

Operational Core Network Using Carrier-Grade Ethernet

Typical users: Transmission & Distribution Power Utilities

For more than 30 years, RAD has worked closely with its worldwide energy utility customers to provide field-proven communications solutions that address the automation, Teleprotection and operational core network needs of their transmission and distribution (T&D) grids.

Service Assured Networking: RAD offers secure, reliable, scalable, managed, and performance guaranteed solutions for automation, protection, security, and ICT networking

that support multiple deployment scenarios over SDH/SONET and carrier-grade Ethernet networks. A vast array of capabilities include service provisioning, traffic management, timing synchronization, TDM pseudowire, ongoing performance monitoring, fault management, and various resiliency mechanisms.



Which Networking Technology Is the Best?

Why Carrier Ethernet Can Replace SDH/SONET

With the shift from SONET/SDH to packet in equipment interfaces and substation services, RAD is again at the forefront of assisting power utilities to rapidly adapt to the changing landscape of requirements. Today, RAD is

applying its carrier-grade expertise in the field of Service Assured Networking and Carrier Ethernet to provide the most affordable, reliable and – most importantly – secure alternative to traditional SDH/SONET networks.

Service Requirements	Carrier Ethernet	SDH/SONET	Carrier Ethernet Attributes
Multiservice	+	+	Pseudowire, traffic management, OAM, deployed worldwide
Synchronization and Timing	+	+ (-)	SyncE, 1588V2, IEC C37.238, SDH only frequency
Critical Services	+	+	5-10 times lower latency than SDH/SONET
Resiliency	+	+	Sub 50ms: G.8032, G.8031, LAG, PWE redundancy, HSR, hardware redundancy
Deterministic Paths	+	+	E-line, E-LAN tunnel
Traffic Management	+	+	Hierarchical scheduling, end-to-end CIR for TDM
OAM	+	+	Y.1731, IEEE 802.1ag
End-to-End Management	+	+	End-to-end NMS and service management
Cyber Security	+	+	802.1X, MacSec, SNMPV3, app level: IPSec

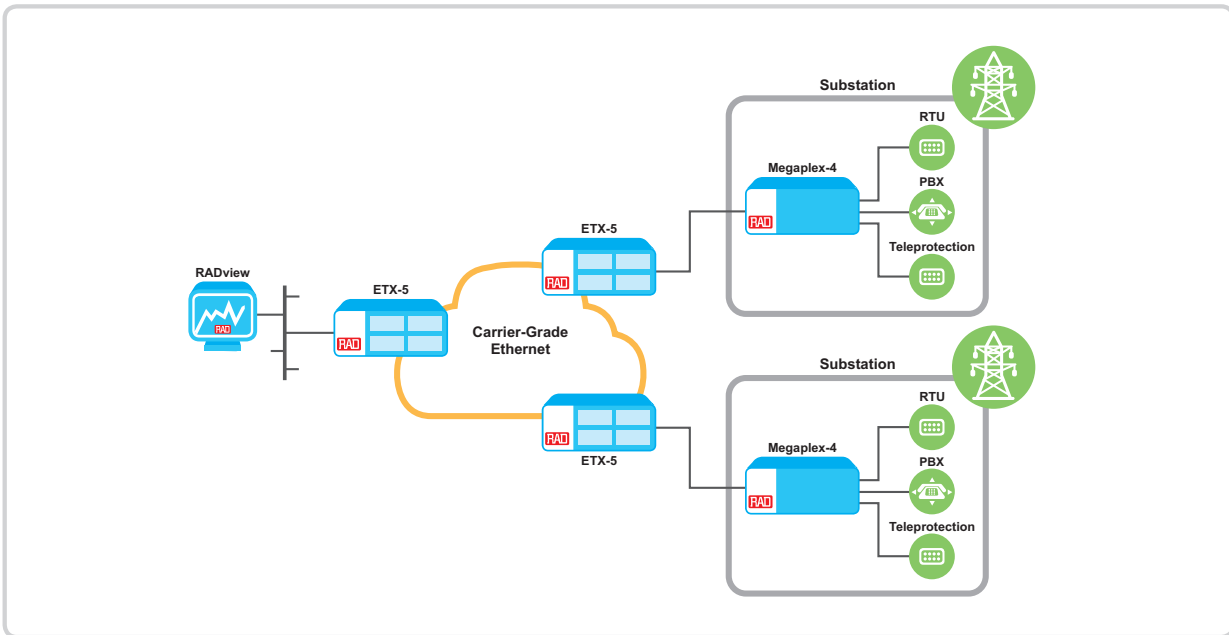


Carrier Ethernet Compared with MPLS and MPLS-TP

Which packet switched network technology is the best fit for power utilities communications networks? RAD has selected Carrier Ethernet as the most suitable technology to replace the trusted SDH/SONET network. The reasons why are outlined in the table below:

	Carrier Ethernet	IP/MPLS	MPLS-TP
Simplicity	Simple – Similar in architecture to SDH/SONET	Complex – Requires an IP overlay and architecture	Complex – Requires an IP overlay and architecture
Resiliency	High Resiliency – Mesh and Ring	High Resiliency – Mesh and Ring	High Resiliency – Mesh and Ring
Security	Secure – Resistant to control plane attacks and has robust support for source authentication	Low Security – Many vulnerabilities exist. See RFC 5920 for complete list	Low Security – Vulnerable to data plane attack, snooping and scouting
Cost	Inexpensive	Higher cost per bit	Higher cost per bit
Circuit Set-up	Static – Requires NMS support for provisioning network services	Dynamic – Able to self-configure services on the fly	Static – Requires NMS support for provisioning network services
Field-proven	High – Many networks deployed and commonly supported by many vendors	High – Many networks deployed and commonly supported by many vendors	Unknown – Vendors only starting to support and deploy

Operational Core Network Using Carrier-Grade Ethernet



Carrier-grade Ethernet is ideal for replacing SDH/SONET for operational applications, offering various advantages:

- Simplified architecture and management
- Increased security
- Lower latency
- Assured QoS using Carrier Ethernet tools
- Ongoing performance monitoring
- TDM support using Pseudowire



RADview
Carrier-Class Network
Management System

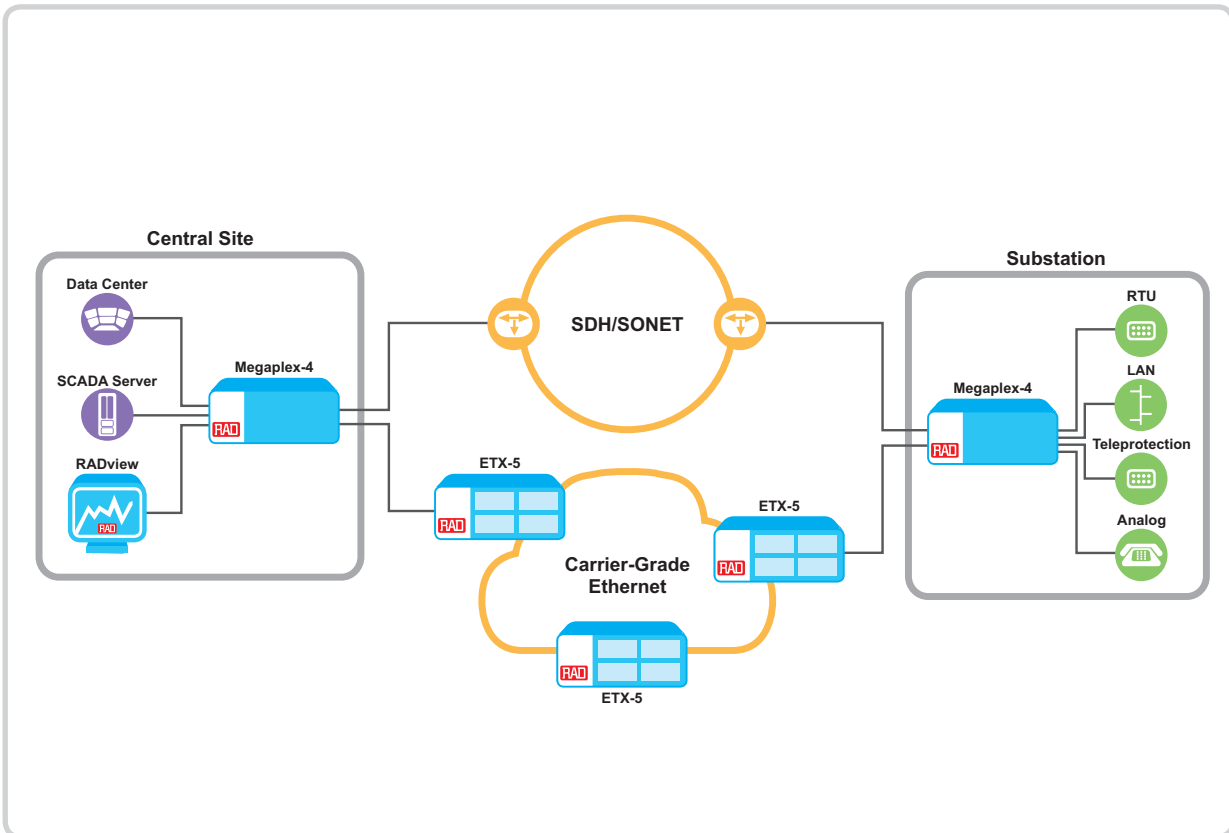


Megaplex-4
Hybrid Cross-Generation
Multiservice Multiplexer



ETX-5
Ethernet Service
Aggregation Platform

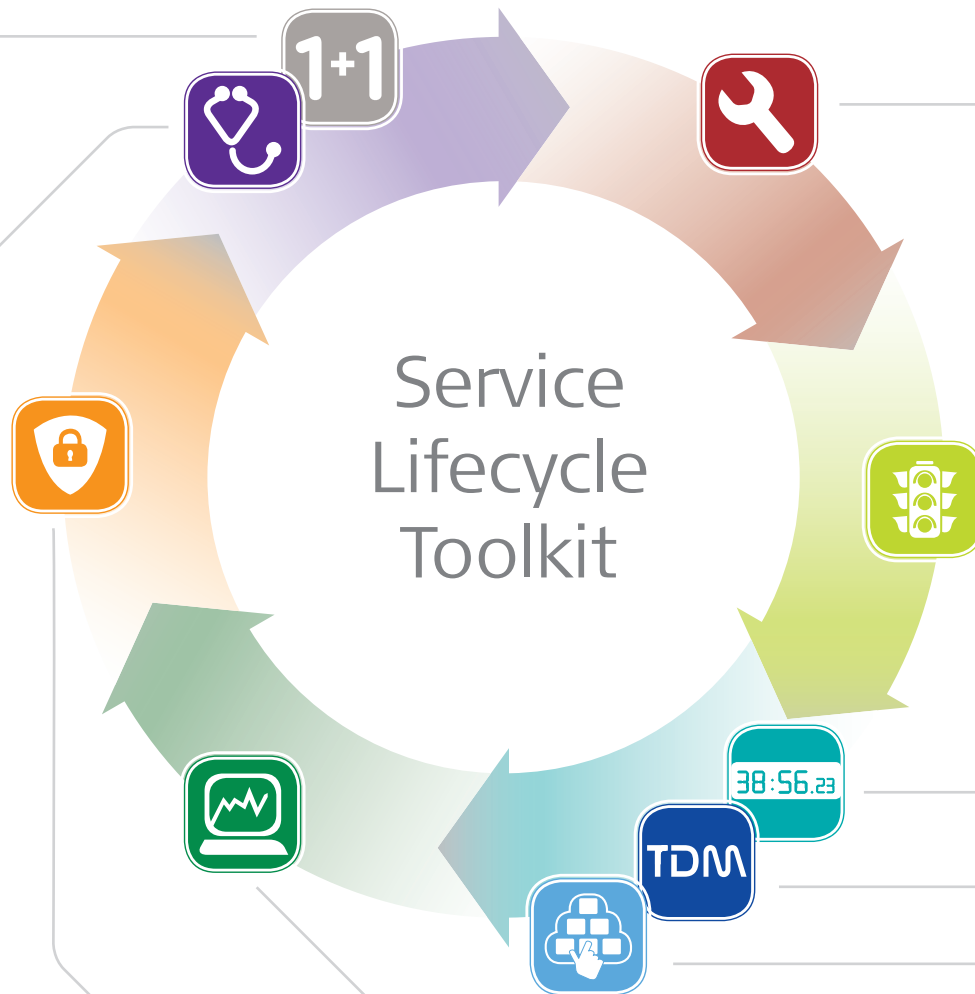
Hybrid Solution with Traffic Duplication



Traffic Duplication is a unique technology developed by RAD as part of its Service Assured Networking solution, to allow networks with mission critical applications to enhance reliability and performance. It can be used to minimize delay on critical utility applications (such as Teleprotection) by capitalizing on Carrier Ethernet's reduced latency at higher speeds. Mission-critical traffic can be transported over a new Carrier Ethernet network that's running in parallel to the existing SDH/SONET, preparing for full service migration later on. RAD's Traffic

Duplication yields proven gains on network resiliency by employing a redundant transport method. In addition, it does so with a minimal investment by using any existing PSN network. Finally, because of the physics of the packet network technology, this feature can be leveraged to actually provide shorter network delay and improve critical application performance such as Teleprotection. These technological and cost reduction benefits are available only with RAD's Service Assured Networking solution.

Service Assured Networking Throughout the Service Lifecycle



Resiliency

- Link aggregation group (LAG) using IEEE 802.3-2005 LACP (link aggregation control protocol)
- Ethernet Ring Protection Switching (G.8032 ERPS)
- EVC protection (G.8031)
- Traffic Duplication
- IEC 61850-3 and IEEE 1613 compliant

Fault Management

- Automated fault detection & isolation
- Fast detection (3.3 ms) of LOC
- EVC alarm propagation (AIS & RDI)
- HW-based fault management, OAM (CC, LB, LT)
- Wire-speed loopback testing (L2/L3)

Security

- 802.1X, MACsec
- SNMPv3
- SCADA Firewall
- IPSec

Ongoing Performance Monitoring

- Scalable long-term KPI collection engine
- One-way delay measurements
- PM dashboard (SLA policies, correlation, violation alerts)
- End-customer PM portal & SLA reports
- PM as a Service

Service Turn-Up

- Automatic installation
- Zero-touch configuration
- Auto-inventory discovery
- One-touch service validation
- On-demand remote modification

Traffic Management

- Classification
- CIR + EIR traffic policing per flow (CoS)
- Hierarchical scheduling, shaping
- Congestion avoidance mechanism

Timing

- Synchronous Ethernet
- Built-in GPS
- IEEE 1588v2 TC & slave for frequency & phase
- Distributed IEEE 1588v2 Grandmaster
- Hybrid Sync-E & 1588 ToD

TDM

- CESoPSN
- SAToP
- CESoETH (MEF-8)
- UDP/IP encapsulation
- PDH and SDH/SONET

Distributed NFV

- Rapid deployment/upgrade of network functionality
- Relocate functionality to CPE for more effective performance, reduced expenses
- Combine layer 2/3 demarcation with standard virtual machine (VM) platform

Service Assured Networking comprises the following attributes:

- Advanced H-QoS
- Compliance with environmental standards
- Ethernet & legacy services
- Low latency
- Performance monitoring
- Reliability & protection
- Same service look & feel over any access
- Security for SCADA applications
- Service visibility, end-to-end
- Synchronization over packet
- TDM pseudowire
- Traffic Duplication



Service Management System

- Point-and-click provisioning
- Security access profiles, network partitioning
- GUI: Network clouds, links, nodes, end-to-end services, status indication
- Multi-platform Java for Windows, UNIX
- Northbound TMF MTOSI interface to NMS/OSS

Ethernet Performance Monitoring Portal

- Collects, stores and presents KPIs from RAD devices
- Actual performance metrics based on ITU-T Y.1731:
 - Frame delay (latency)
 - Packet delivery ratio
 - Frame delay variation (jitter)
 - Availability
- Threshold policy management
- Performance dashboard with aggregated and drill-down views
- Instant and scheduled report generation
- Immediate detection of service degradation

Additional RAD Service Assured Networking Solutions for Power Utilities

