BRIDGING THE MANAGEMENT AND AVAILABILITY STANDARDS GAP TO INCREASE COTS VALUE FOR NEPs

Technical Brief

June 2005

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Chapter 1

Executive Summary

Emerging from the market downturn of the past few years, the telecommunications industry is poised to experience dramatic growth. Users worldwide are embracing cell phones as their new standard for communication, while businesses around the globe continue to generate exponential increases in data traffic. This strong demand for next-generation services is driving carriers to invest in third-generation (3G) wireless networks to remain competitive. At the same time, however, telecom players must keep a close eye on capital expenditures and operating expenses in order to succeed in today's cut-throat business environment.

The market conditions squeezing carriers from both sides are creating a number of challenges for network equipment providers (NEPs). To address carriers' financial constraints, NEPs must develop solutions that enable their customers to deliver new services cost-effectively. To keep their customers a step ahead of the competition, NEPs must also bring these solutions to market quickly. These formidable business requirements are driving NEPs to move away from the traditional development of custom solutions built in-house to a more efficient approach that leverages commercial off-the-shelf (COTS) components for crucial time and cost savings.

The efficiency gains offered by COTS components, however, are limited by NEPs' need to tightly manage all solution components to prevent unplanned downtime. Historically, NEPs built numerous sensors and probes into each custom-built component to closely monitor service availability. By leveraging COTS components, NEPs lose control of component development and must take on extensive development of heuristic code to implement the fault management capabilities they require. Industry consortiums are working to ease this development burden by including system management specifications in standards, but wide gaps still remain.

As a systems company with a long and successful history with the telecommunications industry, Sun Microsystems, Inc., is uniquely positioned to increase the value of COTS components for NEPs by helping to bridge the management and availability standards gap. Starting in mid-2005, Sun will deliver next-generation telecom products that adhere to Advanced Telecom Computing Architecture (also known as AdvancedTCA or ATCA) specifications and emerging Service Availability Forum (SAF) standards. Unlike other vendors, Sun will also provide advanced system management and availability technologies that allow NEPs to further speed time to market and reduce implementation costs by as much as 30 percent per application by significantly reducing the need for heuristic coding.

This technical brief provides an overview of the market conditions driving change in the telecommunications industry, including the move toward COTS-based infrastructures. The brief also outlines Sun's involvement in standards development and its unique strategy for helping telecom players implement cost-effective, carrier-grade ATCA infrastructures for next-generation service delivery that can handle the rising traffic demands of today and well into the future.

Chapter 2

Business Environment

Current Industry Conditions

Telecom companies are facing enormous challenges. The highly competitive marketplace has created relentless pricing pressure, forcing companies to become extremely cost-conscious. At the same time, customers are demanding next-generation voice and data services such as push-to-talk, advanced wireless services, Voice over IP (VoIP), and integrated messaging. Caught between a rock and a hard place, carriers must find a way to both reduce costs and rapidly expand services to stay competitive—and they are passing these rigorous requirements on to their NEPs.

These intense market pressures are driving NEPs to reconsider their approach to solution development. Historically, NEPs addressed carriers' rigorous solution requirements by engineering proprietary hardware and software from the ground up in order to deliver the needed bandwidth, compute capacity, and service availability. Such proprietary solutions met carriers' exacting performance and uptime demands but at a very high cost both in terms of development and ongoing management.

To compete more effectively, over the last decade most NEPs and carriers have initiated a shift towards a COTS strategy. By using components based on the pervasive CompactPCI (PICMG 2.x) standards, NEPs can lower development costs and speed time-to-market. The 50-watt per slot limitation of CompactPCI standards, however, fails to support the bandwidth and scalability required to handle the most critical part of telecommunications infrastructures—the voice and data traffic. As a result, NEPs have typically only tapped CompactPCI-based COTS components for less-demanding adjunct computing and service applications.

The arrival of the AdvancedTCA standard—which succeeds CompactPCI—takes COTS components up to the next level, ushering in a new era of time and cost efficiencies for the telecom industry. Designed to meet the specific growth requirements of the telecommunications industry, AdvancedTCA is a new series of PCI Industrial Computer Manufacturers Group (PICMG) specifications for the development of next-generation, carrier-grade communications equipment. Also known as PICMG 3.x, AdvancedTCA is the largest specification effort in the history of PICMG, with more than 100 companies participating in development efforts, including Sun.

AdvancedTCA paves the way for the delivery of high-bandwidth 3G services on COTS-based architectures by offering numerous advancements over the previous CompactPCI standard. Specifically, enhanced power and cooling designs support use of multiple high-performance processors and high-speed interconnect fabrics in ATCA-based carrier-grade infrastructures, providing the increased performance and bandwidth required by next-generation data services.

This increased capacity enables NEPs to realize greater economies of scale by leveraging standards-based building blocks across their infrastructures. NEPs can now use cost-effective COTS products for adjunct applications and their core 3G network components, including radio network controllers (RNCs), gateway GPRS support nodes (GGSNs), and serving GPRS support nodes (SGSNs).

By replacing greater numbers of proprietary components with interoperable, best-of-breed, carrier-grade COTS products from a variety of vendors, NEPs can lower development costs and speed time-to-market without compromising reliability, availability, or serviceability (RAS). Increased use of COTS components also allows NEPs to focus limited engineering and research resources on service and software differentiators for a crucial competitive edge. Use of COTS components has one significant drawback however: *The increased complexity of managing a mixed architecture.*

The Management and Availability Standards Gap

State-of-the-art management systems are a highly effective way to increase operational efficiency and reduce costs in central offices. Advanced management systems enable administrators to oversee a hierarchy of managed objects, from the smallest manageable element such as a network interface card (NIC) to a top-level, integrated view of the entire solution. By implementing comprehensive system management, NEPs can quickly identify and address problems at the lowest level while streamlining operations, administration, and maintenance (OA&M) activities across a solution through high-level functionality, including configuring, provisioning, monitoring, diagnosis, recovery, reporting, and inventory management.

Historically, just as NEPs developed proprietary solutions in-house to meet carriers' high capacity and uptime demands, they also developed integrated management systems to support high service level requirements. As NEPs integrate more and more COTS products into their telecom solutions, they face a catch-22 situation. Although NEPs are able to significantly reduce the time and cost of solution development by using COTS products, they must expend considerable time and expense developing an overarching framework that unifies management of components from multiple vendors, including ATCA-compliant servers, network processors, storage, DSPs, and gateways as well as off-the-shelf, carrier-grade operating systems and high-availability software.

A number of current and evolving standards are attempting to address this problem:

- AdvancedTCA—The aforementioned PICMG 3.0 standard defines specifications for limited system management at the board level.
- SAF standards—A consortium of industry-leading communications and computing companies, the Service Availability Forum (SAF) is currently developing specifications for availability and management middleware to support use of COTS products in demanding telecom solutions. SAF specifications include the following:
  - The SAF Application Interface Specification (AIS) defines the interface between the applications and the high-availability middleware and makes each independent of the other.
  - The SAF Hardware Platform Interface (HPI) defines the interface between the hardware and the high-availability middleware and makes each independent of the other.
  - The SAF Systems Management Specification (SMS) enables service event and error reporting by the SAF AIS and HPI.
- OSDL Carrier Grade Linux Requirements Definition V3.0 (CGL)—This document from the Open Source Development Labs (OSDL) defines the next-generation Linux for carrier-grade implementations, including OS-based APIs for availability, serviceability, and clustering.
- DMTF CIM V2.9 Schema—This common information model (CIM) from the Distributed Management Task Force (DMTF) provides a standard definition of management information for enterprise systems, networks, applications, and services. Allowing for vendor extensions, CIM definitions enable vendors to exchange semantically rich management information between systems throughout the network. Groups are working together to converge and coordinate this CIM with the NGOSS SID model described below.
- NGOSS SID—Another information model has been developed by the TeleManagement Forum. The next-generation opera-

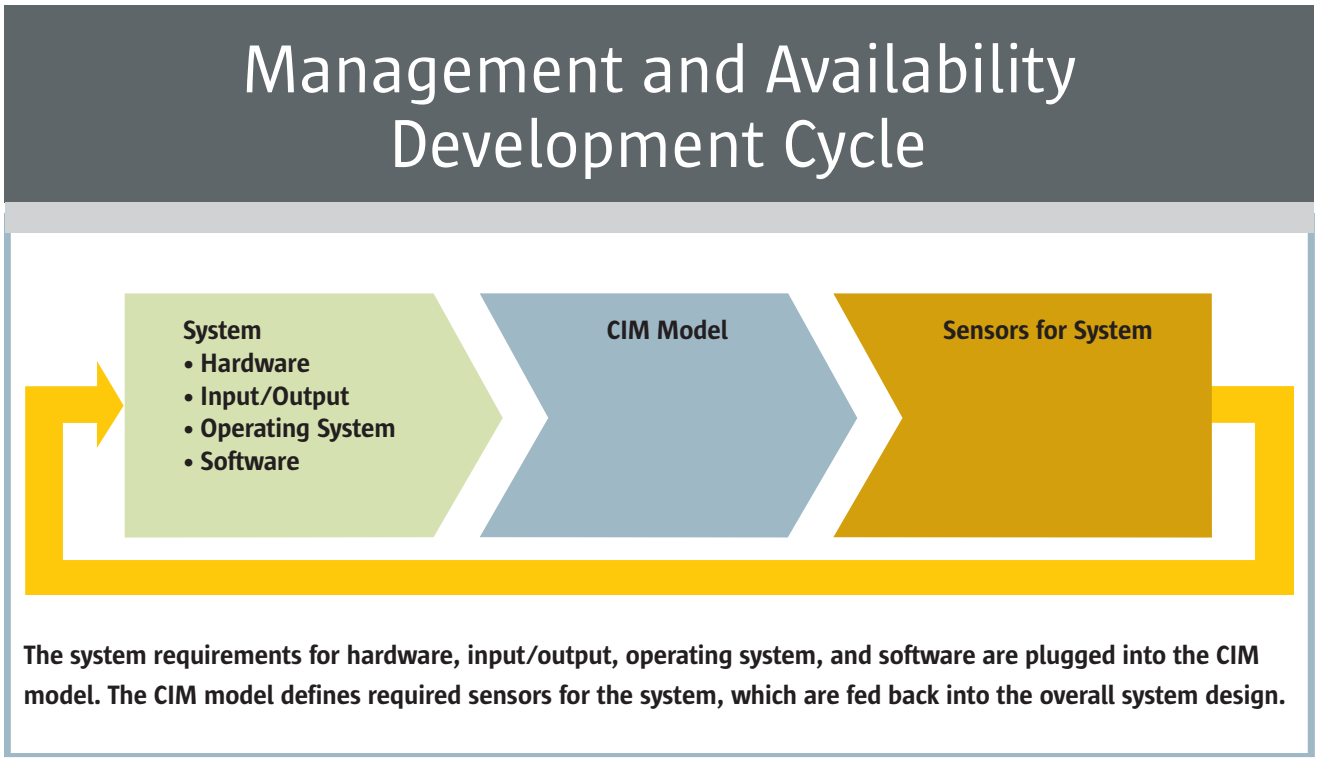
tional support system (NGOSS) shared information/data (SID) model provides a common vocabulary and set of information/data definitions and relationships for use in NGOSS architectures. Groups are working together to converge and coordinate this SID with the DMTF CIM described above.

While these standards move NEPs closer to lifecycle management savings, they fall short of providing NEPs with the comprehensive, detailed data they require about the availability of a service. For example, no mechanism exists to seamlessly share the hardware monitoring information provided by an ATCA-compliant fan to the SAF HPI, as emerging standards fail to specify rules for applying system management specifications based on informational models.

The lack of integrated management across all heterogeneous network elements and applications in a solution results in system management weaknesses. Consider, for example, a power failure in a 14-slot chassis. The NEP receives notification of the failure from the Slot 3 shelf manager, but the software is unable to identify the exact source of the fault. As a result, the NEP is left to guess if the fault is the result of bent pins in the slot, overloaded power zones, a blown fuse in a power entry module (PEM), or a problem with the main power feed inputs. Administrators waste time attempting to isolate the fault and may even send a component back to a vendor only to have no trouble found.

To eliminate this inefficiency and increase service availability, NEPs have historically architected extensive fault management into their solutions by applying an information model to each component, with the goal of achieving fault coverage for 98 percent of components. NEPs placed sensors, controls, and field replaceable units (FRUs) in optimal locations and developed APIs that were syntactically and semantically consistent across a solution's hierarchical informational models. System management software could then monitor the availability of all network components and immediately detect any failure, with high-availability technologies providing immediate failover for continuous service availability.

Figure 1. By leveraging the hierarchal CIM model at the system level, development of a management and availability framework is dramatically simplified.



Most COTS components fail to incorporate such advanced fault management, leaving NEPs with the time-consuming and costly task of developing extensive heuristic coding as a fault management Band-Aid. Although the heuristic coding provides software-based fault isolation, it isn't as efficient or reliable as hardware-based fault management built into solutions from the ground up. In addition, NEPs must rewrite the heuristic code whenever system components are changed or moved within a solution and must then conduct complete regression testing for the entire solution—a task that can take six to nine months. As a result, the benefits gained from using COTS components to speed solution development in the first place are minimized over the lifetime of a solution. Standards bodies are aware of these problems but have yet to define rules for applying system management specifications based on informational models to allow for easier integration of COTS components.

Leading the industry forward, Sun is uniquely positioned to bridge the management and availability standards gap. By leveraging its systems expertise, Sun is extending the proven information models it previously developed for its CompactPCI-based Netra servers to deliver advanced systems management and availability in its next-generation, SAF-compliant ATCA systems. This sophisticated system-level innovation will enable NEPs to shave years off their overall development cycles and reduce implementation costs for individual applications by as much as 30 percent.

Chapter 3

Sun's OA&M Advantage

Leveraging its system-level control and understanding, Sun has already implemented robust instrumentation and developed integrated information models to deliver exceptional fault management in its CompactPCI-based Netra servers. Sun is now extending this innovative OA&M development to its next-generation SAF-compliant ATCA systems, with the goal of reducing overall development time and associated development costs for NEPs.

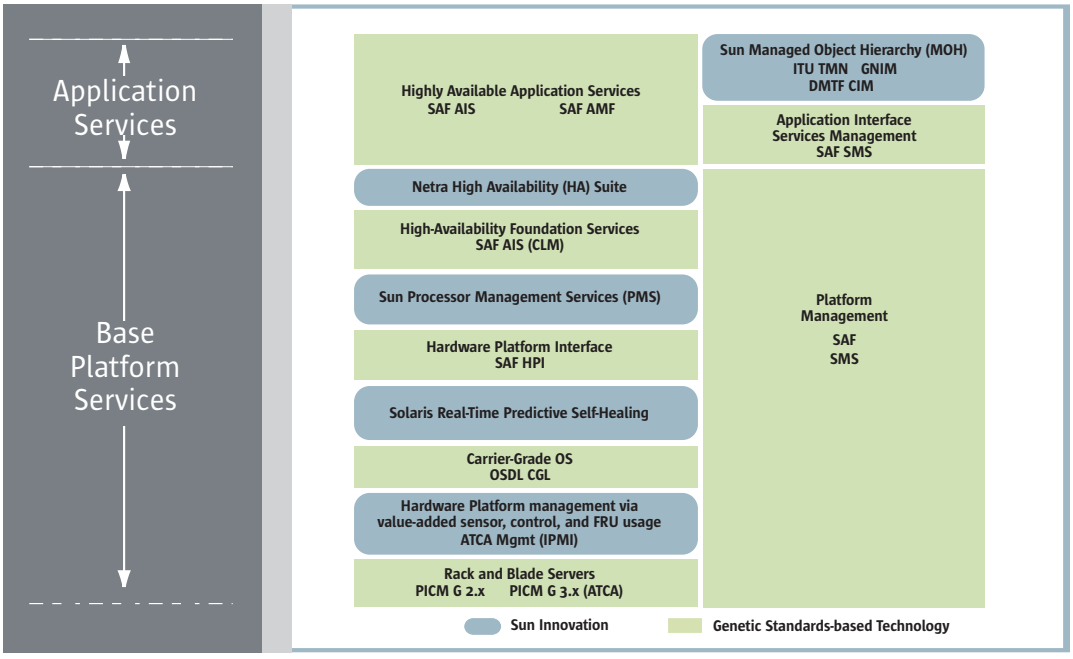
Sun is also deeply involved in standards development. Sun provides its system-level expertise to numerous standards bodies to help drive the creation of standards and—as importantly—develop rules for applying system management specifications based on informational models to allow for easier integration of third-party COTS components. This involvement also gives Sun the hands-on knowledge required to rapidly develop and deliver products that comply with emerging specifications.

Bridging the Management and Availability Standards Gap

Sun understands that NEPs must be able to aggregate COTS components into a unified system that can be managed as an integrated service. This requirement is critical for controlling OA&M costs and delivering the high service availability required in the telecommunications industry.

To support NEPs' use of commercial components, Sun undertook the development of an advanced system management stack for its CompactPCI-based Netra servers. This innovative middleware coupled with Sun's high-availability technology bridges the standards gap by providing integrated information models that enable system management at the hardware, OS, I/O, and application levels—and ultimately at the solution level, once integrated with an NEP's element management system (see graphic). As new standards emerge, Sun is overlaying next-generation APIs onto its existing technologies, making use of COTS components more attractive and efficient for NEPs.

Figure 2. Sun delivers modular standard compliant components and applies its innovation to bridge the standards gap.



Sun's OA&M innovation gives NEPs the advanced fault management and availability they require in two key ways. First, Sun intelligently places numerous hardware sensors, OS probes, and health monitors into its products for rapid detection of system problems. These tools continually monitor a wide range of parameters, such as temperatures, voltages, and active states, to ensure components are operating as required and expected. When a tool detects an event that falls outside of set thresholds, it can trigger an alarm or execute a previously defined action to accelerate recovery.

Second, Sun has applied a standard information model to each layer in the stack (hardware, I/O, OS, and software) and mapped the telemetry information provided by its robust instrumentation into usable models. This advanced development work provides comprehensive monitoring capabilities, enabling NEPs to have in-depth knowledge at each layer within a vertically integrated solution.

Sun implements the system management stack in modular pieces at the most appropriate layer. As a result, NEPs gain the flexibility to use individual pieces of Sun technology, such as the Solaris Operating System or the Netra High Availability (HA) Suite, or the entire set based on their needs. Furthermore, Sun's management middleware ensures that critical information is provided to both the service management interface for availability monitoring and to high-availability middleware for service failover—a crucial requirement not currently addressed by emerging standards.

In addition, Sun developed its Managed Object Hierarchy (MOH) as a Java™-based framework that NEPs could run on top of any OS with a well-defined set of carrier-grade APIs, in either blade-based or rack-mounted implementations. MOH uses Java™ Management Extensions (JMX) technology to define each component, with each layer reporting to the next, to provide the data needed to diagnose and isolate faults and even offer detailed replacement instructions. Providing critical flexibility, Java's portability eliminates OS lock-in and sets the stage for the fast integration of mixed hardware and mixed operating systems in a solution.

In sharp contrast to Sun, competing vendors are foregoing this advanced development work—leaving NEPs and integrators with the time-consuming task of developing heuristic code for needed levels of fault management—or are scrambling to catch up by building platform instrumentation and a management stack from scratch. In fact, few vendors outside the telecommunications industry are even able to deliver this level of advanced system management and availability. Developing such a comprehensive management stack requires system-level experience, with Sun leveraging its end-to-end systems knowledge from the lowest level hardware, up through the operating system and infrastructure software, and across high-availability middleware and system management software.

By ensuring that standards-based APIs are syntactically and semantically consistent across an infrastructure, Sun's advanced management stack will enable NEPs to maximize the value of COTS components. Sun's innovative platform instrumentation and middleware will eliminate up to 75 percent of the heuristic code NEPs would otherwise have to develop, speeding time to market for new services and reducing implementation costs per application by up to 30 percent. As a result, NEPs can focus critical resources on service development to hone a more competitive edge.

NEPs can achieve the greatest lifecycle cost savings by using the complete base platform offering from Sun—which includes SAF HPI- and IPMI-compliant ATCA hardware, a carrier-grade OS, predictive self-healing technology, processor management services, and the Netra High Availability (HA) Suite Foundation Services software. If NEPs also use the high-availability and system management middleware stack available from Sun, they will be able to leverage the capabilities of the underlying base platform services instead of having to glue together third-party point products that may have gaps due to the fact that standards have yet to address them.

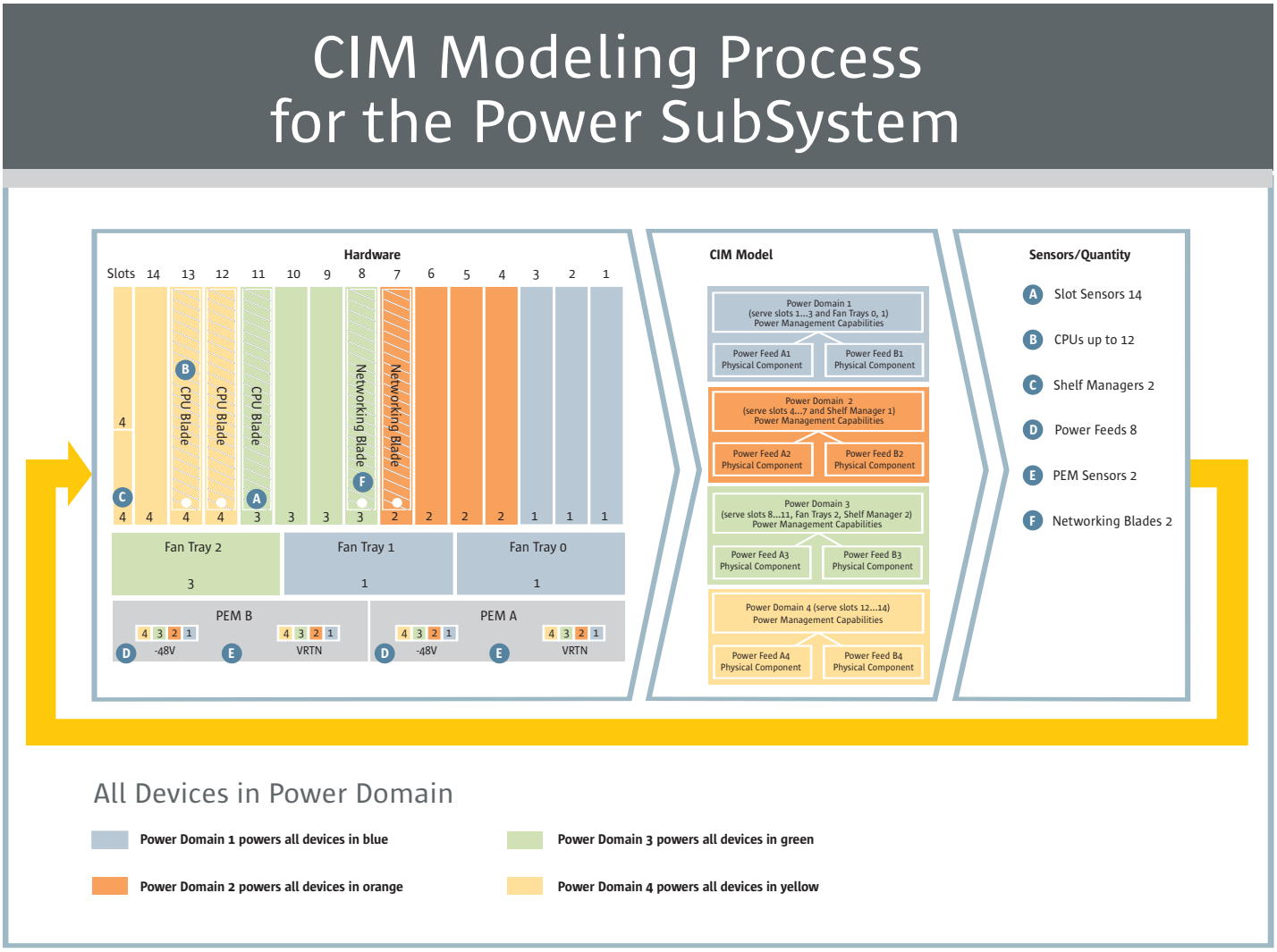
Bottom line: In addition to being standards compliant, Sun's solution offers the competitive benefit of addressing existing gaps in today's management and availability standards. NEPs that implement Sun's vertically integrated, COTS solution will win in the long term over those that simply integrate other vendors' products in a loosely coupled fashion and must incur the expense of additional dollars and time to fill the holes.

Sun Innovation in Action

A real-world example illustrates the added value provided by Sun solutions. Consider a standard 14-slot chassis (see graphic). The midplane has multiple power elements:

- Two sets of four 48-volt VDC input feeds, with shunts creating two sets of four feeds
- Two power entry modules (PEMs)
- Four power zones
- 14 slots that accommodate each board's power converter

Figure 3. CIM Modeling process for the power subsystem.



If a slot loses power, the shelf manager software sends immediate notification. Without additional development, however, there is no way for the software agent to determine the exact source of the power failure, preventing it from providing clear recovery instructions. The administrator is left to check all of the aforementioned power elements to determine the fault and eventually may have to resort to guesswork.

Sun knows that the telecommunications industry cannot tolerate such delays and risk. To provide fault isolation, Sun adds multiple sensors throughout the chassis to monitor each power element. As a result, system management software can precisely identify the exact location of the fault and determine appropriate corrective action. Administrators no longer need to change power feeds, pull boards to check for pin damage, or send components out for replacement only to discover no trouble found. Faults are isolated immediately, increasing efficiency and reducing operational costs.

Furthermore, Sun's innovative development ensures that monitoring information is provided to both the service management interface for availability monitoring and to high-availability middleware for service failover. For example, if a failure occurs in Power Domain 3 , the power domain sensor immediately notifies both the system management software and the Netra High Availability (HA) Suite. The Netra High Availability (HA) Suite can immediately determine that Slots 8, 9, 10 and 11 and fan tray 2 will fail, as they receive power from Domain 3. Without waiting for failure notification from all the sensors on each board, the Netra High Availability (HA) Suite immediately begins moving services to other boards, speeding recovery.

Sun has implemented such innovation across its platform, intelligently placing sensors in each layer (hardware, OS, I/O, and software) and mapping the telemetry information provided into usable models. This closed mapping across a platform—from power elements to memory modules to software kernels—reduces the need for NEPs to add heuristic code to achieve 98 percent fault coverage. In fact, Sun innovation can reduce the need for heuristic coding for a given solution by as much as 75 percent, significantly speeding time to market and reducing implementation costs for an application by as much as 30 percent. Sun's built-in innovation also saves NEPs considerable time by eliminating the need to retest a solution whenever components are moved or changed.

Standards Involvement

Sun is a firm supporter of industry standards and has long been a participant and leader in worldwide standards organizations and consortiums. Sun has been actively involved in defining new specifications and is sharing its OA&M innovations with standards bodies to increase the value of COTS components in NEPs' next-generation solutions.

- An active Network Processor Forum (NPF) member, Sun helps facilitate and accelerate the development of next-generation networking and telecommunications products based on network processing technologies.
- An active PICMG member, Sun is helping to define the evolving ATCA standard, giving Sun the insight and expertise needed to rapidly deliver highly attractive products that adhere to the new specifications. Sun is also an active participant in the PICMG-SAF advisory group.
- Sun has been an active participant in SAF since its inception. Leading the SAF-AIS working group, Sun is helping SAF develop acceptable standards for implementing system management and high-availability services for the telecom industry.
- Sun is a founding member and an active participant in the Distributed Management Task Force (DMTF), which develops management standards and integration technology for enterprise and Internet environments.
- A member of Open Source Development Lab (OSDL), Sun participates in the Carrier Grade Linux and Data Center Linux working groups to help advance the use of the Linux OS and its functionality in the enterprise and telecommunications environments.

Sun believes that hardware standards must be adopted by more than one customer to drive down hardware costs, especially in the 2006-2007 timeframe when individual customer volumes are low. Therefore, Sun is currently developing ATCA components that both adhere to existing standards and have sufficient market interest.

Sun is also aggressively driving and adopting middleware standards, because the operational costs of managing multivendor hardware can be much greater than the hardware cost savings achieved by using multivendor hardware. Though a number of standards such as SAF, OSDL, DMTF CIM, and NGOSS SID have evolved in the recent past to address some of the issues involved in reducing lifecycle management costs, they still fall short of providing NEPs with significant cost savings. NEPs will face hidden costs if they overlook the high expenses they will inevitably incur to fill the management and availability gaps yet to be addressed by emerging standards. Solving this problem, Sun's aggressive adoption of middleware standards enables customers to gain true total cost savings much sooner than they would otherwise, providing a solid business justification for adopting a multivendor hardware strategy.

By assisting the telecommunications industry in standards development, ensuring that its products comply with these emerging specifications (including mandating compliance for components purchased from its suppliers), and extending standards efforts through innovation, Sun is helping NEPs and carriers drive cost and complexity out of central offices for a low cost of implementation and operation.

Industry Expertise

Sun has been the leading provider of carrier-grade telecommunications infrastructure equipment for years. Eighty percent of the largest service providers around the world run solutions on Sun, supporting more than 500 million subscribers. In addition, nine out of the top 10 NEPs, which command more than 90 percent of the communications infrastructure market, use Sun Netra servers in their carrier-grade solutions. Sun also offers the broadest lineup of cost-effective, carrier-grade rack and blade servers in the marketplace and is the installed base leader in carrier-grade servers.

Sun's family of ATCA products will leverage 20 years of advanced technology development, including Sun's unparalleled RAS and guaranteed binary compatibility. Furthermore, as a systems company, Sun has the unique ability to provide comprehensive solutions that are built from the ground up—from base-level hardware to enterprise infrastructure applications—with manageability and availability in mind. By leveraging Sun's OA&M advancements, NEPs can lower development costs and speed time to market for a low total cost of ownership and a highly competitive edge.

Chapter 4

Sun's Management and Availability Edge

Telecom customers demand exceptional service. Dropped data transactions or voice calls over fixed lines are simply not tolerated, and service expectations continue to rise for cellular calls as well. In fact, carriers must meet federal regulations for service delivery and face million-dollar penalties in the event of an unplanned service outage. Not surprisingly, carriers pass on these exacting requirements to NEPs, who then pass the requirements on to platform vendors through contractual obligations of system availability.

To achieve the high service levels required, telecom players can implement a three-prong approach based on manageability, availability, and high availability. Advanced system management enables administers to monitor availability of all network components. By building fault management into every solution component—from I/O boards to system hardware to the operating system and software—administrators can immediately detect any failure as it occurs. High-availability technologies, such as clustering, then ensure continuous service availability by providing immediate failover.

Sun can help NEPs meet stringent management and availability requirements while lightening their OA&M development burden. Having provided rugged solutions for the telecom industry for more than two decades, Sun offers numerous integrated management and availability technologies that support extremely high levels of services. These technologies, available now, will comply with emerging standards to help NEPs drive down the cost of delivering next-generation services.

NEBS-Certified Netra Servers

For ruggedized environments that demand optimum horizontal scalability, continuous availability, and easy management, Sun builds Netra rack and blade servers that are certified to meet NEBS Level 3 requirements. NEBS Level 3 certification (not merely compliance) means that servers have passed tests showing they can operate under demanding conditions. Numerous architectural features, such as redundancy and serviceability, enable Netra servers to deliver outstanding levels of availability and reliability to drive continuous system operation and a low total cost of ownership.

Sun's next-generation NEBS-certified Netra servers will adhere to AdvancedTCA specifications as well as emerging SAF standards. Providing exceptional implementation flexibility, these servers will support both UltraSPARC® and AMD Opteron™ processor technologies as well as two of the most popular carrier-grade operating systems—the Solaris Operating System and Carrier-Grade (CG) Linux. NEPs will be able to lower cost and complexity by mixing and matching blades within the same system, including running both SPARC® and x64 blades in the same chassis or running Solaris OS and CG Linux in the same system. NEPs will also benefit from Sun's integrated MOH and PMS middleware services, as well as extensive platform instrumentation, reducing the need for custom development of OA&M software.

Solaris 10 Operating System

The Solaris Operating System (OS) is virtually an industry-standard OS for mission-critical telecom applications. In fact, the Solaris OS' roots extend to the telecommunications industry, having originated from Berkeley UNIX, which emerged from Bell Labs.

By delivering integrated new features that provide end-to-end improvements in performance, reliability, availability, and manageability, the Solaris 10 OS helps telecom players increase service levels and reduce costs while delivering a strong foundation for new markets and services. Key features and benefits of Sun's upgraded Solaris OS include the following:

- Providing high performance through such tools as Solaris™ Dynamic Tracing, Solaris 10 enables NEPs to maximize the number of users per system and improve response times for increased customer satisfaction.
- Real-time predictive self-healing maximizes the availability of system and application services by automatically diagnosing, isolating, and recovering from system faults as they occur.
- Solaris™ Containers enable NEPs to provide predictable service levels even when multiple applications are on the same system by allocating additional resources to applications as needed to meet peak demand.
- Security enhancements—including buffer overflow protection at both the server and application level, process and user rights management, an integrated IP filter, and a new cryptographic framework—reduce the likelihood of network downtime.
- New management features, such as Solaris Flash Archives for quickly installing new OS and application software on servers over a network, help reduce system administration costs.
- Available for SPARC and AMD Opteron processor-based platforms, Solaris 10 offers NEPs valuable implementation flexibility.

Netra High Availability (HA) Suite

Sun's Netra High Availability (HA) Suite Foundation Services software helps NEPs accelerate the deployment of highly available services while lowering costs by reducing the need for custom software development. Providing a modular suite of reliable, scalable software services for deploying Solaris OS and Carrier Grade Linux applications in a highly available environment, the Netra High Availability (HA) Suite delivers the fast failover requirements demanded in the telecommunications industry.

NEPs can use the Netra High Availability (HA) Suite to augment existing high-availability frameworks or to create a highly available, dynamically scalable cluster of distributed nodes that enhance platform reliability. Delivering zero recovery time for network link failures, the suite ensures continuous availability of core services, including fault management, reliable NFS, reliable cluster communication and management, reliable IP transport, and reliable boot and DHCP services. Automated software installation and configuration allow for quick and easy deployment, while support for the dynamic addition of new nodes and applications streamlines horizontal scaling.

Netra High Availability (HA) Suite Foundation Services software enables NEPs to:

- Reduce development time and cost by embedding HA software into solutions based on the Sun computing platform to increase overall availability.
- Reduce OS and hardware integration costs by using pre-integrated, Netra-based platforms.
- Focus valuable resources on more strategic activities, such as developing value-added services.

Sun℠ Net Connect

Sun™ Net Connect services are an integrated set of online system management tools for Sun SPARC systems that help increase system uptime and reduce management costs. The tools enable administrators to use a single common, portal-based interface to monitor key system metrics, view detailed configuration and performance data, receive automatic notification of system events, and take advantage of remote servicing from Sun professionals if desired. Sun Net Connect services also enable NEPs to detect and resolve problems more quickly by providing clear, actionable service messages that identify repair part numbers and the appropriate repair procedure.

Chapter 5

Business Benefits From Sun

By turning to Sun, customers can leverage the strengths of a trusted systems company to reduce the time, cost, and risk involved in delivering next-generation telecom services. Sun's proven technologies offer NEPs significant business benefits.

Choice and Flexibility

- Unparalleled choice in platforms and operating systems protects technology investments by avoiding solution lock-in.
- A wide range of COTS solutions—from highly available blade servers to cost-effective rack systems—meets specific customer needs.
- Modular standards-based solutions provide implementation flexibility.
- Java-based innovation delivers crucial portability.

Advanced Management and Availability

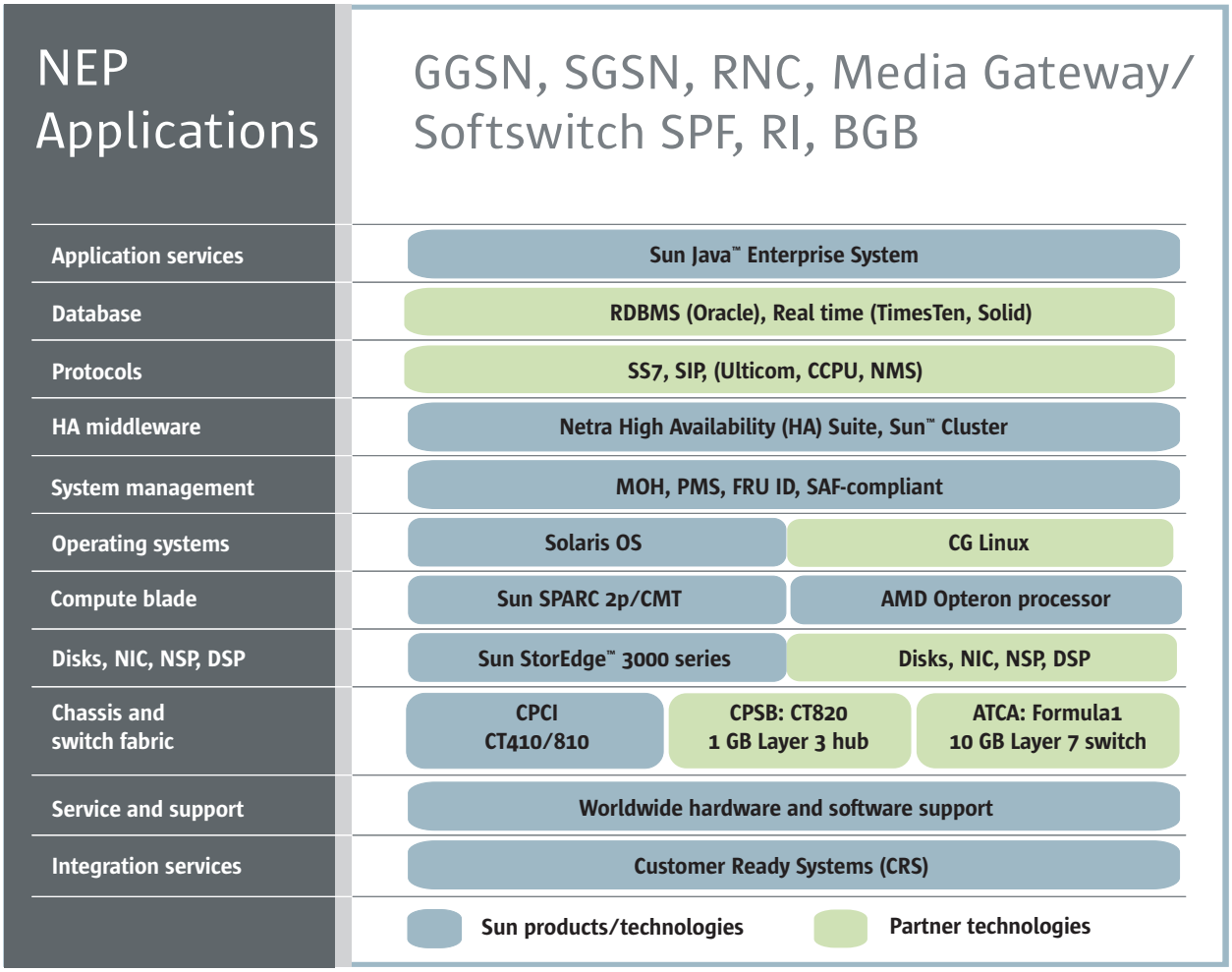
- Sun's hardware and middleware innovation—including built-in fault management and integrated information models—lets NEPs shave years off overall development cycles for lower costs.
- Proven management and availability technologies maximize uptime and lower TCO.

Reduced Risk

- Pretested, industry-standard, carrier-grade offerings significantly speed development cycles without compromising solution quality.
- Exceptional RAS, as well as strong price/performance, help lower total cost of ownership.
- Proven technologies and guaranteed product life cycles from a leading vendor, including advanced change notification and extended system availability, reduce the risk of adopting new solutions.
- A full complement of Sun Services, including the Sun Customer Ready Systems (CRS) program and a global presence in more than 170 countries, supports customers every step of the way.

Sun offers additional time and cost savings to NEPs with its comprehensive integrated service delivery platform (see graphic below). In conjunction with best-of-breed partners, Sun provides NEPs with everything needed to implement a standards-based central office infrastructure, helping to speed development cycles and reduce integration and support costs by working with a single vendor.

Figure 4. Sun and its partners offer a complete line of modular and integrated products and services for the telecom industry.



By serving as a single point of contact and ensuring the interoperability of its products with components provided by partners, Sun enables NEPs to confidently leverage standards-based COTS offerings to speed solution development and streamline ongoing management for a competitive edge.

Chapter 6

Conclusion

To survive in today's highly competitive telecommunications industry, NEPs must be able to rapidly deliver cost-effective solutions for deploying and managing next-generation voice and data services. By integrating COTS components into solutions, NEPs can reap time and cost savings, but these gains are quickly eaten away by the extensive heuristic coding required to provide the fault coverage needed for extremely high service levels.

Sun has a solution that NEPs can tap today to extract more value from COTS components. Taking a system-level approach to its ATCA-compliant products, Sun builds comprehensive fault management into its Netra servers and uniquely delivers integrated information models that provide advanced system management at the hardware, OS, I/O, and application levels. This hardware and middleware innovation decreases the amount of heuristic coding NEPs must undertake to integrate COTS components into next-generation infrastructures, enabling NEPs to significantly speed time to market and reduce implementation costs per application by up to 30 percent.

By taking advantage of Sun's unparalleled AdvancedTCA strategy and proven telecommunications expertise, NEPs can rely on a single trusted source to maximize return on investment and protect investments into the future. Sun's complete line of blades and carrier-grade operating systems, advanced system management development, proven high-availability technologies, and end-to-end Sun Services offerings will allow NEPs to rapidly deliver next-generation telecom services at a low total cost of development and ownership for a highly competitive edge.

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