NEXCOM
The Intelligent Systems

White Paper

Enhance Surgeon Precision with 4K Ultra-HD

Compact Solution Handles Imaging, Video, and Patient Data

As medical equipment proliferates in the operating room (OR), surgical teams need advanced monitoring and control systems that can integrate data from many sources and display it in on multiple high-resolution screens (Figure 1). Such centralization of information is critical to surgical precision, decision making, and patient outcomes.

Formerly located in control rooms monitored by technicians, surgical monitoring and control systems are increasingly moving into the OR where they can be operated directly by the surgical team. This places new demands on these systems, requiring them to be more compact and quiet. At the same time, these systems need excellent performance to handle multiple high-resolution data streams, along with top-notch reliability.

In this article, we show how you can meet these challenges with the high-performance, space-saving NEXCOM ICES 670 COM Express Type 6 Module. We demonstrate how the ICES 670's triple-display capabilities and ultra-high definition (UHD) 4K resolution enable detailed views on multiple screens. We additionally consider how the ICES 670 helps maintain security, regulatory compliance, and reliable operation.

Finally, we show how the 4th generation Intel® Core™ processor family enables all of these capabilities. We examine how these processors provide excellent compute and graphics performance at low power, and how they enhance reliability through hardware-assisted security features.

Figure 1. The proliferation of medical equipment creates demand for monitoring and control systems that can centralize and display vital information.

The Need for Monitoring and Control Systems

Modern ORs and their control rooms are full of specialized equipment such as C-arms, endoscopes, intravascular ultrasound (IVUS) units, surgical navigation systems, vital signs monitors, and other devices. Surgeons and technicians depend on these devices for real-time images, video, and patient and equipment data. Many teaching hospitals also use video cameras and other equipment to provide interactive training, displaying live feeds on video walls outside the OR so medical students can observe surgical procedures. These video capabilities are also important for collaboration and co-diagnostics (that is, telemedicine) with physicians of various specialties, who may be within the hospital or located remotely.

The growing number and complexity of these devices is forcing surgical staffs to spend more of their valuable time and energy interacting individually with each device, distracting the staff from the fundamentals of the operation. As a result, hospitals are seeking surgical monitoring and control system that centralize OR device interfaces. These emerging systems consolidate functions ranging from visual assistance and procedure documentation to ambient control (Figure 2). Surgical monitoring and control systems can also simplify the sharing of real-time video for telemedicine and teaching.

Figure 2. A surgical monitoring and control system has multiple roles and functions in an operating room (OR).

A Compact Solution

Monitoring and control systems must integrate video, 2D and 3D medical imaging inputs, and data feeds from various equipment, and display the results on one or more high-resolution displays. Squeezing this functionality into a form factor that can fit in the crowded OR is a tricky proposition. The NEXCOM ICES 670 meets this challenge with a COM Express architecture that can connect to custom carrier boards (Figure 3). By assigning features such as signal conversion and RAID to the carrier boards, developers can pack server-grade functions into a chassis that is only half the size of a rack server form factor.

Figure 3. NEXCOM's ICES 670 COM Express Type 6 Module packs server-grade functionality into a chassis half the size of a rack server form factor.

The 4th generation Intel® Core™ i7 processor at the heart of the ICES 670 provides the performance, space savings, security, and upgrade path needed for surgical monitoring and control systems (Figure 4). These quad-core processors offer up to 15 percent faster performance than their predecessors in the same power envelope, enabling cooling with lower fan speeds. This support for quiet operation is an important consideration as monitoring and control systems migrate from the server room to noise-sensitive

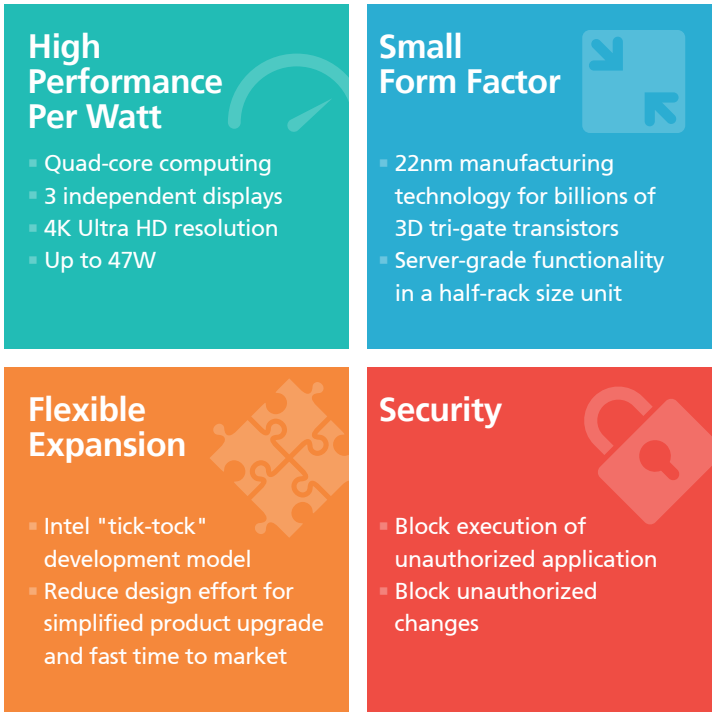

Figure 4. The 4th generation Intel® Core™ i7 processor provides the performance, space savings, security, and upgrade path needed for surgical monitoring and control systems.

ORs. The processors also benefit from the Intel® Advanced Vector Extensions (Intel® AVX) 2.0, an upgraded vector processing technology that effectively doubles the peak floating-point throughput in comparison with the previous generation. The result is improved analysis of medical imaging and other incoming signals.

The processor's abundant performance also enables the ICES 670 to consolidate functions ranging from patient monitoring to procedure documenting, as well as system control including cameras, lighting, and A/V systems. Developers consolidating multiple functions on the ICES 670 may wish to use virtualization, which allows multiple operating systems (OSs) to run on a single hardware platform. To support virtualized solutions, the processor features Intel® Virtualization Technology (Intel® VT), which performs key virtualization tasks in hardware to reduce overhead and improve performance. Developers can also use Intel VT to isolate safety-critical code, improving security and stability.

The ICES 670's modular design also speeds development. Developers can quickly assemble the required hardware, and then focus their energy on value-added software. The combination of the COM Express form factor and Intel® processors also provides a high level of flexibility and reduces upgrade effort. System developers can quickly overhaul product offerings by replacing the ICES 670 with a different COM Express module as new hardware becomes available. And Intel's reliable "tick-tock" roadmap ensures that developer can count on continuous upgrades that will allow them to add new features.

Ultra-HD Video and 2D/3D Graphics

Surgeons and their assistants increasingly require high-resolution video and 3D imaging for faster, better informed decision making. The 4th generation Intel Core processors meet this challenge with flexible hardware encoding, decoding, and transcoding for multiple simultaneous videos streams, now at up to 4K UHD resolution. 2D/3D graphics performance has also been improved by up to 60 percent compared to the previous generation, and by up to 75x from Intel's integrated graphics in 2006 (Figure 5). In addition, the platform supports next-generation graphics application programming interfaces (APIs), such as Microsoft* DirectX* 11.1, OpenGL* 4.0, and OpenCL* 1.2, for faster, hardware-accelerated rendering.

The processor's integrated graphics can support up to 4K resolution on up to three independent displays. The ICES 670 fully supports these capabilities via a COM Express Type 6 pinout

carrier board that enables easy implementation of HDMI, DVI, DisplayPort (DP), embedded DisplayPort (eDP), and legacy VGA, as well as a single-channel 18/24-bit LVDS interface. These outputs allow the ICES 670 to provide each member of a surgical team the necessary individualized information to support their function – including the sharp images required to perform delicate microsurgeries.

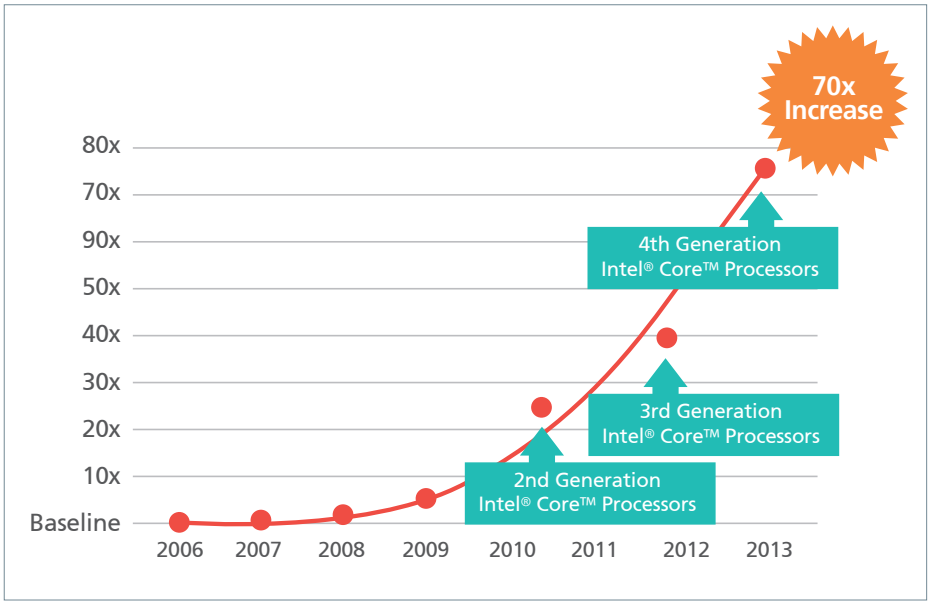

Figure 5. Intel's trajectory of increasing graphics continues with a 75x increase from 2006 to 2013. Source: Intel, 3DMark06. For more information, see www.intel.com/performance.

System Integrity Assurance

In this age of telemedicine, surgical monitoring and control systems and other medical equipment are no longer isolated from the Internet. With patient data at risk, platforms need to defend against security threats, maintain regulatory compliance, and support a health organization's privacy policies.

The 4th generation Intel Core processor family provides Intel® Data Protection Technology (Intel® DPT) security enhancements not available with the previous generation processor. Intel DPT includes hardware-assisted encryption capabilities like new Intel® Advanced Encryption Standard New Instructions (Intel® AES-NI). Intel AES-NI provides faster data encryption and decryption for securing data and helping protect surgical records and patient data from loss – all without slowing response times or compromising performance.

The 4th generation Intel Core processor family also includes Intel® Trusted Execution Technology (Intel® TXT), which provides a measured launch of hypervisors and OSs, ensuring that the system boots into a trusted state. The processor also supports error-correcting code (ECC) memory for improved data integrity and system uptime.

NEXCOM offers an additional layer of security to these hardware security features by including McAfee Embedded Control in the ICES 670. (Like NEXCOM, McAfee is an Associate member of the Intel® Internet of Things Solutions Alliance.) This security software uses a whitelisting approach instead of depending on a regularly updated virus database. McAfee Embedded Control automatically creates a dynamic whitelist of the authorized code on the embedded system. Once the whitelist is created and enabled, the system is locked down and no program or code outside the authorized set can run, and no unauthorized changes can be made. This approach removes the risk of zero-day attacks and frees hospitals from having to continually update antivirus (AV) software on the device.

This protection is crucial because healthcare systems are

increasingly under attack. The information contained in healthcare systems has tremendous value, and can too often be accessed by insider attacks. According the Computer Security Institute, insider breaches have recently surpassed viruses as the most-reported information security incident. In addition, hospital staff often violate security policies, creating unintentional security breaches. Outside threats are also growing more sophisticated, with the time to exploit accelerating. These risks make automatic protection essential.

McAfee Embedded Control also addresses many of the requirements imposed by the Food and Drug Administration (FDA) and Health Insurance Portability and Accountability Act (HIPPA) in the United States. By controlling what software can run, and what software can change on any system, it ensures that any software change can happen only via authorized mechanisms - for example, authorized change control time windows, authorized updaters, or secure signed updates. It also provides the ability to capture an audit trail of authorized changes, again facilitating compliance and reporting to meet HIPAA data security requirements for privacy and auditable control.

To further simplify system management, the ICES 670 supports NEXCOM Xcare™ 3.0, a utility that can keep track of hardware status. The API of Xcare 3.0 is compliant with the PICMG Embedded Application Programming Interface (EAPI) standard, and can provide users information on processor, RAM, basic input/output system (BIOS), fan speed, operating temperature, and more. Functions of Xcare 3.0 include hardware status monitoring; remote keyboard, video, and mouse (KVM); and remote configuration and recovery.

Improving Patient Outcomes

To improve patient care and outcomes, the medical industry constantly pursues innovation. As we have shown in this article, powerful, compact, versatile surgical monitoring and control systems provide an excellent solution for putting consolidated information at the surgical teams' fingertips and helping them save lives.

As ORs continue to evolve, surgical monitoring and control systems based on the NEXCOM ICES 670 and Intel processors will continue to evolve right along with them. Intel's tick-tock model for advancing its manufacturing process technology and microarchitecture enables ever-more powerful, energy-efficient systems in smaller form factors. Hospitals basing their surgical monitoring and control systems on NEXCOM solutions using these processors will share a path to increasing performance and greater capabilities in everything from graphics and video displays to system security and integrity.

Founded in 1992, NEXCOM has five business units which focus on vertical markets across industrial computer, in-vehicle computer, multimedia, network and communication, and intelligent digital security industries. NEXCOM five its customers worldwide through its subsidiaries in seven major industrial countries. NEXCOM gains stronghold in vertical markets with its industry-leading products including the rugged fanless computer NISE series, the in-vehicle computer VTC series, the network and security appliance NSA series and the digital signage player NDiS series.

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