Technology Backgrounder

DaVinci™ Technology Provides High Performance and Flexibility for Video Transcoding

As the accelerating video market extends its reach to products such as cell phones, portable media players and automotive infotainment systems, consumers are demanding easy access to their video content throughout the home and on the go. Multi-format transcoding will enable the seamless transmission of video content between all types of video devices.

Digital video continues to gain momentum in the market, enabled by the availability of advanced display and storage technology and cost-effective digital signal processors (DSPs). Digital TV (DTV), especially high-definition TV (HDTV), is the most noticeable application, but any system that can be used for video reception or playback may eventually need to accept input from a DTV source, whether it can display the picture at full resolution or not. The communication and entertainment networks in homes are rapidly becoming more connected, so that video from various sources will be received and recorded in various formats and shared with devices with different capabilities in terms of resolutions and compression schemes. With the many potential variables, video systems will often have to accept content input one way, and then shift it to the appropriate output. In other words, systems will have to be capable of transcoding, or changing resolutions, encoding schemes and data rates in real time.

Transcoding has long been familiar in network infrastructure equipments, but its importance is only beginning to be felt in set-top boxes (STBs), DTVs, digital media adapters (DMAs), DVD and personal video recorders (PVRs), video cellphones and portable media players. As system developers look for processing solutions for video transcoding in these and other products, they need to bear in mind both the performance requirements of transcoding and the necessary flexibility to support multiple video formats. All video has high data rates, and throughput for HD is several times greater than for standard definition (SD, the digital equivalent of traditional analog TV), so that HD transcoding systems will need to be designed to provide even more memory and computations while taking into account cost constraints. Programming flexibility is essential in order to support evolving coding-decoding (codec) algorithms and to adapt to different codecs on the fly as inputs change.

These factors point to transcoding solutions based on advanced DSP technology. TI's DaVinci technology provides an exceptionally high level of computational performance and programming flexibility, as well as peripheral integration that helps keep designs affordable. In-depth video software and support simplify development and speed time-to-market. Video systems based on DaVinci technology will be able to handle video performance loads while adapting to the growing need for transcoded content shifting across standards.

Matching Inputs to Outputs

DTV provides for multiple formats, including both HDTV and SDTV, the latter with North American NTSC and European PAL/SECAM digital equivalents, and all with multiple refresh rates expressed in frames per second (fps). While the HDTV formats offer high resolution and a wide aspect ratio, the better picture quality comes at a cost in bandwidth. Compared to the NTSC-equivalent format (often expressed as 480i60, meaning 704×480 pixels at 60 interlaced fps), the commonly broadcast HDTV 1080i60 format requires 6× the number of bits per second for uncompressed video, and the HDTV 720p60 (with progressive fps) format requires 5.33×. HDTV systems must be capable of supporting this high level of throughput and, if necessary, rescaling display outputs in real time.

But DTV represents only the beginning of the wide range of content source and digital display formats. At the lower end is CIF, which with its subdivisions such as QCIF is widely used in streaming video and provides the basis for divided screen applications on DTVs. There are also computer displays, including a group of HD formats that are used at times for entertainment systems, too, and range from WXGA (1366×768 pixels) on up. A wide range for format conversions are needed between source content resolutions and the target display resolution including scaling down HD video for low-resolution displays and scaling up low resolution content for HD displays.

Add to this complexity the enormous data rates involved in all video, but especially HD. An uncompressed 1080i60 HDTV signal with YCbCr 4:2:0 color sampling requires 746.5 megabits per second (Mbps) to transmit, and 336 gigabytes (GBytes) to store a 60-minute video. To deal with such vast amounts of data, the well-established MPEG-2 codec achieves compression ratios between about 30:1 and 50:1 on varied content, while more advanced codecs such as H.264/MPEG-4 part 10/AVC and WMV9/VC-1 effectively double these ratios. Migration to the more advanced codecs is taking place gradually, so transcoding for backward compatibility with MPEG-2 will be a key requirement. For instance, MPEG-4 AVC transmissions will have to be transcoded for playback on legacy set-top boxes and DTVs. MPEG-4 AVC-capable STBs and DVD recorders can leverage transcoding to reduce the amount of storage required for HD MPEG-2 broadcast content.

In home networks, it will be necessary to transcode not only in order to shift content bit rates and rescale formats, but also to convert ownership protection methods between the TV industry (various forms of conditional access) and the PC world (digital rights management, or DRM). Home video systems that are forced to deal with the varied combinations of coded inputs, and display outputs will require processing solutions that are fast, flexible and affordable.

TI's DaVinci™ Technology

By design, DSPs supply the high computational performance needed for video data streams and real-time codec algorithms. Multi-core processors have the added advantage of being able to partition performance between a DSP for signal processing and a RISC for control, communications and software applications. Programmability provides the flexibility needed to support varied transcoding needs, and it also allows the system to be scaled readily, so that the same basic design can support different market segments. A comprehensive, easy-to-use software platform with audio-video application programming interfaces (APIs) simplifies development, and system-on-a-chip (SoC) integration helps keep system costs down.

DaVinci TMS320DM644x processors integrate a TMS320C64x+™ DSP and/or an ARM926EJ-S RISC processor core, along with additional hardware acceleration to perform specific operations frequently used by video codecs. The fully programmable cores are supported by on-chip caches, advanced video, networking and memory management peripherals to minimize external system components and ensure the device supports the high data throughput required for transcoding. Much of the software required for a video system has already been created, and the open platform is supported by a variety of standard development tools.

TI's video specialists have also addressed codec issues specific to transcoding that can improve system efficiency and maintain high picture quality. The techniques developed indicate the depth to which TI, through its DaVinci technology, is prepared to support the move to transcoding that will be necessary in the home video industry.

Overcoming the Video Complexity Problem

In the near future, as the video appliances in the home become more connected, the sheer number of standards for video display, compression, transmission and storage threatens to swamp consumers. Video systems that are capable of transcoding can overcome the complexity problem, allowing content to be shared automatically while using bandwidth and storage as efficiently as possible. System designers need to consider that programmable DSPs offer them the performance they need for video transcoding, plus the flexibility to introduce additional standards or upgrade existing ones. TI's DaVinci technology brings together the hardware and software needed for rapid development of cost-efficient video systems that not only handle HD-level throughputs, but also allow users to shift content among standards easily through transcoding.

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