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Making it all work

The steady move from proprietary platforms to ones based on open industry standards shows no sign of slowing down. The telecommunication industry, which is the largest market for communications equipment outside of the consumer space, is slowly but surely moving away from a one-hundred-year tradition of building everything themselves while at the same time discouraging competition by keeping the equipment proprietary. What the telecommunication industry is moving towards is the outsourcing of design and manufacturing tasks to others, based upon open standards. Sometimes the telecom equipment providers play a crucial role in the definition of the platforms, as was the case with AdvancedTCA. The military and aerospace markets continue their move towards COTS platforms, and seem especially interested in the potential of ruggedized MicroTCA.

What do telcos want?

But a number of tough problems remain. Today’s high-speed, highly available, switched-fabric platforms are extremely complex, and the core hardware is but a piece of the overall system. Telecom manufacturers want to purchase platforms that are ready to accept their application, which is their real value add. A reliable operating system – increasingly Linux – must be ported to the hardware. High Availability, also called HA, middleware must be integrated, and all of the system management bits must be connected physically and logically. Careful thermal design is required to make everything work reliably at high temperatures. And, to top it off, these telcos want to buy different parts of the system from different vendors to get best in class performance and to encourage price competition. In other words, they want interoperability.

These requirements have led our industry to realize that interoperability just doesn’t happen automatically. There must be methods developed to establish interoperability requirements, develop test methods, and do the actual testing. PICMG has been conducting interoperability workshops since 1993 on an informal basis, and these workshops have served the ecosystem well. But they are not enough. Formal testing methodologies must be developed, and someone has to own them. In the case of AdvancedTCA, MicroTCA, and the Advanced Mezzanine Card, that organization is the Communications Platforms Trade Association, or CP-TA. In this issue, Nirlay Kundu from Emerson Network Power, who also chairs the Compliance Group at CP-TA, explains the problems they are addressing, their approach, and their goals. He does a good job of explaining how their programs can reduce costs for both vendor and customer. You can also find out more about the organization’s activities at their Web site, www.cp-ta.org.

Sven Freudenfeld from Kontron digs a little deeper into interoperability issues, discussing additional issues for systems integrators, who are becoming an indispensable part of the AdvancedTCA value chain. He explains the importance of integration management, platform pre-validation, and testing. Sven is very active in CP-TA, and he presented a recent web seminar on the issues of bringing application-ready platforms to market quickly, noting that forecasters expect 80 million IPTV subscribers by 2011. AdvancedTCA is becoming the platform of choice for IPTV, as we’ve discussed in previous issues. His presentation can be viewed at www.cp-ta.org.

I’ve noted in earlier columns that Ethernet is the overwhelming choice for most AdvancedTCA applications. Gary Lee from Fulcrum Microsystems tells us about a new development in the form of Carrier Ethernet, which is replacing SONET-SDH technology in backbone and access networks, describing its higher performance and lower cost. He points out that the availability of high-volume boards and switches makes AdvancedTCA a good choice for Carrier Ethernet systems.

One of the attractions of AdvancedTCA and MicroTCA is the ability to build highly available and highly reliable platforms. While the size, capacity, and speed of conventional mechanical hard disks continues to improve, they are a weak component in systems trying to reach 5-nines and 6-nines availability and 20 years of operational life. Paul Dinh from Virtium Technology introduces us to Solid State Drive technology using Flash memory and explains how system performance as well as reliability can improve. The military and aerospace markets have been moving to Flash storage for some time and will likely demand it for upcoming MicroTCA applications.

In this month’s Global Technology column, our colleague Hermann Strass provides us quite a bit of detail about who is doing what with AdvancedTCA. He notes that last year’s sales of AdvancedTCA gear worldwide totaled about $600-700M, and we’re on target for about a billion dollars in sales this year. I think his numbers are about right and agree that a few early, overly enthusiastic predictions by a few excited analysts were unrealistic and have been scaled back.

To round out this month’s editorial, Curt Schwaderer’s Software Corner gives us some examples of how the convergence of multiple applications onto single platforms is providing very capable multimedia solutions for businesses at ever lower costs and operational expense.

Joe Pavlat, Editorial Director
AdvancedTCA: why market predictions don’t always hit the mark

By HERMANN STRASS

AdvancedTCA is a technology that is deployed in large telecom systems. Designing, testing, and qualifying such a system takes a long time. This is something that market analysts did not figure into their predictions of supposedly skyrocketing sales. In Europe and many other parts of the globe AdvancedTCA has been slow to get to significant sales other than test installations. It remains to be seen which developments generate big sales in the future. Specifications and standards are in place. There are all types of products available in great variety, including middleware in Europe and worldwide, as a product search at www.compactpci-systems.com reveals.

AdvancedTCA adoption

Because of the nature of the products there are only a small number of users who might require AdvancedTCA products and accessories. Several of them have to be convinced to adopt AdvancedTCA in a big way before we see the market take off. A brief summary of the status of some of these potential users, based in Europe and Asia, follows.

Ericsson AB

Ericsson AB (Sweden) has said it is sticking with a proprietary architecture, although the company is reportedly interested in adding AdvancedMC cards to the mix. Ericsson produces MicroTCA power modules and sells them to other MicroTCA vendors.

Huawei Technologies Co., Ltd.

Huawei’s (China) AdvancedTCA solution supports both fixed and mobile services. One Huawei customer, Magyar Telekom (Hungary), uses the Open Standard Telecom Architecture (OSTA) platform of Huawei, which complies with AdvancedTCA. Magyar Telekom is Hungary’s largest full-service telecom operator and a holding company of Deutsche Telekom (Germany) in Hungary with a 59.2 percent share. T-COM, a subsidiary of Magyar Telekom, has the largest share (80 percent) of the fixed network market and T-Mobile, another subsidiary, has the largest share (45 percent) of the mobile network market in Hungary, with networks that cover Hungary and neighboring countries including Romania and Macedonia.

The Huawei Tecal T8000 platform is another AdvancedTCA-based computing platform. This platform employs AMD64 (Opteron) processors on its BA22 AdvancedTCA server boards. (See Figure 1 courtesy of Huawei Technologies.) A number of other operators including TATA (India), China Mobile, Korea Telecom, Brazil’s Vivo, Vietnam’s Vinaphone, Pakistan’s Ufone, Singapore’s StarHub, and Chile’s Movistar use the Platform of Advanced Radio Controller (PARC) platform, which Huawei developed. PARC represents a new-generation all-IP hardware platform. Benefiting from the advantages of AdvancedTCA, the third-generation PARC is large in capacity, highly integrated, and highly reliable, while significantly reducing energy consumption and maintenance costs.

NEC Electronics

NEC Corporation in Europe uses AdvancedTCA and MicroTCA modules for its AM3100 Series Multi Service Access Node (MSAN) product range. The AM3110 (AdvancedTCA) and AM3160 (MicroTCA) provide scalable and flexible broadband platforms. NEC claims to have introduced the world’s first operational AdvancedTCA-based system for SGSN and GGSN (GPRS support nodes) in September 2003 (Figure 2, courtesy of NEC Corporation, Japan). On December 3, 2004, NEC reported that it had sold more than 100 AdvancedTCA systems using Carrier Grade Linux (CGL) from MontaVista (United States), as developed by the Open Source Development Lab (OSDL) working group, and NEC middleware.

Nokia Siemens Networks

Nokia Siemens Networks Oy (Finland), a joint venture of the two companies’ networks divisions, claims to be one of the second largest equipment vendors after Ericsson AB. Nokia Siemens Networks prefers the Siemens AdvancedTCA, which is significant,
because Nokia has not been enthusiastic about AdvancedTCA in the past. In the mobile packet core, it chose Nokia’s SGSN and GGSN products. Fujitsu Siemens Computers (FSC) had high expectations in AdvancedTCA at the first International Service Availability Symposium (ISAS), which took place in 2004 in Munich.

TietoEnator
TietoEnator (Sweden) is a Scandinavian IT service company with headquarters in Finland and Sweden, which has taken over Siemens Communications R&D, Germany, and many other companies or sections of companies throughout Europe and other countries. They have an AdvancedTCA signaling blade (Figure 3, courtesy of TietoEnator) that can handle many protocols, from ANSI and IETF to ITU and TTC, including Chinese SS7.

Alcatel-Lucent
Alcatel-Lucent, specifically the company’s American section (Lucent), has been active in developing the AdvancedTCA specification.

Predictions
AdvancedTCA sales will close 2007 at $600 million to $700 million ($736 million in 2008), estimated Crystal Cube Consulting (CCC) in December 2007. CCC is fairly confident that AdvancedTCA will hit close to $1 billion in 2008 and they are predicting a $3 billion to $4 billion AdvancedTCA market in 2010, where part of the 2010 sales could be IBM BladeCenter HT revenues. IBM is testing AdvancedMC modules in some systems.

Outlook
According to a survey of telecommunication vendors in Europe (published May 1, 2008), operators are migrating to IP networks at a high rate. About 72 percent still had not phased out their SS7 infrastructure entirely and noted that ongoing support was vital to business. Many vendors are still trying to squeeze as much as they can out of their existing signaling networks and investments before committing to the transition to an all-IP infrastructure. Choices would be AdvancedTCA or IBM BladeCenter HT products.

As can be seen by taking a wide-angle view of 3G Network Architecture, these are very large systems with long-term tested and verified parts, which will only be replaced with newer products (possibly AdvancedTCA) as they become obsolete over the years. This alone puts strong brakes onto fast deployment of new (AdvancedTCA) products.

For more information, contact Hermann at: hstrass@opensystems-publishing.com
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Simplification of VoIP deployment through effective software architecture

As new network technologies are standardized, functional components are identified and placed into an overall system architecture. Once the system architecture is defined, network product development focuses on a single product per defined function. Over time, functional components begin to merge into fewer products that implement multiple functions within the network system architecture.

Today’s multimedia networks are also following this pattern. For example, as VoIP service matures within these multimedia networks, this convergence becomes evident as well. In this month’s column, we will look at the Critical Links (www.critical-links.com) edgeBOX product features and software architecture. This architecture illustrates how flexible and intelligent software architecture leads to rapid development and deployments of these converged products.

Today’s multimedia businesses

Businesses deal with a multitude of connectivity issues these days. On the networking side of things, high-speed connectivity with the Internet and associated network access control is one large issue. The Virtual Private Network (VPN) and firewall technologies are needed to allow remote access to enterprise information while still providing security from outside threats. Bandwidth management is important to ensure the critical networking tasks of the company are performed within proper time constraints. Wireless access that enables visitors to be productive at the business site while preventing them from accessing secure areas is also an important dimension of business network requirements.

More companies are looking at VoIP services for cost-effective communication among employees and for conference calls.

Certainly every company must have a Web site that needs to be efficiently maintained and updated with the latest information available. Other business productivity requirements include groupware such as e-mail and task/meeting scheduling software. Configuration and management of these services within the company is necessary. Scheduled backup of critical information within the company is also vital.

This myriad of voice, data, and multimedia services has given rise to the proliferation of a large number of single-purpose devices. This makes for a large capital investment for businesses, with regard to the equipment itself and to the learning curve and manpower needed to configure and maintain the equipment.

Network services convergence

Another important issue with respect to network services convergence is how the deployment of these services affects other aspects of the management and security capabilities of the business. For example, if a business wants to use VoIP, the service will not work unless the firewall for the business allows the VoIP connections to happen. Specifically, the VoIP signaling, which is typically the Session Initiation Protocol (SIP), negotiates which port numbers the sender and receiver will communicate over. If the firewall disallows these ports to be passed into or out of the firewall, the voice call completes successfully, but the conversation will be blocked.

When the firewall and VoIP service equipment (sometimes called the IP-PBX) are separate devices, the administrator is forced to open an entire range of port numbers – the firewall has no idea which ports will be used for any conversation. If the firewall and VoIP services products are combined into one product, the SIP signaling could simply inform the firewall to open a single pair of ports when a phone call is established. This could occur dynamically and with far more security than with two separate products.

This example of how the VoIP call indirectly interacts with the firewall is an important example of how an integrated, multifunction product not only saves capital equipment expense, but also saves operational expense by reducing the amount of configuration the system administrator must do.

The services configuration and maintenance approach

I recently talked with Abdul Kasim, Vice President, Marketing/Business Development and Alex Sarin, Vice President, Product Management, at Critical Links about the company’s edgeBOX product line. The edgeBOX is a great example of how convergence of multiple services into one integrated product can result in multimedia business solutions that offer a robust set of services, yet minimize capital and operational expense.

Despite the name edgeBOX, Critical Links is a software company. It can provide an integrated solution in a software-only format, load the software solution on a customer’s COTS platform, or deliver a complete plug-and-play appliance.

This makes for a large capital investment for businesses, with regard to the equipment itself and to the learning curve and manpower needed to configure and maintain the equipment.
Figure 1 shows the software functions available. These individual pieces are software from the open source community.

For example, the VoIP, IP-PBX component is from the Asterisk open source telephony platform. Key additional pieces making up the Critical Link integrated solution are:

- The integration software that enables one component to dynamically configure another component
- The unified management system

Demonstrating depth of integration, the edgeBOX software will take the ports provisioned to carry the voice traffic of a VoIP call and configure pin holes within the firewall component of the security software block. When the call ends, these pin holes are removed. Further, when the VoIP call has negotiated the parameters of the call, these parameters are used to configure the Quality of Service (QoS) component as well. The QoS handles inbound and outbound Service Level Agreements (SLAs) for VoIP calls and allows for custom QoS pipes that guarantee bandwidth in the event of congestion for communication or data transfer tasks that are critical for the company.

In addition to its IP-PBX, security, and QoS components, the edgeBOX solution has router software that transparently handles traffic between the WAN, wireless LAN, LAN, and DeMilitarized Zone (DMZ). The edgeBOX Wi-Fi support includes operation as an embedded access point or as an access point controller. When combined with the IP-PBX component, the edgeBOX allows for Wi-Fi VoIP phone access. Network Attached Storage (NAS) is also available with scalable storage capacity and Redundant Array of Independent Drives (RAID) capability. Collaboration services including e-mail and groupware (calendar and task lists) are also available.

All these distinct components are stitched together in such a way that a component performing a dynamic task can use that information to configure other components involved in the delivery or access of that information.

If you look at the configuration of each of the open source component products, you will notice that they tend to be configured in a technology-centric way. For example, configuring the Asterisk IP-PBX service involves setting up user IDs, call IDs, call port number ranges, available codecs for encoding and decoding the audio passed in the call, and many other things. The unified management component exposes a higher level services-oriented view for the user. So the system administrator configures the edgeBOX system taking into account users of the system and their access and service capabilities. The edgeBOX software then takes this general services-oriented configuration, identifies the information...
pertinent to each component in the system, and does the nuts and bolts configuration of each of the components.

Some companies find it convenient to use the edgeBOX configuration and management interface. This capability allows for businesses with multiple sites to deploy multiple products and manage them from a single, unified point. For those companies that currently use other management interfaces such as HP OpenView, all the edgeBOX software can be configured with those management stations as well. Figure 2 is the integration communication and management UI.

**Software architecture**

Figure 3 shows the edgeBOX software architecture. Each of the open source components is housed in the edgePACKS block. The edgeBOX services block implements the glue code that passes the dynamic information of each of the individual components among each other as needed. This block also interfaces to the management block, which enables monitoring and reporting of system operation.
At the top of Figure 3, each of the interfaces and APIs comes up through the edgeBOX unified management interface and can also be accessed through other third-party management systems. The software architecture also takes Linux system health and debug facilities and exposes them as monitoring agents to third-party software or to the reporting software of the edgeBOX management user interface.

Dynamic updates of existing components and addition of new components are performed through the Linux RPM facility. Critical Links has architected the software so the integration code can understand which components are enabled in the system and provide the communication services between the existing components as needed. If a software component is not enabled in the system, the integration code simply does not call the service APIs of that component.

About Critical Links
Critical Links was spun out of Critical Software, a company based in Portugal that develops mission-critical applications for a variety of customers worldwide. While Critical Links received its first round of funding only last year, the 50-plus employee company is already involved in hundreds of deployments around the world.

Critical Links is also involved in the Intel Enabled Server Acceleration Alliance (www.esaa-members.com), where the company focuses on fault tolerance and utilizing multicore technology with its converged services software platform. Critical Links recently announced support for an Intel multicore, multiservice business platform. The software does not currently provide anything special for multicore platforms other than utilizing the Symmetric Multiprocessor (SMP) capabilities of the Linux v2.6 operating system. But future versions may include dedicating specific services to specific cores.

Conclusion
Critical Links appears to be at the nexus of multiple forces pulling at today’s small- and medium-size business needs. This is largely due to a flexible software architecture that accommodates integration of multiple components to achieve a business services solution that is simple to configure and use. The open source community provides a solid foundation of technical capability for specific functional components, but at the cost of a very technology-centric user interface. Silos between these open source components make it too expensive and time consuming for businesses and their IT departments to use directly. The need for a more efficient, complete solution for effective capital equipment spending and lower operational expense is also important. Critical Links has recognized these trends and produced an integrated software solution with easy to use user interface hooks into some very technical software to make it a readily configurable solution for the enterprise.

For more information, contact Curt at cschwaderer@opensystems-publishing.com.
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Customer First. Quality Always.
With IPTV quickly becoming closer to reality, Sven Freudenfeld, Chair of the Communications Platforms Trade Association (CP-TA) marketing workgroup focusing on the interoperability of COTS standard building blocks, outlines why network equipment designers are now looking to a COTS approach driven by standards in order to accelerate the development cycle, reduce risk, and ultimately shorten time-to-market.

Advantages of AdvancedTCA

A recent report by Cisco Systems suggests that as early as 2009, use of IPTV will eclipse that of Internet video-to-PC streaming and downloads. But, building a system to deliver the performance required for IPTV is a complex design task. Designing the entire system in-house is no longer a realistic use of resources or cost-effective option.

IPTV requires very high levels of processing horsepower to perform the coding and transcoding of live and stored video streams. This requirement can be met by the latest AdvancedTCA multicore processing platforms, which offer extremely high computing power, high communication bandwidth, and high availability.

Processing capabilities and available bandwidth increase with multicore processors. At the same time, multicore processors make it possible to maintain a smaller footprint and lower power performance than were achievable in past rack-mount configurations. Manufacturers who take advantage of the latest multicore processors in the AdvancedTCA form factor will be able to build faster, more scalable systems without upgrading the framework or increasing floor space.

The AdvancedTCA specification defines a number of backplane protocol and topology choices, providing flexibility depending upon the needs of the application. The processing boards communicate over the backplane via high-bandwidth channels, typically Gigabit Ethernet or 10 Gigabit Ethernet, in either a star, dual star, or full mesh topology. Peripherals such as packet processing modules and storage drives using iSCSI communicate over the backplane, typically via PCI Express, GbE, 10 GbE, Serial RapidIO, SATA, or SAS.

The redundancy of the dual star and full mesh topologies is a key factor in making AdvancedTCA systems highly available. Other features of AdvancedTCA that support high availability include the ability to hot swap all FRUs, redundant Intelligent Platform Management Interface (IPMI) buses for blade management, and shelf management. These features, if leveraged through the proper use of middleware and/or application support, can provide systems with up to 5-nines (99.999 percent) availability.
Advanced Mezzanine Cards (AMCs), which are AdvancedTCA plug-in expansion cards, address the need for high levels of modularity and configurability. AMCs can extend the benefits of the AdvancedTCA fabric to individual modules, enabling designers to customize, scale, upgrade, and service their systems.

The Micro Telecommunications Architecture (MicroTCA) is a complementary, smaller scale platform built around the use of AMC modules. Despite its small size, MicroTCA offers a wide range of bandwidth options with regard to both compute bandwidth and communication bandwidth. Up to 12 compute boards on a single backplane give MicroTCA a tremendous amount of computing resources, especially when each board has the potential to use a multicore processor. Communication bandwidth capabilities range from 1 Gbps to 10 Gbps using multiple switch protocols such as 1 GbE, 10 GbE, or brio.

With this amount of compute and communication power, MicroTCA shows great promise for IPTV-based or content delivery services. Designers can use MicroTCA for residential media gateways, capitalizing on this platform’s high availability, low-power, ultra dense processing, and lower operating costs. The smaller form factor and lower entry cost of MicroTCA communications servers supports a “pay-as-you-grow” business model, allowing Service Providers to enter a market with less initial capital expenditure and expand their computing platform capabilities in small, low-cost increments as demand for the new service increases.

Together, AdvancedTCA, MicroTCA, and AMCs make up the open modular xTCA ecosystem with multiple vendors offering a variety of solutions. Because the system configuration options using the xTCA approach are diverse, multivendor interoperability is vital.

**Other critical building blocks**

Along with the benefits provided by xTCA comes a degree of complexity in the details of virtually every facet of the system. Besides the standards-based COTS system management building blocks (Figure 1), a number of other elements must all work together seamlessly.

System design engineers must also integrate the associated OS and in some instances the Board Support Package (BSP) with the associated supporting drivers for the components on the board or system and develop middleware to integrate the hardware with the application reliably. The management capabilities for all the hardware, fabrics, software, and system components are quite sophisticated and require an expertise in the complex standards to pull all the building blocks together into a cohesive system.

Given the difficult, detailed, and time-consuming nature of pulling the pieces of the platform together, embedded system companies should not be discouraged from developing an xTCA-based system. Standards-based middleware provides new opportunities for realizing fully integrated carrier grade platforms.

Frequently a lapse looms between the availability of the hardware and date that it is possible to deploy applications. This gap derives from the schedule cost of the back-end software development. It can be filled with middleware platforms, as shown in Figure 2, that provide chassis management functions, inter-process communications, and services that are scalable from deeply embedded to large, complex systems.

![Figure 2](image-url)

The availability of open system solutions and open architecture middleware platforms makes it possible to integrate essential services without being a technical expert in communications. Preintegrated open modular platforms take much of the guesswork out of system operability and reliability. This is especially the case when the Network Equipment Provider (NEP) or Telecommunications Equipment Maker (TEM) collaborates with hardware and middleware suppliers from an early stage in the design process to understand the goals, implementation, and operation of the system.

**Integration management**

While the number of benefits to using an open modular standard are many, it still requires a certain level of integration effort, one that can take from six to 12 months, to make sure all the building blocks work seamlessly together. In addition, integrating the hardware platform can require a great deal of support in the form of program management, functional experts, quality assurance, tools, and deployment support – all of which adds up to a tremendous amount of precious personnel, time, and money resources.

To begin with, integration efforts are on different levels, starting from interoperability on the hardware level when using multiple sources for the system components. There are also the considerations of thermal, mechanical, fabric connectivity, and Intelligent Platform Management Interface (IPMI) interoperability. This first integration task can become quite complex. Having all the tools to perform this task is already a significant investment, not to mention the engineering time to perform that validation and integration. When integrating multisourced standard components, further challenges arise when it comes to identifying which “vendor” is at fault when problems occur.

The next level of integration requires that the preferred OS is working and supported on the desired blades and might require an additional validation effort. The manageability within the system can take a major undertaking. Even by using standards-based components, the system management (middleware), HPI, and shelf
management all need to be validated as a cohesive management unit. Even if the components are designed based on standards or a recipe, every vendor may have a different method of implementing it. For a product to be successful, it needs to be a complete solution with hardware, middleware, OS, and the like. Integrating all these elements is a year’s worth of intense work, which can be a time-consuming and costly task for a systems provider.

Instead of modifying the middleware for an altered application in-house, the equipment manufacturer can utilize a preintegrated system and COTS software tools to ensure the application integration is seamless. An out-of-the-box integration with middleware can deliver a complete control, management, and data platform. Buying a market-tested product ensures greater operational flexibility and takes foreseeable hardware, software, and application upgrades into account.

Kontron and Enea jointly developed an AdvancedTCA Gigabit and 10 Gigabit system preintegrated with the Enea Element middleware platform to offer a reference platform for telecom equipment manufacturers. Kontron’s modular, high-performance AdvancedTCA systems, combined with Enea’s carrier grade software framework, provide best-in-class network supervision, fault management, device management, and data management services. This preintegrated solution offers equipment makers a flexible, high availability platform for scalable, upgradeable, 5-nines equipment to deliver uninterrupted, high-quality multimedia services over IP networks.

**Importance of prevalidation and testing**
Preintegrated open modular platforms take much of the guesswork out of system operability and reliability. The combination of open system solutions and open architecture middleware platforms make it possible to integrate essential services without being a technical expert in communications. This is especially the case when the NEP or TEM collaborates with hardware and middleware suppliers from an early stage in the design process to understand the goals, implementation, and operation of the system.

The Communications Platforms Trade Association (CP-TA) is a global association of communications platform and building block providers dedicated to accelerating the adoption of SIG-governed, open specification-based communication platforms through interoperability and testing. CP-TA has delivered interoperability documents for AdvancedTCA and is currently addressing AMC and MicroTCA specifications. COTS building blocks are tested according to the CP-TA Test Procedure Manual and validated according to the Interoperability Compliance Document.

Besides the CP-TA, there are a number of additional working groups dedicated to solving issues related to xTCA interoperability and compliance. The SCOPE Alliance has defined a reference architecture for a generic Carrier Grade Base Platform (CGBP). This architecture, which includes hardware, operating system, operations and maintenance functions, and tools also specifies middleware as a fundamental component for service availability. In addition SCOPE creates profiles for the Service Availability Forum (SA Forum), the main organization active in the middleware standardization effort.

The SCOPE Alliance has also published the AdvancedTCA profile, which provides guidance for a common platform to create carrier grade platforms that fulfill the needs of NEPs and their customers, the Service Providers.
Summary
Along with the standards-based COTS system management building blocks, there are a number of other elements that must all work together seamlessly in a cohesive system. Pulling all of these pieces together can be difficult, detailed, and time-consuming. For a product to be successful, it needs to be an integrated solution with hardware, middleware, OS, and the like. Finding the right building blocks and partnering with experts that can provide integrated, validated, and tested platforms is very important to the long-term success of any IPTV application. CP-TA tested building blocks offer developers the freedom of choice to select the best of breed in price and performance, alleviating the issues about hardware integration or interoperability and allowing them to focus on differentiating their application.

Sven Freudenfeld is responsible for North American Business Development for the Kontron AG line of AdvancedTCA, AdvancedMC, MicroTCA, and preintegrated OM solutions. Sven possesses more than 15 years of experience with voice, data, and wireless communications, having worked extensively with Nortel Networks in systems engineering, Sanmina-SCI in test engineering, and Deutsche Telekom in network engineering. Sven holds an electrical engineering degree from Germany. He is VP of CP-TA and Chair of the CP-TA marketing workgroup focusing on the interoperability of COTS standard building blocks.
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The Embedded Communications Computing business of Motorola is now a business of Emerson Network Power.
Delivering Ethernet-based backplane fabrics for AdvancedTCA-based Carrier Ethernet designs

By Gary Lee

Carrier Ethernet requirements
Carrier Ethernet started within the Metro Ethernet Forum and many of its standards have been completed within the IEEE. Figure 1 shows a simplified example of a Carrier Ethernet network along with corresponding frame formats, which illustrates how customers are connected to the provider network through CE Access Switches (CEASs). These devices add bytes to form a Provider Bridge (PB) frame (802.1ad), which is used to tunnel the packet through the provider network. The provider network may also contain CE Switch-Routers (CESRs), which can locally switch PB frames or encapsulate the PB frames into the Provider Backbone Bridge (PBB) frames (802.1ah). The carrier network will use CESRs to transport the packet between provider networks using the Provider Backbone Transport (PBT) standard. The redundant PBT path is not shown in Figure 1.

The original scope for Carrier Ethernet was within the service provider domain using the 802.1ad standard (Provider Bridging), which adds a 4-byte service tag to the customer’s Ethernet header as shown in Figure 1. By using a second VLAN ID in the service tag (S-VID), different customers can be supported using unique S-VIDs (known as Q-in-Q). The PB can use this S-VID along with learned customers’ destination addresses and...
VLANs to forward data between customer locations. With this standard, customers are isolated from each other using the S-VIDs, and their original Ethernet packets can be transparently tunneled through the provider network. In addition, the VLAN priority field in the service tag can be used to provide up to eight levels of service within the provider network. Q-in-Q also offers the ability to remap customer VLAN IDs.

When the CE concept started to expand beyond the service provider network and into the transport network, it became quickly apparent that the 4K service IDs provided by VLAN encapsulation would not be enough. Because of the need to go beyond 4K service IDs, the standards bodies defined a new 801.2ah 16-byte Ethernet header extension used in PBB. The original PB frame is preserved intact and simply encapsulated and tunneled through the carrier network. This new header allows 48-bit MAC source and destination addresses (known as MAC-in-MAC) along with VLAN tags to be used to identify unique customers, significantly improving network scalability while maintaining Class of Service (CoS). In addition, the learning of customer addresses is not required, which significantly reduces the MAC address table sizes.

With SONET-SDH transport becoming too costly at 40 gigabit per second data rates and above, backbone system designers started looking at CE as a low-cost alternative. One major problem they had to overcome was the network configuration issues and long failure recovery times when using variations of the Spanning Tree protocol. To sidestep this issue, the standards bodies developed the new PBT standard on top of PBB. This traffic engineering standard allows the network carriers to disable Ethernet learning and statically configure active and protective paths between service providers. It also defines OAM functionality, including network monitoring and fault recovery, with failover times that fall within SONET-SDH standards.

**Advanced Ethernet switches**

Carrier Ethernet requires new features usually not found in standard Ethernet switches, which have been designed for the LAN or data center environments. These advanced features include quality of service, congestion management, load distribution, and advanced header processing. The switches need to provide a number of 10 Gigabit Ethernet ports along with scalable topologies in order to meet the increasing bandwidth demands of the network.

Networks transporting data such as voice, video, or storage must provide minimum bandwidth guarantees for this traffic. This can only be done if this traffic is classified, queued separately from lower priority traffic, and scheduled based on programmable bandwidth parameters in the switch. The latest generation of Ethernet switches offers CoS queues and multilevel schedulers to meet these requirements. These schedulers typically make combinations of strict priority, deficit round robin, and traffic shaping possible. By providing low latency along with minimum bandwidth guarantees, voice and video latency jitter can be minimized and storage traffic latency can be bounded, which is required for this type of traffic.

Because the switch egress ports are a point of congestion in the network, it is ideal to have an output-queued switch with a set of CoS queues at each switch egress port, but it is not enough to have CoS queues if they cannot be flow controlled separately. Traditional Ethernet switches try to meet QoS by classifying flows and then dropping lower priority packets during periods of high congestion. This approach will not be accepted in telecom transport networks where data loss is considered a fault condition. The IEEE is addressing this by defining standards such as Class-Based Pause (CBP) frames (802.3x) that can be used to provide lossless operation in conjunction with the QoS guarantees described earlier.
Telecom backplanes typically operate at 2x line rate in order to account for factors such as congestion, multicast fan-out, and the insertion of management frames. The AdvancedTCA specification only allows four high-speed lanes from a given line card to a given switch card across the backplane. When using standard Ethernet XAUI backplane connections with active-protective switch cards, there is not enough bandwidth to the active switch to sustain 10G line rates. Advanced Ethernet switches solve this problem by distributing the load across both switch cards in an active-active configuration. If one of the switch cards has a failure, only low priority traffic will be affected. This load balancing must be uniform and flow-based so that reordering is not required at the fabric egress.

An advanced Ethernet switch can off-load many NPU or Traffic Manager (TM) functions by performing actions based on header inspection while operating at full line rate. For example, the provider bridging (Q-in-Q) forwarding can be done by the fabric if it can insert and inspect VLAN fields in the 802.1ad header. In addition, ACLs can be used to trap CE OAM frames to a local CPU or direct them to a dedicated OAM processor port. By off-loading these functions, fewer NPUs or TMs are required, significantly reducing system cost.

**Switch fabric design for CE backplanes**

Advanced Ethernet switch fabrics can provide a low-cost packet-based backplane solution for CEAs and CESRs. This solution is unlike that offered by traditional telecom switch fabrics, which use more complex and costly cell-based operation. But these packet switches must maintain the CoS and congestion management features that are expected in telecom backplanes.

Figure 2 shows how an advanced Ethernet switch can support these features. In this figure, the switch and the NPU both support CoS queues. For optimal performance, the switch should implement a shared memory structure using egress queuing. This requires significant cross-connect bandwidth within the chip, but eliminates the double queuing and removes an extra point of congestion that can be found in input-output queued switch devices. These output queues should also provide advanced scheduling options such as strict priority, minimum bandwidth, and traffic shaping as discussed earlier.

Figure 2 shows Advanced Ethernet switch congestion management. Identical sets of CoS queues are shown in the NPU and the switch. The NPU sends flow control to the switch egress ports using CBP frames. When switch egress queue thresholds are crossed, congestion notification frames are broadcast to ingress NPUs, which contain Virtual Output Queue (VOQ) planes in the NPU ingress buffer memory.

To provide truly differentiated services, each CoS queue must be flow controlled separately. At the egress, the NPU can do this by sending CBP frames to the switch egress port. The IEEE is currently finalizing a specification for supporting up to eight traffic classes for this type of application. Some advanced Ethernet switches support only CBP frames. Although this is fine at the switch egress, at the ingress it can cause head-of-line blocking due to CBP frames stopping all traffic for a given class when only one switch output is congested.

Head-of-line blocking can be avoided by utilizing VOQ planes in the NPU ingress buffer memory, one plane for each egress port in the switch. The switch can generate congestion notification frames when an output queue becomes congested, and after receiving these frames, the NPU will only flow control traffic to that output. Traffic to other outputs will not be blocked. With these two flow control mechanisms, a lossless fabric can be created with CoS provisioning. The Fulcrum FM3000 switch family has been designed with these features in mind for telecom backplane applications including Carrier Ethernet systems.

**AdvancedTCA Carrier Ethernet design example**

One of the stated goals of Carrier Ethernet is to minimize cost. This can be done by using commodity parts such as commercial Ethernet switch fabric devices, which are also used in high-volume LAN applications. Another way to reduce cost is by designing the system using the AdvancedTCA form factor, taking advantage of industry standard components such as chassis, backplanes, and AdvancedTCA cards. Figure 3 shows how a Carrier Ethernet system can be implemented using standard AdvancedTCA components.

The heart of this system is a switch and control module. Standard modules of this type utilizing the Fulcrum FM3224 switch can provide 12 10G backplane connections to other AdvancedTCA cards while also providing up to 12 10G connections to a Rear Transition Module (RTM). The switch module also provides chassis management using a CPU subsystem. The access line cards can utilize standard NPUs or TMs that are designed for CE access services. The PBB processing card can use standard NPUs or TMs for backbone processing functions. The 10G uplink cards can contain single or multiple 10G links to the backbone utilizing OTN mappers, which include advanced functions such as Forward Error Correction (FEC). All of these devices are available today or will be shortly available with XAUI interfaces to the backplane. Also, this AdvancedTCA system configuration allows flexible allocation of these cards based on the end customer requirements.
In the provider network, this system can be a powerful and flexible solution. Customer packets arriving on the Gigabit Ethernet access ports can be converted to PB frames before entering the switch module. The FM3224 can implement Q-in-Q forwarding for packets that will remain within the provider network. These local CE systems within the provider network can be interconnected through the 1G ports on the RTM. Various RTMs can be designed depending upon cabling distance requirements. Packets that require transmission through the backbone can have PBB header encapsulation performed in the PBB processing card before being forwarded through the 1G uplink card. The switch can also be programmed to identify OAM messages from the PBT network and redirect these to the local control processor or dedicated processing card.

If the system is only used for provider network access such as the CEASs on the left in Figure 1, the PBB processing cards and 10G uplink cards can be replaced with access cards. If the system is used for the CESR function shown in the provider network of Figure 1, then the access cards can be replaced with PBB processing cards as needed. If the system is used for the CESR function in the carrier network, the access line cards can be replaced with 10G uplink cards.

In all of these configurations, the CoS and congestion management features of advanced Ethernet switches are required to provide the end-to-end QoS that telecom customers come to expect from these systems. Also, load-balancing features found on some of these switches can be used to distribute the processing load across multiple NPUs or TM cards or to distribute traffic across multiple 10G uplinks. This reduces the processing power required on each card and is flow-based, which eliminates any packet reordering requirements. This load-balancing capability also provides the system designer with various redundancy options. For example, if a switch card fails, only the flows across that switch card will be affected until fail-over is complete.

**Conclusion**

Carrier Ethernet can provide a standards-based methodology for transporting Ethernet packets between customer locations across the WAN. To do this, it requires the features available in advanced Ethernet switches such as QoS, congestion management, load distribution, and advanced header processing. Low-cost CE designs can be achieved by using these commodity Ethernet switches in AdvancedTCA platforms. This article has shown how these two technologies can be combined in various ways to provide solutions covering many of the Carrier Ethernet network system requirements.

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**Gary Lee** has been working in the semiconductor industry for over 27 years. For the last 12 years he has been involved in the development of switch fabrics for the telecommunications, data communications, and storage industries. While at Vitesse Semiconductor, he was a key member of the team that developed the CrossStream, GigaStream, and TeraStream switch fabric families and holds patents in this area. He has also worked on ASI, PCI Express, SAS, and Ethernet switch fabrics. He is currently a Product Segment Manager at Fulcrum Microsystems focusing on the telecom backplane and storage markets. Gary has a BSEE and an MSEE from the University of Minnesota.

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Choices in AdvancedTCA storage technology

Paul compares Hard Disk Drive (HDD), Solid State Drive (SSD), and Flash-on-board options to help the AdvancedTCA community better understand the technology that best fits various applications.

The applications for AdvancedTCA continue to challenge electrical and mechanical engineers by constantly demanding more functionality in smaller spaces. In addition to the overriding macro trends in the marketplace for higher density and reliability, the need for physical compactness of the technology in storage media is quickly becoming an absolute requirement in AdvancedTCA and MicroTCA.

Advanced Mezzanine Card with Hard Disk Drive (AMC-HDD) and AMC with Solid State Drive (AMC-SSD) are technologies that aimed at filling the overall needs for the AdvancedTCA community with regard to higher density, reliability, and costs. Despite the unique advantages of these technologies as well as their timeliness to the market, these ad hoc solutions have yet to meet the compactness requirement that is so crucial for the end users of AdvancedTCA products.

AMC with HDD
The HDD has come a long way since its invention 52 years ago but surprisingly has not changed much in the past five years. When we look at their basic design we see that HDDs are not much different today than the original drives installed in the first IBM PCs in the early 1980s. However, in terms of their capacity, storage, reliability, and other functional characteristics, hard drives have improved dramatically.

The consistent trend in HDD form factors is for ever-smaller drives. Larger size 5.25” drives have now virtually disappeared from the mainstream PC market, and 3.5” drives dominate the desktop and server segment. In the embedded telecom market, particularly in AdvancedTCA, 2.5” drives mounted on AdvancedTCA blades and AMC boards are prevalent in most applications because of their higher densities and competitive prices.
Over the next few years, desktop and server drives will transition to the 2.5" form factor, giving HDD extended life. In the AdvancedTCA environment however, SSDs have made a bigger impact due to improved reliability over HDD. Figure 1 illustrates the HDD mounted in the AMC board in a cross-section view.

**AMC with SSD**

In response to increased demands for smaller, faster, and better products, the first SSD made its debut in 1978. SSDs have come a long way since their introduction, when they included a rechargeable battery to preserve the memory chip contents. It wasn’t until 1995 that the first Flash-based SSDs were introduced. Since then SSDs have been used successfully as hard disk drive replacements in many applications, including AdvancedTCA.

The military and aerospace industries, as well as other mission-critical applications, drove early SSD growth. These applications required high reliability to provide greater resilience to physical vibration, shock, and extreme temperature fluctuations.

Today, the SSD storage medium is not magnetic and has no moving arm like a hard disk. It is built with NAND Flash or DRAM and/or a combination of both technologies, and in some applications it is a good alternative to rotating disk drives.

SSDs built with Flash have nonvolatile memory, which makes them a more rugged, compact alternative for high-end applications. Unlike their predecessors, they don’t require batteries. In addition, nonvolatility allows Flash SSDs to retain memory even during unexpected power outages, ensuring data retrievability. Relative to HDD, SSD is more flexible in increasing densities and is more easily upgradeable.

AdvancedTCA and AMC modules deliver high-performance networking and storage solutions at the board and blade level, but in some cases the SSD form factor limits these solutions. The AMC-SSD has the same footprint as the AMC-HDD – leaving no room for adding more components. The introduction of Flash-on-board has brought a new dimension to the dilemma by mounting the Flash components directly on the AMC module, providing more functionality, less weight, and a smaller size.
superior ruggedness to endure in vibrational and shock-prone environments, which could lead to catastrophic failures with total loss of stored memory. In addition to access speed, NAND Flash technology brings a higher level of functionality for storing multimedia applications. With smart wear leveling, Error Correction Code (ECC), and Single-Level Cell (SLC) NAND Flash on board, reliability is aligned with its silicon components. The AMC module becomes a lighter product by eliminating the heavier SSD or HDD and simplifying design and procurement efforts.

Mounting Flash components directly on the AMC board simplifies the interface and eliminates issues with disk rotation speed. This process and architecture provides a higher reliability than any rotating disk currently available and improves the performance and redundancy of the drive.

AMC with Flash offers a high availability platform and increased reliability storage option for mission-critical applications requiring 99.999 percent uptime and 15 to 20 years of field service life. Plus, its ability to deliver superior ruggedness in harsh environments makes this solution a fundamental player in military operations, such as defense, aerospace, or aviation applications.

Cost is always an important factor and concern in many consumer systems. Designers are always evaluating the “cost versus features” trade-off. It is also a primary consideration by managers that if a desired system can be brought to the market for an affordable price, that product should succeed. As indicated by market trends, solid state memory capacities are increasing while the cost per bit of Flash continues to decline at notable pace, making AMC with Flash a readily viable solution for the AdvancedTCA platform.

AMC-HDD might have a slightly lower price, but does it have the features and benefits of a chip on board option? It is clear that issues do exist in regards to storage on an AMC, but getting over this hurdle depends on the choice of AMC-HDD, AMC-SSD, or AMC with Flash technology. Also, the risk of HDD storage malfunctioning is three to four times that of an SSD. Incorporating a Flash on board AMC solution eliminates the impact of infringing on the AMC height and depth standards (form factor) and as a plus allows additional space for more functionality to address thermal issues. Critically examining the system integration times for SSD and for Flash reveals economic benefits; engineers will need less time to validate AMC with Flash because it can be assembled and integrated on
the board. The cost savings in reduced engineering time for Flash clearly outweighs the initial procurement outlay.

Solid state storage provides the user with high performance, high reliability, and greater design flexibility and a lower total cost of ownership. AMC with Flash provides for higher data reliability (nonvolatility), multyear product life cycles, and high shock and vibration tolerances. It is not uncommon to see greater than 4,000,000,000 hours MTBF while operating over temperatures ranging from -40 °C to +85 °C.

Table 1 compares AMC-HDD, AMC-SSD, and AMC with Flash on board, shown left to right in Figure 3.

<table>
<thead>
<tr>
<th></th>
<th>AMC-HDD</th>
<th>AMC-SSD</th>
<th>AMC w/ Flash Technology On Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access time</td>
<td>Slow</td>
<td>Fast</td>
<td>Faster</td>
</tr>
<tr>
<td>Capacity</td>
<td>40 GB – 20 GB</td>
<td>10 GB – 60 GB</td>
<td>16 GB – 128 GB</td>
</tr>
<tr>
<td>Reliability</td>
<td>Low – Potential disk failures</td>
<td>High – Improved shock and vibration resistance</td>
<td>High – Improved shock and vibration resistance</td>
</tr>
<tr>
<td>Disk Performance</td>
<td>High</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>Moving Parts</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Highest</td>
<td>Low</td>
<td>Lowest</td>
</tr>
<tr>
<td>Thermal Management</td>
<td>Needs fan</td>
<td>Yes – due to blockage</td>
<td>No – has air gap</td>
</tr>
<tr>
<td>Vibration Management</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Reliability</td>
<td>Hard disk failure is a common occurrence</td>
<td>High MTBF</td>
<td>High MTBF</td>
</tr>
<tr>
<td>Error Correction Capability</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Table 1

**Summary**
The technologies and solutions described in this article creatively address the needs of the AdvancedTCA market. It is quite compelling that perhaps the new Flash on board technology overall could emerge as the next evolutionary products and as the storage media of choice for achieving higher functionality and density, best reliability and nonvolatility, faster access speed, lighter weight, and most of all for its compactness that meets form factor constraints. Logic would suggest that AMC with Flash “fits the bill” as a new and significant technology driving even greater growth and development in AdvancedTCA applications.

**Paul Dinh** is the Director of Technical Marketing at Virtium Technology Inc. Over the last 20 years, Paul’s professional work experiences have encompassed leadership roles in both the technical and business arenas. He has an extensive background in strategic marketing management, strategic account management, product management, and outside sales. His strong technical skills positioned him to be a member of the technical staff and to be involved in applications engineering and product engineering positions. He has experience in diverse markets such as aerospace, biotech, instrumentation, pharmaceutical, semiconductor, and government and military markets. Paul holds a BS degree in Physics from the University of California, Los Angeles (UCLA) and an MBA from the University of California, Irvine (UCI).
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The landscape for the Telecom Equipment Manufacturer (TEM) is rapidly evolving. Traditionally, TEMs developed equipment by themselves, essentially proprietary systems, structured within the architecture. The corresponding interfaces to the outside world were based on open standards – such as Ethernet – and the TEMs deployed the systems into open networks. During this time, the equipment behind the infrastructure was a legacy system – proprietary with some standards. For example, the size of a shelf that fits within a specific rack would be considered standard. However, if one disassembled a shelf into various parts, the interfaces between the building blocks would be proprietary.

In recent years, TEMs have moved from developing equipment based on proprietary standards to open standards, thus enabling companies to outsource various equipment parts and specific functions to third parties, with the option to source a building block from multiple suppliers.

TEMs often designed a switch card or a processor blade based on proprietary standards and deployed that blade in multiple applications. However, in the case of open standards, a TEM can reuse building blocks for various applications over a long period of time, increasing the production volume, which subsequently lowers the overall cost for the specific building block. While reusing the building blocks may imply that the role of the TEM is reduced, TEMs do not lose control at the application layer. In addition, TEMs gain the ability to outsource as many building blocks as needed from the ecosystem. In the scheme of different layered models – including the silicon, the blade, and middleware – anything can be outsourced, including the application-ready platform. Outsourcing gives TEMs a broader choice with a different feature set and lower cost. It also allows TEMs to concentrate on their niches and not worry about the ancillary components.

Adding to these benefits, the same non-recurring cost that is incurred in creating these common building blocks can be divided among multiple customers. This business model also helps smaller players to enter the telecom market. For example, a small company may have the expertise to build an application, but may not have the expertise or the resources to build a system from scratch. As a result, a standards-based platform would help enable the second-tier TEMs to enter the telecom market.

As with any specification, the PICMG AdvancedTCA and MicroTCA specifications can be interpreted by users in different ways. As a result of these varying interpretations, firmware designers and implementers have occasionally created building blocks that are not interoperable with one another.

Nirlay will address interoperability in this article, beginning with the objectives of the Communications Platforms Trade Association (CP-TA, www.cp-ta.org). He will give examples of how this global organization is working to address the interoperability challenges.
Need to address interoperability

Manufacturers are continuously looking for standards-based products that offer improved functionality and are cost-effective, reliable, safe, and high performing. Over and above standardization, a key gap has not yet been addressed – interoperability among various building blocks at the platform level. Figure 1 shows an array of platform interoperability components to illustrate how a TEM can choose components from the ecosystem at any layer. The interoperability chasm is the number one reason why TEMs are not reaching the mainstream market for standards-based communications platforms. This is where CP-TA has taken the initiative to fill the interoperability gap. The goal of the CP-TA is to certify building blocks that are interoperable with each other.

As an association of communications platforms and building block providers, the CP-TA is dedicated to accelerating the adoption of SIG-governed, open specification-based communications platforms through interoperability testing and certification. Through industry collaboration, the CP-TA plans to drive a mainstream market for open industry standard communications platforms by certifying interoperable products.

Taking the specification ambiguity bull by the horns

The communications platforms industry has developed a rich set of open specifications in order to build modular communications platforms. However, the industry has been unable to move to the next level of interoperability due to the number of optional requirements and inconsistent interpretations of mandatory requirements.

For example, there is ambiguity regarding the association of Hot Swap sensor to FRU 0 or to its Managed FRU. The intention of the requirement is to remove the Shared Data Repositories (SDRs) from the Intelligent Platform Management Controller (IPMC) Device SDR repository that is added during M0 to M1 transition for a particular FRU. There are different opinions on whether the SDR for FRU Hot Swap sensor should be removed from the Carrier Device SDR Repository when the module is not present.

If the SDR is not deleted, the Current State reading mechanism will be the same for M0 and any other state. But this practice contradicts the AMC.0 Specification R2.0 requirement 3.124b, which states: When PS1# of an AMC Slot deactivates, the Carrier IPMC shall remove the Module SDRs of the respective Module from the Carrier IPMC Device SDR repository. SDRs with an entity instance field equal to that AMC Slot’s AdvancedMC Site Number + 60h shall be removed. If the SDR is deleted, then it does not contradict the specification. But the Current State reading mechanism will not be the same for M0 and any other state. It also adds additional complexity to the System/Shelf Manager in State reading procedure.

The goal of the CP-TA is to identify the inconsistencies in the requirements and address them, so that they are aligned with the intentions of the original authors of the specification. When PICMG authors wrote the AdvancedTCA specs such as: An IPM Controller shall remove from its Device SDR Repository all SDRs for a non-intelligent FRU that it represents before transitioning this FRU to M0 from any other state, they wanted to target this for the non-intelligent managed FRU with the non-intelligent RTM in mind. However, intelligent managed FRU RTMs have now entered the market. This means that the AMC needs to be considered as a managed FRU, because many things can now be interpreted from the multiple specifications, which can create different behaviors for managed FRUs.

Thermal considerations

In the thermal domain, the CP-TA is addressing airflow distribution in the chassis, as well as slot thermal impedance. Consider two types of boards: a switch board with low impedance and a high-density processor board with hefty heat sinks, which will have higher airflow impedance. When these two boards are placed next to each other, the switch board with low impedance will steal the air away from the processor blade beside it. The airflow scenario becomes more interesting when there is an AdvancedTCA carrier board with a variety of possible AMC combinations – including height and width variations, in addition to the number of the carrier’s AMC slots.

CP-TA documents and certification model

In pursuit of achieving the interoperability dream, the CP-TA created a requirements document called the Interoperability Compliance Document (ICD). Within this document, the requirements are addressed to ensure they are in alignment with the SCOPE Alliance (www.scope-alliance.org) profile. In addition, some should requirements in the PICMG AdvancedTCA specification, which have significance from interoperability perspective, have been upgraded to shall requirements and are mandated for CP-TA in order to receive CP-TA compliant status. Each of these requirements is mapped to one or more test cases, which are vendor agnostic. This mapping comprises the Test Procedure Manual (TPM). Any tools vendor can implement...
the tests in the TPM in an automatable test tool. Currently DegreeC (www.degreec.com) and Polaris Networks (www.polarisnetworks.net) are the CP-TA’s chosen tool vendors. The ultimate goal of the CP-TA is to provide certifiable building blocks to the ecosystem. Figure 2 shows a roadmap for CP-TA’s interoperability and how each layer is derived from the other. Companies can claim tested, compliant, or certified status on their building blocks against a specific version of the Test Procedure Manual.

The interoperability guidelines are as follows:

- **Tested to CP-TA v1.1**
  - A subset of all of the mandatory tests for certification are performed on the DUT, and the standardized CP-TA test report is completed stating the results of the tests: pass, fail, or not executed.

- **Compliant to CP-TA v1.1**
  - All of the mandatory tests for certification are performed on the DUT with a 100 percent pass rate using CP-TA authorized test tools, and the standardized CP-TA test report is completed.
  - For this level, all of the mandatory tests are required to be performed and passed by the DUT. This level requires a CP-TA authorized test tool be used to execute the test procedures. This level can be obtained by the DUT provider executing the required tests.

- **Certified to CP-TA v1.1**
  - All of the mandatory tests for certification are performed on the DUT by a CP-TA authorized testing service with a 100 percent pass rate. The standardized CP-TA test report is completed by the same CP-TA authorized testing service confirming this result.
  - For this level, all of the mandatory tests are required to be performed, and all of them are required to be passed by the DUT. This level requires a CP-TA authorized service to execute the test procedures and validate the results.

CP-TA is currently researching suitable test labs to provide independent certification testing at a reasonable cost.

### CP-TA’s value proposition

In order to show value in CP-TA testing, CP-TA and B-Star, Shanghai (www.b-star.cn), joined in an integration effort to demonstrate that CP-TA tested building blocks from different vendors require much less time to integrate than non-CP-TA-tested boards. During the process, each building block went through the benchmark testing and bug fixing against a common tool that eliminates the primary interoperability issues. The CP-TA tested building blocks and base platforms consistent with SCOPE profiles to demonstrate that Network Equipment Providers (NEPs) can simplify the selection process, increase supply chain flexibility, improve predictability of successful integration, and reduce life cycle management costs with a more robust application-ready system. Service providers will be able to increase the flexibility and scalability of their network as well as realize faster time to market with new, innovative services.

The CP-TA is currently addressing interoperability in the AdvancedTCA, AMC, and MicroTCA domain. It also has an ambitious dream of moving up the layered stack to address interoperability in the Carrier Grade Linux, Service Availability Forum compliant Hardware Platform Interface and Application Interface Specification arenas.

The CP-TA participates in PICMG coordinated Interoperability Plugfests that provide a confidential environment for the community to harmonize the execution of automated test suites, as well as offer a true multivendor environment for enhanced interoperability testing. CP-TA offers free tests against the CP-TA adopted thermal and manageability tools and provides the building block providers free test reports.

### Conclusion

Given the interoperability issues addressed and explained in this article, Emerson Network Power firmly believes that it is crucial to support and promote a compliance program to ensure that building blocks can be integrated with third-party products. With the help of the TEMs and industry-wide endorsement, the CP-TA will continue to deliver economic benefits to the entire value chain.

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At Emerson, he is responsible for platform integration and verification in AdvancedTCA, MicroTCA, CompactPCI, and other legacy products. His previous 15 years of industry experience was spent in research in Electrical Engineering, working with networking protocols for network equipment manufacturers.

Nirlay holds masters degrees in Design Engineering from Leicester University, in Control Systems from Indian Institute of Technology, Kharagpur, and an MBA from Babson College.

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