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Easing the Way: The Migration to IP and Ethernet

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As telecommunications infrastructure continues to evolve, advanced business and residential IP services are changing the way voice, data and video applications are delivered and used. From our telephone lines at the office to the video-on-demand service at home, these offerings have two things in common: the underlying use of IP, and ubiquitous connectivity via Ethernet.

New services such as IPTV and VoIP demonstrate how even traditional services, such as TV and telephone, are being delivered over the IP-based infrastructure. The introduction of Ethernet has also helped fuel the growth of IP-based applications. From its plug-and-play simplicity for home users to its high bandwidth of up to 10 Gigabits per second (Gbps), it is no wonder that Ethernet is appreciated on many levels.

Concerns about whether Ethernet is reliable enough and/or high-grade enough for telco environments continue to be addressed by vendors and standards bodies alike. The Metro Ethernet Forum has introduced its own Carrier Ethernet certification program to help ensure compliance with minimum standards, and many vendors have enabled Ethernet interfaces on traditional carrier-class SONET/SDH and WDM equipment.

IP applications over Ethernet present the most compelling value proposition by enabling new services, significant cost efficiencies and worldwide ubiquity. However, with the large installed base of existing transport networks built largely on SONET/SDH, carriers continue to ask for flexible solutions that allow them to maximize investment protection while guaranteeing future readiness. Flexible solutions such as programmable network elements play a critical role in creating on-demand capabilities that allow carriers to install the services they need when they need them.

While some greenfield network operators may be willing to build an all-Ethernet network, many have tried and failed to convince incumbent operators to do the same. Indeed, adding support for Ethernet over legacy infrastructure to protect existing investments is critical for operational as well as
financial reasons for most network operators. They have made large investments in existing -infrastructure and are not ready to simply throw it away and start over.

New standards, new technology and innovative products are offering more flexibility, including the use of programmable network elements, which will play a critical role with on-demand capabilities that allow carriers to install the services they need when they need them.

The need to offer any service, at any time and anywhere applies not only to the data networks down to the customer premise, but also to the service provider core transport networks. New technologies combined with intelligent devices offer service providers the ability to add higher levels of flexibility to their networks while drastically reducing the total cost of ownership without any reduction of service capabilities. Some of these technologies are described below.

ITU G.709, a.k.a. digital wrapper, a.k.a. Optical Transport Network (OTN)

Better known as digital wrapper to many, G.709 combines different types of traffic, such as Ethernet, Storage, Digital Video and SONET/SDH onto a single Optical Transport Unit (OTU) frame. OTU-1, a 2.7 Gbps frame and OTU-2 a 10.7 Gbps frame offer speeds slightly higher than SONET/SDH OC-48 and OC-192 frames. The larger frame allows for full performance monitoring of all of the traffic being carried as well as transport of SONET/SDH without losing any of its performance monitoring capabilities. An additional benefit of the OTN framing is that it offers a simple and easy way to managed Ethernet, something the Ethernet standards themselves do not address very well. G.709 is popular in Europe with several networks operational and in various phases of implementation. U.S. operators are in various stages of trial and implementation, with live network deployments targeted for late this year and early next year.

New-generation flexible Small Form factor Pluggable (SFP) optics

As optical networks have evolved, so have the components. With the availability of pluggable optics for network interface cards, network operators can choose the protocols, speed and distance they need and can then reuse the components as needs change. New generation SFPs being delivered to the market are able to support SONET/SDH and Gigabit Ethernet that allow operators to migrate customers from TDM-based services to packet services without replacing the optics. Unfortunately, as customers migrate from TDM to Ethernet, most network interface cards must be replaced to support the new protocol and/or new speed requirements. The introduction of programmable optical line cards, however, is changing that paradigm as well.

Programmable Network elements

Programmable network elements represent the ultimate in flexibility. With the evolution of Digital Signal Processors, network processors and Field Programmable Gate Arrays (FPGA), technology has continued to move forward with varying degrees of flexibility. While DSPs have proven themselves in consumer devices such as cell phones, FPGAs and Network Processors historically have proven expensive for network equipment. They lacked the performance to compete with hard coded Application Specific Integrated Circuit (ASIC). ASICs offer a low price point with high performance, but require long lead times to develop and are NOT reprogrammable, even to fix a software bug. New-generation FPGAs, however, offer speed, performance and reprogrammability at low price points and low power consumption.

New-generation optical devices are now able to take advantage of such technology so that networks can support any optical protocol including Gigabit Ethernet, Sonet/SDH, Fibre Channel, Digital Video and more at speeds up to 10Gbps. This not only means that network line cards can be reused, regardless of when and how the customer plans to migrate, but that SONET/SDH line cards can be reprogrammed to support Ethernet, and Ethernet line cards can be reprogrammed to Digital Video.

Most importantly, this technology not only protects existing investments of network operators, but is offered at dramatically lower price points, reducing both capital expenditures and operational expenditures. New-generation metro, regional and long-haul DWDM networks will benefit significantly from this technology, since native IP over Ethernet over DWDM has proven popular for most network operators. Operators can now migrate their networks as well as their customers to Ethernet while continuing to support all of their legacy technology. Metro networks will require the most flexibility as the mix of protocols in the metro go beyond just SONET/SDH and Ethernet. Since FPGAs can be programmed remotely, On-Demand services can now be extended to areas that have traditionally been underserved, including the core network.

Conclusions

IP-based services and applications are the fastest growing segments of the market. New applications, new customers and new networks continue to be added with network operators scurrying to support all of their customers emerging requirements. IPTV infrastructures remain in their infancy, but their traffic demands alone tell us that the broadband access networks are still growing. VoIP will not drain the network of bandwidth, but it does imply that there is a massive migration of voice from legacy technologies to IP technologies. However, the correlation of IP as the universal language and Ethernet as the universal microphone is having a profound impact on today networks. Improving flexibility while protecting today investment is critical. New standards such as G.709, new technology such as Small Form factor Pluggable optics and innovative new programmable optical elements based upon FPGA offer operators the ability to reduce their cost structure while improving customer satisfaction.