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Embedded Intel® Solutions
SUMMER 2011

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Impossible Astronaut and Supercomputers in the Desert

By John Blyler, Editorial Director

The premier of a science fiction favorite and the start of a supercomputing competition all take place in a landscape rich in secret labs and alien sightings.

Have you ever noticed how coincidences and connections complement one another? It’s almost a “chicken and egg” relationship in terms of which comes first. Do seemingly unrelated, coincidental bits of information come first, sparking the imagination to make connections? Or do seemingly loosely coupled connections suggest a coincidental alignment at certain points in time?

Consider the following loosely coupled sequence of events. Last Saturday was the premier episode of the new science fiction season of Dr Who. The following Monday, the US National Nuclear Security Administration (NNSA) announced a new supercomputing website which highlights a competition taking place in New Mexico.

The Dr Who story line dealt with strange meetings with a lake-bound astronaut and aliens cowering in tunnels (see Figure 1). This episode – “The Impossible Astronaut” – was unique because it was the first time in the series’ 48-year history that an episode was filmed in the US, specifically in Utah. Together, the landscapes in Utah and New Mexico help form the Great Basin Desert, which some call the Navajoan Wilderness.

The Great Basin Desert shares the same mystic intonations as its neighbors; the Chihuahua, Mojave and Sonoran Deserts.

The sheer barrenness of these wastelands provides fertile ground for the imagination, from lost cities of gold and ancient petroglyphic carvings to UFO sightings. Interesting, these vast areas are also the hubs for some of the most hidden and high-tech facilities known to man, from Area 51 to secret military-university R&D operations stretching throughout all of these deserts.

Let’s return to the seemingly coincidental supercomputing event in New Mexico, located at the Los Alamos National Laboratory (LANL). In stark contrast to the 130F temperatures of the outside desert, the inside of the LANL is maintained in the mid-60s. Such cave-like inside temperatures are needed to cool the monolith high-performance supercomputers which owe their existence to the world of semiconductor, chip and EDA innovation (see Figure 2).

During this one week in April, select middle- and high-school students have the “opportunity to work on the most powerful computers in the world...” Teams of students work throughout the year to complete science projects worthy to be run on the high-performance supercomputers.

Not surprisingly, past successful projects have come from computational problems in astronomy, geology, physics, ecology, mathematics, economics, sociology, and computer science. The one restriction is that the problem being addressed deals with a measurable “real world” rather than imaginary challenge.

Yet, it was probably the imaginary challenge from a sci-fi show like Dr Who that originally sparked the scientific and engineering interest of these young students.

There are strange things done in the desert sun by the men (and women) that moil for gold. (My apologies to Robert Service).

Is it by random chance that the intersecting paths of coincidence and connections and of science fiction and hard science meet in the vast, seemingly barren deserts of America?

John Blyler can be reached at: jblyler@extensionmedia.com
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Bring this ad to the Wind River booth at the Intel® Developer Forum for a chance to win one of several Emerson NITX-315 embedded development kits.

Powering 30 Years of Innovation
**Product News**

**By Jim Kobylecky, Managing Editor**

**Axiomtek PICMG1.3 SBC Supports Intel® Core™ i7, Core™ i5, Core™ i3 processors - SHB106**

Utilizing the 2nd Generation Intel® Core™ processors and Intel® Q67 Express chipset, Axiomtek developed SHB106 PICMG 1.3 single board computer for applications where security, display and computing performance are critical. It incorporates Intel® Q67 Express chipset, the SHB106 powered by the new Intel® Core™ i7, Core™ i5, and Core™ i3 processors with LGA1155 socket supports Intel® Turbo Boost Technology, Intel® Hyper-Threading Technology, Intel® QuickPath Technology, 8GB DDR3 1066/1333 memory, and PCIe Gen2 running at 5GT/s. With Intel® Active Management Technology 7.0 built into the Intel® Express chipset, IT administrators can remotely monitor, maintain and update systems.

**ADLINK Technology MXE-3000 Compact and Rugged Fanless Embedded Computer**

Equipped with the 1.66 GHz Intel® Atom™ processor D510, the MXE-3000 delivers twice the performance of the previous Intel® Atom™ processor N270-based platform, meeting high-performance computing needs at all times. Featuring maximum operating shock tolerance up to 100 G, minimal footprint with a small profile, and unique thermal design with zero cable management requirements, the MXE-3000 provides reliable performance in mission critical and harsh environments for a variety of applications. With changes in market trend from toward smaller fanless configurations, the MXE-3000’s compact 210 mm (W) x 170 mm (D) x 53 mm (H) size suits it ideally for applications requiring limited storage space and demanding zero-noise, dustproof performance.

**X-ES Introduces VITA 62 Power Supply: Conduction-Cooled 3U VPX XPm2020**

Extreme Engineering Solutions (X-ES) announces the immediate availability of the XPm2020, a conduction-cooled, VITA 62, 3U VPX power supply that takes in MIL-STD-704 28V-DC input voltage and provides up to 300W on 3.3V, 5V, and 12V at 90% efficiency. Designed for rugged, deployed military applications, the XPm2020 integrates MIL-STD-461E EMI filtering and on-card hold-up capacitance to provide 75 ms of hold-up time. With support for current sharing, two XPm2020 power supplies can be connected in parallel to provide increased power output.

**VersaLogic Ethernet Expansion Module for PC/104-Plus Systems**

VersaLogic Corp. has released the VL-EP M-E2 embedded expansion module featuring high-performance network capabilities and extensive ruggedization features. Based on the industry standard PC104-Plus form factor, the VL-EP M-E2 provides for simplified stack-up expansion with PC104-Plus CPU and expansion modules. The VL-EP M-E2 is available with single or dual Fast Ethernet ports using standard RJ45 output connectors. For extremely rugged applications, a dual Ethernet configuration with latching header connectors is available. All VL-EP M-E2 configurations are designed and tested for operation over the full industrial temperature range (-40° to +85°C) and meet MIL-STD-202G specifications for mechanical shock and vibration.

**COMMELL launches FS-A73---Intel® Core™ i7, Core™ i5 and Core™ i3 processors, rPGA988A PICMG 1.3**

Taiwan Commate Computer Inc.(COMMELL), is releasing the FS-A73 PICMG 1.3 full-size CPU card that designed for the new mobile Intel® Core™ i7, Core™ i5 and Core™ i3 processors in the rPGA988A socket with a 1066/1333MHz FSB. The Single Board Computer(SBC) based on the Mobile Intel® QM57 Express chipset, along with compatible next generation 64-bit, multi-core processors built on 32 nm Intel Core processor technology with HD Graphic function or 45nm technology without Graphic, placing the memory controller and graphics core on the processor die provides a two-chip system architecture, Innovative two-chip solution provides Intel® Turbo Boost Technology and Intel® Hyper-Threading Technology which maximizes performance to match your workload and lower power than previous three-chip platform.

**Lippert Offers Ruggedized COM Express Module**

LiPPERT’s Toucan-QM57 is a high-end COM Express Type 2 module with an Intel® Core™ i7 processor. The module is specifically built for applications exposed to rugged environments. This is underscored by the integration of the highly rugged RS-DIMM memory module. The memory module is fastened by screws. The raw computation performance of the processor and DDR3 RAM lends itself to image processing, video encoding, communications and other demanding tasks. The COM Express module offers 4GB of soldered DDR3 ECC RAM and another 4GB of RAM by way of RS-DIMM card, which optimizes board space and ruggedness.

**WinSystems Creates Fanless 1.66GHz Industrial SBC of EPIC Proportions**

WinSystems’ EPX-C380 is a highly integrated, single or dual core, single board computer designed for rugged, performance-driven applications. It operates over a temperature range of -40° to +70°C without a fan and is designed for applications including...
In 2010, Extreme Engineering Solutions, Inc. (X-ES) developed more Intel® Core™ i7 processor-based products based on VPX, CompactPCI, VME, CompactPCI Express, and XMC form factors than anyone in the industry. This year, X-ES has added solutions based on the 2nd generation Intel Core i7 processor. Providing products customers want, when they want them – that truly is innovation that performs.

X-ES offers an extensive product portfolio that includes commercial and ruggedized single board computers, high-performance processor modules, multipurpose I/O modules, storage, backplanes, enclosures, and fully integrated systems.

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industrial automation, security, medical/diagnostic equipment, MIL/COTS, test and measurement, and transportation. The EPX-C380 features two gigabit Ethernet ports, simultaneous display of both XVGA and LVDS flat panel video, eight USB 2.0 ports, four serial COM ports, HD (7.1) audio, and 48-lines of digital I/O.

**Portwell Bases Mini-ITX Embedded Board on 2nd Gen Intel® Core™ Processor Family**

American Portwell Technology, Inc. introduced WADE-8012, a new Mini-ITX form factor embedded system board. The product provides high performance and flexibility for functional expansion and is ideal for applications in gaming, kiosk, digital signage, medical/healthcare, defense and industrial automation and control. The WADE-8012 supports the Intel® Q67 Express chipset and the latest 2nd generation Intel® Core™ processor platform.

**MEN Micro CompactPCI Serial SBC for Harsh Environments**

Micro Inc. has released the G20, its first single-board computer (SBC) based on the newly ratified PICMG CPCI-S.0 CompactPCI Serial specification announced at Embedded World 2011. The G20 uses the extremely fast 64-bit Intel® Core™ i7 processor with a base processing speed of 2.53 GHz that supports Intel® Turbo Boost Technology and Intel® Hyper-Threading Technology to provide a maximum speed of 3.20 GHz. A CPU-independent microprocessor in the G20 based on the Intel® Active Management Technology allows remote access via an integrated Ethernet controller, even when the computer is in soft-off or stand-by state.

**congatec COM Express Compact Module Based on Intel® Atom™ Processor E6xx Series**

congatec AG introduced the conga-CA6 module, which is based on the new Intel® Atom™ processor E6xx series and the Intel® Platform Controller Hub EG20 for COM Express Type 2. All components of this embedded design are specified for the industrial temperature range of -40 to +85°C, making the conga-CA6 an ideal solution for extreme environments. With a power consumption of less than 5 Watts and a compact size of 95 x 95 mm, the new computer-on-modules are an excellent fit for applications in the medical and automation sector.

**Expanded Wind River On-Board Program Creates Unique Development Kits**

Wind River expanded its On-Board Program, which provides participating commercial off-the-shelf (COTS) processor board vendors with software tools, documentation and training to develop, test and validate their own unique Embedded Development Kits for the first time. These kits provide customers with processor boards and with optimized configurations of Wind River's operating systems, development tools, embedded hypervisor and graphics software. Wind River will enable board vendors to create their own Embedded Development Kits using Wind River's automated board support package (BSP) validation suite, technical support and training.

**TenAsys® Announces Networked RTOS for Multi-Core, Multi-Platform Embedded Systems**

TenAsys Corporation announced a new scalable real-time OS called INtime Distributed RTOS at the Embedded World show. Based on the company's established product, INtime for Windows®, INtime Distributed RTOS enables programmers to write applications that run without modification on different system configurations spanning from single-core or multi-core processor systems to multi-platform systems with multi-core processors.

**Kontron Offers Intel® Core™ i7 Processor-Based 6U VME Single-Board Computer**

Kontron announced the 6U VME single-board computer (SBC) VM6050 with an Intel® Core™ i7 processor. It combines extremely high x86 computing and graphics performance with flexible and modular expansion possibilities in four different ruggedization levels. OEMs can tailor the Kontron VM6050 to the individual requirements of new and existing applications and benefit from a reduced time-to-market. In addition, with Kontron's long-term supply program with availability of 10 years or more, OEMs can further optimize the life cycle and total cost of ownership (TCO) for applications.

**IEI 5.25” SBC with Intel® Atom™ Processors D425/ D525 & Quad PCIe GbE Connectors**

IEI Technology Corp. (IEI) released a 5.25” Single Board Computer (SBC), the NOVA-PV-D4251/D5251, featuring quad PCIe GbE for networking applications. The NOVA-PV-D4251/ D5251 is equipped with Intel® Atom™ processors D425 and D525. These SBCs are specifically designed for affordable, entry level computing with 800 MHz DDR3 memory support and an increased processor speed of 1.8 GHz. The key features of the NOVA-PV-D4251/D5251 include ASF 2.0 support, TPM V1.2 hardware security functions, and UEFI BIOS architecture that supports over 2.2 TB of HDD storage on a 64-bit operating system.

**AMAX Bases Security Solutions on the Intel® Xeon® Processor E3-1200 Family**

AMAX announced the AMAX AX-1105, AX-1106 and AX-1107 1U uniprocessor ioEM appliance solutions based on the revolutionary 2nd Generation Intel® Xeon® processor family. The new turnkey servers target security software vendors seeking increased performance and power efficiency to battle the latest invasion of data breaches and security attacks. According to the 2010 Ponemon Institute study on the cost of data breaches, the average total cost per reporting company in the study was $7.2 million per breach, which is prompting organizations to re-evaluate their approach to protecting themselves and their customers.
Do you need to know, on-line and immediately, what is happening with your remote system? „LEMT is for you.”

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- Save time and money, keep your system under control and bring the best possible products to market. LiPPERT’s Condition Monitoring can help you.
It is no secret that today’s market favors electronic products that use less power while providing ever greater feature sets at higher levels of performance. These conflicting requirements have caused many embedded hardware and software developers to consider competing processor architectures for their next design iteration. Architecture migrations are tricky since they involve taking software designed to run on one computer hardware and porting the same software to execute on a totally different system.

Migrating software to run on a new processing platform can be risky and time consuming. Many factors must be considered, such as the choice of an operating system. Common concerns center on the best way to optimize both power and performance during the migration. Other issues deal with available tools for debugging in the new environment.

These questions and many others are addressed by a new book by Lori M. Matassa and Max Domeika published by Intel Press. The book is titled “Break Away with Intel® Atom™ processors: A Guide to Architecture Migration.” The book obviously focuses on migration strategies from competing platforms to embedded Intel Atom processors. Still, an interview with one of the author’s reveals a variety of useful development tips that apply to architectural migration in general.

**EIS:** What motivated you to write a book on migration strategies?

**Domeika:** Lori and I saw a need to help embedded software developers and engineers migrate to the Intel Atom processor. Over the last several years, our customers have asked many questions about the details of things they need to know to be successful in the migration. Lori and I wanted to document all of these questions and answers in one place to benefit a broad spectrum of people, from managers considering migration to the engineers that have to do the work.

**EIS:** Which competing processor platforms are covered in the book? Also, will the migration be to a single core or the new double-core version of the Intel Atom processor?

**Domeika:** We primarily cover migration strategies from the two big architectures of PowerPC and Arm. Many customers have experience on these embedded architectures but now want to explore of move over to the Intel Atom processor. Some developers want to know the low-level architecture details, such as the special features of x86 assembly language. Other details we cover include the pros and cons of an in-order processor instead of an out-of-order processor like our other, bigger processors. Many questions center around the issue of porting existing software to a new platform. One common issue that we see from customers deals with byte order. How do you migrate from a larger processor architecture like to PowerPC to a smaller one like the x86? The multicore question is a challenging one. Once the software is migrated to the Intel Atom processor, it is easier to take advantage of new multicore platforms. In general, embedded developers are still learning the advantages of multicore systems. One of the challenges is that no one roadmap exists for customers in the multicore space. We still have customers who are struggling with the same multicore issues that we were talking about two to three years ago.

**EIS:** The cover of the book has pictures of tablets, nettops and smartphones. Do these different development targets have different migration strategies? Or are the differences minimal, confined to hardware-specific issues like display screen resolution and memory?

**Domeika:** Every migration has both common and unique aspects, which made writing the book a hard task. You don’t want to be so specific that you have things that only apply to one person. On the other hand, you don’t want to be so general that it applies to nobody. Lori and I have done our best to try to generalize and discuss the key topic areas. As I mentioned, some folks want to know about the low-level details. But many don’t need the low-level details. These developers don’t need to know the details of assembly language or Intel Atom processor architecture, especially if they are application developers coding in a higher level language like C++.

Operating system (OS) issues are common to most customers. Some use commercial of the shelf OSes that make certain tasks easier but other tasks harder. Other folks are bound by a proprietary OS that they need to port.
tary OSes bring in other system level and assembly language issues in terms of device drivers. So it really depends. We try to be general enough to suit the needs of many folks, but provide enough detail that it is of some value.

**EIS**: Let’s talk about available migration tools.

**Domeika**: Historically, Intel’s tool focus has been on best performance, i.e., trying to get the most optimized performance. Our compiler engineers sit closely with the Intel Atom processor architectures so we are able to design compilers that know the internals and create very fast code. Similarly, our profiling tools are tuned to watch for events that have more or less impact on the processor. One of the big embedded tool areas is power optimization. How do you optimize the processor for power? There are tools available now and some coming out later. One of the currently available, common open source tools is called PowerTop.

There were many demonstrations at the last Embedded Systems Conference (ESC) that relied on external electrical devices to measure power. These devices had external probes that would monitor the power on a chip or board. PowerTop is different. It is a software tool that monitors the idle states of a processor – specifically, the C and P states – while the software is running. Idle processors use less power. PowerTop monitors the processor as it is transitioning between its C states and P states. Knowing the transition timing allows the designer to figure out what part of the software is causing the processor to wake up. Too many interrupts may increase the systems power consumption. The software developer can use this information to determine if all of those interrupts are actually needed. Perhaps fewer processor interrupts can be used. Sometimes, the solution is silly things, like insistent polling of the processor by an application. One solution may be changing the polling behavior or even moving to a different processing architecture.

**EIS**: How about chip power management systems that are based on RTOS software control, e.g., turning off specific sections of the chip as needed?

**Domeika**: Those low power techniques are certainly useful. However, my focus has been on the software development side. Many developers don’t want to go to a deep level of detail. This has been an eye opener for me, a realization that has caused me to think in a new way.

While there are ways to micromanage the chips power usage, it is usually more efficient to simply let the chip manage the power at that level of detail. A great many power decisions are controlled by the processor. We’ve found that application developers don’t have a big desire to manually tell the processor which sleep state to enter or when to wake up. Their interest is at a higher level, such as deciding how often to interrupt the processor.

This is analogous to threading issues in multicore processing. Multicore threading is considered the assembly language of multicore programming. Here, too, the questions arise as to whether it is better to have libraries that address most level power and performance issues so developers can focus exclusively on their software applications. Not surprisingly, mainstream developers want things to be easier.

**EIS**: Are there any third-party tools that can be used for multicore design?

**Domeika**: The book also covers some third-party tools. One such tool is called Prism, by CriticalBlue. This tool supports multicore programming on embedded processors by allowing users to play “what if” performance scenarios. For example, what if you were able to make a section of the code run in parallel? How much faster would the code run across four cores? What are some of the potential issues that you’d have to worry about if you are going to make something run in parallel? Common issues include the use of shared variables and parallelism, concurrency concerns and ensuring that the code runs correctly.

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**Max Domeika** is an tools architect in the Developer Products Division at Intel, creating tools targeting the Intel Architecture market. He earned a BS in Computer Science from the University of Puget Sound, an MS in Computer Science from Clemson University, and a MS in Management in Science & Technology from Oregon Graduate Institute. Max is the author of “Software Development for Embedded Multi-core Systems” from Elsevier and “Break Away with Intel Atom Processors” from Intel Press. In 2008, Max was awarded an Intel Achievement Award for innovative compiler technology that aids in architecture migrations.

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**Lori Matassa** is a Staff Technical Marketing Engineer in Intel’s Embedded and Communications Division and holds a BS in Information Technology. She has over 20 years of engineering experience developing software for embedded systems. In recent years at Intel she has contributed to Carrier Grade Linux, as well as the software enablement of multicore adoption and architecture migration for embedded and communication applications.
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<td><strong>Motion Video Support</strong></td>
<td>Single channel 80MHz LVDS transmitter, support for flat panels with 1x18 and 1x24 bit data mapping up to a resolution of 1280x768@60Hz.</td>
</tr>
<tr>
<td></td>
<td>Single channel 160MHz SDVO interface, supports resolutions up to 1920x1080@60Hz and 1280x1024@85Hz.</td>
</tr>
<tr>
<td></td>
<td>Dual independent display support</td>
</tr>
<tr>
<td><strong>congatec Board Controller</strong></td>
<td>Multi Stage Watchdog, non-volatile User Data Storage, Manufacturing and Board information, Board Statistics, I²C bus (fast mode, 400 kHz, multi-master), Power Loss Control</td>
</tr>
<tr>
<td><strong>Embedded BIOS Features</strong></td>
<td>OEM Logo, OEM CMOS Defaults, LCD Control, Display Auto Detection, Backlight Control, Flash Update, based on AMI Aptio UEFI</td>
</tr>
<tr>
<td><strong>Power Management</strong></td>
<td>ACPI 3.0 compliant, Smart Battery Management</td>
</tr>
<tr>
<td><strong>Operating Systems</strong></td>
<td>Windows® XP, Windows® XP embedded Standard, Windows® CE 6.0, Linux 2.6, QNX 6.x</td>
</tr>
<tr>
<td><strong>Power Consumption</strong></td>
<td>Typ. application ~5 Watt @ 5V</td>
</tr>
<tr>
<td><strong>Temperature Range</strong></td>
<td>Operating: 0 to +60°C (opt. -40 to +85°C)</td>
</tr>
<tr>
<td></td>
<td>Storage: -20 to +80°C (opt. -40 to +85°C)</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>Operating: 10 to 90% r. H. non cond.</td>
</tr>
<tr>
<td></td>
<td>Storage: 5 to 95% r. H. non cond.</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>70 x 70 mm (2¾” x 2¾”)</td>
</tr>
</tbody>
</table>
**Engineering Tools / Accessories for Qseven**

<table>
<thead>
<tr>
<th>Article</th>
<th>PN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>conga-QA6-HSP-B</td>
<td>042745</td>
<td>Heatspreader, Standoff with 2.7mm bore hole</td>
</tr>
<tr>
<td>conga-QA6-HRT</td>
<td>042740</td>
<td>Heatspreader, Standoff with 2.5mm thread</td>
</tr>
<tr>
<td>conga-QA6-CSP-B</td>
<td>015562</td>
<td>Standard passive cooling solution, surface orange anodized with 1.8mm fins, bore hole bracket, threaded standoff.</td>
</tr>
</tbody>
</table>

**CONTACT INFORMATION**

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www.embeddedintel.com | Embedded Intel® Solutions — Summer 2011 | 13
Ed Sperling sat down with Jonathan Luse, director of marketing for Intel’s Low-Power Embedded Products Division. What follows are excerpts of that conversation.

**EIS:** Will Intel® Atom™ microarchitecture use the new Tri-Gate technology?

**Luse:** We have no announcements at this point because Tri-Gate is a 22nm technology. We do plan to use that in the future, though.

**EIS:** What node is the Intel® Atom™ processor at?

**Luse:** We’re at 32nm. So Tri-Gate is the next-generation process technology. You can expect to see the entire Intel® product line use this at 22nm.

**EIS:** Where will the Intel Atom processor be targeted? Is it geared toward smart phones or is it other devices that will require low power?

**Luse:** It’s both. The Intel Atom processor has found success so far in ‘tethered’ devices—things that are plugged into the wall that still need low power. For example, think about industrial HMIs, controllers and medical equipment like ultrasound. Even though they’re looking at bandwidth and low power, most of the traction has been in a scaled down version of the traditional (Intel) business model. Going forward, we’re at a tipping point with the new Intel® Atom™ processor Z6xx series, which reduces the power by about 30% from the previous generation. We’re at 3.3 watts. The average power is about one-third or one-half of that. That opens up a tremendous market for untethered devices. It will be things like portable retail devices or industrial handhelds for factory automation and medical. We’re really getting to the point where it’s battery-powered portable devices. This is the next big wave. It’s battery life, standby power, and performance per watt per cubic inch.

**EIS:** Is the future of the Intel Atom processor as a single processor or would it be in a chip set with other processors, as well?

**Luse:** That depends on the customer application. We provide the CPU and the graphics processors, and we have a couple Intel® architecture (IA)-based acceleration processors. Then customers can add their own acceleration processors or graphics cards. If you get into print imaging, the Intel architecture would do print control and motor control, but color correction and image control and rotation might be done in a proprietary ASIC. A lot of that is the customer’s secret sauce for performance, and doing a dedicated process like half-toning or color balancing is going to be faster on a dedicated chip than doing it in software on a general-purpose processor. It makes sense to put a dedicated-function device right next to the processor.

**EIS:** Where do your acquisitions like McAfee and Wind River fit in?

**Luse:** McAfee and Wind River have a broad customer base. Part of our acquisition strategy was to leave them isolated from the core Intel® silicon business because they need to operate autonomously. In my world, it’s all about IA.

**EIS:** But a general-purpose operating system running on IA isn’t always the most efficient. Are you seeing an uptake beyond just the Intel-Microsoft alliance?

**Luse:** The breadth and depth of operating systems required to service the market is increasing. We had about a dozen OSes we used for the first generation of Intel Atom processors. We now support about 30, with full board support and packages optimized for those OSes. It’s definitely increasing, and there’s a bit of specialization. When you get into industrial applications, real-time operating systems come into play. VxWorks and Green Hills Software become very attractive markets. You multiply that times the number of segments we pursue and there’s a big market.

**EIS:** Is virtualization being used in portable devices?

**Luse:** I’ve seen a lot of investigation in the market, but I haven’t seen it in widespread use yet. But when multicore first came out eight or nine years ago, there was a lot of interest and it still took time. We’re seeing a lot of interest for a lot of different applications.
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Some people are using it to isolate systems. So for an industrial application you might see the machine controller on one side of the virtualization and the safety management system on the other, so you can monitor the safety aspects of the system and shut down, if necessary. Today that has to go through a bunch of regulatory approvals. Sometimes it takes a while to prove that’s robust enough, but the benefits are definitely there.

**Luse:** This is the same approach as separating work and home environments on the same device, right?

**EIS:** Yes, and I’ve had multiple conversations around the country and the world about those usage models. Security becomes more important as malware begins hitting embedded devices. There’s a range of how you use those devices. Some people would maximize performance and minimize security. Others would maximize security and minimize performance. You have to build an architecture in between. But from a usage perspective, there is a huge demand for better and better experiences. That could be productivity or it could be simplifying your life. How do you apply technology in a way where it’s invisible?

**EIS:** Is there enough real estate now, with the process shrink, that you can do more with a piece of silicon?

**Luse:** Yes, and we’re surprised with the type of precision and compute performance you can put into a device. If you look at the long term instead of just one generation, 10 years ago the most powerful Intel processor was the Intel® Pentium® II processor. It had a SPECint of 18, ran at 40 watts and cost $1,000. Today the average Intel® Atom™ processor is less than $50, has a SPECint of 56 and runs at 2 watts.

**EIS:** Is there any shift in terms of how Intel looks at building processors. Is software now a consideration rather than just hardware performance?

**Luse:** Yes. BIOS, middleware, applications and OS have their own attributes. How do you take advantage of the platform of choice and still support more than one? That’s the challenge—figuring out how to strike a balance in the silicon itself.

**EIS:** Intel has been talking for years about moving into the SoC market. Does the Intel Atom processor become a base platform for an SoC, possibly in a 3D stack?

**Luse:** That’s probably a couple steps away from where we are right now. Because of the fragmentation you need a lot of SoCs. There is differentiation on BOM (bill of material) costs and power. If you have a general-purpose CPU it’s going to be large and more expensive than the market requires. You have to figure out ways to design a catalog of them, and each one is more of an application-specific rather than a generalized approach. That’s the challenge we’re looking at. There’s a need for general-purpose chips, but there’s a need for market-specific ones, as well.

Ed Sperling is Contributing Editor for Embedded Intel® Solutions and the Editor-in-Chief of the “System Level Design” portal. Ed has received numerous awards for technical journalism.
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MARKET WATCH

Are Tablets Stealing PCs’ Fire?
Intel Makes Late Foray as Tablet Market Takes Off

By Cheryl Coupé, Contributing Editor

Recent research seems to indicate that tablets are cannibalizing PC sales, but that the cannibalization is due more to consumer confusion than direct competition. According to market research firm iSuppli Corp., (now owned by IHS) global tablet shipments will grow by as much as 197.7 percent in 2011 and 57.4 percent in 2012, while PC shipments will see only 12.5 percent growth from 2010 to 2011 and 11.3 percent the following year. This decline comes after a new quarterly record for global PC sales (driven by corporate demand) in the fourth quarter of 2010.

In the first quarter of 2011, three of the world’s top five PC makers suffered year-over-year declines in shipments. Notably, number three-ranked Acer, which sells a high proportion of netbook-style PCs that compete with tablets, bore the brunt of the downturn, with first-quarter shipments down 20.4 percent to 9.2 million units from 11.6 million during the same period in 2010.

Gartner, Inc. also projects weaker worldwide PC unit growth in 2011, showing PC shipments growing 9.3 percent in 2011, which is down slightly from its previous projection of 10.5 percent growth for this year. Both Gartner and iSuppli blame the weak market on consumer confusion about competing device types as well as economic uncertainty.

Caption: iSuppli percentage growth shipment forecasts for PCs and tablet devices in 2011 and 2012.
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“Consumer mobile PCs are no longer driving growth, because of sharply declining consumer interest in mini-notebooks,” Ranjit Atwal, research director at Gartner, said in a release. “Mini-notebook shipments have noticeably contracted over the last several quarters, and this has substantially reduced overall mobile PC unit growth. Media tablets, such as the iPad, have also impacted mobile growth, but more because they have caused consumers to delay new mobile PC purchases rather than directly replacing aging mobile PCs with media tablets. We believe direct substitution of media tablets for mobile PCs will be minimal.”

Results of a survey of 1,142 consumers conducted by ABI Research in March 2011 indicate that netbooks and media tablets are actually neck-and-neck in terms of consumer interest. According to the survey, 25% of respondents rated themselves as either ‘extremely’ or ‘very’ interested in acquiring a netbook, while for media tablets, the number was 27%. In contrast, nearly half of those surveyed reported that they are either ‘not very’ or ‘not at all’ interested in purchasing a media tablet. The most common reason for the lack of interest was ‘I don’t see the need,’ selected by 60% of this group. ABI believes that purchases of these devices are likely to result in prolonged PC lifecycles and delayed replacement.

The total impact of the growth in tablets has yet to be seen, according to at least one researcher. At the recent Semico Summit, Jim Feldhan, Semico Research president, anticipated approximately 100 tablet models being introduced in 2011, each with a market share goal of more than 1%. He believes that as the market shakes out, the result will be excess capacity and inventory in the channel. Combined with the impact of the smartphone market, which continues to grow at double-digit rates and has increasing semiconductor content, he believes overbuilding will result in excess capacity and inventory and lead to falling semiconductor prices.

As the tablet market heats up, the question has been: Where is Intel? According to IHS, Intel® Atom™ processor revenues were down 4% sequentially in the third-quarter of 2010, which may be construed as a sign of cannibalization by tablets, most of which are powered by ARM processors.

The new Intel® Atom™ processor Z760 platform is Intel’s response. At the Intel® Developer Forum in Beijing in April, Intel announced that Oak Trail will be available in more than 35 devices beginning in May 2011, running a variety of operating systems including Android, Windows 7 and MeeGo. The Intel Atom processor Z760 system-on-chip (SoC) was designed specifically for tablets, with specs that include as much as 50 percent less power consumption than previous processors and support for full high-definition video.

At the forum, Doug Davis, vice president and general manager of Intel’s Netbook and Tablet Group, also presented “Cedar Trail,” Intel’s next-generation netbook and entry-level desktop platform. Based on leading-edge Intel 32nm process technology, Cedar Trail will include features that will improve media, graphics and power consumption in upcoming netbooks and will enable fanless, fully enclosed, ultra-sleek devices. Davis said other new features will be disclosed in the coming months, with the processor due in the second half of the year.

Matt Wilkins, principal analyst for compute platforms at iSuppli, said in a statement, “Intel is smart. The company knows perfectly well that the media tablet market is being defined right now. And if the company doesn’t become a player immediately, its prospects of getting into the market in the future will only grow dimmer.”

The new Intel® platforms are also ideal for small form-factor and portable embedded designs, such as tablets used in retail, medical and industrial applications.

Cheryl Berglund Coupé is editor of EECatalog.com. Her articles have appeared in EE Times, Electronic Business, Microsoft Embedded Review and Windows Developer’s Journal and she has developed presentations for the Embedded Systems Conference and ICSMAT. She has held a variety of production, technical marketing and writing positions within technology companies and agencies in the Northwest.
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What’s All the Buzz About Thunderbolt?

By Dan Harmon, Texas Instruments

The new Intel wired external interface, Thunderbolt™ technology, with technical collaboration from Apple, is all the buzz these days. Developers are already wondering whether Thunderbolt technology is going to replace USB 3.0 as the main I/O of choice on PCs. But before diving into the USB 3.0 versus Thunderbolt discussion, let’s take a quick review of what Thunderbolt really is.

According to the Intel Thunderbolt technology product brief, the basic concept is to take the DisplayPort and PCI Express (PCIe) interfaces, multiplex them, and then send out a combined transmission from the host system. The peripheral system will then take the Thunderbolt signal in, de-multiplex the PCIe and DisplayPort content and provide those for use by the peripheral system.

One implication of this has been lost in the buzz: The source of the DisplayPort and PCIe data is not changing and therefore the performance remains identical for those interfaces. In other words, if the source is DisplayPort 1.1, then the throughput across is still at DisplayPort 1.1 rates (2.7 Gbps). If the source is DisplayPort 1.2 capable, then the performance for the DisplayPort throughput bumps up to the 5.4 Gbps of DisplayPort 1.2. For PCIe, the assumption is that it will be an x1, Gen 2 link, which drives 5 Gbps on both Tx and Rx lines. If you add the bandwidth of PCIe x1 Gen2 to that of DisplayPort 1.2, you get approximately 10.4 Gbps versus the Thunderbolt port transmission speed of 10.3 Gbps. This means that the mux chip must be doing more than simply time-slicing the two signals together. It must be eliminating some of the protocol overhead and replacing it with Thunderbolt protocol-specific transmission overhead.

So if you really are not getting any better DisplayPort or PCIe performance than what an existing system is capable of, what is the value of Thunderbolt technology? What is likely is form factor and ergonomics.

Thunderbolt technology (originally codenamed Lightpeak) can enable the elimination of various connectors on a system to be replaced by a single Thunderbolt connector. For example, removing the DisplayPort receptacle is obvious. Less obvious, could be the elimination of the eSATA, FireWire, HDMI, and even USB receptacles depending on the needs of the system. This opens up the possibility of some very slim form factors while still enabling multiple high-bandwidth I/O. This prompts several follow-on questions: What will this cost to the system implementers? How much more will the additional chip and the new receptacle cost than the existing connectors? Are end users willing to pay the premium for sleeker form factors, but no additional performance?

Getting back to the initial question of Thunderbolt technology versus USB 3.0, these technologies appear to be complementary rather than conflicting. USB will not go away as a key interface for PC systems—it has become too ubiquitous. One way to think of this is to consider that for most portable PCs, ultimately there is a docking solution for fixed-usage scenarios such as in the office. Thunderbolt technology would be an ideal interface for a new docking paradigm—a cabled dock. A single cable passes both the monitor interface (DisplayPort) as well as the data interface (PCIe). Then, inside the dock, the PCIe interface can be used to add any other data I/O that are typically available in docks today, such as USB 3.0, Firewire IEEE-1394 or eSATA via the use of PCIe packet switch and various PCIe-based host controllers, such as the Texas Instruments TUSB7340 for USB 3.0 or the XIO2213B for 1394. These docks also can offer the full user I/O experience via additional downstream devices.
such as flash media readers or stereo audio, as well as ports for thumb drives. The DisplayPort signal can be mapped directly to a DisplayPort receptacle or, if the dock wants to support HDMI in addition to DisplayPort, then a simple 1:2 switch with level-shifting capabilities, such as the Texas Instruments SN75DP122A (DisplayPort 1.1++) or soon-to-be-available DisplayPort 1.2++ can be used.

Finally, there are legal regulations that mandate that USB continues to be available for the foreseeable future. The Chinese government and the European Union Commission both have mandated that all mobile phones use the micro-B USB receptacle for charging and cannot have any other type of dedicated power receptacle. While this does not necessarily mean that a PC must have a USB connector as a dedicated wall charger, USB in the host system offers a simple means to not only charge a mobile phone, but to exchange data with the PC. With the passing of these governmental rules, most other portable consumer products (personal navigation devices, portable music players, portable media players, tablets, eBooks, etc.) have chosen to use the same micro-B receptacle as their only charging port as well.

At first glance, it may appear that Thunderbolt protocol is a new I/O standard that could replace SuperSpeed USB; however, in actuality, both technologies will reside on the same system and work together to deliver high-speed capabilities to the end user. Thunderbolt technology will continue to rely on underlying protocols such as DisplayPort, PCI Express or USB for the real data transfer between PCs and peripherals.

Dan Harmon is product marketing manager for consumer and computing interfaces at Texas Instruments. He also serves as TI’s USB-IF representative and chair for TI’s USB 3.0 Promoter’s Group. He earned a BSEE from the University of Dayton and a MSEE from the University of Texas at Arlington. You can reach Dan at ti_danharm@ti.com.
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Micro electro-mechanical systems (MEMS) sensors, that enable machines to hear, see, touch, feel and smell, are creating opportunities for new consumer products and services that profoundly affect the way we live.

MEMS accelerometers, magnetometers and gyroscopes, for example, already enable smartphones to respond to our hand gestures, rotate displays when we tilt the handsets, tell us which way is north, pinpoint our longitudes and latitudes, count our steps and lead the way to our destinations.

The sheer complexity and quantity of information that sensors can create requires new and different ways to handle the raw data for it...

Such competence is the result of seamless integration among the sensor hardware, middleware and smartphone application software. Achieving such seamless integration requires that at least one of these three layers—hardware, middleware or software—has the computational intelligence to interpret data from our surroundings and feed it to the other two layers for a desired result. The million-dollar question is: In which of these layers should the intelligence reside?

Unfortunately for smartphone manufacturers, there is currently no firm answer to that question. Taking a look at a mobile operating system (OS) such as Google’s Android, the most popular smartphone platform, may tell us why.

In the tradition of Linux on which it is based, Android’s mobile operating system is the result of collaboration among approximately 80 hardware, software and telecom member vendors in an open-source handset alliance.

Open source doesn’t mean available

When participating vendors develop a new application, they often are forced to add the computational intelligence to make it work because the technology they need is not available. Case in point: Android has no sensor fusion application solution for magnetometers or accelerometers. Yes, there are placeholders in the Android sensor API for sensor fusion (quaternion, rotation matrix, linear acceleration, gravity), but it is up to sensor vendors such as Kionix to provide the actual algorithm solutions that populate the placeholders. Therefore, if system and application designers want to combine sensory data from disparate sources to...
make an application more accurate, more complete or more dependable, they need to add that capability themselves. As these efforts are multiplied over and over—and Android is said to have more than 200,000 available apps already—the intended open-source effort ultimately becomes closed to all but a few companies that have the financial resources to create breakthrough technologies on their own.

The sheer complexity and quantity of information that sensors can create requires new and different ways to handle the raw data for it to be incorporated in a computational platform and an alternate way of managing and storing it.

It wasn’t always so

Previously, accelerometers simply would detect when a specific acceleration threshold was reached, such as when a laptop computer was dropped. The information flow to the host processor was practically zero. The “yes” indication, confirming that the laptop was dropped, was received by the system controller, which would then notify the hard drive to shut down and park the read-write head. The data-processing needs of the host were minimal and the sensor’s local hardware minimally processed its own data flow.

Later, when accelerometers were employed to notify host applications about the orientation of handheld devices, there were computational requirements for multi-axis motion detection and acceleration forces, as well as tracking of past, current and present positioning. Now there was a need for more dialogue between the host operating system and the sensor, plus communication to the application at the presentation layer.

This is the point at which the complexities of sensors, the operating system and mobile applications became challenging and data-rate intensive, while also requiring the interchange of data between several applications and several—maybe disparate—sensors.

Many of today’s smartphone computational platforms rely on available operating systems such as Android that do not necessarily accommodate the high information-rate streams of sensors.

Android – not up to the task

The Android OS architecture consists of a Linux kernel, including specific hardware drivers, that allows the processor to operate. Sitting on the Linux OS are abstraction and adaptation layers that allow Java apps and programs to run. The adaptation layer operates like a browser running real-time applications. Each app runs at the top layer totally independent and isolated from all other apps available or running. The architecture permits some apps to run concurrently.

In this example, the resource demands on new and future sensors on the underlying host processor could become so significant that it would force all other running apps and processes to freeze (assuming the OS allowed it to hog the bandwidth requested). While the sensors are being serviced, all the other communications and resident running apps also require system resources and servicing.

Using the resident host processor and operating system—to support sensor motion algorithms, for example—may simply overload today’s embedded-processing platforms. Some flavors of Android do not have a Direct X equivalent that allows applications to tunnel through to the base layers and manage the lower layers of the processing stack. Any sensor requesting high demands on processor bandwidth would not be accommodated.

So until Android can build in the appropriate processing algorithms and allocate the necessary resources and device management, any new sensor that has relatively high bandwidth demands requires additional processing power that can only be delivered by additional hardware.

Platform upgrades unlikely

While we are peering into the future, let us suppose that next-generation processors will have the ability to integrate many high-level functions that easily accommodate the requirements of the high data transactions of new sensors. This approach has significant appeal and few apparent down sides.

Is this the answer? Maybe. But smartphone developers who have made significant investments in legacy processors will likely prefer to add sensors to an existing design, along with software and new apps, without reinvesting in a new processing platform. They would use the existing infrastructure and have the sensors serviced by adding hardware and software, and deploy existing protocols and device handlers provided by the operating system.

Insight into how the smartphone industry will solve this problem may be found in the recent history of personal computers. As the PC industry developed during the 1980s, hardware design was simplified to accommodate the intensive processing requirements of printers and modems. Ultimately, an embedded microcontroller or microprocessor was engaged to process data locally to lower the overhead of the host processor. Designers achieved system integration through a set of software drivers that communicated with the hardware abstraction layer of the operating system.

Short term: smarter, more powerful sensors

Engineers at Kionix believe that this traditional approach is inevitable as processing demands of sensor-information streams increase. In other words, it will be up to sensor devices to process the data and provide information to the middleware and the application software in a smartphone.
To see how this might work, take the example of smartphone location-based services. The outdoor typical solution is based on the global positioning system (GPS) using satellites that tell time and find your location on the earth as long as it can calculate the distance from an already-known location. Besides helping you find your way, GPS also provides such perks as geotagging your smartphone photos with the exact place and time of day they were taken. It is the smartphone sensors, however, that provide data to the GPS system so it can give you the local time and tell you where in the world you are.

Since the GPS provides location information only where there is an unobstructed line of sight, it, of course, does not work within a building. Indoors, smartphones must be smart enough to switch to a local-range communications technology such as Bluetooth and WiFi to facilitate the more intimate interaction—e.g., hand gestures—between smartphone users and the smartphone sensors.

Both local and long-range positioning systems need to communicate with sensors such as gyroscopes, magnetometers and accelerometers—sometimes one at a time, sometimes concurrently—to provide users with the most accurate response. Furthermore, the operating system and the application software are required to concurrently exchange and process information from each of the sensor devices and their respective applications.

If we delve into the requirements and individual tasks that are needed to manage all of the above, it becomes evident that this is not only very complex but also will require enormous amounts of bandwidth and processor cycles to execute in real time. Additionally, the physics and mathematics required to convert the many degrees of motion taking place in real time has to be handled in such a manner that the application programmer gets to work with parameters that are simple to understand and manage.

Furthermore, the complexity has to be hidden to ensure that, from the end user’s point of view, the technology just plain works.

No standards exist currently. Maybe the time has come to standardize where in the product-implementation phase the sensor-bandwidth issue is solved. Kionix engineers believe that, in the short term, the processing power should lie in the sensor hardware acting as a co-processor to the microprocessor.

**Future cooperation?**

Long term, as sensor capabilities and performance level increase, perhaps vendors from all three device layers will be able to work together to see that sensor-processing demand is met.

Admittedly, developing industry standards for sensor behavior and performance would likely be slow going and technology develops too fast to wait. Furthermore, sensor suppliers—Kionix included—have no desire to commoditize solutions, even if standards do emerge. The newness of motion control in mobile applications, its rapid acceptance and performance enhancements, make it extremely difficult to nail down a set of standards without impacting the growth and diversity of potential applications.

**IP That Senses and Cares**

**Blog By John Blyler**

Engineers may be nervous about user experience (UX) based hardware design trends, but the future lies in creating devices that sense and care about their owners.

This week, Semicon West has taken over all the halls at the San Francisco Moscone Center. The show focuses on microelectronics design and manufacturing, from EDA (mostly DFM/DFY) an device fabrication (wafer processing), to final manufacturing (assembly, packaging, and test).

IMEC, a large nano-electronics research organization headquartered in Leuven, Belgium, is also at Semicon West. The R&D organization partners with many major semiconductor companies, both IDM and fabless, in both microelectronic design and manufacturing.

At this year’s Semicon show, IMEC tried something different. They held one of their technology forums. This one was on smart phone design. After introductions, the forum began with a talk by Intel’s CTO, Justin Rattner.

Rattner presented many interesting factoids during his presentation. My favorite was that Twitter handles over 146M tweets per day that require more than 1.4 TB of storage per day. That’s a lot of bird seed!

But the main thrust of his talk was two fold. First, smart phones are becoming as important as our vital senses. Second, user experience now drives innovation. Each of these observations has rather staggering implications.

**To read more, please visit:** http://www.chipestimate.com/blogs/1PInsider/?p=189
The emergence of smartphones and tablets provides many new possibilities for creating, sharing and consuming data, audio and video content. Improvements in the Wi-Fi chipsets built-into these devices should sustain the high speeds and high quality of service (QoS) required for many of these applications. Recent innovations in technologies such as MIMO and simultaneous dual-band operation provide a large reduction in cost and power consumption. This coupled with Moore’s law enables their integration into tomorrow’s smart phones and tablets. This article describes the challenges facing wireless connectivity in smart phones and tablets, and provides a path forward for high-performance Wi-Fi integration into these devices.

The wireless traffic deluge

More than 50% of Internet traffic in North America is today driven by real-time entertainment services such as Netflix. This contribution is increasing with HD 1080p and 3D streaming catching on. Smartphones and tablets are important consumers of real-time entertainment and future applications would allow wirelessly projecting the same onto HDTVs.

Touchscreen handhelds today come equipped with flash storage up to 64GB. Cloud-based services such as iCloud, Drop-box, Windows live, etc., can use large bandwidths (>100Mbps) to minimize the wait time and to enable seamless data access to the end user. Applications would wirelessly stream high QoS media content present on the smartphone or the tablet onto projectors, TVs and high-definition audio systems.

There are many such scenarios—multi-player gaming, etc.—which require a Wi-Fi broadband connection and would concurrently use a high-bandwidth, high QoS connection from the handheld to a PC, TV or home entertainment system. In the fourth quarter of 2010, the Wi-Fi Alliance started certifying Wi-Fi Direct-enabled, peer-to-peer Wi-Fi devices. Wi-Fi Direct enables easy and secure discovery and setup of connections from smartphones and tablets to TVs, computers, PC-
peripherals, audio devices, etc. This is a key enabler to the applications described above.

802.11 evolution

Over the past decade and a half, 802.11 has evolved with the Internet to provide a 5x throughput increase every three to four years. Wireless innovation and Moore’s law make it possible to achieve this throughput increase at the same cost and power consumption. Table 1 gives a brief overview of the evolution from 11b -> 11g -> 11n -> 11ac. It is important to note the shift in 11n and 11ac to the 5GHz band for supporting high bandwidth and high QoS.

Table 1: Evolution from 11b -> 11g -> 11n -> 11ac

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>RELEASED</th>
<th>TECHNOLOGY DETAILS</th>
<th>FREQ</th>
<th>BANDWIDTH</th>
<th>HIGHEST DATA-RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>802.11 (Legacy)</td>
<td>1997</td>
<td>DSSS 2.4GHz 20MHz</td>
<td>2Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>802.11b</td>
<td>1999</td>
<td>CCK 2.4GHz 20MHz</td>
<td>11Mbps</td>
<td></td>
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<tr>
<td>802.11a</td>
<td>1999</td>
<td>OFDM 5GHz 20MHz</td>
<td>54Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>802.11g</td>
<td>2003</td>
<td>OFDM 2.4GHz 20MHz</td>
<td>54Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>802.11n</td>
<td>2009</td>
<td>OFDM, MIMO 2.4GHz, 5GHz 20MHz, 40MHz</td>
<td>1x1: 150Mbps 2x2: 300Mbps 3x3: 450Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>802.11ac</td>
<td>2012-13 (Expected)</td>
<td>OFDM, MIMO, MU-MIMO 5GHz only</td>
<td>20MHz, 40MHz &amp; 80MHz (Opt)</td>
<td>2x2 (80MHz) : 866Mbps 4x4 (80MHz) : 1733Mbps</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: 40MHz Channels available in ISM bands

The challenge – providing a high-QoS 5GHz information highway

The 2.4GHz ISM band is widely used for all Wi-Fi and Bluetooth wireless communication today. The advent of the smart-grid wireless home-area network and the “Internet-of-things” further chokes the unlicensed 2.4GHz spectrum. There is a “single” non-overlapping 40MHz channel in 2.4GHz, in comparison – the 5GHz band provides 11 non-overlapping 40MHz channels. It is therefore widely agreed that all high-bandwidth and high QoS Wi-Fi communication would need to run in the 5GHz band.

Switchable dual-band Wi-Fi (2.4/5GHz) is increasingly found in high-end smartphones and tablets today. This offers the possibility to establish high-bandwidth and high QoS links in the 5GHz band. But the prevalence of 2.4GHz Wi-Fi networks requires that these handhelds need to also support active links in 2.4GHz. In theory it is possible to support a high QoS, high-bandwidth 5GHz link along with a legacy 2.4GHz link in today’s dual-band handhelds. This would need the device to constantly switch from 2.4GHz band to 5GHz band and vice-versa at millisecond granularity. But in practice, the congested nature of 2.4GHz spectrum delays the packet exchanges and affects the QoS of the high-
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bandwidth 5GHz link implemented using such a switching mechanism.

The solution – simultaneous dual-band

Simultaneous (concurrent) Wi-Fi connectivity in 2.4GHz and 5GHz delinks the 5GHz bandwidth and QoS from the 2.4GHz network congestion and is the ideal solution for the applications described.

In the past few years high-end gaming routers have been available, which implement this feature at the system level by using two copies of “switchable” dual-band chipset. Such an approach addresses the performance requirement for such routers, but is not feasible for implementation in handhelds due to the cost and power-consumption implications.

More-recently “switchable” dual-band MIMO chipsets for tablets and laptops have been announced to meet the cost and power requirement of handhelds but not the performance requirement described above.

The block diagram in Figure 3 shows a novel implementation of a software-configurable, simultaneous dual-band 3x3 802.11n solution.

The above block diagram shows a 3x3 802.11n SoC that can be programmed as a simultaneous dual-band 802.11n solution. This innovative implementation enables simultaneous dual-band 802.11n operation of 2.4GHz and high-QoS 5GHz links with minimal area and power overhead compared to a “switchable” dual-band MIMO solution. The solution can also be software-configured to support a single 3x3 802.11n link (similar to a 3x3 “switchable” dual-band SoC).

It is likely that in the future such approaches will be used with the 5GHz link being able to support higher bandwidths with 802.11ac.

It is also important to also note that 4G smartphones and tablets have a very stringent battery-life requirement. It is not obvious that such high-throughput 802.11n (or 802.11ac) chips are two to five times more energy-efficient than single-antenna or single-band counterparts. Simultaneous dual-band MIMO WLAN solutions for handhelds can save battery life by transferring a given amount of data in much smaller duration. This enables the WLAN radio to enter into a low-power mode and thus save battery life. There are many other advantages of high-throughput MIMO 802.11n such as better throughput and QoS at a given range and support for more bandwidth (and more nodes) in a Wi-Fi hotspot.

Conclusion

The applications and opportunities presented by smartphones and tablets come with tight requirements on wireless throughputs and QoS. Next generation connectivity technologies such as high-performance, single-chip, simultaneous dual-band 802.11n and 802.11ac are needed to unlock the true potential of such applications. Efficient silicon implementations of these technologies would help system vendors satiate the bandwidth hunger caused by real-time entertainment, cloud-based services and peer-to-peer wireless links.

Partha Murali is the product manager and system architect for Redpine Signals MIMO Wireless LAN solutions. He holds an MS in EE from Stanford University, California and has been working on Redpine Signals’ Wireless LAN chips since July 2002. He has filed for 28 US Patents with 10 patents granted to date.
Sometimes referred to as the “network of things,” the machine-to-machine (M2M) market by any name is poised for dramatic growth, and large companies – Intel included – are paying attention. M2M can be viewed as a collection of market segments that includes connected-consumer, e-health, telematics and smart grid applications. What all of these applications have in common are devices that need to be connected – ideally into a core network or the cloud – so that data can flow to be analyzed and used remotely.

M2M wireless Internet boom sees a few challenges

According to the market research firm iSuppli Corp., global revenue from sales of wireless wide-area networking (WWAN) modules for M2M systems will increase nearly sevenfold from 2010 to 2014, from $1.0 billion in 2010 to $6.5 billion by the end of 2014.

“Wireless Internet access for connecting people to each other or for connecting people to machines has exploded over the last decade, driven by the rise of mobile computing and smart phones,” Francis Sideco, principal analyst for wireless research for iSuppli said in a release. “However, a new wireless Internet boom is shaping up in the M2M area. WWAN technologies increasingly are being used in M2M modules to enable new communication capabilities, in the process powering innovations and enhancing the efficiency of key markets like utilities and healthcare.”

iSuppli’s data shows the largest markets today using WWAN M2M modules are wireless gateways and remote monitoring, but healthcare is the fastest-growing vertical; it is projected to consume 16.5 million units by 2014, up 155 percent from 2009. Other sectors include vehicle tracking, automotive infotainment, security, payment and ruggedized computers.

Despite its growth potential, the M2M market needs to address a few key challenges. One problem is the market’s fragmentation. Another is that many of the companies entering the market lack the expertise to integrate communication capabilities into their specific vertical-market applications.

iSuppli believes that the M2M ecosystem can help speed up the learning curve if the industry shifts its focus toward solution-based, system-level collaborations, which contrasts with the current emphasis on individual component sales. At the same time, standards bodies from around the world – and from a wide range of industries – are beginning discussions on how to define M2M and what the implications of varying definitions are for that country or standards body. Ultimately, the hope is that a layer of standardization will help create efficiencies in the market and help address the common concerns around security for these connected devices.

Intel addresses fragmented market with open, modular solution

Robert Hunter, strategic marketing manager for the Intel® Embedded Group, agrees. He’s seeing a wide range of M2M companies that have similar technical capabilities but that are so focused on specific vertical markets that there’s little overlap between them. “That tells me there’s continued fragmentation in the market,” Hunter explains. “If we had a more efficient, more
common way of doing some of these similar mechanisms, we could expect greater empowerment of individuals to innovate because they don’t have to build from scratch. That’s the reason Intel is in there with open, modular, off-the-shelf solutions, because we see what has happened in many other industries.”

Hunter describes Intel’s recent acquisitions as strategic moves that support its M2M activities. Those include the wireless solutions business of Infineon Technologies AG—now called Intel® Mobile Communications—as well as Wind River Systems and McAfee. Along with Intel’s core processing capabilities, “that all combines to create a very compelling package that is connected, managed and secure,” says Hunter.

Currently, as companies realize the opportunities in adding connectivity to stand-alone devices or sensors, they are creating their own solutions, which brings opportunities for innovation but is also expensive. “Intel’s standard playbook is that we look at the market and we try and find a place to encourage platforms from our ecosystem partners that meet the needs of our customers,” explains Hunter.

One such solution is the M2M Smart Services Developer Kit recently announced by Kontron and developed in collaboration with Intel. The kit is a deployable Intel® Atom™ processor-based, services-ready system that uses a standard COM Express™-compatible Kontron computer-on-module and includes a M2M system carrier board and an AV board to support headed configuration use. The kit provides simple ‘plug & play’ capability to help designers develop and test their application’s connectivity and performance, then quickly deploy. It supports 802.11a/b/g/n wireless local-area network(WLAN) and 802.15.4 wireless personal-area network(WPAN) for rapid development of wireless connectivity solutions. 3G WWAN is either pre-installed or easily enabled by dropping in a pre-certified PCI Express 3G/4G module for further broadband connectivity. The Kontron M2M System is preloaded with a 90-day free trial of Wind River Linux 4.1 and includes a Wind River LiveUSB drive that provides the software stacks and drivers to support immediate wireless connectivity testing.

“Designed as a production-ready solution that helps to accelerate smart services deployment opportunities, Kontron is simplifying M2M application development by providing connected computing M2M intelligent devices based on Intel® architecture, as well as the infrastructure building blocks to enable M2M technology data from the point of collection through the cloud to the point of aggregation and decision,” said Dirk Finstel, CTO of Kontron. “The Kontron M2M Smart Services Developer Kit works out-of-the-box, and its extensive capabilities allow the developer to test the smart services application in a connected environment that will be similar to an actual deployment.”

Extensibility a key consideration for M2M designs
While today’s M2M device developers may be considering low-end processors and single-purpose operating systems to meet basic product needs, they may find themselves pushed into extensive redesigns if they don’t look ahead to future requirements. Hunter sees the systems in the M2M space moving from single-device, single-purpose to single-device, multiple-purpose. As the market continues to evolve and as the cost to incorporate connectivity continues to fall, he expects to see more general-purpose operating systems in those devices, managing multiple applications and standard protocols for I/O and security—which may require a more robust compute engine.

There may also be requirements for real-time analytics, especially in supervisory, control and data acquisition(SCADA) applications in which large amounts of data are being collected but may not need to be constantly transmitted. If those types of systems evolve to manage video transmissions, site security or other applications, they’ll require a general-purpose processor and operating system. Hunter anticipates that many M2M devices will quickly evolve as users find new ways to apply them—and the limiting factor could be compute power. “That’s why we see Intel relevant in this space,” says Hunter, “because we have compute cores that start fairly low and go into fairly significant in terms of compute power.”

Cheryl Berglund Coupé is editor of EECatalog.com. Her articles have appeared in EE Times, Electronic Business, Microsoft Embedded Review, and Windows Developer’s Journal. She has developed presentations for the Embedded Systems Conference and ICSPAT. Berglund Coupé has held a variety of production, technical marketing, and writing positions within technology companies and agencies in the Northwest.
A recent innovation in computer-on-module (COM) technology has been the introduction of the ultra-compact Qseven form factor. Measuring only 70mm x 70mm, it uses an MXM system connector with a standardized pin-out regardless of vendor. (See Figure 1.)

The Qseven form factor was defined as an open standard, primarily aimed at ultra-low-power applications. Open standards allow any company to build, market and sell their own Qseven products to end customers; it’s fundamental to any product that will be used by the industry. Open standards ensure that customers have a second-source supplier, which is one of the key goals of the COM concept.

Just like COM Express, ETX and XTX, Qseven provides a scalable platform with a range of processor options, as well as customizable BIOS with custom flat-panel support within the BIOS.

The best of both worlds

Compared to the PC/104 form factor, which measures 90mm x 96mm, the Qseven module is a complete PC-on-module in a much more compact format. However, an ideal scenario might be to have PC/104 support for Qseven technology by way of a PC/104 custom carrier board. (See Figure 2.) This would provide all of the COM benefits to PC/104 designers, providing scalable products using a wide range of Intel® Atom™ processors on the same carrier design with customizable BIOS. The defined open-standards Qseven pin-out specification would allow PC/104 vendors to offer products from different Qseven suppliers with the same carrier design.

Recently a new Qseven PC/104 carrier card has become available that meets the specifications and price points of PCI/104-Express. (See Figure 3.) This makes Qseven COM technology accessible to many PC/104 form-factor system developers, providing all the benefits of COMs. There are a wide range of Qseven modules available with older Intel Atom processors through to the latest Intel® Atom™ processor.
E6xx series. With Intel’s guaranteed support for the processor range of typically seven years from processor launch, this provides real choice to system builders and allows long-term product management for existing and future PC/104 projects. Additionally, new ranges of processor shall be made available that will be pin-compatible with Qseven specifications, allowing much easier mid-life equipment updates.

The latest Intel Atom processor E6xx will be available shortly in extended temperature ranges, featuring -40 degrees C to +85 degrees C operating temperatures for truly embedded applications.

COM technology has been shown to improve time to market for new and existing designs, at the same time reducing complexity of design for the system builder as the Qseven supplier takes ownership of the complexities of the Qseven module design. System designers have the choice to make their products scalable by using different COM product options, directly based on power, performance and cost. COM is pin-compatible, reducing legacy nightmares of the past and allowing smoother mid-life updates. With adoption of the new and open Qseven standard starting to build up very quickly, new product developments will be guaranteed near legacy-free upgrades for the future.

**Technical details of the integration**

COM products are nearly always used in custom designs, so a system designer producing many thousands of units would typically require a custom carrier balanced to the system requirements while keeping a keen eye on product costs. The custom part of the COM design is the COM carrier card, the cost of which is affected by component or connector counts; a simple carrier design for product equipment may only require a serial, Ethernet and video connector. All projects have their own custom requirements; however a base carrier design may be used to define other custom variants, which may reduce the cost of production for each custom design.

Designers of PC/104 systems need to determine if their project is a custom project before taking the next steps in the system design using COM. If the project does not require custom design, it’s normally better to use a standard PC/104 off-the-shelf product.

The Qseven standard defines mechanical and form factor information only; the specification may be downloaded from http://www.qseven-standard.org. The Qseven standard does not cover software requirements of the Qseven architecture, as this would be outside the confines of the standard. Software is a custom option, chosen by customers for their platforms and would use specific operating systems with associated devices drivers or board support packages. However, it’s important from a system maintenance and company-wide product viewpoint to select a Qseven solution that has common driver, BIOS and utilities across all COM architectures to ensure that maintenance of the system products becomes consistent across all form factors.

The Qseven standard has been specifically developed to utilize the latest low-power-consuming technology and to meet the demand for small form factors. It has a typical power consumption of less than five watts, is barely larger than a credit card, has integrated functions for battery and ACPI 3.0 power management and features real-time watchdog support. With these specifications, the Qseven modules are optimized to enable all mobile applications.
The Intel® Atom™ processor E6xx series-based Qseven modules feature fast serial differential interfaces such as USB, PCI Express and Serial ATA. In total, it supports 6x USB 2.0, 2x SATA, 1x SDIO, 3x PCIe, LPC bus, I²C bus, Gigabit Ethernet, high-definition audio, SPI and CAN bus interfaces. The CAN bus and SPI interfaces are new additions to the Qseven standard and utilize previously unused pins. (See Figure 4.)

Controller Area Network (CAN) is a 1Mbps technology on differential twisted pair cabling with termination at both ends. CAN is now used extensively on commercial, industrial and even military applications, as the technology is cheap when compared to similar technologies such as MIL STD 1553. MIL STD 1553 is much more expensive, but is deterministic, while CAN technology as it stands is not deterministic. However, MIL CAN appears to have resolved these determinism issues.

The most significant advancement of the Intel Atom processor E6xx series is that the graphics, high-definition audio, memory controller, SM Bus interface and PCI Express interfaces are inside the processor. This is significant from a software processing capability, as random access memory (RAM) access by software is directly from the processor, which will increase processing performance, even on ultra-low-power processors. Another significant improvement in the processor I/O hub architecture is the massive increase in bandwidth between the processor and Intel® Platform Controller Hub EG20T by using a PCI Express interface.

In short, from a software-engineering and system-response aspect, this new Intel processor has broken some of the more traditional bottlenecks, such as the typical 400/800MHz front-side bus interface from processor to input output devices such as USB, SATA and Ethernet. PCI Express bandwidth greatly optimises software throughput within the system.

In summary, PC/104 system providers that adopt the Qseven COM technology approach will benefit from a range of fully scalable products, much faster time to market, the latest Intel® technology ahead of the competition and lower costs on larger projects. This importantly increases margins in real terms and maintainability of systems in the field becomes far less complicated.

Fischer earned a Dipl.Ing (FH) degree from the University of Applied Sciences in Munich, Germany. He has more than 13 years of experience in hardware design, EMC, avionics engineering and graphics, and has previously held positions with ATI Professional Graphics in Germany, as well as IndustrieHanda Consulting and Engineering.
The Hottest Technology: Touch
What is needed to drive today’s robust touchscreens, including large sizes?

By Binay Bajaj, Atmel Corporation

The explosion of touchscreens started merely four years back, in 2007. Touchscreen technology has been around for nearly 20 years but it never made it to the masses. So why is it just now that it is hitting mainstream and being adopted by all walks of life? The answer is easy. Touchscreen technologies with multi-touch gestures, flicking and light touches are being developed to be more intuitive, easy-to-use, intelligent interfaces to the everyday user, whether they are 3 or 90 years old. Apple® definitely helped this mainstream adoption with the launch of the (fourth-generation) iPod® in 2004, the iPhone® in 2007 and the iPad in 2010.

To understand the success of these devices, one must understand the basics of touchscreen technologies and features device manufacturers look for in order to make a phone that is truly intuitive to the user. Let’s explore the basics required to make a touchscreen successful.

The basics

Large or small, the success of any touchscreen device is a function of the technology choices made in designing it, the most important being projected-capacitance technology, sensor design and driver chip.

Projected-capacitance technology

Today’s devices overwhelmingly use capacitive touchscreens, which operate by measuring small changes in capacitance—the ability to hold an electrical charge—when an object (such as a finger) approaches or touches the surface of the screen. However, all capacitive touchscreens are not created equal. Choices in the capacitive-to-digital conversion (CDC) technique and the spatial arrangement of the electrodes that collect the charge determine the overall performance and functionality the device can achieve.

Device manufacturers have two basic options for arranging and measuring capacitance changes in a touchscreen: self-capacitance and mutual-capacitance. Most early capacitive touchscreens relied on self-capacitance, which measures an entire row or column of electrodes for capacitive change. This approach is fine for one-touch or simple two-touch interactions. But it presents serious limitations for more advanced applications, because it introduces positional ambiguity when the user touches down in two places. Effectively, the system detects touches at two (x) coordinates and two (y) coordinates, but has no way to know which (x) goes with which (y). This leads to “ghost” positions when interpreting the touch points, reducing accuracy and performance.

Alternatively, mutual-capacitance touchscreens use transmit and receive electrodes arranged as an orthogonal matrix, allowing them to measure the point where a row and column of electrodes intersect. In this way, they detect each touch as a specific pair of (x,y) coordinates. For example, a mutual-capacitance system will detect two touches as (x1,y3) and (x2,y0), whereas a self-capacitance system will detect simply (x1,x2,y0,y3). (See Figure 1.)

The underlying CDC technique also affects performance. The receive lines are held at zero potential during the charge-acquisition process, and only the charge between the specific transmitter X and receiver Y electrodes touched by the user is transferred. Other techniques are available, but the key advantage of the CDC is its immunity to the noise and parasitic effects. This immunity allows for additional system design flexibility; for example the sensor IC can be placed either on the FPC immediately adjacent to the sensor or farther away on the main circuit board.

Sensor design

Electrode pitch, a key parameter in sensor design, refers to the density of electrodes—or more specifically, (x,y) “nodes”—on the touchscreen, and to a large extent determines the touchscreen resolution, accuracy and finger separation. Naturally, different applications have different resolution requirements. But today’s multi-touch applications, which need to interpret fine-scale touch movements such as stretching and pinching fingertips, require high resolutions to uniquely identify several adjacent touches.

Typically, touchscreens need a row and column electrode pitch of approximately five millimeters or less (derived from measuring the tip-to-tip distance between the thumb and forefinger when pinched together). This allows the device to properly track fingertip movements, support stylus input and, with proper firmware algorithms, reject unintended touches. When the electrode pitch is between three to five millimeters, the touchscreen becomes capable of supporting input with a stylus that has a finer tip—a boost in accuracy that will allow the device to support a broader range of applications.

Touchscreen driver chip

At the core of any successful touch-sensor system is the underlying chip and software technology. As with any other chip design, the touchscreen driver chip should have high...
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introduction, minimal footprint and close to zero power consumption along with the flexibility to support a broad range of sensor designs and implementation scenarios. Any driver chip will be measured by the balance of speed, power and flexibility it achieves.

Supersizing the touchscreen

The considerations described above apply to any size touchscreen device. But what are the specific considerations for moving to large-format devices? Manufacturers will find that the key requirements for modern touchscreen technologies—multi-touch support, performance, flexibility and efficiency—become even more critical when users adopt larger screens and the more complex touch applications they enable.

Delivering true multi-touch

Users of the Apple iPhone and other contemporary devices will be familiar with today’s multi-touch gestures; typically pinching or stretching of two fingers. With a larger screen, however, it becomes possible to envision much more complex multi-touch gestures. Imagine painting and music applications for young students, for example, that involve gesturing with all 10 fingers and thumbs. Or new tablet-based games that pit two or more users against each other on the same screen. However large-format touch computing evolves, application developers will want the flexibility to take full advantage of new kinds of touchscreen interactions. Device manufacturers don’t want to stand in their way—and certainly don’t want to build a device that can’t support the next hugely popular touch application.

As large-format touch applications begin using four, five and 10 touches, it’s important to consider not just how new applications might exploit these capabilities, but also how the controller chip will use this richer information to create a better user experience. For example, the ability to track incidental touches around the edge of a screen and classify them as “suppressed” is even more important on a large-format device than on a small one.

Just as a mobile phone’s touchscreen needs to be able to recognize when a user is holding the phone or resting the screen against her cheek, so a larger-format system must account for the different ways that users will hold and use the device—for example, resting the edge of the hand on the screen when using a stylus, or resting both palms when using

Figure 1. Self-Capacitance versus Mutual Capacitance

<table>
<thead>
<tr>
<th>SELF CAPACITANCE</th>
<th>MUTUAL CAPACITANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4 + 4 = 8 Sensors</strong></td>
<td></td>
</tr>
<tr>
<td>- Each X and Y line is pulsed/sensed in turn</td>
<td></td>
</tr>
<tr>
<td>- Two fingers on one line gives the same result as one finger</td>
<td></td>
</tr>
<tr>
<td>- There is ambiguity of touch point “ghost” positions</td>
<td></td>
</tr>
<tr>
<td>- Some level of correction possible in software</td>
<td></td>
</tr>
<tr>
<td><strong>4 * 4 = 16 Sensors</strong></td>
<td></td>
</tr>
<tr>
<td>- Each X line is pulsed in turn</td>
<td></td>
</tr>
<tr>
<td>- Y lines are scanned for a change in capacitance</td>
<td></td>
</tr>
<tr>
<td>- Each ‘node’ (XY intersection) on the screen is individually addressed</td>
<td></td>
</tr>
<tr>
<td>- All touch points on the screen are unambiguously sensed</td>
<td></td>
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</tbody>
</table>
a virtual keyboard. And it’s not enough to simply identify and suppress incidental touches; the device must track them so that they remain suppressed even if they stray into the active region. The more touches that a controller can unambiguously resolve, classify and track at once, the more intuitive and accurate the user experience can be.

Achieving high performance

Touchscreen performance is a function of six basic factors:

- **Accuracy** means the fidelity with which the touchscreen reports the user’s finger or stylus location on the touchscreen. An accurate touchscreen should report touch position better than +/- 1 millimeter.
- **Linearity** measures how “straight” a line drawn across the screen is. Linearity depends on sound screen-pattern design, and should also be accurate within +/- 1 millimeter.
- **Finger separation** describes how closely the user can bring two fingers together before the device recognizes them as a single touch.
- **Response time** measures how long it takes the device to register a touch and respond. For basic touch gestures such as tapping, the device should register the input and provide feedback to the user in less than 100 milliseconds. Factoring in various system latencies, that typically means that touchscreens need to report a first qualified touch position in less than 15 milliseconds. Applications such as handwriting recognition require even faster response.
- **Resolution** is the smallest detectable amount of finger or stylus motion. It is important to reduce the resolution to the fraction-of-a-millimeter level for a number of reasons: chief among them being the enabling of the stylus-based handwriting and drawing applications.
- **Signal-to-noise (SNR) ratio** refers to the touchscreen’s ability to discriminate between the capacitive signal arising from real touches and the capacitive signal arising from accidental noise. Capacitive-touchscreen controllers measure very small changes in the row-to-column coupling capacitance, and the way those measurements are performed has a strong influence on the controller’s susceptibility to external noise. Large-format touchscreens are especially challenging in this regard, as one of the most significant noise generators is the LCD itself.

As touchscreens get larger and support more simultaneous touches—and more complex interactive content—achieving top performance in all of these categories becomes even more important.

**Touchscreen flexibility**

Most of today’s small touchscreens are designed to support a specific device, and often, specific software and applications. Emerging large-format touchscreens, however, will need to be much more versatile. For example, a tablet device is a natural fit for handwritten input using a stylus. But to support that, the touchscreen needs a higher resolution than one intended for fingertip gestures on a five-inch screen.

The majority of the mobile handset and tablet devices have been shipping with Android™ operating systems (OS). However as Microsoft® comes closer to delivering Windows® 8 (Win8) OS, Windows Hardware Quality Labs (WHQL) certification will be required. As Win8 OS become available, users will have more choices on the OS they select for their tablet devices. The big application processor hardware vendors who play in this space currently include NVIDIA®, Qualcomm®, Intel®, Texas Instruments®, etc. Other applications for the Atmel® large-screen solution is the e-reader application and the players such as the Kindle from Amazon, Nook from Barnes and Noble and Noble and Novel e-reader from Pandigital.
Motherboards Move from ‘Compromise’ to ‘Perfect’

Creating a customized board for your OEM needs can be as easy as ordering a standard motherboard from a supplier’s catalog

By Rod Anliker, Nigel Forrester, and Shlomo Pri-Tal, Embedded Computing, Emerson Network Power

In the hunt for an embedded motherboard, the commercial off-the-shelf (COTS) market can often provide a fit that is good enough. However, it is rarely a perfect fit. Certain classes of design requirement are not well served by these standard boards. These designs fall into four categories:

- **Outliers**: design projects with uncommon requirements. The limited demand means it’s not economical for embedded board manufacturers to make a standard product.
- **Long-lived platform products**: it is difficult to maintain uniformity of board specifications over time and over multiple product variants when sourcing from board manufacturers’ COTS products, since the specifications of these COTS offerings changes frequently to keep pace with changes in technology and customer demand.
- **Volume products**: customized designs can often yield lower product costs over the life of the product by precisely matching required features with market requirements.
- **Differentiated products**: choosing a COTS motherboard design that is also readily available to your competition inevitably leads to cost pressures and a greater challenge to add additional value in your design.

Unfortunately, the alternative – commissioning a unique, custom board – has in the past been commercially unattractive for many projects. Customization services have been slow, inflexible, burdened with complex legal provisions and, above all, expensive. (See Figure 1) Original equipment manufacturers (OEMs) have learned to work around the potentially large number of design compromises that go along with accepting a COTS motherboard with a good enough fit.

What OEMs really need, however, is a way to create truly optimized board designs when no COTS board is suitable. Now Emerson Network Power has introduced a rapid board customization service that allows OEMs to specify processor, I/O, connector and other options within a standard or custom board form factor. Called the RapiDex™ service, this capability is available for boards using Intel® embedded processors (see Figure 2).

Unlike the usual, custom board procedure, this service is fast and straightforward for the customer to use: no special contracts, no statements of work and no project supervision are required. And unlike conventional customization...
engagements, the customer need make no commitment on production volume numbers, and the minimum first order quantity is merely 100 units.

The service is also attractively priced to offer a low cost path to designing a differentiated product versus a COTS design that offers no competitive advantage: the customer pays a flat production setup fee, no non-recurring engineering (NRE) fees, and unit costs per board shipped are comparable to the price of a standard COTS embedded motherboard.

This new service is the result of innovative developments in design and manufacturing automation pioneered by our company (see Figure 3), and it brings the advantages of board customization to a far wider range of embedded OEMs than could previously benefit from it.

Technology developed by our company has enabled the service to be automated at every point, eliminating the delay, cost, and risk of error or inconsistency associated with human involvement in processes.

Crucial to the implementation of this chain of processes is a modular implementation of board functions; the design rules developed by our company enable these functions to be integrated, using advanced design software, into tens of thousands of configurations of processors, I/Os, peripherals and connectors.

Together, this combination of technology and process innovations enables a capability that is faster, more responsive, scalable and more cost effective than any other board customization service.

By choosing our customization service, OEMs gain:

**Optimized design**

Using an embedded Intel® processor, you can specify a choice of I/O configurations, memory specifications and peripheral capabilities (such as wireless communications) in any rectangular form factor. We will design and produce a planar board to your specification with a performance and cost-optimized, as well as competitively differentiated, board layout.

**Fast turnaround**

The innovative design of our customization process has also produced an accelerated delivery schedule: after defining the board specification from a menu of options, the unit price quotation is delivered to the customer within two working days. From the date on which the customer places its order, we can produce first article boards (1-12 units) within four to eight weeks. Volume orders (minimum order quantity: 100 units) follow industry-standard turnaround times, with forecasted orders fulfilled within eight weeks or less of order date.

**Low costs**

Customers of this service pay no NRE fees. A flat production setup fee plus unit costs pays for the first sample boards (1-12 units). In volume production, the customer simply pays the unit price as quoted at the start of the customer engagement. Unit prices are very competitive, and are comparable with the prices of equivalent standard COTS products.

**Straightforward terms**

Since the customer does not pay NRE charges as a part of this design service, it is not required to negotiate the complex legal provisions that normally occur in custom board engagements. Using our customization service is a simple two-step process:

1. **Step 1:** The customer issues a purchase order for the service, based on the customer’s choice from a menu of processor, memory, I/O and peripheral options, at a flat cost which includes the price of the first agreed number of boards.
2. **Step 2:** If the customer decides to pursue a production run (minimum order quantity: 100 units), they simply issue a purchase order. There is no need for a complex contract, a statement of work, provision for penalties or clawback.

What a service like ours offers the OEM:

- Lower materials costs
- Improved form factor – a planar design that eliminates the high-profile daughter cards
- Improved reliability – the use of surface mount technology (SMT) components eliminates the vulnerable connectors to plug-in daughter cards
- Improved supply chain – the complete solution is now available from a single vendor

**Benefits for platform products**

OEMs developing a long life cycle common computing platform for multiple products can use our service to define the requirements for the platform, specifying common features (connectors, I/O, peripherals) and dropping in processor variants to a common board design. Upgrading to an enhanced processor can be accommodated within the board design, with the ability to maintain uniformity of outline and profile across all future variants.

Figure 3: The specially designed RapiDex production lines enable OEMs to enjoy great flexibility and affordability in their choice of customized boards.
arrangements in case production volumes fall short of expectations.

The two steps are not legally coupled: a customer who takes shipment of the first boards has no obligation to order production volumes. The first boards are full production quality, not prototypes or samples.

**Which projects can benefit from using a truly designed for the user customization process such as our RapiDex service?**

A design team should ask the following three questions:

- Will the design functionality or competitiveness be significantly compromised by the selection of a standard COTS embedded motherboard?
- Could these design constraints be eliminated with an optimal selection of memory, I/O, peripheral and connector specifications? Or by specifying a custom form factor?
- Is the design based on a current embedded Intel® processor, such as the Intel® Atom™ processor or another processor that Emerson Network Power supports?

If the answer to all three questions is 'Yes', then consider a motherboard sourced through a OEM-friendly process like the RapiDex service.

**How to specify an optimized embedded motherboard through our service**

The process of engaging with our service for the supply of an optimized embedded motherboard has been designed for speed and simplicity (see Figure 4).

**Within two business days**, you will receive a comprehensive quotation package. As well as stating the guaranteed unit price for your required production volume, the package includes a datasheet, a user manual and a 3D rendering of the proposed board configuration. This quotation package confirms the specifications of the board that we will manufacture.

**Within four to eight weeks** of receiving your purchase order, our service will ship first article boards (1-12 units) to you. These boards are produced according to the specific specifications identified in the quotation package.

**Within another eight weeks** of receiving a forecasted volume order, we will begin production shipments. (Volume orders follow our company’s standard turnaround time.)

To meet OEM expectations, the process of any customization process should be simple and fast. As you can see, our procedures are similar to the process of ordering a standard embedded motherboard from a supplier’s catalog.

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As chief technology & strategy officer for the Embedded Computing business of Emerson Network Power, Shlomo Pri-Tal translates the voice of the market into long term technology and product requirements.

Rod Anliker is the director of services marketing with a primary focus on developing value-added offerings centered on customer needs.

Nigel Forrester is a market development manager with a primary focus on industrial and automation markets, including retail, digital signage, energy and test equipment applications.
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Small-Form-Factor Platforms Propel Evolution of Tablet Applications

Intel® Atom™ processor-based designs have become an application-enabling force for mobile and tablet devices

By Christine Van De Graaf, Kontron

There was a definite opportunity for new small-form-factor platforms based on the low-power Intel® Atom™ microarchitecture. In order to match embedded market requirements, these small form factors needed to deliver high performance that could withstand harsh operational demands. They also had to provide the low-power envelope considered necessary to support a broad range of power supplies and batteries. Market need coupled with available advanced technology has spawned the development of new, ultra-small and efficient computer-on-modules (COMs).

One of the primary evolutionary factors in compact/ultra-small platform development is the availability of the Intel Atom processor. It is rooted in an advanced hafnium-based, 45-nm microarchitecture, which is comparable in processing power to the Intel® Pentium® M and Intel® Celeron® M processors. Due to its compact design and energy-efficient technology, the power dissipation of the 1.66-GHz, second-generation Intel Atom processor totals between 8 and 18 W. Compared to other ultra-low-voltage processors that offer similar central-processing-unit (CPU) performance its physical dimensions are significantly smaller and require a fraction of the power dissipation.

The use of computer-on-modules in the compact COM Express™ Type 2-compatible form factor has become an optimal method to integrate a core solution for interface-rich, ultra-low-power, semi-custom designs. It also provides developers with the highest design security and long-term availability. A new ultra COM form factor is being considered, which is compatible with the COM Express’ pinout Type 1 and Type 10 with respect to pin definition and connector location (see Figure 1). Several embedded-computing suppliers are supporting the new 55-x-84-mm COM. Both platforms are optimal building blocks to achieve maximum power savings in applications that require mid- to high-performance x86 technology.

These specifications very much define the requirements for today’s small tablet-based applications. The primary difference between the compact and ultra modules and the original COM Express module is the overall physical size and the performance envelope supported by each. Both modules have the same pin-out at the same position as all of the other COM Express Basic modules. In addition, they follow all of the PICMG guidelines.

![Figure 1: This table highlights the evolution from Type 1 to Type 10 pinouts, which have been developed to address the needs of next-generation compact processors.](image)

**Connectors count**

A number of ultra-small embedded modules based on the Intel® Atom™ microarchitecture have entered the market. While all of them boast small size, they aren't created equal in terms of performance, ruggedness, and scalability. For tablet application designers, it’s key to remember that only those COMs that are compatible with standardized COM Express pinout Type 1 through 10 connectors can offer the highest level of cost, performance, and scalability benefits—along with improved shock and vibration resistance.

These rugged and space-saving PICMG COM Express standard pinout types are used by both the compact and proposed ultra COM Express form factors. The COM Express specification offers significant advantages compared to other connector standards. For example, the Type 1 pinout creates less signal damping than a card-edge connector, thus enabling longer trace...
lengths on the motherboard. Interface support is another plus. Type 2 adds a second connector and supports the 32-bit PCI interface plus IDE ports needed for legacy PATA devices and CompactFlash memory cards. There are also more PCI Express lanes available that support PCI Express Graphics (PEG) with the Type 2 pinout. Type 10 addresses the requirements of newer and extremely compact processors, providing support for serial ports and the latest display interfaces.

Significant for the mobility requirements of tablet-based designs, COM Express connectors also are more mechanically robust and offer increased impact and vibration resistance. It may be difficult to meet the higher ruggedization requirements for tablet applications with other types of connectors. There are also considerable advantages regarding electromagnetic compatibility (EMC). This is particularly important for second-generation PCIe interfaces. Here, the clock rate and frequency are doubled, increasing the interference level.

**Tablet Applications Win**

The number of fist-held or tablet applications that can take advantage of new compact and ultra-small modules is sizeable. Designers now have an ideal, compact, and energy-saving COM platform to develop ultra-mobile applications that require energy-saving x86 processor performance, high-end graphics, PCI Express, and Serial ATA combined with longer battery life.

Tablet-based applications are being developed for varied and diverse markets. Tablets are useful solutions for portable measurement and test devices, medical devices, decentralized industrial-control systems, vehicle-diagnostic devices, gaming machines, point-of-sale and point-of-information systems, and telecommunication and transportation systems. Healthcare is one of the fastest-growing markets for mobile tablet solutions. Medical professionals are already using handheld tablet devices to access and manage patient information.

Intel Atom processor-based small form factors, such as the nanoETXexpress and microETXexpress, are serving as a catalyst for the evolution of tablet applications in the healthcare sector based on size and their compatibility with electronic medical records (EMRs). Smaller-form-factor, tablet-based systems are simply easier to use for hospital rounds or during patient appointments. In addition, they give physicians and other healthcare professionals a streamlined approach for EMR documentation.

Future generations of smaller and more highly integrated Intel® processors and chipsets will help drive smaller-form-factor platforms. Such platforms may be an application-enabling force for mobile and tablet devices. Facilitating emerging tablet applications that weren't previously possible due to size or power-consumption restrictions, for example, the microETXexpress-PV is pinout Type 2-compatible. It incorporates the new second-generation Intel® Atom™ processor D510, which delivers 2 x 1.66-GHz performance (see Figure 2). With its highly integrated two-chip design, dual-core option, and cost-efficient processors, microETXexpress-PV modules vow to accelerate the development of ultra-low-power embedded applications.

For more space-constrained designs, COMs like the credit-card-sized (55 x 84 mm) nanoETXexpress-TT feature an Intel® Atom™ processor E6xx. The nanoETXexpress-TT is designed with industrial-grade components that are fully functional even at the extended temperature range (E2) from -40° to +85°C. This ultra-small COM takes full advantage of the COM Express type 10 pinout. Its on-board memory, micro-SD card socket, or optional SATA Flash memory make this COM platform ideal for harsh-environment tablet designs.

**Figure 2:** This COM enables designers to implement cost-effective, low-power, and multicore processing in dedicated 2-in-1 hardware-consolidated systems.

Christine Van De Graaf is the product manager for Kontron America’s Embedded Modules Division located in Northern California’s Silicon Valley. Christine has going on a decade of experience working in the embedded computing technology industry and holds an MBA in marketing management from California State University, East Bay, Hayward, CA.
ADLD25PC - 1.80GHz PCI/104-Express Single Board Computer with Dual Core Intel® Atom™ D525


The Intel® Atom™ processor D525 integrates the graphics and memory controller functions of a traditional GMCH. The processor is interfaced to the Intel® I/O Controller Hub 9M-E and provides the PCI/104-Express I/O bandwidth necessary to enable performance-based rugged, portable and thermally constrained applications.

Features
- Dual Core Intel Atom Processor D525, 1.80GHz
- Up to 4GB DDR3-800 DRAM SoDIMM204
- Type 2 Bottom-Stacking PCI/104 Express – 4 x1 Lanes
- 2x SATA 300 Ports, 8x USB2.0 Ports
- 1x 10/100/1000Mbit Ethernet LAN Port
- 4x COM Ports - 2x RS232 Ports, 2x RS232/422/485 Ports
- Operating Range -25°C to +70°C (-40°C to +85°C available - call sales for details)
- Optional PCIe Mini Socket for Wireless Applications & On-board Flash
- Serving the PC/104 Industry for over 15 Years!

Application Areas
Rugged Portable Applications such as Transceivers for Tactical Communication, GIS Mapping, Night Vision, Railway and other applications that often use Battery-Type Power Sources.
3U & 6U VITA 46 VPX & VITA 65 OpenVPX Processor Boards

The 6U iVPX7220 and 3U iVPX7223 VITA 46 VPX & VITA 65 OpenVPX™ processor boards from Emerson Network Power features the dual-core and quad-core 2nd generation Intel® Core™ i7 processor @ 2.20 GHz, with integrated graphics and memory controller and the Mobile Intel® QM67 Express chipset with leading edge I/O functionality. This high compute density platform offers both high speed fabric connectivity with PCI Express and Gigabit Ethernet control plane connectivity with data transfer rates up to 5Gbps.

On-board memory includes up to 16GB DDR3-1333 memory, embedded USB flash and 256KB non-volatile F-RAM. Additional connectivity includes a variety of USB 2.0, serial and SATA ports, GPIO, DisplayPort, VGA and XMC sites for maximum flexibility. An optional 2.5” SATA SSD is also available on the 6U iVPX7220.

The boards are fully rugged for extreme environments with extended shock, vibration, temperatures and conduction cooling. They are designed for a range of industrial, communication and military/aerospace applications. Software support includes Solid and Stable BIOS with password protection and a wide range of operating systems.

Features:
- 2.20 GHz dual- or quad-core, 2nd generation integrated Intel® Core™ i7 processor & Mobile Intel® QM67 Express chipset
- Up to 8GB (3U) or 16GB (6U) ECC-protected DDR3-1333 soldered
- VITA 48 REDI two-level maintenance (2LM)
- Extended temperature -40 C to +85 C and rugged variants
- Air and conduction cooled

CPCI7203 Air- and Conduction-Cooled 3U Processor Board

The CPCI7203 3U SBC from Emerson Network Power features the integrated dual-core Intel® Core™ i7 processor for use in high performance, space-constrained applications. This leading edge thermal and rugged solution makes the CPCI7203 ideal for harsh environments. On-board memory includes up to 8GB DDR3 and 256KB non-volatile F-RAM and 4GB MicroSD flash.

Connectivity is optimized for maximum throughput and flexibility. The air-cooled variants have two Gigabit Ethernet ports, two USB 2.0 ports, and one VGA on the front panel. Rear IO includes one serial port, two SATA ports and four PCI interfaces to the rear. Conduction-cooled variants also provide rear VGA. The Trusted Platform Module (TPM) enhances data security and encryption capabilities.

The CPCI7203 is a low-power, high-performance SBC that offers full hot swap compliance per PICMG® 2.1 and supports the PICMG 2.9 System Management specification and PICMG 2.30 CompactPCI PlusIO specification. It also supports a range of operating system and software options.

It is ideal for a wide range of industrial, medical and military/aerospace applications, such as railway control, factory automation, semiconductor processing, robotics, image processing, vetronics, VoIP and first responder.

Features:
- Integrated dual-core Intel® Core™ i7 processor (up to 2 GHz)
- Up to 8GB ECC-protected DDR3-800/1066 (soldered)
- 256KB non-volatile F-RAM
- Mobile Intel® 5 Series chipset: Ibex Peak-M PCH
- One VGA, two USB 2.0 & on-board Gigabit Ethernet interfaces
- 4GB MicroSD
- Air- and conduction-cooled
- Extended temperature range (-40 °C to +85 °C)
- Optional rear transition module
Embedded Computers

The Emerson Network Power Embedded Computers are based around x86 Intel® architecture embedded motherboards with processor and memory, plus a disk. These are integrated into an application-specific enclosure that is designed for long-life applications with very little or no maintenance. Typical uses include medical clinical instruments, digital security and surveillance, industrial control and digital signage.

Emerson is offering two classes of Embedded Computers that are ideal for digital signage applications:

- Fanless, small, metal solutions that are designed to be mounted to a screen or instrument. These are noiseless, maintenance-free embedded computers that are available to suit a variety of operating temperature environments. They are easy to use and offer capability to fit a wireless module.
- Small, low cost embedded computers with some expansion capability. These are typically supplied in a plastic enclosure with mounting options, operate in an environment of 0 °C to 35 °C and are air cooled.

The KR8-315 is a fully integrated embedded computer. Enclosed in a custom, fanless case, the KR8-315 features the Intel® Atom™ processor E640 running at 1.0 GHz. Two versions are available – a standard temperature and an extended temperature version. The extended temperature version utilizes a solid state drive eliminating all moving parts.

The MCASE series consists of a Mini-ITX plastic enclosure and features the 2nd gen Intel® Core™ processor family. MCASE is a fully configured, application-ready platform ready to be powered up and loaded with applications.

MITX-CORE-800 Mini-ITX Motherboard

The MITX-CORE-800 series of Mini-ITX motherboards is designed for intelligent kiosk, digital signage, medical cart and slot machine applications and offer a flexible mix of features and expansion options. Featuring the 2nd generation Intel® Core™ processor family, the MITX-CORE-800 will have better power and performance for both general and graphics processing and will be fully Intel® vPro™ technology-certified. The MITX-CORE-800 series is designed with future Intel® Core™ processors in mind to allow a seamless performance and display upgrade path to customers.

The MITX-CORE-800 series features a standard latching 12 Vdc power input connector for ease of use and low cost integration by OEMs. It also presents the user with a PICMG® standard Extended Application Programming Interface (EAPI) to simplify the control of essential hardware functionality such as the backlight inverter and the watchdog timer. Emerson Network Power has also simplified the way in which developers can customize and configure the motherboard’s BIOS to speed integration and accelerate time-to-revenue.

Features:

- Single PGA socket for 2nd generation Intel® Core™ processor family
- Up to 8GB memory with two DDR3 SO-DIMM sockets
- Dual display capability from multiple physical display connections
- PCI Express (PCIe) expansion via PCIe slot and PCIe Mini Cards
NITX-300 Series Ultra Low Power Nano-ITX Motherboards

The NITX-300 series of Nano-ITX motherboards from Emerson Network Power feature the Intel® Atom™ processor E6xx series. These ultra low power motherboard solutions offer passive cooling capability for reliable operation. They are designed for use in a variety of applications such as embedded instruments, medical carts, audio visual display systems, and other applications that require an easy-to-use Nano-ITX motherboard with support for a variety of operating systems.

With a size format of 120 mm x 120 mm, Nano-ITX form factor motherboards are very suitable for low power embedded applications. The NITX-300 series has a low height profile to fit into most enclosures and has a wide range of built-in connectivity including LCD and/or CRT displays; SATA for physical or solid state disks; a PCI Express x1 expansion slot and a PCI Express Mini Card slot for Wi-Fi/WiMAX; USB and Gigabit Ethernet networks; audio; and multiple serial ports.

Features
- <7 Watts typical power consumption
- Ideal for low power embedded applications
- Up to 1.0 GHz Intel® Atom™ processor E6xx series
- Up to 1GB DDR2 memory, soldered on board
- Gigabit Ethernet, SATA and USB
- PCI Express x1 and PCI Express Mini Card slot
- Dual display support
- Four serial ports

RapiDex™ Board Customization Service

The RapiDex™ board customization service from Emerson Network Power enables cost-effective embedded solutions by tailoring motherboard design to match your requirements. Emerson’s unique design and manufacturing technology delivers quick turns with minimal setup fees. First boards are delivered within eight (8) weeks of the order. Any following production order has a volume commitment of only 100 pieces, with unit costs comparable to standard products.

Emerson’s rapid customization capability can remove the need to use a less optimized standard product, leading to improved cost, space and power profiles.

As one of the most respected vendors in the embedded board space, Emerson is a Premier member of the Intel® Embedded Alliance and collaborates closely with Intel to enable customers to bring products to market quickly.

Emerson’s RapiDex service is based on select embedded Intel® processors and chipsets, with custom boards available within a few weeks of silicon launch. The first supported platform is the Intel® Atom™ processor E6xx series coupled with the Intel® Platform Controller Hub EG20T. This ultra low power Intel Atom processor variant supports soldered down memory and a wide variety of interfaces.

Features:
- Custom motherboards, COMs, or COM Express carriers
- Intel® Atom™ processor E6xx series
- Fast turnaround time
- Designed and built by Emerson

For more information, visit www.Emerson.com/RapiDex
EC200 Series System Uses Modular Construction Targeting Industrial Computing Applications

The industrial grade ITOX EC200 series system features sealed construction and anti-shock drive bay mounting designed for factory floor environments. Up to 12 modular system configurations are supported using four riser cards and three I/O module types. Virtually unlimited configuration options are possible using low-cost custom I/O modules designed to meet specific customer requirements.

All configurations feature passive cooling and a 1.8 GHz dual core Intel® Atom™ processor D525 with Intel® 82801 HM I/O controller hub requiring only 15.4 Watts maximum power. The integrated Intel® Graphic Media Accelerator 3150 with DX9.0c and OpenGL 1.4 compliance supports VGA displays up to 2,048 x 1,536 @ 60 Hz. Systems can be configured with up to 4 GB DDR3 800 MHz memory, 8 USB 2.0 ports, 10 RS232/422/485 serial ports, 16 GPIO, and 3 PCIe/PCI expansion slots.

EC200-LRA060 System Model Features (pictured)
- 1.8 GHz dual core Intel® Atom™ processor D525
- Fanless, passive heatsink cooling
- Single 19-24V DC power input, with AC adapter
- Compact 55mm x 203mm x 275 mm (H x D x W)
- Desktop, VESA, and wall mounting
- 2.5" SATA HDD bay, CompactFlash socket
- Up to 4GB DDR3 800 MHz memory
- 2 Gigabit LAN, 6 USB 2.0, and 10 RS232/422/485
- 1 Mini PCIe expansion card slot
- 2-channel Analog and HD Audio support
- UL, CE and FCC Class B approvals

This low-power industrial system is ideal for applications requiring a stable revision-controlled platform, such as industrial control, factory automation, POS and other applications requiring flexible system configuration.

TRACE32® PowerTools for Intel® Atom and Intel® Core™ i3, Core™ i5 and Core™ i7 Processors

Lauterbach TRACE32® with Intel® processor support brings its mature high-end debugging solution to the Intel® Atom™ and Intel® Core™ i3, Core™ i5 and Core™ i7 processors.

The TRACE32® PowerView GUI provides fast assembly debugging and includes a very efficient and user friendly high-level debugger for C and C++. All major compilers are supported, e.g. Microsoft Visual C/C++ and the GNU Compiler Collection (GCC).

A user configurable display system for internal and external peripherals helps examining the target behavior at a logical level.

Integrated Flash support allows programming external and internal Flash memories. Developers can use virtually unlimited software breakpoints, even for code running in Flash memory.

The powerful PRACTICE® scripting language helps to set-up the debug environment and allows creating complex automated test cases.

Lauterbach offers a wide range of TRACE32® PowerTools that can be connected to either Windows or Linux hosts via USB and/or Ethernet 100/1000.

The TRACE32® debug system comes with a highly sophisticated “operating system awareness” debug facility. Operating system awareness for Linux and Windows CE / Windows Embedded Compact is available and allows debugging of the complete target system, including interrupts, drivers, applications and libraries. Also supported is SMP debugging, including hyperthreading.

The TRACE32® PowerDebug system supports platforms based on Intel® Atom™ and Intel® Core™ i3, Core™ i5 and Core™ i7 processors.
MSI Offers Premium Embedded Solution IM-QM67 with Intel® Core™ i7, Core™ i5 and Core™ i3

MSI launches IM-QM67 with the latest Intel® Core™ Platform. This is the multi-display outputs of mini-ITX form factor board with the latest 32nm process technology for the highest HD graphic quality.

Based on the Intel® Core™ i7, Core™ i5 and Core™ i3 processors, IM-QM67 offers lower power consumption and enhanced graphic and media performance. The IM-QM67 is equipped with dual-channel DDR3 1067/1333/1600 MHz memory up to a maximum of 16 GB in dual SO-DIMM slots. MSI IM-QM67 is improved with power efficiency and high-speed data transfer for performance-driven industrial applications, such as industrial control, automation, digital signage, kiosk, POS, gaming, ATM and medical electronic.

MSI IM-QM67 supports multi-display outputs, including Dual Channel 18/24 bit LVDS, VGA, dual DVI, HDMI and dual display configurations. It has great 3D graphics performance and support for up to 1080P high definition video. IM-QM67 also features support for Intel® Active Management Technology7.0, Direct-X 10 shader model 4.0, and full hardware acceleration. IM-QM67 provides a wide range of storage, I/O, and expansion connectivity, including 4 COM ports, 8 USB ports, and 4 SATA ports. Expansion takes the form of one CFast slot, one PCI slot and one Mini-PCIe slot.

Like all products made by LiPPERT, the Toucan-TC is optionally available in the extended temperature range of -40 °C to 85 °C. Cooling is supported with a suitable heat spreader. All memory is soldered to the board, allowing for high levels of shock and vibration resistance.

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**Intel® Core™ 2 Duo processor on standard EBX footprint**

VersaLogic’s Mamba SBC provides extreme performance and high reliability for the most demanding embedded applications. It combines a 2.26 GHz Intel® Core™2 Duo processor, high-end graphics and video, and extensive on-board I/O on an industry standard EBX platform.

Standard features include dual gigabit Ethernet, up to 8 GB DDR3 RAM, six USB 2.0 ports, four serial ports, two SATA ports, HD audio, and eUSB flash storage. Data acquisition features include up to sixteen analog inputs, up to eight analog outputs, and thirty-two digital I/O lines. Expansion is available via PC/104-Plus, PCIe Mini Card, and SPX. Analog and LVDS interfaces support flexible display configurations.

- 2.26 GHz Intel® Core™ 2 Duo processor
- Up to 8 GB DDR3 RAM
- Dual gigabit Ethernet
- Mid power – 18.5W typical
- PC/104-Plus expansion
- Industrial temp. (-40° to +85°C) version
- High-performance video and audio
- Standard EBX format (5.75” x 8”)
- On-board data acquisition support
- MIL-STD-202G shock/vibe

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**Low power Intel® Atom™ processor Z5xx on a PC/104-Plus form factor**

VersaLogic’s Tiger is a compact single board computer on a rugged 3.6” x 4.5” PC/104-Plus form factor. Featuring the low power Intel® Atom™ processor Z5xx (Menlow XL), Tiger packs powerful 1.6 GHz performance backed by legendary VersaLogic quality. Available in both commercial (0° to +60°C) and industrial (-40° to +85°C) temperature versions!

Add VersaLogic’s long-term (5+ year) product availability guarantee and customization options and feel the power of the Tiger!

With more than 30 years experience delivering extraordinary support and on-time delivery, VersaLogic has perfected the art of service, one customer at a time. Experience it for yourself. Call 800-824-3163 for more information!

- Intel® Atom™ processor Z5xx up to 1.6 GHz
- Low power, 6W (typical)
- High-performance video and audio
- Gigabit Ethernet
- Up to 2 GB DDR2 RAM
- PCI & ISA expansion
- Fanless operation
- Industrial temp. (-40° to +85°C) version
XPedite7302: An Intel® Core™ i7 Processor-Based XMC Module with SecureCOTS™

XPedite7302 is a high-performance XMC module featuring the Intel® Core™ i7 processor, Mobile Intel® QM57 Express Chipset and SecureCOTS™. With its SecureCOTS capabilities, the XPedite7302 can provide data encryption and decryption and enables developers to address a program’s protection requirements. Each of the five external PCI Express interfaces and the Gigabit Ethernet port links can be controlled directly by the FPGA. The serial interface passes through the interface to allow the FPGA to control what data is passed externally to the CPU system.

The XPedite7302 uses NOR flash exclusively rather than any NAND based flash to further its long term data retention. Both the SPI NOR flash used for booting firmware and the parallel bus NOR flash are routed through the FPGA to allow for any type of user encryption on the data before it is presented to the CPU system. The parallel bus NOR flash is accessed via PCI with a DMA unit for efficient transfers from the NOR Flash to CPU system’s memory.

Configurable as either air-cooled or conduction-cooled, the XPedite7302 is designed to meet a wide range of environmental requirements. Wind River VxWorks and Linux Board Support Packages (BSPs) are available.

XPedite7302 features:
- Intel® Core™ i7 processor operating at 2.00/1.06 GHz
- 8 GB DDR3-1066 ECC SDRAM in two channels
- 8 MB SPI NOR boot and 256 MB parallel NOR flash
- One x4 PCI Express link and four x1 PCI Express links
- Gigabit Ethernet port
- Two serial ports

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By Alex Goldhammer, Xilinx Inc.

Intel has done a fabulous service for the electronics industry over the last two decades by enabling PCI and subsequent PCI Express (PCIe) interconnect standards. The PCI standards, managed by the PCI-SIG, have helped an enormous amount of companies mix and match their electronic systems to create an even more enormous amount of products that have profoundly impacted our daily lives. I anticipate that the coming PCIe Gen3 standard will rapidly accelerate the creation of a multitude of new products across a growing number of vertical markets, all interconnected via 10 Gigabit Ethernet, 40 Gigabit Ethernet and even 100 Gigabit Ethernet.

But with the introduction of each new generation of the interconnect standard, new challenges arise for the companies creating devices that will comply with the standard. PCIe Gen2 and Gen3 are certainly no exception.

The biggest advantage of moving to any new PCI Express generation is that each new one typically doubles the speed and bandwidth over the previous generation. This means remarkable things for each new generation of devices but can be quite a challenge for the folks designing systems that comply with the standard.

For IP and device manufacturers, this means each generation of their IC or core’s internal data path must also double. This can be a huge challenge for companies creating next generation devices but even more so for IP companies or companies that maintain their own IP libraries. In making their cores comply with the standard, they must also ensure their cores remain efficient but stay essentially the same size when implemented in silicon. Creating compliant devices and IP is further complicated by the fact that the PCI-SIG and other companies are constantly coming up with new optional features above and beyond the base standard.

On the IC side, companies wishing to create products that comply with each new generation of PCIe must also deal with ever more complex link training and state machines. The link training is the automatic mechanism where systems linked via PCIe negotiate lane widths and lane speeds. These operate autonomously (without need for user intervention) and must be extremely robust for reliable system performance.

With PCIe Gen3, data rates increased to 8Gbps and the encoding has changed to 128b/130b with scrambling. Unfortunately, this isn’t the same encoding used for PCIe Gen1 and Gen2. Thus companies wishing to comply with the standard must ensure their systems can easily switch encoding from Gen3’s 128b/130b to a more industry standard 8b/10b used in Gen1 and Gen2 (PCIe Gen3 must also support Gen1 and Gen2 data rates). In addition to requiring encoding switches, Gen3 requires chips to include transceivers that support complex decision feedback equalization (DFE). Many companies will need to add DFE support to their devices, if they don’t have them already.

But from a developer’s perspective, it isn’t all bad news. Both PCI Gen2 and USB 3.0 protocols are wonderful in that that they use the Intel® PIPE 2.0 specification as the basis for the internal interface between the Protocol Layers and the gigabit transceivers (PHY). From a gigabit transceiver development perspective this helps engineers reuse a lot of the verification and testing infrastructure needed for transceivers. If this trend continues, it will also hopefully reduce the numbers of different transceivers in the market, making transceivers easier to test and validate while increasing reliability. This will seemingly help companies like Xilinx bring products based on PCIe Gen3 and subsequent generations to market even sooner.

“Creating compliant devices and IP is further complicated by the fact that the PCI-SIG and other companies are constantly coming up with new optional features above and beyond the base standard.”
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