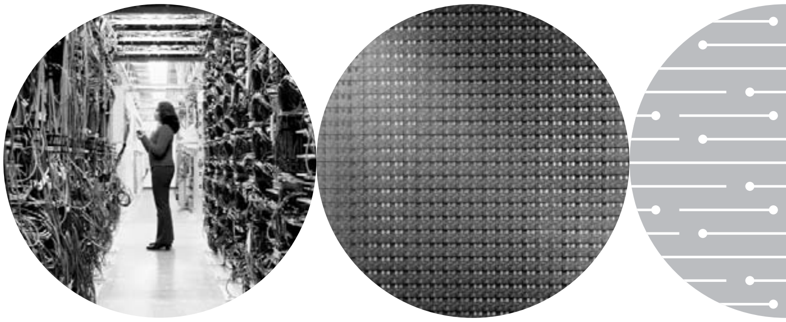
White Paper

Intel in
Communications

Modular Communications Platforms

The Open, Industry-standard Framework for Telecom Infrastructure Solutions



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Executive Summary

For many years, telecommunications platforms were based on closed proprietary frameworks that emphasized network availability. While the resulting proprietary network infrastructure achieved robustness, it was not designed to flexibly and cost-effectively accommodate new voice and data services. The need for new revenue-generating services and applications is changing the way service providers design and deploy their networks.

The demand for services is also driving a fundamental shift in the solutions frameworks used by the telecom industry. To minimize the time and cost of delivering new equipment, telecom equipment manufacturers (TEMs) are adopting a new and open industry-standard development framework known as Modular Communications Platforms (MCP).

While multiple "standards-based" solutions frameworks are currently being advertised, they are not created equal. This paper provides an overview of why the MCP framework is important, describes the industry standards on which it is based, and outlines the benefits of these open standards for TEMs. It describes how MCP provides a clear alternative to proprietary frameworks.

MCP: Benefits for TEMs

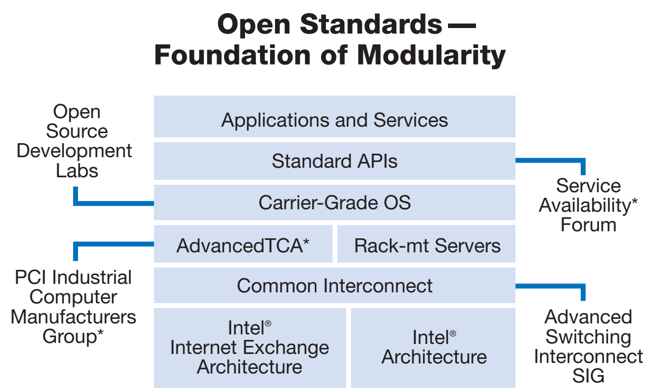
Modular Communications Platforms have compelling benefits:

- MCP enables TEMs to select best-of-breed commercial-off-the-shelf (COTS) products and then integrate them into a platform solution. This approach reduces total development time.
- TEMs can invest their resources in areas that provide the most differentiation and value for service providers, enabling the build-out of network infrastructure to support new services at reduced cost.

Providing these benefits requires a truly standards based industry-wide solutions framework that:

- Has broad industry support from network equipment providers and solutions vendors.
- Provides modularity, interoperability and reusability of COTS solutions.
- Is designed from the ground up to meet the needs of the telecommunications industry.
- Provides the benefits of open industry standards for hardware platforms, interconnects, backplane switching fabrics, platform management, carrier-grade operating systems and high availability middleware.

Figure 1. Open standards for Modular Communications Platforms



Broad Industry Support

The MCP paradigm is based on essential open and industry-wide standards initiatives:

- Advanced Telecom Computing Architecture (AdvancedTCA*) is an open industry specification designed to meet the requirements of next-generation carrier-grade communications equipment. AdvancedTCA represents the largest specifications initiative in the history of the PICMG* organization.
- An extension of PICMG's work for ATCA includes the Advanced Mezzanine Card (AMC) Standard. The AMC significantly increases the density of mezzanine cards on standard AdvancedTCA carrier boards.
- Advanced Switching (AS), based on the PCI Express* architecture, is a multipoint, peer-to-peer switched interconnect technology that enables standardization of proprietary backplane fabrics through encapsulation of any communications protocol, with extended features for QoS and high availability. AS is supported by leading switching fabric vendors and is an initiative of the Advanced Switching Interconnect SIG* (ASI-SIG).
- Carrier Grade Linux* is an open source operating system based on the 2.4 Linux kernel, with enhancements that support the carrier-grade requirements of high availability and reliability. It is supported by the Carrier Grade Linux Working Group within the Open Source Development Lab (OSDL).
- Service Availability* Forum middleware interfaces enable delivery of carrier-grade systems based on standards-based COTS hardware platforms, high availability middleware and service applications. The Service Availability Forum is a consortium of industry-leading communications and computing companies working together to create and promote open standard interface specifications.

Modularity, Interoperability, and Reusability

Today, MCP solutions are being deployed in applications from the edge to the core of the network. MCP enables a wide choice of interoperable blades for I/O, applications processing, and packet processing. Together, these building blocks simplify the integration of multi-vendor communications solutions and enable faster and lower cost deployment of new services.

One of the chief benefits of MCP for TEMs is the reusability of standard modular components across multiple network elements and applications. For example, a TEM could potentially base all the elements of a Radio Access Network on a common platform built around standards-based chassis, line cards, and switch fabric blades. This flexible modular architecture can drive benefits throughout the value chain.

In announcing its Next Generation Telecom Architecture,* here is how Siemens mobile summarized the value of AdvancedTCA across its family of products:

> "Infrastructure network elements were previously based on proprietary, product-specific hardware, but the Next Generation Telecom Architecture from Siemens mobile will leverage the use of interoperable industry standards including AdvancedTCA, Carrier Grade Linux, and SA Forum's application interface specifications for high availability middleware. Siemens will increasingly implement transport, control, and service network elements as software applications based on a common modular hardware platform approach. In particular, providers of 3G mobile services will benefit from this transition due to the need for rapid deployments and network build outs." (Source: Siemens mobile press announcement, 2/2004.)

TEMs can use MCP to take advantage of the cost benefits of volume manufacturing and the cost savings of flexible building blocks that can be used across a variety of network elements. In its value proposition study focusing on AdvancedTCA blades, the Yankee Group stated that by purchasing ATCA packet-processing blades, a TEM specializing in carrier-edge solutions can realize the following benefits:

- Up to an 85 percent reduction in hardware engineering labor costs
- Up to a 40 percent reduction in overall product development costs
- A time-to-market advantage of 3 to 5 months for hardware upgrades
- A time-to-market advantage of 3 to 9 months for developing new blades

- A time-to-market advantage of 12 to 18 months for development of new carrier edge systems
- A simpler cost structure
- A high level of flexibility with product design
- A more predictable product development cycle
- A comprehensive suite of development tools

Here is how NEC described the time-to-market advantage of AdvancedTCA for its advanced new platform for mobile operators:

> "The new platform was created to achieve a short-term development period (1/3 of current systems), and drastically reduce development costs by utilizing open software/hardware." (Source: NEC press announcement 9/2003.)

COTS Silicon

AdvancedTCA lets TEMs use commercial general-purpose silicon to eliminate the complexity of proprietary ASIC designs while meeting stringent network infrastructure requirements. This allows TEMs to free up R&D resources and focus on adding value in other areas of the communications platform.

The Intel® Communications Alliance Advantage

To help the telecommunications industry make a smooth transition to Modular Communications Platforms, Intel has established a worldwide community of more than 150 hardware and software developers, integrators, and solution providers committed to the development of modular, standards-based building blocks, platforms and solutions. The Intel® Communications Alliance helps equipment manufacturers find the right components for their solutions through a trusted ecosystem supply line based on Intel® technologies, processors, products, and services, including embedded Intel® Architecture processors and Intel® network processors. Members of the Alliance work closely with Intel to develop standards-based offerings. This provides TEMs with options at multiple levels of integration to accelerate time-to-market.

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

Open Standards

An open telecommunications architecture based on industry standards provides TEMs and their customers with the ability to drive technology innovation by using best-in-class methods, capabilities, and product features from multiple vendors. This provides a distinct advantage over architectures originally designed for enterprise server applications that have been subsequently modified to support the more stringent requirements of telecommunications.

AdvancedTCA*

The AdvancedTCA standard specifies a standard blade form factor, backplane, mechanical features, power and thermal characteristics, and management system. It takes the MCP concept to the next level with a new and larger form factor, significantly higher thermal envelope, and higher performance.

AdvancedTCA supports the switched fabric architectures required by carriers and operators:

- PICMG 3.1 AdvancedTCA Ethernet/Fibre Channel
- PICMG 3.2 AdvancedTCA InfiniBand
- PICMG 3.3 AdvancedTCA StarFabric
- PICMG 3.4 AdvancedTCA PCI Express
- PICMG 3.5 AdvancedTCA RapidIO

Maximizing Multi-Vendor Support

The choice of available vendors has a dramatic impact on the ability of an equipment manufacturer to select solutions with the optimum balance of cost, performance, feature set, and scalability. Since the PICMG published the AdvancedTCA specification in December 2002, AdvancedTCA has had tremendous support, with, at last count, more than 38 vendors producing over 90 products that are either available or in development, including chassis, server blades, I/O blades, switch fabric blades, storage, management modules, power supplies, and a growing list of standardized software modules. The overwhelming adoption by the vendors on the AdvancedTCA specification is largely due to the robustness of the architecture and its ability to meet customer requirements.

Vendors can freely build upon the AdvancedTCA architecture with no licensing or royalty fees. The short version of the AdvancedTCA specification is available at the PICMG Web site: **www.picmg.org**.

Scalability and Upgradeability

One of the most powerful ways to upgrade AdvancedTCA blades is to take advantage of standard mezzanine modules. These include Processor Mezzanine Cards (PMCs) or Advanced Mezzanine Cards (AMCs). AdvancedTCA PMC and AMC modules, which are widely available from multiple vendors, cut time-to-market significantly by enabling TEMs to take advantage of COTS compute and I/O engines and outsource T1/E1 protocol engines. The large form factor of AdvancedTCA blades provides ample architectural headroom for the highest performing processors.

Maximizing Platform Density

Platform density is a key next-generation network requirement. Vendors have announced solutions based on AdvancedTCA that cover a broad spectrum of chassis and slot configurations, ranging from 2U chassis with 3 slots up to 14U chassis with up to 14 slots.

AdvancedTCA takes platform density to new levels with the 10U chassis developed by Intel. This configuration can support 24 processors (dual star configuration with two switches) in a standard 19" rack with up to 4 chassis per frame. This highly dense configuration enables up to 96 processors per frame within the standard AdvancedTCA specification of 200 watts or less per blade.

Cost Advantages

AdvancedTCA standards-based architectural flexibility allows board, chassis, and system-level designers the freedom to implement standard reconfigurable shelves in many different form factors and configurations. The flexibility of AdvancedTCA makes it the platform of choice for access, edge, and some core network elements, as well as server-based applications. The ability to support multiple network elements on a unified architecture can significantly cut development time and reduce cost for TEMs. For manufacturers, these flexible, reusable building blocks enable economies of scale, and eliminate the need to retrain developers when a new network element is introduced.

Advanced Switching for the PCI Express* Architecture

Advanced Switching is an emerging technology that allows for the standardization of blade-to-blade communication. It is a multi-point, peer-to-peer switched interconnect capable of encapsulating any protocol, supporting multiple data transport mechanisms, providing scalable QoS with congestion management, and delivering carrier-grade high-availability features. Advanced Switching is the only standards-based fabric technology that allows the transport of both packet and cell-based traffic including PCI Express, Ethernet, IP, Fibre Channel, ATM, SONET/SDH, TDM, and others. ATCA platforms support bandwidth scalability for a broad range of applications through a choice of fabric technologies such as AS, 10G Ethernet, InfiniBand architecture, PCI Express architecture and StarFabric.

Since it employs the same physical and data-link layers as PCI Express architecture, AS can take advantage of the robust developer community aligned with PCI Express, in addition to the support of leading switch fabric vendors.

Advantages of AS include:

- Supports multi-protocol encapsulation using standard and user-defined protocol interfaces, which allow designers to simplify equipment designs and avoid costly protocol conversions.
- Enables re-use and economies-of-scale from the large PCI Express ecosystem.
- Delivers multiple, scalable serial lanes with multiple link sizes without protocol or electrical modifications.
- Enables enhanced QoS mechanisms that can scale from simple to complex, including congestion management, egress scheduling, multiple Virtual Channels and multiple traffic classes.
- Provides carrier-grade high-availability through full redundancy, fault identification and isolation, security, and hardware-based reliable transport.
- Implements multiple native data transport capabilities including sockets-based communication via Load/Store or Queuing movement models.

Carrier-Grade Operating System

The demands of telecommunications require extremely robust and reliable operating systems that can deliver advanced management capabilities required by carrier-grade network equipment. With the network convergence currently under way, true multimedia telecommunications services will soon become an everyday reality. This is driving the need for more capacity and an optimized architecture to deliver these services with consistent profitability. Modular Communications Platforms provide a choice of carrier-grade operating systems that meet these stringent requirements while providing the advantages of an open software environment.

For developers who choose Linux, Carrier Grade Linux (CGL) is well suited to be the preferred operating system for AdvancedTCA platforms. The advantage of CGL is that it has been developed by many of the same companies and developers involved in the development and specification of AdvancedTCA, ensuring tight integration and support. This is important because tuning and "hardening" a carrier-grade operating system requires an in-depth understanding of the specifications and requirements of the platform.

Carrier Grade Linux supports multiple technology areas to meet carrier requirements:

- High performance and scalability
  - OS platform supports millions of subscribers
  - Typical transactions: hundreds to thousands of transactions per second per node
- Reliability
  - Hardware mechanisms to prevent any single point of failure
  - At least five "9s" required
- High availability
  - Support for Active-Standby/Active-Active clusters
  - Redundant networking and storage
- Online updates and upgrades
  - Upgrade mechanisms that minimize downtime

Service Availability* Forum Middleware Interfaces

Today's users expect new services to be delivered when they want them without interruption. To meet this demand, communications equipment needs to incorporate the highest possible levels of availability and dependability, while at the same time meeting time-to-market and cost constraints. The Service Availability Forum is a consortium of industry-leading communications and computing companies working together to develop and publish the high availability and management software interface specifications that enable the delivery of highly available carrier-grade systems using COTS hardware platforms, middleware, and service applications. The Service Availability Forum promotes and facilitates the adoption of these specifications by the industry.

Service Availability high-availability middleware APIs based on open standards are designed to create an open programming environment that can be used to simplify upgrades and provide heightened vendor interoperability. To meet these objectives, the Service Availability Forum provides standard API specifications to the telecom industry. The purpose of management middleware is to provide services for monitoring and managing platform components to meet the goal of 100 percent service availability. This in turn requires a robust developer community capable of offering the widest possible choice of management middleware products, providing developers with the freedom to match manageability to the service needs of a given system.

Service Availability middleware is complemented by AdvancedTCA, which supports multiple standard chassis management interfaces including CLI, SNMP, HTTP, RPC, HPI, and RMCP (IPMI over LAN) and easily integrates with COTS middleware solutions from multiple vendors. This high level of interface standardization and flexibility eliminates the need for TEMs to develop applications from scratch and port them to each new hardware platform.

Conclusion

As telecom equipment manufacturers continue the transition from proprietary designs to "standards-based" architectures, the degree of openness present in the architectural framework can be crucially important. Modular Communications Platforms are based on truly open industry standards that provide TEMs with the following benefits:

- The competitive advantages of maximum openness and choice, enabled by widely supported industry standards for hardware platforms, interconnects, backplane switching fabrics, platform management, carrier-grade operating systems, and high-availability middleware.
- Modularity to enable highly scalable implementations based on reusable COTS building blocks.
- Ability to use industry-standard-based building blocks to develop platforms, enabling them to speed time-to-market and allowing them to free up resources for new software innovations.
- An architecture designed from the ground up to meet the demands of the telecom industry.

Modular Communications Platforms span a broad ecosystem of building blocks including silicon, boards, chassis, operating systems, middleware, applications, and more, providing the multi-vendor choices that TEMs need to add value and meet the demand for new services. Modular Communications Platforms not only provide TEMs with a clear alternative to proprietary frameworks, they also provide compelling advantages over "standards-based" frameworks that may retain some proprietary elements. As the infrastructure build-out continues, the industry needs to preserve the flexibility that only truly open standards can provide.

Where to Learn More

Intel is driving the development and broad adoption of numerous industry standards in networking and communications to ensure customers have the broadest possible choice of standards-based products. For more information visit Intel Modular Communications Platforms on the web at **http://www.intel.com/go/mcp**.

The Intel Communications Alliance includes providers of modular, standards-based building blocks, platforms, and solutions. You can learn more at **http://www.intel.com/go/ica**.

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