

A White Paper from Telco Systems

T-Marc 300 Network Edge for Carrier Ethernet



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Today's service-enabling, high-bandwidth networks demand provisioning, monitoring, fault isolation, trouble-shooting and remote management tools that have long been deemed crucial in traditional, business-class WAN transport services. While Carrier Ethernet is being increasingly used as the unifying delivery service, increased geographic reach is far more likely to depend on multiple carriers and technologies. Multiple streams of concurrent voice, video, data and wireless services are required to be delivered over different transport networks.

Though Carrier Ethernet is an excellent medium for service convergence and provides an effective foundation for optimizing total cost of ownership, effective management across the service delivery lifecycle can get unwieldy, if unchecked.

Telco Systems' T-Marc™ Ethernet Demarcation and Extension (EDE) products are intelligent and remotely managed, multi-port customer-premises equipment (CPE) that deliver managed converged services over virtual Ethernet, MPLS/VPLS and IP access networks. T-Marc allows service providers to deliver multiple services on separate customer interfaces, including multiple services over a single customer interface, thereby facilitating different business models.

Network Edge: Purpose-built Carrier Ethernet solutions

T-Marc is a purpose-built Ethernet demarcation system that maps into existing standards-based networks. Using multi-layer networking, flexible traffic management and engineering, and an embedded OAM, test and assurance framework, the T-Marc product line provides a secure, managed, high-performance solution QoS-enabled Ethernet service delivery.

Telco Systems' AccessNetworking™

Realizing the potential of Ethernet – its simplicity, flexibility and affordability – Telco Systems embarked on a mission to extend Ethernet with Carrier-enabling attributes. Using attributes such as transparent Operations, Administration and Maintenance (OAM) and remote system management, Telco Systems pioneered remotely managed carrier-grade Ethernet Access.

These solutions offer service providers the ability for proactive fault management by performing remote troubleshooting, loopbacks, statistics collection for performance management.

As networks evolve to provide converge service delivery over multiple transport technologies, they drive the need for highly-intelligent Ethernet demarcation and access systems. Not only do these systems need to run OAM for

service assurance by performing loopbacks, performance management statistics collection, and verify the remote health and status, but they are also required to be service-aware: manage customer traffic flows to enable different

business/franchise models, and operate in different markets.

Service delivery lifecycle management is a key element in reducing Total Cost of Ownership (TCO). All operation from initial circuit turn-up and provisioning, service administration and qualification, performance assurance and management, and application delivery must be consolidated in a managed offering. For example, once network elements have been provisioned as part of service creation, it is essential that such services be verified during service turn-up without a need for external test heads. Demarcation systems function as test elements during the service turn-up phase.

Once a service is validated, the corresponding demarcation system must change operational modes to provide managed, multi-service networking, along with integrated performance monitoring.

These key elements form the basis and provide a foundation for Telco Systems' T-Marc 3x0 EDE product family. Being purpose-built for demarcation and service extension –



including access and aggregation – T-Marc 3x0 provides the following features:

- Adaptation to multiple transport domains
- IEEE 802.1D (MAC Bridging), 802.1Q (VLAN Bridging), and 802.1ad (Provider Bridging)
- MPLS and MPLS-based Hierarchical Virtual Private LAN Service (H-VPLS)
- IEEE 802.1ad (Provider Backbone Bridging), PBT, 802.1Qay (Provider Backbone Bridging with Traffic Engineering)•Conformance to multi-layer OAM frameworks•IEEE 802.1ag for connectivity OAM
- ITU-T Y.1731 for added performance management
- MEF Services OAM for application-type monitoring
- Service management and interworking with service provider workflow paradigms

Telco Systems' innovative and state of the art EDE solutions embody a purpose-built framework which ensures revenue- assured delivery of managed converged services (voice, video, data and wireless) by providing:

- Adaptation over multiple transport domains for transparent deployment into existing networks.
- Extensibility to allow future transport options and protocol suites.
- Multi-layer OAM capability for managed and assured service delivery.
- Full service management for adaptation into service provider and OEM management use models.
- Workflow interfaces to flexibly map into service provider business operations.

T-Marc 300 AccessNetworking™ components

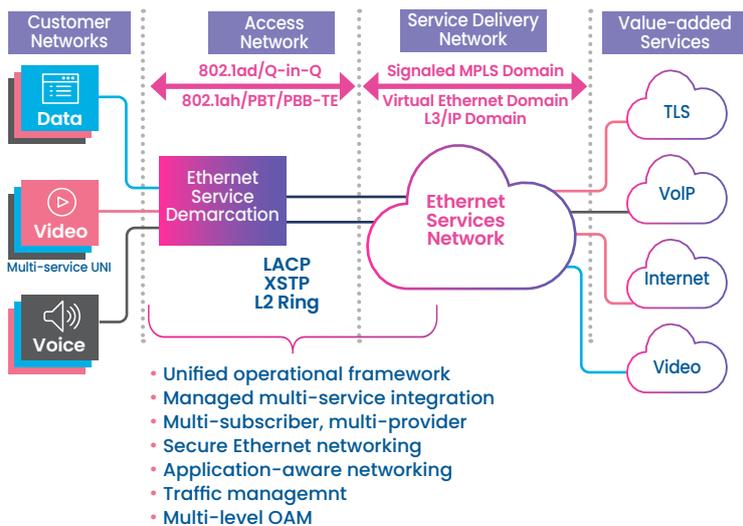
AccessNetworking comprises of a set of components – building blocks – that formulate purpose-built demarcation, access and service extension solutions for service providers. Standards, along with standards-friendly extensions, are customized for use in access networks, but allow full interoperability in multi-vendor networks. Corresponding extensions are leveraged to provide co-resident, value-added features that can be used within Telco-specific sub- domains.

Telco Systems' AccessNetworking includes, but is not limited to, the following:

- AccessEthernet™
- AccessMPLS™
- AccessIP™
- AccessManagement™

AccessEthernet™

The AccessEthernet™ network model is shown in the following diagram:



AccessEthernet provides total flexibility in deployment, provisioning, and delivery of Ethernet services based on advanced MEF-compliant and emerging IEEE-based 802.1Q/ah transport services. It provides the capability for physical and virtual networking, automates address management and discovery, ensures flexible bandwidth profiles and advanced traffic classes, and allows complete control over how customer traffic is transported across a service provider's network.

Residing at the edge of the carrier's network – between carrier's and customer's networks – T-Marc 3x0 use AccessEthernet to provide carrier-class service delivery of converged services. Multiple customers and/or multiple applications are aggregated onto redundant network interfaces, with each service (customer and/or application) being provided its unique service quality. Services can be terminated and hosted by one of more application service providers, allowing carriers complete flexibility on mapping offered services to different and evolving business models.

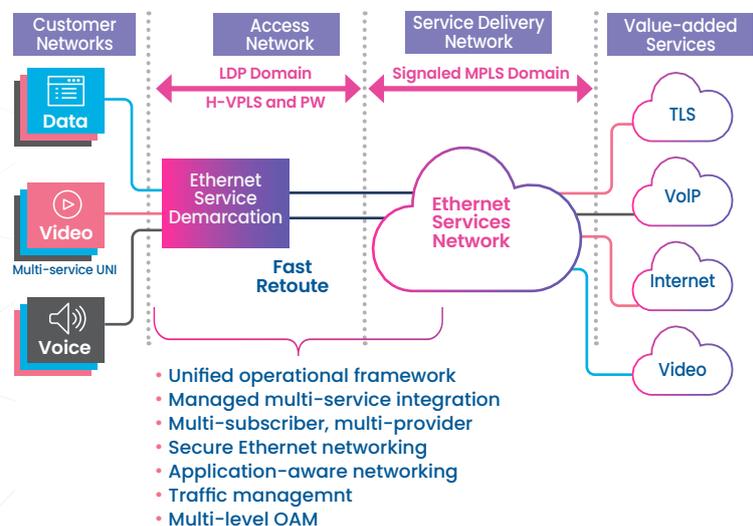
This framework also provides a flexible evolution and phased migration to delivering SONET-like, circuit-oriented Ethernet services based on PBT agreements, with an evolution to IEEE

802.1Qay, PBB-TE. Circuit-oriented point-to-point VLANs and VLAN cross-connect topologies can be used to provide interoperability and backward compatibility. Physical and

virtual networking capabilities are augmented with off-the-shelf provisioning systems for automated address management and discovery, flexible bandwidth profiles, advanced traffic classes, and complete control over how customer traffic is transported across a carrier's network.

AccessMPLS™

The AccessMPLS network model is shown in the following diagram:



AccessMPLS extends H-VPLS or T-MPLS domains to the customer premises for expanded, integrated multi-service networking. In cases where service providers want to extend the many benefits of H-VPLS and Pseudowires to customer premises equipment (CPE), AccessMPLS provides a purpose-built solution to map into existing MPLS-based networks in a transparent manner, while utilizing a common set of rich management, provisioning and OAM tools.

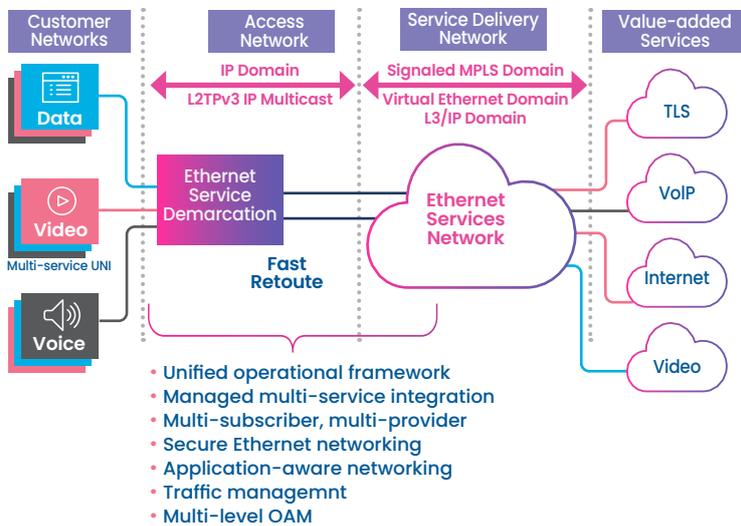
Residing at the edge of the carrier's network – between carrier's and customer's networks – T-Marc 3x0 use AccessMPLS to provide carrier-class service delivery of converged services. Multiple customers and/or multiple applications are aggregated onto redundant network interfaces, with each service (customer and/or application) being provided its unique service quality. Services can be terminated and hosted by one of more application service providers, allowing carriers complete flexibility on mapping offered services to different and evolving business models.

This framework also provides a flexible evolution and phased migration to delivering SONET-like, circuit-oriented Ethernet services based on T-MPLS agreements. Physical

and virtual networking capabilities are augmented with off-the-shelf provisioning systems for automated address management and discovery, flexible bandwidth profiles, advanced traffic classes, and complete control over how customer traffic is transported across a carrier's network.

AccessIP™

The AccessIP network model is shown in the following diagram:



AccessIP provides a managed provider-provisioned CPE, allowing service providers to administer "end-to-end" IP services. Similar to H-VPLS, an IP-based CPE provides an "abstract" access networking model, allowing service providers to leverage compelling networking, troubleshooting, and assurance services, independent of the underlying transport technology. This model is extremely important to carriers that prefer to provide managed IP services that allow customers to outsource their networking operations, and thereby focus on their core business.

Residing that the edge of the carrier's network – between carrier's and customer's networks – T-Marc 3x0 use

AccessIP to provide scalable, carrier-class service delivery of converged IP services. Multiple customers and/or multiple applications are aggregated onto redundant network interfaces, with

each service (customer and/or application) being provided its unique service quality. Services can be terminated and

hosted by one of more application service providers, allowing carriers complete flexibility on mapping offered services to different and evolving business models.

AccessManagement™

AccessManagement™ provides service delivery lifecycle management for reduced total cost of ownership (TCO). It provides the network management framework, whereby other Access Networking components are managed in a consistent and cohesive operation model.

Multiple access protocols are supported: SNMP, industry-standard command line interface (CLI), and connection-oriented transport such as Telnet and Secure Shell. In addition to SNMP-based managed objects,

AccessManagement also provides integrated support for XML/XSL-based interfaces and schemas to map into NETCONF-based management paradigms.

Using direct (IP-based) and proxy access models, AccessManagement provides consistent FCAPS management across transport, network and service layers. It serves as the foundation to map into carriers' operational procedures to facilitate initial circuit turn-up and provisioning, service administration and qualification, performance assurance and management, and application delivery.



Summary

Networking frameworks, rich protocol suites and managed solutions are key enablers that allow vendor solutions to address carrier requirements. However, it is extremely critical that vendor solutions transparently map into carrier networks, adapt as those networks evolve, and flexibly interface into existing process workflow and business operations.

Telco Systems believes that any compelling networking solution must be capable of mapping into existing carrier workflow processes and business operations. Using a policy-enabled networking framework, T-Marc 3x0 and other Telco Systems' products provide such a capability by:

- Adapting to multiple transport domains for transparent deployment into existing networks.
- Being extensible to allow future transport options and protocol suites.
- Supporting multi-layer OAM capability for managed and assured service delivery.
- Providing full service management for adaptation into service provider and OEM management use models.

Telco Systems' Carrier service-enabling AccessNetworking framework provides a sound foundation to allow service providers to not only address all of the abovementioned, but to also cope with business, regulatory, and political issues. Using a flexible set of building blocks, Access Networking extends the Telco Systems solution set

across networking (physical and logical), administrative (business and operations), and exogenous (competitors and politics) boundaries. Individual AccessNetworking components are purpose-built to not only address specific areas, but to also interoperate to provide an extensible solution set.

By addressing functional, operational, and usage requirements, Telco Systems offerings provide the most:

- feature-rich demarcation, access and service extension solutions by automatically customizing features by discovering usage models;
- interoperable solution set by deploying not only standards, but using key options and friendly innovations;
- flexible set of solution by driving a minimal set of targeted standards activities.
- adaptable solution features by focusing on software differentiators and forging unique relationships with silicon and component vendors;
- future-proofed system solution by anticipating future trends and advance planning.
- systems integrator-friendly solution offering by forging strong OEM relations;
- forward-looking carrier service-enabling vendor by providing solutions that transcend networking, administrative, competitive, regulatory and geo-political boundaries.

ABOUT TELCO SYSTEMS

Telco Systems delivers a portfolio of Network Edge (Carrier Ethernet and MPLS) demarcation, aggregation, and uCPE solutions that enables service providers to create intelligent, service-assured, CE 2.0-compliant networks for mobile backhaul, business services, and cloud networking. Telco Systems end-to-end Ethernet, SDN/NFV-ready product portfolio delivers significant advantages to service providers, utilities, and city carriers competing in a rapidly evolving telecommunications market. Telco Systems is a wholly owned subsidiary of BATM Advanced Communications.

To learn more, visit Telco Systems at <http://www.telco.com>