For the First Mile:

MSAP Delivers Metro Ethernet to Business Customers

A new technology, the Multi Service Access Platform, aggregates Ethernet demand

By Don McCullough ■ *Entrisphere*

Worried about your multi-tenant office complex being too far from a fiber point of presence? It might be wise to check again. What was difficult and expensive a year or two ago might now be a lot easier. A new technology, the Multi Service Access Platform, makes it possible to access fiber-borne bandwidth over pure Ethernet. The MSAP brings media conversion (fiber to copper, for instance) and 802.3ah network control closer to customers.

Metro Ethernet service, of course, offers higher bandwidths than typical DS1 service. And because Ethernet is the native protocol for virtually all corporate Local Area Networks, it eliminates the need to convert from Ethernet to DS1 Frame Relay and back again. Metro Ethernet also offers virtual LAN service that can make the Wide Area Network simply an extension of the LAN, allowing enterprises to connect geographically separated offices – like a public school district, regional business offices or a health care service group – on a single virtual network.

But if Metro Ethernet is so hot, why isn't it taking over as the service connection for all enterprises? Metro Ethernet is certainly gaining momentum in the market, but the changeover from legacy services like Fractional T1, TS1 and DS3 has been slowed by several factors:

- Technology issues like ensuring carrier-class reliability.
- Marketing issues like migrating customers from DS1 to Ethernet in an orderly way that maintains service and customer relationships.
- Access network capabilities.

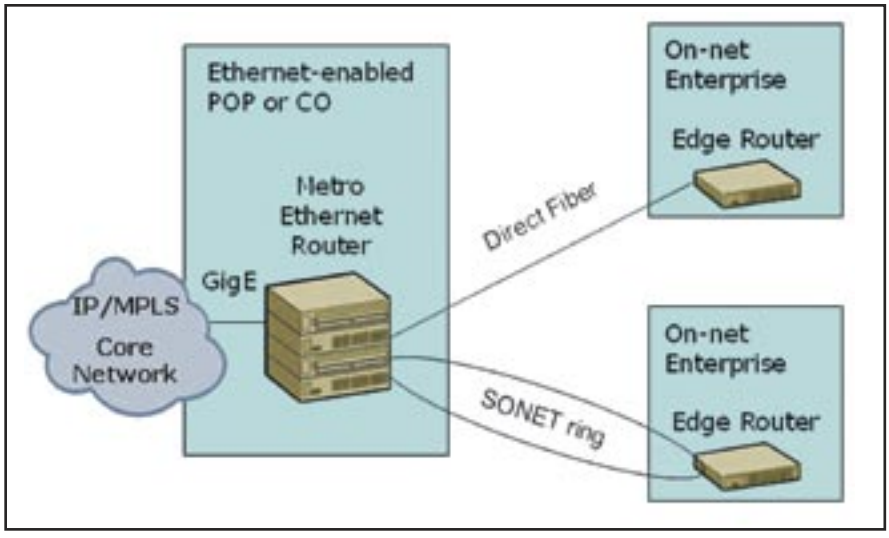

Figure 1. A typical Metro Ethernet access network today, without MSAPs.

While there is work going on in all these areas, this article looks at developments in the access network that are making Metro Ethernet service more reliable and easier to deliver while helping with some of the marketing issues.

Delivering Metro Ethernet Service Today

Ethernet service is indeed generally available in metro areas and carried mostly over fiber connections. SBC offers GigaMAN and OPT-E-MAN services, both of which deliver Ethernet service over fiber connections at speeds from 5 Mbps to 1 Gbps. Verizon offers Switched Ethernet Service or Ethernet Private Line service, both of which use a fiber or SONET connection to deliver 10 Mbps, 100 Mbps or 1 Gbps. AT&T offers Ethernet Switched Service MAN, at 10 Mbps, 100 Mbps and 1 Gbps Ethernet service on-net over fiber and SONET connections.

These services are typically launched on the access network side from large carrier-class routers toward the customer over point-to-point fiber or Ethernet-over-SONET connections. On the network side, these routers provide interfaces into the carrier's core network, which use Multiprotocol Label Switching. MPLS, well known among telcos, speeds up network traffic flow by setting

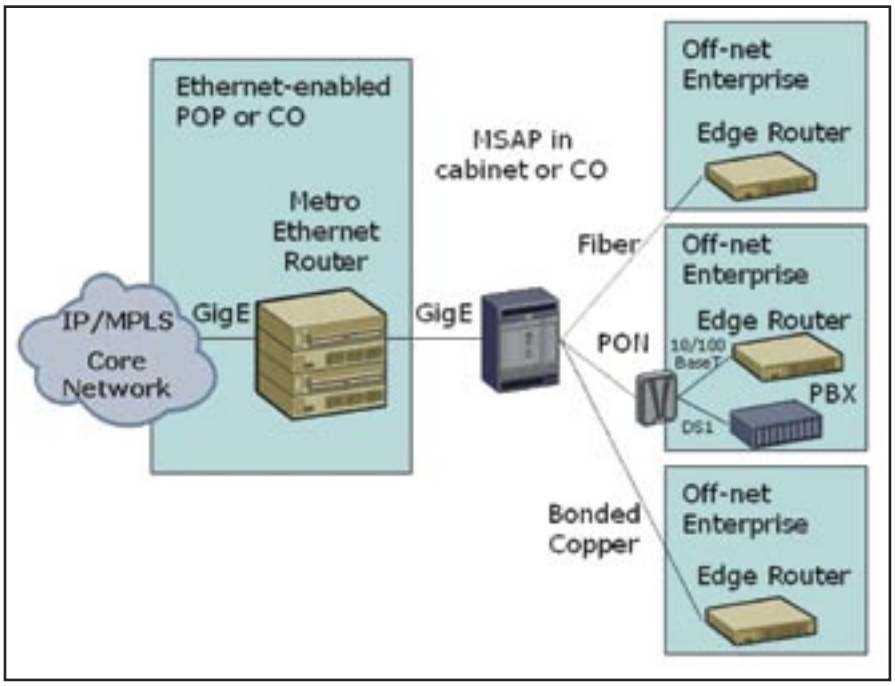

Figure 2. Using MSAPs (multiple service access platforms) in a Metro Ethernet network. Note conversions between copper and fiber.

up a specific path for a given sequence of packets, identified by a label put into each packet. This saves the time needed for a router to look up the address to the next node to forward the packet. MPLS is called multiprotocol because it works with the Internet Protocol (IP), Asynchronous Transport Mode (ATM), and frame relay network protocols.

The interface between the access network and the core network is a large router built specifically to offer Metro Ethernet service in a carrier's network. The direct fiber and SONET access connections that extend to the enterprise customer terminate on these routers. These routers are located in the carriers' Ethernet-enabled Points of Presence (POPs) or Central Offices (COs). See Figure 1 for a current typical Metro Ethernet access network.

New Metro Ethernet Access Platforms

Property owners know that the availability and location of Ethernet-enabled POPs or COs may limit the geographical availability of certain Ethernet services. An enterprise must have access to Ethernet-enabled POPs or COs (or be "on-net") in order to subscribe to Ethernet service. In addition to limited on-net geographic availability, the access networks involved (direct fiber connections or SONET) are new, and expensive compared to DS1 service carried over the copper network.

Thus, relying solely on large routers in on-net POS and COs is limiting Ethernet service availability. One of the keys to expanding the availability of Ethernet service is deploying new types of access network systems that can deliver the service while fitting into the existing Metro Ethernet network. The new access systems, Multi Service Access Platforms (MSAPs) offer three new access technologies for delivery of Ethernet services:

- Optical Ethernet from Broadband-enabled Digital Loop Carrier (DLC) platforms
- Passive Optical Network (PON) systems
- Bonded copper from DLC and Digital Subscriber Line Access Multiplexer (DSLAM) platforms

These options deliver the same service (native Ethernet at speeds from just above 1.5 Mbps T1 speeds up to 1 Gbps), and they use the same routers to provide the interface into the core network. However, these services rely on MSAPs to aggregate Ethernet services in remote sites and COs that are not on-net and transport them to the on-net POPs and COs that interface to the Metro Ethernet routers. The routers then provide service features and access to the IP/MPLS core network.

Unlike a router, an MSAP is hardened and can be deployed in outside plant cabinets. Using an MSAP allows carriers to offer Ethernet from remote sites that are served by such cabinets.

MSAPs are so named because they deliver multiple services, including voice, DSL, PON, and IP video as well as increasing amounts of Ethernet service. They also can connect different network media, like copper and fiber. An MSAP can be deployed with Ethernet service cards to extend the size of the on-net footprint beyond just the Ethernet-enabled POPs and COs. See Figure 2 for a Metro Ethernet network that includes an MSAP.

An MSAP offers Ethernet service cards that provide native Ethernet service, either as electrical 10/100 BaseT interfaces or often as optical interfaces at either 100 Mbps or at 1 Gbps. These systems aggregate the multiple Ethernet services and provide an interface to the routers over SONET or (preferably) gigabit Ethernet (GigE) interfaces.

Unlike a router, an MSAP is hardened and can be deployed in outside plant cabinets. Using an MSAP allows carriers to offer Ethernet from remote sites that are served by such cabinets. The MSAP also provides valuable economic advantages and saves router ports by aggregating lower-speed service interfaces into a single GigE interface to the Metro Ethernet router. In other words, an MSAP performs many of the same functions – especially aggregation and remote access – that traditional DLC platforms provide in the legacy voice world.

PON-based Ethernet Services

In addition to using MSAPs for remote direct fiber connections for Ethernet services, carriers are also using the Passive Optical Network (PON) capabilities in the MSAP to expand their Ethernet offering. The MSAP provides the Optical Line Terminal function (OLT) in a PON system, and it also provides Ethernet aggregation for services arriving from the PON network. Carriers rolling out PON to residential customers for Triple Play services (voice, data and video) can use special PON Optical Network Terminals (ONTs) at the customer site to offer Ethernet and DS1 services.

The PON offering that mixes Ethernet, DS1 and POTS service in one element (the ONT) provides a solution to one of the marketing challenges for Metro Ethernet service, which is how to bridge from the current offering (FT1 or T1) to Ethernet. Enterprises often buy two services from the carrier via DS1 service. They buy a DS1 with Primary Rate Interface (PRI) to interface to their PBX and provide voice service. And they buy a second DS1 with a Frame Relay interface to link to their edge router and provide data service.

Smaller businesses may buy separate FT1 services for voice and data. Upgrading the edge router to accept a native Ethernet interface from the WAN is easy. But upgrading the PBX from a TDM to IP–based voice service can be much more difficult.

With a PON ONT that offers both DS1 and Ethernet ports, this marketing problem is solved simply. The carrier continues to provide a DS1 with PRI interface for voice services and moves the data service to Ethernet. The MSAP is able to uplink the DS1 service to the TDM network and aggregate Ethernet services into a GigE interface for delivery to the Metro Ethernet router. With this mixed mode, PON allows carriers to deliver high bandwidth Ethernet service – up to 100 Mbps – while maintaining the legacy offering simultaneously to the same customer base from a single MSAP.

Interim Solution: Ethernet over Copper

In addition to delivering Ethernet over fiber (either point-to-point or PON), an MSAP can use its copper capabilities to offer Ethernet over copper. But since twisted pair copper has limited bandwidth (usually 1.5 Mbps), the MSAP must logically bond pairs together to offer higher bandwidth services. The standard for bonding copper pairs is ITU-T G.998.1, also called G.Bond, which allows for bonding together multiple pairs to a single customer to create a single larger logical Ethernet pipe. An MSAP with Ethernet capabilities can typically use G.Bond functions to offer Ethernet service of up to 10 Mbps by bonding two to four pairs together.

The use of existing copper pairs to deliver Ethernet services from an MSAP should greatly expand the customer base for Ethernet. By some estimates, only 10 to 15 percent of businesses have fiber access. Ethernet over copper makes it physically possible to deliver Ethernet to virtually every business, not just the ones that are able to support a fiber connection to an on-net POP or CO.

In addition to overcoming the physical challenges of a fiber connection, Ethernet over copper overcomes the marketing challenge of offering lower-speed data services. Ethernet services typically start at 10 Mbps, although some Metro Ethernet offerings like OPT-E-MAN go down to 5 Mbps. One reason for the lack of lower-speed service is that the costs of installing fiber can only be justified by the larger revenue stream generated by higher-speed services.

Many customers that are currently purchasing DS1 service at 1.5 Mbps are not ready to move all the way to 10 Mbps. By differentiating low-speed Ethernet-over-copper service from higher-speed Ethernet-over-fiber service, carriers may be able to offer speeds as low as 2 to 5 Mbps at price points that are competitive with DS1 service.

The reason is that carriers can deliver the lower-speed services without installation costs by using the existing copper plant.

	Metro Ethernet Router with fiber or SONET	MSAP with fiber	MSAP with PON	MSAP with Bonded Copper
Separate access equipment	No for on-net sites	Yes	Yes	Yes
Enterprises in target market	On-net	On- or Off- Net	On- or Off- Net	On- or Off- Net
Available data rate speeds	10 Mbps to 1 Gbps	10 Mbps to 1 Gbps	1 Mbps to 100 Mbps	1 Mbps to 10 Mbps
Aggregation to optimize high speed router ports	No	Yes	Yes	Yes
Hardened for Remote Access	No	Yes	Yes	Yes
Fiber installation cost	From POP or CO	From remote site	Part of PON build-out	None

Table 1. Relative costs for Metro Ethernet access alternatives.

Metro Ethernet Access Costs

Table 1 shows the relative costs for Metro Ethernet access alternative architectures. For large enterprises and high-speed services that are also on-net, the current access architecture of direct fiber or SONET connections clearly makes sense from both a service and cost perspective. To expand the target market, however, both in terms of geography (on-net or off-net) and in terms of service offering (including speeds below 10 Mbps), the carrier must use an alternative access strategy such as an MSAP. These differences in the applications make direct cost comparison difficult, so the table shows relative costs. And with an MSAP, the carrier must continue to support a Metro Ethernet router to provide the interface from the MSAP to the IP/MPLS core network.

One of the most compelling cost issues is the relative construction cost of reaching the enterprise.

With direct fiber, either from the Metro Ethernet router or an MSAP, the carrier must build a fiber connection to the customer. The MSAP can be placed remotely and therefore reduce the construction costs, but direct fiber is still run from the MSAP to the enterprise.

With PON, the fiber network is often already being built in order to upgrade the access network over a large area, so construction costs are shared among multiple customers. And for Ethernet over bonded copper, there are no construction costs because the carrier reuses the existing copper pairs.

By deploying MSAPs in their access networks, carriers can expand their Metro Ethernet service footprint and solve several challenges. A hardened MSAP supports Ethernet service from remote cabinet sites, bringing it within reach of more customers. The PON and G.Bond interfaces in an MSAP also expand the number of customers that can receive Ethernet services.

With its aggregation functions, an MSAP can reduce costs by ensuring that the GigE ports on core routers are fully optimized.

In short, the new access technologies offered over an MSAP will help carriers accelerate their Metro Ethernet offerings while optimizing capital and operational costs. **BBP**

About the Author

Don McCullough is Director of Product Marketing for Entrisphere, a MSAP vendor. He can be reached at 408-850-0389 or dmccullough@entrisphere.com.