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APRIL/MAY 2010 | VOLUME 14 NUMBER 2

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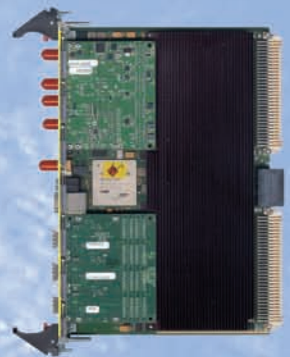

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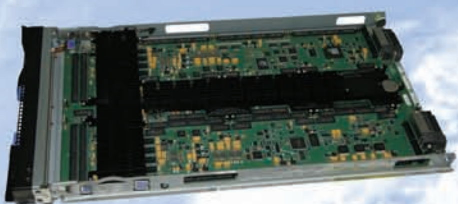

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COVER

The simple *connect clients-to-data* model network role is appearing more often than not in the rearview mirror now as military and other markets look ahead to new generations of intelligent networks that feature sophisticated security and application and content awareness. As these features become increasingly important, and as migration to Web 2.0 and cloud computing ramps up, 40 Gbps AdvancedTCA systems will be key.

EDITOR'S FOREWORD

Speed bump

By Joe Pavlat

We should all raise a glass to honor Dr. Robert Metcalfe, who along with his colleague, David Boggs, invented Ethernet. The year was 1973 and the place was Xerox's Palo Alto, California Research Center. I'm sure he must find it surprising that Ethernet is now the most ubiquitous networking technology on the planet and just keeps getting better and faster.

The ever-increasing demand for bandwidth in mobile applications and cloud computing makes one wonder how long Ethernet can continue to perform and what might replace it in the future. Flat rate data plans for data-hungry devices like the iPhone mean that carriers must provide more data to more devices and customers but with limited budgets for equipment upgrades. Although Dr. Metcalfe predicted in 1995 that the global Ethernet infrastructure would collapse under its own weight in 1996, fortunately, his prediction turned out to be wrong (interestingly, he also thought open source software and wireless networking would die out by the late 1990s).

The communications industry is about to see today's 1 and 10 Gbps data transmission speeds bump up to 40 Gbps. A technical committee within PICMG has been working on bringing 40 Gbps speed to AdvancedTCA for some time now, and they expect to complete their work later this year. Silicon should be available about the same time. Several articles in this issue address different technical and commercial aspects of this significant upgrade to AdvancedTCA's capability, and all authors agree that this is an important and much-needed feature.

Brian Carr, Rob Pettigrew, and Michael Schaepers from the Embedded Computing division of Emerson Network Power spotlight applications for 40 Gbps networks. They also point out that multicore processors are essential to making a system work at full speed, which will approach 1 terabit/second throughput for a typical dual star backplane configuration. That's a lot of Tweets.

Drilling a bit deeper into the issue of multicore processor capabilities and requirements, Jeff Hudgins from NEI gives us some details about the latest generation of Intel processors, and why they will be key to developing 40 Gbps systems.

AdvancedTCA was designed from the get-go to address central office telecom applications. Its features are now making it popular in other markets, including military. It is beginning to be used in advanced data centers, says Jarrod Siket of Netronome. Whereas a network has historically been used primarily to connect clients to data, new generations of "intelligent networks" incorporate sophisticated security as well as the application and content awareness required for services like QoS, deep packet inspection, and I/O virtualization. The move toward Web 2.0 and cloud computing will make these features very important, and Jarrod explains where 40 Gbps AdvancedTCA systems fit in.

A logical "glass cockpit" adjunct

As a private pilot, I lug around about 10 pounds of paper when I go flying, including navigation charts, instrument approach charts, airport terminal diagrams, aircraft operating handbooks, and a logbook. Trying to find what you suddenly need while flying the plane, especially in instrument conditions, can be a challenge. This is being made easier by an innovation known as the Electronic Flight Bag, or EFB, which Christine Van De Graaf of Kontron describes in this issue as she explains how Computer-On-Module boards play a role in decreasing cockpit clutter. EFBs are becoming more sophisticated every year. Some operate as stand-alone devices and some are integrated with the aircraft avionics. As new aircraft now usually have "glass cockpits" that replace traditional vacuum gauges with graphic displays and solid-state sensors, EFBs are a logical adjunct. Too bad I can't afford any of this neat new stuff.

Curt Schwaderer gives us a detailed look at Microsoft's Windows Embedded roadmap, and it is clear from the breadth of offerings, both current and planned, that Microsoft plans on being a major supplier of embedded operating systems.

One question I am often asked is, "What is the difference between the Service Availability Forum (SA Forum) and OpenSAF?" Writing in our online edition for us, John Fryer of the SA Forum and Monica Hatlen of the OpenSAF Foundation explain the role of the two organizations. and anyone interested in high availability middleware should read their article.

Joe Pavlat, Editorial Director

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SOFTWARE CORNER

Set to follow Microsoft's embedded software roadmap

By Curt Schwaderer

Microsoft has historically been the undisputed leader when it comes to desktop personal computer Operating Systems (OSs). As PC technology has evolved from desktop computers to laptops, Consumer Internet Devices (CIDs), Personal Digital Assistants (PDAs), and smartphones, Microsoft's Windows Embedded platforms and technologies have proliferated into those devices as well.

The primary driver for this has been twofold: user familiarity with the look and feel of the Windows graphical user interface and the ability to run Windows applications on these smaller devices. Microsoft's Windows Server has also enjoyed success in enterprise applications due to its connectivity and synergy with the Windows desktop environment. What you might not be aware of is Microsoft's efforts to move the Windows OS into the traditional embedded space, a space that includes COM Express applications. In this month's column, we'll take a look at Microsoft's history and recently announced roadmap for the embedded environment and what makes this strategy applicable to embedded systems.

Windows applicability for embedded applications

The historical argument against using Windows in an embedded application is the infamous "blue screen of death" that may have been experienced when using a Windows PC. Many embedded applications like industrial control and robotics can't afford a bug that could cause robot arms to go spinning out of control.

Pinning the "blue screen of death" strictly on a Windows OS reliability problem is pretty unfair. Like most embedded OSs, the Windows Embedded family is multithreaded with strong memory protection. And the compatibility and conformance validation among the massive number of Windows-compliant hardware and software suppliers for the Windows OS environment is strict. However, guaranteed fail-safe operation of every possible desktop PC combination of hardware, driver, and application components within the Windows environment is unrealistic.

Testing … testing … and still more testing

A closer look shows that Microsoft's attention to software and hardware component reliability and interoperability on the desktop translates favorably to the embedded environment. Few (if any) other embedded OSs can rival the sheer volume of software testing that occurs with a Windows platform on a daily basis. The embedded environment can also be more closely controlled. Also, Microsoft's interoperability and conformance testing of components branded with the Windows logo forms a stable baseline upon which to build further reliability testing.

Windows Embedded platforms

Microsoft delivers four core platforms focused around the embedded space:

1. Windows Embedded CE – Windows Embedded CE is a componentized Real-Time Operating System (RTOS) for a wide range of small footprint consumer and enterprise devices. With the latest release of Windows Embedded CE 6.0 R3, device manufacturers can use familiar tools and innovative technologies to create devices differentiated by an immersive user interface, a rich browsing experience, and a unique connection to Windows PCs, servers, services, and devices. By building on the high-performance and highly reliable Windows Embedded CE platform, device makers can bring their devices to market quickly and efficiently.

2. Windows Embedded Standard – Windows Embedded Standard 2011 delivers the Windows 7 OS in a highly customizable and componentized form, enabling OEMs in industrial automation, entertainment, consumer electronics, and other markets to readily create product differentiation. The Community Technology Preview (CTP) of Windows Embedded Standard 2011 is currently available for download here: http://connect.microsoft.com/windowsembedded. The platform will be released in the first half of this year.

3. Windows Embedded Enterprise – Windows 7 Professional for Embedded Systems and Windows 7 Ultimate for Embedded Systems are the next-generation platforms in the Windows Embedded Enterprise portfolio. Both are fully functional, license-restricted versions of the Windows 7 desktop OS with full Windows application compatibility intended for use in embedded devices, including ATMs, kiosks, industrial PCs, and medical devices. One common platform form factor for these devices is COM Express – a Computer-On-Module (COM) form factor that is essentially a miniaturized PC with I/O you'd expect on a PC motherboard.

4. Windows Embedded Server – Windows Server 2008 R2 for Embedded Systems builds on the Windows Server 2008 for Embedded Systems platform, with new features to assist OEMs in delivering dedicated embedded solutions and appliances with increased reliability and flexibility for unified messaging, telecommunications, security, medical imaging, and industrial automation markets. New virtualization tools, management enhancements, and Server Core help save time and reduce costs, making Windows Server 2008 R2 for Embedded Systems a highly robust and reliable foundation on which to deliver dedicated solutions and appliances. The target platforms range from the COM Express appliances mentioned earlier through CompactPCI, MicroTCA, and AdvancedTCA form factors.

For more on how the four platforms just described support the market horizontally, as well as a discussion of Microsoft support of vertical or device markets and a robotics manufacturer case study, please see the expanded edition of *Software Corner* at www.compactpci-systems.com/.

For more information, contact Curt at cschwaderer@opensystemsmedia.com.

Catching the 40G wave

By Brian Carr, Rob Pettigrew, and Michael Schaepers

Hunger for high-bandwidth, media-rich content is pressuring already strained service provider networks across both wireless and wireline connections. As a result, demand has increased for new, high-bandwidth network infrastructure equipment capable of supporting these applications today and into the future at decreasing costs per transmitted byte.

This article discusses the technology trends that are boosting bandwidth demand and argues that timing is key: Developers who delay in preparing for quick and painless system upgrades risk being throw off balance by, rather than catching the 40G wave, as the technology for creating blades and systems that interact at 40 Gbps arrives.

Enhancements to the open standard-based AdvancedTCA specification – as well as high-performance processor and hardware technologies – are already under way, signaling that advanced high-bandwidth transport technologies are on the near horizon. To date, mainstream markets have found few processing systems capable of reliably interacting at 40G available. However, the advent of processing blades and infrastructure capable of sustaining 40G per slot in a bladed AdvancedTCA system architecture is certain to open the door to a new performance dimension.

One thousand endpoints per person forecast

Recent forecasts from the Wireless World Research Forum project that as many as seven trillion wireless devices will be in operation by 2017 – an average of 1,000 communicating endpoints for every person on the planet. Furthermore, according to the Next Generation Mobile Network Alliance, wireless technology has responded to increasing demand by moving from peak download performance of about half a megabyte per second (Mbps) in 2004 to the 5-7 Mbps range today, as shown on Figure 1. Next-generation mobile networks are expected to nearly triple to more than 20 Mbps in the coming decade. Some mobile voice communications are also switching over to IP-based infrastructures, further inflating worldwide expectations and demand for high-speed wireless connectivity.

A new generation of smartphones is connecting people with data in fun and useful ways

From a carrier's perspective, the Apple iPhone acted as a game changer for wireless networks. The iPhone's ease-of-use for mobile entertainment and Internet access continues to increase the traffic demand to unexpected levels. Clearly this presented an issue for most carriers, whose

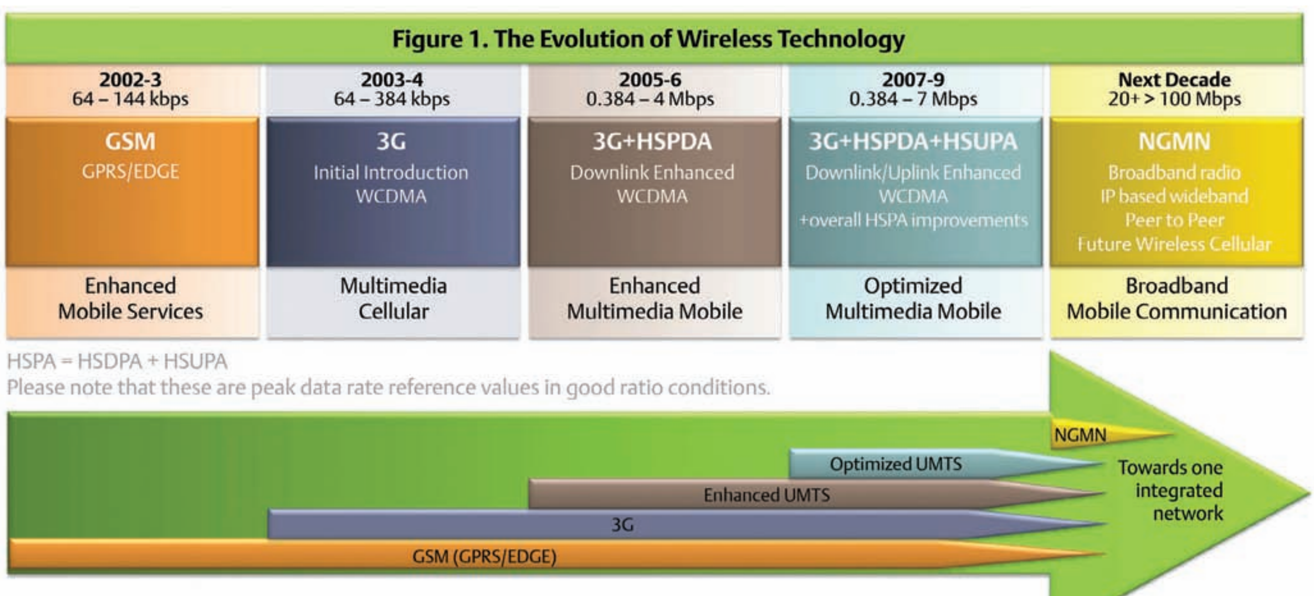

Figure 1 | Since 2004 peak download performance of around half a megabyte per second (Mbps) has improved to today's 5-7 Mbps range.

billing structures for mobile subscribers are traditionally flat and remain so. In response, developers created service-oriented billing structures for subscribers and providers to motivate carriers to invest in profitable new high-bandwidth networks. Identifying services, assigning bandwidth and quality according to the subscriber's individual contract, and billing are relatively new challenges, and the next-generation LTE network has zeroed in on them. These challenges demand extensive processing performance to investigate and control data traffic on the fly. From a commercial standpoint, it suggests that new small network elements operating at high bandwidths will be required to perform such tasks.

Cloudy weather and greater ROI ahead

Beyond wireless, cloud computing is another trend buoying the need for 40G. In an effort to keep up with increasing system demands between the Internet and globally dispersed corporate intranets, network-attached, high-capacity storage systems for enterprise databases are rapidly growing in size. To reduce costs, providers of streaming data and non-telecom applications (such as on-demand video) are also seeking ways to aggregate multiple media streams for distribution. This would enable smaller infrastructures to provide more compelling services, such as High-Definition (HD) streaming, ultimately resulting in greater return-on-investment for providers.

Responsive systems are increasingly used to monitor everyday processes

A heightened interest in ambient intelligence is emerging, resulting in the creation of several wireless sensor and ID tag protocols that serve various functions, including transported goods tracking, smart building power management, and wide-area environmental sensing networks. Automobiles, for example, are embedding multiple wireless communications devices – an average of 10 per vehicle in newer models – for such things as hands-free cell phones, real-time traffic and route displays, tire pressure sensors, and live roadside assistance services such as OnStar. Nearly all these wireless nodes feed into an IP network to handle data as well as performing remote network access and management, further increasing IP bandwidth demand.

Supporting up to 80 Gbps of bidirectional I/O

As bandwidth demand rises, many equipment providers are being faced with a need to develop new generations of equipment to process the increased traffic. Those already using the AdvancedTCA architecture have found a solution in existing multicore computing technologies, helping them bridge today's infrastructure with some of the next-generation bandwidth demands. While many advanced packet processing devices are already employing multicore designs with as many as 64 cores on a chip, next-generation general-purpose or server-class processors (such as the latest Intel Xeon processors) are also designed with multiple processor cores.

By using multicore technology, greater bandwidth can be achieved via a single chassis or even a single blade, combining data and control planes to simplify scalability as the subscriber base grows. Next-generation processing technology will offer much higher performance. For example, a well-designed AdvancedTCA blade supporting two of these multicore CPU chips can generate enough processing power to make possible up to 80 Gbps of bidirectional I/O to other network elements.

High-speed AdvancedTCA shelves
This new dimension of performance is driving the AdvancedTCA community to upgrade the bandwidth of the AdvancecdTCA internal network. Fully redundant 40G Ethernet to each payload blade in the AdvancedTCA system is in its final stage of standardization. This boosts the headroom for data processing toward 1,000 Gbps per AdvancedTCA shelf. Shelves with new high-speed backplanes have been shipping now for more than a year, while network and payload blades are being developed, and all are interoperable with currently shipping 1G and 10G payloads.

Luck favors the prepared infrastructure

While a full transition to a 40G infrastructure may be a year or more away, it is critical that equipment developers begin planning for its adoption now. Recent analysis indicates that AdvancedTCA systems can start upgrading to 40G operation as soon as late 2010 to mid 2011, with payload blades serving as the final link in the chain of availability. While developers and customers will instinctively hold back to avoid the expense of upgrading too soon, they risk allowing competitors to leapfrog ahead in offering new features and functionality once 40G payload blades become a standard offering.

Of paramount importance is the adoption of 40G-ready platforms
For service providers to utilize the new, higher-speed blades in their systems as soon as they become available, it is critical that they already have AdvancedTCA shelves in place with backplanes capable of supporting 40G data rates. With this fact in mind, many network equipment providers are beginning to offer solutions that meet current specifications, yet are forward compatible. Adopting this approach enables service providers to continue using existing blade technologies with confidence that their infrastructure will be able to reliably handle higher data rate blades when they become more widely available.

Expansion avenues

Network equipment providers also must be able to address a wide range of customer needs with their AdvancedTCA designs. System size and capacity need to match the initial deployment requirement to help minimize capital investment during the economic recovery. Systems should also be scalable to readily handle capacity growth as the customer base increases and as service offerings evolve. While some of this capacity growth will occur with the move to 40G, the system should also offer other expansion avenues.

Having access to compatible platform cores in a variety of sizes gives network equipment providers a clear expansion avenue, with most elements of an AdvancedTCA platform core essentially unaffected by the platform's size. Individual blades, the operating system, and application software, for instance, behave in the same way whether there are two slots in a system or twenty. This size indifference makes the development effort needed to integrate and verify a system design essentially "re-usable" when creating a range of system offerings. The lessons learned and debugging results of the first system development effort directly apply to the scaled version when working from compatible platform bases.

Figure 2 | The two-slot Centellis 2000 AdvancedTCA Platform Core

As proof of this concept, Emerson Network Power has addressed this need for design scalability in its Centellis series of Platform Core products. Current offerings include a two-slot platform core for small system installations (Centellis 2000, Figure 2) and a 14-slot version for larger systems (Centellis 4440, Figure 3). Intermediate system sizes are achievable by using multiple Centellis 2000 systems in a single rack.

Figure 3 | The 14-slot Centellis 4440 AdvancedTCA Platform Core

The needs of individual endpoint nodes and the number of nodes installed, along with the proliferation of wireless nodes, are feeding bandwidth demand. And bigger demand is increasing the requirement on throughput per network element. Cost and space constraints, meanwhile, call for network elements to shrink their physical size and price per packet handled. This reduction can only be achieved by increasing the processor performance and I/O bandwidth that individual blades can offer.

The 40G future is clear

It is certain that as customer demand for high-bandwidth services continues to increase, AdvancedTCA systems will ultimately be forced to move from 1G and 10G operation to the next logical step: 40G. Component-level technologies are already preparing for the future, with next-generation multicore processors with the I/O and computing capacity that projected data traffic will demand. Developers of switching and packet-processing silicon are also preparing for the transition, with 40G blades as close as a year away from commercial availability.

With a 40G future looming low on the horizon, network equipment providers are well-positioned to help their service provider customers prepare today by delivering systems that will allow quick and easy speed upgrades through simple blade replacement. By taking steps to ensure that a compatible infrastructure is in place, equipment and service providers will be able to experience the smoothest possible migration to 40G with minimal investment in time and cost.

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Emerson Network Power Embedded Computing
www.emerson.com/EmbeddedComputing

Positronic Zone 1 Connectors Receive "Environmental Claims Validated Mark" for Low Contact Resistance

Energy has become an area of focus for governments, private industry, and citizens. Enhanced methods of producing energy from traditional sources, development of new energy sources and conservation of energy from all sources have become more crucial than ever before.

Across the world, a vast amount of energy is consumed by electronic equipment. Lowering resistance in connector contacts will reduce the amount of wasted energy. Additional energy will be saved as cooling systems will have less heat to draw out of the equipment.

Contact resistance is used by UL Environment as the metric to determine the relative efficiency of connector contacts. UL Environment offers independent third party assessment and verification of claims made by manufacturers, and issues an Environmental Claims Validated Mark (ECV) once assessments are made. Visit www.ulenvironment.com for more information.

Recently an ECV was presented to Positronic by UL Environment which will aid Zone 1 power connector users in evaluating contact efficiency as it relates to energy consumption. The ECV lists the average contact resistance for Positronic's VPB series size 16 power contacts at less than one milliohm each. This low contact resistance is achieved by use of high conductivity contact materials. In addition, Positronic's Large Surface Area (LSA) contact system is utilized as the interface between male and female power contacts in VPB series connectors.

The VPB series was designed for use as the Zone 1 power connector in AdvancedTCA (ATCA) telecommunication computing systems. Zone 1 connectors provide power from backplanes to front boards in ATCA chassis. The low contact resistance of Positronic's VPB series provides energy savings opportunities in any application using this connector.

The following formula verifies the energy savings of a lower resistance contact at a given current: *Power Consumption (Watts) = Current Flow^2 (Amperes^2) X Contact Resistance (Ohms).* Contact resistance has a one-to-one effect on power consumption. If the contact resistance is reduced by half, the power consumption is reduced by half.

Low resistance power contacts also provide benefits in systems sensitive to voltage drop. This is demonstrated in the following formula: *Voltage drop across contact pairs = Current Flow (Amperes) X Contact Resistance (Ohms).* Once again, contact resistance has a one-to-one effect. Reducing the contact resistance by half reduces voltage drop by half.

If we consider the vast numbers of power contacts in electronic equipment around the world, it is clear to see how lower contact resistance can play a role in meeting energy conservation goals.

Positronic utilizes high conductivity contact materials and unique contact interfaces to provide low contact resistance in our power connector products.

UL Environment™
ENVIRONMENTAL CLAIMS VALIDATED

- ✓ Average power contact resistance is less than 0.001 ohms
- ✓ Average signal contact resistance is less than 0.005 ohms
- ✓ RoHS compliant

VPB Series ECV Mark

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FEATURE

COMs help assure air safety is "in the bag"

Figure 1 | An Electronic Flight Bag (EFB) replaces a substantial amount of items that would otherwise contribute to flight deck clutter.

By Christine Van De Graaf

Portable, functional, and power-efficient EFBs are maturing, streamlining the cockpit and increasing aircraft safety.

The Electronic Flight Bag (EFB), an electronic display system, (Figure 1) is replacing the paper charts and manuals pilots use to access critical data. Named after the traditional document-filled flight bag, with information required to safely captain each specific aircraft, EFBs have become an invaluable tool in improving efficiency and safety for general, commercial, and military aviation. Reducing weight and eliminating paper clutter on the flight deck, these portable embedded devices today offer maps, navigation charts, weight and balance calculations, terminal procedures, schedules, weather condition updates, aircraft operating handbooks, and a variety of flight management tools in digital form with real-time access.

Primarily made possible due to the high-performance, small form factor Computer-On-Module (COM) platform, EFBs have been formally defined by the Federal Aviation Administration (FAA) and can be assessed by specific hardware and software criteria. Ease of use and size, weight, and power consumed are key design elements. So, too, is overall performance. Accessibility to multiple applications, error handling, and friendliness and usability of the display interface maximize an EFB's functionality. Modularity and upgradability are also critical to the EFB market. To get to market quickly with minimized design risk EFB designers must have a firm understanding of application requirements as well as next-generation features and upgrade paths.

Defining Electronic Flight Bags (EFBs)

Flight operators have long recognized the benefits of using portable electronic devices, such as commercially available portable computers, to perform a variety of functions traditionally accomplished using paper references. To address this need, the FAA has defined three physical categories for EFBs:

- Class 1: portable displays
- Class 2: display attached to a mounting device
- Class 3: display built into the aircraft

All demand small form factor systems with high performance, and they may either replace or be used in conjunction with the paper reference material typically found in the cockpit.

EFBs electronically store and retrieve information required for flight operations, delivering information that is pre-composed and static, with consistent and verifiable content, as well as interactive content presented dynamically via software applications. Interactive EFB device features require data-oriented software algorithms and introduce concepts of de-cluttering and on-the-fly composition for what the flight deck needs when it needs it.

Aircraft operators see great value in replacing conventional paper-based reference materials with a fully digital environment on the flight deck.

"A streamlined cockpit is critical to aircraft safety, and maintaining safe and smooth operations is the key," says Al Morgenthaler, president, American Air Charter, Inc., St. Louis, MO. He adds, "We've found Electronic Flight Bags lighten our pilots' workload, simplify flight operations, and improve situational awareness."[1]

The flight deck benefits with improved ergonomics and readable information under all cockpit lighting conditions and phases of flight. Systems are rugged for reliable operation, compact and lightweight, and designed for the extreme computing conditions found onboard aircraft. EFBs integrate innovative hardware and software solutions onboard aircraft and expand the exchange of information between airborne and ground systems, which in turn improves safety and efficiency.

COMs pass the performance test

With systems under development that support functions required for all phases of flight operations, the EFB market is seeking better power management and increased overall performance for these devices. COMs answer this need by delivering significant power-to-performance ratios in very small form factor systems, based largely on a steady stream of technology advances, coupled with broad industry adoption among both suppliers and users.

Recent processor advances are helping COMs significantly improve performance while taking a miserly approach to power. For instance, the 45nm Intel Atom processor architecture achieves fast performance (with clock speeds between 1.1 GHz and 1.6 GHz) in a sub 5 W thermal power envelope. It features a power-optimized front side bus (of up to 533 MHz) for faster data transfer. As a result, designers can develop energy-saving, high-end graphics devices based on the Intel Atom processor and the Intel System Controller Hub US15W – without leaving the safe and proven development path of COMs as an established and future-proof industry standard.

Modules that integrate Intel Core i7 advancements deliver even greater design flexibility for the COMs platform in terms of both performance and onboard features. Core i7-based COMs solutions are available now and incorporate an efficient two-chip solution for better signal integrity and minimized board space, enabling higher performance for smaller, power-constrained portable designs with no performance trade-offs for the enhanced I/O capabilities.

Customization is king

Effectively tapping the advantages of COM-based design, EFB designs can offload the needed application-specific customization onto the module's carrier board rather than the module itself. This practical design approach lets system design engineers focus on the EFB application.

Standard modules include processor, bus, memory, and I/O components. Custom design hardware challenges, such as the task of designing in interfaces and switching circuits, exist primarily on the carrier board. The solution that results from meeting such challenges can last for multiple generations with various CPU cores, as one CPU module is swapped out for the next. COMs work well for EFB devices that require scalability not only from generation to generation, but also within a single generation. When additional computing power or improved energy efficiency is required by a future generation, the EFB's COM can be quickly and easily replaced for one that meets the appropriate performance and power requirements.

Details pop up when switching out a CPU core. Designs can be upgraded within a product family, for example a COM Express module to a COM Express module, or the design can be upgraded within the COM specification. The second scenario differs from the first. In the second situation, the EFB application moves from legacy technology such as ETX into the more current I/Os and interfaces found in COM Express. This is not technically a core CPU module change, but rather an actual swap of the COMs technology implemented and it requires a new carrier board. However, because of the similarities between platforms, designers would be able to leverage the compatible software technology.

Planning for longevity

Many EFBs originated on the ETX 3.0 platform, an earlier computer-on-module standard, so a common issue among EFB designers is considering whether to remain on ETX or move forward into the COM Express standard as a means of future-proofing designs and incorporating new features and levels of performance. Each standard has its best fit, however, and the imperative lies in planning ahead for future generations of specific device design, as well as understanding when it is best to upgrade designs from legacy ETX to next-generation COM Express.

Side by side with ETX 3.0, COM Express achieves next-generation performance with a greater number of pins in fewer connectors – however there may not necessarily be a need to jump standards. For example, ETX-based designs are heavily adopted in EFBs, meeting performance requirements with a four-connector layout and Intel Core 2 Duo and Core Duo processing. ETX-based products such as the Kontron ETX-CD (Figure 3) have long-term availability and deliver high-performance capabilities while still

Figure 3 | Many Electronic Flight Bags (EFBs) rely on ETX-based designs.

Linking legacy systems to advanced technologies

Advantages of COMs have increased steadily with each new standard. As Figure 2 indicates, the concept began as the credit-card-sized DIMM PC in 1998; two years later the ETX standard was established and included full PC functionality, minimum engineering and adoption expense, low cost, reliable connectors, extremely slim design, and simple upgradeability and scalability. The upgrade to ETX 3.0 implemented SATA connectors while maintaining the same pin-out, eliminating carrier board redesign to take advantage of the new SATA-based hard drives. When PCI Express ushered in more advanced technologies, a new COM standard was required, as ETX could not be modified and still retain the same pin-out. Enter COM Express, a proven PICMG open specification originally sponsored by Kontron, Intel, PFU, and RadiSys, enabling a smooth transition from PCI, ISA, and IDE (legacy technology) to PCI Express, SATA, and other future-focused technologies.

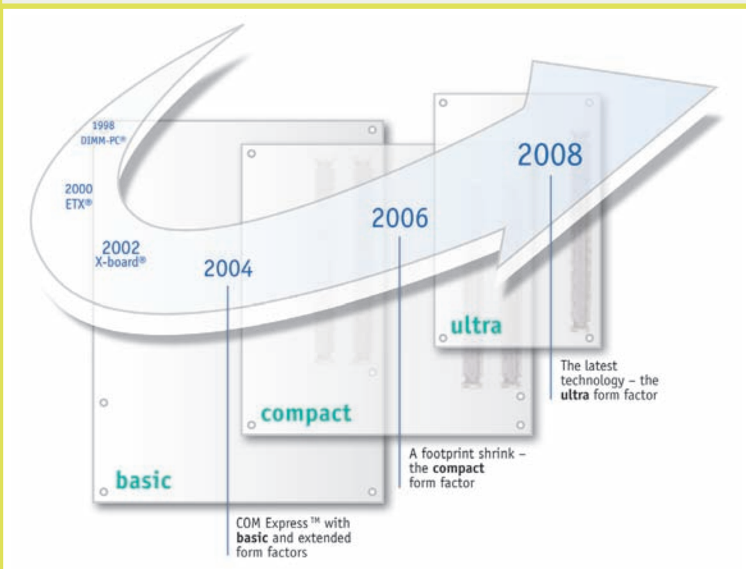

Figure 2 | COM Express paved the way for migrating from legacy PCI, ISA, and IDE to PCI Express and SATA.

supporting legacy technologies such as IDE. The Kontron ETX-CD is the high-end COM for embedded designs requiring PCI, ISA, SATA. and USB 2.0 as well as all standard ETX interfaces. It integrates the low-voltage Intel Core 2 Duo processor L7400 (2x 1.5 GHz, 4 MB L2 cache, TDP 17 W) and the mobile Intel 945GM Express chipset.

Remaining on ETX makes sense when multiple generations of the EFB product have been developed on this platform. SATA support is critical in EFBs because of the small size and low profile. SD cards can also be integrated, supported either natively or with functionality brought out by the module's carrier board. Overall, with Intel Core 2 Duo processing delivering performance and solid graphics capabilities, ETX-based designs have native support for the primary throughput technologies with the exception of PCI Express.

Bringing PCI Express into the picture

Moving out of an ETX-based product family and into COM Express may be the appropriate design choice for new EFB products, as this choice brings with it the availability of PCI Express. The two-connector layout of the COM Express standard would require a new carrier board. However, designers would be well positioned for advanced I/O interfaces and performance enhancements such as extended temperature tolerance. Available PCI lanes may depend on the carrier board design or chipset incorporated (for example, the smaller microETXexpress-XL supports 2x PCI Express lanes but borrows these lanes to implement support for Gigabit Ethernet and PCI), although the pin assignments are standard as defined by COM Express.

The newest COMs such as the Kontron ETXexpress-AI (Figure 4), based on COM Express, include Intel 32nm processing architectures and Intel Core i7 features for greater performance and functionality. For example, the ETXexpress-AI product family supports up to 2 x 4 GB of dual channel DDR3 SO-DIMM modules with ECC and offers a comprehensive range of interfaces via the COM Express COM.0 Type 2 connector. Designers can integrate 1x PCI Express Gen 2 graphics (PEG), which are also configurable as 2x PCIe x8, 6x PCI Express x1, 4x Serial ATA (SATA), 1x PATA, 8x USB 2.0, Gigabit Ethernet, dual-channel LVDS, VGA, and Intel High Definition Audio. Also, designers can incorporate legacy non-PCI Express-compliant components via the integrated PCI 2.3 interfaces.

Figure 4 | The Kontron ETXexpress-AI module.

Figure 5 | Designed today for use in extreme conditions, COMs offer industrial temperature ranges of -40 °C to +85 °C as well as the necessary tolerances for shock and vibration that high reliability requires.

EFB variables affect COM choice

Required EFB features may vary significantly depending on the EFB's workplace. For example, a transport aircraft may not demand the level of navigation encryption required by a military aircraft – in fact, such an aircraft may require that navigation systems are much more open.

Designers should choose COMs accordingly, and depending on the manufacturer, may have a choice of features that includes access to higher-end graphics, increased security, and advanced functions such as very-low-power sleep states.

Although standard and modular, not all COMs are created equal. Boards that can function efficiently with smart battery features on carrier boards are desirable. Leveraging native low-power consumption via ultra-low-voltage options integrated at the manufacturer level is another plus. Designers of safety-critical applications seek encryption built into the board with an optional Trusted Platform Module (TPM) and standard support for up to 8 GB of ECC system memory.

Designers are finding the toolbox available to them includes a range of available features and scalable performance options that make the most of COM Express and offer opportunities for the most appropriate application-specific performance. This trend will continue. Designers can anticipate that future COMs such as the recently introduced microETXexpress-XL shown in Figure 5 will be a good option for next-generation EFB devices that must withstand shock and vibration while operating in extreme temperature conditions.

Moving forward

The EFB market stands to benefit from the continued promise demonstrated by COMs in very specific applications – particularly low-power, ultra-mobile applications that require energy saving x86 processor performance, high-end graphics, PCI Express, and Serial ATA combined with longer battery life. Uniquely applicable to a range of aviation markets, COMs will continue to offer size and performance scalability while gaining higher levels of safety and cockpit efficiency.

An extended temperature range along with greater shock and vibration tolerance will make COMs increasingly attractive for the EFB market. Next-generation EFBs will incorporate Intel Core i7 technology advancements such as higher-performance graphics capabilities, new display integration, stronger security features, and more performance in general – driving this market, minimizing design risk, and allowing aerospace device designers to excel at what they do best.

Christine Van De Graaf *is the product manager for Kontron America's Embedded Modules Division located in Northern California's Silicon Valley. Christine has close to 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. She can be contacted at Christine.vandegraaf@us.kontron.com*

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[1] Disclosure: Al Morgenthaler is the brother of managing editor Anne Fisher.

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Packet Pressure:

Next-gen applications raise benchmark for network capacity

By Venkataraman Prasannan, General Manager, ATCA, RadiSys

The convergence of telecom and IP networking has forced mobile service providers to evaluate new investments in 40G capable networks. In fact, it is hard to overestimate future mobile data demand. We're seeing more and more laptops and a growing number of next-generation handsets primed for high-speed, high-quality video. For example, today a single high-end phone, such as an iPhone or Blackberry, generates more data traffic than 30 basic-feature cell phones.

Devices such as the iPhone have data traffic rising sharply.

With this growth explosion, the benchmark for network capacity and usage is no longer bits per second but packets per second. And the larger the packets (as in the case of video), the more the processing demands shoot up. Bandwidth-hungry services growth is driving the need for new technologies and platforms. Applications that are in-line with this exploding data-video traffic must support much higher densities per subscriber, forcing 40G or higher throughput and processing power requirement per AdvancedTCA system. Some examples of 40G applications include Long Term Evolution (LTE) Evolved Packet Core (EPC), Deep Packet Inspection (DPI) and Mobile Media Adaptation (MMA).

A network infrastructure upgrade to LTE promises higher data speeds, but also includes an evolution of core mobile networks from circuit-switched to packet-switched technologies. In this environment, the mobile network is an all IP network that includes a retooling of core elements to the EPC: the Packet Gateway, Security Gateway and Mobile Management Entity. Core elements desire not to be deer in the headlights of data-video traffic as its expected sharp increase occurs over the next couple of years, and so want to be 40G capable to support the bandwidth requirements. This is one of the key reasons why Telecom Equipment Manufacturers are already factoring in 40G capabilities and requirements as they build new solutions.

DPI encompasses devices and technologies that inspect and take action based on the packet payload contents rather than just the packet header. Deployed in-line with data traffic, DPI examines each packet for a variety of purposes, so the density requirement curves for this application are likely to follow those of LTE EPC elements. The demand for DPI capability will continue to grow as service providers upgrade their networks. One of the key drivers for DPI network deployments will be maximizing service revenues and profitability. Programmable DPI functionality allows service providers to offer a wide variety of value-added services on top of basic broadband access. Premium services require traffic management, monitoring, metering, and policy enforcement based on subscriber Service Level Agreements, and content modification at the application layer. With these capabilities, service providers can look forward to monitoring and billing for advanced value-added service, expanding Average Revenue per User.

MMA refers to redirecting traffic to media adaptation engines. Elements involved in MMA include traffic shaping, media caching, streaming, and adaptation solutions. This helps in optimizing the mobile users' Quality of video Experience (QoE) as well as in reducing the Over-The-Air (OTA), backhaul, and core network bandwidth requirement on a per stream, per user basis. Terrestrial IP networks will also need MMA as Over-The-Top (OTT) video downloads by PC users increase. The elements involved must address very high line-speed processing to reduce latency, providing smooth video streaming with minimal buffering. This requires the high density that 40G systems offer as well as the ability to scale individual functions in a modular fashion, making AdvancedTCA an appropriate platform architecture.

To meet the demand for more bandwidth, service providers are mapping their transition to 40G. The good news is that technology is keeping pace with this growth, and the next generation of AdvancedTCA systems can handle the processing and I/O requirements of the newest applications.

> ... service providers need the ability to migrate systems at their own pace.

RadiSys led the industry transition to 10G, and keenly understands that service providers need the ability to migrate systems at their own pace. RadiSys is again ahead of the innovation curve to 40G. Our ATCA 4.0 platform, based on our company's fourth generation of AdvancedTCA products, ensures "investment protection," by allowing for a smooth and economical transition from 10G to 40G, providing a state-of-the-art platform that is backward compatible and ready to handle next-generation applications.

FEATURE

AdvancedTCA in the data center: Intelligent networking designs for 40 Gbps and beyond

By Jarrod Siket

Jarrod examines major market changes and their effect on system design requirements, focusing on virtualized data center servers and appliances.

Widely used in telecom central offices, AdvancedTCA systems are gaining a foothold in data centers. Two major networking changes are behind this. One is the ongoing evolution to a new, intelligent network driven by secure, content- and application-aware processing at increasingly higher speeds. The other is the shift to next-generation data centers based on highly virtualized servers. Accelerating this shift is the drive to offer enterprise and public services using cloud computing. This combination of increasing network throughput with L2-L7 intelligent networking in highly virtualized servers introduces new CPU and network I/O system design requirements.

As the architecture of network infrastructure equipment, data center servers, and network and security appliances evolves to meet these demands, designers of networking equipment are considering AdvancedTCA systems. Of particular interest to these designers are the attributes that helped AdvancedTCA succeed in the central office.

The intelligent network evolution

Not long ago the network infrastructure was merely a super highway between clients and their network-based content. Increasing bandwidth and network throughput was the primary objective. With the advent of cloud computing, Web 2.0 applications, and other outsourced managed network services, more information is moving throughout public networks. Fast, dumb pipes are giving way to end-to-end intelligent and secure communications paths.

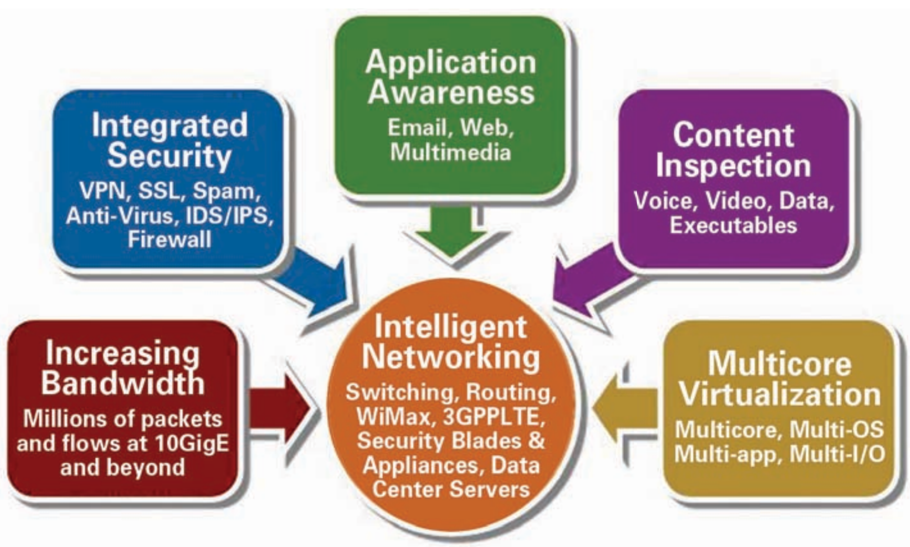

Figure 1 | New Intelligent Networks

As Figure 1 shows, there are five distinguishing attributes of the new intelligent networks:

Increasing bandwidth

Demands for a more intelligent network accompany the need for speed. Networks have rapidly begun moving from multi-gigabit to 10 Gbps. And 40-100 Gbps looms. Intelligent networks must keep pace with network performance requirements. Gaining intelligence at the expense of throughput and latency is not acceptable.

Integrated security

Threats to networks are increasing, and networks are taking steps to become more secure at nearly every point along the communication path. Threats can come from the inside in the form of accidental and intentional data loss, or from the outside in the form of spam, botnets, and other types of malware. Intelligent networks must offer integrated security functions such as intrusion prevention and detection, cryptography, data loss prevention, and firewalling. These computationally intense applications must be supported without degrading performance.

Application and content awareness

Intelligent networks make forwarding decisions for policing and shaping as well as QoS and service level agreement guarantees, and they enforce acceptable use policies. These tasks require line-rate deep packet inspection at L2-L7 for all traffic.

I/O virtualization

With many network and security applications being delivered on high-performance multicore IA/x86 systems, intelligent networks must provide equivalent I/O virtualization. This network virtualization must tightly couple with the multicore IA/x86 processors to guarantee the applications have adequate performance, including throughput and latency.

Meeting higher performance and resiliency demands

Network applications and security applications increasingly require "intelligence" in the form of deep packet and content inspection. Network applications include test and measurement, service assurance, Session Border Controllers (SBCs) and

Deep Packet Inspection (DPI) systems. Security related applications include:

- Intrusion Detection and Prevention Systems (IDS/IPS)
- Firewalls
- Unified Threat Management (UTM)
- Forensics
- Data Loss Prevention (DLP)
- Lawful intercept (CALEA)
- High-speed packet capture

The just-mentioned network and security applications have historically been offered in x86 based appliances. And now more often than not these devices find their jobs taking them to locations that require better performance and resiliency than a typical appliance can support. This is where modular, chassis-based AdvancedTCA systems as shown in Figure 2 come in. As network I/O begins to scale, and as these devices anticipate deployment in larger networking locations, the use of COTS hardware platforms for application hosting is gaining ground.

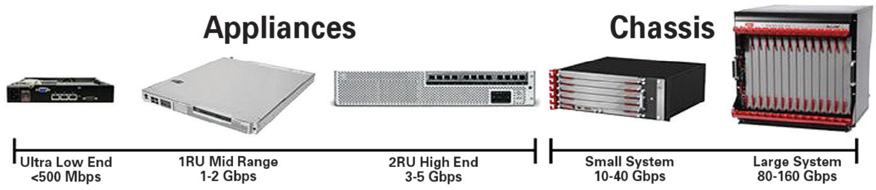

Figure 2 | Modular Chassis-Based System Range

A scalable product architecture based on COTS systems makes possible a range of price-performance hardware platforms and allows for rapid, yet independent control plane or data plane component enhancements as innovations occur and market requirements expand.

Common attributes of intelligent networking devices

Intelligent network and security devices share several common attributes. In all cases, they require very high-speed packet capture with zero packet loss. By the nature of their applications, they must see 100 percent of network traffic. In many cases, these devices are also involved in packet forwarding, requiring line-rate network I/O for 1 Gbps, 10 Gbps, 40 Gbps, and eventually 100 Gbps interfaces. It also requires very low latency, equating to a maximum of 250 microseconds of delay in 1 Gbps networks.

In the cases where the devices are involved in packet forwarding, the decisions are often far more sophisticated than basic L2-L3 decisions. These advanced L4-L7 decisions, based on security and on application and content processing, are computationally intense. In order to keep pace with the increasing performance, most of these applications have been written to IA/x86 platforms. With the advent of multicore IA/x86 and CPU virtualization, designers of these systems are also able to combine network and security functions into single systems.

These devices are deployed in networks where the protocol and application topography is changing rapidly. Keeping pace requires a high degree of programmability across application, control, and network data planes without degrading performance.

Network developers are responding to the scenarios just noted by offering a wide array of flexible interface options spanning 1, 10, 40 and 100 Gigabit Ethernet. And devices must be deployable both as passive systems that are out of band and as active inline network elements. The latter network configuration presents additional requirements for resiliency, such as the inclusion of highly redundant components. Redundant control plane processing and integrated bypass technologies such as fail-to-open, fail-to-close, and other fail-to-wire mechanisms are common.

Ramping up product performance by separately enhancing network processing

The AdvancedTCA form factor supports architectures that separate the control/application plane and data plane processing. Developers using AdvancedTCA can increase product performance by separately enhancing network processing for the I/O and the general-purpose computing for the application and control plane.

AdvancedTCA modularity means designers can follow the x86 roadmap for application-processing blades. As a result, designers can improve the performance of AdvancedTCA-based network and security applications. Upgrades take place for application-processing blades without requiring major changes to other system components.

While the x86 architecture may be the application processor of choice, it is not designed to provide the highest levels of network processing at up to 100 Gbps. Therefore, dedicated line cards that are optimized for network and flow processing form a logical complement to the x86. In supporting a model that allows for the separation of application and data plane processing an AdvancedTCA solution can also significantly improve performance. And the solution can address evolving network performance and functionality requirements via dedicated network interface cards.

Just as developers can quickly enhance the application-processing blades with improved general-purpose CPUs, they can also upgrade networking cards to support new network interface requirements. When designed with programmable network flow processors, the networking cards can be powerful, field-configurable interface modules for inline or look-aside acceleration that can be programmed toward specific functions such as DPI, security processing, or algorithmic acceleration (Figure 3).

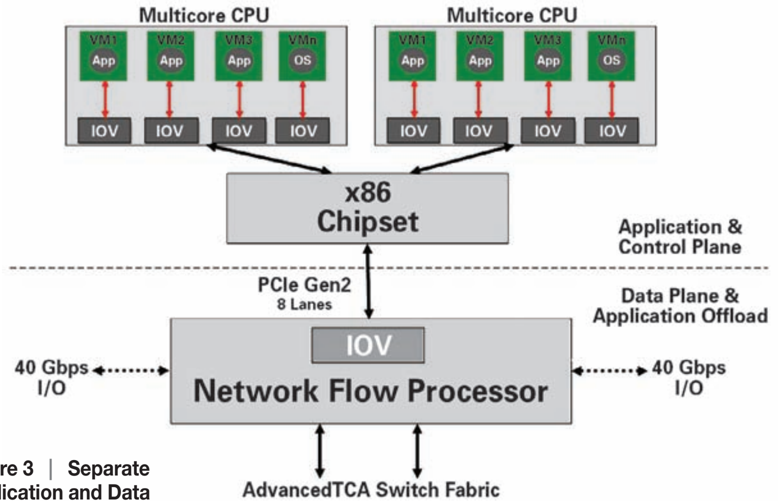

Figure 3 | Separate Application and Data Plane Processing

Separating the application/control plane processing from the data plane guarantees the best application performance and best networking throughput. This unique, heterogeneous processing architecture, when used in an AdvancedTCA form factor, will allow equipment providers to rapidly deliver programmable products that satisfy the new requirements of intelligent networking.

The role of I/O virtualization

The important role of network I/O virtualization requires special mention because it is critical to the solution. Networks have been virtualized with many familiar technologies like VLANs and VPNs for years. With the increasing usage of multicore CPUs that might also be virtualized, there is a missing link in the architecture. The mechanism to get data from the virtual network interfaces to the x86 CPUs is typically a single shared pipe. A better approach would be an underlying I/O subsystem that is also virtualized.

When designing data plane line cards for AdvancedTCA systems, special design considerations must be made. The network processors used in these line cards must be purpose-built to be aware of the virtualization that exists among the application plane processors. This I/O virtualization ensures that the network line cards efficiently direct traffic to the appropriate cores with dedicated resources, and in some designs offload specific network processing from the applications, directly to the network line cards.

Designers of AdvancedTCA-based systems have options for implementing a heterogeneous architecture. One option includes creating separate general-purpose processing line cards for the network and security applications, while offering a wide array of networking line cards for I/O flexibility and L2-L7 processing. Or the architecture can combine control plane and data plane processing in a single hardware design. In order to preserve the benefits of independently increasing performance among different processing elements, designers could provide the I/O and networking processing in AdvancedMC form factors while tightly coupling with the IA/x86 application processors on an AdvancedTCA carrier.

AdvancedTCA designs are proven and successful in carrier central office applications. Many of those same requirements are now found in the evolving requirements of data center applications. When designers take advantage of a heterogeneous processing architecture for network and security application processing and L2-L7 network flow processing, AdvancedTCA systems can help scale the most demanding data center applications to 40 Gbps and beyond.

Jarrod Siket *is senior VP of sales and marketing for Netronome Systems, Inc., based in Pennsylvania. He has 18 years of experience in the data and telecommunications industry, including roles at Tollgrade Communications, FORE Systems, and three terms (2000-2005) as the vice chairman of the IP/MPLS Forum Technical Committee. Jarrod holds a BS in Information and Decision Systems from Carnegie Mellon University and an MBA from the Joseph M. Katz Graduate School of Business at the University of Pittsburgh. He can be reached at jarrod.siket@netronome.com.*

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2010 makes AdvancedTCA deployment a whole new ball game

By Jeff Hudgins

In 2010 telecom equipment manufacturer and network equipment providers will make AdvancedTCA deployment decisions in a world markedly changed by two major technology shifts.

First, the Intel Xeon 5600 (aka Westmere) processor series has arrived. This silicon dramatically increases transistor density while enhancing performance and energy efficiency within a smaller, more refined version of the existing Xeon 5500 architecture. The Xeon 5500-based processors typically used in an AdvancedTCA blade are 60 W and four cores (L5518 at 2.13 GHz). The next-generation Westmere options are 60 W and six cores (L5638 at 2 GHz) or 40 W and 4 cores (L5618 at 1.87 GHz). A single Xeon 5500 or Xeon 5600 blade design can meet the PICMG 3.0 rev 2 AdvancedTCA specification limit of 200 W per slot; however, dual 60 W Xeon 5500 or Xeon 5600 designs require > 200 W per slot.

While the latest version of the PICMG 3.0 AdvancedTCA specification, Revision 3, allows for the use of blades > 200 W per slot, implementation of > 200 W per slot power and cooling is optional. Many AdvancedTCA platforms already deployed in the field are still limited by a 200 W per slot threshold for cooling and power provisioning, preventing the use of higher wattage blades. It is possible to design a dual Xeon 5600 blade under the 200 W limit by using the 40 W processors. This blade design will have a lower clock speed per core as compared to a single Xeon 5600 blade counterpart, but (as shown on Figure 1) twice the memory channels (six versus three) and two extra processor cores (eight versus six), allowing for the potential of higher performance with several applications.

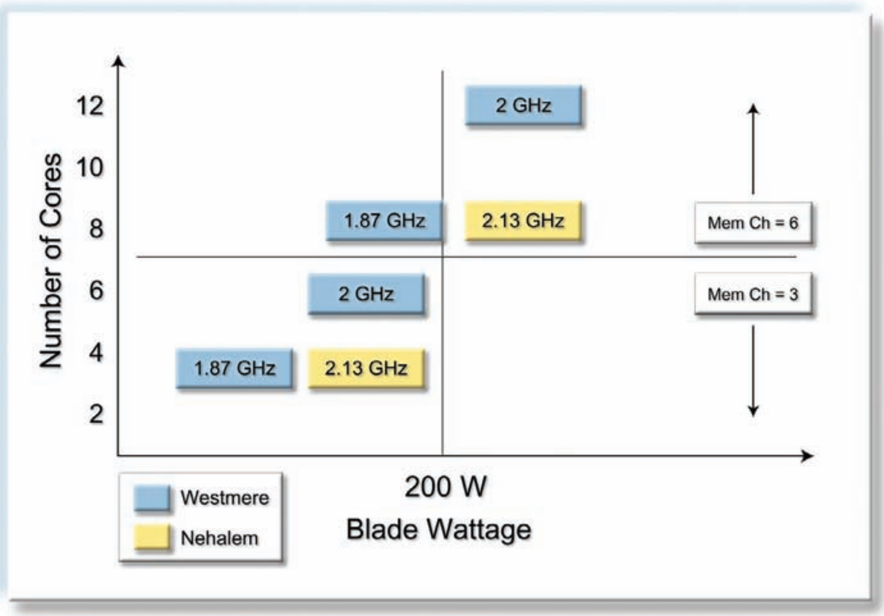

Figure 1 | **A blade design conducive to higher performance for a number of applications.**

The second change is that the PICMG 3.1 Rev 2 AdvancedTCA standard is being finalized to offer 40G bandwidth architecture sometime in 2010 as well. The original 1G AdvancedTCA products began shipping in volume in 2004 and 10G followed in 2008. Today, many data centers have 10G uplinks, and many applications are driving the AdvancedTCA ecosystem to meet the demand of higher bandwidth with four 10G links.

Fragmented purchase volumes?

The success of implementing open standard designs is determined by faster time to market at a reduced cost. When combined, these two technology shifts create consideration for several design alternatives. If multiple design paths are taken, the purchase volumes will become fragmented across a large selection of "standard" products. The end result is a standard product that is no longer "off the shelf" or price competitive.

Consider the following application scenarios:

Mobile video applications

Processor performance hems in typical mobile video applications. These video applications don't come close to saturating four 10G links (40G). In this case, the design consideration is a Westmere dual-processor 60 W AdvancedTCA blade that is more than 200 W per slot but cannot take advantage of the 40G bandwidth.

Deep packet inspection

A typical deep packet inspection application may be limited by the bandwidth but operate quite efficiently on a single 4-core Westmere blade. In this scenario, the customer needs to adopt a 40G solution immediately. However this customer has no interest in enhanced cooling to support more than 200 W per slot.

Billing

Constrained by memory, run-of-the-mill billing applications do not require additional bandwidth. A 10G-capable platform

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with a Westmere dual 40 W blade to maximize the number of memory channels solves this challenge.

Inflexibilty strikes out

A dual Westmere SBC that can support both 60 W and 40 W processors would offer flexibility for network equipment providers and telecom equipment manufacturers facing the scenarios just described.

Creating an AdvancedTCA architecture that can support up to 300 W per slot and 40G bandwidth for the same cost as the current 200 W, 10G solutions on the market today will allow consolidation of purchases around a standard set of off-the-shelf AdvancedTCA components and achieve economies of scale.

Jeff Hudgins *is vice president of marketing at NEI. In this role, he is responsible for the overall corporate marketing and product/services strategy including field engineering, product management, and marketing communications.*

Prior to NEI, Jeff was vice president of engineering at Alliance Systems, where he led the corporate efforts in new technology areas such as carrier grade rack-mount servers, AdvancedTCA, MicroTCA, PCI Express, and NEBS compliant designs.

Prior to Alliance Systems, Jeff held various management positions in operations, quality, customer service, and engineering at Texas Instruments, M&S Systems, and Marlow Industries and played a key role in all three companies' receipt of both State and National Quality awards. He can be reached at jeff.hudgins@nei.com.

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