WHITE PAPER

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Embedded technologies are helping the video security industry 'go green'

Introduction

Going green isn't just a trend. It's a necessity today because of obvious environmental reasons. Most industries have started taking a green approach, but semiconductor manufacturers have taken this challenge very seriously for much longer than just the past few years. Following Moore's Law, metrics for digital technology have improved at exponential rates including power dissipation, size, cost, density, processing speed and resolution (or number of pixels) supported by image sensors. In other words, digital electronic products from semiconductor manufacturers deliver higher quality, offer more options, and are faster, requiring less components leading to greener and more cost-effective video end systems.

With Internet Protocol (IP) video security systems being deployed everywhere in today's life, using the latest and greatest embedded processor technologies help original equipment manufacturers (OEM) and original design manufacturers (ODM) design and produce energy efficient IP network camera and digital video recorder (DVR) end-to-end solutions.

The last decade showed improvement in the complementary metal-oxide-semiconductor (CMOS) process technology enabling manufacturers to design and produce embedded processors with smaller geometries every two to three years. Technology shrank from 130 nanometers in 2000 to the recent 45 nanometers enabling embedded processors to consume less power as they operate at lower voltage. In addition to the lower voltage, deep sub-micron geometries offer integration of hundreds of million of transistors on a single chip enabling semiconductors specialized in embedded processing to increase intellectual IP integration while enhancing performance. This results in more efficient and more powerful video processors known as DVRs and IP cameras on-a-chip. Along the video security value chain, it allows OEMs and ODMs to design smarter, more powerful systems with fewer power optimized components and integrators to deploy in-the-field end-to-end solutions, driving an overall reduced impact on the environment without compromising any features or system cost.

For example, in March 2010 Texas Instruments (TI) announced the DM8168 DaVinci™ digital video DVR-on-a-chip, where a single chip can replace the functionality of more than 10 discrete components significantly reducing board area and power consumption. Designed specifically for video security and video communications applications, this best-in-class video SoC offers extreme integration including a 1.2 GHz ARM® Cortex™-A8 and a 1 GHz TI C674x digital signal processor (DSP) core. This integration of the DM8168 DaVinci video SoC drastically reduces system electronic bill of materials (eBOM) costs by 50 percent, as well as reducing board area and power consumption by replacing the functionality of more than 10 discrete components.

Manufacturers are faced with dynamic and static power challenges when leveraging deep sub-micron process geometries combined with design speed increases that require lower voltage thresholds. Some advanced embedded processors are now leveraging a broad range of intelligent and adaptive hardware and software techniques imported from the wireless mobile phone industry that dynamically control voltage, frequency and power based on device activity, modes of operation and even temperature for most complex techniques. It includes traditional power management techniques like low-power modes and clock gating. To help further reduce both active and leakage power dissipation, very innovative solutions are being deployed.

Some of these solutions are implemented at the silicon device level. Major ones include dynamic voltage and frequency scaling (DVFS), which enable flexible clocking schemes and power down mode as well as independent clock control of various sub-systems in the device to achieve sub 1V operation for low activity cases. Another one is adaptive voltage scaling (AVS) in response to silicon processes and temperature variations. Another solution is dynamic power switching (DPS), which reduces power leakage by switching to low-power modes in response to active processes. The last solutions are standby leakage management (SLM) and memory retention capabilities.

As most of closed-circuit television (CCTV) systems are now converted to digital and IP streaming, above innovations on core semiconductor technologies are helping important power dissipation reduction from the camera to infrastructure. Additionally, video processors can help optimize video traffic and storage, reducing the need for additional infrastructure. That's why H.264 and scalable video coding (SVC) advanced codecs, which dramatically reduce the amount of data needed to store and transmit video, versus uncompressed video or legacy codecs (MPEG-2, MPEG-4), are also essential enablers to a greener approach for video security systems. Utilizing the available processing horsepower in today's low-power ICs, such as programmable DSPs and fixed-function ASICs, these codecs are capable of squeezing very high compression ratios. For example, standard definition National Television System Committee (NTSC) video is typically digitized at 720x480 using 4:2:2 YCrCb at 30 frames per second, which requires a data rate of over 165 Mbits/sec. To store one 90-minute video requires over 110 GB. H.264 enables a 60 to 1 compression ratio and maintains excellent video quality, saving on bandwidth and storage for a greener approach. Similarly, H.264 high profile will compress video up to four times more than MPEG4 standard profile. Using SVC, standardized as the Annex G of H.264/AVC video compression standard in 2007, temporal scalability can be added to video security applications giving the ability to reduce frame-rate without the need to re-encode (i.e. by just dropping some of the packets in the bit-stream). Leveraging SVC temporal scalability will provide a greener approach to manage terabytes of video data stored in CCTV systems by preventing additional transcoding for storage optimization after one day, one week or one month.

One of the most promising innovations to optimize video traffic, data storage and CCTV system efficiency is video analytics (VA) on edge devices which consolidates all of the capture, recording and storage functionalities into a single IP camera. Enabled by most advanced low-power embedded processors, built-in video analytics bring sufficient targeted intelligence into the camera so only necessary video sequences are recorded, streamed and locally stored, preventing 24/7 operation. The most popular and robust features are camera tamper detection, trip zone alarm, object counting and intelligent motion detection, which can be implemented on programmable cores such as DSP, FPGA or run-on dedicated accelerators such as the vision co-processors embedded into TI's digital media video analytics (DMVA). Specifically targeted at the video security market, the DMVA2 DaVinci digital media processor provides both HD video capability and entry level analytics by integrating TI's first generation vision co-processor, which allows customers to easily deploy smart analytics functions. Additionally, by coupling the vision co-processor with smart analytics all on a single chip, customers can reduce the cost of video analytics-enabled IP cameras by an order of magnitude.

Semiconductor manufacturers have taken the challenge very seriously to help end-users reduce video security systems cost of ownership, which has direct impact on their environmental footprint. By introducing high-definition video processors and Wide Dynamic Range (WDR) sensors, OEMs and ODMs can now design and produce megapixel IP cameras that can replace several analog CCTVs at even better image quality. As an example, a megapixel camera (1280x720) can replace two standard definition (480x720) analog cameras, providing 33 percent greater field of view (320 horizontal pixels). Some IP cameras-on-a-chip recently announced the ability to deliver real-time four-megapixel video, providing an even more energy-efficient approach. Additionally, if the same IP camera integrates the power-over-internet (PoE) technique, this will save many wires compared to analog cameras, which each require a coax cable for video and a power line. Additionally, if OEMs and ODMs choose a programmable and flexible video processor versus a fixed-function ASIC, they will be able to support hybrid configurations combining analog CCTV, motion JPEG (MJPEG), MPEG-4, H.264 and even non-standard IP cameras, providing maximum reuse and preventing an automatic and environmentally costly replacement of existing infrastructure.

This white paper analyzes the green impact of some but not all of the innovations semiconductor manufacturers have released during the last decade that helps the video security industry go green. It's a long journey, and Texas Instruments is committed to continuing innovation in the security space.

For more information on TI's video security solutions

DVR Reference Designs - www.ti.com/dvr

Low-cost, low-power, integrated multichannel reference designs ranging from the Hybrid DVR (DVR/NVR) reference design based on the highly integrated TMS320DM816x DaVinci video processor to the ultra low-cost DVR reference design based on the TMS320DM36x DaVinci video processor and the TVP5158 multi-channel video decoder. These single platform solutions allow faster development at a reduced cost.

IP Camera Reference Designs - www.ti.com/ipcamera

Highly optimized reference designs based on the TMS320DM812x, DM3xx and DMVA1 DaVinci video processors for the IP camera market to enable developers to speed through the design process as well as reducing overall bill of materials costs.