Pushing the boundaries of video decoding

Bosch Security Systems advances HD video decoder technology with the 2nd generation Intel® Core™ i3 processor

Shifting from analog to IP HD video

According to Bosch Security Systems, digital security surveillance (DSS) customers want the cost savings and performance benefits that can be attained by moving from analog to digital video streamed over IP networks.

Some of the fastest growing applications for advanced DSS systems are city surveillance, commercial facility monitoring and retail applications, including the use of large HD displays that allow many people to view video at the same time.

IP encoding requires a decoder capable of handling multiple video streams and driving large digital displays. There is increasing demand for high performance decoders in casinos and critical infrastructure facilities that require video display without blur while auto dome cameras perform high-speed movements.

To meet these market demands, Bosch Security Systems and Adtech, a leading global provider of design, fulfillment and support of computer technology and services, worked closely with Intel to develop a new decoder designed to push the boundaries of decoding technology.

CHALLENGE
Bosch digital security surveillance customers need high performance HD decoders that support maximum bit rates and a high number of concurrent video channels.

SOLUTION
Bosch based its high performance VIP XD HD Decoder* on the 2nd generation Intel® Core™ i3 processor. The high performance decoder handles four H.264 720p/30 streams or two 1080p/30 streams at 10 Mbps, or six H.264 standard definition streams at 6 Mbps from dome cameras. Each channel can be AES encrypted.

IMPACT
The digital security and surveillance market is rapidly moving from analog to IP based systems. Bosch Security Systems is harnessing Intel® architecture to push the boundaries of IP video decoding technology, with industry-leading advances that meet the growing demand for cost effective multi-channel performance.
**Design requirements**

One of the principal challenges faced by the design team was qualifying a processor with the performance and scalability to handle present and future decoding and data encryption algorithms, while helping Bosch meet its device footprint and operating temperature targets.

Explains Konrad Simon, IP Video product manager at Bosch Security Systems, “We need to support 4 streams of 720p at up to 10 Mbps, which is the performance required to support dome cameras and other applications that generate high bit-rate workloads that must be displayed without interruption.”

One of the major challenges is that the decoder must support simultaneous traffic from multiple video cameras all with equal priority on a single Ethernet port. All data traffic must be processed within a single computing environment, while allocating system resources for all the streams simultaneously.

The decoder is part of a total management system created by Bosch that enables remote control without direct user interaction. “Video resource optimization software running on the decoder ensures that each video stream gets sufficient performance to maintain smooth video performance on each window of the display,” says Konrad Simon.

“A prerequisite was that we wanted to use our existing PC-based video software for decoding and rendering, in addition to software that provides connection control and distribution of video over selected screen layouts.”

The two software components include Bosch VideoSDK 5* software, capable of handling simultaneous rendering and decoding of virtually unlimited video streams, in addition to Bosch Monitor Wall* software to provide connection control and distribution of video over selected screen layouts.

“There reason we need such high performance is that we need to anticipate that an operator may freely connect SD and HD camera streams to the device without thinking of performance limitations. The goal is to support four HD cameras in quad-view without losing frames and provide fluid video in all video windows.”

Konrad Simon, Product Manager IP Video, Bosch Security Systems

The VIP XD HD decoder displays high definition and standard definition video from cameras and encoders using H.264 or MPEG-4 encoding at up to 30 images per second over IP networks.
Video Decoding Workload Analysis Tool

Bosch collaborated on the design project with Adtech. To evaluate processor solutions, Adtech used the Video Decoding Workload Analysis Tool, a benchmarking software tool developed by Bosch that measures the performance of the decoder. The tool is being used at Adtech to evaluate processor performance and tune the decoder system to meet customer requirements.

The PC-based test system provides high performance video streams to stress the system under extreme workload scenarios, such as fast-switching videos that challenge a decoder. The tool represents a realistic workload, including decoding and CPU-based decryption algorithms in addition to processing incoming Ethernet traffic on a GbE controller.

The Video Decoding and Video Analysis Tool is a test application used for evaluation, development and validation of new decoder systems at Bosch Security Systems. By emulating a real digital security surveillance decoding workload scenario, the tool generated performance data that supported the selection of the 2nd generation Intel® Core™ i3 processor for the Bosch VIP XD HD decoder.
Performance analysis
Adtech conducted a trial that compared multiple CPU options, ultimately leading to the selection of a platform based on the 2nd generation Intel® Core™ i3 processor. Table 1 summarizes the results of the workload analysis.

<table>
<thead>
<tr>
<th>Encoding</th>
<th>Streams</th>
<th>Resolution</th>
<th>Max. bit rate/stream</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.264 HD</td>
<td>2</td>
<td>1080p/30</td>
<td>10 Mbps</td>
</tr>
<tr>
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<td>720p/30</td>
<td>10 Mbps</td>
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<td>H.264 HD</td>
<td>6</td>
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<td>H.264 HD</td>
<td>8</td>
<td>4CIF/480p/30</td>
<td>2.5 Mbps</td>
</tr>
</tbody>
</table>

Table 1. Performance of the Bosch VIP XD HD* decoder based on the 2nd generation Intel® Core™ i3 processor (source: Bosch Security Systems, Bosch-Adtech Video Decoding Workload Analysis Tool).

The analysis tool automatically measures all relevant video resolutions and bit rates with one-percent accuracy. In the results shown here, all video streams are decoded on the Intel Core i3 processor, without the involvement of a graphics co-processor. The performance testing includes the Ethernet stack, enabling Bosch engineers to optimize decode performance.

The 2nd generation Intel Core i3 processor meets performance targets in a small footprint device with an operating temperature range of 0° to 40° C, in a housing measuring less than DIN A5, and a maximum of 1.5 HU, allowing the device to be mounted directly on the back of a display.

Adtech Business Development Manager Dan Davidovici explains one complexity of the project, “When it comes to handling four video streams with 10 Mbits each, one of the biggest challenges was modifying video drivers to handle multicasting. Intel engineers worked closely with Adtech to help optimize the video driver software.”

For total data protection, each video communication channel can be independently AES-encrypted with 128-bit keys, once the encryption site license has been applied. Encryption is performed in software.

As Simon explains, “We see an increasing requirement for fully protected data transmission while performing CCTV over IP So we are preparing for that, including the use of the Intel® processors integrated AES hardware accelerator, if needed in the future. With the Intel Core i3 processor, AES encryption at our data rates currently requires about 5-8 percent of CPU capacity.”
Bosch VIP XD HD Decoder
The VIP XD HD decoder displays high definition and standard definition video from cameras and encoders using H.264 or MPEG-4 encoding at up to 30 images per second over IP networks.

The device can decode and display four H.264 720p30 streams at 10 Mbps or two 1080p30 streams at 10 Mbps, in addition to VCA metadata. Alternatively, it can simultaneously decode six H.264 standard definition streams at up to 6 Mbps from fast-moving auto dome cameras with extremely high video clarity.

For scenes with moderate levels of activity, the decoder can display up to 12 streams of H.264 standard definition streams at up to 2.5 Mbps. The VIP XD HD decoder can drive a HD display directly, a capability that makes it ideal for flat-screen monitor walls.

Driving the system is a 2nd generation Intel Core i3 processor with Intel® H67 Express chipset, an 8 Gbyte flash module as a boot device for the OS and application code and a 10/100/1000 Base-T Ethernet port. Outputs include DVI-I, HDMI and DP, on a mini-ITX system board.

The decoder runs a custom version of the Microsoft Windows 7 Embedded* operating system, and Bosch Monitor Wall software based on HD-capable VideoSDK 5, with both software components fine-tuned for HD video decoding.

Pushing the boundaries
Konrad Simon explains that the Intel® processor roadmap is also a key consideration for Bosch Security.

“The requirements of the total system are so critical that the 2nd generation Intel Core i3 was the optimum solution for the VIP XD HD Decoder. And one of the advantages of the Intel-based platform is that we can increase the performance. We see a growing need for higher and higher resolutions, with next generations moving beyond full HD.”

“At Bosch we are targeting continuous advances in decoder performance and planning for continuous advances in decoder performance to 1080p/60 resolution.”

“We predict we will see 16 megapixels in the next two years, at frame rates of up to 60 fps.”

Konrad Simon, Product Manager IP Video, Bosch Security Systems
Advantages of Intel® architecture

- Decoding performance to display high definition and standard definition video from cameras and encoders using H.264 or MPEG-4 encoding at up to 30 images per second
- Compatibility with Windows-based Bosch decoder software suite and ease of future software updates
- Fast development from inception to finished product in 7 months
- Intel® processor roadmap enables Bosch to target even higher levels of decoder performance

About Bosch Security Systems

The Bosch Security Systems division (www.boschsecurity.com) is a leading global supplier of security, safety and communications products, solutions and services. Some 12,000 associates generated sales of 1.36 billion euros in fiscal 2010. The Bosch security Systems product portfolio includes video surveillance, intrusion alarm, fire alarm and voice evacuation systems as well as access control, management systems and care solutions designed to protect lives, buildings and assets. Professional audio and conference systems for communication of voice, sound and music complete the product line. Bosch Security Systems develops and manufactures in its own plants across the world.

About Adtech Corporation

An ISO 9001:2008 registered company, Adtech (www.adtechglobal.com) is a global technology solutions company focused on the design, fulfillment and support of computer products and services that drive industry-leading applications including embedded solutions, converged communications and video management and distribution.

References

Please follow the links below for more information.

Intel® Media Software Development Kit: http://software.intel.com/en-us/articles/media

FourCC: http://www.fourcc.org/