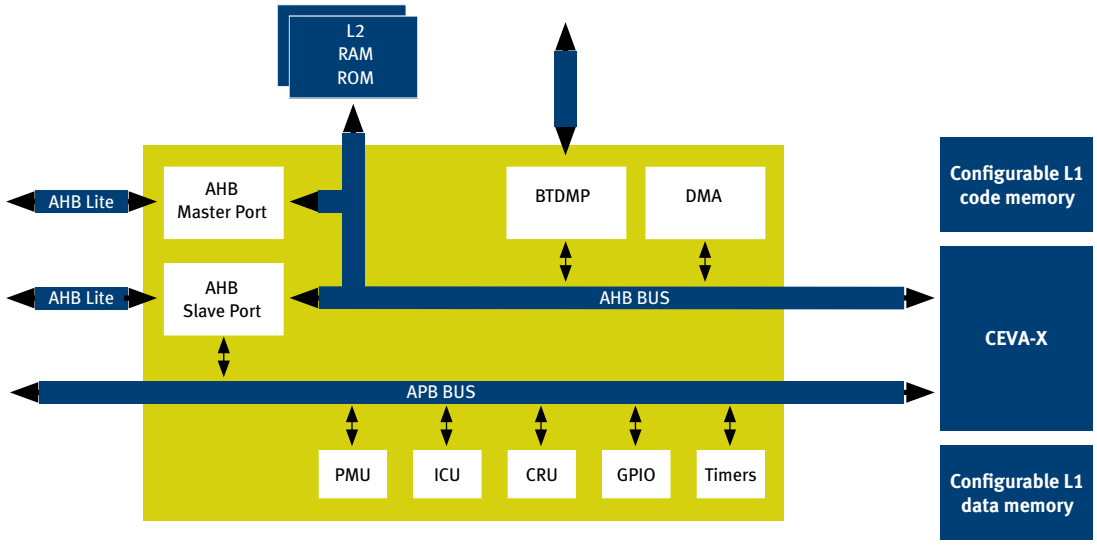
32-bit integer unit is integrated into the processor, offloading all control and overhead functions and making the CEVA-X1622 an efficient hybrid of CPU and DSP processors.

The CEVA-X1622 DSP core also includes built-in multimedia instructions and mechanisms, significantly accelerating the software implementation of multimedia codecs without compromising on power consumption. A complete Level 1 memory subsystem is also included, with configurable size level 1 program and data memory and the required memory controllers, DMAs and cache controllers. Its support for unified and cached memory subsystems reduces overall die size, cost and power consumption for various applications.

The CEVA-XS1200A DSP subsystem is designed specifically for multimedia applications. It includes a set of DSP peripherals such as an Interrupt Controller and Power Management Unit, up to 4 Time Division Multiplex (TDM) ports for effective audio/voice interfacing, and a programmable 3D DMA coprocessor responsible for all media data transfers. The different media peripherals embedded into the hardware platform offload tasks that are not signal-processing related from the DSP, allowing the DSP to focus on the media codecs implementation. The CEVA-XS1200A also incorporates AHB and APB bridges with CPU subsystems and a built-in interface with Level 2 memories.

MM2000 Benefits to Licensees

- A fully programmable solution, providing various multimedia capabilities including H.264 decoding / encoding up to full D1, 30 fps
- Single reusable platform powers multiple devices
  - Quick and cost-effective deployment of new products
  - Easy differentiation through software
  - Easy integration with host layers through embedded IPC
- Lowers development and integration costs
  - Complete multimedia solution – Audio, Video, Imaging, Voice
  - Easy SoC integration through provided bus bridges
- Multi-standard support shrinks die size and cost
  - Single engine supporting virtually any multimedia codec
- Significantly increases battery life
  - Low speed requirements translate to low power consumption
- Open architecture and standardized APIs
  - Licensees can easily incorporate additional software and hardware components
  - Leverage on a wide-range of offerings from CEVAnet's third-party community



Block Diagram for MM2000 HW Platform

MM2000 Software Framework

The software framework layer of the MM2000 solution links the software layers with the hardware platform, using a set of device and I/O drivers. A Real-Time Operating System (RTOS) is also included in the software framework layer, scheduling tasks according to various priorities and on-the-fly events and allocating resources accordingly.

An Inter-Processor Communication (IPC) protocol is also incorporated into the software framework layer. This protocol was defined in conjunction with other processor vendors, allowing MM2000 to easily communicate with other processors in the system on the application level, including sending commands, data and status notifications. This significantly eases the software integration of MM2000 with other CPU systems.

MM2000 Optimized Multimedia Codecs

MM2000 incorporates a complete set of multimedia codecs, fully optimized to execute on the CEVA-XS1200A hardware platform. These codecs fully utilize the media processing capabilities of the CEVA-X1622 DSP core, as well as an innovative software acceleration technology.

The multimedia codec library complementing the MM2000 solution includes (partial list):

- **Video codecs:**
  - H.264 baseline profile, VC-1, MPEG4 simple profile, MPEG4 advanced simple profile, DivX, H.263 baseline profile, Real Video 8/9/10, AVS
- **Audio codecs:**
  - AAC-LC, HE-AAC encoding/decoding
  - MP3, MP3Pro encoding/decoding
  - WMA encoding/decoding
  - BSAC, Ogg Vorbis
- **Voice codecs:**
  - AMR, WB-AMR
  - G.723.1, G.726, G.729
  - CDMA vocoders
- **Imaging:**
  - JPEG encoding/decoding, up to 12 Mpixel per second
  - Image enhancements, scaling, rotation, etc'
  - Color conversion

In addition, the CEVA-X is an open architecture, allowing licensees to easily customize and differentiate with additional hardware and software components. A wide-range of offerings from CEVA's third-party community, CEVAnet, can be leveraged in order to complement MM2000 with additional unique features and functions.

MM2000 Complete Application Frameworks

At its top layer, the MM2000 solution offers complete application frameworks, combining components from previous layers and producing fully integrated and ready-to-implement applications.

MM2000 for Media Player

Use Case

Video processing
- H.264 baseline profile decoding
- D1 resolution, 30fps, 2Mbps
- "Market" stream

Audio processing
- HE-AAC decoding, 48Kbps

Overhead
- OS, Context switching

File Parsing
- MP4 format

Video	Audio	File Parser	Overhead	Total
166MHz	23MHz	10MHz	15MHz	214MHz

1 Power consumption at 65nm G process, typical conditions
2 Decoding MHZ depends on system setup and test file used

The Media Player framework supports playing any video and audio stream, including synchronization. It supports decoding of all common file formats and streaming protocols, making it useful for different applications such as MobileTV, streaming video-on-demand, and playing recorded video clips.

The Media Recorder framework enables recording synchronized video with audio. It supports encoding the raw data to various file formats and streaming protocols, enabling applications such as digital camcorders and surveillance equipment.

MM2000 Development Platform

The MM2000 platform employs the Evaluation and Development Platform (EDP) for CEVA-X. It interfaces to a host PC through the JTAG interface (JBox) for full application control and contains the following:

- On board 128MByte DDR SDRAM
- On board Flash memory
- SSRAM memory
- VGA TFT LCD
- PC monitor interface
- CMOS sensor interface
- EDP interfaces
  - 2 X UART ports
  - Stereo Audio input
  - Stereo Audio output
  - MMC/SD flash socket
  - USB 2.0
  - Ethernet module

Software Development Tools

The Mobile-Media solution is supplemented by CEVA's ad-vanced Integrated Development Environment (IDE) of software development tools for embedded applications. The tools are available for all PC/Windows, UNIX/Solaris and Linux operating systems.

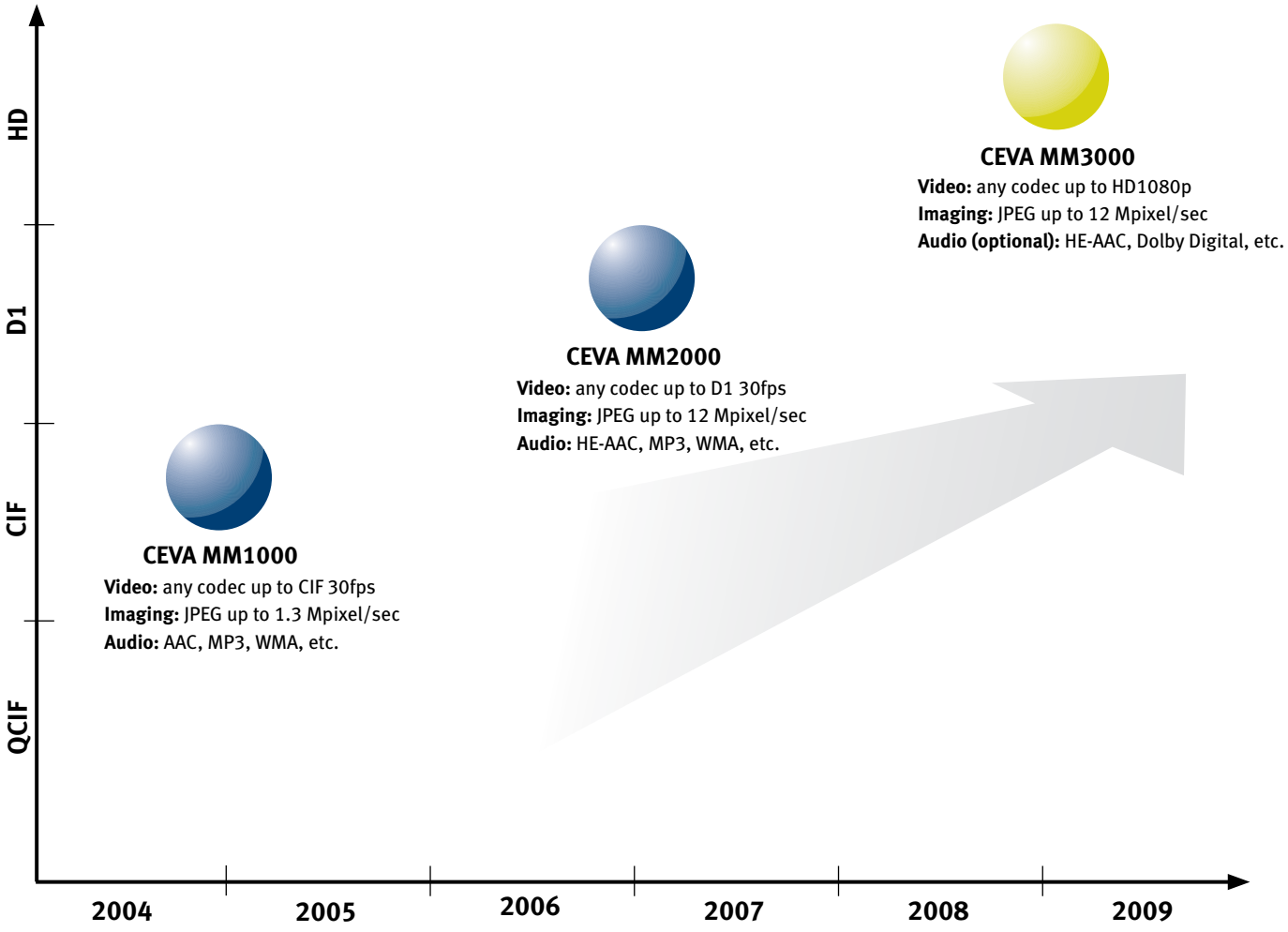
A highly optimized C compiler exploits the DSP core's architecture for efficient code generation.

The Macro Assembler and Linker tools contain a mechanism for checking architectural restrictions and overcoming errors and an advanced mapping mechanism. Post-Linker Optimizer is included for performing global optimizations for code size and cycle count reduction. Section overlayis also supported.

The tool chain also includes an advanced GUI-based source level debugger, including an extendable built-in simulator, supporting Instruction Set Simulation (ISS) and Cycle Accurate Simulation (CAS), complete Memory Sub-System (MSS) simulation and profiling, emulation support through a JTAG port, extensive scripting language capabilities, standard C file I/O support, MATLAB bi-directional connectivity and extensive breakpoint support.

The tools are configurable and apply robust C design, including User customizable DLLs. The tools have been developed in-house, leveraging over a decade of accumulated tools development experience to create a comprehensive solution to diverse programming challenges.

CEVA CDM development Board with LCD touch screen



CEVA's Multimedia Roadmap

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› www.ceva-dsp.com

PRINCIPAL OFFICES

USA
2033 Gateway Place, Suite 150, San Jose, CA 95110-1002,
Tel: +1 (408) 514 2900 Fax: +1 (408) 514 2995

Israel
2 Maskit Street, POBox 2068, Herzelia, 46120, Israel
Tel: +972 9 961 3700 Fax: +972 9 961 3800

Ireland
2nd Floor, 8-11 Lower Baggot Street, Dublin 2, Ireland
Tel: +353 1 678 8873 Fax: +353 1 678 8877

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