FORCE10™

NEWS INSIDE

PAGE 1
Samsung Electronics Upgrades with Terascale E-Series

Force10 Transforms Service Provider Network Economics

PAGE 2
U.S. Government High Performance Computing Center Increases Network Scalability with Force10

PAGE 3
Low Latency 10 GbE Switching for Cluster and Storage Interconnects

PAGE 4
Force10 Expands S-Series to Bring High Performance Resiliency to the Network Edge

PAGE 5
CEO Column: New Technology Offers Service Providers a Path to Profits

PAGE 6
Upcoming Events

Force10 Networks Contact Information

FORCE10™

Samsung Electronics Upgrades Network with Force10 Terascale E-Series to Increase Manufacturing Efficiency

SAMSUNG

Samsung Electronics has deployed the Force10 TeraScale E-Series family of switch/routers in its semiconductor facility to speed collaboration, design and automated manufacturing processes. With the high density and resiliency of the TeraScale E-Series, Samsung can leverage its network as a strategic asset, gaining a distinct competitive advantage.

"The efficiencies of automated manufacturing processes are critical to the ongoing success of our business, and to gain further advantage, we needed a reliable network that could scale with our growth," said Chan-Ho Yoon, network architect at Samsung Electronics. "With the Force10 solution, we can increase our productivity while establishing a reliable and flexible networking infrastructure that will support our future business goals."

Supporting 630 Gigabit and 112 Ten Gigabit Ethernet ports, the Force10 TeraScale E600 delivers the high density foundation Samsung requires at the core of its manufacturing network, providing the electronics leader with a highly flexible foundation that can seamlessly scale with demand. In addition to high density, the Force10 TeraScale E-Series provides the unmatched resiliency required to assure business continuity. The unique three CPU architecture of the TeraScale E-Series distributes switching, routing, and management functionality between three distinct processors to maximize network uptime.

"With a high performance network anchored by the Force10 TeraScale E-Series, Samsung can now speed up daily tasks within its manufacturing

Continues on page 4, see Samsung Upgrades with Force10

Force10 Transforms Service Provider Network Economics with Introduction of Cost-Effective Packet over SONET

Force10 is fundamentally altering service provider network economics by integrating multi-rate packet over SONET/SDH (PoS) technology into the TeraScale E-Series family of switch/routers. As the first in the industry to cost effectively combine packet over SONET/SDH functionality with an advanced 10 Gigabit Ethernet architecture, Force10 is driving down the cost of building and maintaining networks for service providers, Internet exchanges, broadband providers, transit carriers and hosting providers.

Multi-Rate Packet over SONET/SDH

"The rise of IP-based services coupled with declining profit margins has forced service providers to explore new ways to optimize their networks for packetized traffic while still maintaining their significant investment in SONET/SDH technology," said Scott Clavenna, principal analyst at market research firm Heavy Reading. "Moving SONET/SDH functionality to an Ethernet-based architecture allows service providers to transition to an IP-based network while reducing the cost of maintaining the network, thereby increasing margins."

Continues on page 6, see Cost-Effective Packet over SONET

U.S. Government High Performance Computing Center Increases Network Scalability With Force10 Terascale E-Series

The Aeronautical Systems Center Major Shared Resource Center (ASC MSRC) at Wright-Patterson Air Force Base, Ohio, has deployed the Force10 TeraScale E-Series family of switch/routers in a 10 Gigabit Ethernet network upgrade. With the TeraScale E-Series at the foundation of its network, the ASC MSRC is increasing the scalability of its high performance network to more efficiently support the computing needs of scientists and engineers dedicated to solving complex problems for the Department of Defense.

ASC MSRC Powering Tomorrow's Solutions

"To upgrade our network, we needed a best of breed switch that could both integrate with the existing network as well as provide a solid foundation for our future network and computing needs," said Steve Wourms, director at the ASC MSRC, a premier high performance computing center that supports a myriad of scientific research and analyses projects. "With the Force10 E-Series we can upgrade our existing clusters and network to 10 Gig and still have room to add additional clusters in the future, providing us with the high performance foundation we can rely on for years to come."

"With the Force10 E-Series we can upgrade our existing clusters and network to 10 Gig and still have room to add additional clusters in the future."

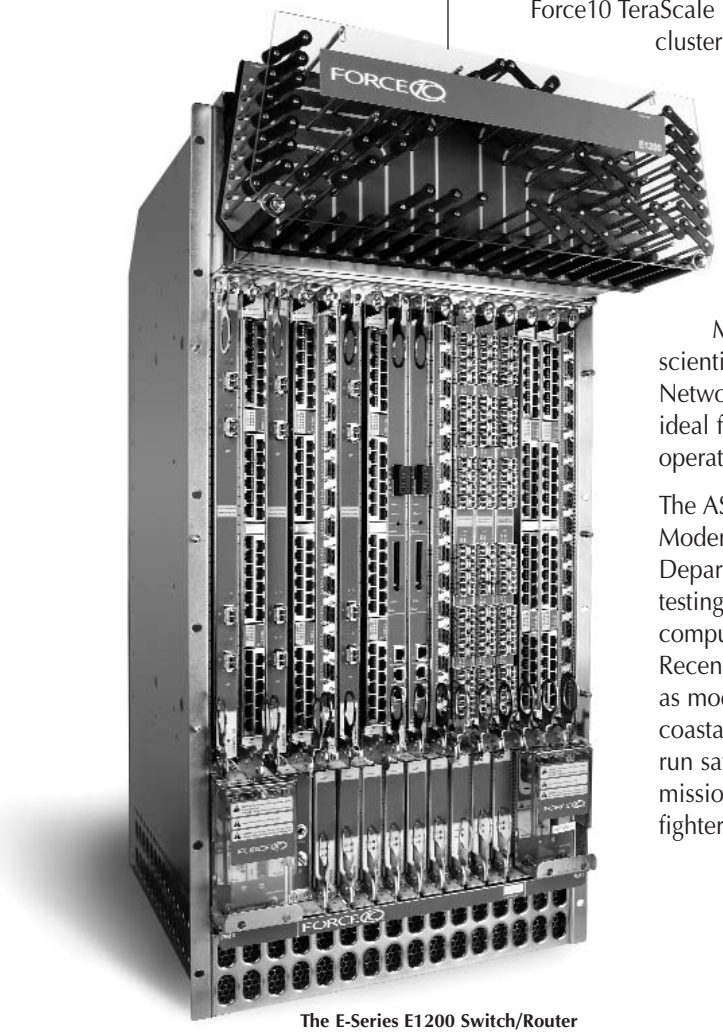
Steve Wourms
Director at the ASC MSRC

The ASC MSRC is leveraging the high line-rate density of the Force10 TeraScale E-Series to upgrade its existing network to 10 Gigabit Ethernet. To build its high performance network core, the ASC MSRC has deployed 20 Ten Gigabit Ethernet ports and 144 Gigabit Ethernet ports that will connect both computing clusters as well as critical ancillary systems.

Supporting 672 line-rate Gigabit and 56 line-rate 10 Gigabit Ethernet ports in a single system, the Force10 TeraScale E1200 allows the ASC MSRC to upgrade its existing network and computing clusters to 10 Gigabit Ethernet while providing available capacity for future expansion of the network. The leading density of the TeraScale E-Series enables the ASC MSRC to reduce the number of systems within its network, simplifying the architecture and reducing the total cost of network ownership.

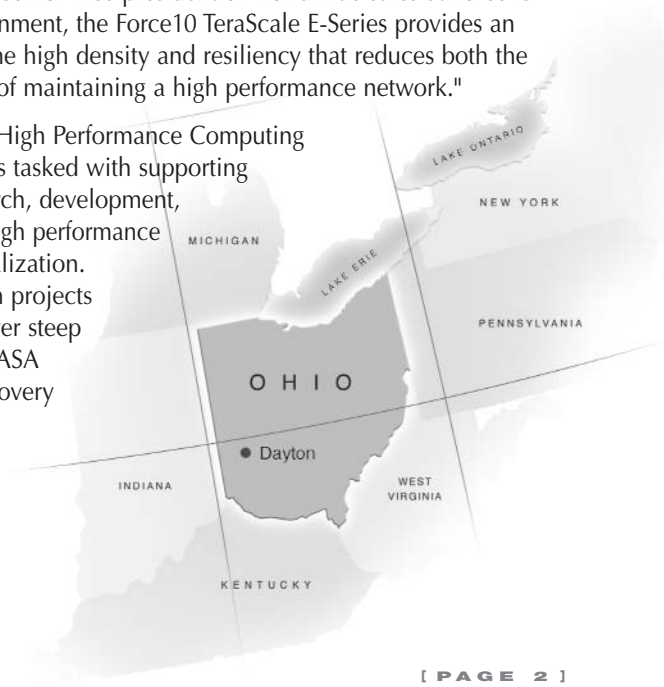
Additionally, the ASC MSRC has deployed the Force10 TeraScale E600 to test new applications and technologies prior to deployment in the production network.

"As a computational facility for Department of Defense research, the ASC MSRC is relying on the most advanced technology to further the research of its scientists," said Mark Cooper, senior vice president of worldwide sales at Force10 Networks. "Within this environment, the Force10 TeraScale E-Series provides an ideal foundation, delivering the high density and resiliency that reduces both the operational and capital costs of maintaining a high performance network."



The E-Series E1200 Switch/Router

The ASC MSRC is part of the High Performance Computing Modernization Program and is tasked with supporting Department of Defense research, development, testing and evaluation using high performance computing research and visualization. Recent research includes such projects as modeling air circulation over steep coastal mountains, helping NASA run safety checks for the Discovery mission and improving F-22 fighter flight worthiness. F10



Low Latency 10 GbE Switching for Cluster and Storage Interconnects

High Performance Data Centers

As the data center continues to evolve to meet rapidly escalating demands for higher levels of performance and resource virtualization, three rather distinct networking requirements have emerged. The typical server in a high performance data center may require connection to three switching fabrics, a LAN for connecting users and general networking, an inter-processor communications (IPC) fabric for low latency message passing between compute cluster applications and a storage fabric for access to shared storage/file resources.

While Ethernet is the defacto technology for the general purpose LAN, it has been widely considered as a sub-optimal switching fabric for very high performance cluster interconnect IPC (e.g., for MPI parallel applications). In particular, GbE's end-to-end message-passing latency in the range of 50-70 µ is significantly higher than the latency of < 10 µ achieved using specialized cluster interconnects. In the absence of congestion, end-to-end latency includes two basic components: 1) sending/receiving delay in the end systems/NICs for moving the message between the application buffers and the network, and 2) network latency involved in serializing the message and switching it through network nodes to its destination.

In spite of the latency issues, the cost effectiveness of GbE has resulted in its being chosen as the IPC interconnect for over 50% of the cluster computers on the June 2006 Top500 list. Therefore, the higher latency of GbE doesn't prevent excellent performance on parallel benchmarks.

As a block storage fabric, GbE with iSCSI has offered a good medium performance solution for access to networked block storage. However, iSCSI has not yet posed a serious threat to Fibre Channel due to the lower bandwidth of GbE vs. 2 and 4 Gbps Fibre Channel, plus Ethernet's traditionally higher CPU utilization, higher memory bandwidth consumption and higher latency.

However, recent developments in 10 GbE NIC hardware and low latency switching are positioning 10 GbE to offer bandwidth and latency performance that is on a par with, or surpasses, that of the more specialized interconnects, including Fibre Channel and InfiniBand. These developments will allow network managers to minimize the complexity of the data center by using Ethernet as the "converged" switching technology that can meet the highest performance requirements of each type of data center traffic.

Low Latency Cut-through Ethernet Switching

With cut-through Ethernet switching, the switch delays the packet only long enough to read the Layer 2 packet header and make a forwarding decision based on the destination address and other header fields (e.g., VLAN tag and 802.1p priority field). Switching latency is reduced because packet processing is restricted to the header itself rather than the entire packet.

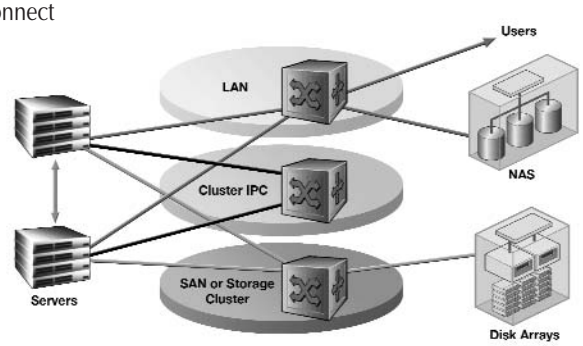


Figure 1. Data center switching fabrics

Ethernet Network Latency: Cut-Through vs. Store-and-Forward

The store-and-forward switch has to wait for the full packet serialization before it begins packet processing. The switch latency for a packet is measured as the delay between the last bit into the switch and the first bit out (LIFO) of the switch. After packet processing is complete, the switch has to re-serialize the packet to deliver it to its destination.

The cut-through switch can overlap the serialization of the outgoing packet from the switch to the destination end system with the serialization of the incoming packet. The switch latency is measured as the delay between the first bit in and the first bit out (FIFO) of the switch.

Fat Tree Topologies for Layer 2 Cluster & Storage Interconnect

In its current incarnation, cut-through switching is generally based on a single chip, non-blocking switch implementation. Because of the limitations of VLSI technology, the number of high speed switch ports per chip is typically in the range of 8-32 irrespective of the technology involved (Fibre Channel, InfiniBand, Myrinet or 10 Gigabit Ethernet).

The most common technique for building larger cluster and storage interconnect fabrics from smaller switching elements is to aggregate multiple switches in a "fat tree" configuration such as a 2-tier fat tree.

The cut-through switch and network latencies compare very favorably with those of InfiniBand, Fibre Channel and the other specialized interconnections.

Design Guidelines for Layer 2 Fat Trees

In a fat tree configuration, there are numerous parallel switched paths between any pair of node switches. Maintaining CBB requires that the switch configuration can exploit the full bandwidth of all of these parallel paths. This means that none of the parallel paths can be blocked by spanning tree and that there must be an effective load balancing mechanism that prevents unequal loading of spine switch ports.

Intelligent 10 GbE NICs

The traditional Ethernet NIC relies on the host CPU to handle the TCP/IP protocol processing. With a software-based protocol stack, the host CPU is shared between the application and the network. The generally accepted rule-of-thumb is that each bit per second of network traffic consumes a Hz of CPU bandwidth. Therefore, a software protocol stack causes CPU utilization to become very high with network bandwidths in excess of 1 Gbps, resulting in the CPU itself becoming the bottleneck that limits throughput and adds significantly to end-to-end latency.

Layer 2 Fabric Interconnection Enabled by Converged NICs

With a converged NIC it is possible to configure servers with a single 10 GbE NIC for access to both cut-through and store-and-forward LAN fabrics. In an example, the server with the converged NIC is connected to the cut-through fabric via the leaf switch while some of the ports of each CT switch in the fat tree are allocated to inter-fabric connectivity.

Another possibility would be to define different colors of VLAN in a fashion similar to the typical high availability/redundant 2-tier access/distribution network. This would allow

Continues on next column

an active-active mode of redundancy that simultaneously exploits the bandwidth of both the primary and secondary paths.

Conclusion

With the advent of 10 GbE cut-through switching and intelligent 10 GbE NICs, Ethernet is ready to challenge the specialized low latency interconnect technologies for performance supremacy in IPC cluster interconnect and storage interconnects.

These developments are clearing the way for network managers to simplify the technology makeup of the data center and leverage the cost effectiveness of Ethernet to minimize TCO without any compromise in performance. As data centers move toward virtualized applications and infrastructure, the combination of lower port prices and lower latency will be crucial drivers of the adoption of 10 Gigabit Ethernet as the converged data center switching technology.

For the typical large enterprise, the most significant impact of low-latency 10 GbE networking will be the large cost savings that will be realized through deployment of high performance iSCSI SANs and clustered storage as alternatives to DAS, Fibre Channel SANs or InfiniBand SANs. F10

For a more complete story, visit the Web at http://force10networks.com/products/LowLatency10GbESwitching.asp

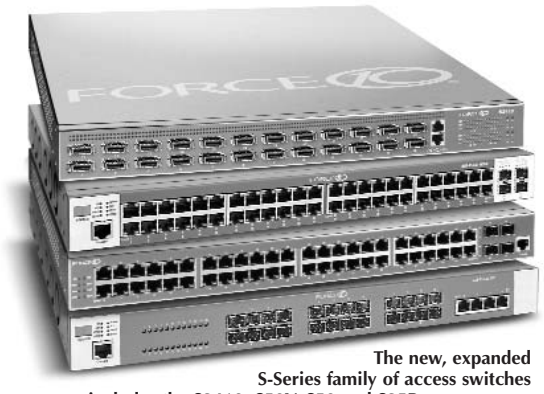
Samsung Upgrades with Force10 *[Cont'd from p. 1]*

facility, increasing efficiency and reducing operating costs," said Mark Cooper, senior vice president of worldwide sales at Force10 Networks. "The combination of leading density and unmatched resiliency provides enterprises like Samsung with the tools they need to effectively leverage their network as a strategic asset."

Force10 has increasingly expanded its presence throughout the enterprise data center, service provider, and research communities in South Korea. Among its customers are leading online game portals Neowiz and Nexon, Korea's national supercomputing center KISTI, Hanaro Telecom, and Korea's leading content delivery network provider CDNetworks. For these customers, the Force10 TeraScale E-Series provides the seamless scalability that provides investment protection well into the future. F10

Force10 Expands S-Series to Bring High Performance Resiliency to the Network Edge

The Force10 S50V and S25P S-Series access switches deliver the resilient power over Ethernet (PoE) and secure connectivity organizations require to build advanced network edges that provide seamless access to mission critical applications.



The new, expanded S-Series family of access switches includes the S2410, S50V, S50 and S25P *(top to bottom)*

"To build out a state-of-the-art network in our new facility, we deployed the Force10 E-Series for our high performance research needs and are extending that deployment with the S50V to provide PoE capabilities for our VoIP and wireless connectivity," said Tim Korb, assistant department head of the Department of Computer Science at Purdue University. "The Force10 S50V delivers the resilient density we need to build out an advanced infrastructure that can reliably support hundreds of faculty, employees, researchers and students."

As enterprises continue to adopt VoIP, expand wireless connectivity and locate strategic assets in the data center, it is essential to ensure maximum uptime and access to critical business applications. The S50V brings resilient, high density power over Ethernet in a compact form factor to the network edge. With 48 line-rate Gigabit Ethernet ports and four optional 10 Gigabit Ethernet uplinks, the S50V provides the capacity and functionality that organizations require at the edge of their networks.

For organizations that are building secure, advanced network edges, Force10 has introduced the S25P to its product portfolio. With 24 fiber Gigabit Ethernet ports and four optional 10 Gigabit Ethernet uplinks, the Force10 S25P cost effectively delivers a higher level of protected capacity to secure the network edge. The increase in network intrusions has created a need for greater security in the wiring closet. However, enterprise network economics dictate that the edge must also cost effectively support applications such as VoIP and wireless connectivity. With high density fiber, port security, 802.1X and access control lists, the S25P delivers the secure networking functionality that IT managers require to secure their wiring closets.

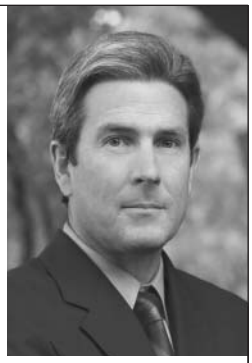
As networks and applications continue to evolve, equipment flexibility is essential to managing the product life cycle. The Force10 S50V and S25P deliver maximum flexibility by providing IT managers with the option to add both stacking capabilities and 10 Gigabit Ethernet ports. With optional 10 Gigabit Ethernet and stacking, IT managers can add the functionality as needed to tailor the switches to their network requirements, thus reducing initial deployment costs. This level of flexibility also allows organizations to repurpose the S50V and S25P in various locations, extending the lifetime of both products and providing a high level of investment protection.

Both the S50V and S25P deliver maximum resiliency through stacking capabilities that enable network operators to connect up to eight switches that can then be managed as a single switch. With stacked link aggregation and automatic failover stacking, if a single switch fails, the others continue to process traffic, ensuring maximum network uptime.

"Force10 is leveraging its expertise in the high performance data center to cost effectively bring core-like resiliency to the network edge," said Andrew Feldman, vice president of marketing at Force10 Networks. "By strategically expanding its product portfolio to target additional markets, Force10 is enabling a more resilient network from core to edge."

As Force10 continues to expand its customer base from high performance data centers and service providers to the enterprise LAN, it is also expanding its product portfolio to cost effectively deliver the scalable and flexible solutions that enterprises require in their evolving networks. F10

New Technology Offers Service Providers a Path to Profits



Marc Randall
President and CEO
Force10 Networks

A revolution is taking place today in the way people interact with the Internet, which is transforming it into a place where people around the world come together to share ideas, videos, music, photos and more. The emergence of the so-called Web 2.0 companies, including Photobucket, YouTube, Live365 and Pandora, and their innovative applications are primarily behind this transition. Not surprisingly, these same applications are driving a substantial increase in traffic and not only on the networks of the companies that are spurring this change but also across the global service provider ecosystem as well.

"As a higher density, cost-effective alternative to SONET/SDH, Ethernet is a clear winner, particularly as traffic continues to grow exponentially."

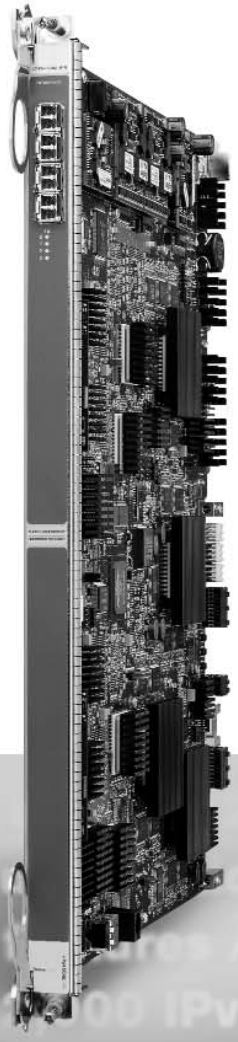
Service and hosting providers, Internet exchanges, IP transit carriers and access providers are all witnessing greater traffic on their networks. Coinciding with this rise in traffic is a transition to 10 Gigabit Ethernet for a more scalable and cost-effective infrastructure than traditional carrier SONET/SDH networks can provide.

But how can service providers deploy new 10 Gigabit Ethernet networks without wholly abandoning their significant investments in legacy SONET/SDH technology?

Packet over SONET/SDH technology offers a way for service providers to transition to 10 Gigabit Ethernet while continuing to maximize the investment in their existing infrastructure. The transition comes at a cost that is far less than the equivalent cost of adding capacity via a SONET/SDH platform. More importantly, it enables service providers to deploy 10 Gigabit Ethernet today to build the high capacity networks they require to respond to this new era of Internet interaction.

With end user prices falling while infrastructure costs remain the same, service providers are finding it increasingly difficult to get a return on their investment in infrastructure. But as a higher density, cost-effective alternative to SONET/SDH, Ethernet is a clear winner, particularly as traffic continues to grow exponentially. It is both easier to manage and far more scalable than legacy technology. This is particularly important as service provider margins are increasingly under pressure.

For these service providers, as well as the thousands of network operators that are projecting tremendous growth in the traffic on their networks, Ethernet is the choice. And packet over SONET/SDH is the way to extract maximum value from legacy technologies while transitioning to next generation 10 Gigabit Ethernet networks. F10



UPCOMING EVENTS

NOVEMBER

SC2006, Booth #1539, Nov. 14–16, Tampa, FL

RSNA 2006, Nov. 26–Dec. 1, Chicago, IL

DECEMBER

ISS World Fall 2006, Dec. 4–6, Washington, DC

Internet2 Member Meeting, Dec. 4–7, Chicago, IL

APRIL

NAB 2007, Booth #SU7622**,** April 14–19, Las Vegas, NV

MAY

Interop Las Vegas 2007, Booth #1837, May 20–25 Mandalay Convention Center, Las Vegas, NV

JUNE

Cable-Tec Expo 2007, June 19–22, Orlando, FL

For a complete list of events, see: force10networks.com/news/events.asp

CONTACT INFO

FORCE10 NETWORKS
350 Holger Way, San Jose, CA 95134 USA
www.force10networks.com

408-571-3500 PHONE
866-600-5100 PHONE (U.S. ONLY)
408-571-3550 FACSIMILE

Sales:
sales.americas@force10networks.com AMERICAS
sales.europe@force10networks.com EUROPE
sales.china@force10networks.com CHINA
sales.japan@force10networks.com JAPAN
sales.korea@force10networks.com KOREA

Strategic Alliances/Partnerships:
strategicalliances@force10networks.com

Customer Support: support@force10networks.com

Employment: jobs@force10networks.com

General Information: info@force10networks.com

Press Inquiries: pruzicka@force10networks.com

Printed in the USA 08 1006 v1.7

FORCE10 NETWORKS
350 Holger Way
San Jose, CA 95134

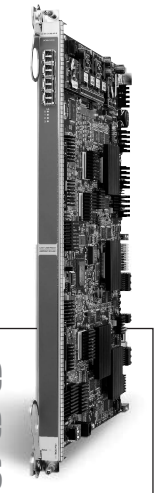
PRE-SORTED FIRST CLASS
U.S. POSTAGE
PAID
SAN FRANCISCO, CA
PERMIT NO. 11882

Cost-Effective Packet over SONET *[Cont'd from p. 1]*

While 10 Gigabit Ethernet deployments are growing rapidly in service provider networks, there remains a multi-billion dollar installed base of SONET/SDH. With the addition of packet over SONET/SDH to the TeraScale E-Series, Force10 enables service providers to seamlessly and cost effectively expand existing legacy infrastructure while laying the foundation for the migration to 10 Gigabit Ethernet.

The Force10 four-port multi-rate line card allows service providers to select between OC-3c/STM-1c, OC-12c/STM-4c and OC-48c/STM-16c speeds on a per port basis, delivering the flexibility required to efficiently provision the network. Service providers can also select between SONET and SDH framing on a per port basis, as well as various encapsulation methods, to further simplify the architecture of transcontinental networks.

Traditional solutions, originally designed for voice networks, are based on more expensive SONET/SDH architectures. The addition of Ethernet functionality to these solutions prevents service providers from realizing the cost advantages of Ethernet, forcing them to pay SONET-like prices for 10 Gigabit Ethernet. The Force10 TeraScale E-Series is the first next-generation switch/router to leverage an Ethernet architecture to deliver packet over SONET/SDH functionality, providing a significant cost savings to service providers that want to leverage existing networks as they transition to 10 Gigabit Ethernet. F10



Cost-Effective PoS for the E-Series