DELIVERING TRUE CARRIER ETHERNET® BUSINESS SERVICES

Rapid increases in the breadth and sophistication of business applications are impacting enterprises' networking requirements and driving the adoption of next-generation packet-based Virtual Private Network (VPN) services. Ethernet, in particular, provides attractive benefits: simplicity, scalability, lower cost, and the ability to support multiple applications and services over a single network interface.

Today, business customers can rely on robust network-based Ethernet business services to deliver a full range of critical business applications, such as:

→ Secure, multi-site connectivity with traffic separation

→ Data Center Interconnect

→ Access to Layer 3 services (Internet access, IP VPNs)

→ Transport of advanced communications applications (voice, data and video)

→ Access to cloud services (server virtualization, Software as a Service (SaaS))

Enterprise customers are drawn to network-based Ethernet services as a means to control costs and ensure business processes can scale effectively, while maintaining control over critical IT functions. Users only pay for the bandwidth they require, and have the flexibility to introduce new applications and additional bandwidth rapidly—in very granular increments—when needed. A single, familiar Ethernet interface enables convergence of all services over a common network infrastructure, simplifying operations.

Layer 2 Ethernet VPN services, unlike IP VPNs, are compatible with non-IP traffic and typically are simpler to manage and less expensive to deploy. In addition, Ethernet services provide secure traffic separation and full service transparency, allowing the enterprise to maintain in-house control over routing information and security and encryption techniques.

Unlike the complexity of multiple overlay networks based on legacy technologies, Ethernet has ushered in a new era of "one network, multiple services". Ethernet gives service providers the ability to customize and differentiate service offerings with tiered classes of service, performance reporting, and SLA guarantees. In addition, Ethernet's bandwidth offerings—much more granular than in legacy TDM services—provide the flexibility and scalability end-users want.

Benefits

→ Provides standards-based and interoperable Ethernet business service solutions that deliver significant service differentiation and create competitive barriers

→ Enables high-velocity and automated service creation, activation, and management for faster time to market, revenue, and profitability

→ Integrates next-generation Carrier Ethernet QoS for predictable service delivery, OAM for service assurance, and resiliency for service protection

→ Features a common service-aware software architecture that delivers consistency across all Ethernet access and aggregation applications

However, not all Ethernet services are created equal. A number of business trends—including the maturation of virtualization and cloud-based applications—are impacting service provider networks and service consumption. Service providers must adapt quickly in an environment where demand for services is evolving continuously, network traffic distribution is changing constantly, and bandwidth is growing continually. Pure cost reduction, although very important, is no longer sufficient; the emphasis must shift to growing top-line revenue through the creation and deployment of new Ethernet business services with greater velocity, automation, and customization.

Ciena's Ethernet business service solutions enable the transition to service-driven networks—combining software intelligence and programmable devices to create low-touch, high-velocity networks. Only Ciena delivers True Carrier Ethernet, which offers a wide range of enhanced Ethernet capabilities and features above the minimum standards—defined by organizations such as the Metro Ethernet Forum (MEF)—that significantly accelerate and automate scalable Ethernet service creation and activation.

Ciena's Carrier Ethernet Service Delivery Solution

Ciena's True Carrier Ethernet services architecture and Carrier Ethernet Service Delivery (CESD) portfolio are depicted in Figures 1 and 2. This solution allows service providers to realize new levels of speed, differentiation, operational scalability, and reliability in delivering revenue-generating Ethernet business services.

The ActivEdge 3000 Series of Service Delivery Switches (SDS) is available with a range of 10/100 Ethernet, Gigabit Ethernet (GbE) and 10GbE physical port counts, to fit small, medium, and large customer sites and multi-tenant office buildings precisely, with placement in customer premises, on the sides of buildings, or on utility poles.

The ActivEdge 5000 Series of Service Aggregation Switches (SAS) provides multiple tiers of FE/GbE/10GbE aggregation to better fill the transport facilities within both the metro access and aggregation tiers and ultimately minimize the number of IP/MPLS router ports with which they interwork. These switches

MEF Carrier Ethernet Services Overview

The MEF pioneered the term Carrier Ethernet by classifying five significant technical attributes that distinguish it from the Local Area Network (LAN) Ethernet:

1. Standardized Services
2. Scalability
3. Reliability
4. Quality of Service (QoS)
5. Service Management

These attributes provide carrier-class capabilities to transform traditional LAN Ethernet into a technology suitable for deployment in service provider Metro and Wide Area Networks (MANs and WANs). Providers can use Carrier Ethernet-based business services to deliver these capabilities while minimizing the cost of delivery, compared with other technologies.

The MEF has defined three service types:

→ E-Line services provide a secure, point-to-point connection between two customer locations

→ E-LAN services enable an extension of a business LAN to multiple locations

→ The emerging E-Tree service type supports multicast services, such as business IP television (IPTV)

Each service type supports both port-based Ethernet Private (EP) services for delivering a single service terminated at a single port, and sub-port VLAN-based Ethernet Virtual Private (EVP) services for delivering multiple services simultaneously. This capability results in a choice of six fundamental MEF Ethernet business services to deliver the full range of business applications.

Service Type	Port-Based	VLAN-Based
E-Line (point-to-point)	Ethernet Private Line (EPL)	Ethernet Virtual Private Line (EVPL)
E-LAN (multipoint-to-multipoint)	Ethernet Private LAN (EP-LAN)	Ethernet Virtual Private LAN (EVP-LAN)
E-Tree (rooted multipoint)	Ethernet Private Tree (EP-Tree)	Ethernet Virtual Private Tree (EVP-Tree)

MEF Ethernet Services

With the breadth and flexibility of the six key Ethernet business service types, service providers have the means to customize a wide range of value-added Ethernet applications and services that can drive top-line growth and profitability.
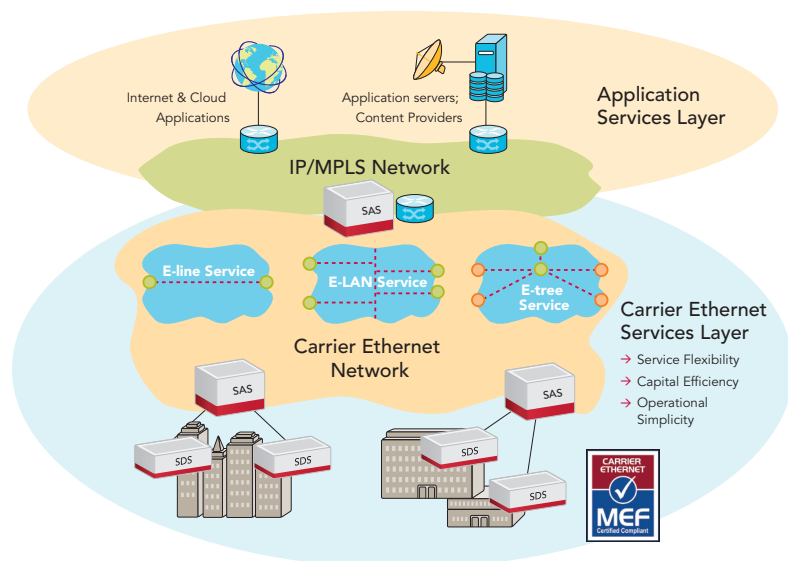
Figure 1. True Carrier Ethernet services architecture

This combination enables the service provider to deliver carrier-grade business services backed up by verifiable SLAs with rigorous performance and availability guarantees.

However, the CESD portfolio is much more than just a set of network devices. It is a unified portfolio that employs a common service-aware operating system and Ethernet Services Manager (ESM) system to provide exceptional operational efficiency and consistent system and service attributes across all Ethernet access and aggregation applications. The more services, customer types, and locations served with a common operating model, the greater the return on investment.

can be deployed in a wide variety of locations, including business parks, outside plant cabinets, and central offices.

The CESD portfolio incorporates the latest innovations in Ethernet switching technology, control plane protocols, encapsulation techniques, QoS capabilities, and Operations, Administration, and Maintenance (OAM) mechanisms.

With Ciena's CESD portfolio, service providers can optimize all aspects of the service lifecycle, accelerate time to revenue, and increase profitability. A common Service-Aware Operating System (SAOS) across all CESD platforms provides consistent service offerings and a common deployment and provisioning model across the network. This consistency drives operational efficiencies and cost savings by permitting rapid rollout of new services and the latest advances in Ethernet technology and standards.

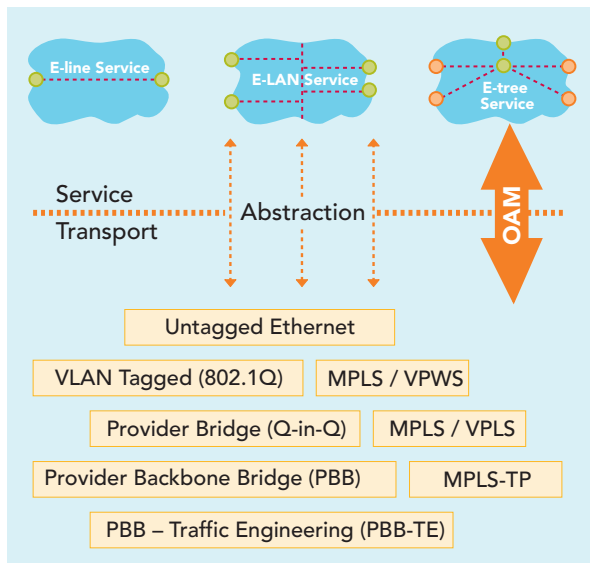| Model	Description	NNI/UNI Ports	UNI Ports	Total Gb/s	Form Factor	Temp Range
ActivEdge 3000 Series (Service Delivery Switches)						
3180	Multiservice Pseudowire Gateway (8T1/E1)	(2) 100M/GbE SFP	(8) 10/100M RJ45 (8) T1/E1	2	1RU	-40°C to +65°C
3181	Multiservice Pseudowire Gateway (16T1/E1)	(2) 100M/GbE SFP	(8) 10/100M RJ45 (16) T1/E1	2	1RU	-40°C to +65°C
3190	Multiservice Delivery and Aggregation	(40) 100M/GbE SFP (2+2) 10G SFP+	(16/32) STM-1/OC-3 (4/8/32) STM-4/OC-12	84	3RU	0°C to +50°C
3911	Weather-proof Ethernet Demarcation (10-port)	(2) 100M/GbE SFP	(8) 10/100/1000M RJ45	10	Outdoor	-40°C to +65°C
3916	Ethernet Demarcation (6-port)	(2) GbE SFP	(2) 100M/GbE SFP (2) 100MGbE SFP/RJ45	6	1RU ETSI ~280mm (w)	0°C to +50°C
3920	Ethernet Demarcation (12-port)	(4) 100M/GbE SFP	(8) 10/100/1000M RJ45	12	1RU ETSI	0°C to +50°C
LE-311v	Ethernet Service Delivery	(4) GbE SFP	(24) 10/100M RJ45	6.4	1RU	0°C to +50°C
3930	Extended-temp Ethernet Service Delivery	(2) GbE/10G SFP+	(4) 100M/GbE SFP (4)100M/GbE SFP/RJ45	28	1RU ETSI	-40°C to +65°C
3931	Weather-proof Ethernet Service Delivery	(2) GbE/10G SFP+	(4) 100M/GbE SFP (4)100M/GbE SFP/RJ45	28	Outdoor	-40°C to +65°C
3940	1st Tier Ethernet Aggregation	(4) 100M/GbE SFP/RJ45	(20) 100M/GbE SFP/RJ45	24	1RU	0°C to +50°C
3960	10G Ethernet Service Delivery	(2) 10G XFP	(2) 10G XFP (8) 100M/GbE SFP/RJ45	48	1RU	0°C to +50°C
ActivEdge 5000 Series (Service Aggregation Switches)						
5140	Extended-temp 1st Tier Aggregation	(4) 100M/GbE SFP/RJ45	(20) 100M/GbE SFP/RJ45	24	2RU ETSI	-40°C to +65°C
5150	Extended-temp Aggregation/MPLS Edge	(2) Dual 10G XFP Option Slots	(48) 100M/GbE SFP	88	2RU ETSI	-40°C to +65°C
5305	Ethernet Aggregation/MPLS Edge	(5) Slots-> (10) 10G or (120) GbE	NA	50	6RU	0°C to +40°C
5410	High-capacity Aggregation/MPLS Edge	(10) Slots-> (40) 10G or (480) GbE	NA	1000	22RU	0°C to +40°C

Figure 2. CESD platform summary

Figure 3. A common service portfolio for all markets

The Ciena Advantage: True Carrier Ethernet

While the CESD portfolio supports the complete catalog of MEF-compliant Carrier Ethernet service offerings, it goes above and beyond the minimum capabilities defined by the standards to provide True Carrier Ethernet—a design implementation that allows service providers to differentiate their service attributes for each of the five key MEF-defined Carrier Ethernet characteristics: Standardized Services, Scalability, Quality of Service, Reliability and Service Management.

Standardized Services, Scalability and Quality of Service

Ciena provides the greatest flexibility for building and deploying Ethernet networks by abstracting the services from the access or transport network technology and supporting all MEF services across any topology and different tunnel encapsulation formats, as shown in Figure 3. The service and transport layers are coupled through comprehensive, standards-based OAM capabilities to provide visibility, manageability, and controls.

With no constraints imposed by the transport network, a common service portfolio can be deployed for all markets and operators can optimize bandwidth, network paths, and reliability alternatives without sacrificing service selection or quality. In addition, all services can be provisioned on any port. In fact, one important differentiator of True Carrier Ethernet is that logically separate Ethernet Virtual Connections (EVCs) with different encapsulations can be on the same physical port.

The cornerstone of True Carrier Ethernet is Ciena's virtual switching architecture. Services are typically identified with tagging/labeling schemes which can be difficult to coordinate across larger topologies with many service instances. With Ciena's virtual switching architecture, the physical switch can be partitioned into logically partitioned switch resources, known as Virtual Switches, which create separate, secure address and switching domains within a single Ethernet service switch. Virtual switches provide:

→ Isolated domains for repeating MAC Addresses, VLANs, and MPLS labels

→ Simplified tagging architectures with improved security (reduced cross-talk)

→ Easier interworking between disparate encapsulation formats

→ Tremendous MAC scalability

Virtual switching expands the operator's ability to address customer connectivity and service needs while overcoming network and topology limits. In fact, Ciena's virtualized architecture scales to thousands of virtual switches to provide an exceptional level of service scalability. In addition, rich hierarchical classification and traffic management work in combination with the virtual switches to provide granular and measurable bandwidth control for predictable QoS.
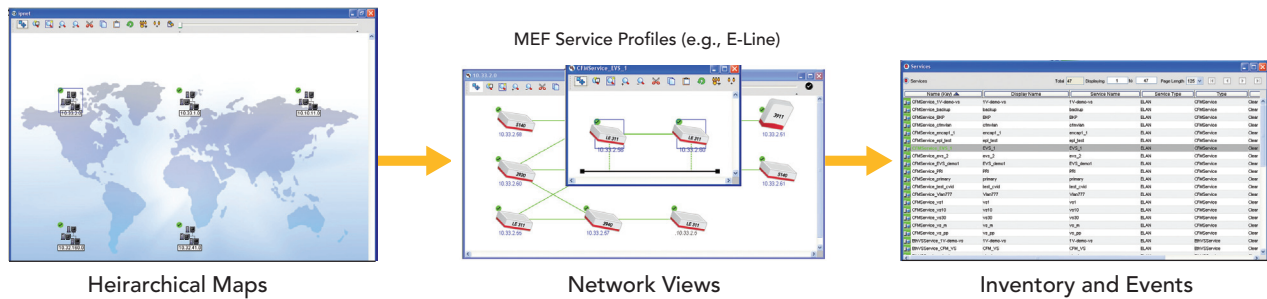
Superior QoS controls provide predictable service delivery and allow the creation of enforceable and reliable SLAs. With True Carrier Ethernet, granular traffic contracts can be applied to very richly defined services using a combination of Layer 1 through Layer 4 parameters to classify a service flow. Tight control is achieved by segmenting bandwidth (i.e. service category, customer, department or user, and application) using a hierarchy of virtual ports, with traffic profiles and traffic management applied at all levels in the hierarchy. Providers then can create unique service offerings, for broader customer appeal and higher revenues.

Reliability

Ciena's CESD portfolio provides Ethernet flexibility and transmission reliability with multiple resiliency options, including G.8032 Ethernet Ring Protection Switching and multi-tiered, dual-homed PBB-TE.
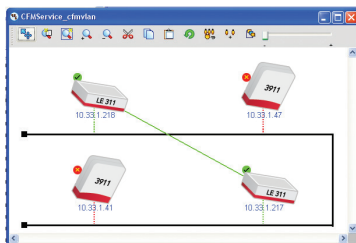
G.8032 provides deterministic 50 ms protection switching enabling operators to deliver carrier-grade Ethernet services and attain the resiliency capabilities of the legacy SONET infrastructure without the associated costs. Ciena's G.8032 solution enables operators to create 1GbE or 10GbE rings that are highly flexible and scalable, permitting the number of network elements on the ring to increase as needs grow and even include ring spans based on other service layer technologies and speeds.
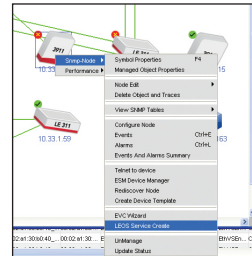
Service Visualization

MEF Service Profiles (e.g., E-Line)

Heirarchical Maps   Network Views   Inventory and Events
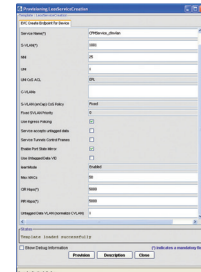
Service Provisioning

1) Select end-points   2) Run wizard

3) Choose service template
Complete menu options

Done !

Figure 4. Service visualization and provisioning

Ciena's proven PBB-TE solution applies a multi-tiered tunnel approach, with tiers of PBB-TE tunnels providing device and path protection such that operators can add, service, and upgrade sites without having to reconfigure all layers of network elements. This capability provides deterministic protection while simplifying the provisioning and ongoing maintenance effort.

Service Management
Ciena's industry-leading service management tools, including the ESM and comprehensive OAM capabilities, empower operators to deploy Carrier Ethernet networks quickly and easily, accelerate new service introduction and assure service quality and availability.

Ciena's ESM is an automated service activation, creation, and management platform that implements a groundbreaking service provisioning technique to dramatically accelerate service roll-outs. As shown in Figure 4, network operators can create service visualization screens providing hierarchical, network, service, and inventory/events views. Each view is instrumented to provide the necessary access and control for managing the network. Service provisioning has been simplified through the use of service templates and provisioning wizards. For example, an operator can select two endpoints for a point-to-point service and run the provisioning wizard to set service-specific fields, automatically creating the

service and configuring any intermediate elements. Service attributes, such as QoS parameters—committed information rate, excess information rate and burst parameters—can be configured and later changed automatically through the use of service templates defining those parameters.

Once services are deployed, operators require an effective OAM strategy to monitor the health and performance of the network and end-customer services. The approach to OAM can make or break the business case as ineffective implementations will drive up costs and leave customers dissatisfied with SLA performance. Ciena's portfolio delivers an extensive OAM feature suite to monitor the status of system and network links; measure the performance of customer Ethernet services; confirm link and service throughput and quality conform to SLAs; and distribute this management information across the network. OAM features available today include:

→ IEEE 802.1ag Connectivity Fault Management (CFM)

→ IEEE 802.3ah Ethernet in the First Mile (EFM)

→ IEEE 802.1AB Link Layer Discovery Protocol (LLDP)

→ ITU-T Y.1731 Performance Monitoring: Delay, Jitter, Loss

→ IETF RFC 5618 TWAMP Sender & Responder for L3 SLA Monitoring

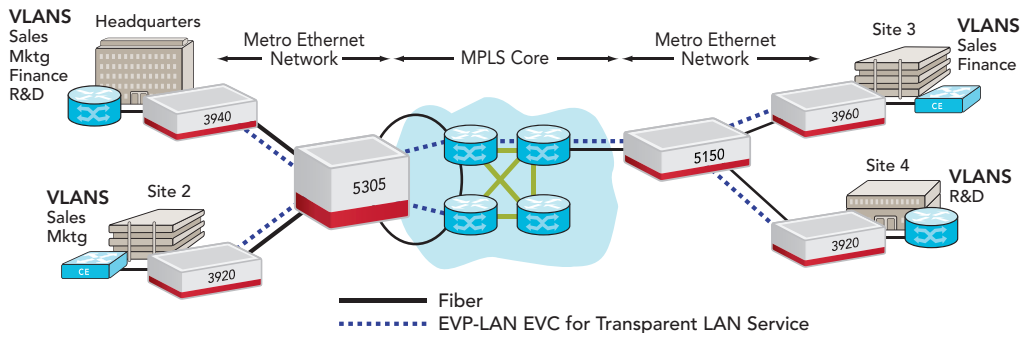→ IETF RFC 2544 Performance Benchmarking Test Generation and Reflection

Figure 5. L2VPN service

These OAM tools pave the way to increased competitiveness and customer satisfaction. For example, built-in RFC 2544 Performance Benchmarking capabilities empower the operator to be highly responsive to service disruptions. When service impacts are detected by ongoing PM tests (Y.1731 or TWAMP) or are reported by the end-customer, performance tests can be initiated immediately by the NOC—no technician scheduling is required, no trucks are rolled. Testing can occur at virtually no cost to isolate and localize the issue and then focus resources on addressing the specific root cause. The responsiveness means troubles are fixed faster, minimizing service impact and creating higher customer satisfaction.

Putting It All Together—A Service Example

Figure 5 shows an example in which a service provider—here referred to as "XYZ Communications"—delivers managed True Carrier Ethernet business services for an enterprise customer who wants to interconnect multiple sites over a single, reliable, and cost-effective network to provide guaranteed, scalable services that are compatible with their growing suite of IP and Ethernet applications.

In this example a multipoint-to-multipoint EVP-LAN EVC provides a L2VPN service connecting four enterprise sites, so that all sites appear to be on the same LAN and have access to shared resources such as servers.

Using customer-located ActivEdge 3000 Series service delivery, XYZ Communications provides VLAN tagging for traffic separation and differentiated classes of service for different applications and departments, with individual traffic prioritization per flow. Customer satisfaction and loyalty are ensured by providing strong SLA guarantees, based on the rich set of QoS and traffic management techniques, combined with sophisticated OAM diagnostic tools.

ActivEdge 5000 Series service aggregation switches cost-effectively interwork with XYZ Communications' existing

IP/MPLS core, providing efficient aggregation over a shared Metro Ethernet Network (MEN) and minimizing the number of expensive IP/MPLS router ports required. The aggregators provide VLAN to MPLS mapping and Ethernet traffic separation for service transparency, security, and scalability. With Ethernet providing the access and aggregation, this configuration is simpler and less expensive than a fully routed L3VPN, and allows the customer to maintain in-house control over routing tables and security and encryption techniques.

XYZ Communications takes advantage of the True Carrier Ethernet service management capabilities to achieve rapid automated service activation, simplify and scale their operations, and lower deployment costs for service activation, changes, and upgrades.

When each CESD switch is connected to the network, it automatically retrieves and loads its configuration file, improving the speed and accuracy of device turn-up and eliminating the need to deploy a highly trained installation technician. Once the device has been auto-configured, it is auto-discovered by the ESM and added to the existing network topology.

Using the ESM, XYZ Communications creates differentiated service templates based on the wealth of CESD traffic classification features and capabilities. To provision a new service, the operator launches a provisioning wizard and, with point-and-click simplicity, creates the desired EVC, applies the appropriate service templates, and activates the service.

As the customer's Ethernet service requirements evolve over time, upgrading the traffic contracts at each CESD switch is as simple as modifying the handful of service templates. Rather than a truck roll to each site or device-by-device remote configuration, the appropriate service template is modified and pushed out automatically to update all the devices with EVCs implementing that service. For example, when XYZ

Communications changed their "Silver" service from 40 to 50 Mb/s, every service configured to Silver was changed automatically, dramatically reducing the number of configuration and provisioning steps required and enabling a rapid, error-free service upgrade.

Realizing the Service-Driven Network

To stay ahead of the curve, service providers must automate the network, from customer edge to service provider core, and deliver high-performance business services with plug-and-play simplicity. The realization of these capabilities requires a new level of intelligence and functionality from the network: a service-driven network that provides the ability to rapidly respond to a multitude of customer requirements, deliver and guarantee a dynamic range of guaranteed network services, and add new features and capabilities as customer needs and bandwidth requirements change.

By developing a service-driven network, providers create the means to compete more effectively, delivering new Ethernet services with greater velocity while adapting to and capitalizing on the application innovation driving end-users' bandwidth usage and networking behavior.

Ciena enables service providers to create true service-driven networks optimized for top-line revenue growth. These are software-defined, fully-automated networks that can activate any service between any set of endpoints and adapt to end-users' changing needs. With True Carrier Ethernet advances delivering a wide range of capabilities and features that enhance the key Ethernet business service attributes, service providers can realize new levels of speed, agility, and performance in the deployment of revenue-generating services.

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Specialists in unlocking network potential to help you change the way you compete.