

DaVinci™ Technology Background and Specifications

Executive Summary

DaVinci technology is the first integrated portfolio of DSP-based processors, software, tools, and support for developing a broad spectrum of optimized digital video end equipments. It enables original equipment manufacturers (OEMs) to more easily and quickly develop a range of innovative, cost-efficient digital video products, transforming the way consumers experience digital video. DaVinci technology will accelerate the pace of innovation and expand the market for digital video applications.

TI introduced the first DaVinci products to the market in December 2005 and has since added a variety of components to the DaVinci technology portfolio, including processors, software, tools and partnership solutions. The comprehensive DaVinci technology roadmap addresses the demand for real-time video for a host of emerging digital video product innovations. These application segments include: video security, IP set-top box, videoconferencing, automotive infotainment, portable media, digital cameras and other video products that have yet to be invented.

To further illustrate DaVinci technology, the following components have been optimized to work interdependently for digital video end equipments:

DaVinci Processors

DaVinci processors are built on the industry's leading digital signal processing technology from TI. DaVinci processors consist of scalable, programmable processors, including DSP-based digital media processors, ARM® processors and DSP-based systems-on-chips (SoCs), which include accelerators and peripherals. All DaVinci processors are optimized to match price, performance and feature requirements for specific digital video end equipments.

• DaVinci Processors in the Market

A number of DaVinci processors are already available and they have been adopted for the following digital video markets:

- Digital cameras
- Video security
- Video telephones
- Portable media players
- IP set-top box
- Medical imaging
- Automotive infotainment
- Networked video for emerging applications

Specific offerings include the TMS320DM644x and TMS320DM643x processors. The TMS320DM644x architecture is a highly integrated system-on-chip (SoC) that has absorbed many of the external components required for digital video, dropping hardware bill of materials by as much as 50 percent. The DM644x devices are based on TI's performance-leading TMS320C64x+™ DSP core, an ARM926 processor, video accelerators, networking peripherals and external memory/storage interfaces all specifically tuned for video performance. The TMS320DM6443 processor, tuned for

video decode applications, provides all of the processing components required to decode digital video, including both analog and digital video output with integrated resizer and on-screen display (OSD) engines. The TMS320DM6446 processor, tuned for video encode and decode applications, adds video encoding capabilities through a dedicated video processing front end capable of capturing various digital video formats.

Additionally, the TMS320DM643x processors are the first DSP-only devices for DaVinci™ technology and provide greater processing power at a lower price point than ever before. These processors include the TMS320DM6437, TMS320DM6435, TMS320DM6433 and TMS320DM6431. All four processors feature the new TMS320C64x+™ core and operate between 300 and 600 MHz. Three of the processors (the TMS320DM6431, DM6435 and DM6437) offer special features that make them suitable for automotive vision applications, such as lane departure warning and collision avoidance and they meet the AEC-Q100 automotive quality standard.

TI also offers two digital still camera processors, one for low-end cameras and the other for high-end cameras. The digital media processor based on DaVinci technology for the low-end digital camera market provides up to 75 megapixels (MP) per second of hardwired performance. In addition, a flexible software pipeline to enable original design manufacturers (ODMs) to easily and efficiently incorporate differentiating features that truly set them apart in such a competitive consumer market. The processor for the high-end digital camera market supports camera resolutions up to 16 megapixels (MP) and offers a high-definition video capture mode greater than 30 frames per second at 720p resolution. The abundance of processing headroom allows the camera to rapidly perform core features, including shutter lag, boot time and picture playback that rival D-SLRs (digital-single lens reflex), while also offering advanced features such as noise filtering, instant red-eye removal, video/image stabilization and in-camera photo editing.

• **Accelerators and Peripherals**

Tightly coupled within the system architecture are targeted peripherals and accelerators for video and audio device acceleration and implementation. DaVinci processors are made up of combinations of DSP and/or ARM® cores, memory configurations, accelerators and peripherals optimized for targeted digital video applications. Peripherals and accelerators include:

- Advanced video acceleration
 - Video I/O processing subsystem
 - Video and imaging accelerator

- Advanced audio
 - Audio serial port (ASP) for codec interface and communication
- External memory interfaces
 - Double Data Rate memory (DDR2)
 - Onboard NAND flash controller
 - NAND/NOR flash-capable async EMIF
- Video display
- Connectivity
 - USB 2.0 high-speed host and client function
 - Full 10-/100-Mbps Ethernet MAC
 - Inter-integrated circuit (I²C) bus interface
 - Special interface for FPGA complement
- Data storage interfaces
 - ATA (Hard drive)
 - Compact flash controller
 - Multimedia Card (MMC) / Secure Digital Card (SD) controller
- Integrated support for popular resolutions and interfaces

DaVinci™ Software

DaVinci software includes configurable frameworks that are presented via published APIs within popular operating systems for rapid software implementation with DaVinci processors.

• **Video, Imaging, Audio and Speech Codecs**

TI is designing and will be delivering standard video, imaging, audio and speech codecs as software products that will be licensed and supported by TI and its third parties. The following codecs are planned for release in the coming months:

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|-----------------|---------------|
| – H.264 decode | – JPEG decode |
| – H.264 encode | – JPEG encode |
| – MPEG-4 decode | – AAC+ decode |
| – MPEG-4 encode | – AAC encode |
| – H.263 decode | – WMA9 decode |
| – H.263 encode | – WMA8 encode |
| – WMV9 decode | – MP3 decode |
| – WMV9 encode | – G.711 |
| – MPEG-2 decode | – G.728 |
| – MPEG-2 encode | – G.723.1 |
| | – G.729ab |

- **Operating Systems**

Standard operating systems will allow developers with expertise on these systems to leverage their programming know-how and at the same time achieve peak performance from DaVinci technology's system integration, including its robust DSP engine and accelerators. The DaVinci technology portfolio currently includes several OSes which are appropriate for different applications, including open source Linux, MontaVista™ Linux, Green Hills INTEGRITY™, Green Hills VeLOSiTy, QNX Neutrino and others. Support for additional popular operating systems, such as WinCE, is expected to be available in the future.

- **Application Programming Interfaces (APIs)**

The DaVinci technology portfolio offers several classes of APIs that are poised to accelerate innovation for digital video equipments. The APIs bring together the best of both worlds for DSP and ARM® software developers. While the DSP platform remains open for DSP experts, ARM software developers can program to APIs and are assured that popular combinations of codecs required for next-generation digital video processing are tested to work together and optimized for specific video applications. Ultimately, whatever the development team's expertise or preference, the DaVinci APIs integrate DSP and accelerator content transparently for a broad set of high-performance video, audio, imaging and speech codecs.

- **Frameworks**

The DaVinci software framework is built to ensure that all hardware and software components work seamlessly together. By offering complete, application-specific software solutions previously built by OEMs, the DaVinci software framework abstracts system developers from the inner workings of the processors. This dramatically reduces OEM research and development, system architecture, implementation and test schedules so that OEMs can focus on their value-add – differentiating their products.

DaVinci Development Tools

DaVinci technology offers a set of cost appropriate tools and kits for a variety of application spaces and designs, including low-cost starter tools, complete development kits and even reference designs to speed OEM design and development. An ARM/DSP Integrated Development Environment (IDE), operating system tools and DSP tools allow developers to program in a familiar environment while accessing the full benefits of the DaVinci technology, including:

- Development Kits
 - Digital Video Evaluation Module (DVEVM)
 - Digital Video Software Development Kit (DVSDK)
- Reference Designs
- Code Composer Studio™ Integrated Development Environment (IDE)

- **Development Kits:**
 - **Digital Video Evaluation Module (DVEVM)** – Developers can begin evaluation and implementation of the TMS320DM644x and TMS320DM643x devices with the Digital Video Evaluation Module. The DVEVM contains the MontaVista™ Linux Professional Edition, which allows developers to begin code development immediately, as well as a NTSC/PAL camera, LCD screen, pre-wired video encode and decode codec demos and the ability to create new demos with original video streams. The DVEVM also offers connectivity to video input/outputs, networking interfaces, storage interfaces and standard daughter card connections, so developers can use the DVEVM for their application prototypes. Using the DVEVM, developers can write production-ready application code for the ARM® and access the DSP core using DaVinci APIs to begin application development immediately on the aforementioned processors.
 - **Digital Video Software Development Kit (DVSDK)** – System designers can also use the Digital Video Software Development Kit to have even greater access to TI's DaVinci technology. The DVSDK includes the eXpressDSP™ Configuration Kit, TMS320DM644x SoC Analyzer based on eXpressDSP Data Visualization Technology and MontaVista's Linux to help reduce the application development cycle from months to weeks. Developers can use the DVSDK to create and tune optimized IP set-top boxes, video phones, video security systems and other advanced digital video applications.

- **Code Composer Studio™ IDE**

Code Composer Studio™ Integrated Development Environment supporting the TMS320DM644x and TMS320DM643x devices is also available, giving design engineers the flexibility to work with a familiar tool chain. DaVinci products are backed by TI and its third-party network that is able to offer video system expertise to customers worldwide.

DaVinci™ Technology Support System

The support system for DaVinci technology includes an end-to-end video ecosystem, system integrators, hardware and software solution providers with DaVinci technology knowledge, and video system expertise to accelerate OEM product introductions. Providers who are supporting and designing solutions on DaVinci technology include:

- ATEME
- AwoX
- eInfochips Inc.
- eSol Co., Ltd.
- Green Hills Software
- Ingenient Technologies, Inc.
- Ittiam Systems
- Logic Product Development
- Mistral Software
- MontaVista™ Software
- MPC Data
- Nuvation
- QNX
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Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265