IP MULTIMEDIA ... SECURITY ... TRIPLE PLAY

CompactPCI® and AdvancedTCA® Systems

The Magazine for Developers of Open Communication, Industrial, and Rugged Systems
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JUNE 2006 VOLUME 10 NUMBER 5

MicroTCA: Just what the doctor ordered

SPECIAL: RadiSys Supplement

Voice Product Guide

PICTURED
Artesyn Communication Products KAT4000, a configurable AdvancedTCA blade for telecom infrastructure applications

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COLUMNS

8 Editor's Foreword
Healthy, wealthy, and wise
By Joe Pavlat

10 Software Corner
Execution partitioning for embedded systems increases security, reliability
By Curt Schwaderer

12 Technology in Europe
Find your way
By Hermann Strass

EVENTS

GLOBALCOMM
June 4-8
Chicago, IL
www.globalcomm2006.com

VoIP Developer Conference
August 8-10
Santa Clara, CA
www.tmcnet.com/voipdeveloper/

E-LETTER

June: www.compactpci-systems.com/eletter
Execution partitioning for embedded systems increases security, reliability
By Curt Schwaderer, OpenSystems Publishing

COVER:
Changing dynamics are making the medical and health care market, which has been somewhat successful for CompactPCI, an ideal market for MicroTCA. See page 30.

Published by: OpenSystems Publishing™

FEATURES

GUEST: COTS

16 COTS adoption in telecommunications
By Dr. Asif Naseem, GoAhead Software

GUEST: TRIPLE PLAY SERVICES

23 Four IPTV trends shaking service provider foundations
By Curtis Miller, RadiSys

SPECIAL: BUSINESS CASE FOR AdvancedTCA

26 Covering all the bases: AdvancedTCA, MicroTCA, and triple play packet equipment
By Thanh Nguyen, Artesyn Communication Products

30 MicroTCA: Just what the doctor ordered
By John Groezinger and Paul Virgo, Motorola Embedded Communications Computing

TECHNOLOGY: ADOPTING IP MULTIMEDIA SOLUTIONS

34 Future safe networks: The DNA2 uncertainty
By Haim Melamed, AudioCodes

38 Getting to the IP Multimedia Subsystem: Migrating the Home Location Register to the Home Subscriber Server
By Pavitra Krishnaswamy, Karl Medina, and James Radley, Continuous Computing

44 Telecommunication servers and IMS: The perfect match for the perfect storm?
By Ed Dylag, Intel

PRODUCT GUIDE: VOICE

48 Enterprise VoIP grows up
By Herman Abel, Aculab

WEB RESOURCES

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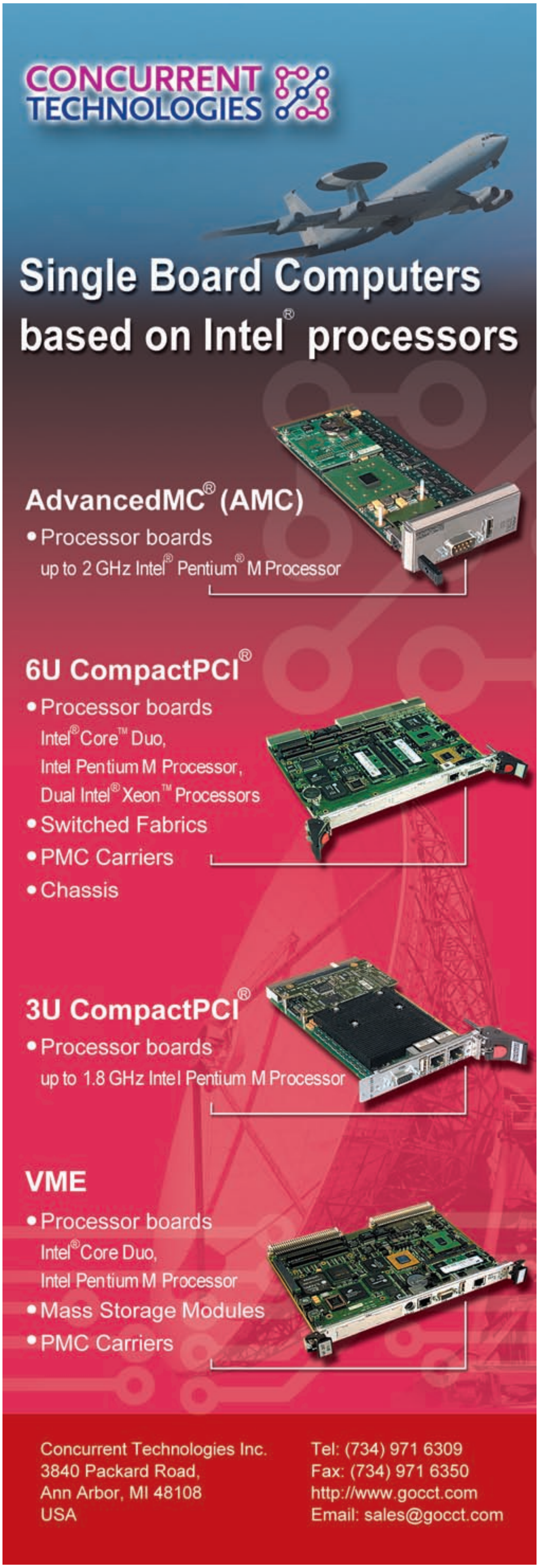

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By Joe Pavlat

Healthy, wealthy, and wise

This column's title came to mind during the enjoyable task of previewing this month's articles, including Paul Virgo and John Groezinger's piece on AdvancedTCA, MicroTCA, and the health care industry. Paul, who is director of marketing at Motorola Embedded Communications Computing, and John, an architecture consultant for the company, delve into issues surrounding medical electronics and the need for the health care industry to deliver services more efficiently. He explains how this translates into requirements for high compute densities, more scalability, and broadband connectivity. Paul and John go on to tell us how the new MicroTCA standard is an ideal platform for many medical applications, which can take advantage of its small size, communications capability, and always-on high reliability architecture crucial to much patient care equipment.

As to wealthy, that adjective sums up the recent Embedded Systems Conference in San Jose. It was packed with a wealth of both exhibitors and visitors, with booths spilling out of the main hall into the hallways. People I talked to were positive and indicated quite a bit of business was being done.

The summer tradeshow season is upon us, and more excitement is in the air than in several years. You may be reading this at GLOBALCOMM in Chicago. GLOBALCOMM has replaced SUPERCOMM, and it is arguably the largest communications and telecom show in America. Expect to see lots of AdvancedTCA and Advanced Mezzanine Card products. The new MicroTCA standard, which uses standard Advanced Mezzanine Cards plugged directly into a backplane, will be making its major debut. OpenSystems Publishing will be present as will PICMG, which is sponsoring the PICMG Technology Showcase (Booth #12042) with more than 40 exhibiting companies.

Whether you are reading this at GLOBALCOMM or anywhere else, I believe you will find several challenges to what is conventionally considered wise with regard to hardware, software, systems, and business issues.

Thanh Nguyen, Product Manager and Strategic Architect at Artesyn Communication Products, gives us a broad overview of a number of major PICMG-developed open standards, beginning with the groundbreaking PICMG 2.16 standard, which brought to the open standards world packet switched Ethernet connectivity and integrated system management. He then explains how lessons learned from PICMG 2.16 found their way into the much more powerful AdvancedTCA standard with more sophisticated system management, fabric flexibility, higher power, and carrier grade design.

The GoAhead Software COO and CTO Dr. Asif Naseem explores the COTS ecosystem around AdvancedTCA and the Service Availability Forum's Hardware Platform Interface specification, which enables off-the-shelf high availability middleware to be married to AdvancedTCA hardware. This reduces the time required to deploy products and reduces product development costs by allowing product teams to concentrate on application development and not on operating system and failover software. In "COTS adoption in telecommunications," Dr. Naseem also provides us a basic tutorial on what high availability middleware does and why it is important.

Herman Abel from Aculab explores the increasingly cutthroat world of VoIP and IP telephony. The needs of R&D organizations differ greatly from those of integrators, and intellectual property issues abound. Herman provides an excellent tutorial of the elements of a carrier grade VoIP system, explaining the requirements and architectural trade-offs that designers face. He offers examples of high availability VoIP designs and shows us the importance of platform management and failover capability in such systems.

Our industry is abuzz with the importance of IP Multimedia Subsystems (IMS) as the glue that will hold together the architectures of next-generation networks and the *triple play* or *quadruple play* services that carriers are rushing to provide. Haim Melamed, Director of Channel Marketing at AudioCodes, discusses the future converged networks and explains how they might not be as converged as might be expected. While Internet Protocol communications will be the basis of these networks, he details the large number of competing technologies being implemented and provides insight into the issues carriers face, including the choice between proprietary products from a single vendor versus open architecture solutions. Haim does a good job of taking some of the frills out of the myriad colorful PowerPoint presentations one sees at virtually every communications conference of late, educating us, instead, about the tough decisions equipment designers and carriers face.

Internet Protocol TV (IPTV) is a very hot topic as carriers looking for the *triple play* begin the transition to new networks that offer voice, video, and data to consumers. Curtis Miller, Product Marketing Manager at RadiSys Corporation argues that the leap to IPTV is an enormous one, but that the chasm can be bridged with innovative designs and modular solutions. This is good news for suppliers of AdvancedTCA and related open industry standards.

In this month's *Software Corner,* Curt Schwaderer, OpenSystems Publishing Technology Editor, details some of the challenges facing embedded system software designers, including the increasing need for network connectivity and the security and reliability issues that arise from it. As embedded systems become more sophisticated, partitioning and executing many independent tasks in a reliable and efficient way is important. Beginning here and continuing online at www.compactpci-systems.com/software_corner, Curt discusses the issues and some of the possible solutions, focusing on hardware and software trade-offs. He explains how the adaptive partitioning of QNX's Neutrino operating system works and how it can be used to simplify code development and speed time to market.

Joe Pavlat
Editorial Director

By Curt Schwaderer

Execution partitioning for embedded systems increases security, reliability

Embedded systems software continues to grow in complexity. With the increase in performance and capacity of embedded hardware platforms, embedded software programming has grown to where it is not uncommon for an embedded system to reach or exceed 100,000 lines of code. In fact, one QNX Software Systems white paper refers to research suggesting that the code base for a typical embedded project doubles every 10 months. Increasing complexity, coupled with the fact that today's embedded systems are network-connected, leads to performance, reliability, and security issues that need solutions. This column is the first of a two-part exploration of adaptive partitioning from QNX, a leading Real-Time Operating System (RTOS) provider. Both parts of the column are available in full at www.compactpci-systems.com/software_corner. The discussion centers on how adaptive partitioning addresses security and reliability concerns.

Security and reliability

The concept of security for a network-connected device is a well-documented and well-known challenge for networked embedded systems. These issues strike at the very heart of the embedded system, the RTOS. Historically, two models of OSs have been used in embedded systems. One model is a simple threads-based approach where each thread has the ability to access any resource (memory or I/O) in the system, accidentally or maliciously.

The other model is a process model where each process in the system runs in its own protected memory space. The OS manages memory and I/O, and processes can only access memory, I/O, and other resources within the embedded system environment through formal methods using RTOS API calls. For low complexity, simple embedded systems, a threads-based OS has the advantage that everything can be directly accessed without the overhead of the OS management. But for the vast majority of today's embedded systems applications, a process model OS and the protection it provides against accidental or malicious corruption is a necessity. Most process model OSs are also multithreaded, so the developer can take advantage of the simplicity of thread interactions while still having the protection of a process model environment.

Another dimension is the development complexity involving process and thread execution not only from the memory and resource sharing point of view, but from the execution interaction point of view. When multiple teams are developing software subsystems to be deployed on an embedded system, finding and fixing stray memory pointers or improper use of I/O resources is only the beginning of the test process. Perhaps the most daunting task in the system test process involves the complex execution interactions between subsystems when run together on the same embedded platform. Subsystems that work fine running alone might spuriously error or malfunction when run with the entire system. These issues have led to the concept of partitioning CPU cycles in an analogous manner to process model memory and I/O partitioning. Figure 1 is an excerpt from a QNX white paper on partitioning that shows the options

Partitioning Approach	Product Cost	SW Development Cost	Time to Market
Hardware Partitioning	• Redundant hardware cost passed on to customers; results in less competitive pricing	• Less software complexity; requires less development effort	• Favorable time to market, but higher hardware costs
OS-controlled Partitioning	• Minimal processing overhead	• Minimal software complexity to provide CPU guarantees	• Favorable time to market assuming existing code base can be easily used
Application-level CPU Control	• Processing overhead consumed by application may require incremental hardware	• Complex design required to manage CPU allocation	• Complicated, multiparty design and implementation reduces productivity and slows time to market

Figure 1

a developer has when deciding how to implement the execution partitioning of an embedded system.

Execution partitioning

Execution partitioning means that each subsystem is developed and compartmentalized within a specific execution *partition*. The execution partition is guaranteed to be allocated the defined percentage of the CPU cycles for the platform. The idea is twofold:

1. Address security challenges – Execution partitioning minimizes Denial of Service (DoS) attacks by limiting the amount of CPU cycles applications can consume. Thus, malicious applications cannot totally consume the hardware processing resources.
2. Address system integration challenges – Each subsystem can be tested with a certain percentage of the CPU cycles allocated.

This twofold approach minimizes the effects that change the execution characteristics of the subsystem within the context of the entire system software.

Approaches to partitioning

Hardware partitioning (where subsystems execute on different processors within the embedded system) can reduce the software complexity, but adds significant cost to the product.

Application level partitioning increases engineering costs and complexity because software must be written within the application to implement the partitioning algorithms. This makes the application less portable, more complex, and does little to prevent denial of service attacks since the applications are governing themselves.

The OS level partitioning is a favorable mix of software managed execution partitioning with no impact on the application and software subsystem complexity. When this form of partitioning is done properly, the applications are not even aware of the execution partitioning happening in the system.

Therefore, the concept of execution partitioning boils down to identifying what percentage of the CPU cycles each task or group of tasks are to be allocated and, within the OS, implementing the algorithm to enforce the execution partitioning. For example, I may have some networking tasks that are very important to the system, while the graphics and serial I/O subsystems are of less importance. I can assign all threads and processes relating to the networking a partition to get 66 percent of the execution cycles while assigning 20 percent to the graphics tasks and 14 percent to the serial I/O tasks.

Both parts of this column appear in full at www.compactpci-systems.com/software_corner, where you will find more on how the OS schedules tasks for partitioning, on allocating execution partitions, and on the QNX Neutrino OS and the company's Momentics development suite.

For more information, contact Curt at cschwaderer@opensystems-publishing.com.

This column appears in full at:
www.compactpci-systems.com/software_corner

More information on QNX adaptive partitioning: www.qnx.com

WWW

By Hermann Strass

Find your way

European products

EKF Elektronik GmbH, Germany, has put a GPS system and a global time receiver on a 3U CompactPCI card. The CG2-SHANTY card is provided with a high-performance receiver engine that continuously tracks all satellites in view for time accuracy better than 1 µs and horizontal accuracy better than 3 m (approximately 10 feet). The receiver is compatible with active and passive antennas. It supports the National Marine Electronics Association (NMEA-0183) data protocol, allowing almost any GPS application software to use it. Precise global time Universal Time Coordinated (UTC) is derived from the GPS system, because different countries or geographical areas use different protocol and transmit methods for transmitting radio-controlled atomic clock time signals.

The exchangeable 12-channel receiver module provides rapid Time To First Fix (TTFF). A hot start is accomplished in eight seconds. Positioning accuracy can be enhanced through communication with a Differential GPS (DGPS), which is mostly used in Europe. A DGPS system uses knowledge about the exact location of terrestrial reference stations to correct GPS errors. The GPS system has *dead reckoning* or movement tracking capability to better *find your way*. Direction and distance of travel are additional inputs to the GPS system for better accuracy and faster position determination. Gyro, inertia, or radar data are used for this purpose. This CompactPCI card from EKF Elektronik GmbH can be used *in the field* as it operates from -40 °C to +85 °C and in altitudes between -300 m and +18,000 m to help you find your way even under extreme environmental conditions and in extreme locations. EKF's CompactPCI card is shown in Figure 1. Its powerful multi-function GPS and UTC receiver enable precise time and location determination.

Figure 1

GÖPEL electronic GmbH, Germany, a global leader supplying boundary scan components and instrumentation systems, has presented the first PXI Express card as a new edition to their SCANFLEX product platform. This card was first presented at the Virtuelle Instrumente in der Praxis (VIP) 2006 congress in Fuerstenfeldbruck, Germany. GÖPEL also presented the world's first PXI Express card with Media Oriented Systems Transport (MOST) interface. The MOST bus uses plastic optical fiber for noise-free, high-performance communication in cars and trucks.

The F206N card from MEN, Germany, is in many ways rather unusual. This 3U CompactPCI card has no onboard microprocessor. The CPU is an FPGA running the NIOS II *soft processor* inside. Because of the FPGA, it is extremely flexible in the selection of functions (such as CAN, Ethernet, DSP, HDLC, memory controller, and so on) that can be used to customize the application. A set of LEDs, I/O connectors, and SA-Adapters as well as cache, SDRAM, and flash memory are available for individual configuration and function selection. SA-Adapters are very small plug-on boards with the matching mechanical/electrical connector and electrical driver circuit for the chosen type of serial interface. They plug onto a

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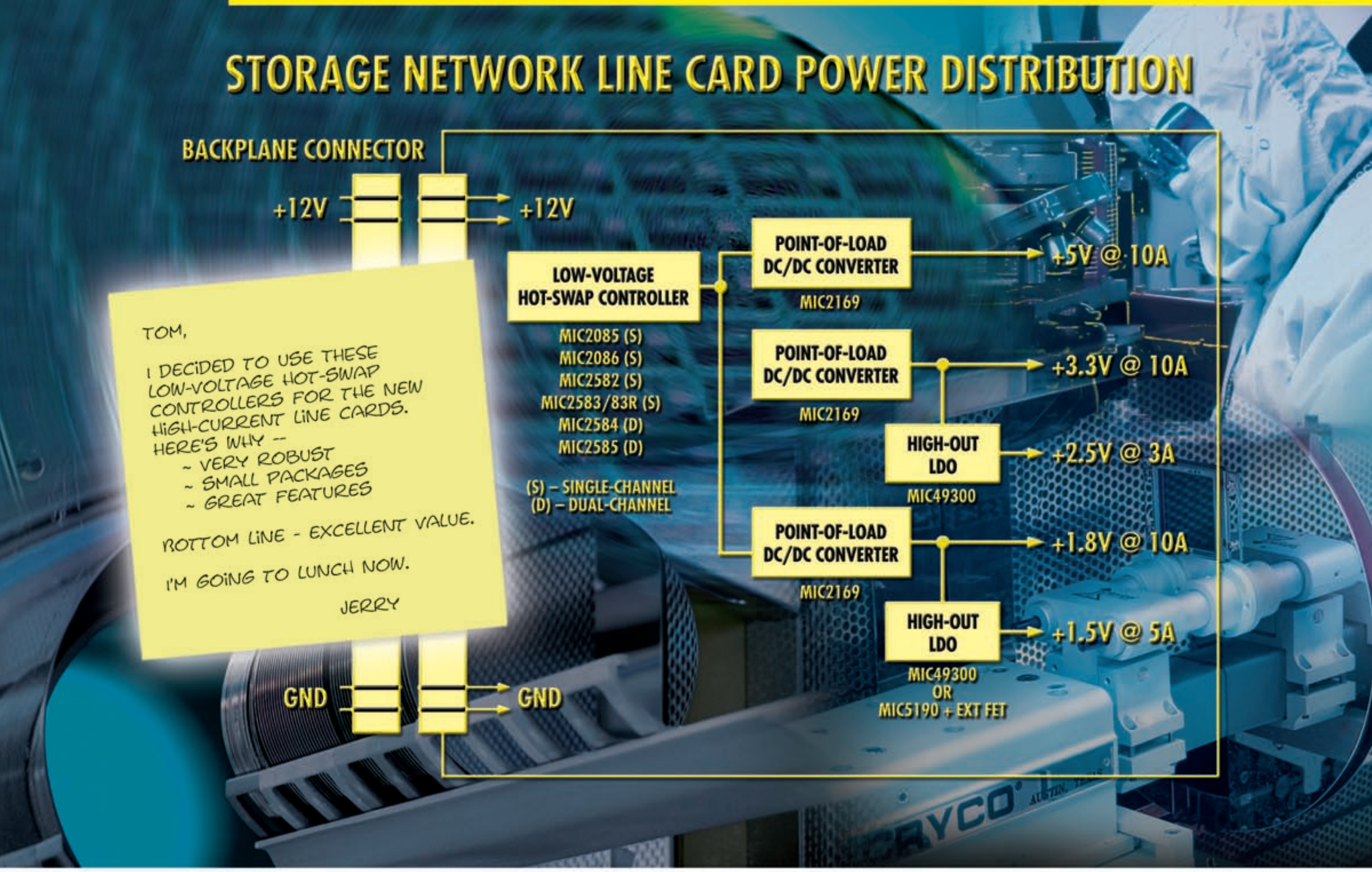

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standardized pin header. The matching protocol is typically implemented in the FPGA. This is a flexible solution that can be customized last minute before final delivery. There is no need to stock many different CompactPCI board versions.

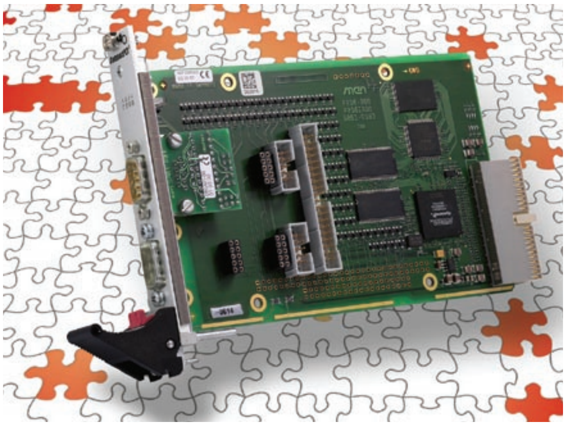

Figure 2

Internal functional elements communicate via an Avalon and a Wishbone bus and via bridges between these two buses. The F206N card (Figure 2, courtesy MEN Micro) is specified for harsh environments in a temperature range between -40 °C and +85 °C. Shock, vibration, Electro-Magnetic Compatibility (EMC), and other parameters are tested to conform to Conformite Européenne (CE), European Norm (EN), and International Electrotechnical Committee (IEC) requirements. Conformal coating is available on request. Library functions, IP cores, design, and supporting packages are available from MEN, Altera, OpenCores, and other third parties.

European applications

Transportation applications in Europe are a good market for CompactPCI system suppliers and integrators. Because Europe is densely populated, transportation by railway is used both for long distance and commuter trains. The most modern signaling systems no longer use mechanical or inductive transponder signals. They use GPS for positioning information and GSM for communication to find their way.

MEN is supplying electronic signal system boxes based on 6U CompactPCI systems configured for railway management and communication solutions by a major global railway system supplier. The systems use PC•MIP and M-Module mezzanines for I/O flexibility. For safety reasons, these boxes use three independent, redundant system units in a two-out-of-three voting system. A driverless train system (3U CompactPCI-based), built in Germany, is projected for first use in India and China, where railways transport huge masses of people every day. It uses 3U CompactPCI cards from MEN with special flexibility in functions through the use of FPGAs. It finds its way through the maze of tracks without colliding with other trains. Many European trains use the Multifunction Vehicle Bus (MVB) as a serial control and communication bus onboard the trains. Passenger information systems also use 3U CompactPCI systems from MEN for information and entertainment onboard the trains. The self-monitoring software runs on a Transmeta Crusoe processor. The FPGAs provide flexibility in I/O options.

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- More information on EKF: www.ekf.de
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WWW

COTS adoption in telecommunications

By Dr. Asif Naseem

The emergence of a set of key industry standards is catalyzing a change in the way telecommunications systems are developed and deployed. It is no longer feasible from cost and time perspectives for Telecom Equipment Manufacturers (TEMs) to build network gear that is completely vertically integrated using proprietary components. The service provider demand for converged services, speed of deployment, and reduced operating expenses is putting unprecedented pressure on TEMs to reexamine, and possibly change, the ways network equipment is built and delivered to the service providers. Adding to this pressure are TEMs' own business realities: Faced with massive staff cuts in recent years and price erosion, they are motivated to look at more cost-effective ways of building the network gear.

An industry in transition

With the ongoing consolidation of various service providers, we are reminded of the days of a large phone monopoly prior to the deregulation of the mid eighties. The 1986 telecom decree spawned a whole array of new competitors that accelerated the emergence of new services, not to mention fierce price wars and innovative strategies to attract subscribers from each other. We were introduced to terms such as *subscriber churn* perhaps for the first time in the telecom industry. There is not a suggestion here by any means that the current service provider consolidation is headed towards creating monopolies of the early eighties. However, it is to be noted that in a short span of time, seven of the largest service providers in the United States have already merged into three – (1) AT&T, Cingular, and SBC, (2) Sprint and Nextel (the company that started an envy-raising average revenue per user with their push-to-talk service) and (3) Verizon and MCI. A few key points to note about this consolidation are:

- It is creating fewer larger service providers with network footprints that are reaching national level.
- It was not long ago when smaller fragmented players – especially wireless service providers – were offering services in various regions based on disparate technologies (for instance, analog, TDMA, CDMA, and GSM).

Now most service providers are converging towards networks based on either CDMA or GSM:

- There is a sharp focus on converged services, and talk of *triple play* – bundling of voice, text, and video – and *quadruple play* – (triple play plus mobility) abounds. It is an established fact that voice alone, and perhaps best-effort data services, are no longer the growth engines they were once considered. An important implication is that the service providers must upgrade their traditional circuit switched networks to IP-based networks to be able to deliver these converged services.
- Fewer players with larger scales is resulting in increased buyer leverage for these service providers over their suppliers – the TEMs.

More than ever these service providers are focusing on a few key metrics to run their businesses:

- Reduce churn – this requires continuous innovation to deliver new and compelling services that consumers need and want. The goal is to create enough stickiness through these services so consumers are not compelled to switch service providers.
- Subscriber growth – as the *teledensity* increases, the competition to increase market share stiffens more than ever. In addition to holding onto existing subscribers, the service providers must continue to focus on capturing new subscribers.
- Increased margins – whereas traditional telephony services such as voice and best-effort data continue to generate cash, their profitability is precipitously going down. Service providers need to offer new converged services to justify higher margins.
- Top-line growth – this business driver is affected by the previous three in that it requires increasing average revenue per user, growing the subscriber base, and offering higher margin services.

The service provider business environment and challenges can be crystallized as:

- They must continue to focus on the expense structure, especially operating expenses, to bring and keep it in line with their anticipated revenue.
- They must offer new and compelling converged services to achieve their revenue and profitability goals.
- They must address the increasing competitive pressures to bring new services to market quickly and cost effectively – time to market is of the essence.

The challenges faced by the service providers determine, for the most part, the business reality of their suppliers – the TEMs. So what are TEMs doing to address these challenges?

TEMs reality

The service provider consolidation and its implications are certainly not lost on the TEMs. A service provider consolidation also seems to be underway. Merger of the two telecom giants Lucent and Alcatel, and the talk of Motorola and Siemens possibly coming together are a couple of recent examples. Is this a start of a trend? It is early to say, but these events have certainly spawned a great deal of lively debate and speculation in the industry. In any case, there are a few notable trends shaping this industry.

Whether part of a merger or not, TEMs are more than ever focused on reducing, if not eliminating, redundant and/or nonprofitable product lines. There is an opportunity, especially in a merger, to exploit operational efficiencies by streamlining various processes, especially how network gear is developed and deployed. There is a steady move towards standardization. At the handset level – especially in the mobile industry – the multifunction, high-end handsets are increasingly conforming to accepted industry standards such as PALM, Symbian, Microsoft Smart Phone, and Pocket PC. On the infrastructure side standards released by industry consortia such as PICMG (AdvancedTCA), OSDL (Carrier Grade Linux), and Service Availability Forum (HPI and AIS) are having profound impact on the platform layers traditionally thought to be competitive differentiations for TEMs.

TEMs value-add is migrating through hardware and middleware and up into the software and services layer. Another reality that is here to stay in the TEMs' world is outsourcing. Broadly, this is taking two forms. One involves the use of offshore resources to perform a variety of engineering functions to free up precious few local resources to focus on innovation. The other is the consequence of the recognition that TEMs value-add is continuously migrating up into the software and services layers, and therefore, the TEMs need to rely more on an emerging ecosystem of partners for other system components. This trend is not a temporary phenomenon and will be a fact of life for the foreseeable future.

There are profound implications of the current market realities that the TEMs need to address.

First and foremost, the TEMs must address the service provider cost, functionality, and time to market requirements for new and converged services.

Second, they need to recognize that their true value-add is in the software and services layer, and that they need to rely on their partners and suppliers for other components to put together the network elements. They can play a pivotal role in the development and proliferation of a viable ecosystem of Commercial Off-the-Shelf (COTS) components.

And lastly, they need to recognize that product attributes such as homegrown hardware, speeds and feeds, and middleware, are no longer key differentiators for them. Flexibility, cost, and time to market are more important than ever before in this industry. They must offer solutions that can address triple/quadruple play services. This requires quickly migrating to platforms and technologies that can deliver these services on a timely and cost-effective basis. Subsystem reuse can greatly reduce the cost of systems, and time to market. It has another added advantage: The reuse subsystems have most likely been field-tested before and offer minimal risk and cost associated with deployment and support. Reuse is maximized when the underlying layers conform to agreed-upon standards that allow for the higher layer to migrate with considerably less pain than would have been possible without such standards.

"Reuse is maximized when the underlying layers conform to agreed-upon standards that allow for the higher layer to migrate with considerably less pain than would have been possible without such standards."

The transition

The growing adoption of a set of key standards previously mentioned is evidence that a transition is underfoot in the telecom industry. This transition is analogous to what the enterprise computing industry went through in the 1990s. We all remember that companies such as IBM, AT&T Computer Systems, and others developed complete vertically integrated systems starting with their own silicon, boards, chassis, operating systems, myriad middleware components, and, of course, the applications. I remember my colleagues writing homegrown databases and transaction monitors during my fond tenure at AT&T Bell Laboratories in the eighties. Well, market forces – and standardization – changed all that. The system vendors began to realize that they were better off focusing on what they were really good at, and leaving the development and delivery of other components to a burgeoning ecosystem of component suppliers that developed their subsystems based on accepted industry standards. Thus the birth of a viable and vibrant ecosystem of COTS component suppliers for the computing industry.

The telecom industry is currently poised to go through a similar transformation. Figure 1 illustrates the high level anatomy of a telecom network element. Figure 2 depicts migration from proprietary to standards-based platforms. At a high level such an element can be viewed as including four layers – hardware, operating system, middleware, and the application. The traditional approach employed by the TEMs has been to build each layer using in-house proprietary technology resulting in unique offerings complete with distinct lists of differentiating features. TEMs have considered such features and functionality as their unique competitive advantage for which they expected to charge premium prices. The reality is that they were able to command high prices for such proprietary systems and, thus, fund expensive development projects with long time-to-market intervals. The current market realities – fewer development resources, increasing price pressures, and short time-to-market requirements – render such approaches to system development very difficult if not impractical. Furthermore, the adoption of standards and an emerging body of COTS component suppliers makes it not only possible to put together such systems quickly and cost effectively, but, equally important, makes the reuse of COTS components a real possibility, thereby protecting engineering investments made in building such systems. Indeed this transition from fully vertically integrated systems to a horizontal industry model is made possible primarily by the commercial availability of COTS components at each of these layers.

At the hardware level, purpose-built AdvancedTCA systems based on the PICMG 3.x specification is offering a viable alternative to proprietary systems. Many major players – including Motorola Embedded Communications Computing, Kontron, and RadiSys – have already started to ship systems compliant with the AdvancedTCA specification. These systems are being used in a variety of telecom network applications.

At the next layer up, even though there are other commercial operating systems available for a variety of industry standard hardware platforms, Carrier Grade Linux (CGL) defined by the Open Software Development Laboratory is becoming the operating system of choice by the TEMs. Companies such as Wind River, MontaVista, and Red Hat are leading the support for CGL.

The middleware layer consists of a variety of different software pieces that include, but are not limited to, service availability management, systems management, databases, and protocol stacks. The Service Availability Forum (SA Forum) has released interface specifications that enable middleware developers to abstract the lower layers, thereby developing software that is interoperable and can be transported across hardware platforms from different vendors with relative ease.

In addition, SA Forum has defined interface specifications for the application layer that allow application developers to write portable and interoperable software by abstracting the underlying service availability middleware. Several large players have been promoting standards-based modular platform architectures that provide for integration with COTS pretested middleware components. Two examples are HP's Advanced Open Telecom Platform (AOTP) and Intel's Modular Communications Platform. Other companies such as Kontron and RadiSys have alliance programs that enlist a select set of COTS suppliers to help put together carrier grade platforms.

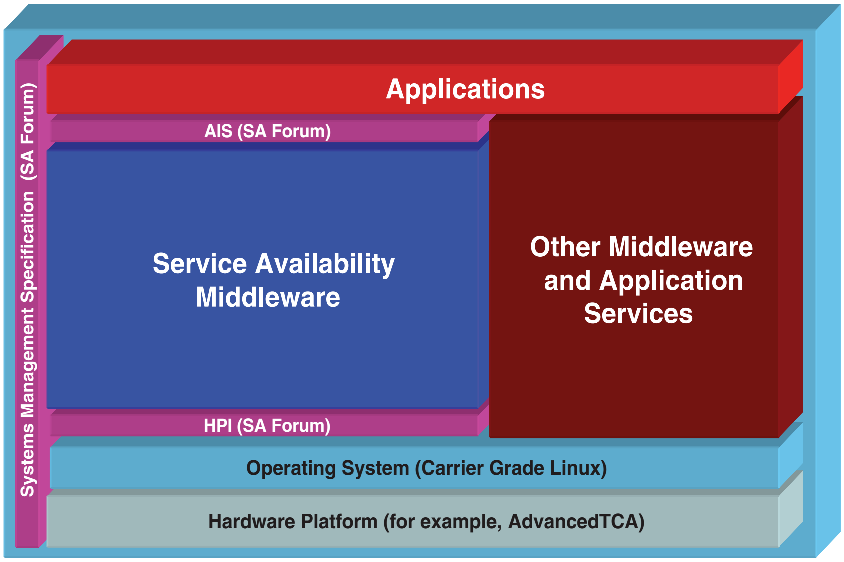

Figure 1

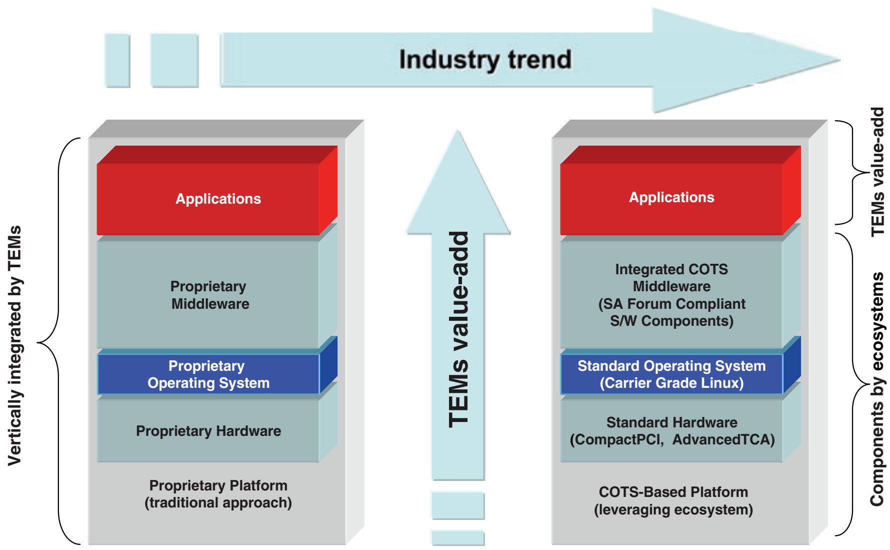

Figure 2


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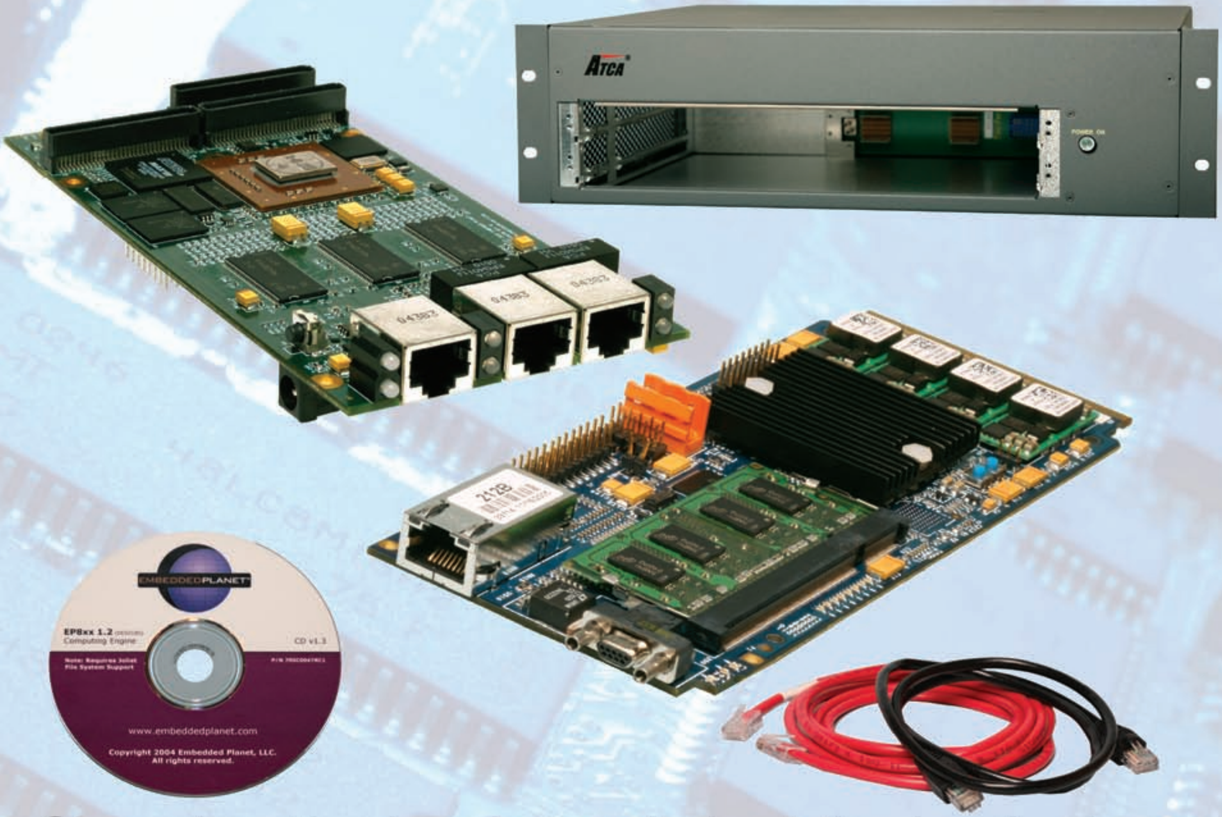

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The bottom three layers depicted in Figure 1 can be viewed as an underlying application-ready platform that supports the top layer – the application. This is where the most value-add resides for TEMs. This is where they can differentiate themselves by developing and providing compelling revenue-generating applications and services that the service providers demand. The bottom three layers can be quickly and cost effectively put together using COTS elements from a variety of ecosystem suppliers. Today there are enough components available from various suppliers to put together a carrier grade application-ready platform by using COTS components that conform to the standards mentioned in this article.

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Four IPTV trends shaking service provider foundations

By Curtis Miller

Telcos eyeing triple play home services – voice, video, and data – must transition existing networks. Four trends affect the transition:

1. The shift away from centralized networks
2. The use of Ethernet for bandwidth
3. Flexible I/O
4. The need for off-the-shelf building blocks

As Curtis explains here, understanding these trends provides options that can smooth this shift.

Using existing broadband connections, IPTV promises service providers a nearly sacred trinity of video, voice, and data delivery to consumers' homes. But four trends involving this multibillion-dollar triple play are already sending tremors beneath the fault lines of existing service provider technology.

Centralized to distributed

Today service providers place Digital Subscriber Line Access Multiplexers (DSLAMs) in central offices to support thousands of DSL users. When they only delivered Internet connectivity to as many locations as possible, this was a cost-effective and efficient structure. But delivering video to homes – even with compression – means a magnitude more bandwidth. For video delivery, service providers will have to move DSLAMs closer to their residential customers, because DSL rates increase when DSL loop-length decreases. This means placing smaller DSLAMs in *neighborhood service areas* to serve hundreds, if not thousands, of customers.

In part, residential video delivery shifts existing service provider networks from centralized, high-speed Internet services toward distributed architectures delivering triple play services. Video demands transitioning legacy Asynchronous Transfer Mode (ATM) based Broadband-Remote Access Server (B-RAS) to scalable, Ethernet-centric networks with multigigabit rates, either Gigabit Ethernet (GbE) or 10 GbE. As ATM-based B-RAS products shift to Ethernet-based edge routing, the network edge also follows.

Ethernet means bandwidth

When service providers introduce IPTV, the subscriber bandwidth needed will increase an order of magnitude, affecting aggregation, B-RAS, and IP edge routing needs. To deliver triple play service, network architectures overall will drift toward the distributed model.

Converged networks are driving bandwidth needs up – and pushing Ethernet deeper into the network architecture. In turn, the progression towards Ethernet-compliant DSLAMs causes a change in the physical interfacing, handoff, and density. As Ethernet moves deeper into more network layers, it influences signal aggregation and network edges. Sometimes, Layer 2 ATM aggregation switching is being capped. In other instances, it's removed from the network to handle new Ethernet-based access networks, driving carrier Ethernet switching that supports dense GbE and 10 GbE interfaces and switching capacities.

This change affects edge routers, and increasingly B-RAS supports Ethernet-based architectures. More and more, there's growing emphasis on GbE and 10 GbE while preserving support for ATM and Packet over Sonet (POS) to continue the high-speed Internet service that helps fund the equipment transition.

Modularity and flexibility

Service providers' network needs vary. Every central office differs when it comes to scalability, capacity, and I/O needs. It's important for vendors to support modular architectures with standardized components that enable application-ready platforms to meet these basic requirements. This approach provides service providers with an array of options to tackle broad sets of applications. And by offering a mix of products based on AdvancedTCA, MicroTCA, and AdvancedMC vendors give TEMs the latitude to deliver solutions meeting service providers' cost and scalability needs.

Eventually this approach will enable carriers to design cost-optimized networks. These networks will deliver services rapidly to limited markets for testing, tweaking, and later scale-up, based on demand. It also allows service providers to create transitional platforms working with their existing technologies.

Off-the-shelf building blocks

Commercially designed off-the-shelf, application-ready solutions based on AdvancedTCA provide an opportunity for both vendors and service providers. Common managed platforms compress time to market and cost, so TEMs can avoid proprietary module designs. In turn, this allows vendors to scale their markets. Service providers can take these off-the-shelf solutions, develop cost-effective systems for market testing, gather customer responses, and then scale quickly based on market demand. This approach lowers service provider risk and shortens time to revenue, and over the long term will lower general support costs.

Because of its complexity and pressure on network architectures, IPTV is one of the biggest challenges service providers face. Originally they built their networks for voice. Then they upgraded them for data delivery. But today these networks are insufficient to deliver video. IPTV is a large leap from legacy technologies to bandwidth hungry converged networks. To realize this opportunity, the pressure is on vendors to close the gap with innovative designs and modular solutions that are flexible, scalable, and cost effective for service providers to implement.

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Covering all the bases: AdvancedTCA, MicroTCA, and triple play packet equipment

By Thanh Nguyen

As Telecom Equipment Manufacturers (TEMs) ready the next generation of triple play packet equipment, they are taking a hard look at open platforms like PICMG 2.16, AdvancedTCA, AdvancedMC, and MicroTCA that enable them to get to market faster with more competitive products. Open platforms reduce time to market by making it easy for TEMs to outsource larger portions of their equipment design. They reduce cost by enabling TEMs to leverage increased off-the-shelf economies of scale. They enhance functionality by giving TEMs easy access to best-of-breed third-party products. And they enhance product differentiation by enabling TEMs to focus on value-added application software and services.

PICMG 2.16

The first open platform to peak interest among TEMs was an enhanced version of CompactPCI, which added a number of telecom-friendly features. Hot swap, for example, enhanced availability by enabling service providers to remove and replace individual CompactPCI blades from live shelves in the field without having to disable the shelf and disrupt overall service. The addition of a dedicated H.110 telephony bus, meanwhile, enhanced data flow efficiency by enabling CompactPCI systems to acquire Time Division Multiplexed (TDM) data, process that data, and move it between multiple blades in its native format.

What really motivated TEMs to embrace CompactPCI, however, was its support for packet transport and integrated system management. PICMG 2.16 (CompactPCI Packet Switching Backplane) added support for Ethernet backplane transfers, a key requirement for next-generation IP-based packet infrastructure. PICMG 2.9 added a system management framework based on the familiar enterprise Integrated Platform Management Interface (IPMI) model, which made it easy for remote shelf management systems to monitor and control individual blades.

The next-generation open framework: AdvancedTCA

PICMG is continuing to develop and improve the CompactPCI specification by exploring new telecom-friendly enhancements, and consolidating those enhancements under the CompactTCA banner. However, AdvancedTCA is quickly emerging as the likely successor to CompactPCI.

Adopted in January of 2003 with input from TEMs and service providers, AdvancedTCA provides a higher performance, higher density platform aimed squarely at next-generation packet networks. For example, Artesyn's PICMG 2.16 version of its SpiderWare SS7 and SIGTRAN signaling gateway blade provides up to 64 SS7/SIGTRAN signaling channels; the company's AdvancedTCA edition of this blade (Figure 1) provides up to 128 SS7/SIGTRAN channels.

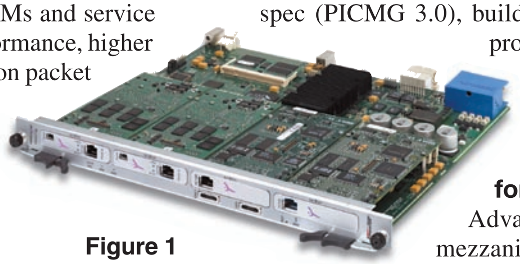

Figure 1

AdvancedTCA is an open architecture framework for building high-performance, high-density telecom shelves with 5-nines or greater availability. These high availability telecom shelves also comply with NEBS and are rack-mountable (19-inch, 23-inch, or 600 mm ETSI). AdvancedTCA's centerpiece is its high-speed switched fabric, which provides a peak throughput of 10 Gbps per link, 10 times higher than that of PICMG 2.16 backplanes. The AdvancedTCA fabric supports a full mesh interconnect, which enhances availability. Each blade can simultaneously communicate with every other blade in a given shelf via dedicated channels. The AdvancedTCA fabric is also protocol agnostic, enabling it to support multiple packet-oriented protocols, including Ethernet, InfiniBand, PCI Express, and RapidIO. PICMG 2.16, by contrast, specifies Gigabit Ethernet as the transport.

In addition to its high-speed fabric, AdvancedTCA provides a number of other features that are critical for TEMs. Its large form factor (8U) and high-power capabilities (200 W per blade, versus only 50 W for CompactPCI), gives AdvancedTCA the capacity to support complex functions and higher-density configurations. And its redundant fabric, redundant power, and hot swap capabilities reduce susceptibility to point failures and enable individual blades to be serviced and upgraded without disrupting overall service.

With regard to service providers, one of AdvancedTCA's most attractive features is its support for IPMI system management, which enhances availability by facilitating active monitoring and control of individual AdvancedTCA blades. IPMI utilizes an I2C-based physical interface to link chassis management with board-level Field Replaceable Units (FRUs). Through this interface, chassis management can monitor physical system health characteristics such as voltages, fan speeds, temperatures, and power supply status. Chassis management can also utilize IPMI for automatic event notification, remote shutdown/restart, and to dynamically allocate power to individual blades, which helps optimize system-wide power consumption and cooling.

CompactPCI, through the PICMG 2.9 add-on, provides a comparable management framework. The AdvancedTCA framework, by contrast, is incorporated as part of the baseline AdvancedTCA spec (PICMG 3.0), building on the PICMG 2.9 spec to provide a higher level of detail and additional IPMI commands.

AdvancedMC provides flexibility and scalability for AdvancedTCA

AdvancedMC is a field-replaceable mezzanine card for AdvancedTCA systems that enhances AdvancedTCA flexibility by extending its high-bandwidth, multiprotocol interface to individual hot swappable modules. The resulting fabric gives TEMs a versatile platform for building modular telecom systems that can be outsourced, designed/manufactured, stocked, and spared at a lower cost. The modular fabric also reduces service provider operating expenditures by reducing the impact of component failures, and enabling service providers to scale, upgrade, provision, and repair live systems with a finer degree of granularity and minimal disruption to overall service.

AdvancedMC modules feature a serial packet interface with up to 21 I/O channels, each supporting data transfer rates of 12.5 Gbps per channel. The modules are hot swappable. Service providers can replace individual modules in the field without taking entire AdvancedTCA blades off line. With AdvancedMC high power handling capability (up to 60 W per module), TEMs can implement complex functions at the module level. And they provide an IPMI interface, which enables shelf management to monitor and control individual AdvancedMC modules residing on AdvancedTCA blades.

AdvancedTCA carriers can be equipped with up to eight AdvancedMC modules, which come in four sizes: Half-height single-width, half-height double-width, and a full-height version of both of these. The modules have escalating power limits, ranging from 20 W for the smallest module to 60 W for the largest module.

MicroTCA addresses low- to mid-range applications

Because of its high performance, modularity, and 5-nines reliability, the AdvancedTCA/AdvancedMC platform is an excellent fit for many mid-range to high-end telecom infrastructure applications. This performance, flexibility, and reliability, however, comes with a price tag that may make it too expensive for many central office, outside plant, and customer premises applications. AdvancedTCA's generous form factor is also a stumbling block for outside plant applications such as wireless basestations with tight space constraints.

To address these low- to mid-range telecom applications with space and/or cost constraints, PICMG is in the process of creating a new system-level specification based on the AdvancedMC platform known as MicroTCA, which will target low- to mid-range telecom applications with tighter cost and space constraints.

With ratification expected in June 2006, MicroTCA essentially eliminates the AdvancedTCA carrier and enables equipment makers to directly plug AdvancedMC modules into a variety of chassis. MicroTCA enables equipment makers to leverage the installed base of off-the-shelf AdvancedMC modules, while offering lower cost and a smaller footprint. TEMs can reuse the same serial fabric interface and integrated IPMI system management used in AdvancedTCA/AdvancedMC systems in MicroTCA. This combination makes MicroTCA an outstanding complement to AdvancedTCA for small form factor central office and outside-plant applications like wireless basestations, Wi-Fi/WiMAX radio boxes, next-generation digital loop carriers, optical ADMs, Fiber to the Curb optical network units, media servers, media gateways, and others.

The foundation for the MicroTCA chassis is the MicroTCA Carrier Hub (MCH), which provides the switched fabric (Common Region and Fat Pipe Region) and shelf management functions. MicroTCA backplanes provide scalable bandwidth up to 40 Gbps. Using the same serial transport mechanism as AdvancedMC, MicroTCA backplanes can provide a raw bandwidth of 12.5 Gbps per channel, and support star, dual star, and mesh topologies. As they are protocol agnostic, MicroTCA-based systems can support a variety of packet-based protocols, including Ethernet, PCI Express/AS, and RapidIO.

To enhance availability, MicroTCA shelves support hot-swappable AdvancedMC modules, enabling service providers to replace individual modules in the field without taking the entire shelf off line. The MicroTCA backplane also provides IPMI, which enables the shelf management to monitor and control each module installed in the backplane.

MicroTCA shelves will be able to accept any standard AdvancedMC module in a variety of form factors, including

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RSC# 28 @ www.compactpci-systems.com/rsc half-height/single-wide, half-height/double-wide, full-height/single-wide, and full-height/double-wide. Figure 2 shows a MicroTCA concept shelf. A typical high availability shelf could combine redundant MCHs and power modules with up to 12 AdvancedMC modules. MicroTCA shelves will take power from an AC main or traditional -48 Vdc telecom source, and convert it to 12 V for delivery to individual AdvancedMC modules.

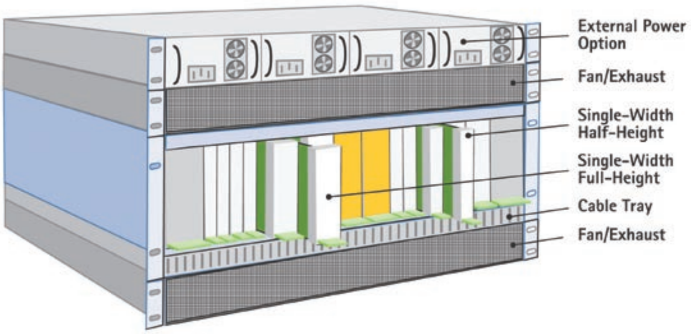

Figure 2

At SUPERCOMM June 2005, several PICMG members collaborated to provide the first MicroTCA shelf demonstration, which featured a live application server capable of servicing millions of subscribers. The demo was built around a 2U MicroTCA chassis equipped with five Artesyn AdvancedMC modules and redundant Artesyn power conversion modules. At the recent 3GSM (February 2006) show, Artesyn took MicroTCA to the next level, demonstrating a turnkey 12-slot MicroTCA development system equipped with KosaiPM payload modules, an MCH module, power supply, Fat Pipe switch module, application/protocol processing, and platform management software (Figure 3). Artesyn demonstrated a compact, cost-effective MicroTCA platform for evaluating and developing wireless basestation (WiMAX and 3G), IMS, MSPP, and IPPBX applications

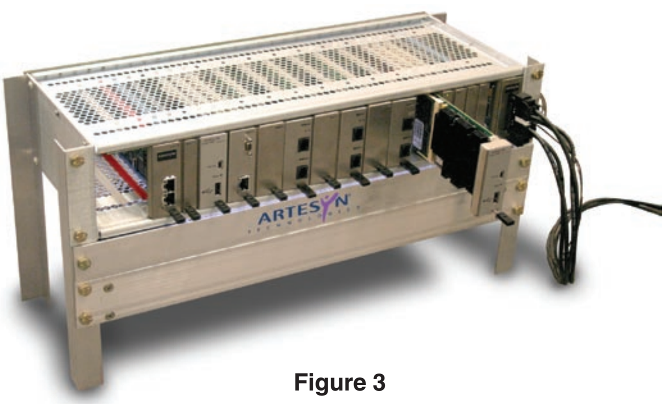

Figure 3

Conclusion

CompactPCI-based systems can still provide a good solution for many telecom projects. However, taken together, AdvancedTCA, AdvancedMC, and MicroTCA provide a modular, scalable, end-to-end framework that addresses the full spectrum of next-generation, high availability packet-based telecom applications, from core routers and WDMs, to converged customer premises equipment. This open framework helps drive equipment costs down by enabling telecom OEMs to quickly develop and configure systems by using affordable, off-the-shelf hardware and software components. And it reduces operating costs by providing a modular, field replaceable framework with integrated system management that enables carriers to scale, manage, and service their systems with a higher degree of granularity.

Thanh Nguyen *is a product manager and architect at Artesyn, where he is responsible for Artesyn's AdvancedTCA, AdvancedMC, and signaling protocol product lines, including long-term strategic vision. Thanh has 20 years of experience in the telecom and embedded industry, with a strong emphasis on telecom infrastructure technologies such as ISDN, ATM, MPLS, VoIP, and NPU. Prior to joining Artesyn, Thanh worked in a variety of technology, marketing, business, and management consulting capacities. Thanh is a graduate of Penn State University.*

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MicroTCA: Just what the doctor ordered

By John Groezinger and Paul Virgo

MicroTCA is predicted to make major inroads into the telecommunications arena, particularly for access applications. A major expectation, though, is that the technology will be adopted across several other major market segments, thereby fulfilling an economies-of-scale proposition that will benefit all applications and make MicroTCA a viable alternative to proprietary designs in cost-sensitive markets.

In this article, John and Paul look at one potential MicroTCA market, the medical and health care industry. Changing dynamics are making a market that has been somewhat successful for CompactPCI an ideal market for MicroTCA.

Background

Worldwide pharmaceutical spending is about $500 billion annually. Another $150 billion is spent on nutriceuticals (herbal and other quasi-medical remedies sold over-the-counter by specialty outlets and Internet sites). Chronic care accounts for 75 percent of all health care spending in the United States, approaching $1 trillion each year[1]. These costs are projected to increase significantly as baby boomers reach retirement age, and an increasingly obese nation experiences heart disease, diabetes, and other diseases associated with a sedentary lifestyle.

Diagnostic modality trends

Reducing capital investment in medical equipment is always welcome, and can be aided by building systems around open standard platforms that provide cost reduction through economies of scale and competitive pressures. However, the bigger challenge is to reduce operating expenses by increasing the efficiency with which services are offered. This translates to making equipment more portable, with higher compute density (MIPS per watt), increased scalability to support smaller served markets, greater flexibility, availability, and serviceability, and providing the broadband connectivity to support a decentralized distributed network of equipment that, to borrow terminology from the telecom industry, brings a wealth of services to the last mile, or last few miles anyway, of the patient location.

In the health care industry, the pendulum is swinging from low-margin/low-value diagnostics and high-margin/high-value drugs to the complete opposite. Leading drug companies have seen their companies devalued due to competition from generic drugmakers and failure to adequately contain costs. High-value/high-margin diagnostic modalities and advances in human genetics will usher in new treatment paradigms that utilize specialized drugs that are closely monitored and managed, improving outcomes and reducing costs.

MicroTCA can capitalize on high-value/high-margin diagnositic modalities. The paradigm shift is visible in GE Healthcare's vision to move from *Late Disease* care to *Early Health* by driving the industry to utilize comprehensive diagnostics and specific therapies before symptoms occur, resulting in higher clinical efficacy and efficiency. Likewise, Siemens Medical Solutions has said, "We are moving from treating illness to treating patients," which translates into demand creation for broadly based diagnostic modalities[2].

These and other health care industry leaders are pursuing the theory that costs for chronic care will decrease and patient health will improve if molecular imaging technologies detect diseases before symptoms occur. Molecular imaging can also be used to predict a drug's efficacy, help prevent Adverse Drug Reactions (ADRs), and determine safety margins for new drugs. Again, this will accelerate demand for high-end diagnostic modalities to levels never seen before.

Enter a new term, *theranostics*, which refers to tailoring generic therapeutic pharmaceuticals by utilizing diagnostic functional imaging techniques. Using scanning technology such as functional Magnetic Resonance Imaging scanners (fMRI), new drugs can be designed, therapy monitored, and patient care improved by working at the molecular level before symptoms appear. This trend will increase the need for new scanners of all types, including radiology technologies for diagnosis, as well as technologies for monitoring therapies. Pharmaceutical companies consider this *Disruptive Technology* vital for drug discovery and as a way to offset a significant portion of the typical $1-2 billion development cost per new drug[3].

Problems in the modalities

Leading-edge technology continues to create new applications (read reimbursable procedures) for advanced scanners such as Positron Emission Tomography/Computed Tomography (PET/CT) to diagnose epilepsy and dementia (for example, Alzheimer's disease). An aging global population along with the need to reduce chronic care costs of pharmaceuticals will drive increased demand for advanced scanners to more effectively, that is, economically, deploy health care at earlier stages of disease. As the cost of diagnostic equipment decreases, it becomes more practical to install equipment outside the hospital at clinics and laboratories, which operate under a much more stringent cost model. Performance, patient throughput, and relative expense make up the principal feature set driving secondary equipment acquisition. This growing market coupled with developing world medical expenditures drives a high-performance, compute-dense, and cost-effective base system model such as MicroTCA. Thus, the industry growth of 10-15 percent is likely to accelerate and drive the need for more embedded and integrated computing platforms such as µTCA. Figure 1 depicts a hospital network centric diagnostic imaging system for health care.

Slice wars

The slice wars continue with 64 MultiSlice CT (MSCT) scanners considered to be flagship products and 16 MSCT rapidly

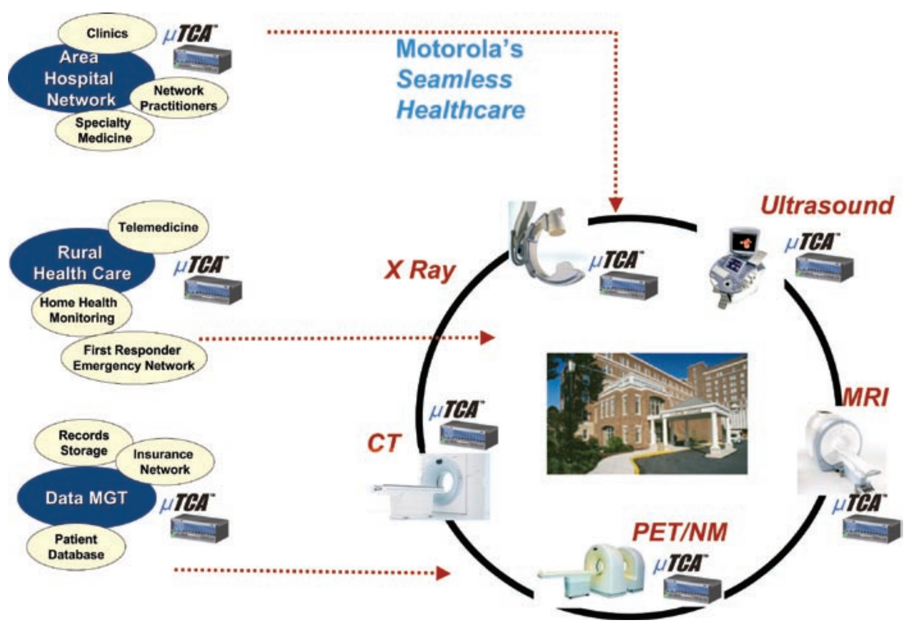

Figure 1

becoming outdated. The 64 slice scanners are enabling coronary CT Angiography (CTA), or CT Colonoscopy (CTC) applications. These procedures have higher diagnostic accuracy at reduced cost and increased patient comfort. As a consequence, 64 slice scanners will replace diagnostic coronary angiography and colonoscopy screening in the future. CTA is also proving to be a more effective ER triage tool than traditional Electrocardiogram (ECG) and enzyme markers techniques in determining whether chest pain is due to acute cardiac syndrome.

Dual Source CT, another leading-edge technology, provides increased speed and accuracy while addressing the concern regarding MSCT by reducing patient exposure to electromagnetic energy. CT systems are generating image data that is growing at an exponential rate, requiring higher scalability compute platforms such as MicroTCA. In addition, imaging applications such as CT and PET/NM are being combined to enhance multiple diagnostic throughputs at lower cost points. These *hybrid* devices – coupled with the implementation of 64 MSCT and Dual Source CT scanners – will drive a convergence of modular imaging functions into a common base platform. MicroTCA is the common thread that will allow these massive imaging and data intensive applications to attain the next level of integration in health care.

MicroTCA is embracing the requirements for higher power processors with 60 W per module available. Deploying modules with embedded processors results in the maximum processor per the physical volume the system occupies, thereby reducing the medial system footprint. Ten payload slots are available per system for processing, I/O, or third-party modules. The performance increase results in a huge reduction in recon and more time for patient procedures.

PET nuclear medicine

Through molecular imaging, PET/CT has been shown to provide early detection of brain disease, such as Alzheimer's, Parkinson's, and Lewy Body Disease (LBD). Statistics show that 10 percent of the North American population will suffer from some form of dementia between the ages of 78-84. This increases to 25 percent between the ages of 85 and 92[4]. By screening for these diseases, it is anticipated that care will be more cost effective and the disease less debilitating. This will drive demand for these high-end ($2 million and up) scanners. MicroTCA can help here, too.

Due to the *integrated* nature of PET/CT, OEMs are faced with integrating operator consoles running on Linux workstations (system #1), the CT image processing platform (system #2), and the positron detection platform (system #3) to create one cost-efficient modality. Typically, a high-speed, low-latency 100 Mb serial connection (other than Ethernet) between these systems is required, resulting in additional hardware and cost. MicroTCA delivers an embedded platform with Linux running on Intel architecture processors for console functionality. In the basic connection, two x2 PCI Express (PCIe) full duplex links will interconnect image processing cards at 1 GBps each. The extended connection can be used to obtain two more x2 PCIe links. Gigabit Ethernet (moving to 10 Gigabit Ethernet) interconnects everything in the same chassis, resulting in less equipment to manufacture, install, and service.

The Intelligent Chassis Management Bus (ICMB) in conjunction with software (such as Motorola Basic Blade Services software) allows intelligent reporting of system configuration and events to an internal system manager. This mechanism provides an orderly power up and health check of all processing functions. Clogged filters resulting in system downtime and increased costs can be prevented since elevated temperatures are reported before damage can occur. Front serviceability makes field upgrading modules easy. And the same manager will quickly re-inventory and reconfigure the platform when the customer purchases new diagnostic applications to field upgrade their existing equipment. All of this results in lower service cost for OEMs and higher uptime for end users.

New MRI applications

Applications including fMRI and high field (3Tesla) systems provide increased diagnostic accuracy for MR Angiography (MRA) as compared to Digital Subtraction Angiography without the use of ionizing radiation. In addition, multichannel and parallel sensing techniques, such as SENSE or SMASH, enable 10-second scan times for trauma applications. Therefore, additional techniques must be used to achieve reductions in scan times. All of this depends on embedded computing platforms, such as MicroTCA.

Building an MRI system that makes use of multiple channels and parallel sensing techniques typically requires integration of a wide variety of processing cards interconnected with a low-latency communication network. With MicroTCA, the communication network is integral to the architecture. The MicroTCA specification allows for 16 communication ports each per 12 modules resulting in 192 ports for data transmission. These ports talk to a MicroTCA Carrier Hub (MCH) switch, which may be reconfigured as platforms are upgraded. This high-speed network can result in PCI Express links as fast as x16 8 GBps, which are nonblocking through the fabric switch.

And the platform is deployable with a wide variety of options, ranging from a low cost of entry solution with just a few slots to a multiple chassis solution. Consider the possibility of creating a remote image reconstruction console that is based on exactly the same MicroTCA technology as the MRI console, but located next to the radiologist. MicroTCA is small and scalable enough to be deployed for remote reading of images. Its size also allows it to be buried within the imaging device itself.

Ultrasound

Due to the rapid evolution in this market segment, many of the traditional ultrasound applications are being challenged or superseded by the advanced functional imaging technologies described earlier. While far from obsolete, ultrasound equipment providers will have to respond to this competitive pressure by focusing on markets that offer leaner margins, such as small practices, home health care, and developing world health care infrastructure, which require smaller, more portable systems and cost-optimized technologies. These are two of the essential value propositions of MicroTCA. Packaging such as PICO and the cube, coupled with performance and cost advantages, extend MicroTCA far beyond today's platforms with similar base technology.

Utilization of MicroTCA in very small form factors allows for the use of the same console technology that is being used in other modalities but with small, bolt-on firewall packaging. Even in small, cost-effective platforms, the platform has high processing power: The capability to integrate third-party cards and draw on the technology that is being created for other markets at cost-effective price points. Typical ultrasound modalities need graphics and sound processing, which will be available from the ecosystem that is being created by MicroTCA.

X ray

That old standby, the X ray, is also seeing changes that bring new life. Film-based systems are migrating to full digital detector systems, often incorporating features for computer aided diagnosis. These digital modalities require processing and consoles that provide the same look and feel of the other modalities found at health care providers. These include a wide variety of applications, such as vascular, fluoroscopy, and mammography.

Utilizing solutions (such as integrated consoles and image processing cards) already developed for other modalities enables a cost-effective platform development. MicroTCA application platforms provide upwards and downwards scalability while retaining a common communications infrastructure and Serial ATA storage technologies. The very fine level of granularity allows for insertion of new technologies and creates future cost reduction opportunities. This drives a much more flexible scaling model that is well suited to the ever increasing and dynamic nature of these diagnostic imaging modalities.

Health care physical for MicroTCA

MicroTCA has benefitted from the lessons learned from CompactPCI and AdvancedTCA in terms of building a modular/scalable, communications-centric, price/performance-sensitive architecture. Add to that value proposition the opportunity for commoditization through volumes more akin to enterprise applications, and we have a serious contender in the race to build a unified medical equipment platform strategy – a singular platform foundation for all modalities.

Until the advent of MicroTCA, a base platform has not been available to address all modalities. With the emergence of MicroTCA, medical OEMs can now start to realize their collective goals of applying a base foundation technology that addresses urgent health care economic issues while supporting the profound diagnostic advances required to revolutionize health care.

MicroTCA will enable the medical OEMs to provide theranostics and diagnostic preventative health care solutions for today, tomorrow, and beyond, ensuring it a healthy future and long life in medical diagnostics.

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Future safe networks: The DNA2 uncertainty

By Haim Melamed

Triple play, Fixed Mobile Convergence (FMC), and IP Multimedia Subsystems (IMS) are the three main drivers of the telecom world today. Quadruple play, which is actually the first two (triple play and FMC) bundled together, is the direction in which carriers are moving forward, providing multiple, optionally bundled services to customers. The third – IMS – is the unified future network, based on Internet Protocol, required to seamlessly support various services of the quadruple play, or any subset of the quadruple play.

Any telecom expert that you encounter will agree that voice, video, and data in the fixed and mobile environments will eventually ride over IP. Convergence is apparent, allowing additional services to run on a single IP network.

Are we close to a point where one solution will fit all? Surprisingly, the answer is negative. Any carrier that is currently building a Next Generation Network (NGN) is facing multidimensional uncertainty.

The networks' Devices, Network, Access, and Applications (DNA2) future is actually diversifying rather than consolidating. Stronger and feature-rich handheld devices and Customer Premises Equipment (CPE) products have been created. New network-based protocols and codecs emerge each day. Different types of broadband access technologies exist including xDSL, Cable, Fiber to the X (FTTx), Broadband over Power Line (BPL), and Broadband Wireless Access (BWA). Many new applications and services need to be deployed rapidly to increase Average Revenue Per User (ARPU) and reduce churn.

Any carrier that is trying to build a *future safe network* under this multidimensional uncertainty is facing a great challenge. Selecting a single vendor as an infrastructure provider will possibly lock the carrier to specific devices, network, access, and service creation environments. Moving towards the best-of-breed direction as derived from the IMS architecture has proven to be the correct course forward.

Devices

The IT and telcom worlds exhibit similar behaviors over time, with the telecom world lagging behind the IT world. The IT world has moved forward from a dumb terminal based world, connected via a fixed connection over a slow network to a centralized mainframe computer. This new world encompasses high-performance personal computers communicating peer-to-peer via a wireless, fast network.

Similarly, the telecom world has moved from the old POTS telephone, connected via a fixed line, voice-only TDM connection, to a world where mobile devices, supporting voice, data, and video communicate with each other over high-speed, 3G networks. See Figure 1.

Current telecom devices are hybrid devices, supporting multiple applications in a compact form. The CPU power in today's mobile telecom devices equals the power we had 5 years ago in a home personal computer. In parallel, the speed of today's cellular 3G networks equal the speed of local area PC networks that existed 10 years ago. Today there is storage space in mobile devices that is equivalent to storage we had in home PCs 5 years ago.

The combination of powerful edge devices on one hand, and a very fast network on the other hand, enables the creation of many applications. Distributed computing, file sharing, video conferencing and streaming, and additional applications are available today in our home PC over broadband Internet connection. These applications are becoming available on the mobile telecom devices, too. The life cycle of telecom devices today is between 9 and 30 months, depending on the geographical and cultural elements. However the replacement of the user's mobile device will create new revenue for the service provider, while the substitution of a network infrastructure supporting new device applications leads to expenses being incurred. Therefore, service providers must become vigilant while building an infrastructure correctly as this will support robust, faster, and application-rich devices.

Network

Building a network to support new applications and devices is not an easy task. Although some levels of uncertainty have

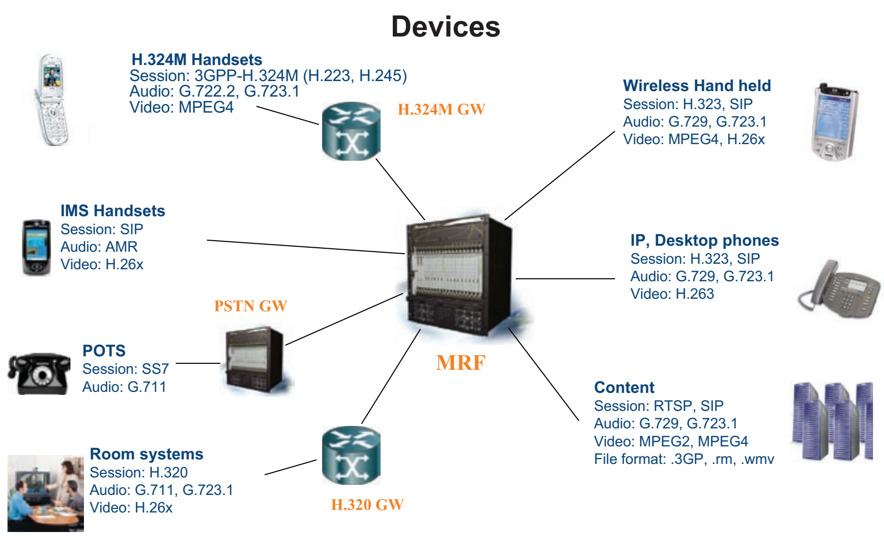

Figure 1

been eliminated, we are left with many unanswered questions.

IP is the chosen protocol for all future networks. Naturally, voice is carried on these networks using VoIP protocols. The architecture of IMS as the core solution for NGN networks enables the interoperability and integration of different network elements among themselves and various network services and applications.

The interaction between new world devices and the NGN IMS network creates many new media types, formats, and protocols. On top of the core IP-based network we see:

- Multiple control protocols
  - SIP
  - H.248
- Multiple media types
  - Voice
  - Video
  - Data
  - Audio
  - Images
  - Animations
- Numerous media formats (G.711, G.722, G.723, G.726, G.728, G.729, G.729e, EFR, AMR, WB-AMR, EVRC, QCELP, 4GV, iLBC, ISAC, H.263, H.264, MPEG4, and many more to come)

Building a network to allow the transparent move of all of these and many others to come involves many open questions. A service provider must select the right equipment for the IMS infrastructure to support all of these and myriad unknown others in the future, without a forklift upgrade.

Access

The advantage (and disadvantage) of IMS is that it does not define the access technology. The greatest variety in the telecom world today is of access technologies. In the wireline space, other than the TDM telephony network, the dominating technology is broadband. Among the different broadband technologies we can find dozens of variations of xDSL, cable, fiber, and broadband over power line. In the wireless space, we can find many variations of cellular broadband wireless technologies, wireless LAN technologies, and Fixed Wireless Access technologies. A partial list of these technologies includes:

- UMTS
- CDMA2000
- 3.5G
- 4G
- TTD
- Wi-Fi
- MetroFi
- WiMAX (2004/16e)
- Flash-OFDM and many future additions

Although all of the technologies mentioned earlier are the transport technologies for voice, video, and data packets riding over IP, each one of them requires the infrastructure to support different network characteristics (such as bandwidth, delay, jitter, and packet loss) and different media codecs.

In addition, the use of all of these access technologies and protocols in parallel requires massive resources of transcoding and protocol translation in the access and in the network. A solidly built, future safe NGN network must take into account these requirements, and the uncertainty of the future winning access technologies.

Three application waves

Customer applications drive the multidimensional uncertainty of NGN networks. Introducing new applications is the only way to address telecom operators' chief concerns: increasing ARPU and reducing churn.

Telecom applications come in waves. Globally, we can see different waves of applications occurring at different times.

The first wave starts from voice, followed by text, data, video, and multimedia (Figure 2). Our parents used the telecom infrastructure for voice calls only. We are using it today extensively for text messaging, too (mainly SMS). Our children are now using it to browse the Internet and download music and games, while some of us are already using it for video calls and video streaming.

The second wave begins from real-time use of the network and adds the support for store-and-forward applications. For each type of telecom media we have the real-time and the store-and-forward versions (Table 1).

The third wave starts from 1:1 applications and adds the support of group applications. Once again, all types of media have both versions, for example, a phone call or a conference call, a personal chat or a group chat, a personal SMS or a group SMS and a video call or a video conference call.

All of the above services must be supported on the future NGN concurrently.

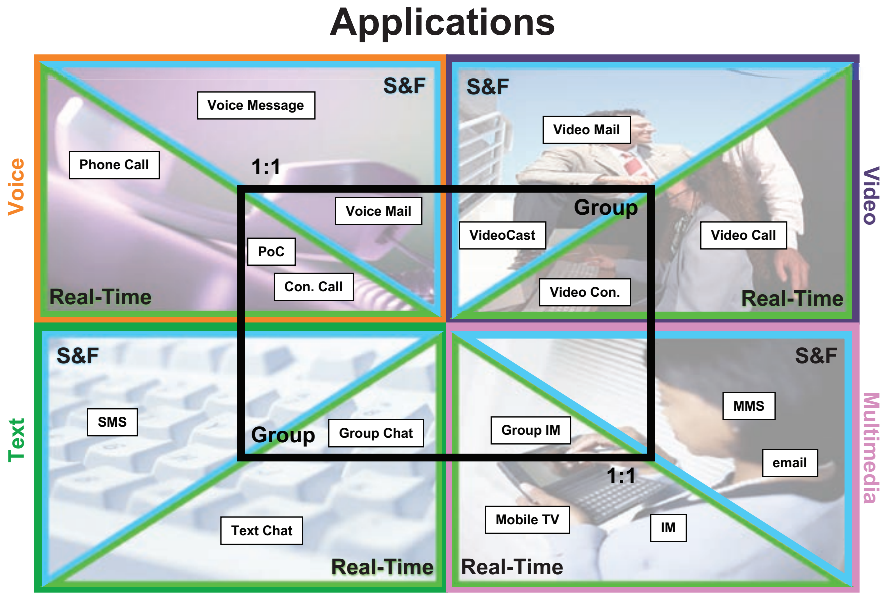

Figure 2

Real-time use	Store-and-forward service
Phone call	Voice mail
Chat	SMS or e-mail
Video call	Video mail
Live video broadcasting	Video On Demand (VOD)

Table 1

Each of them requires different device capabilities, different network services and protocols, and has different characteristics on top of different access networks. Again, a service provider planning a NGN must take into account the evolving new applications and plan a NGN to support all of those in the future.

End-to-end versus best-of-breed

Understanding the multidimensional uncertainty in building an NGN, a service provider can take one of two approaches: The easier approach is to work with one solution provider for most (if not all) of his network components. Another approach is to adopt the best-of-breed architecture, and build an open, standards-based network, to allow future flexibility in devices, network, access, and applications.

In the short-term, working with a single solution provider is an easier and safer approach. No integration hassle, no interoperability problems, and short time to market. On the other hand, the essence of the NGN architecture is the openness, and the ability to introduce future, unknown applications and technologies quickly and easily. Working with a single vendor will possibly lock the service provider into some proprietary architectures and protocols. It will make it harder, and in some cases impossible, to integrate other vendors' solutions into the network. Most important, it will not leave the freedom of choice in the hands of the service provider.

Choosing the best-of-breed approach is not an easy choice. It does involve more integration efforts in the short term, and introduces the overhead of system integration challenges. On the other hand, implementing a standards-based, best-of-breed NGN will allow the choice of the best available network elements, services, and applications, and the future introduction of any device, access network, or application supporting standard protocols and services. IP, VoIP, and IMS make this option easier.

Combining these two approaches yields an interesting situation whereby a service provider makes a hard requirement from his solution vendor to become an integrator and use best-of-breed elements for important parts of the solution network elements such as application servers, media gateways, softswitches, and media servers.

Two crucial components

In the world of best-of-breed IMS telecom networks, two of the most important components of the carrier networks are the media gateways and media servers. These devices are the only devices in the network that:

- Mediate between the different access protocols and technologies
- Mediate between the different media types' codecs
- Connect the TDM and the IP world

The media server function is the hardware resource for many NGN applications.

Selecting the right media gateway and media server for an NGN today captures every aspect of the multidimensional uncertainty. A future safe media gateway and media server must support existing and future control protocols, media types, codecs, and PSTN protocols, in order to be able to support the evolving NGN technologies into the future.

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Getting to the IP Multimedia Subsystem: Migrating the Home Location Register to the Home Subscriber Server

By Pavitra Krishnaswamy, Karl Medina, and James Radley

In this article, Pavitra, Karl, and James identify and help clarify the key issues likely to be faced in the process of deploying one of the most critical nodes in the IMS network – the Home Subscriber Server (HSS).

Many see the IP Multimedia Subsystem (IMS) both as a way to deliver existing services in more efficient and convenient ways and as a means to provide new and enhanced features that were previously unavailable due to irksome technical or economic barriers. Catalyzed by a clean separation of the call control plane (used to route calls) and the application space (used to provide service features and to differentiate network operators), IMS beckons us to pursue the telecom network we always wanted, but could never quite attain – until now.

A few years ago the Next Generation Network (NGN) – a technology/architecture that enabled one to complete voice calls over packet networks – was the hot topic. A more mature version of the NGN, IMS addresses many of NGN's shortcomings by merging the architecture with wireless standards from 3GPP, 3GPP2, ETSI, ITU, and other standards bodies. However, unlike the NGN, IMS is expected to be less of a forklift upgrade and more of an intrinsic infrastructure model that evolves with the transition from circuit-switched to packet-switched networks. In other words, IMS will be with us for quite some time, and it is in our collective best interest to make sure it really works.

Much has been written regarding the vision of IMS and the benefits of converged architecture. In order to get there, however, we in the telecom networking industry must stay clearly focused on the immediate steps that need to take place.

HSS: An evolved version of the HLR

A key component of IMS is the HSS, which harks back to the Home Location Register (HLR) of the pure wireless world (Figure 1). In a wireless network, the HLR is the central location where user information is stored. Such information includes account numbers, features, preferences, and permissions. An evolved version of

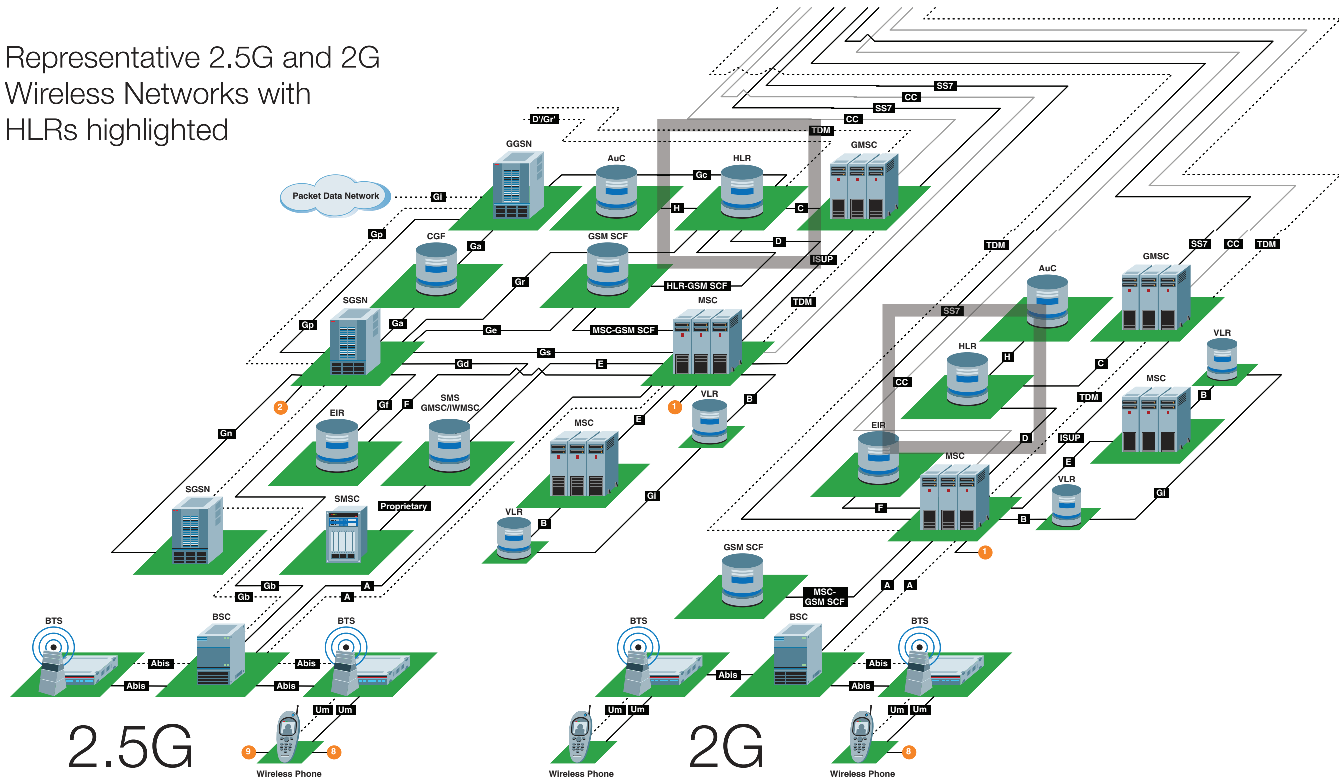

Figure 1


ARE YOU READY?
AdvancedTCA®
MOTOROLA
Arrow Electronics and Motorola have teamed up to offer the pre-integrated and verified AdvancedTCA® Development System, complete with software, and designed to save you time and money. Accelerate your time to market with this innovative system from Motorola, and benefit from the broad range of services, customer focus, and world-class expertise of Arrow. Now you can save your resources for bigger things—like the competition.
Go to **www.arrownac.com/AreYouReady** for more information on the AdvancedTCA Development System or to download data sheets. System availability is limited, so visit today. To speak with your local Arrow representative, call **800-777-2776**.
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the HLR, the HSS provides a much wider range of features and is meant to act as a master repository of all subscriber and service-specific information. It combines the HLR/Authentication Center (AuC) functionality of Global System for Mobile Communications (GSM) networks. The HSS also supplies information that the IMS network specifically requires.

In the wireless network, the HLR is essential to providing access. In conjunction with the Visitor Location Register (VLR) and the Mobile Switching Center (MSC), the HLR enables end users to send and receive calls within the home network and to travel (roam) within other networks while still maintaining access to familiar and desired services.

In the IMS world, the HSS takes on many of the same roles as the HLR, and more. Not only does the HSS fulfill the user database function, but it also:

- Provides routing information.
- Maintains data about a subscriber's real-time location.
- Keeps track of the capability of available communication devices and so on.

In today's pre-IMS wireless networks, each application or service module uses its own repository for storing end user data pertinent to the specific service provided. Although the HLR does include the majority of such data, it is not a comprehensive superset of all end user related information. This lack of a superset requires carriers to spend large blocks of time coordinating information changes across multiple databases and trying to eliminate inconsistencies in the records. As a result, when the standards for IMS were created, there was widespread agreement on the need for a single repository for all end user information, which is precisely the role of the HSS.

Transitioning existent HLRs to become HSS network elements is one of the most strategic and essential steps that carriers have to take when moving to IMS. Because of the tactical challenges associated with such a critical network node, it is important to identify and understand the key issues likely to be faced in the process of HSS deployment.

HLR-to-HSS migration steps

One may ask: How will HSS network elements within the IMS architecture actually be deployed? The answer is easy – incrementally, and with extreme caution. After all, the HSS contains sensitive subscriber information, and carriers are very careful to prevent unintended interruptions of end user services. The initial deployments of HSS nodes will likely be enhancements on existing HLR nodes already in the network. The assumed scenario is that HLR vendors will modify their designs to incorporate HSS functionality for supporting the additional end user information and interface requirements of the new IMS network elements. And, since the HSS is to be a much more extensive database than the HLR, the HSS node may need to be deployed in smaller, geographically distributed elements rather than in a single monolithic location. Although each individual node will be physically separate and more compact than current deployments, the HSS aggregate will be seen by the network as one logical network element.

The new IMS network architecture creates several important technical challenges when migrating to HSS solutions. The steps that need to take place are:

- Integrate new functionality into network equipment.
- Extend the database to accommodate new subscriber information.
- Simplify the management of a highly distributed network.
- Develop a robust high availability framework for HSS databases and clusters.

Integrate new functionality into network equipment

Figure 2 shows the logical functionality of an HSS node. Converting an HLR to support HSS functionality or building a standalone HSS network element requires carriers to complete certain tasks.

- Add new software functionality.
  - The HSS calls for the addition of new software modules and interfaces to support IMS-specific network elements. For example, the HSS communicates with the Serving Call State Control Function (S-CSCF) and Application Servers (SIP AS, OSA SCS, and IM-SSF) in the IMS architecture. The key protocol required to support these HSS interfaces (Sh, Si) is Diameter, and so Diameter software will need to be added.
- Maintain support for existing interfaces and software.
  - The HSS is a superset of HLR functionality, and thus it must go on supporting interfaces supported by the HLR in order to service packet-switched and circuit-switched wireless network interfaces. So, for instance, the HSS must continue to maintain existing interfaces (for example, Gc, Gr) that use the Mobile Application Part (MAP) signaling protocol.

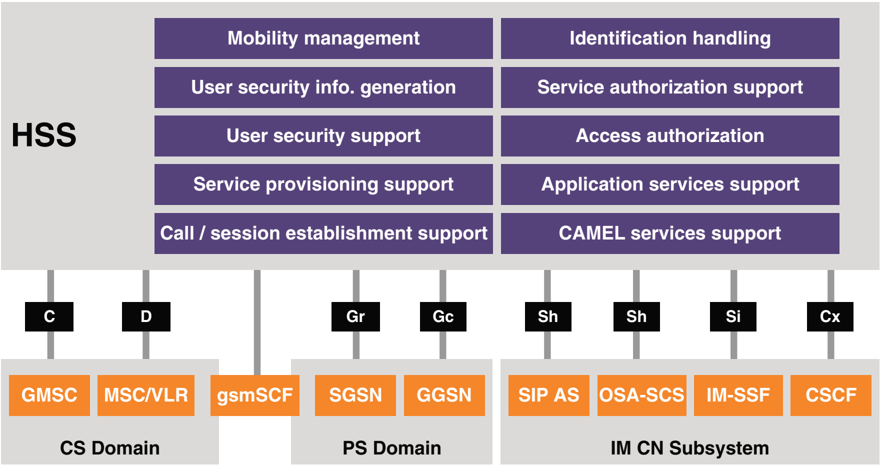

Figure 2

- Verify interoperability between the new and existing node.

Extend the database to accommodate new subscriber information

One of the most important advantages of the HSS is that it is meant to be one consolidated repository of end-user information. In current networks, each application service module maintains its own version of the subscriber database in addition to the data maintained by the HLR. Thus carriers have been required to execute well-defined and often very complex mechanisms to maintain consistency over these many repositories.

Considering these facts, the amount of data that will be stored in an HSS is expected to be much greater than what is stored in HLRs today. In addition to large storage size, the database must also be highly available and immune to failures so that there is minimal or no service disruption. And, to allow for future feature expansion and the addition of more subscribers as time progresses, equipment vendors need to also plan for an HSS database that can easily scale, such as in a *rolling upgrade* fashion where service is not interrupted.

Simplify management of a highly distributed network

One practical consideration that may limit the scaling of HSS databases will be the cost associated with increasing the capacity of database storage elements. In fact, it may not be economical for carriers or equipment manufacturers to increase the size of an existing database beyond a certain limit. The long-term solution to the scalability issue may be to add HSS network elements in a highly distributed manner whereby multiple interconnected computing and storage nodes are used to store the information, but are viewed by the network as a single logical node. Building and maintaining such a robust distributed system will require an integrated mix of hardware, software, and management infrastructure.

The efficiency of managing systems built from disparate compute resources will be important to operational success. The platform management challenges in this environment will be different than those faced in a network that is more concentrated. Fortunately, recent telecom industry equipment standards, such as AdvancedTCA (described later), offer greatly improved platform management functionality and should be considered seriously.

Develop a robust high availability framework for HSS databases and clusters

It's clear: High availability and service reliability (99.999 percent uptime) are of critical importance to the HSS. Since this is the primary repository of subscriber data, an end-user call or session will not be able to take place without reference to it. For the highly distributed architecture of IMS, telecom equipment manufacturers will be required to design the proper clustering mechanism to ensure that traffic is routed to the appropriate compute and storage elements quickly and successfully.

The PCI Industrial Computer Manufacturers Group (PICMG) has defined a family of standards for building carrier-class service platform hardware known as the Advanced Telecom Computing Architecture. AdvancedTCA defines a rugged compute blade architecture that allows for the economic deployment of highly scalable systems in the telecom arena. Scalability is achieved through a bladed architecture that allows for compute blades to be added to a live system when increased capacity is required.

High availability is achieved through rugged design by specifying N+1 redundancy in critical modules and through extensive hardware monitoring and control over the chassis's redundant platform management bus. This internal platform management bus is based upon a widely adopted industry standard called Intelligent Platform Management Interface (IPMI). Hot swappable blades, switches, and shelf management controllers allow for quick repairs to be conducted in the field without necessitating any system downtime, ensuring that 99.999 percent availability can be achieved by applications that are designed to run in an HA environment.

Practical deployment considerations

From a carrier's point of view, these issues need to be addressed as quickly and seamlessly as possible to avoid any possible service disruptions while upgrading to IMS. As a result, telecom equipment manufacturers that provide these services feel extreme pressure to resolve these issues – now.

In the past, network elements like HLRs and MSCs were developed and sold as single entities by major equipment suppliers. The telecom industry was much more vertically aligned then, and carriers were relatively dependent on individual vendors for nearly all of their expansion and upgrade plans unless the carrier chose to replace the entire system and endure massive expense and disruption.

Now, however, the telecom industry is more horizontally aligned, and the standardized nature of IMS architecture provides carriers more flexibility for enhancing and upgrading their systems by purchasing the *best* versions of each module available and then integrating them with their existing networks. With flexibility comes complexity, though, and such a mix-and-match approach invites potential problems in terms of hardware and software interoperability. As above, the key is to work with an integration partner that is proven to understand the intricacies of interoperability issues.

Conclusion

The IMS opportunity is universally acknowledged, and the long-term positive outcome of moving toward a converged architecture is widely embraced. At the same time, the near-term issues of moving quickly to deploy key IMS network elements – like the HSS – should not be underestimated.

So the challenge is clear: Telecom equipment manufacturers looking to build full-fledged HSS modules need to develop and integrate their products into carrier networks as soon as possible. The market opportunity is now, and time is of the essence. However, creating, testing, and deploying all of the protocol software and high availability hardware from scratch is a time- and resource-intensive project.

To minimize the development timeline and get to market quickly, telecom equipment manufacturers can partner with companies that specialize in the underlying infrastructure of network elements so that they themselves can concentrate on their core competency of developing the upper-level HSS software application. Whether upgrading from an existing HLR or building an HSS from scratch, vendors have a significant challenge ahead of them and will need all the help they can get. Having the right integration partner with the requisite hardware and software skills is essential to the successful rollout of IMS.

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Telecommunication servers and IMS: The perfect match for the perfect storm?

By Ed Dylag

In this article Ed explains how IMS has focused attention on COTS telecommunications servers.

Mature markets modularize – I'm sure I read that somewhere. The telecommunications industry is well over 100 years old, and even today there are people like me marketing the benefits of modularization in telecommunications. When I began my career in telecommunications more than 12 years ago, all the hype was about telecom services (specifically voice) over IP. However, three years ago my focus shifted to telecommunication servers and all of the discussion centered around build versus buy. Here I am today writing about those same two items. I sometimes get frustrated with the snail's pace at which this industry moves. But then I have to take a step back and remind myself the impact of the items I promote.

In my simplest definition, a telecommunication server is a box of standards-based hardware designed to do some compute functions for a communication application. Session Initiation Protocol (SIP) processing is a great example. So far, this definition doesn't have that broad-reaching impact I alluded to. Only when you add Commercial Off-the-Shelf (COTS) to the definition do things get much more complex. COTS is the buy in *build versus buy.* Now things start to get interesting.

A search on Google came up with many hits that describe a *telecommunication server* as an application that performs some sort of communication function like IP-PBX, instant messaging, or voice mail. This definition is a good one for the end user of such a server. However, I am going to focus on the underlying hardware only and direct this discussion to telecom equipment manufacturers who build those end-user applications. These are companies like Lucent, Ericsson, and Nokia who must make a decision – should I build the hardware for my next-generation IP services platform, or should I use COTS equipment?

So why all the focus on telecommunication servers now? While the dynamics in the telecommunication industry are too complex for me to fully comprehend, I point to a couple of key catalysts – the emergence of AdvancedTCA and the emergence of the IP Multimedia Subsystem (IMS).

AdvancedTCA is a standard hardware architecture defined by the PCI Industrial Computers Manufacturers Group (PICMG) specifically for the development of telecommunication equipment. The PICMG 3.0 specification was first approved in late 2002 and since then, PICMG 3.1-3.4 have added various fabric switching and mezzanine definitions. What's important about AdvancedTCA is that it is tailored for the telecommunication industry and supports features for high availability including:

- Hot swappable, redundant components
- Extended temperature range
- Advanced chassis level management
- Alarming

As an example, a board that gets inserted into an AdvancedTCA chassis cannot power up until it properly negotiates with the chassis management module, making it more difficult for a technician to inadvertently bring down a system by replacing a board with the wrong one. Why has AdvancedTCA created a renewed focus on COTS telecommunication servers? Because before AdvancedTCA, each and every telecommunication equipment manufacturer had to design their own hot swappable, redundant components with extended temperature range, advanced chassis level management, and alarming. In other words, before AdvancedTCA, there was no viable standard to drive modularization on a large scale at the chassis level.

So how has the emergence of IMS created increased focus on COTS telecommunication servers? IMS is a 3rd Generation Partnership Program (3GPP) standard for deployment of IP-based, real-time multimedia services. Breaking that down a bit, think about an application called *see what I see.* Let's say I am at the grocery store and my wife has asked me to buy some fruit snacks for our two year old. When I get to the store, there is half an aisle full of different brands of fruit snacks and I have no idea what to buy. With see what I see, I can make a (voice) call to my wife, point my video phone at the wall of fruit snacks, and press a button to start streaming real-time video to my wife who can lead me to the only brand my daughter likes out of hundreds of choices.

That example still doesn't explain why the emergence of IMS has created increased focus on COTS telecommunication servers. I could build that application using any number of proprietary systems from one of the large telecommunication equipment manufacturers – in fact, I could build that application without even using IMS. To make the connection, I believe you have to peel back the analysis one more layer.

There are a significant number of market segment pressures on both network operators and telecom equipment manufacturers. As an example, many wireless carriers have been through significant price wars, which push down revenue per user while the number of wireless subscribers continues to grow at a rapid rate (read higher network equipment and operating costs). No fair, this is a double whammy. One way to get out of the double whammy is by bringing up average revenue per user by getting subscribers to pay for additional nonvoice services or so-called data services. The see-what-I-see application is a great example. Getting me to pay a few bucks more a month for that feature goes a long way in improving a network operator's bottom line.

In my view, IMS is a lightning rod pulling the industry toward IP-based, blended data services that can improve the average revenue per user. Once these services enter the IP world, I contend that a COTS server much more readily applies than in a circuit-switched world. One of the key reasons is an entire industry, namely the enterprise data server world, already knows how to deliver IP-based services with COTS servers, making it much easier for the telecommunications industry to make the conversion.

"In my view, IMS is a lightning rod pulling the industry toward IP-based, blended data services that can improve the average revenue per user."

So far, it might seem like the decision to move to COTS telecommunication servers is a no-brainer. The technology exists, the standards exist, and the business model is proven in the enterprise world, so why shouldn't every telecom equipment manufacturer make the move tomorrow? Certainly, the economies of scale of standardized equipment are compelling, right? Theoretically, yes. And those of us heavily vested in COTS telecommunication servers are doing everything we can to turn that theory into practice. The reality in the grand scheme is that the AdvancedTCA and IMS standards are in their infancy. A few years in the 100+ years of the telecom age are – well – a few years. But this current movement looks like it has some legs.

Not an easy move

Nortel, HP, and Alcatel are among the many large telecom manufacturers who have announced the use of COTS telecommunication servers in their product offerings. However having worked with many of these companies, I can tell you the decision to make the transition to COTS telecommunication servers is not an easy one.

While a move to COTS telecommunication servers can help a telecommunication equipment manufacturer focus their R&D dollars more effectively on applications versus building servers, these resources are almost never interchangeable. That means finding other work for hardware engineers – or laying them off – and also means staffing up on the software side. Both can be very trying and challenging.

Next, consider the disruption to the telecommunication equipment manufacturer's supply chain. The purchasing department is probably very oriented to procuring silicon and other parts and managing contract manufacturers who assemble these parts into company-specified products. With the introduction of COTS telecommunication servers, you will be asking this same group to now deal with an entirely different supply chain with different purchasing economics as well as support dynamics.

As a last example, consider the impact to the Service Level Agreements (SLAs) that telecommunication equipment vendors hold with service providers. Building everything yourself means maximum control of the SLA. A move to COTS telecommunication servers means giving up some of that control to a third party. That sounds like heartburn.

Oh, I almost forgot, your cost of goods will probably go up as well because you have introduced one or more middle men into the supply chain.

More pros than cons

It turns out that overall in many cases, the negatives outlined earlier are outweighed significantly by their counter-balancing positives.

Laying off hardware engineers is not an easy thing to do, but making the decision to do so could significantly benefit the company and the rest of its employees overall. This sounds harsh as I write it down, but this is a tough market segment environment right now.

Yes, there will be kinks initially in the supply chain and change is not easy, but once again, the COTS supply chain has proven effective in other market segments, providing examples to learn from.

With COTS comes reduced control on the support side. At the same time, by putting the right SLA in place with the COTS supplier, the number of resources brought to bear resolving an issue can actually go up significantly.

And finally – but in my experience, often overstressed – cost of goods. More than a few years ago, before the use of COTS equipment by telecommunication vendors was as widely accepted as it is today, I actually had a telecommunication manufacturer tell me they would buy my hardware if I could match their Cost of Goods Sold (COGS) plus some 10-15 percent margin. I told them I needed 50-55 percent margin to survive. The deal never closed. The issue was that the telecommunication manufacturer wasn't properly considering total life-cycle costs. I am sure if this particular telecommunication manufacturer was willing to work with me through a life-cycle cost analysis, I could have closed the deal.

As an example, think about all of the product concepts and ideas that never make it completely through to product launch. That is part of the cost of doing business. Consider that for each component a telecommunication manufacturer decides to build (for example, compute blade, Ethernet switch, chassis, and chassis management module), several product concepts and ideas might

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die before they reach the market. While part of doing business, this gets expensive exponentially. When you instead use COTS equipment, your vendor has already incurred that cost. Sure, he will expect higher margins to cover his costs – wouldn't you? The point is the vendor has costs to cover that you might not always think about.

As if I haven't given you enough to think about, here is a parting thought. COTS equipment has a way of helping market segment share laggards improve their position. Said another way, the company one, or two, or three spots behind you in market segment share today is the same company that might be ahead of you tomorrow through the use of COTS equipment. This is usually because these market segment laggards have the *it's broke, we better fix it* mentality and may be more willing to go through the pain of a conversion in order to reap the benefits at the other side of the transition.

So where does all of these leave you? I honestly do not know. Every company's position and dynamics are unique. What I can suggest is there are people out there who sell COTS telecommunication servers who have developed pretty sophisticated life-cycle cost models that can be adapted to your situation. My suggestion is to get in touch with those vendors.

Ed Dylag *is the IMS segment manager for the Modular Communications Platform Division of Intel. He is responsible for defining and delivering world-class AdvancedTCA and rack-mount server solutions to the many service providers now implementing IMS networks. In previous roles, Ed worked extensively with media server products in both the enterprise and service market segments, with significant focus on SIP and IP telephony.*

He received a BS degree in Electrical Engineering from the University of Buffalo and has a patent pending for some of his work in telecommunications. He is a member of the CompTIA Convergence Section Advisory Council, which promotes growth and development in the Convergent Technologies (CT) industry.

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Enterprise VoIP grows up

By Herman Abel

The facts are clear: As even a brief glance at the offerings listed in the Voice Product Guide *that follows will show, Voice over Internet Protocol (VoIP) technology has matured, inevitably leading to increased competition, especially from low-cost solutions. How do equipment vendors and systems integrators survive? How do they protect the gross margins? How do they keep ahead of the competition? Everyone in the VoIP industry faces these dilemmas. Herman aims to provide insight into where to find the answers.*

Technological superiority

Companies can achieve differentiating competencies by developing a technological superiority. Indeed, many R&D organizations in the VoIP industry invest significant resources in research and build incredible portfolios of intellectual property in the fields of their expertise. These companies try to create barriers to entry to secure leadership in the chosen market segments.

What could be suitable for R&D organizations doesn't necessarily apply to systems integrators, who usually have no research activity and base their businesses on integration with components available from suppliers of enabling technologies. In order to stay competitive, this type of organization has to differentiate themselves by selecting and adopting the right kind of new technologies that allow their businesses to expand to a higher level.

As soon as VoIP technology starts to commoditize and the margins erode, two distinct industry trends emerge. First, some companies migrate their business into the lucrative telco market segment. Indeed, there is enough business to grab. According to a recent Infonetics Research study, *Service Provider NextGen Voice and IMS Equipment*, the carrier VoIP equipment market worldwide hit a new high in 2005, topping $2.5 billion, and is projected to increase 145 percent, reaching $6.2 billion in 2009. However, introducing telco grade VoIP offerings into product portfolios is not enough for success. The competition from Tier 1 vendors is fierce, and many companies, historically coming from the enterprise market, are not able to establish strong market positions in this space.

The other trend relates to companies taking a more modest approach while still introducing higher-level functionality than competitors. The challenge of implementing telco grade features on the enterprise level solutions mainly relates to the lower cost expectations of the latter market. This requires innovative engineering approaches and new solution architectures capable of delivering more for less.

In either case, the design of new products starts from identifying all the necessary features.

Telco grade objectives

The architectures of telco grade products are designed to support several major objectives for the final solutions: scalability, remote management, interoperability, and high availability.

Scalability

Scalability is the ability to grow and support larger volumes of calls, connections, end points, and users. The increase in the solution size, or capability, should be allowed in cost-effective increments with minimal impact on the cost of the end solutions, without total replacement of hardware or software, and without the need to re-engineer the system to contain additional services.

Remote management

Remote management is the capability of the system to be integrated with the standard OSS/BSS solutions and therefore be accessed, controlled, and maintained remotely. Standards-based interfaces and protocols, like SNMP, are used to enable smooth integration between the remote management products and the networking equipment.

Interoperability

Interoperability is another crucial objective for any telco grade solution, where hardware and software components from a variety of vendors have to operate seamlessly. The interoperability is usually achieved by checking compliance to the appropriate standards and by performing physical testing involving equipment from several suppliers.

High availability

High availability is the most complex objective. Put simply, high availability of a solution means that it should always work. In the telco grade environment, the meaning of the word *always* means that the solution should provide services 99.999 percent of the time, which leads to a downtime of no more than five minutes per calendar year. Implementation of several additional system functions, like reliability, resilience, hot swap, hitless software upgrades, redundancy, and protection mechanisms, helps enable high availability and service continuity.

Reliability and resilience

The reliability feature is frequently misinterpreted and regarded as a synonym for high quality. Having high quality for a system is certainly important, but in telco grade environments the reliability and resilience usually refer to the system's ability to perform under critical conditions, which could be, for example, severe traffic load creating control application delays.

Hot swap

Hot swap is a low-level feature, which enables removal and insertion of a hardware component from/to the system without the need for powering down and system reboot. Firms use hot swap for live system maintenance and upgrades. The hot swappable elements of a system usually include interface or media processing cards, switchboards, power supplies, fan units, and fan controller boards. Being perceived as obligatory for telco grade environments, the hot swap capability has been designed into a set of international specifications, including CompactPCI and AdvancedTCA.

Hitless software upgrades
The maintenance of the software elements in a solution could require upgrades, which should be done on a live system and without causing an interrupt, or hit, to the system operation and performance. The capability to perform a hitless software upgrade allows the network to remain available while implementing new functionality and maintaining active calls, therefore significantly reducing downtime for the solution.

Redundancy
A system's ability to keep functioning normally in the event of a component failure, by having backup components that perform duplicate functions, describes redundancy. The redundancy feature involves eliminating a single point of failure by introducing alternative hardware and software elements, allowing automatic detection and recovery from element failures without impacting calls in progress. Designers implement this feature using protection mechanisms according to any of the standard protection schemes.

Understanding protection schemes

In the telco grade environment, protection is usually implemented for all active elements of a solution, both for hardware and software. Therefore, card level, interface level, and even system level redundancies are common. Two basic protection schemes exist, 1+1 and N+1.

> "However, introducing telco grade VoIP offerings into product portfolios is not enough for success. The competition from Tier 1 vendors is fierce..."

1+1 protection
The 1+1 scheme means that for every active element in the system there is an alternative, which operates in a standby mode and is ready for action in case the main element fails. This approach is relatively simple for implementation, but is the most expensive, requiring replication of the entire solution and doubling the cost.

N+1 protection
Under the second scheme, N+1, there is only one alternative element operating on the standby mode for a set of N active main components. The approach provides significant cost reduction compared to the previous scheme, but imposes a great implementation challenge, requiring significant engineering skills. Although the concept of this protection scheme is not new to the communications equipment vendors' community, creation of truly redundant systems, keeping architectural flexibility and a relatively low cost, is

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still perceived as a notable engineering achievement.

The following examples illustrate the difference between these protection approaches based on an enterprise level IP to PSTN gateway application. Usually, the enterprise level gateways do not utilize the softswitch architecture, and therefore contain the media and signaling gateway capabilities in one device. The gateway is a standalone chassis, containing hardware cards to deal with the media and signal processing and a high-level control application. The device can be managed locally, or by using a remote management system, which in some instances could be a standard Web browser.

The architecture of the first solution, shown in Figure 1, eliminates a single point of failure by replicating the main device with an alternative one, which operates on standby and which should take control over the voice media and signaling streams in case of failure. The switching between two devices can be manual or automatic, also known as automatic failover. It is evident that the total cost of the solution is high as it includes the expenditure for two identical devices.

The architecture of the second solution, shown in Figure 2, eliminates a single point of failure by introducing minimal additional hardware and software elements and retains only one physical device. It makes use of the inherent strengths of the IP world to create distributed applications, allowing the alternative control application to be remote from the hardware. This example provides the same level of availability for the final solution as the previous one, but with the lower device count and total cost of ownership, therefore realizing significant cost savings.

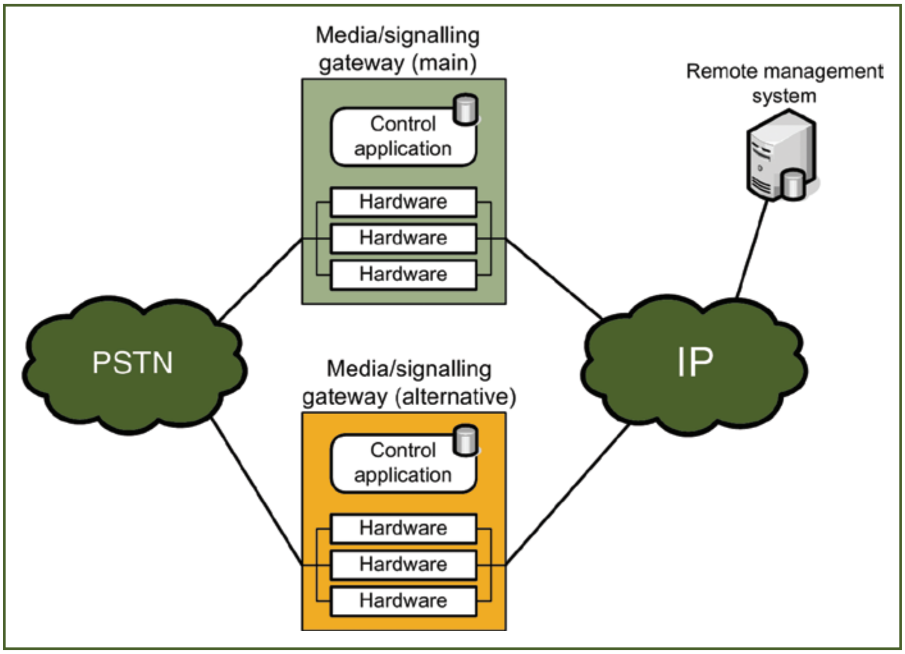


Figure 1

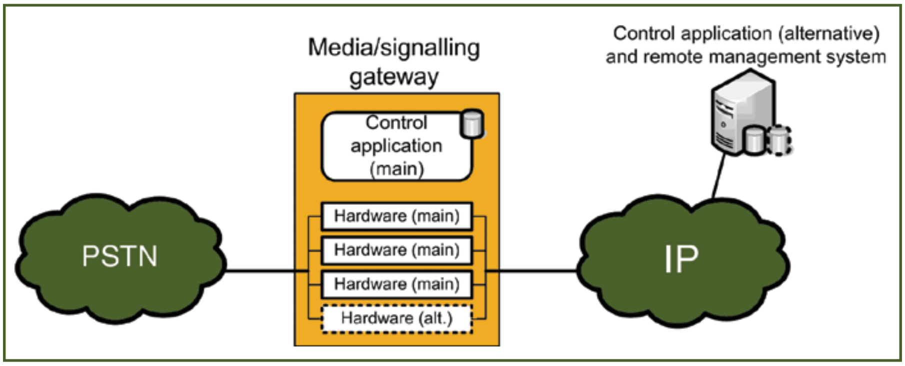


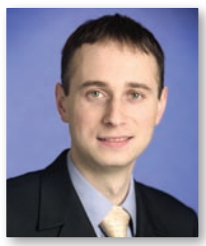
Figure 2

Conclusion

Equipment vendors and systems integrators, designing and building VoIP solutions for the enterprise market segment, are constantly looking to differentiate from the competition. Finding it difficult to sustain barriers to entry in the maturing VoIP industry, these companies have a straightforward option to progress their business by adopting technologies and practices from the telco market segment.

The implementation of telco grade functionality for enterprise solutions is now feasible. Utilizing distributed architecture inherent to the IP environment, innovative organizations are able to create highly available, interoperable, and scalable solutions for lower cost, while guaranteeing telco grade performance and full reliability for highest quality services. The flexible integration of functionality delivers CAPEX and OPEX reductions through minimizing networking equipment count and simplifying operational processes.

It is imperative for enterprises to introduce improved functionality to enhance their converged network platforms for the delivery of innovative, next-generation services for their organizations and customers.



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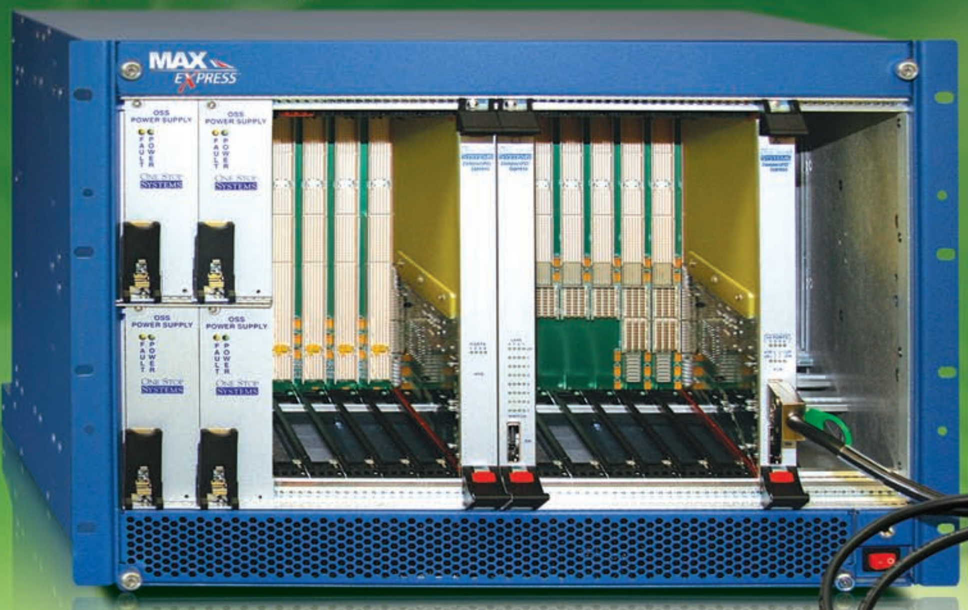

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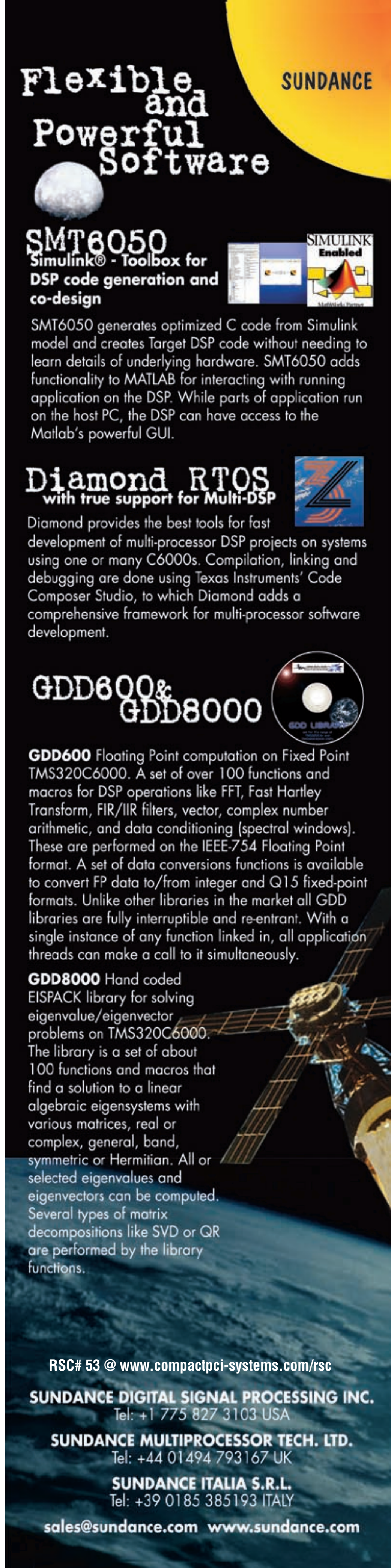

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- Pentium M processor speeds up to 1.8 GHz, or Celeron M option at 1.3 GHz
- Up to 1 GB DDR SDRAM
- Dual 10/100/1000 Ethernet interface
- Four serial ports
- Four USB 2.0 ports
- Serial ATA interface
- SVGA port via front panel
- Optional CompactFlash (Up to 1 GB) or 2.5 inch hard disk drive (60 GB or greater)
- OS support for Windows XP, Windows 2000, Linux, and VxWorks

CP920
CompactPCI Managed Gigabit Ethernet Switch
- PICMG 2.16 compliant
- Layer 2/3/4 switching
- Twenty-four 10/100/1000 Ethernet ports
- PICMG 2.9 Rev 1.5 IPMI compliant
- PICMG 2.1 Rev 2.0 hot swap compliant
- 802.1p, 802.1Q VLAN, deep packet filtering, link aggregation, Rapid Spanning Tree (802.1w, 802.1d), broadcast storm-control, port mirroring
- Conduction cooled model available
  - Twelve 10/100/1000 Ethernet ports

CP946
CompactPCI Managed Layer 2 Switch
- PICMG 2.16/2.9 compliant
- Twenty-four 10/100 Ethernet Ports (All rear I/O)
- Dual 10/100/1000 Ethernet via front panel (fiber or copper)
- Configuration managed via any port (telnet)
- Network Loop detection and disabling (Rapid Spanning Tree – 802.3w)
- SNMP switch management
- Designed for NEBS compliance

GE FANUC

Embedded Systems

RadiSys®

ATCA

ATCA's BLAZING 10-GIGABIT ARCHITECTURE

SPEED AVAILABLE TODAY

AMC

CONVERGING ON VoIP?

COM EXPRESS

INTEL CORE DUO

AFFORDABLE PERFORMANCE, IMPRESSIVE EFFICIENCY

MICROWARE OS-9 REVIEW

LESS POWER, MORE PERFORMANCE

RACKMOUNT SERVERS

MEDICAL OEMs SEEK LOW RISK, LONG LIFE

MOTHERBOARDS

THE SECRET ONLY EMBEDDED PRODUCT DESIGNERS KNOW

RADISYS PRODUCT APPLICATION GUIDE · SUMMER 2006

INNOVATION DOESN'T HAPPEN IN JUST ONE PLACE

GEORGE SHENODA
CTO & VP of Engineering
RadiSys Corporation

Welcome to the first edition of the RadiSys Product and Application Guide. We hope you enjoy the enclosed articles. Throughout this guide you will see evidence of RadiSys' innovation. We believe all innovation happens because someone thinks differently. My team and I, the CTO Office and the Engineering Organization, spend time thinking like our customers, what they are building and what they need. We talk with them constantly. We even talk to their customers so we can understand how they want to use the products our customers will build. That puts us in a position to be aware—to know—what our customers will want.

Thinking ahead embraces innovation. If you start thinking of a product you will need three years from today and start implementing it a year from now, it will likely reach the market in the right time. Thinking in this manner puts us in the forefront of the industry providing products and technologies well ahead of the competition such as the 10-Gigabit ATCA Platform, which is the first product of its kind on the market providing our customers with a state-of-the-art high performance platform that can serve as a base for multiple network elements.

At RadiSys, innovation is finding how to make our products in more effective ways that make it easier for our customers to achieve time to market with high value. We strive to create products with higher performance, lower cost, smaller size—even better looking. The look of a product can make the difference in how effective it is by creating the proper perception of the product.

How we do it is simple. By creating requirements that are beyond the ordinary, beyond what is on the market, pushes engineers to think creatively.

We simultaneously take both a bottom-up approach and a top-down approach to defining, architecting and implementing our products. We see the product's functions, features, architecture and performance from our customers perspective of networking and simultaneously look at the latest technology, the most advanced protocols, and the best silicon available to implement the products. We push the envelope by putting products in development today using silicon parts and software that are not on the market yet and we use common building blocks to maximize the utility of our products.

Innovation doesn't happen in one place; it happens across the industry—and only with continual interaction. One good idea spawns another. It's a regenerative process which creates a perpetual innovation.

ATCA 2

ATCA'S BLAZING 10-GIGABIT ARCHITECTURE

SPEED AVAILABLE TODAY

Utilizing a 10-Gigabit switching architecture lays the framework for a speedy platform.

AMC 6

CONVERGING ON VOIP?

PLANNING & SELECTING A MEDIA GATEWAY

Evaluate the risk and benefit of VoIP by balancing the right solution at the right value with the right connections to wireless and IP networks.

COM EXPRESS 8

INTEL CORE DUO

AFFORDABLE PERFORMANCE AND IMPRESSIVE EFFICIENCY

Announced this year, Intel® Core™ Duo is now appearing in embedded computers like the RadiSys Procelerant™ CE945GM.

MICROWARE OS-9 RTOS 11

HIGH-RELIABILITY, HIGH-PERFORMANCE

EMBEDDED SYSTEM DESIGN

Maximize performance and minimize power consumption with Microware OS-9.

RACKMOUNT SERVERS 13

MEDICAL OEMS SEEK LONG LIFE, LOW RISK

High performance and product stability are critical attributes for embedded services used in medical imaging.

MOTHERBOARDS 15

THE SECRET ONLY EMBEDDED PRODUCT DESIGNERS KNOW

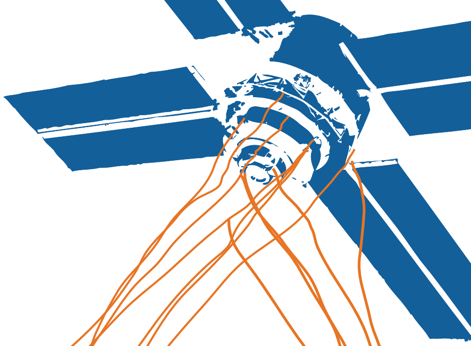
Embedded single-board computers touch our daily lives as they automate, separate, sort, pack, track, stack and inspect our goods and our lives.

LOOK FOR THESE ICONS

APPLICATION NOTES
Quickly learn about important trends, and market applications in next technology sectors.

WHITE PAPERS
Technology focused information to provide you with access to our leading edge knowledge base for topics ranging from design to application considerations.

TIME SENSITIVE
Get the latest information on new products and quickly evolving issues that will help you make next step decisions.



ATCA's BLAZING 10-GIGABIT ARCHITECTURE

SPEED AVAILABLE TODAY.

Once just an ancillary network control application for session setup, monitoring and management, ATCA (Advanced Telecom Computing Architecture) is moving into diverse applications. Combining ATCA with 10-Gigabit Ethernet brings into play new high-bandwidth, compute intensive solutions, including IMS (IP Multimedia Subsystem), radio network controllers, media gateways, and call servers.

With new managed platform and modular building blocks, TEMs (Telecommunication Equipment Manufacturers) can move ATCA into core traffic-bearing applications that demand high-bandwidth and traffic processing power. These new modular computing architectures deliver the highest speed I/O, switching and packet processing—up to 10-Gigabits—configured in a managed ATCA platform and for system applications that include CSCF (Call Session Control Function), application servers, edge routers, voice over IP, wireless network elements, security, and IP television.

While 10-Gigabit Ethernet switching platforms are the future in terms of enabling multimedia, broadband services, few vendors are marketing them. For TEMs, service providers and network operators' wanting to move up to a bandwidth-enhanced platform, the question is not if they should migrate but when.

TIME TO MARKET

Pressured to deliver products to market faster, TEMs and service providers want to turn on services quickly and move high call volumes as soon as possible. Their solution is in a common platform that not only meets today's needs, but "future-proofs" their solution. 10-Gigabit switching fabrics provide the higher bandwidth that platforms need to enable a wide variety of configurations.

For example, the RadiSys® Promentum™ SYS-6010 offers several options to meet the divergent needs of this next generation of applications. The SYS-6010 provides a 10-Gigabit Ethernet switch and control module, the highest bandwidth node connectivity, up-link and cross-link capability and the highest processing density in each slot. AMC-based I/O and packet processing provide modularity that allows for flexible expansion of both features and system density.

Using modules for common platform design provides the tools to address a diversity of requirements from each of the elements in a common network platform. For example, a CSCF solution needs a highly scalable distributed computing function, while a media server requires an abundance of storage. Burdening a CSCF solution with storage costs makes that solution more costly and uncompetitive.

MAKING THE BEST CHOICE

Staying with 1-gigabit switching architectures for the next 12 to 14 months is a short-term choice but all is not lost. If it is early in the development cycle then there is still time to make the change. Looking at the market in which the application will be deployed will help drive the correct decision. The market conditions to take into consideration are:

- Will the system be deployed into an environment with growing bandwidth requirements (Wireless networks, as an example, have seen significant growth in the throughput delivered to subscribers.)
- Will the system be required to interwork a number of different I/O flavours (i.e. ATM, OC-3/STM-1, Ethernet?)
- Will the system be deployed in a test market with expected rapid growth in the number of subscribers?

APPLICATION NOTE

CSCF AND APPLICATION SERVERS ENABLE MULTIMEDIA SERVICES FOR NETWORK OPERATORS

The combination of the CSCF (Call Session Control Function) and application servers within the IMS (IP Multimedia Subsystem) architecture provides network operators a way to create new multimedia services on a low-cost, easy to manage, flexible, and highly-integrated platform. Building applications on a high-availability CSCF/application server platform lowers the economic risk, the unpredictability of consumer adoption and go-to-market risks...

To download the complete application note visit: www.radisys.com/go/atca

REDUCE YOUR RISK

10-Gigabit architectures are the best long-term solution because it offers the capacity to aggressively market multimedia and broadband applications that can increase revenue and market share. It also reduces the risk of the unpredictable consumer response by providing the flexibility to test new services in smaller markets, learn what customers want and then expand the capacity of the service.

When there is a need to make a switching choice, and, for that matter, a platform choice, it is imperative to involve vendors that can identify the strengths and weaknesses of a solution as it applies to a specific application in a specific market. This enables the correct decision when deploying next generation application and platforms, and is the first step towards success.

Eric Gregory, Sr. Product Line Manager
email: eric.gregory@radisys.com

PRODUCT SPOTLIGHT:

PROMENTUM™ ATCA SYS-6010

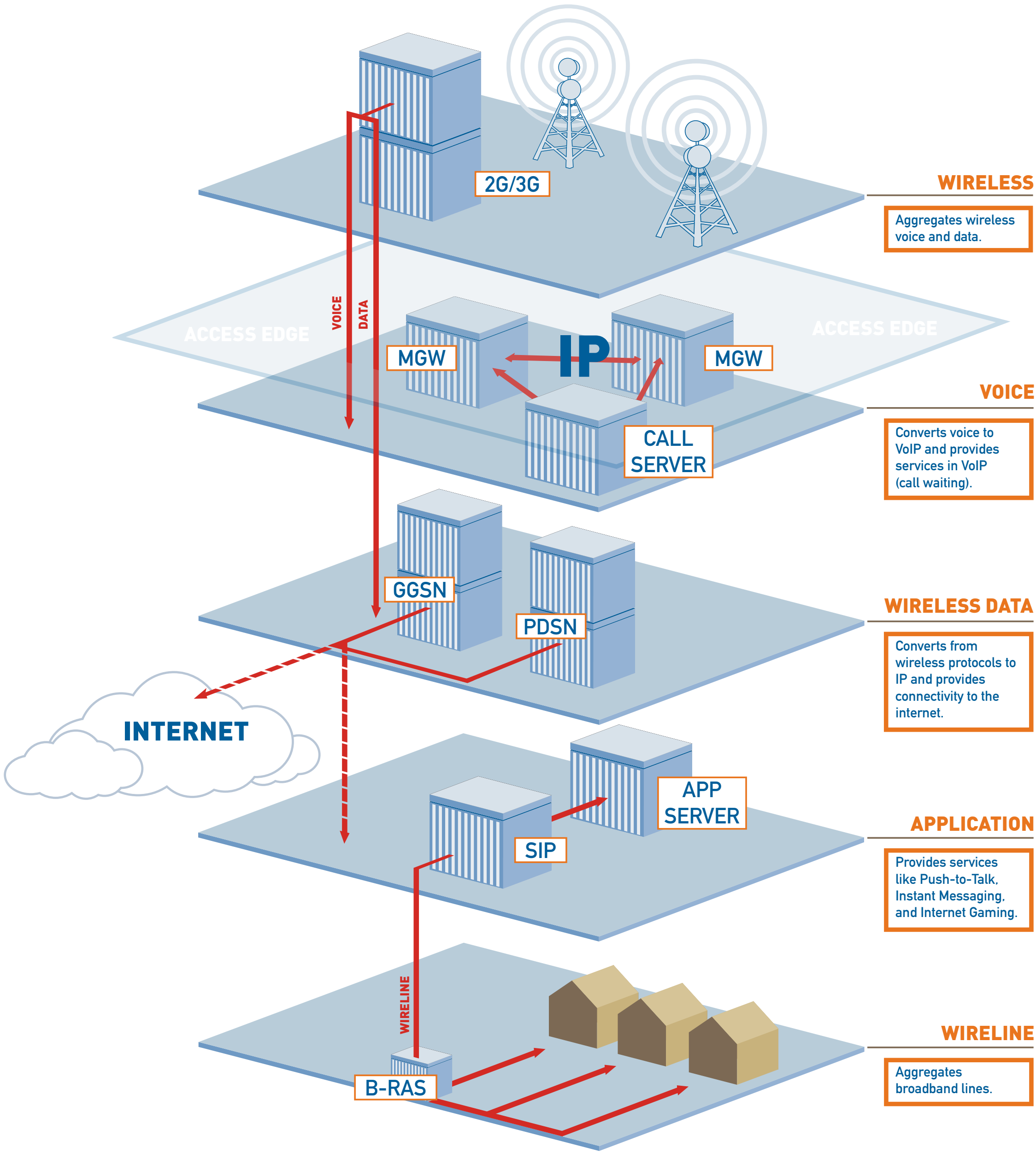
PROMENTUM
ATCA SYS-6010

Radisys Promentum SYS-6010—The industry's first 10-Gigabit managed common platform and modular building blocks for next-generation wireless and wireline applications.

Until now, ATCA has been targeted for use in ancillary network control applications such as session setup, monitoring and management. With the introduction of the RadiSys® Promentum™ SYS-6010 managed platform and new modular building blocks, TEMs (Telecommunications Equipment Manufacturers) can now take advantage of ATCA in core traffic-bearing applications that require significantly greater bandwidth and traffic processing capabilities. The Promentum SYS-6010 delivers the highest speed I/O, switching and packet processing capabilities to be implemented in a managed ATCA platform and can be configured for use in applications such as IMS (IP Multimedia Subsystem), Radio Network Controllers, Media Gateways and Call Servers.

The SYS-6010 is a fully integrated and validated managed platform designed to address high speed I/O and bandwidth intensive traffic-bearing applications implemented in a flexible and reliable architecture complete with comprehensive system management. The Promentum building blocks are implemented in a modular fashion with seamless interoperability. Modularity is made possible with Promentum building blocks and a suite of AMCs (Advanced Mezzanine Cards), which can be used to configure functions such as general purpose and network processing, input/output, and storage. In order to further increase their velocity to market, RadiSys includes data path and platform management software integrated into the Promentum product line. This will enable TEMs to focus on developing the higher value application layer rather then spending precious resource developing basic protocols and platform management solutions.

AdvancedTCA®



ATCA IN A CUSTOMER'S NETWORK

The above diagram demonstrates the ATCA candidates spread across the network that can be implemented in your network.

CONVERGING ON VOIP?

PLANNING & SELECTING A MEDIA GATEWAY

Broadband access and Internet protocol (IP) networks have nearly delivered the promise of information at everyone's fingertips. But in our information rich society, we each choose our own "communicator" according to our work- and life-style. It might be a Blackberry, integrated cell phone, handheld device, laptop or a desktop PC. And wherever we are, we also want all forms of media—data files, e-mail, voice, music, video—wirelessly poured into our personal communicator. Pushing these multiple media types through a common Internet pipe boosts bandwidth needs higher every year. Two of the big issues for service provider and enterprise customers is connecting all these communicators and how to preserve the quality of service when the connections go wireless. This is especially true when they want VoIP (Voice-over Internet Protocol) to be wirelessly packetized and yet maintain wireline quality.

More and more these companies want their employees to have rich-content media and they are considering VoIP to cut telecom costs. But they need to understand that what seems cost-effective today can cost them dearly in the future. When TEMs (Telecommunications Equipment Manufactuurers) sell VoIP solutions to service providers or enterprise customers, there are several questions to ask so that you can select the right-sized, modular media gateway that makes it possible for your customers to minimize their risk before they leap into a VoIP project.

PLATFORMS TO MEET YOUR CUSTOMER'S NEEDS

When planning solutions for your customers, help them consider the business value of moving to VoIP and the way they will deploy it. For example:

- Work with them to select a media gateway that is comprehensive, cost effective and bears no penalties for a fully loaded box in the future.
- Know their existing voice and data traffic and the effects on their network today, including their current voice and data usage patterns.
- Define what audio quality, reliability and uptime is acceptable for each customer.

RIGHT-SIZING VOIP MEDIA GATEWAYS FOR ENTERPRISE AND SERVICE PROVIDERS

To evaluate the risks and benefits of VoIP for enterprise or service providers, balance the right solution with the right value and with the right connections to wireless and IP networks. This value chain takes detailed planning and a deep understanding of what you want to achieve.

OFFER FLEXIBLE CONFIGURATIONS FOR YOUR CUSTOMER'S APPLICATION

A carrier-grade shelf and server platform meeting 5x9 performance offers capacity to add more processors and edge cards. Both ATCA and MicroTCA architectures offer this. A combination of double-wide AMCs (Advanced Mezzanine Cards) in either an ATCA or MicroTCA chassis is also an alternative.

KNOW THE CUSTOMER'S NEED TO SCALE UP OR DOWN

Application call volume determines a customer's approach. Deciding the configuration that suits the application's market size and future scaling drives the decision. The market size and call volume influence the customer's architecture choice, as well as the ability to scale up or down by adding new combinations of cards and chassis. Finding the right balance helps keep the overall system cost lower.

PROVIDE COST-EFFECTIVE SOLUTIONS FOR CUSTOMER APPLICATIONS

To address customer scaling, telecommunications equipment providers need a modular, flexible system that can scale call volumes from a few hundred to thousands. ATCA handles call volumes over 10,000. The advantage of ATCA is the high density it enables—8000 calls or more per slot. However, the same advantage could become a drawback if the requirement is to scale in smaller steps, not to mention the reliability of such high call volume on a single slot. To meet the smaller densities, leveraging the modularity of AMC/MicroTCA is perhaps the right choice. Once fully defined, MicroTCA will handle volumes under 1,000 calls. A mix of ATCA and AMC or MicroTCA and AMC standards offers cost-effective options. Customers using ATCA or MicroTCA chassis with AMC cards can handle call volumes of 500 and 10,000 callers. With lower call volumes, one-to-one redundancy may not be necessary to deliver your customers the service quality they need.

Built on open-system ATCA and AMC standards, a media gateway, like the Promentum platform and building blocks, help your customers stage their multimedia services and solutions and increase their company revenues. Enterprise and service providers are in a competitive market making it important for you to provide media gateway architectures that are cost-effective, robust, flexible and scalable—for their VoIP needs today and their video needs tomorrow. ///

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APPLICATION NOTE

MODULAR MEDIA GATEWAYS ENABLE VOIP AND OTHER MEDIA SERVICES:

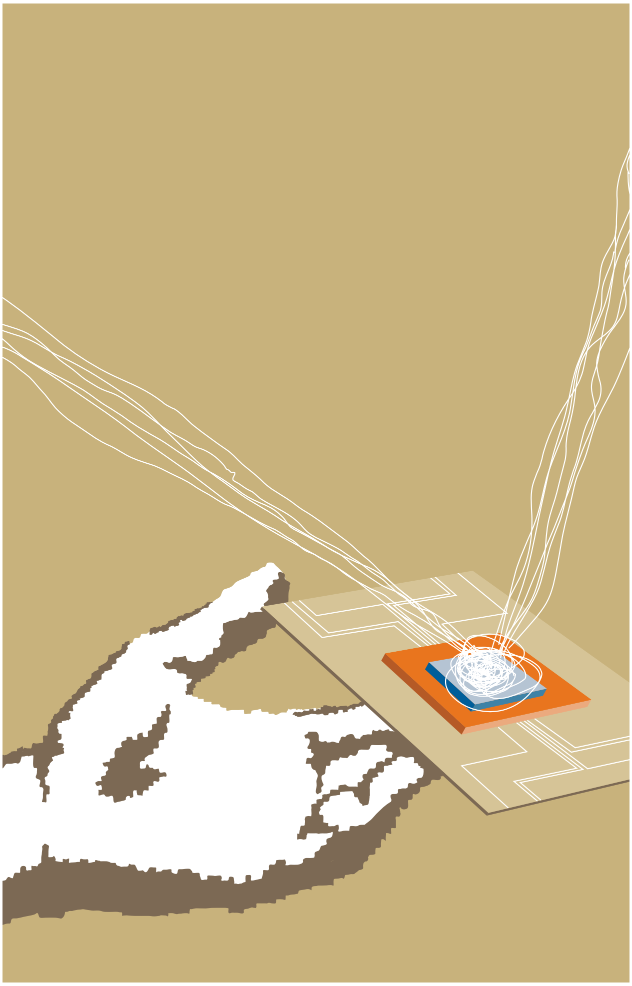
MAKE THE RIGHT CHOICE AND GET TO MARKET FASTER

Every day more companies are concluding that enabling their IT infrastructure with VoIP is a worthy investment with both hard and soft returns on investment. They seek to lower their telephone expenses, while improving workgroup and team communications by using media gateways to deploy a VoIP (Voice-over Internet Protocol) solution while setting the stage for video services. By acquiring media gateways that connect VoIP to wireless and Internet networks from the PSTN (Public Switched Telephone Network), companies can integrate VoIP into their IT infrastructure. This allows companies to get more out of their IT investment by turning to an application-ready platform that meets their needs today and in the future.

To download the complete application note visit: www.radisys.com/go/amc

INTEL CORE DUO

AFFORDABLE PERFORMANCE IMPRESSIVE EFFICIENCY



And new COM Express Duality Pumps up Embedded Performance

RadiSys, a Premier member of the Intel® Communications Alliance, is helping customers take the next leap in microprocessor architecture with new Intel® Core™ Duo processors. The Intel Core Duo processors include two cores in a single processor that enable lower power and higher performance and responsiveness than thought possible with past processor generations.

The RadiSys Procelerant CE945GM is the first generation COM Express product to fully utilize the Intel Core Duo processor. COM Express applications such as medical imaging, test and measurement, gaming, entertainment and industrial automation demand low power platforms with high performance features. Battery life, small spaces with limited air-flow, and cooling fan noise are a critical component of embedded COM Express applications. RadiSys provides thermal engineering expertise, while Intel incorporates thermal reduction features into its dual-core processors, making for a thermally optimized platform.

The Intel Core Duo processor can operate at very low voltages and minimizes clock and signal switching, resulting in lower power dissipation in the active state. The processor can enable the chipset to power down with the processor in low-frequency modes to further reduce dissipation. Additional Intel Core Duo processor features include Dynamic Power coordination, which enables individual cores to dynamically transition to Halt, Stop Clock and Deep Sleep power management states and Intel® Advanced Thermal Manager, which includes a new digital temperature sensor and thermal monitor on each individual core located close to the hot spots for enhanced accuracy at higher temperatures to enable precise fan control. The additional power management features enabled in the Intel Core Duo processor are brought to life by the RadiSys COM Express CE945GM product.

The Intel Core Duo processor on a CE945GM COM Express module brings breakthrough performance to processor intensive data crunching applications such as imaging and gaming. The two mobile optimized cores enable parallel threads or applications to be executed on separate cores with dedicated CPU resources to enable multiple demanding applications simultaneously. The dual core processor features a shared 2MB level-2 cache that enables dynamic cache allocation across both cores to enhance performance and reduce under utilization. Advanced Branch Prediction, the most optimal algorithm to use, significantly reduces the number of mi-predicted branches and in turn, increases performance. The RadiSys CE945GM module increases the performance capacity of the Intel Core Duo processor in the smallest size (95 x 125mm) module by adding the key feature of dual channel memory. The dual channel memory prevents a bottle-neck from occurring as the dual cores access memory; using single channel memory can slow board level performance from 13%-67% depending on the application.

Using a dual core COM Express module can ease the design complexity and development time associated with a high speed, complex processor design by splitting the CPU design from I/O and form factor design. The COM Express module is used as a macro component and enables developers to focus on designing application specific I/O, software, and differentiating the user interface. This modular concept is gaining in popularity as keeping up with the processor generation design can demand resources that take away from the greater value of an application. COM Express ensures future generation upgrades with a performance path that contains new Intel Core Duo embedded processors as soon as they are released. Improve time to market and include performance improvements in any low power, high performance application with the RadiSys COM Express product line, and start with the Intel Core Duo processor based COM Express module, the CE945GM. ///

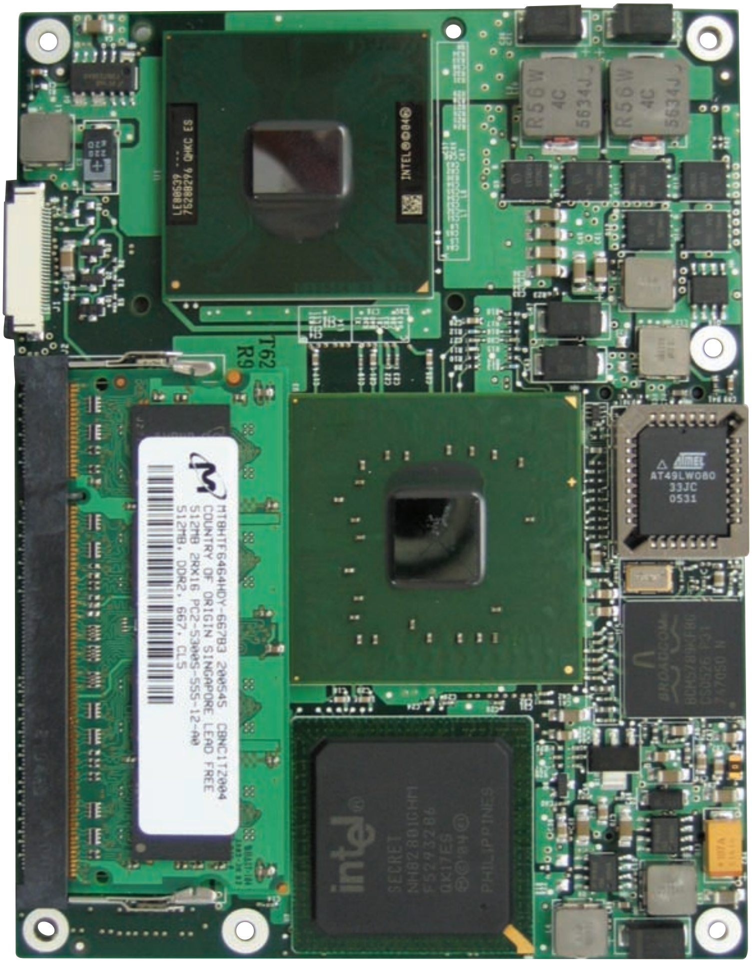
Jennifer Zickel, Product Line Manager
email: jennifer.zickel@radisys.com

PROCELERANT CE COM EXPRESS

- 2GHz Mobile Intel® Pentium® 4 Processor - M and 1.5GHz Celeron® M combined with Intel® 915GM Express Chipset on COM Express module
- Intel® ICH6M I/O hub
- PICMG COM Express compliant
- Basic form factor (95mm x 125mm)
- Type 2 COM Express pin-out

PROCELERANT CR100 COM EXPRESS

- PICMG COM Express Revision 1.0 compliant
- Supports Type 1 and Type 2 basic form factor modules
- FlexATX form factor 7.5" x 9"
- One COM Express module interface
- Two 32-bit 33MHz 3.3V PCI slots, with 33Hz operation capable



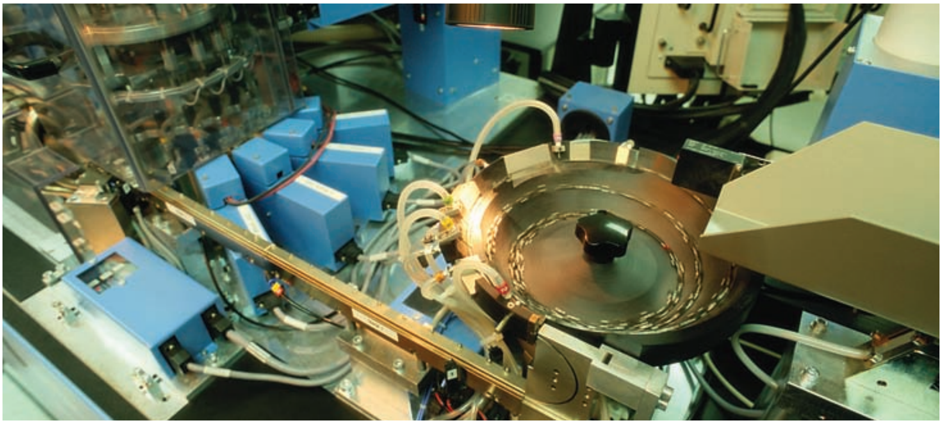
COM Express Board - 95mm x 125mm (Actual Size)

PROCELERANT CE945GM COM EXPRESS

- Intel® Core™ Duo T2500 2.0GHz and L2400 1.66GHz processors
- Intel® 945GM Express Chipset
- Intel® ICH7M Digital Home
- PICMG COM Express compliant
- Basic form factor (95 x 125mm)
- Type 2 COM Express pin-out
- Broadcom BCM5789 1000BaseTX Ethernet controller
- One SODIMM Socket for up to 2GB memory
- Flexible PCI Express Options
  - 1*PCI Express x16
  - 5*PCI Express x1 (or) 1
  - PCI Express x4 and 1* PCI Express x1
- COM Express standard features
- 8 USB ports
- 2 SATA ports
- 1 ATA100 port
- Phoenix BIOS with ACPI 3.0 Power Management
- Win XP/ Win XP Embedded / Red Hat Desktop Linux, Win CE
- Optimized passive and active heatsinks available

Pb RoHS Compliant

MICROWARE OS-9 REVIEW...

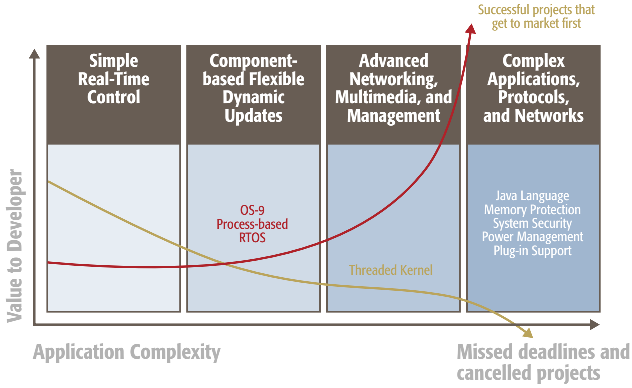


HIGH PERFORMANCE HIGH RELIABILITY

EMBEDDED SYSTEM DESIGN

If you're developing high-performance, high-reliability embedded applications, choosing the correct real time operating system (RTOS) is critical to your application's success. More and more designers are realizing that solving performance and reliability requirements with in-house solutions requires far more time and effort than they expected. Supporting and maintaining this in-house development becomes an unexpected burden on your engineering staff. Windows and Linux-based solutions are one possibility—*if your application doesn't require deterministic, sub-millisecond response times.*

A better approach is to consider using a commercial RTOS that provides the speed, reliability and support your application requires. RadiSys Microware OS-9™ provides this support with the drivers, board-level solutions, development tools, middleware and support you need. You'll have a complete solution, with OS kernel, software components, networking, graphics, power management and development tools. Microware OS-9's performance and reliability have been proven in thousands of products world-wide, including automotive, aerospace, communications, industrial automation and medical applications.



BULLET-PROOF YOUR APPLICATIONS WITH MODULAR CODE

You've probably heard the importance of writing modular code—but does your RTOS actually make that process easier? By focusing on modules as the building blocks for your application, OS-9 increases the reliability and maintainability of your system. Unlike other RTOSes that have a monolithic approach, OS-9's module-based environment ensures that a crash in one process or thread doesn't bring down the rest of the system as well. OS-9 also adds an extra layer of safety by embedding CRC codes within the module, giving additional protection against viruses and accidental code modification. This elegant architecture also makes debug and maintenance easier—you can add, remove and replace individual components (even device drivers!) while the system is on-line and in-use. And it allows for automated configuration management for each product build.

DISKS OR NO DISKS

Depending on your needs, you can specify OS-9 for a diskless environment without I/O, or a full-system supporting serial, disk, Internet and more. OS-9 is multi-user, supports module and file permissions and prevents user applications from corrupting system resources including the kernel or device drivers. And the kernel is easily extendible at run-time for customization. ///

Mike Lottridge, Product Line Manager
email: mike.lottridge@radisys.com

TOP 7 REASONS TO USE OS-9

1. Speed: OS-9 is one of the fastest RTOSes available.
2. Reliability and security: Modular architecture and use of processor MMUs protect against memory faults, viruses and application errors that crash other RTOSes.
3. Development environment: Debug processes and dynamically load system components (even device drivers) without rebooting.
4. Optimize performance with built-in system and application profiling. Generate exceptionally efficient code with a compiler tuned specifically for OS-9.
5. Popular 32-bit processor support: OS-9 supports PowerPC, 68K, x86, ARMv3/v4, Intel XScale® technology, MIPS3000/32/64, SH-3, SH-4 and SH-4A.
6. Standards compliance: Enhanced portability with support for BSD-Sockets, IPv6 and POSIX Threads. Port applications from Linux to OS-9 in days not weeks.
7. Fully Scalable: OS-9 supports the full range of applications, from small and deeply embedded to complete solutions with graphics and networking.

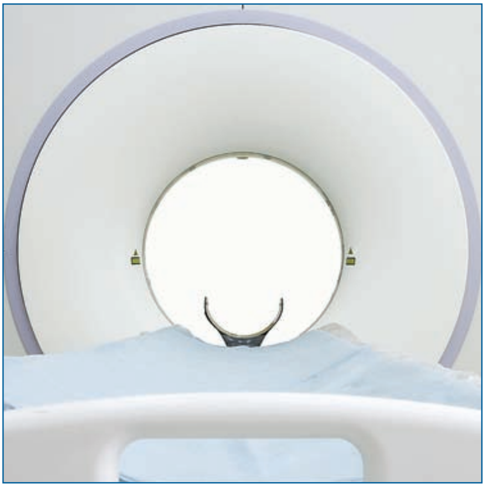
WHITE PAPER BY CANADIAN SPACE AGENCY

A SELECTION METHODOLOGY FOR THE RTOS MARKET

"In past years, the market of Operating Systems (OS) has been quite active. One of those key markets is to support embedded real-time applications in which the OS must guarantee the timeliness as well as the correctness of the processing. Many OS claim to be Real-Time Operating Systems (RTOS), but often, it is only by reviewing the OS specifications or detailed information that one can truly identify the OS that enables real-time applications."

To download the complete white paper visit: www.radisys.com/go/os9

MEDICAL OEMs SEEK LONG LIFE, LOW RISK



For doctors to see inside our bodies, medical imaging equipment needs vast computational power to present detailed 2-D (Two-Dimensional) and 3-D (Three-Dimensional) images. In the past, this might have required a supercomputer. Thanks to Moore's Law, that same processing power is now available in compact, rackmounted servers, such as the RadiSys Procelerant™ Server family. These servers are used by medical manufacturers in a number of imaging "modalities," such as X-Ray, MRI (Magnetic Resonance Imaging) and CT (Computed Tomography).

Processing power requirements are continuing to increase as new imaging instruments offer increased resolution, four-dimensional viewing (3-D images in motion) and combine images from multiple modalities.

FIVE TO 10 YEAR LIFESPAN

Medical imaging and test instruments typically have product lifetimes that stretch over several years from initial design to production of the last unit. These products often stay in use for 10 years or more after they are put into service. Clearly, this is an application that demands more than just a typical "white-box" PC or server to provide computing power.

Product stability is critical for medical imaging and also for other long-life embedded applications such as industrial automation and test and measurement systems. These systems are complex and often require integration of components and subsystems from many vendors. Typical PC lifetimes of 9-15 months and frequent, often undocumented, component changes can result in unexpected incompatibility problems that will bring the manufacturing line to a grinding halt. Costly re-engineering and re-qualification is often required to resolve these types of problems.

The RadiSys Procelerant Rackmount Server family uses carefully selected long-life parts, including processors and chipsets on the Intel long-life embedded road map, and well-documented engineering change-control procedures to ensure consistent product performance.

RMS420-0945RB RACKMOUNT SERVER

- Long-life embedded server
- PCI and PCI Express I/O
- Gigabit ethernet
- Intel® Pentium® D or Celeron® Processor
- Intel® 945G Express Chipset

SCALABLE PERFORMANCE

Medical imaging covers a wide range of performance and price points ranging from portable systems used in a doctor's office to very high performance systems filling entire rooms in hospitals or imaging centers. As a result, there is no "one-size-fits-all" processing solution for medical imaging. The RadiSys Procelerant server family ranges from value products with a single Celeron® processor to high performance products with multiple Xeon® processors. Multiple Procelerant servers are used for the highest performance imaging systems.

Whether buried deep inside a large system or externally mounted and visible to users, RadiSys servers are an integral part of an OEM customer's products. Whatever the approach, system manufacturers want the flexibility to distinguish their products. System designers can often reduce cost and speed time to market by starting with a standard RadiSys server and adding application-specific cards, selecting CPU speed and adding or deleting memory or drives to tailor performance for a specific application. Custom faceplates for most Procelerant servers allow customers to add their own "look and feel" to a product. Extended operating temperature range and low noise at normal operating temperatures are added features that allow customers to differentiate their products. ///

Michael Reunert, Sr. Marketing Manager
email: michael.reunert@radisys.com

RADISYS OFFERS REGULAR SEMINARS ON THE LATEST TECHNOLOGIES INFLUENCING THE EMBEDDED SYSTEMS DESIGN INDUSTRY.

EVENT CALENDAR

Webinar: Role of Signaling Gateways
On-line — June 1, 2006

Global Comm
Chicago, IL — June 6- Jun 8 2006

Webinar: Role of ATCA in IMS Development
On-line — July 11, 2006

Webinar: Building ATCA Systems & Software
On-Line — October 10, 2006

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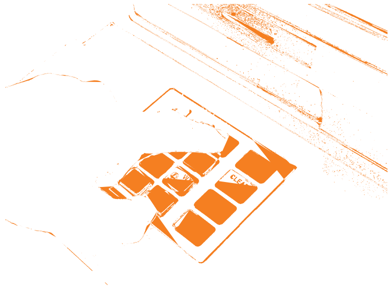
THE SECRET ONLY EMBEDDED PRODUCT DESIGNERS KNOW



[IT'S EVERYWHERE IN OUR LIVES]

Every day people step up to an ATM machine for fast cash. Parents get ultrasounds as part of pregnancy care. Surveillance cameras tape us when we buy gas. While different, each of these machines has one thing in common. Pop their tops and you'll find an embedded, single-board computer. There's a good chance it's one from RadiSys, like the new Intel® Pentium® processor-based OP945G microBTX in the RadiSys Procelerant™ Endura motherboard family.

RadiSys motherboards touch our lives daily. Only engineers developing embedded products know exactly where. Manufacturing plants use RadiSys motherboards powered by leading-edge Intel® processors to automate, separate, sort, pack, track, stack and inspect consumer goods on the way to our homes.

OP945G microBTX with an Intel® Pentium® 4 processor

See chart on page 17 for specifications.

Top test and measurement and medical companies depend on RadiSys to provide motherboards with rigorous requirements. Their product engineers turn to RadiSys to provide long product life, robust designs, customized features and to reduce their field support costs.

Long life and ruggedness make manufacturing, test and measurement and medical applications the toughest of designs. They need both a stream of complex computational features, vibration analysis, humidity testing and sometimes extensive thermal assessment for long-term and hard use. RadiSys also gives product engineers a worldwide support organization to solve any problems their new product designs may encounter—from thermal analysis to selecting the right parts to assure years of use.

Product designers won't lose sleep about product failures or upgrades years down the road. They can rest easy knowing RadiSys motherboards ease long-term field support and provide a smooth product upgrade path, because RadiSys provides a time-to-market product roadmap based on Intel's long life, embedded chipsets and processors.

Peter Mitchell, Product Line Manager
peter.mitchell@radisys.com

TP945GM mini-ITX with an Intel® Core™ Duo processor

The Endura TP945GM mini-ITX is a high performance, low power, small form factor motherboard for use with the new Intel® Core™ Duo processor. The board is highly integrated with multi-media features and a comprehensive set of I/O interfaces.

RoHS Compliant

EM945G microATX with an Intel® Pentium® 4 processor

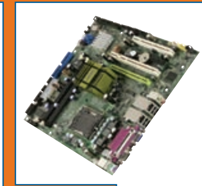
The Endura EM945G microATX is a high performance motherboard for use with Intel®'s Pentium® 4 and Celeron® processors. The integrated GMA950 graphics controller and a PCI Express graphics slot provide a flexible choice of video solutions.

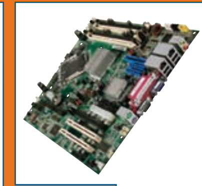
RoHS Compliant

ENDURA PRODUCT CHART

MOTHERBOARDS **RADISYS**

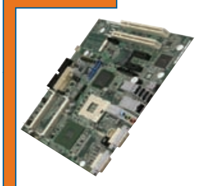


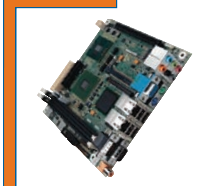




	BG845G	SH845GV	LS855	AB915GM	BY915GV	KP915GV	EM945G	RB945G	OP945G	TP945GM
Form Factor	microATX	ATX	microATX	FlexATX	microATX	ATX	microATX	ATX	microBTX	Mini-ITX
Size	9.6″ x 9.6″	12″ x 9.6″	9.6″ x 9.6″	9″ x 7.5″	9.6″ x 9.6″	12″ x 9.6″	9.6″ x 9.6″	12″ x 9.6″	10.5″ x 10.4″	6.7″ x 6.7″
Intel Chipset	845GV	845GV	855GME	915GM	915GV	915GV	945G	945G	945G	945GM
Intel Processor	Pentium 4	Pentium 4	Pentium M	Pentium M	Pentium 4	Pentium 4	Pentium 4	Pentium 4	Pentium 4	Core Duo
	Celeron	Celeron	Celeron M	Celeron M	Celeron D	Celeron D	Celeron D	Celeron D	Celeron D	Celeron M
Socket	478-pin PGA	478-pin PGA	479-pin PGA	479-pin PGA	LGA775	LGA775	LGA775	LGA775	LGA775	478-pin PGA
Max CPU Speed	2.8GHz	2.8GHz	1.8GHz	2GHz	3.4GHz	3.4GHz	3.4GHz+	3.4GHz+	3.4GHz+	2.0GHz+
Max Memory	2GB	2GB	2GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB
FSB	533MHz	533MHz	400MHz	533MHz	800MHz	800MHz	800MHz	800MHz	800MHz	667MHz
PCI Slots	3	6	3	2	2	3	2	4	2	Mini-PCI
x1 PCI Express Slots	None	None	None	2	1	2	1	2	1	1
Graphics Slot	AGP 4X	ADD	AGP 4X	None	ADD2	ADD2	x16 PCIe	x16 PCIe	x16 PCIe	x16 PCIe
VGA	Extreme 1	Extreme 1	Extreme 2	GMA900	GMA900	GMA900	GMA950	GMA950	GMA950	GMA950
Ethernet	10/100, GbE	10/100	10/100	10/100, GbE	10/100, GbE	GbE	10/100, GbE	10/100, GbE	10/100, GbE	GbE
#LAN Ports	1 or 2	1	1	1	1 or 2	1	1 or 2	1	1 or 2	1 or 2
Audio	AC97	AC97	AC97	HDA	HDA	HDA	HDA	HDA	HDA	HDA 7.1
DVI	Use ADD	Use ADD	Use ADD	Dual DVI	Use ADD2	Use ADD2	Use MEC	Use MEC	Use MEC	Use MEC
LVDS	Use ADD	Use ADD	24-bit LVDS	18-bit LVDS	Use ADD2	Use ADD2	Use MEC	Use MEC	Use MEC	18-bit LVDS
GPIO	13-bit	13-bit	13-bit	13-bit	13-bit	13-bit	13-bit	13-bit	13-bit	13-bit
Flash Memory	None	CompactFlash	None	MM/SD	None	None	None	None	None	CompactFlash
Serial Ports	2	2	2	None	2	2	2	2	2	4
Parallel Port	1	1	1	None	1	1	1	1	1	0
IEEE 1394b	None	None	None	Build Option	None	1394b	None	Build Option	Build Option	None
Watchdog(s)	1	1	1	1	1	1	1	1	1	1
System Management	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hard Disk	ATA/100	ATA/100	ATA/100	SATA	SATA	SATA	SATA 300	SATA 300	SATA 300	SATA
CD-ROM	ATA/100	ATA/100	ATA/100	ATA/100	ATA/100	ATA/100	ATA/100	ATA/100	ATA/100	ATA/100
Floppy Disk	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Rear USB 2.0	4	4	4	4	4	4	4	4	4	4
Internal USB 2.0	2	2	2	3 or 4	4	4	4	4	4	4
PCI Riser Card Ext.	Yes	No	Yes	No	Yes	No	Yes	No	No	No

BG845G SH845GV LS855 AB915GM BY915GV KP915GV EM945G RB945G OP945G TP945GM

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