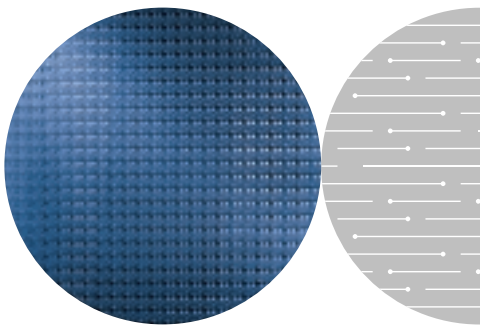
Intel in Communications

Advanced Telecom Computing Architecture:

Enabling accelerated deployments of innovative services while reducing OpEx.

AdvancedTCA* is a groundbreaking new standard for telecommunications solutions. AdvancedTCA enables standards-based platforms to help reduce costs, accelerate deployments, and create greater efficiencies in service provider operations.



Executive Summary

Two objectives remain critical to telecommunications service providers: boosting average revenue per user (ARPU) through accelerated deployments of new, compelling services, and reducing operating costs. A new telecommunications industry standard—developed with leadership from telecommunications equipment manufacturers and building block suppliers—is specifically designed to enable service providers to meet these objectives. This emerging standard gives service providers the needed help they seek.

The Advanced Telecom Computing Architecture (AdvancedTCA*) forms the foundation for highly scalable, modular wireless and wireline communications, core, and network data center solutions that can be quickly integrated from commercially available components based on advanced Intel telecommunications building blocks. These modular-based solutions speed time to market of new services to more quickly meet customer demands and revenue-generating capabilities.

Standard blade-based modules increase port and compute density, reduce complexity and power consumption, and create common platforms, while a standardized, intelligent platform management interface enables automated and highly efficient blade-level, shelf-level, and system-level management capabilities unprecedented in the industry. Together, these advancements create an architecture that vastly reduces solution footprints to a fraction of historical deployments while providing powerful solutions with greater computing capacity and the ability to help reduce operating costs.

AdvancedTCA is quickly gaining traction as the sensible choice for new service deployments. Major equipment suppliers have already announced AdvancedTCA-based wireless solutions.

AdvancedTCA is equally applicable at the edge, in the core, and in the network data center. For example, as consumers increasingly demand next-generation wireless services, service providers race to provide them, deploying 3G solutions based on AdvancedTCA. With the continued expansion in xDSL services over the last year, DSLAM deployments are expected to be the next likely application for AdvancedTCA-based installations, according to an industry study.[1] In addition, modular-based AdvancedTCA solutions, supported by new, high-speed fabric backplanes and very high computing density, can be deployed in the network data center as video-on-demand servers for digital video over DSL (IPTV), unified messaging servers, and core switching systems, to name a few applications.

This paper is important to all service providers looking to reduce operating expenditures and boost revenue through new service deployments or upgrades of existing infrastructures. This paper introduces the AdvancedTCA standard, its benefits, and impact on the industry. By reading this paper, managers and operators at service providers will gain a background in AdvancedTCA and learn how it helps benefit the bottom line for their operations.

Contents

"The new line of AdvancedTCA solutions from Intel provides equipment manufacturers and service providers performance densities required to meet the demands of networks with ever-increasing network traffic at lower operational costs. By adopting open standards-based platforms, they will reduce time to market, ensure access to the latest technologies, and enable rapid implementation of new value-added services."

Howard Bubb, Vice President, Intel, General Manager, Communications Infrastructure Group

Modular communications platforms and AdvancedTCA*

Staying competitive with modular platforms

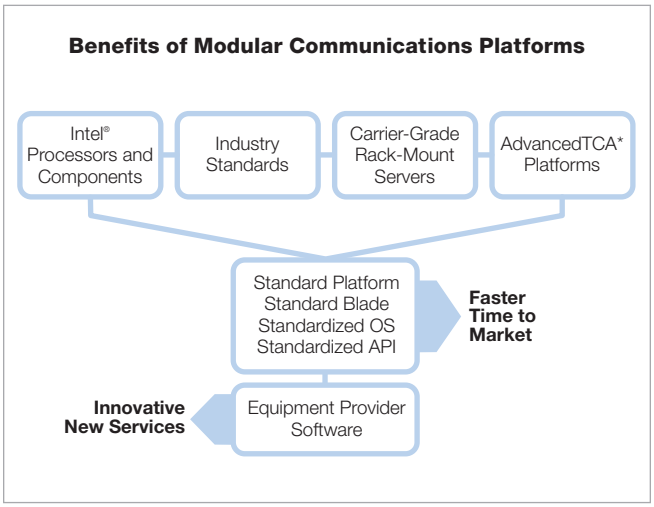
As telecommunications service providers continue to mold the voice and data services of their converging networks, key strategies to stay ahead in this highly competitive industry include:

- Increase average revenue per user (ARPU) with new, unique service deliveries, such as digital video services over IP (IPTV), customized and intelligent ring-tone services, and 3G IP Multimedia Subsystem (IMS) or similar wireless messaging applications.
- Deliver compelling new services quickly to meet the demands of a more sophisticated, fast-paced, and highly mobile customer base.
- Reduce operating costs while expanding network services and creating greater customer service value.
- Build stable, flexible infrastructures that can prepare them to easily take advantage of new opportunities in their markets, including triple-play voice, video, and data services.
- Stay competitive and reduce customer churn in today's rapidly evolving market.

Industry leaders within the telecom industry—both equipment providers and service providers—along with a vast array of technology leaders and developers united over the last few years to create a new modular communications platform standard—the Advanced Telecom Computing Architecture (AdvancedTCA*)—designed specifically to address the issues service providers now face.

The AdvancedTCA initiative highlights an unprecedented move in the telecommunications industry. It brought together over 100 companies worldwide to create a widely deployable, standardized platform for central office and network data center solutions. AdvancedTCA already boasts a large commitment from the industry: in one year, AdvancedTCA development went from approved specification to its sixth interoperability event and 30 companies offering 80 products for the platform. AdvancedTCA is breaking new ground and setting firm foundations for the future.

Figure 1. AdvancedTCA-based solutions enable service providers to cost-effectively expand their networks and quickly deliver new services with improved scalability and operating efficiencies that can reduce costs.



AdvancedTCA delivers choice, efficiencies, and standards

AdvancedTCA-based solutions are built from commercially available, carrier-grade, high-performance, off-the-shelf hardware building blocks designed for interoperability in a standardized chassis. Intel offers many of these AdvancedTCA high-performance building blocks at the chassis, blade, and silicon levels, and through the Intel® Communications Alliance, Intel can help industry movers find the AdvancedTCA-based service delivery solutions they are looking for.

Most of today's services are enabled by application-specific communications software executed on a wide variety of high-performance—and often proprietary—computing, communications, and networking platforms. By pre-delivering a high-performance platform based on open, industry standards, commercially available carrier-grade operating systems, and standardized application programming interfaces (APIs), AdvancedTCA reduces barriers to new service innovation, faster time-to-market—and time-to-money (Figure 1). Equipment developers can focus on the value-added features of their software, instead of the hardware, enabling them to deliver better solutions, faster. For those service providers that develop their own solutions, AdvancedTCA quickly gives them a standards-based, off-the-shelf platform on which they can develop their unique services without reliance on proprietary, customized hardware.

AdvancedTCA—an overview

Modular architecture

Standardized components—high-density chassis; a variety of blades; high-speed backplanes; advanced platform management; power and cooling sources; and interconnects—provide the foundation for an AdvancedTCA-based solution (Figure 2).

Multi-processor, single-board computers based on industry-leading components, such as Intel® Xeon™ processors and Intel® Itanium® 2 processors, provide powerful resources for billing and call software applications. I/O and line cards, wireless radio network controller modules, and digital signal processing blades enable packet and bit-stream processing for wireline and wireless applications. Ethernet backplanes and switch modules today, with other new, high-speed fabric interfaces coming in the near future (such as Advanced Switching), offer very fast routing for advanced services running over packet-switched networks, including voice over IP (VoIP), video mail, and IPTV.

Chassis management modules enable automated blade discovery, shelf management, and remote systems management using the Intelligent Platform Management Interface standard protocol and independent management network connections. AdvancedTCA offers a system-wide solution for large applications of multiple types of service deployments.

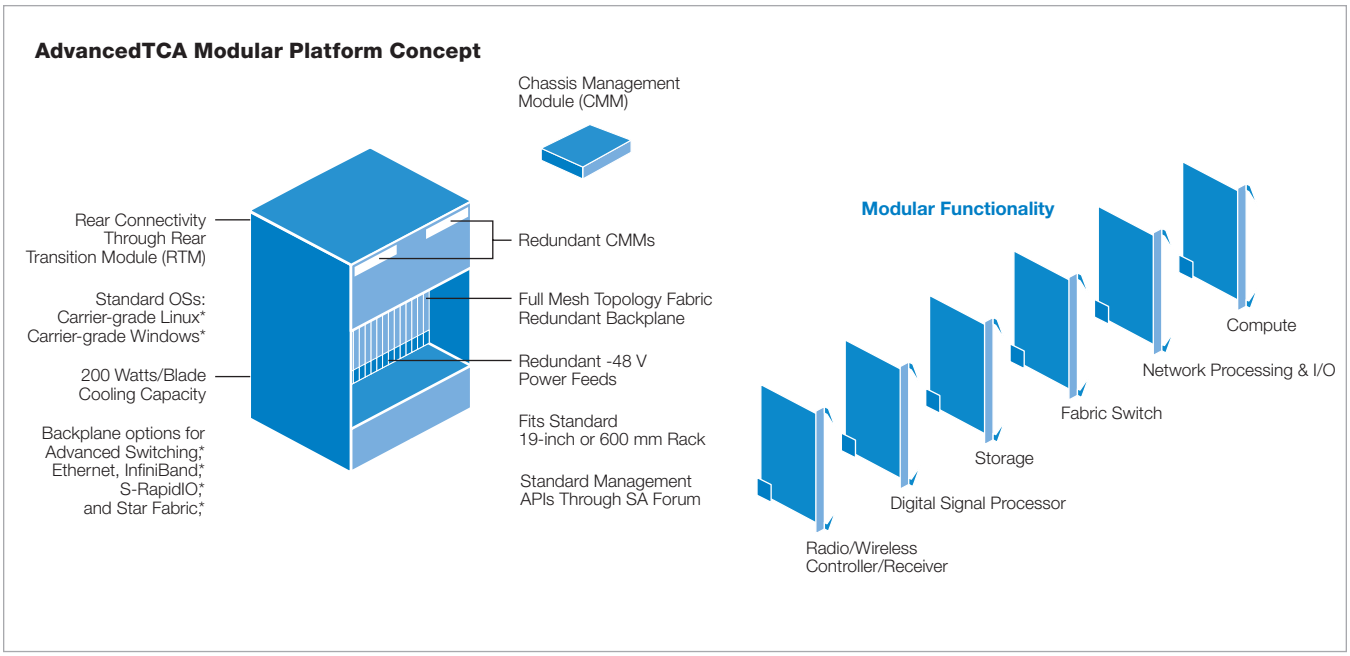
Built-in reliability, availability, and serviceability

AdvancedTCA also specifies the extended reliability features that service providers demand, and the advanced manageability and enhanced scalability characteristics they need. Some of AdvancedTCA's features include:

Five 9s reliability

- Full redundancy throughout (power, backplane, management, and blades), allowing no single point of failure
- Earthquake resistance
- Hot-pluggable blades for easy serviceability
- High-flow-volume vertical cooling keeps high-performance hardware running cool for optimum component life

Figure 2. The AdvancedTCA modular platform can be configured from multiple components to meet service provider needs.



Advanced, remote management and ease of maintenance

- Intelligent Platform Management Interface (IPMI) with system module self-discovery enables advanced platform, rack, and even system management capabilities from anywhere in the world, reducing truck rolls and management costs
- Legacy RS232 serial interface allows backward compatibility with existing management policies and practices
- Choice of front or rear access maintenance

Modularity and scalability

- Configurations today from 4U through 14U in 19-inch and 600 mm wide chassis for high-density installments, enabling diverse functionality in a small footprint
- 8U-high, large blade form factor enables high-performance hardware modules and high I/O density, plus allows quick installation of new processing, storage, or switching components
- Dual Star BASE-T Gigabit Ethernet on Base Interface
- Full mesh, star, and dual-star fabric topologies on optional fabric interface with up to 20 Gbps per node to meet the needs of high-bandwidth services, such as video serving and video mail
- Up to 14 slots in a 19-inch chassis and up to 16 slots in an ETSI 600 mm chassis for configuration flexibility, system scalability, and redundancy
- 200 watts/board cooling capacity for high-performance CPUs, network processors, I/O processors, media processors, switches, and storage technologies
- -48 VDC and 120/240 VAC power feeds for central office and network data center applications
- Advanced Mezzanine Card, enabling greater modularity and scalability at the blade level
- Rear transition module (RTM) for rear I/O cabling

"AdvancedTCA has the most sophisticated system management ever designed..."

Joe Pavlat, PICMG President, 2003

Benefits

Fast time-to-market, time-to-money

AdvancedTCA simplifies new services development and cuts delivery time—by as much as a year, according to The Yankee Group.[2] Based on internal studies at Intel, AdvancedTCA-based solutions are significantly faster to develop and can result in lower overall development cost. As of February, 2004, both NEC Corporation and Siemens mobile announced new wireless 3G solutions based on AdvancedTCA, leveraging the modular concept to reduce development time—one-third of the development time compared to current systems, according to NEC.[3] The hardware is no longer part of the deployment critical path.

Reduced operating expenses

A standards-based, modular approach, with platforms built on Intel® silicon, induces hardware consistencies across a central office or network data center, creating simpler, easier-to-maintain infrastructures. The benefits are many, with the result of driving down operating expenses:

- Intel's advanced silicon technologies increase density to enable more capabilities in a smaller footprint and reduce power consumption, resulting in greater computing capacity, higher efficiencies, and lower operating costs.
- Designed around the IPMI standard protocol, systems are built to be managed across an entire installation and offer self-management capabilities, helping to increase management efficiencies.
- Less variability in the hardware means there are fewer field-replaceable units to inventory, greater interchangeability, and fewer specialists needed to service a mixture of varying proprietary hardware architectures (Figure 3).
- Consistency in human interfaces and operation of systems enables greater efficiencies in overall operating processes.

"From conception to integration of hardware and software components, ...packet-processing blades with integrated data plane software can shorten the total development process by a year or more."

Yankee Group, 2003

Figure 3. AdvancedTCA-based infrastructures utilize common modules, standardized designs, and increased density to reduce operating costs.

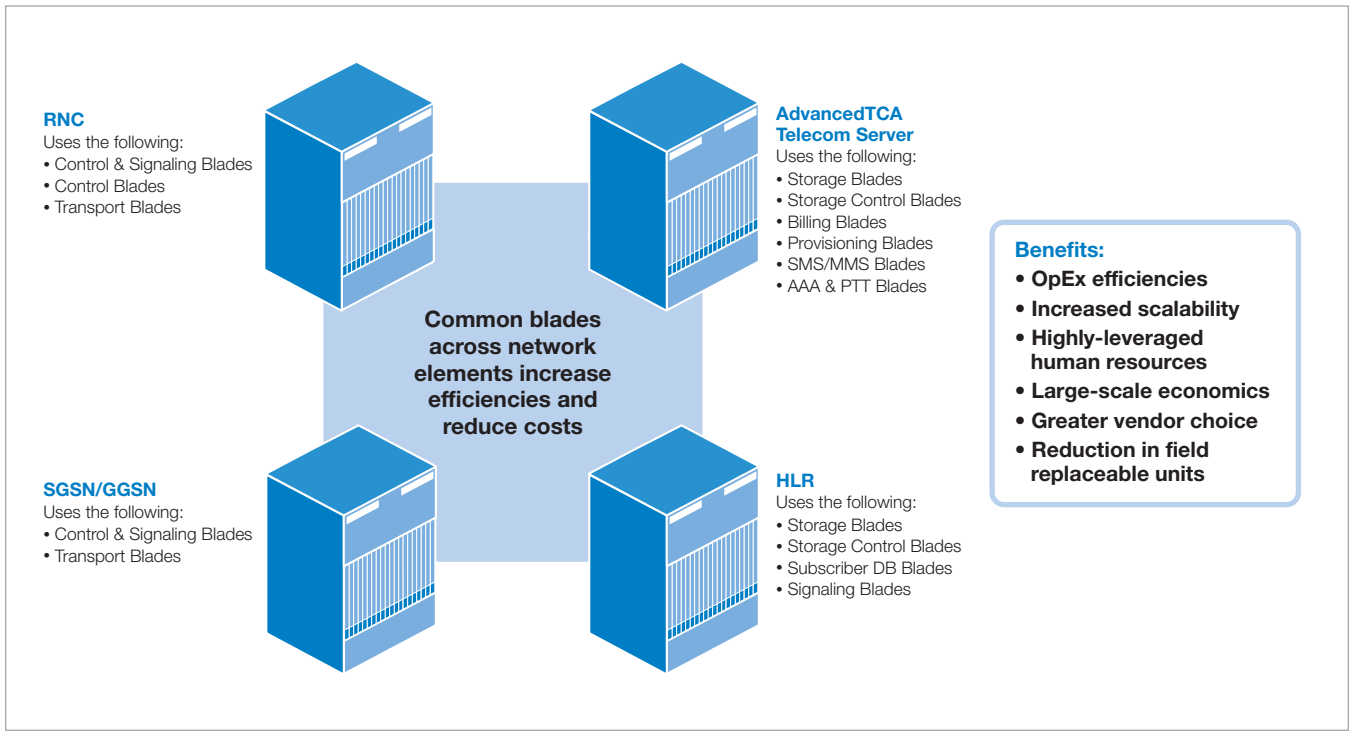
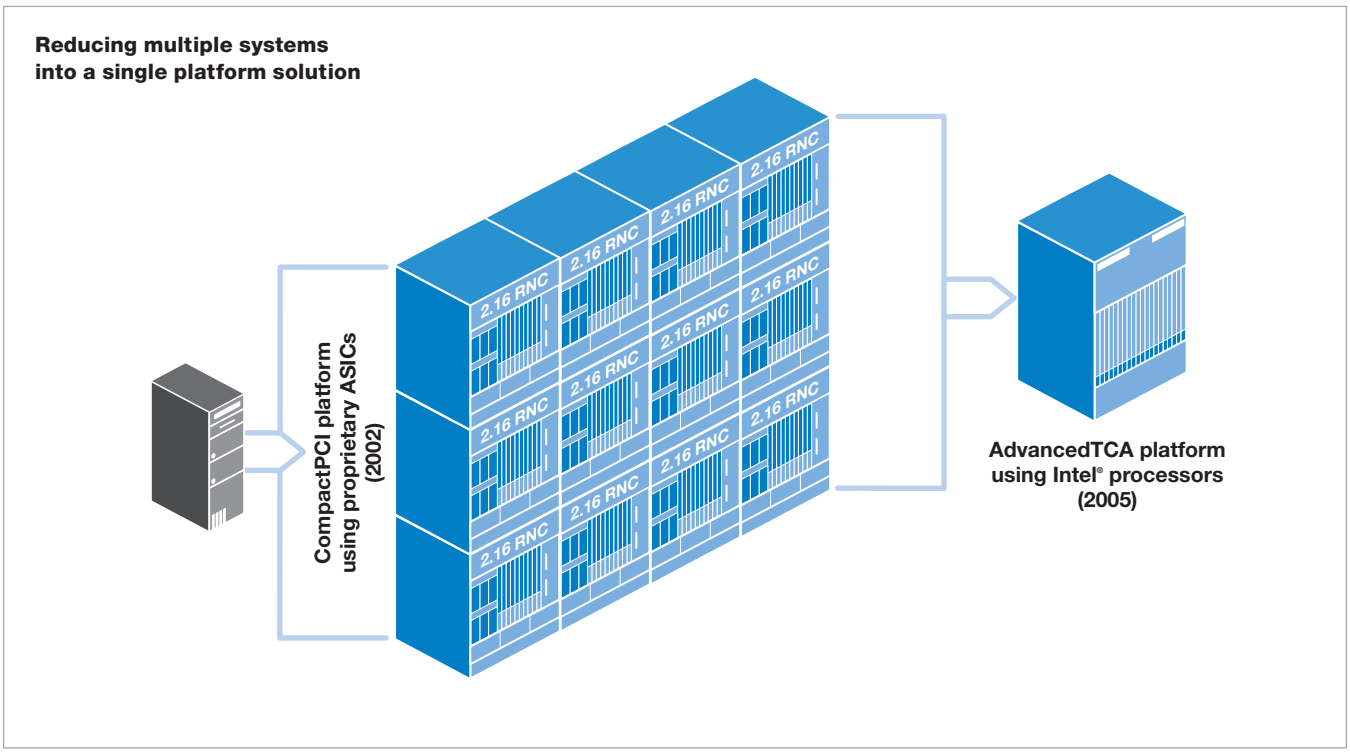


Figure 4. A typical UMTS Radio Network Controller (RNC) deployment for 30,000 active users based on proprietary ASIC technology requiring 12 shelves can be compacted using a standards-based AdvancedTCA chassis solution built on Intel® processors.



Truck rolls are expensive, especially when individual specialists must be dispatched to service different parts of the installation or when the installation is remote, like a radio tower. The AdvancedTCA chassis management modules and Intelligent Platform Management Interface help cut time spent on troubleshooting, repair, and reconfiguration of replaced modules. Blades can incorporate self-monitoring, diagnostic, and management features that communicate with the chassis management modules, and through IPMI, with the maintenance center. Technicians in the maintenance center have visibility deep within the hardware and can respond proactively, before a concern becomes an emergency. When a blade is replaced, the management module and IPMI can automatically detect and configure the module without technician intervention, speeding repair and reducing possible human errors during configuration. AdvancedTCA features like these can reduce truck rolls and reduce management costs.

Increased density: bringing Moore's Law to telecom

As technology advances, functional density increases according to Moore's Law,[4] and technologies converge. For the central office and network data center, AdvancedTCA is the next step in the evolution of this phenomenon, capturing computing, communications, networking, and management in a compact, scalable form factor.

Table 1. UMTS RNC Solution Comparison for 30,000 Active Users

	Platform Architecture and Processor Silicon		
	CompactPCI (PICMG 2.16) With proprietary ASICS	AdvancedTCA (PICMG 3.1d) with Intel® processors	Improvement gain using Intel® processors with AdvancedTCA
# Frames	4	1	12X
Power	9,600W[a]	1,800W	5X[e]
Initial Cost[b]	$1M US	$200K US	5X
Cost of Space[c]	$14,400 US/month	$1200 US/month	12X
Cost of Power[c]	$9,600 US/month	$1,800 US/month	5X[e]

[a] Estimated 40W per board

[b] Estimated price based on $4,000 US per board plus chassis

[c] Estimated cost to maintain based on $100 US/month per 1U of frame rental space and $1 US/month/watt

[d] Based on Intel® IXB 3G board

[e] Intel 90nm silicon process will improve this value by 30 percent

For example, a legacy, proprietary-technology-based radio network controller can occupy four frames of rack space, consume nearly 10,000 watts of power, and expend thousands of dollars of monthly space cost. The same services can be deployed today as an AdvancedTCA solution based on Intel silicon in a fraction of the space, with a significant reduction in operating cost and power consumption (Figure 4 and Table 1), while offering greater scalability of services.

In the network data center, AdvancedTCA enables greater computing capacity and performance. High-density AdvancedTCA chassis offer more processors and processing power than traditional rack-mount server (RMS) solutions. While RMS offerings can provide up to 80 processors in a 40U rack space, 10U AdvancedTCA chassis can populate the same rack space with as many as 96 processors, and 72 processors can occupy the same rack space in 14U AdvancedTCA chassis.

In addition to greater processor capacity, AdvancedTCA enables designs based on high-performance Intel processors, such as the Intel® Itanium® 2 processor and Intel® Xeon™ processor MP.

Greater scalability

With AdvancedTCA, scalability is enabled on several levels. At the chassis level, a high-density chassis allows blades to be added as needed simply by plugging them in. Software developed on the AdvancedTCA platform can take advantage of self-discovery, automatically recognizing and configuring extra resources as they are added.

At the blade level, a large blade form factor accommodates advanced Intel silicon technologies, such as Intel® processors, media switches, I/O processors, and network processors, which execute sophisticated application software. Blades designed with plenty of headroom utilizing Intel processors can continue to support expanding services through software downloads to the system without replacing the blade. This additional headroom helps to reduce hardware upgrade costs in the long term. AdvancedTCA also specifies the largest I/O front panel among standards-based platforms for I/O-intensive network elements, such as wireless Radio Network Controller (RNC) and wireline DSLAM deployments. Finally, a mezzanine card allows even greater expansion of capabilities on a single blade. Further scalability and flexibility can be achieved with solution components based on the emerging Advanced Mezzanine Card specification. Advanced Mezzanine Card designs an be easily incorporated into AdvancedTCA-based solutions.

At the system level, services can be expanded quickly by installing additional blades into an existing chassis or populating new chassis and installing software. Even entire standby platforms can be brought on line remotely, or inactive systems reconfigured in minutes for a new service to cover heavy loads. And AdvancedTCA can grow alongside an existing infrastructure, allowing compatible migration to the new architecture without disruption of current services.

AdvancedTCA market penetration and potential

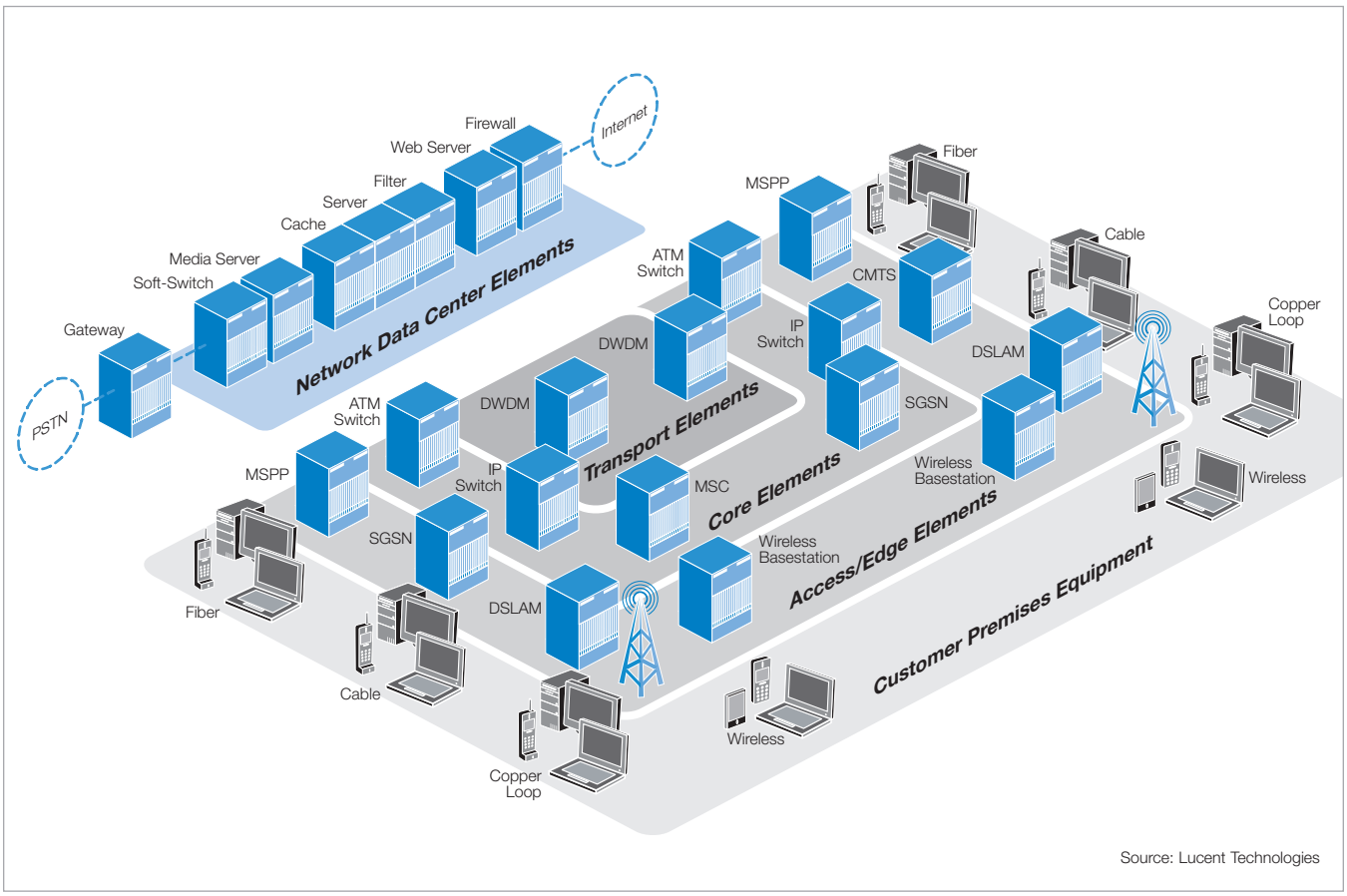
Wireless infrastructure deployments

Crystal Cube Consulting and Metz International expect the largest potential market for near-term AdvancedTCA deployments to be in wireless infrastructures, supporting the rising demand in new wireless services growth and migration to 2.5G and 3G networks.[1] Many vendors, including Intel, have begun offering 3G-enabling AdvancedTCA modules, such as chassis, single-board computers, and wireless line cards. New 3G wireless infrastructure solutions from Siemens mobile, NEC and Huawei Technologies, based on AdvancedTCA, are already being developed for the market to take advantage of an expected growing demand for wireless services.

Future network-wide applications

AdvancedTCA is applicable throughout the networks of tomorrow—at the edge, in the core, through transport, and in the network data center (Figure 5)—with associated benefits to be expected. Common modules reduce complexities and increase efficiencies. Standardized designs help drive costs down through volume economics in chassis component manufacturing, such as sheet metal and cabling. As the telecommunications industry more widely embraces AdvancedTCA, innovation will increase, enabling newer services that can be easily deployed. AdvancedTCA is ready to deliver its benefits in the Core and Network Data Center now. Increased availability of the higher bandwith backplane solutions (>10Gpbs) and solidification of the AMC specification and AMC ecosystem should accelerate acceptance of AdvancedTCA in Core and Access/Edge in 2005 and 2006. It is expected that AdvancedTCA will coexist with other standards-based architectures and custom solutions in the foreseeable future.

Figure 5. Extending AdvancedTCA benefits throughout the network—common modules at the edge, in the core, through transport, and in the network data center reduce complexities and increase efficiencies.



Source: Lucent Technologies

Growing network of suppliers

Delivery of innovative communications solutions today comes from the involvement of many members of the communications industry. AdvancedTCA was developed by the PICMG (PCI Industrial Computer Manufacturers Group) and is defined under specification 3.0. It is backed by over 100 industry leaders and innovative solution providers with product deliveries at every level of the communications solution stack. To learn more about the variety of innovative AdvancedTCA modules, visit www.picmg.org/productlistings.stm at the PICMG web site.

As one of the industry participants in AdvancedTCA, a leading provider of communications silicon building blocks, and developer of modular components for AdvancedTCA solutions, Intel is committed to a growing network of telecommunications suppliers. Intel formed the Intel® Communications Alliance—a community of nearly 200 developers of telecommunications building blocks—to help enable innovative solutions, supporting equipment developers, manufacturers, and service providers around the world.

For more information about the Intel Communications Alliance, visit www.intel.com/go/ica.

Intel® Communications Alliance

A community of communications and embedded developers and solution providers

Conclusion

AdvancedTCA, with the proven performance of Intel silicon and components, enables a standards-based modular approach to central office and network data center solutions that meets the carrier-grade requirements needed in today's telecommunications infrastructure. The telecommunications industry is adopting AdvancedTCA as the new standard for telecom solutions. Analysts expect the AdvancedTCA market to grow to $20 billion US worldwide by 2007.[5]

By building future deployments around AdvancedTCA, service providers can deploy new services quickly, reduce operating costs, and easily scale with demand. Intel recommends that service providers understand their equipment providers' plans for AdvancedTCA and specify AdvancedTCA-based solutions in their requests for proposal.

For more information on AdvancedTCA, the activities of PICMG, the Intel Communications Alliance, and Intel products developed for AdvancedTCA, visit the following sites, or contact your Intel representative.

www.intel.com/go/mcp
www.picmg.org
www.intel.com/go/ica

[1] Crystal Cube Consulting and Metz International, 2003

[2] Yankee Group, 2003

[3] NEC Corporation press release: www.nec.co.jp/press/en/0309/1001.html

[4] Moore's Law is a well-known characteristic of today's silicon industry, stating that about every two years, the number of electronic components on a chip will approximately double, increasing the functionality of the chip (functional density). This has led to the convergence of technologies and applications on a single device, such as we've seen in networking and communications, and rapid integration of functions into smaller hardware footprints, as in AdvancedTCA.

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