Carrier Ethernet: Vehicle for Convergence

Ethernet doesn't just save money for service providers; it enables them to provide the converged services their customers are looking for

By Ravi Medikonda, Juniper Networks

For the first time in decades, service providers have set their sights on a single vehicle for network and service convergence: Carrier Ethernet. Carriers ranging from telephone companies to wireless service providers to cable MSOs have all come to adopt Ethernet as the technology of choice for protecting their legacy subscriber bases, aggregating traffic from myriad service offerings, managing costs in strategic backhaul and transport segments and enabling many new broadband service offerings. (See Figure 1.)

According to research and analysis firm IDC, the Carrier Ethernet equipment market is expected to grow to almost $7 billion in 2010. This is up from $2.3 billion in 2005 and represents a 5-year compound annual growth rate of around 20 percent. As a result, Ethernet now stands primed to supplant (or, in some cases, to supplement) a broad array of legacy TDM technologies and services, including T1, T3, SONET/SDH, ATM, and Frame Relay.

IS ETHERNET REALLY CARRIER-CLASS?

Ethernet offers numerous advantages as a standard for service providers. Because it has long been the predominant standard in the enterprise LAN, tools are already available for simple interconnection, straightforward troubleshooting, and for operations, administration and maintenance (OAM). The technology is mature – the first patent was awarded in December 1977 – so it is well understood, proven and ubiquitously supported. After thirty years of experience and healthy com-

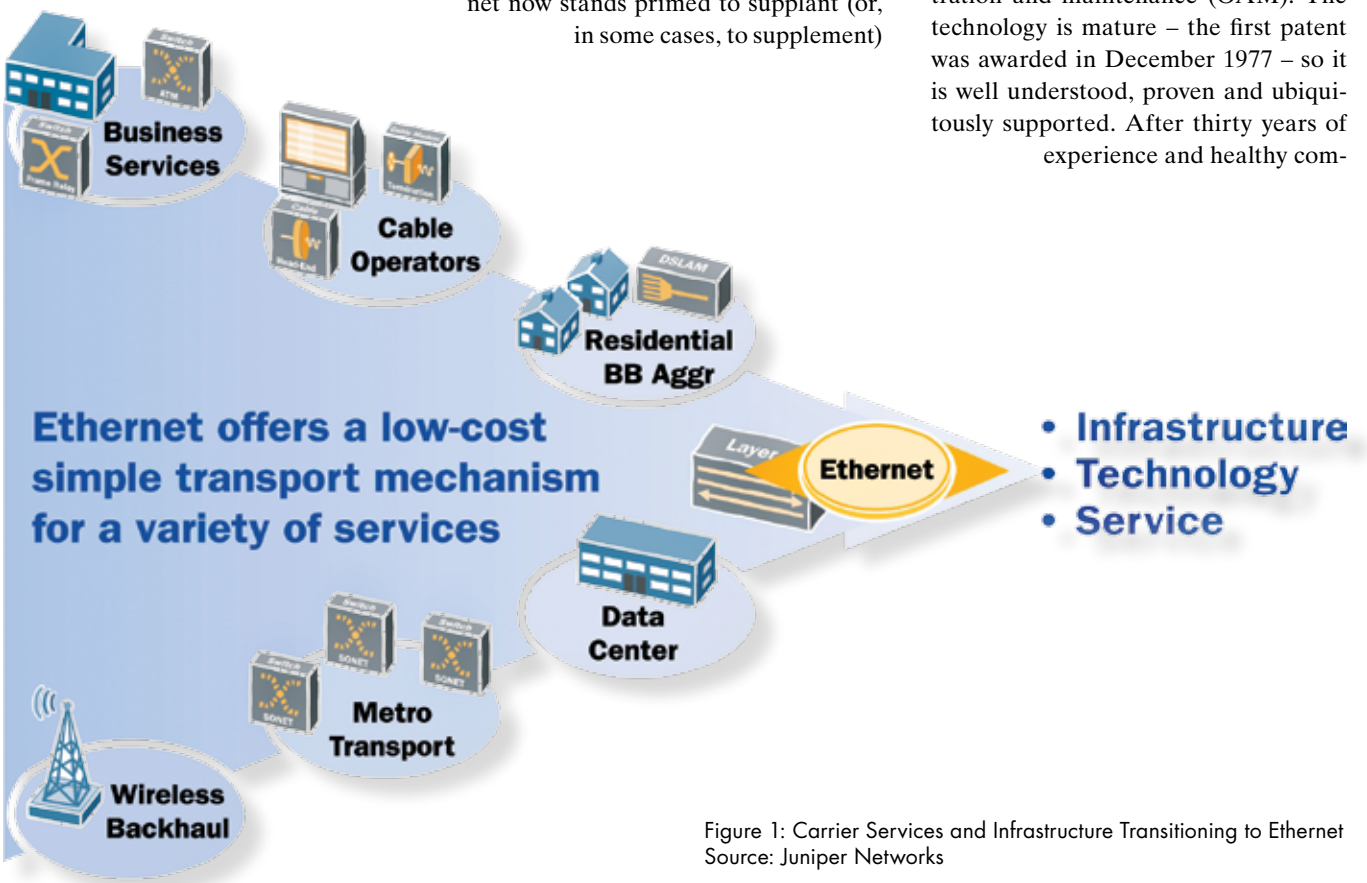

Figure 1: Carrier Services and Infrastructure Transitioning to Ethernet
Source: Juniper Networks

petition among vendors, prices for Ethernet hardware have reached commodity levels, while their quality, capacity and performance continue to improve. Finally, the standard is continuing to evolve. Advances on both technology and standards fronts are leading to steady improvements in Ethernet performance, versatility, security and feature richness, giving service providers the means not only to better manage their myriad legacy services, but to build a foundation for entirely new classes of revenue-generating services.

However, service providers' requirements differ – profoundly, in some ways – from those of enterprise network managers. Access, transport and connectivity are the bread and butter of carrier services, and availability, quality and security are absolutely critical. Any lapse in any of these areas threatens not only revenues but customer loyalty as well. If the ascendance of Carrier Ethernet brings any disadvantage, it is in the ease with which enterprise customers can change providers. Will Ethernet prove reliable enough to meet the needs of service providers?

A set of technologies grouped under the umbrella of Multiprotocol Label Switching (MPLS) has emerged specifically to meet these needs. MPLS, which was originally devised as a simple label-swapping technology, has over the last decade incorporated legacy protocols such as ATM, Frame Relay and TDM as virtual circuits or pseudowires, which are software emulations of packet-switched networks. MPLS also supports features critical to carriers such as Fast Reroute, a sub-50 msec convergence technology that reroutes traffic around failed links; Traffic Engineering, a powerful mechanism to use network resources efficiently; and OAM, a set of tools necessary for efficient network operation.

MARKET TRENDS AND DEMAND DRIVERS

But carriers aren't adopting Ethernet simply because it works. They are using it because it enables them to provide the converged services their customers want. According to IDC, the global Carrier Ethernet–based services market is expected to grow rapidly from $6.1 billion in 2006 to over $17 billion in 2011.

This growth is expected to be fueled by new customer demand for high-speed business services and data centers, as well as by migration from legacy business services that currently use TDM private line, ATM and Frame Relay for accessing the global Internet and private networks.

Telephony. In telephony, three separate developments have led to a broad adoption of Ethernet: transition of residential broadband aggregation networks to Ethernet, the buildout of metro-edge and metro-core networks to support bandwidth-intensive IPTV and Video-on-Demand (VoD) traffic, and the introduction of new Ethernet and VPLS-based-Ethernet business services.

Ethernet offers carriers strategic advantages in the development and introduction of new services, not least because their enterprise customers are using it internally in their own networks. Telephony carriers around the globe use Carrier Ethernet to deliver managed Virtual Private Network (VPN) and MPLS VPN services, such as VPLS and IP-VPNs, to larger corporate customers as a means of enabling multiple services over a single network. For these carriers, whose territories cover broad or discontinuous geographical areas, Ethernet offers a means to connect customers' distributed facilities.

In planning and developing these new services, however, telephony carriers need to exercise discretion. Legacy E1/T1, ATM and Frame Relay services are "cash cows" to telcos, generating healthy, recurring revenues as well as opportunities to sell more advanced services. Here, too, MPLS-enabled Carrier Ethernet offers a particular advantage as an efficient and scalable vehicle for aggregating multiple service interfaces, using pseudowire technology. Armed with the right Carrier Ethernet edge routers, carriers can support a mix of IP, ATM, Frame Relay and TDM interfaces while decreasing network complexity and enhancing resiliency.

Cable. For their part, cable MSOs have come a long way from being mere conduits for broadcast television signals. Like telephony providers, cable companies have invested aggressively in optical fiber. Furthermore, since MSOs began providing business telecommunications services nearly 20 years ago, the distinctions between cable companies and telephone companies have had little to do with either subscriber or technology bases.

Ethernet technologies are every bit as critical to MSOs as they are to the telephony community. In fact, the shift to Ethernet stands to put cable operators on a more equal footing with their telco rivals; where their older coax infrastructures once prevented cable companies from offering an equivalent to TDM-based E1/T1 private line services, Ethernet aggregation now lets them offer the same mix of legacy and next-generation services.

Ethernet has also proven to be a linchpin in the cable companies' growth in the residential market, where digital cable programming, high-margin services such as VoD, and triple play packages, which bundle digital cable, high-speed Internet, and VoIP services, all aggregate onto Ethernet in cable distribution segments.

Not surprisingly, Ethernet has emerged as the technology of choice in the data centers that maintain cable subscriber billing and usage data and in the server farms that store both program content and data for the electronic program guides that let viewers choose programs, set preferences and manage other aspects of their viewing experience.

Wireless. The evolution of wireless service provider networks has paralleled that in telco and cable networks: Fiber facilities have steadily replaced aging copper plant, core networks are shifting from legacy TDM and synchronous transmission technologies to IP, and carriers need to constantly enable innovative new offerings without alienating customers of lucrative legacy services.

Like their telco and cable counterparts, wireless service providers have fully embraced Ethernet as the vehicle of choice for all segments of their networks. Wireless service providers use Ethernet to efficiently aggregate mobile voice with data traffic, which is growing rapidly as handsets morph into gaming stations, MP3 players, Web browsers and text messaging devices. New WiMAX applications, including both fixed and mobile broadband access, will add even more diversity to wireless service offerings and raise the stakes for Ethernet aggregation on the network edge.

Beyond telephony, cable and wireless service providers, Ethernet has also emerged as a critical technology for metropolitan transport network providers, which specialize in high-speed business services for enterprise segments. These metro network operators are aggressively migrating their synchronous SDH/SONET fiber optic rings to gigabit and 10 gigabit Ethernet switches. The simplified architectures and operational enhancements associated with Ethernet will help them serve corporate data centers more efficiently, as well as better accommodate the high volumes of video traffic now surging across corporate networks.

COST REDUCTION AND REVENUE GENERATION

Ethernet addresses both of the concerns that all service providers face in making strategic investments: cost reduction and revenue generation.

On the cost reduction side, Ethernet offers low life-cycle costs. Its mass adoption in LANs means that vendors and networkers alike have progressed far along the learning curve; Ethernet is among the best-understood protocol sets in the IT world. Performance levels and feature richness have reached high levels, and continue to improve, while by all metrics equipment costs continue to decrease. Furthermore, the enormous global base of experience in operating, managing, and troubleshooting Ethernet networks and devices minimizes training and other specialized personnel development costs. These cost advantages make Ethernet as compelling to enterprise customers as it is to service providers; running Ethernet across LAN and WAN segments reduces the pain and costs associated with interworking disparate protocols, and facilitates configuration and provisioning.

AN EVOLVING STANDARD

As a technology, Ethernet is in its prime. Research and development of new features and capabilities continue unabated in private and institutional settings, and standards work is advancing at an equally rapid clip. In addition to the IETF and the IEEE, which continue to develop standards to enable new Ethernet services and trouble-shooting tools, a new organization of particular interest to service providers, the Metro Ethernet Forum (MEF), emerged in 2002 to promote the worldwide adoption of Carrier Ethernet networks and services. A nonprofit consortium of service providers, vendors and other networking companies, the MEF has already approved nearly 20 different technical specifications, and thus augments the work of the other standards bodies. With these steep investments in resources and intellectual capital, the risks of adopting Ethernet for carriers is minimal, and the upside potential vast.

As a carrier technology, Ethernet scales. With GE and 10GE interfaces standardized, the IEEE has now begun early development on standards for 100 gigabit Ethernet, whose objectives include optical fiber standards for a minimum of 100 meters and a minimum of 10 kilometers, full-duplex operation only, and using current standards for frame formats and sizes. To further this work, a new nonprofit corporation, Road to 100G Alliance, was announced in June 2007 with the goal of promoting seamless interoperability among the disparate standards-based components required in building high-capacity network elements. Like the MEF, the Alliance hopes to include vendors and service providers among its members, although its primary activity will consist of interoperability testing rather than standards development.

In summary, the broad adoption of Ethernet among service providers results from a compelling combination of attributes, among them its prevalence in enterprise networks; low life-cycle costs; enhanced robustness and feature richness accruing from active R&D and standards work; and high scalability. These benefits, along with the advancing age of carrier access and transport infrastructures now in place, the availability of MPLS as the underlying technology, and the drive to develop new, broadband-based services, have led to a "perfect storm" of drivers leading to Ethernet.

In its present state, Ethernet bears faint resemblance to the data communication technology first patented by Xerox in 1977. Today's Ethernet is the technology of choice among service providers – including telephone companies, cable MSOs, wireless carriers and other, more specialized, service providers – for traffic aggregation, multiservice management and service delivery. Most encouragingly, Ethernet will continue to evolve thanks to the work of component vendors, standards bodies and industry consortia; much of this work will focus on the specific needs of the carrier community.

About the Author

Ravi Medikonda is Director of Service Provider Marketing at Juniper Networks, responsible for solutions development and marketing for wireline carriers. Prior to that, Mr. Medikonda was Director of Product Marketing at Ericsson with responsibility for product and market strategy of its IP-Edge products. Before that, he was Director of Marketing at Tellabs and was responsible for product management, planning and market strategy for Tellabs' IP/MPLS product line. Mr. Medikonda has 14 years of experience in the telecommunications and data networking industry and has had product management and network engineering roles at Calix and Sprint. He can be reached at ravim@juniper.net.