

Service Assured Solutions

2018 Catalog



Your Network's Edge®



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RAD Catalog 2018

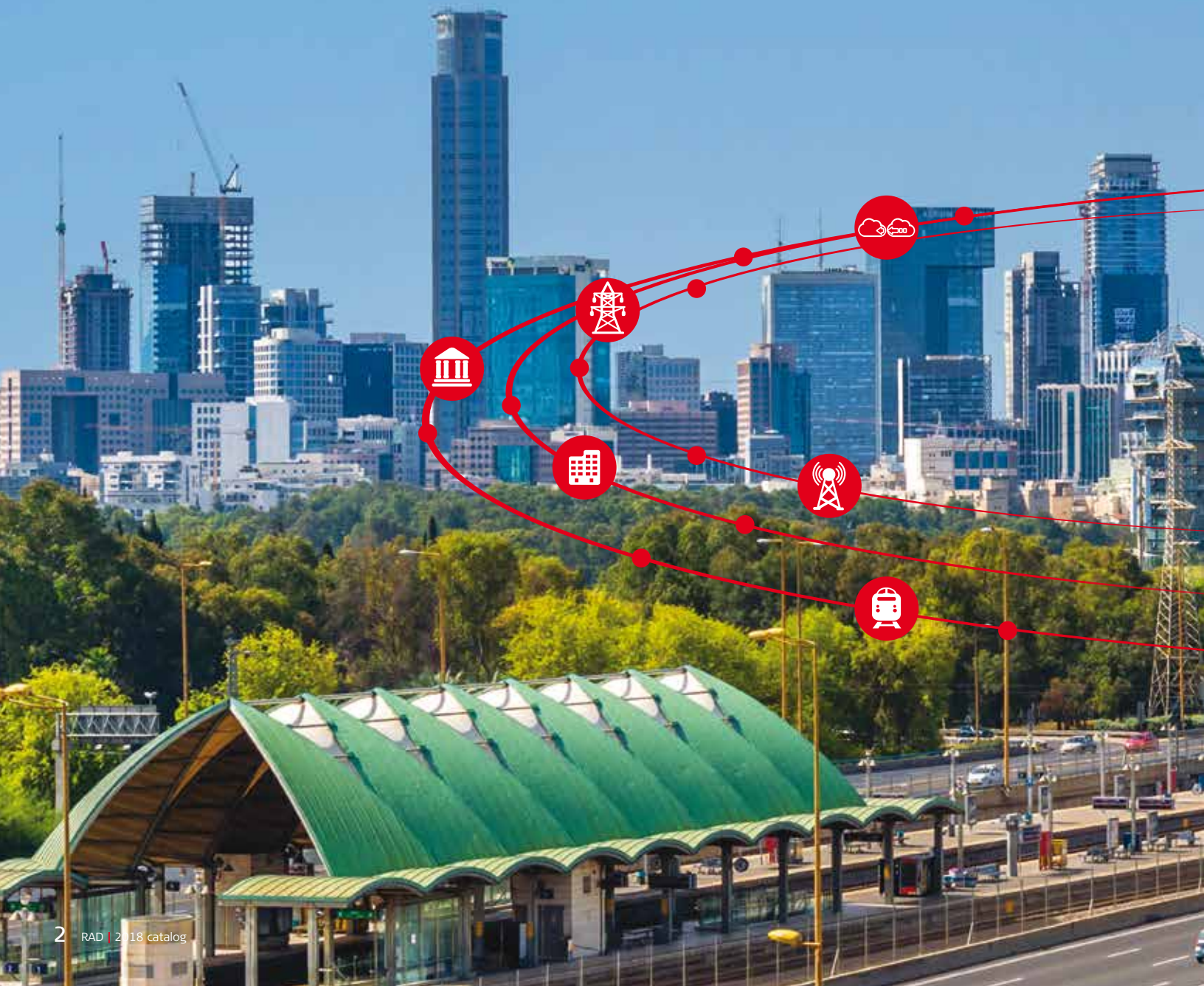
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Evolving Your Network's Edge? Get the Best of All Worlds!

RAD is a global Telecom Access solutions and products vendor. Our customers are top-tier service providers, power utilities, mass transportation systems, and government agencies.

We are at the forefront of pioneering technologies, such as:

- Complete vCPE toolbox for SDN/NFV and network edge virtualization
- Performance monitoring for any network
- Timing synchronization over packet
- Hardware miniaturization
- TDM over packet



Service Providers

Get SDN/NFV access and keep existing network operations and service assurance.

For mobile, business and wholesale service providers, we provide an economical migration path to network edge virtualization.

In addition, our **Service Assured Access** solutions are designed to deliver a competitive edge with complete visibility of network and service performance for greater operational efficiency, as well as timing synchronization for LTE/LTE-A and future 5G deployments.

Critical Infrastructure

Get seamless migration to cyber secure packet networks and keep existing service assurance and reliability.

For power utilities, mass transportation companies and government agencies, our **Service Assured Networking** solutions include best-of-breed tools for cyber-secure critical infrastructure communications.

With over 37 years of innovation, a significant worldwide presence in over 150 countries and an installed base of more than 15 million network elements, RAD has a proven track record of delivering value and addressing our customers' needs.

RAD is a member of the \$1.3 billion RAD Group of companies, a world leader in telecommunications solutions.





Leading the Network Edge Virtualization



Virtualization
by RAD



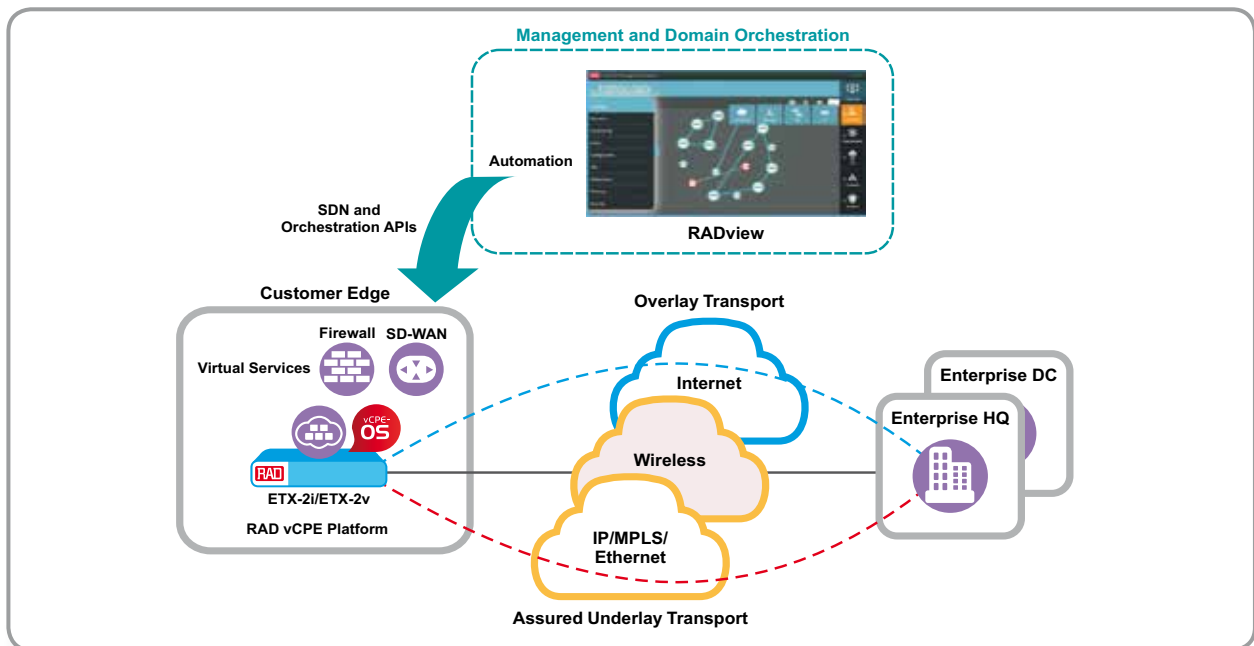
Virtualization

RAD, the industry pioneer of network edge virtualization, provides a flexible vCPE toolbox for the customer edge and a complete solution to fit diverse performance, cost and security needs:

- Powerful, carrier-grade vCPE-OS operating system for third-party and RAD platforms
- Carrier Ethernet NIDs and IP routers with pluggable x86 server modules
- Enhanced white box platforms
- Pluggable physical network functions (P-PNFs) adding connectivity, acceleration and SLA assurance capabilities to any server
- RADview management and domain orchestration
- Virtualized network functions (VNFs), including the vAccess for control and management of RAD's pluggable devices
- D-NFV Alliance: pre-tested VNFs and apps

Comprehensive vCPE Toolbox

The most diverse portfolio in the market to meet specific service provider needs:



Service Assured vCPE – 5 Main Values



1

Any Access

Seamless management of RAD's pluggable PNFs for Carrier Ethernet, cellular, xDSL, PON and TDM

2

Optimized vCPE

Slim and high performance operating system

3

High Availability

WAN, NFVI and VNF performance monitoring, troubleshooting and self-healing

4

Open

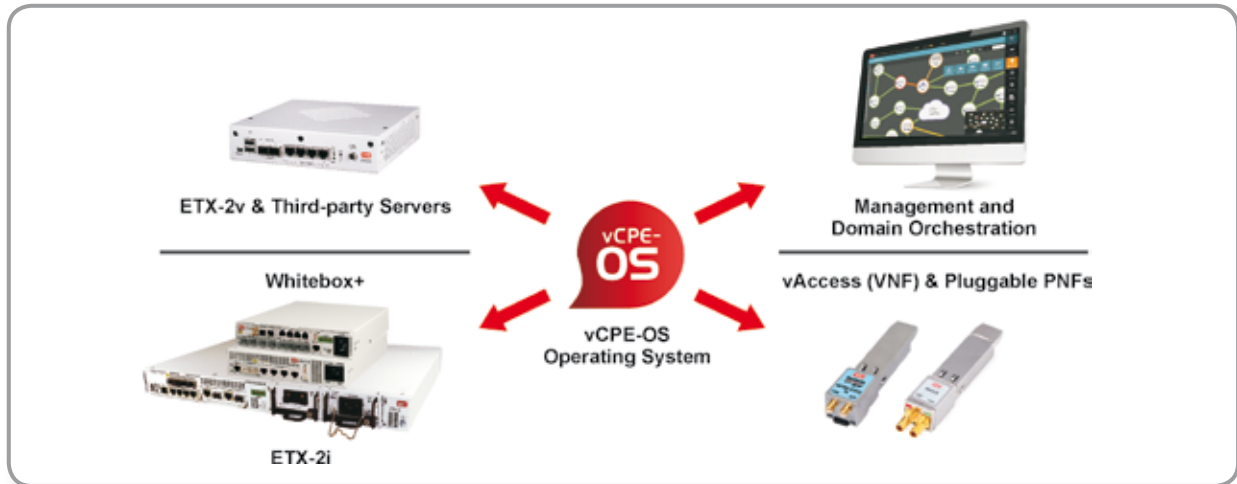
- Any VNF – networking, security and IT
- Any orchestrator and SDN controller
- Rapid evolution based on open source industry components

5

Any Hardware

- RAD's white box and third-party servers
- RAD's gray box supporting Carrier Ethernet and IP routers
- RAD's pluggable PNFs for access monitoring and timing

Powerful, Carrier-Grade vCPE Toolbox



D-NFV Alliance

RAD's Distributed NFV (D-NFV) Alliance is an ecosystem of application developers and virtual function vendors addressing the enterprise market, as well as orchestrator vendors offering network-wide, managed end-to-end solutions, from the cloud to the customer premises. Once tested and approved by RAD, these applications are made available to service providers around the globe via RAD's vCPE platforms, to enhance their service offering for enterprise and SMB customers. D-NFV Alliance applications include:

Security

- Firewall
- Web filtering
- Intrusion prevention system
- Anti-virus
- Encryption

Networking

- WAN optimization
- Router
- Application awareness
- WiFi controller
- SD-WAN

Unified Communications

- IP-PBX
- VoIP GW
- Fax
- Video
- SBC

Testing Tools

- Traffic analyzers
- Troubleshooting applications
- Network monitoring

IT

- Enterprise IT
- Business intelligence
- CRM
- Lawful interception
- Point of sale

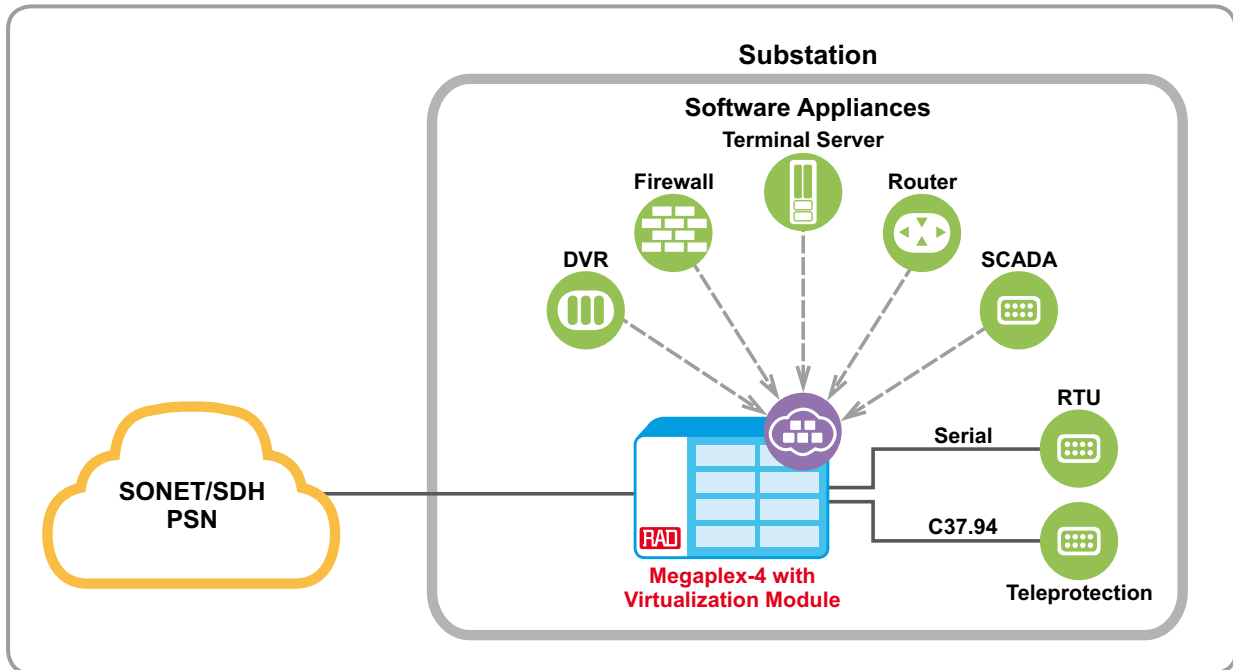
Performance Monitoring

- TWAMP
- Application performance
- Packet collection
- Accounting
- Policy enforcement

Software Appliances for Critical Infrastructure Communications



Virtualization



- Reduces the number of physical network devices for better reliability and simpler operation, with software appliances running on an x86 D-NFV module integrated within RAD's Megaplex-4
- Integrates higher-level applications (routing, firewall, encryption, SCADA, and more) with communications platform in a single device
- Future-ready and flexible solution to meet new application needs
- Terminal server allows transmission of any serial protocol over IP
- Supports tailor-made as well as third-party applications, tested and certified by RAD
- Small footprint

Multiservice Access Node with Virtualization Module



Megaplex-4

D-NFV Orchestrator



RADview



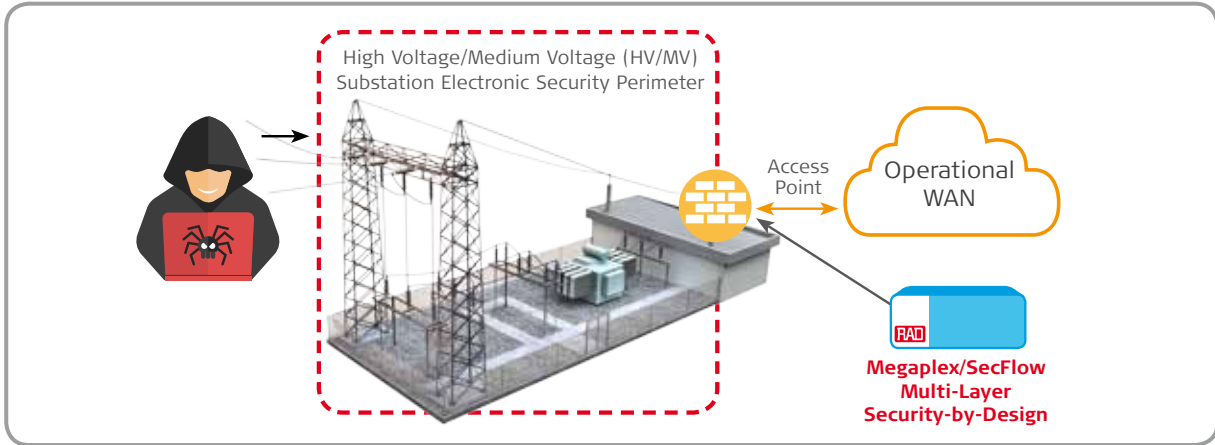
Cyber Security for Critical Infrastructure



Boosting NERC-CIP Compliance

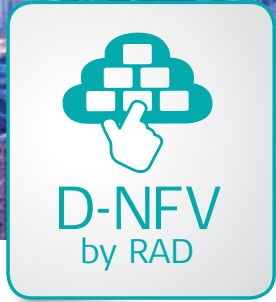
RAD's SAN solutions are in line with recent North American Electric Reliability Corporation Critical Infrastructure Protection (NERC-CIP) directives to boost your cyber security and compliance levels:

- Encryption and integrity for all communications outside ESP
- Application-aware (SCADA-aware) firewall
- Record/monitor all device connections in substations



- Cyber Security solution protects from attacks on SCADA and management traffic
- Strategically located to securely manage all electronic access to the substation's ESP, and to protect the cyber assets within it from external and internal attacks:
 - Device connection control (DCC) using IEEE 802.1x Network Access Control to ensure authenticated and authorized internal substation connections
 - SCADA-aware security layer, including firewall, intrusion prevention, anomaly detection, and more
 - IEEE 802.1AE (MACsec) and IPsec encryption and data integrity verification to prevent source-spoofing, session hijacking, man-in-the-middle and distributed denial of service (DDoS) attacks
- Boost compliance level with NERC-CIP requirements for bulk electric systems (BES) protection
- Layered security approach addresses all vulnerability points including integrity, confidentiality (encryption), authentication, authorization, and auditing
- Access control, user authentication and privilege-level associations for local and remote access using Secure Shell (SSH), TACACS or RADIUS





RAD's vCPE with Versa vSD-WAN

RAD's vCPE Toolbox includes Versa Networks' vSD-WAN virtualized network function (VNF), allowing service providers to expand their managed services portfolio with SD-WAN-based business services:

- Multi-tenant VNF to apply cloud principles to WAN connections
- Optimized vCPE using a slim, high performance operating system
- Any access: Carrier Ethernet, cellular, xDSL, PON and TDM
- High Availability: performance monitoring, troubleshooting and self-healing
- Open solution, compatible with any orchestrator and SDN controller
- Any hardware: RAD's white box and gray box platforms, third-party servers, and RAD's pluggable PNFs

Visit www.rad.com for more information



Your Network's Edge®

A graphic design for a catalog page. The background is a dark gray. A series of red curved lines and dots form a path across the upper half of the page. Along this path are several white icons inside red circles: a power line tower, a cloud with a double-headed arrow, a building, a train, a classical building with columns, and a radio tower. The text "RAD Solutions" is centered in the upper half in a white, sans-serif font.

RAD Solutions

Service Assured Access Solutions for Service Providers

Get SDN/NFV access and keep existing network operations and service assurance.

RAD offers communications service providers (CSPs), who are facing exponential growth in data rate requirements and increasing competition from web giants and OTT providers, a wide range of Service Assured Access (SAA) solutions. RAD's SAA solutions are designed to improve the way CSPs compete, with better service agility and lower TCO. They harness RAD's state-of-the-art innovation, including the flexible vCPE Toolbox for business services, performance monitoring for any network, and cost-effective timing synchronization for mobile networks.

Key SAA solutions include:

- vCPE functionality for faster service rollouts and easier operations, including edge domain orchestration and alliance of VNF and orchestration vendors
- Powerful performance monitoring add-on for any network
- TDM and PSN services and migration
- SLA-assured service life-cycle management
- Timing distribution for LTE/LTE-A, 5G networks

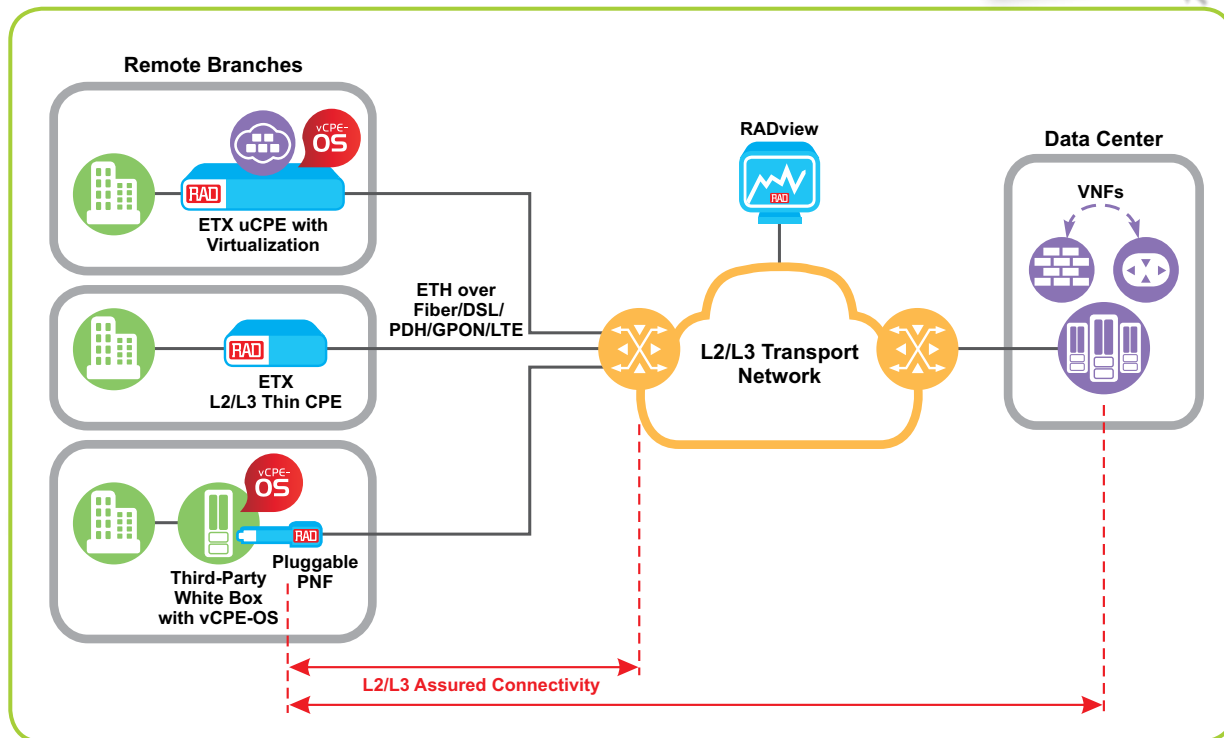
RAD provides the most comprehensive service life-cycle toolkit to easily plan, provision and orchestrate MEF-certified Carrier Ethernet 2.0 and IP services over any access. In addition, we facilitate a smooth, low-risk transition to NFV/SDN-based programmable networks.

Service providers around the world rely on RAD's Service Assured Access solutions to automate their services, boost quality of experience (QoE) and maximize revenues.





vCPE



Your Benefits:

- Scalable solution allows operators to spin-up virtual managed services, from security to routing, SD-WAN to IT services, and much more
- Cost-optimized white box vCPE for business services
- Open, high performance operating system (vCPE-OS) runs on any white box and supports any access with PM, troubleshooting and self-healing
- Pluggable physical network functions (P-PNFs) allow assured seamless connectivity over Ethernet fiber/copper, WiFi, xDSL/PDH/GPON, as well as LTE (uplink/backup)
- Integrated and optimized compute resources enable remote deployment of network functions and value-added services; VNF download and service-chain configuration are performed with a powerful and intuitive edge orchestrator
- CPU hardware offload, together with forwarding plane acceleration, allows consistent and predictable wire-speed performance with built-in service assurance, freeing up CPU resources for additional services

Products Included in this Solution:



ETX-2i, ETX-2v
vCPE Platform



MiNID
Miniature Programmable
Network Interface Device



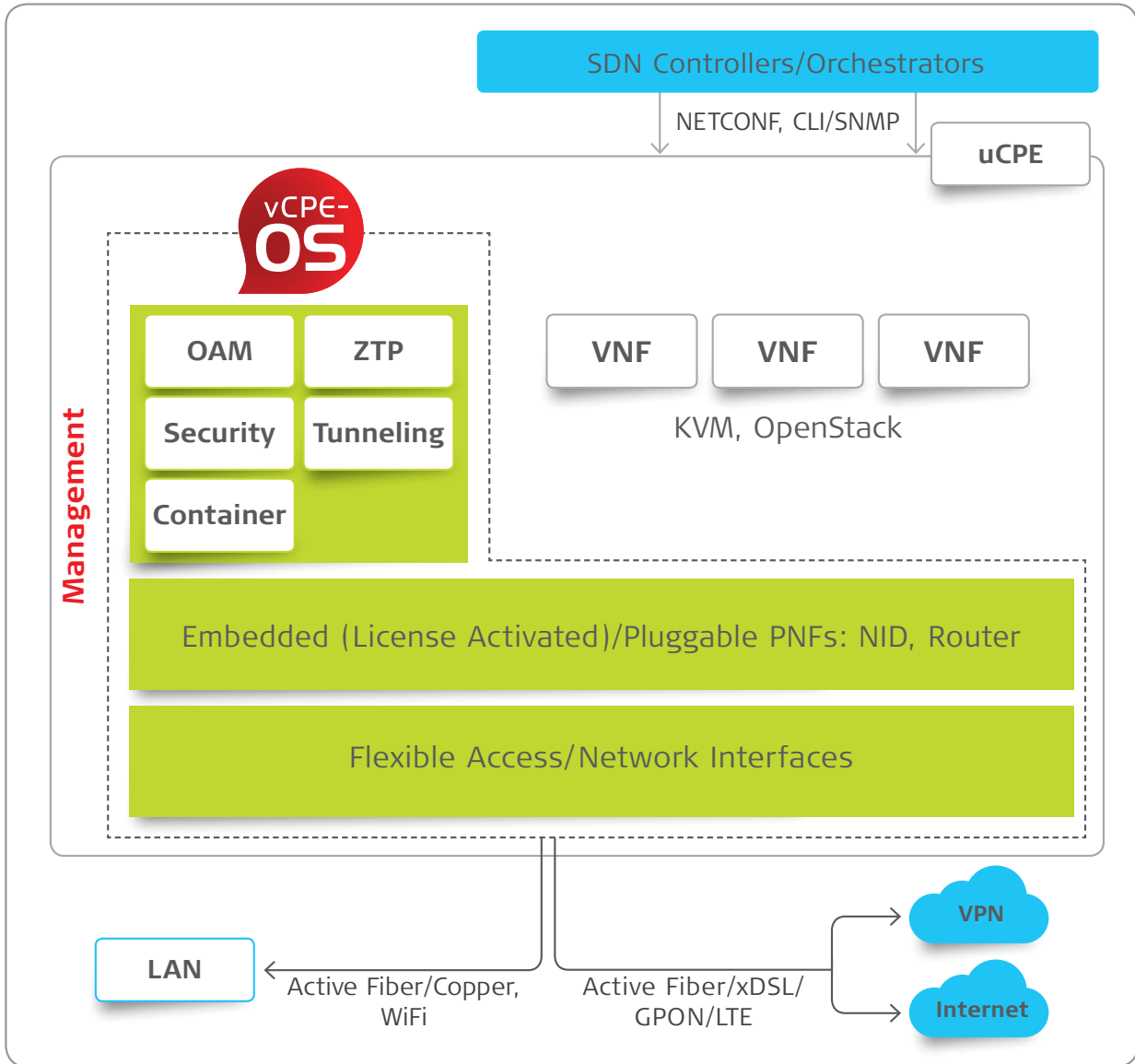
vCPE-OS
Open Carrier-Class
operating system



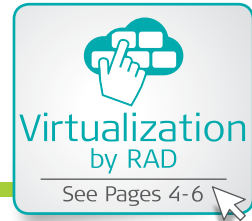
RADview
Management and Domain
Orchestration



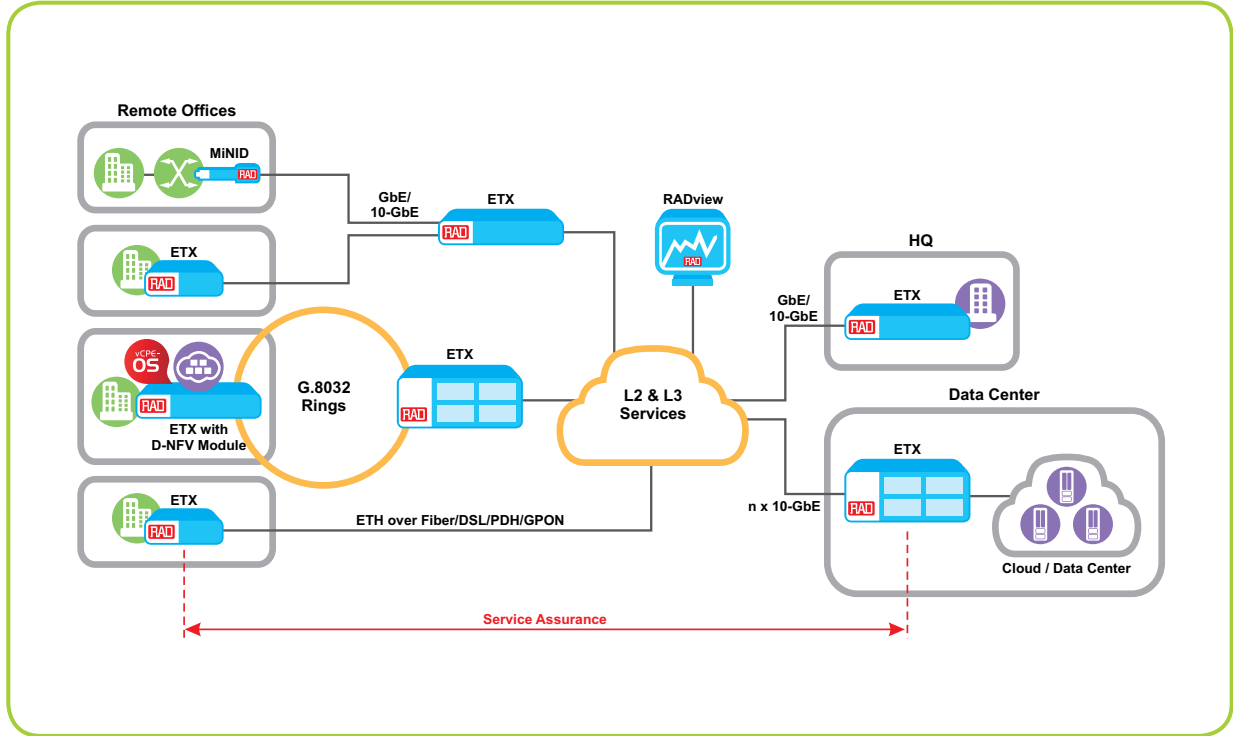
vCPE System Architecture



- Open NFV/SDN architecture facilitates integration with network-wide orchestrators and SDN controllers
- Powerful, carrier-class operating system (vCPE-OS), pre-integrated on RAD's vCPE platforms and also available for third-party white box devices



Carrier Ethernet and IP VPNs



Your Benefits:

- Easily plan, deploy, provision, and maintain SLA-based business and cloud access services with the same “look and feel” over any access: fiber/copper/TDM/wireless
- Carrier Ethernet demarcation switch with integrated L3 router functionality
- MEF CE 2.0-certified with a feature-rich toolkit: RFC-2544/ Y.1564 testing, multi-CoS traffic management, fault management, Y.1731/TWAMP performance monitoring
- Instant upgrades to existing equipment with MiNID service assurance booster
- Enhanced service provisioning, visibility and reporting using RADview Service Manager and RADview Performance Monitoring portal
- vCPE functionality at the customer edge for service agility and premium offerings, e.g., SD-WAN and other value-added services

Products Included in this Solution:



ETX-2/ETX-2i
IP and Carrier Ethernet Demarcation with D-NFV



ETX-5
Ethernet Service Aggregation Platform



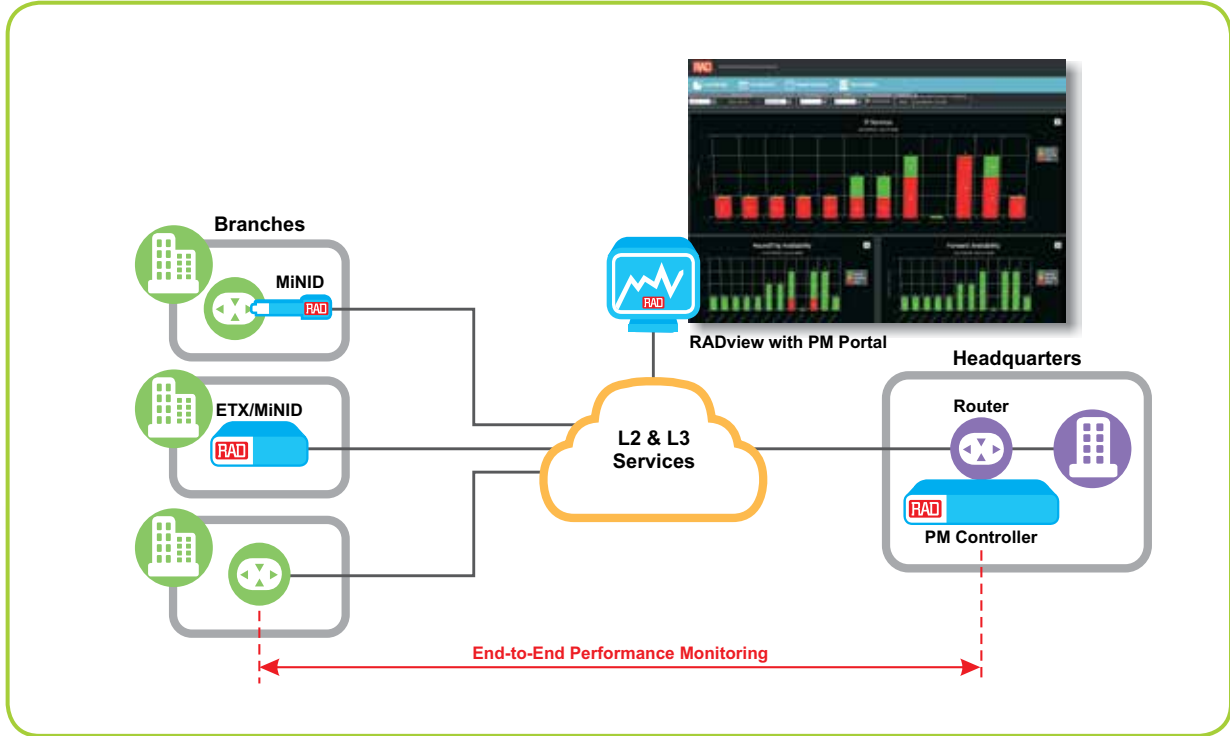
MiNID
Miniature Programmable Network Interface Device



RADview
Management and Domain Orchestration



Performance Monitoring for Business VPNs



Your Benefits:

- Performance monitoring for L2, L3 VPNs to assure service level agreement (SLA) for businesses
- PM Controller functionality (appliance/VNF) supports Y.1731, TWAMP, ICMP Echo (“ping”), and UDP Echo opposite RAD devices or third-party responders
- RADview PM supports SLA reporting with drill-down capabilities per PM session
- Optional service assurance upgrade with MiNID:
 - Easy plug-and-play installation in existing installed base
 - Unique form factor reduces space and power consumption requirements
- L2 (Y.1731) and L3 (TWAMP) test generation and response
- Service activation testing
- Analysis of micro-bursts affecting QoE
- Deep end-to-end visibility and performance monitoring across heterogeneous networks and equipment types, independent of installed-base capabilities

Products Included in this Solution:



ETX-2/ETX-2i
IP and Carrier Ethernet Demarcation with D-NFV



MiNID
Miniature Programmable Network Interface Device



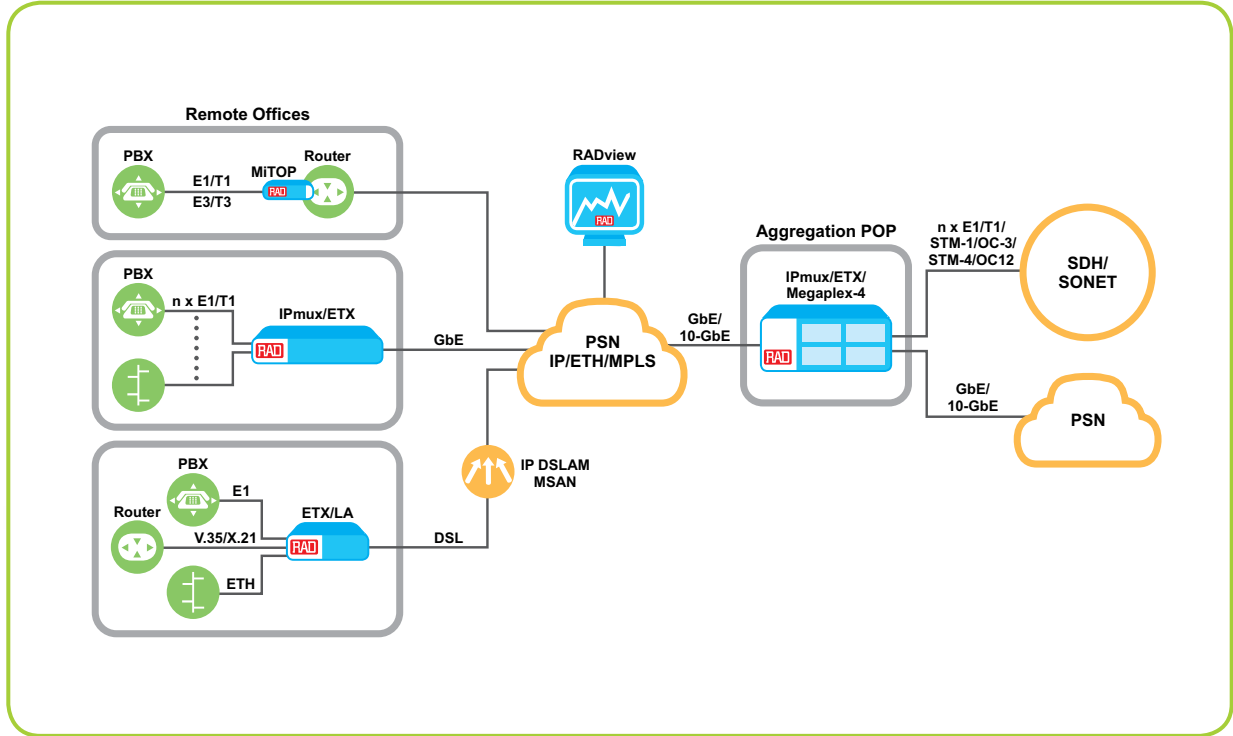
PM Controller
Performance Monitoring Generator



RADview
Management and Domain Orchestration



TDM Migration



Your Benefits:

- Maintain legacy TDM services over new packet network to keep revenue flow and customer loyalty
- Enable alternative providers to add leased lines to their service portfolio to attract new customers
- Support heterogenic First Mile footprint requiring CPE support for DSL/EFM, Ethernet, GPON connections, and flexibility in PWE termination options: customer site-to-customer site, customer site-to-POP/network, POP-to-POP
- Allow a single transport network for IP/Ethernet and TDM services to simplify operations and lower TCO

Products Included in this Solution:



ETX-2
IP and Carrier Ethernet Demarcation



ETX-5
Ethernet Service Aggregation Platform



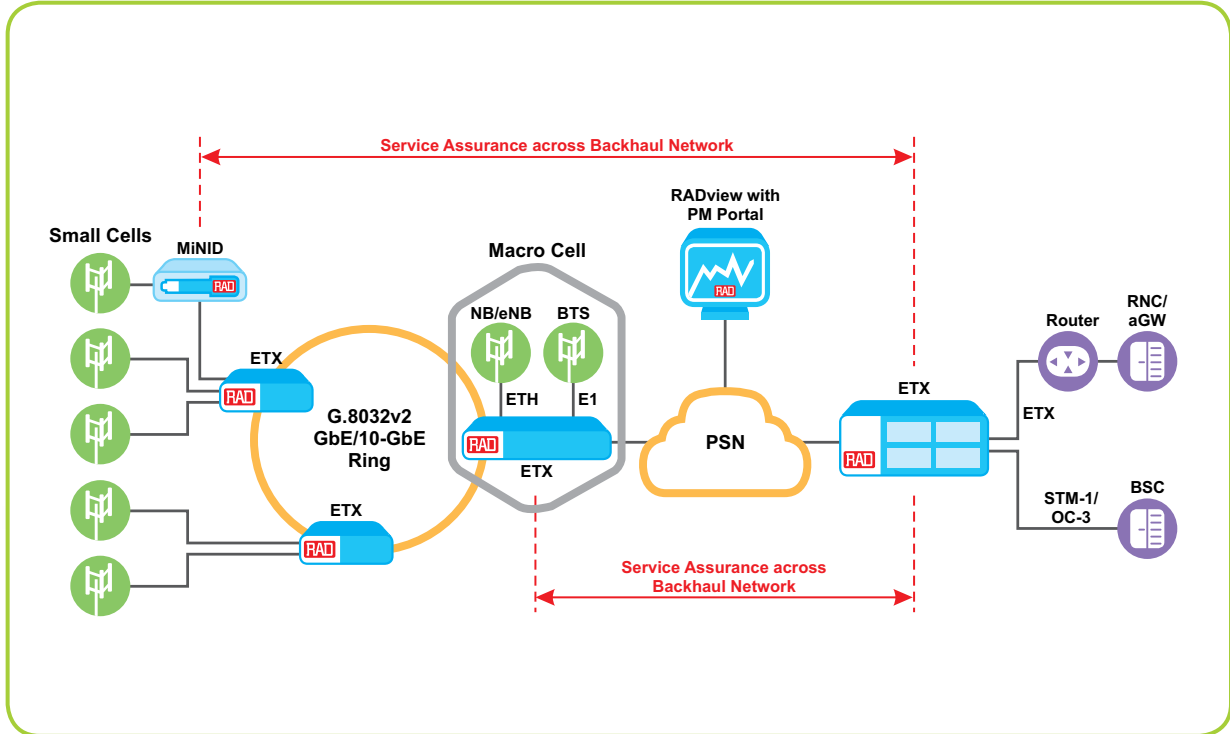
IPmux
TDM Pseudowire Access Gateways



RADview
Management and Domain Orchestration



Mobile Backhaul



Your Benefits:

- Highly efficient small-cell aggregation:
 - Flexible topologies (hub and spoke, ring)
 - Small form factor to meet space and power supply restrictions
 - Timing synchronization
- Ensure service visibility and control service level objectives (SLOs) in small-cell backhaul
- Multi-CoS Carrier Ethernet/ IP backhaul with service management and OAM-based diagnostics
- Performance monitoring for L2-based and L3-based backhaul
- Integrated Carrier Ethernet with TDM pseudowire in the same device for 2G/3G
- Fiber, SHDSL/VDSL, GPON, PDH support

Products Included in this Solution:



ETX-2/ETX-2i
IP and Carrier Ethernet Demarcation with D-NFV



ETX-5
Ethernet Service Aggregation Platform



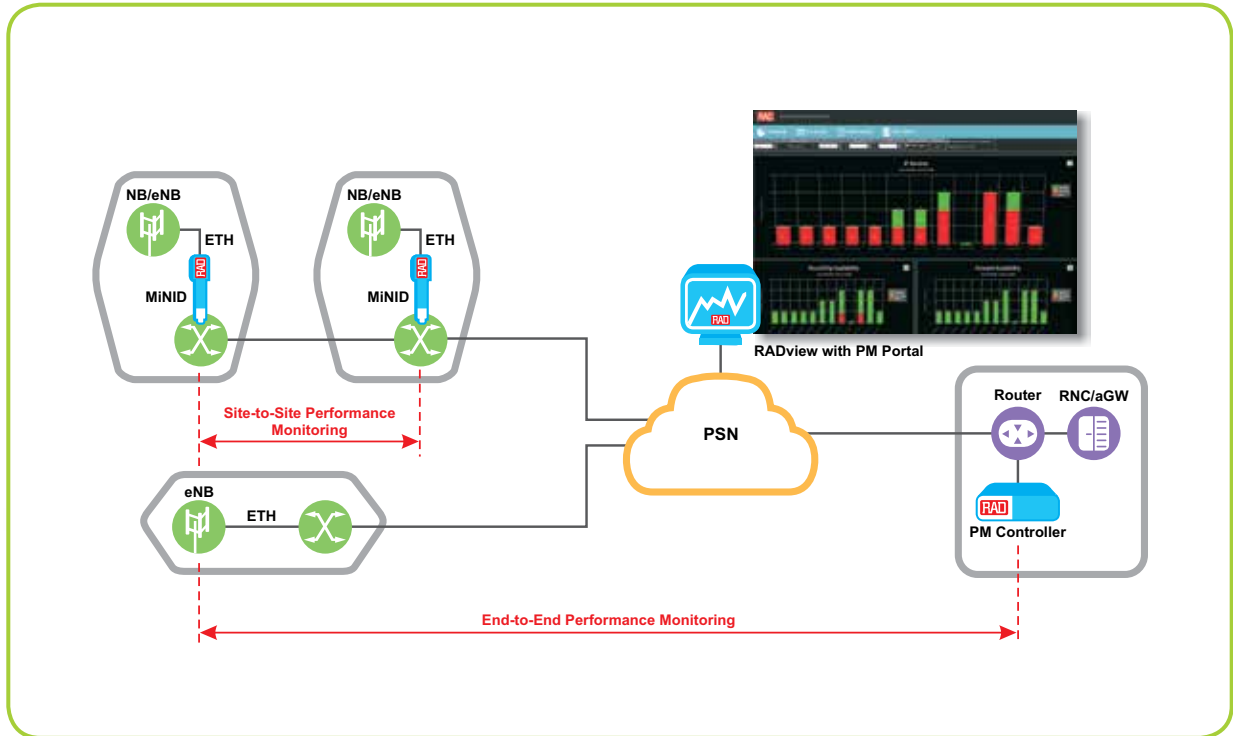
MiNID
Miniature Programmable Network Interface Device



RADview
Management and Domain Orchestration



Performance Monitoring for Mobile Networks



Your Benefits:

- Monitoring and troubleshooting backhaul performance, including LTE X2, S1 traffic path
- Service activation tests (RFC-2544/Y.1564) and continuous performance monitoring
- PM Controller functionality (appliance/VNF) supports Y.1731, TWAMP, ICMP Echo ("ping"), and UDP Echo opposite RAD devices or third-party responders
- High precision one-way measurements opposite any TWAMP responder
- RADview Performance Monitoring portal for SLA reporting
- Enhanced service assurance with MiNID:
 - Easy plug-and-play installation in existing backhaul networks
 - L2/L3 test generation and response capabilities
 - Remote packet capture for deep traffic analysis

Products Included in this Solution:



MiNID
Miniature Programmable Network Interface Device



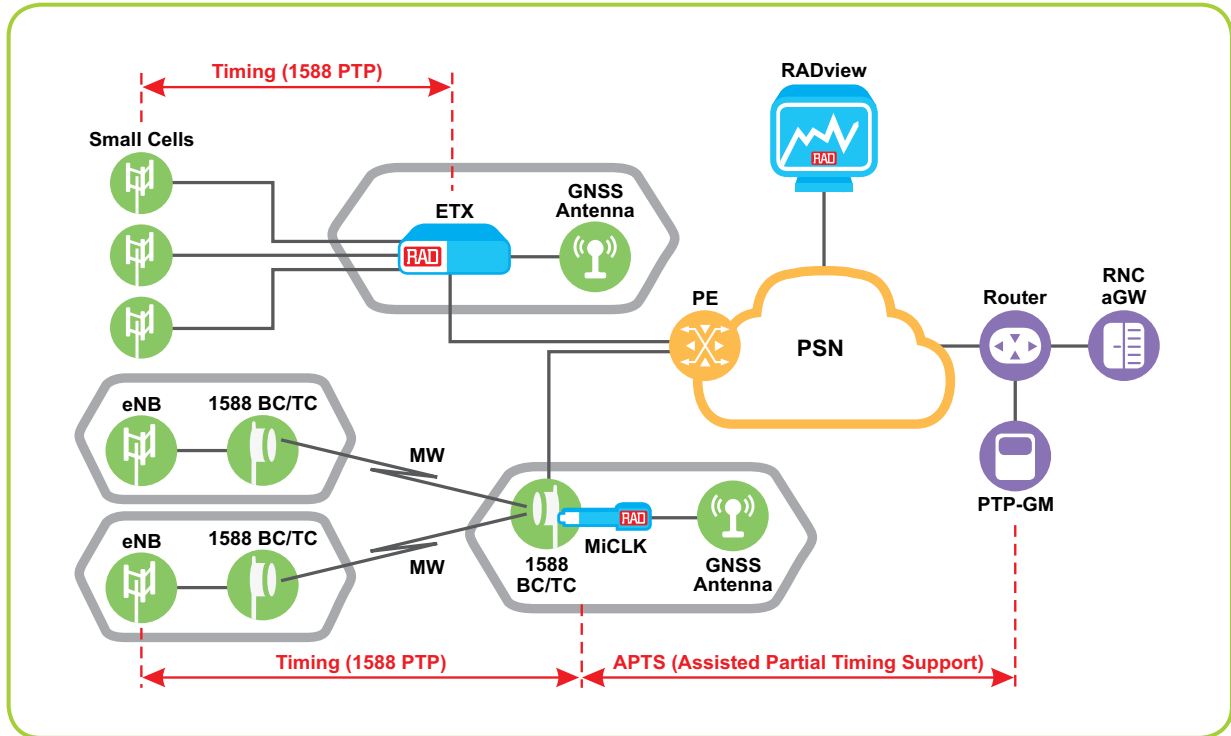
PM Controller
Performance Monitoring Generator



RADview
Management and Domain Orchestration



Timing Synchronization for Mobile Networks



Your Benefits:

- Addressing stringent timing requirements (frequency/phase) for LTE/LTE-A macro and small cells with a fully featured PTP Grandmaster:
 - ETX-2 in a local POP/hub
 - MiCLK unique SFP plugged into an aggregation switch
- Cost efficiency by bringing PTP Grandmaster closer to the cell site
- Built-in GNSS receiver
- Full network coverage, even in underground and indoor installations
- No need to install GNSS antenna on every cell site; avoid spoofing and jamming
- Fits existing installed base – no need for CapEx investments in retrofitting network with 1588 BC/TC support across the entire path
- Robust GNSS backup – time holdover for 72 hours, using Sync-E or 1588 frequency references from the network (Assisted Partial Timing Support)

Products Included in this Solution:



ETX-2
IP and Carrier Ethernet Demarcation



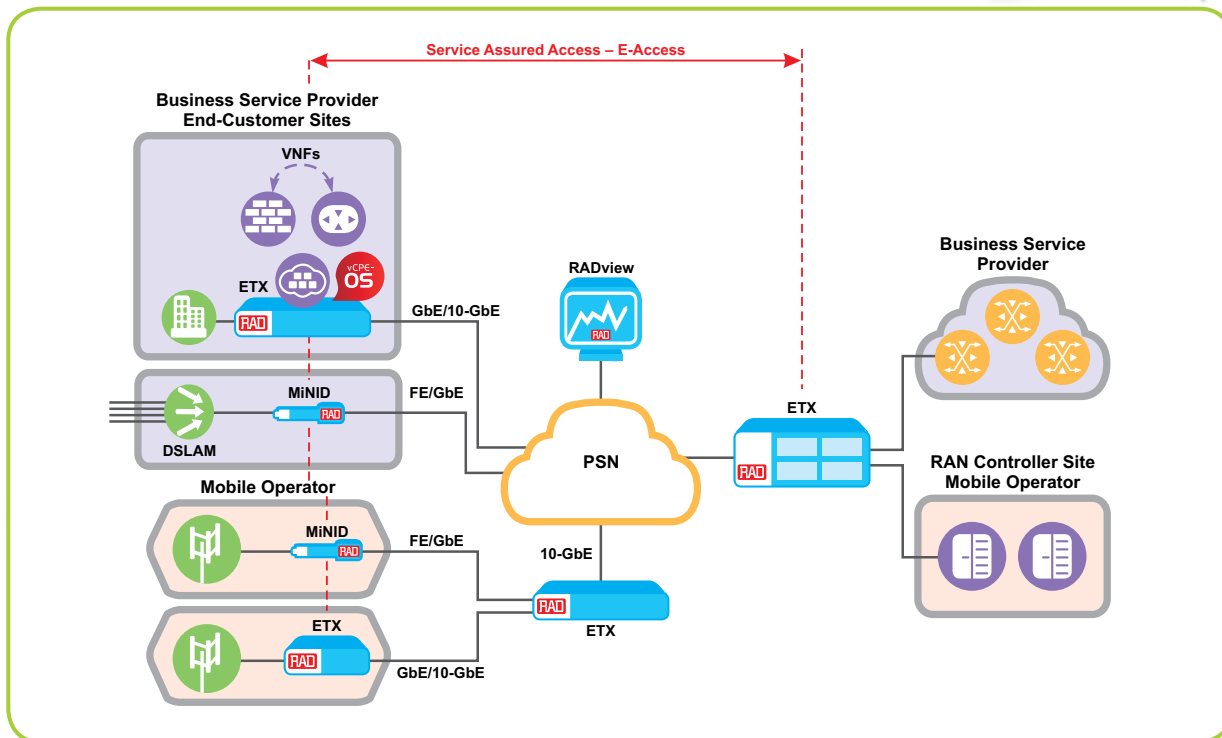
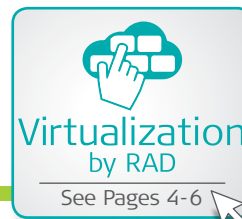
MiCLK
1588 Grandmaster on an SFP



RADview
Management and Domain Orchestration



Wholesale Networking



Your Benefits:

- Provide wholesale Carrier Ethernet transport services to multiple service providers with complete visibility and controlled service hand-off between multiple networks
- Demarcation for business, mobile and DSLAM backhaul over the same transport network
- Provide SLA-based backhaul all the way to the end-customer site, cell site or POP
- MEF-certified Carrier Ethernet 2.0 E-Access support with single-CoS and/or multiple-CoS EVC/OVC for standards-based carrier-to-carrier connectivity
- Seamless connection between networks with 1-GbE and 10-GbE E-NNI interfaces with optional redundancy
- Enhance wholesale offering with VNF-based, customer managed, value added services

Products Included in this Solution:



ETX-2/ETX-2i
IP and Carrier Ethernet Demarcation with D-NFV



ETX-5
Ethernet Service Aggregation Platform



MiNID
Miniature Programmable Network Interface Device



RADview
Management and Domain Orchestration

Service Assured Networking Solutions for Critical Infrastructure

Get seamless migration to cyber-secure packet networks and keep existing service assurance and reliability.

Carrier Ethernet = **The Next-Generation SDH/SONET**

RAD provides Service Assured Networking (SAN) solutions that ensure seamless migration to packet switched communication networks and applications. We address all the mission-critical communication needs of the utilities, transportation and government sectors.

Offering best-of-breed reliability tools, our Service Assured Networking solutions are used for SCADA and WAN communications, cyber security, and distribution automation, as well as Smart/Safe City deployments.

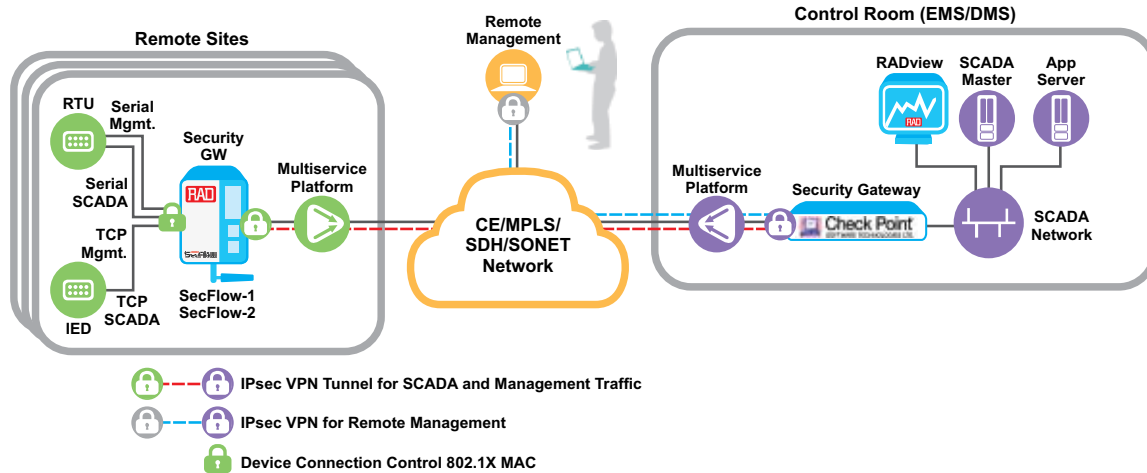




Cyber Shield for Critical Infrastructure



1 Cyber Shield Overlay for Operational WAN



Your Benefits:

- RAD's SecFlow security gateways for remote sites isolate industrial control systems (ICS)/automation devices from attack vectors on management and SCADA planes:
 - Cyber Shield for management traffic (NERC CIP Intermediate System)
 - Cyber Shield for SCADA traffic
- Upgrades existing operational technology (OT) networks with Intermediate System for secure remote and local access, SCADA-aware firewall, Intrusion Prevention System functionality, man-in-the-middle attack prevention, encryption, device connection control, event logger, and anomaly detection
- Fits any OT network architecture and ICS/SCADA device connectivity (serial or TCP)
- The most comprehensive and cost-effective solution on the market simplifies multi-box alternatives
- Ideal for the utilities, transportation and government markets

Products Included in this Solution:



SecFlow-1/SecFlow-2
SCADA Secure Switch/Routers



Check Point Security
Gateway



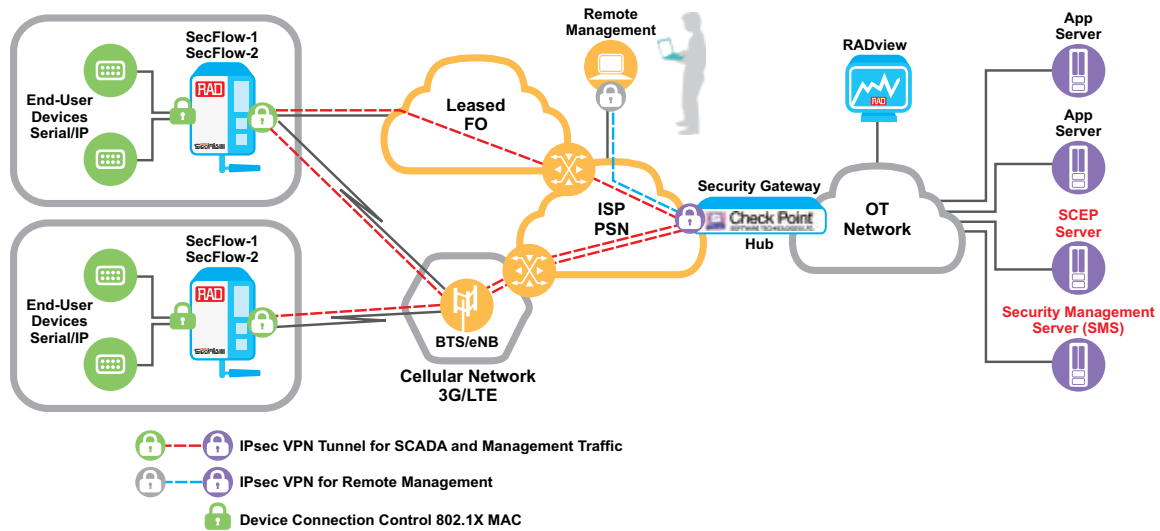
RADview
Management and Domain
Orchestration



Cyber Security
by RAD

See Page 8

2 Cyber Shield for Industrial IoT Backhaul



Your Benefits:

- Ideal for the utilities, transportation and government markets
- RAD's SecFlow security gateways for remote sites isolate industrial control systems (ICSs)/automation devices from attack vectors on management and SCADA planes
- Greenfield communications/security solution for sites connected via

public cellular networks, with Intermediate System for secure remote and local access, SCADA-aware firewall, Intrusion Prevention System functionality, man-in-the-middle attack prevention, encryption, device connection control, event logger, and anomaly detection

- Fits any ICS/SCADA device connectivity (serial or TCP)
- Automated PKI solution for remote sites with dynamic IP address allocated from cellular APN
- The most comprehensive and cost-effective solution in the market simplifies multi-box alternatives

Products Included in this Solution:



SecFlow-1/SecFlow-2
SCADA Secure Switch/Routers



Check Point Security Gateway



RADview
Management and Domain Orchestration





Power Utility Communications

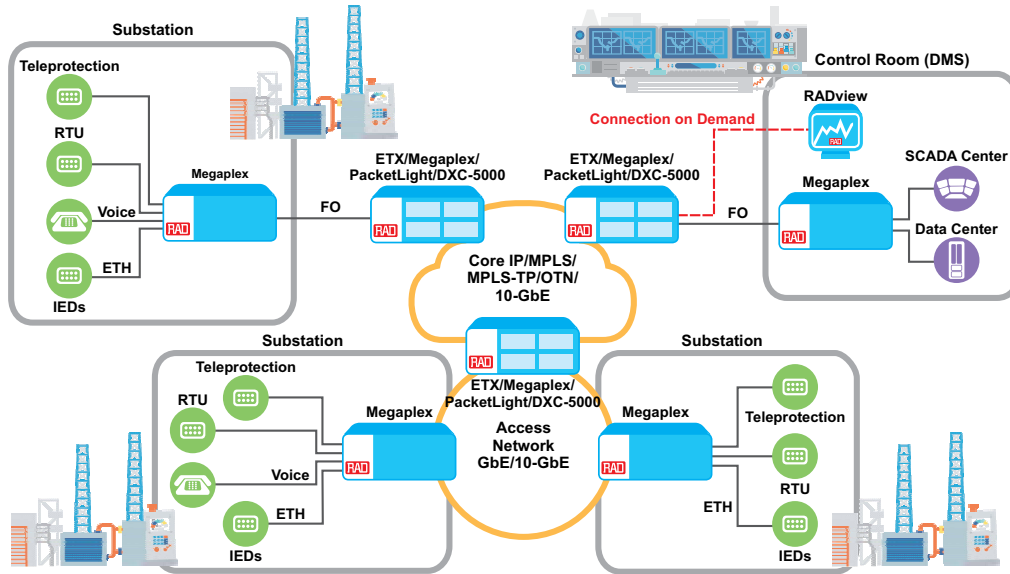


**Cyber Security
by RAD**
See Page 8



**Virtualization
by RAD**
See Page 7

1 Multiservice Operational WAN



Your Benefits:

- Powerful cross-generation TDM and Ethernet capabilities, including TDM DSO cross connect and SDH/SONET, Gigabit Carrier Ethernet with OAM and assured QoS, TDM pseudowire, Ethernet over NG-PDH/SDH/SONET, IP/MPLS, MPLS-TP and OTN/DWDM
- Complete cyber attack prevention suite, including encryption, authentication, authorization, and auditing
- Easily configurable connectivity of all serial automation and Teleprotection devices to either SDH/SONET network or to a packet network
- Supports analog and digital data and voice devices, as well as Ethernet IEDs, with versatile rates from RS-232 up to STM-4/OC-12 or GbE
- Guaranteed smooth migration to PSNs based on hybrid design for reduced latency and better resiliency
- Future-ready with virtualization capabilities for adding new applications (security, router, SCADA) using RAD's innovative x86 D-NFV module

Products Included in this Solution:



ETX-5
Ethernet Service
Aggregation Platform



Megaplex
Next-Generation
Multiservice Networking
Nodes



DXC-5000
High Capacity Hybrid
Cross Connects



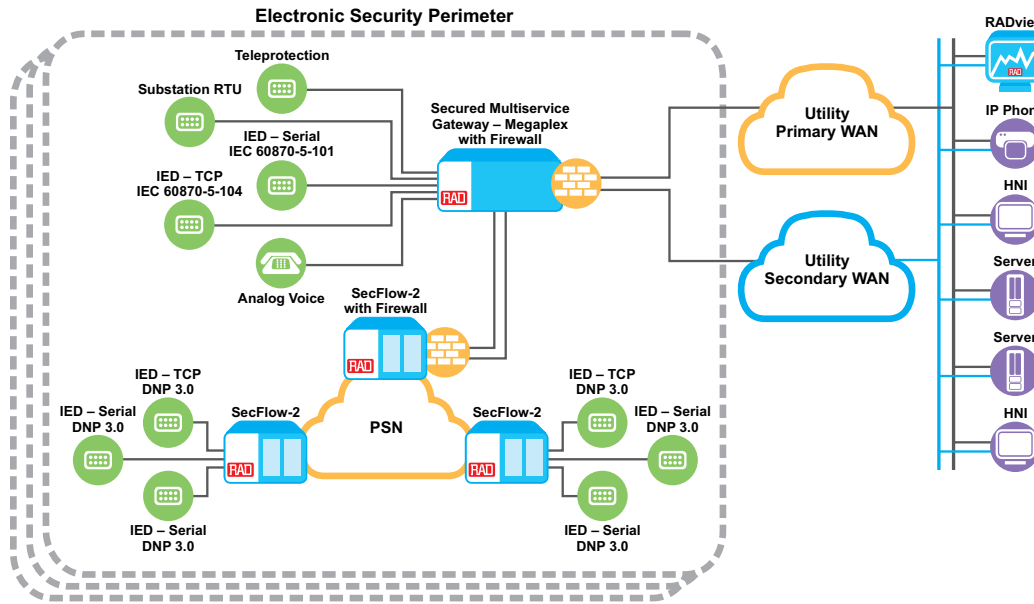
RADview
Management and Domain
Orchestration



Cyber Security by RAD
See Page 8



2 Ruggedized Substation LAN



Your Benefits:

- Support Ethernet-based IEC 61850 substation communications for mission-critical automation traffic within the substation and between SCADA control centers
- Enable co-existence of serial-based RTUs and Ethernet IEDs with full redundancy over various topologies using fiber optic rings, 3G/4G cellular modems and external radio systems
- Comply with IEC 61850-3 and IEEE 1613 environmental standards
- Built-in router enables seamless communication of IP SCADA traffic to both old and new RTUs by converting IEC-101 and IEC-104, or Modbus serial and IP, DNP 3.0 and others
- Enable secure, dedicated networks over fiber and/or radio links using IPsec encryption and distributed security SCADA firewall suite

Products Included in this Solution:



Megaplex-4
Next-Generation
Multiservice Networking
Node



Megaplex-1
Multiservice Pseudowire
Access Gateway



SecFlow-2
Ruggedized SCADA-
Aware Ethernet Switch/
Router

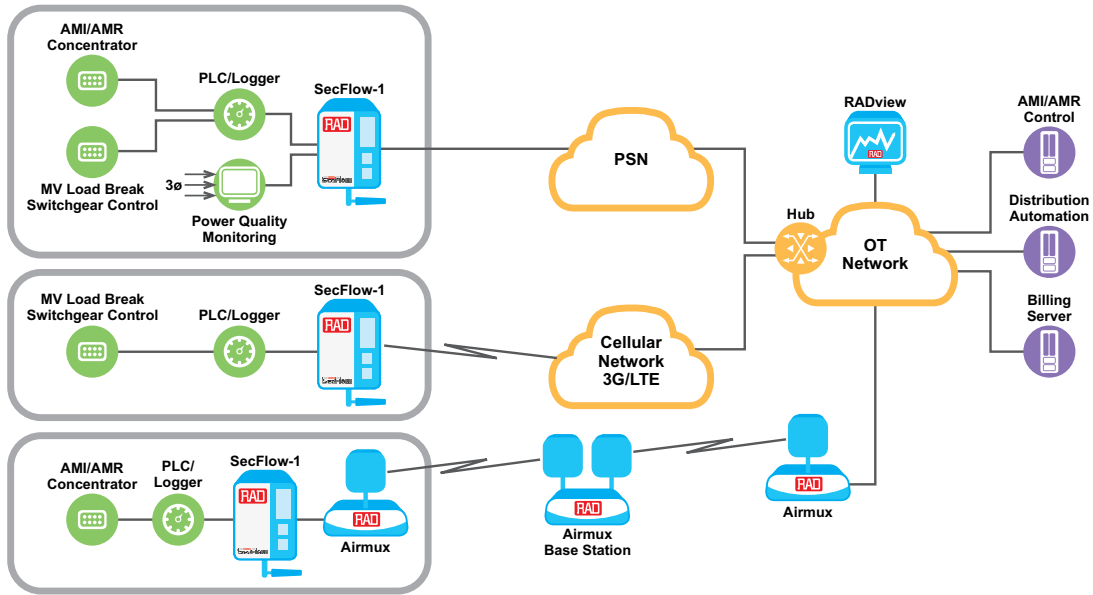


RADview
Management and Domain
Orchestration




Cyber Security
 by RAD
 See Page 8

3 Industrial IoT and Smart Meter Backhaul



Your Benefits:

- A comprehensive solution addressing communications to secondary substations, metering and automation network integration, and cyber security
- Complies with IEC 61850-3 and IEEE 1613 environmental standards for outdoor installations
- Seamless communications over fiber optics, radio links, 2G/3G/LTE cellular links and leased lines from a telecom service provider
- Integrated IPsec encryption
- Point-to-multipoint radio connectivity supports high capacity mission-critical traffic over licensed and unlicensed sub-6 GHz bands, with dedicated bandwidth allocation and service level agreement (SLA) per subscriber
- Transparent delivery of SCADA protocols

Products Included in this Solution:



Airmux-5000
Point-to-Multipoint
Broadband Wireless
Access



SecFlow-1
Ruggedized SCADA-Aware
Gateway

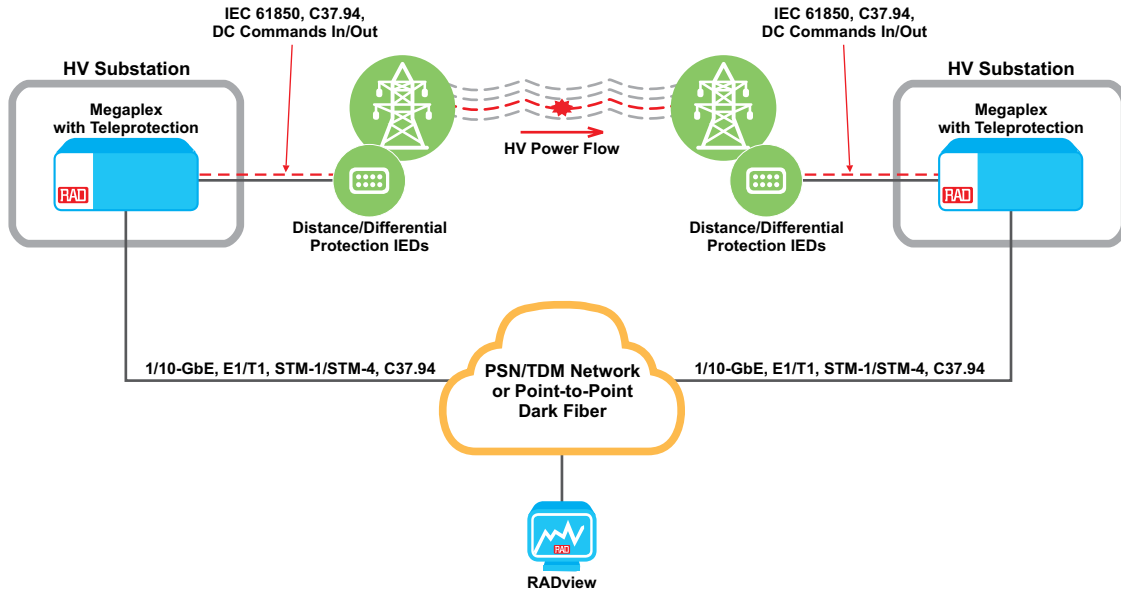


RADview
Management and Domain
Orchestration



**Cyber Security
by RAD**
See Page 8

4 Distance and Differential Protection Communications



Your Benefits:

- Single product supports both distance trip command relays and differential Teleprotection delivery over TDM or IP network
- Wide range of Teleprotection interfaces – serial, G.703 co-directional, E&M, C37.94 – to extend differential Teleprotection relay communication over any infrastructure
- Reduce CapEx and OpEx by using a single-box solution for all substation communication services, including voice, data, automation, and Teleprotection signals
- Redundancy hierarchy from the Teleprotection interface up to the communication link ensures 0 (zero) msec hardware protection
- Sub-2 msec end-to-end delay over PSN
- Tested interoperability with most Teleprotection contact relays from leading vendors (such as Alstom, ABB, Siemens, SEL, Schneider)
- Distance protection complies with IEC 60834

Products Included in this Solution:



Megaplex-4
Next-Generation
Multiservice Networking
Node



Megaplex-1
Multiservice Pseudowire
Access Gateway



RADview
Management and Domain
Orchestration



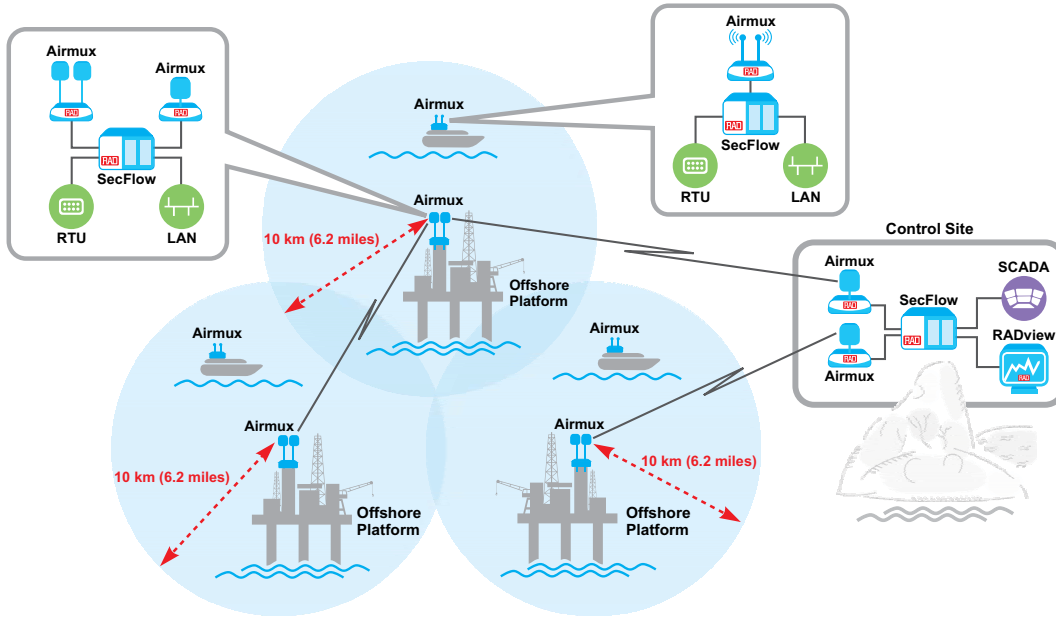
Oil and Gas Utility Communications



Cyber Security
by RAD

See Page 8

1 Fixed and Mobile Wireless Broadband for Offshore Communications



Your Benefits:

- Supports bi-directional broadband connectivity to deliver real-time video, internet access (WiFi), telemetry, data, and VoIP to supply and service vessels
- Up to 100 Mbps total available throughput per vessel
- 360° mobility coverage across a range of up to 10 km (6.2 miles)
- Seamless handover between base stations for non-stop communications
- Advanced QoS mechanisms, encryption and guaranteed bandwidth per vessel
- License-free, sub-6 GHz frequencies

Products Included in this Solution:



Airmux-400
Point-to-Point Broadband
Wireless Access



Airmux-Mobility
Mobile Wireless Access



SecFlow-2
Ruggedized SCADA-Aware
Ethernet Switch/Router



RADview
Management and Domain
Orchestration

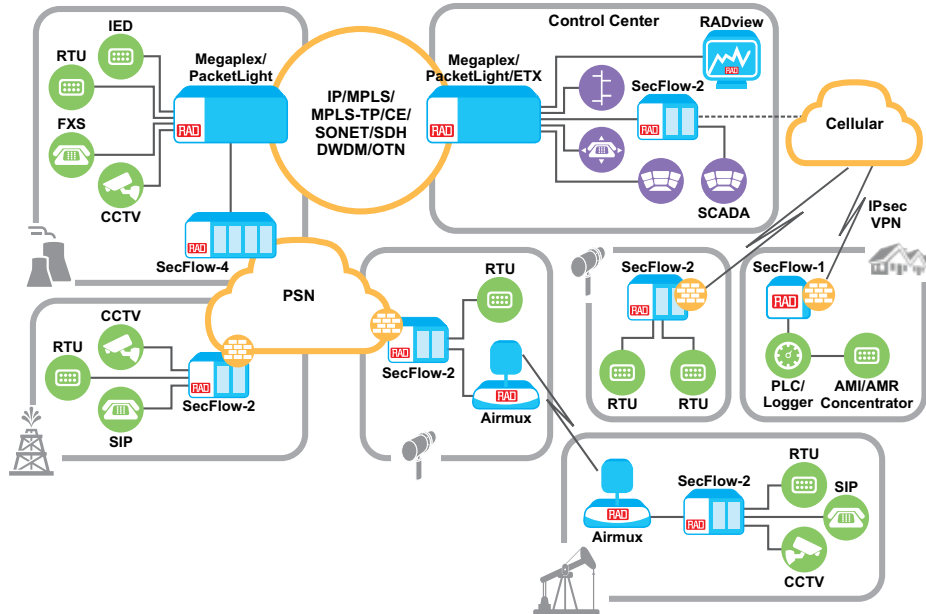



**Virtualization
by RAD**
See Page 7



**Cyber Security
by RAD**
See Page 8

2 Multiservice Operational WAN for Oil and Gas Utilities



Your Benefits:

- Cyber-secure SCADA connectivity for compressor stations, storage tanks, LACT and flow meters, cathodic protection, etc.
- Multiservice aggregation for any transport network, including SDH/SONET, IP/MPLS, MPLS-TP, CE and OTN/DWDM
- Complies with environmental standards for outdoor installation in harsh conditions
- Supports any available media and connectivity option, including fiber, radio, 3G/4G cellular links, or leased lines from a local telco
- Distributed SCADA security suite with integrated firewall and encryption
- Point-to-point and point-to-multipoint radio system supports up to 250 Mbps over sub-6 GHz bands, with dedicated bandwidth allocation per site and service reach of up to 120 km (74.5 miles)
- Supports all communication needs, including SCADA protocols, voice and new packet services (CCTV, VoIP, etc.)

Products Included in this Solution:



Megaplex
Next-Generation
Multiservice Networking
Nodes



PacketLight
Complete Solutions for
WDM/OTN and Dark
Fiber Applications



SecFlow-2
Ruggedized SCADA-Aware
Ethernet Switch/Router

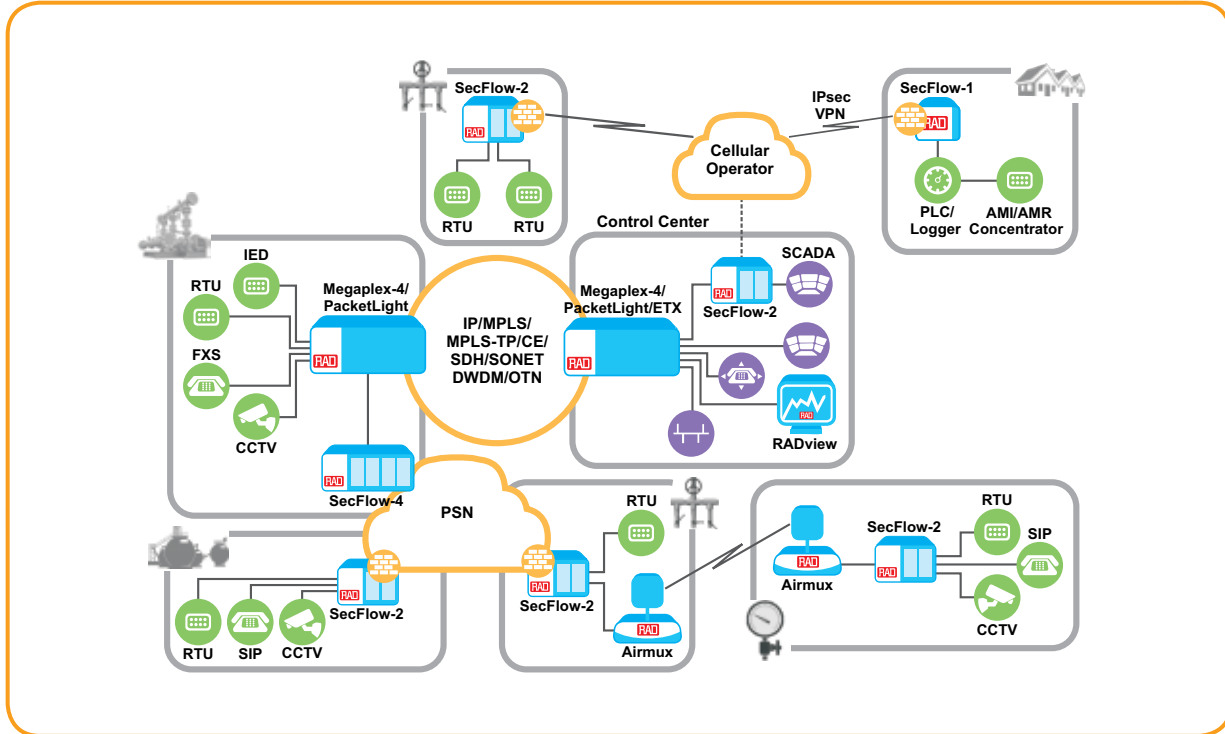


RADview
Management and Domain
Orchestration



Water Utility Communications






**Cyber Security
 by RAD**
 See Page 8



Your Benefits:

- Cyber-secure SCADA connectivity for water monitoring and automation devices, sensors, pumps, surface and groundwater availability tracking devices, etc.
- Multiservice aggregation for any transport network, including SDH/SONET, IP/MPLS, MPLS-TP, CE and OTN/DWDM
- Supports any available media and connectivity option, including fiber, radio, 3G/4G cellular links, or leased lines from a local telco
- Distributed SCADA security suite with integrated firewall and encryption
- Point-to-point and point-to-multipoint radio system supports up to 750 Mbps over sub-6 GHz bands, with dedicated bandwidth allocation per site and service reach of up to 120 km (74.5 miles)
- Supports all communication needs, including SCADA protocols, voice and new packet services (CCTV, VoIP, etc.)
- Complies with environmental standards for outdoor installation in harsh conditions

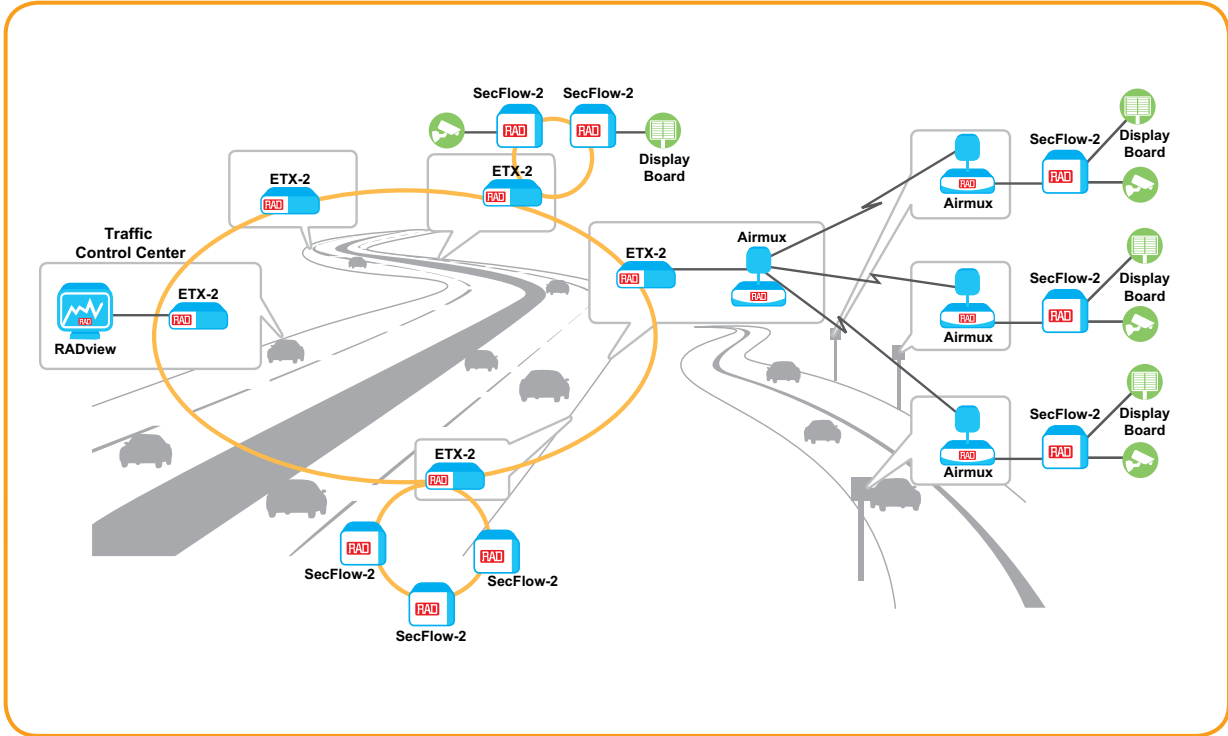
Products Included in this Solution:

 Airmux-5000 Point-to-Multipoint Broadband Wireless Access	 Megaplex Next-Generation Multiservice Networking Nodes	 SecFlow-2 Ruggedized SCADA-Aware Ethernet Switch/Router	 RADview Management and Domain Orchestration
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Highway Communications


**Cyber Security
 by RAD**
 See Page 8



Your Benefits:

- Backhaul high-definition video feeds and roadside display board data from remote facilities over fiber, high throughput sub-6 GHz radio links and 10-GbE rings
- Enable outdoor installations with industrial design and ruggedized enclosures
- 10-GbE carrier-grade Ethernet core rings with traffic management capabilities ensure reliable connectivity with appropriate quality of service for various applications

Products Included in this Solution:



Airmux-Mobility
 Mobile Wireless Access



ETX-2/ETX-2i
 IP and Carrier Ethernet Demarcation with D-NFV



SecFlow-2
 Ruggedized SCADA-Aware Ethernet Switch/Router




RADview
 Management and Domain Orchestration



Train and Metro Communications

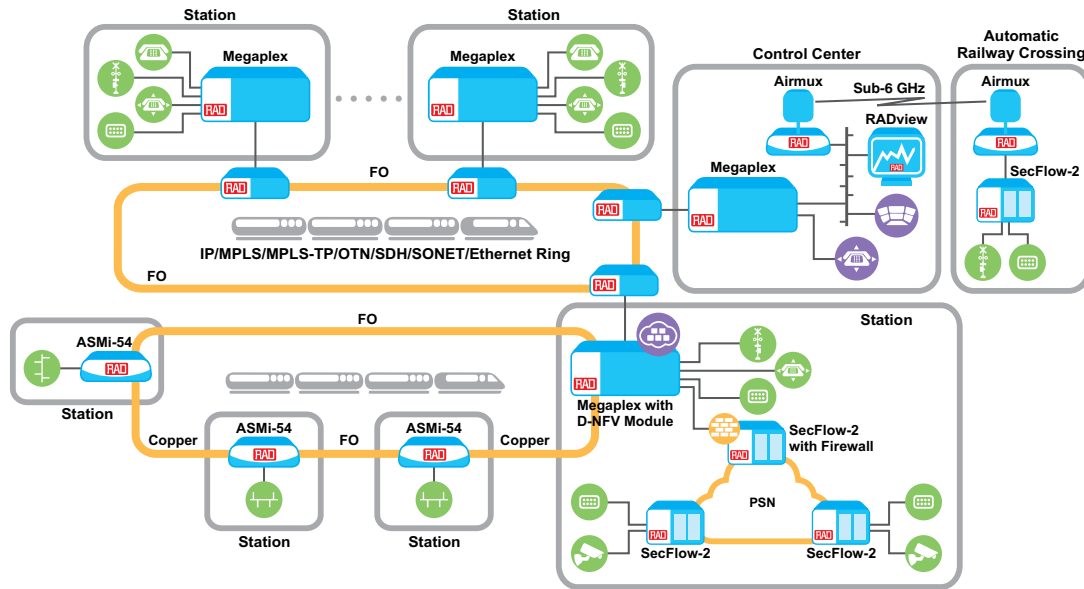


**Cyber Security
by RAD**
See Page 8



**Virtualization
by RAD**
See Page 7

1 Multiservice Operational WAN for Trains and Metros



Your Benefits:

- Ensure protected connectivity between stations and control room using multidrop and ring topologies
- Support mission-critical railway applications, including automatic train supervision (ATS), centralized traffic control (CTC), SCADA, and multiparty hotlines, as well as passenger information systems (PISs)
- Support legacy TDM and Ethernet traffic delivery over SDH/SONET/IP/MPLS/MPLS-TP/CE/DWDM/OTN and/or carrier-grade fiber optic rings
- Carrier-grade Ethernet ensures service performance and ongoing KPI monitoring
- Ethernet extension over fiber or copper to enable service reach to remote M2M and video devices
- Enable Layer 3-7 applications (routing, security, SCADA), in addition to communications platform, using x86 Distributed Network Functions Virtualization (D-NFV) module

Products Included in this Solution:



ASMi-54
SHDSL.bis Modems



Megaplex
Next-Generation
Multiservice Networking
Nodes



DXC-5000
High Capacity Hybrid
Cross Connects

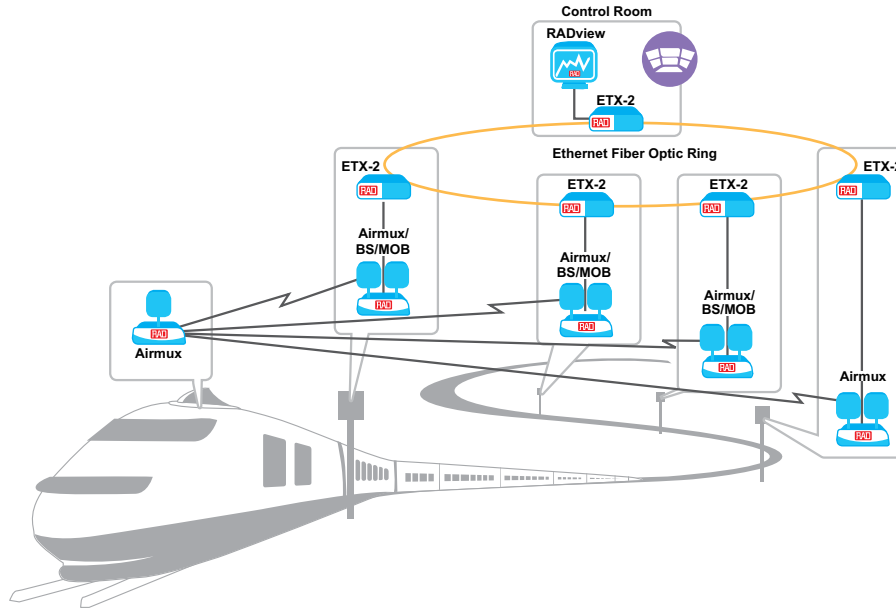


RADview
Management and Domain
Orchestration



**Cyber Security
by RAD**
See Page 8

2 Fixed and Mobile Wireless Broadband for Trains and Metros



Your Benefits:

- Supports bi-directional broadband connectivity for on-board video surveillance, infotainment and WiFi in moving vehicles using easy-to-deploy base stations and Ethernet access switches
- Guaranteed high capacity mobile video and data connectivity for ruggedized mobile units mounted on vehicles, trains and vessels at affordable total cost of ownership (TCO)
- Supports connectivity on moving vehicles at up to 300 km/h (186.4 mph)
- Up to 100 Mbps total throughput
- Seamless handover for real-time video streaming
- Reliable coverage over long distances in various terrains and topologies
- Best reliability and performance in metro and underground deployments

Products Included in this Solution:



Airmux-Mobility
Mobile Wireless Access



ETX-2/ETX-2i
IP and Carrier Ethernet
Demarcation with D-NFV



RADview
Management and Domain
Orchestration

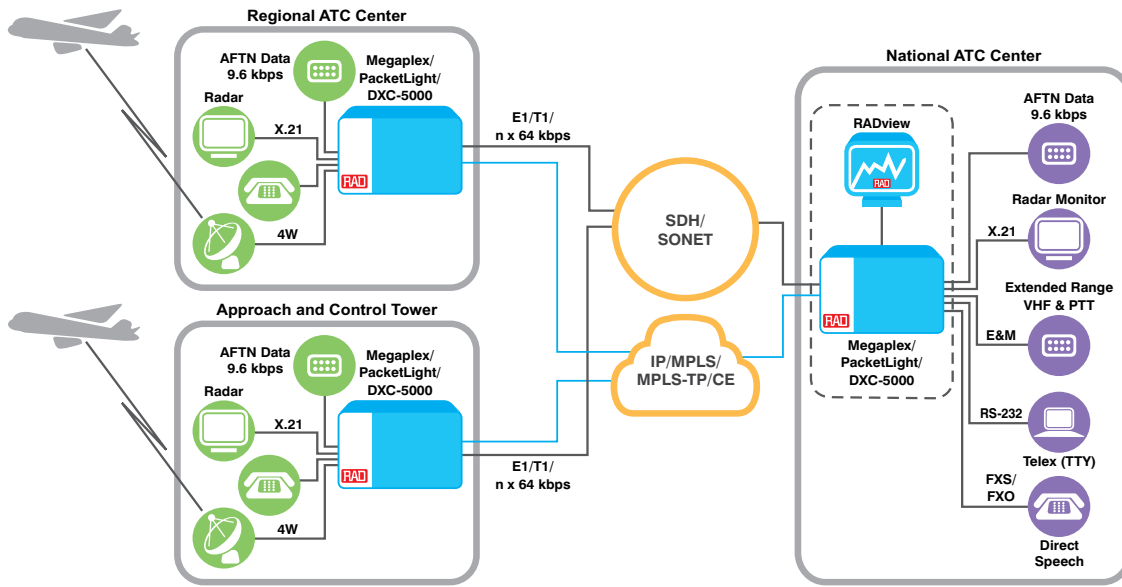


Air-Traffic Control Communications

**Cyber Security
by RAD**
See Page 8

**Virtualization
by RAD**
See Page 7

1 Multiservice Operational WAN for Air-Traffic Control



Your Benefits:

- Ensure reliable, uninterrupted communications between different traffic control centers with RAD's multiservice connectivity solutions over any transport network, including SDH/SONET, IP/MPLS, MPLS-TP, CE, OTN, DWDM
- Deliver direct speech (DS), Telex (TTY), radar data (RD), extended range VHF (ER), and VHF data link (VDL) traffic, together with other voice, fax and LAN services, using industry-standard interfaces
- Transport traffic over copper, fiber, microwave, or satellite links
- Distributed SCADA security suite with integrated firewall and encryption
- Optimized for subrate leased line transmission and backup to reduce OpEx
- Ruggedized platforms withstand the rigors of field operations
- Support fail-safe operations with ISDN, VSAT and Ethernet backup

Products Included in this Solution:



Megaplex
Next-Generation
Multiservice Networking
Nodes



DXC-5000
High Capacity Hybrid
Cross Connects



PacketLight
Complete Solutions for
WDM/OTN and Dark
Fiber Applications



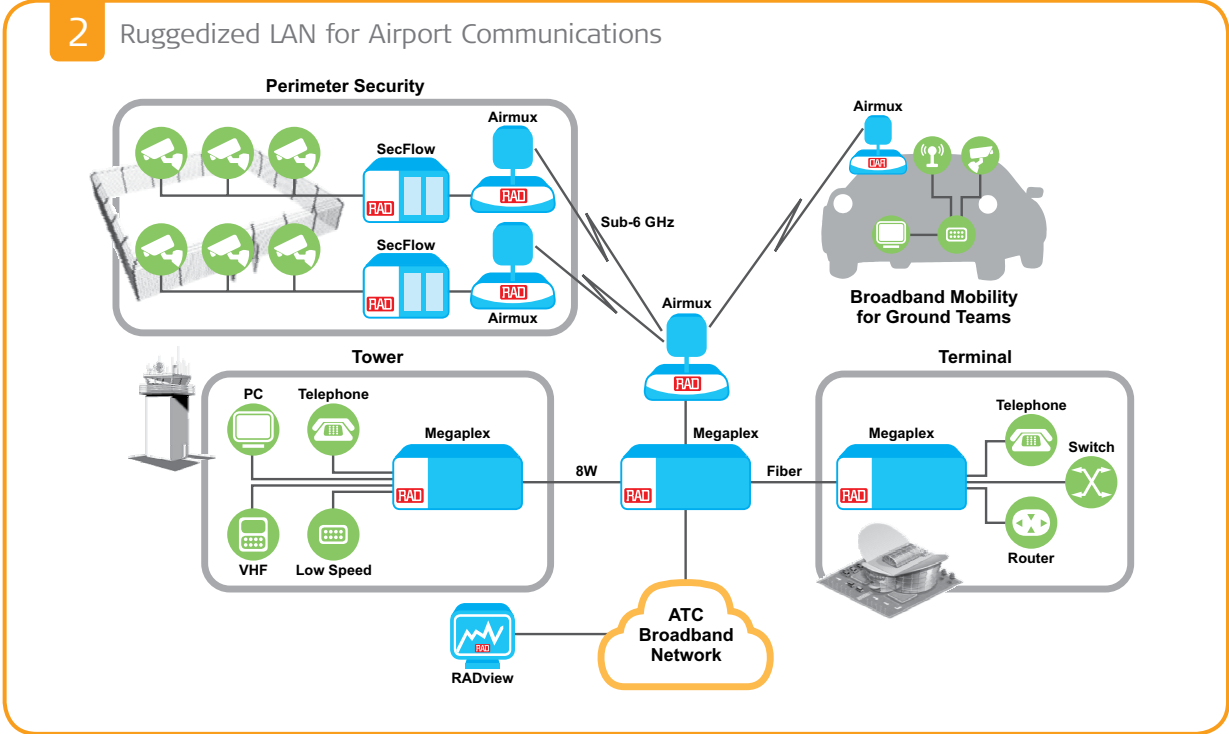
RADview
Management and Domain
Orchestration




**Cyber Security
by RAD**

See Page 8 

2 Ruggedized LAN for Airport Communications



Your Benefits:

- Ensure uninterrupted communications between control towers and traffic control centers with RAD's multiservice connectivity solutions for airport communications
- Deliver direct speech (DS), Telex (TTY), radar data (RD), extended range VHF (ER), and VHF data link (VDL) traffic, together with other voice, fax and LAN services, using industry-standard interfaces
- Ruggedized platforms withstand the rigors of field operations for outdoor CCTV cameras and other security applications
- On-the-move communications for vehicles and vessels in airports and harbors
- Transport traffic over copper, fiber, microwave, or satellite links
- Distributed SCADA security suite with integrated firewall and encryption

Products Included in this Solution:



Airmux-Mobility
Mobile Wireless Access



Megaplex-4
Next-Generation
Multiservice Networking
Nodes



Megaplex-1
Multiservice Pseudowire
Access Gateway



SecFlow-2
Ruggedized SCADA-Aware
Ethernet Switch/Router

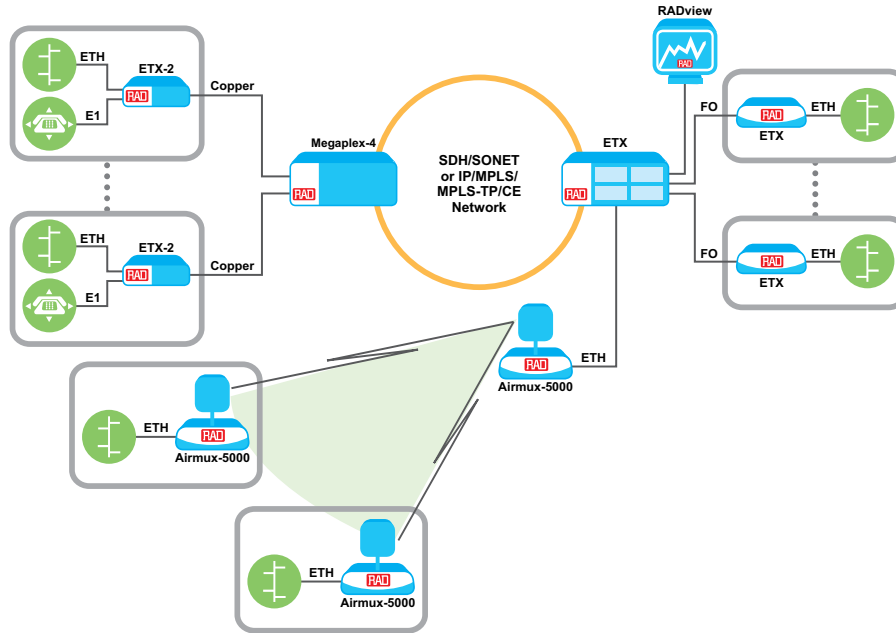


Police and Military Communications

 Cyber Security
by RAD

See Page 8 

1 Multiservice Operational WAN for Police and Military



Your Benefits:

- Connect a privately owned government/military/public network to remote sites using diverse infrastructure
- Support multiple services, including Ethernet, TDM and low speed data, using the same device
- Utilize existing SDH/SONET network or build a state-of-the-art IP/MPLS, MPLS-TP, CE backbone

Products Included in this Solution:



Airmux-5000
Point-to-Multipoint
Broadband Wireless
Access



ETX-2
Carrier Ethernet
Demarcation Device



ETX-2i
IP and Carrier Ethernet
Demarcation with D-NFV

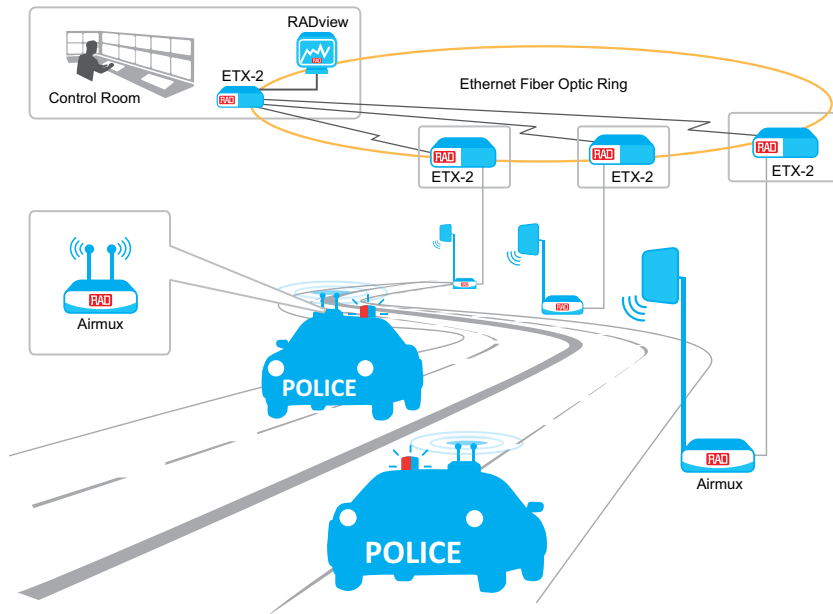


RADview
Management and Domain
Orchestration




**Cyber Security
 by RAD**
 See Page 8

2 Fixed and Mobile Wireless Broadband for Police and Military



Your Benefits:

- Support bi-directional broadband connectivity for real-time video surveillance feeds to and from police patrol cars
- Support connectivity of moving vehicles at up to 300 km/h (186.4 mph)
- Up to 100 Mbps total available throughput per vehicle
- Guaranteed bandwidth per vehicle, using a point-to-multipoint, sub-6 GHz encrypted radio system with advanced QoS mechanism
- Seamless handover for real-time video streaming
- Reliable coverage over long distances in various terrains and topologies
- WiFi coverage extends outside the vehicle for video transmissions

Products Included in this Solution:



Airmux-Mobility
Mobile Wireless Access



ETX-2/ETX-2i
IP and Carrier Ethernet
Demarcation with D-NFV



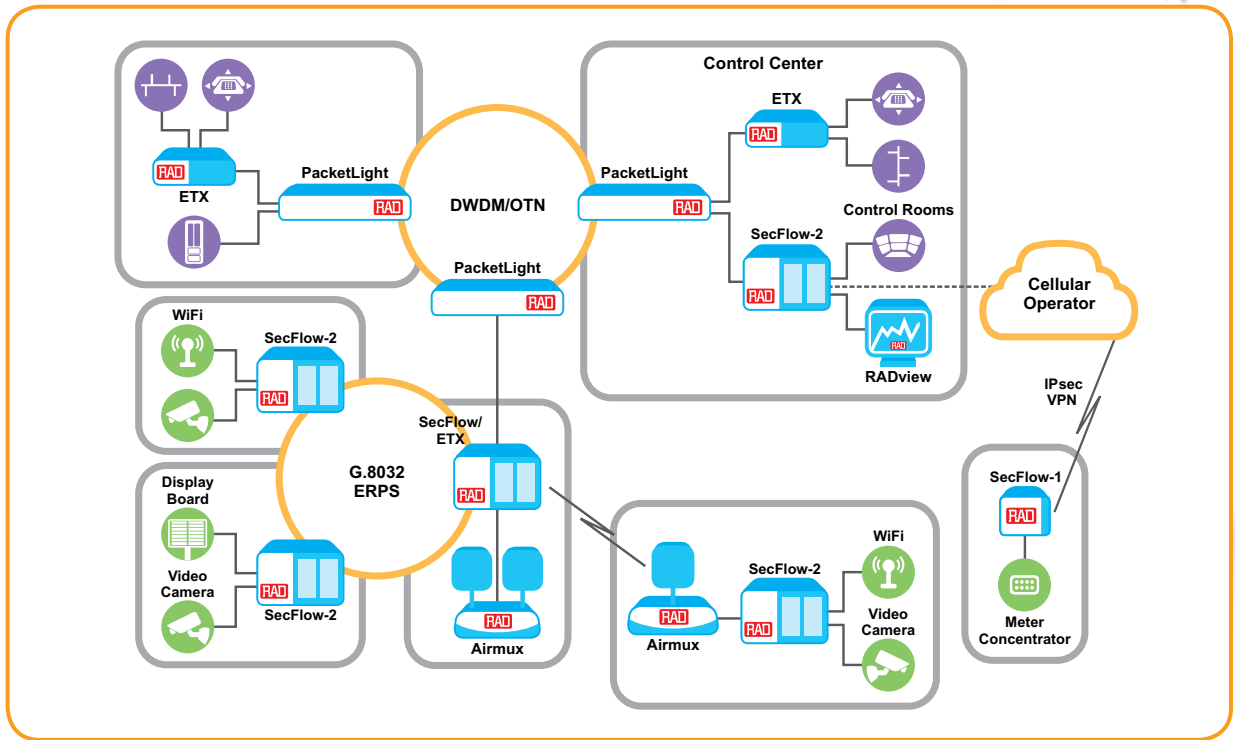
RADview
Management and Domain
Orchestration





Smart City Communications


**Cyber Security
 by RAD**
 See Page 8



Your Benefits:

- Provide coverage for Smart City communications
- Connect security cameras, WiFi access points, display boards, meter concentrators, and other sensors in urban and rural areas over fiber optics and wireless radios
- Central management to provision and control the communications network
- Long-distance fiber optic private network backbone with OTN/ DWDM multi-tunneling at rates of up to 100G
- Turnkey deployment solutions by RAD for Safe City and security projects, including consulting, communications, video surveillance and analytics systems, cameras, and sensors
- G.8032 Ethernet Ring Protection Switching (ERPS) and PoE support

Products Included in this Solution:

<p>Airmux-5000 Point-to-Multipoint Broadband Wireless Access</p>	<p>PacketLight Complete Solutions for WDM/OTN and Dark Fiber Applications</p>	<p>SecFlow-2 Ruggedized SCADA-Aware Ethernet Switch/Router</p>	<p>RADview Management and Domain Orchestration</p>



RAD Products



Virtualized Network Functions by RAD

RAD's comprehensive vCPE Toolbox includes, among others, a range of virtualized network functions (VNFs) that are pre-tested and integrated in RAD's platforms. Some of these VNFs include the vSD-WAN VNF that applies software-defined networking (SDN) to WAN connections; vRouter, which applies routing and security gateway functionality to WAN connections for IP-based business services; and vEncryption – performing Layer 2 encryption of user traffic for point-to-point and multipoint vCPE-based services.

The vAccess (see page 73) manages RAD's pluggable PNFs and provides carrier-grade capabilities to white boxes. Additional VNFs are available via RAD's D-NFV Alliance (see page 6 for more details).

vSD-WAN

Virtualized Networking Function for SD-WAN-Based Business Services by Versa Networks



The vSD-WAN by Versa Networks is a virtualized network function (VNF) that applies software-defined networking (SDN) to WAN connections. Featuring both networking and security functions in a single software, it is used to connect enterprise branch offices and data centers at a lower cost compared to IP VPNs. vSD-WAN offers multi-tenancy and high availability to optimize cost/performance of end-customer services. It features distributed network service functions to provide the flexibility and elasticity for easy, highly scalable and secure deployments. In addition, self-provision and self-care capabilities transform the customer experience. vSD-WAN is part of RAD's vCPE Toolbox. It can be hosted as a VNF on RAD's vCEP-OS and deployed with any ETX platform, as well as any supporting white box. This allows service providers to expand their managed services portfolio with a simplified and unified architecture.

- **Zero-touch provisioning**
- **Multi-tenant support**
- **Application awareness, QoS**
- **Flexible deployment options: bare metal, gray box and VNF**
- **Advanced routing: VRRP, IPAM, OSPF/BGP/MP-BGP/PBR, segment routing, MPLS L3VPN and L2VPN, QoS**
- **Security capabilities with UTM: stateful firewall, DDoS prevention, malware protection, IPS-IDS, IPsec, antivirus, user and group authentication, URL and file filtering**
- **Visibility and analytics**
- **WAN optimization**

vRouter

Virtualized Router Function for IP-Based Business Services



The vRouter is a virtualized network function (VNF) that applies routing and security gateway functionality to WAN connections. Featuring both networking and security functions in a single software, it is used to address all WAN connectivity requirements of a business branch, providing VPN or internet access services. vRouter is part of RAD's vCPE Toolbox and available with all ETX-2i and ETX-2v platforms, allowing service providers to expand their managed services portfolio with a simplified and unified architecture.

- **Stateful packet filtering firewall or pure router**
- **IPv4/v6 routing**
- **Static, dynamic, or policy-based routing**
- **VPN support with IPsec, OpenVPN and NAT**
- **DHCP, DNS and NAT support**
- **Intrusion prevention**

vEncryption

Virtualized Network Encryption Function for vCPE-Based Services



The vEncryption virtualized network function (VNF) is a data encryption software running on RAD's vCPE-OS operating system within the ETX-2i and ETX-2v white box and vCPE platforms, as well as other KVM-based virtualization platforms. It provides extremely tight protection for data transmitted across high speed networks.

The virtualized encryptor operates at the data link layer (Layer 2), masking the payload of received network traffic. The headers are left unencrypted to ensure traffic forwarding through the network remains unchanged. The vEncryption VNF can be used in both point-to-point and multipoint topologies for transport services such as:

- **Dark fiber**
- **CWDM/DWDM**
- **Layer 2 MPLS (VPLS)**
- **Carrier Ethernet MEF services – E-LAN, E-Line, E-Tree**
- **Ethernet pseudowire**
- **Ethernet Virtual Private Line (EVPL)**
- **Local Area Networks (LAN)**
- **Internal server interconnects**

• A

Airmux-400
Point-to-Point Broadband
Wireless Access

Hot Product



RAD's Airmux-400 series of point-to-point broadband wireless radios deliver native Ethernet and TDM services over a single wireless link in various sub-6 GHz frequencies. With a flexible combination of Ethernet and up to 16 E1/T1 interfaces, the high capacity Airmux-400 radio systems provide aggregated throughput of up to 750 Mbps and a range of up to 120 km (75 miles).

The Airmux-400 incorporates advanced features, such as MIMO and OFDM for optimal performance and unmatched robustness in all environments, making it ideal for:

- Cellular, WiMAX and ISP backhaul
 - Broadband access
 - Private networks
- **Multi-band operations over 2.3 to 2.5 GHz, 2.7 GHz, 3.5 GHz, and 4.8 to 6 GHz in a single device**
 - **5 MHz, 10 MHz, 20 MHz, 40 MHz, or 80 MHz channel bandwidth**
 - **Up to 16 E1/T1 ports; up to two Gigabit Ethernet interfaces**
 - **Net throughput (aggregated):**
 - Airmux-400H: up to 750 Mbps
 - Airmux-400Hi: up to 750 Mbps
 - Airmux-400P: up to 250 Mbps
 - Airmux-400L: up to 200 Mbps
 - Airmux-400LC: up to 250 Mbps
 - Airmux-400SP: up to 25 Mbps
 - **OFDM, MIMO and antenna diversity capabilities**
 - **Extended range – up to 120 km (75 miles)**
 - **Hub-site synchronization (HSS) supports simultaneous transmission from up to 16 collocated Airmux-400 and Airmux-5000 units**
 - **Ring protection link (RPL) for Ethernet resiliency**
 - **Spectral power measurement and RF survey tool – “Spectrum View” – for quick and easy installation**

Airmux-5000
Point-to-Multipoint
Broadband Wireless
Access

Hot Product



RAD's Airmux-5000 point-to-multipoint broadband wireless radios are the ideal wireless solution for business users demanding high capacity throughput with dedicated traffic bandwidth allocation and service level agreement (SLA) per subscriber. Featuring up to 750 Mbps aggregated sector capacity and a range of up to 40 km (25 miles), a single Airmux-5000 base station supports up to 64 remote subscriber units (SUs) with multi-band operation, making it ideal for:

- Service providers and ISPs, offering IP backhaul and 4G/broadband access for remote, rural and underserved communities
 - Private networks requiring high capacity inter-branch connectivity for university campuses, healthcare organizations, government institutions, large enterprises and public establishments
 - Security and surveillance applications requiring aggregation and backhaul of traffic from multiple collocated HD cameras
- **Multi-band operation over 2.5 to 2.7 GHz, 3.3 to 3.8 GHz and 4.8 to 6.4 GHz in a single device**
 - **Up to 750 Mbps aggregated throughput per sector**
 - **Up to 64 remote subscriber units per sector with aggregated throughput of 5, 10, 20, 25, 50, and 100 Mbps**
 - **Supports fixed and nomadic applications**
 - **Airmux-5000i with beamforming antenna**
 - **5 MHz, 10 MHz, 20 MHz, or 40 MHz channel bandwidth**
 - **OFDM, MIMO and antenna diversity capabilities**
 - **Range up to 40 km (25 miles)**
 - **Intra- and inter-site TDD synchronization using hub-site synchronization (HSS) and GPS**
 - **Low constant latency – typically 4 to 10 msec in full sector load**

Airmux-Mobility

Mobile Wireless Access



RAD's Airmux-Mobility family of point-to-multipoint radios ensures continuous service to subscribers in motion with bi-directional, uninterrupted broadband connectivity on the move for offshore installations and vessels, Safe City vehicles, as well as on-board communications for trains and metros.

• Airmux-5000MOB

Airmux-5000MOB is ideal for oil rigs, maritime vessels and police/patrol vehicles. It supports real-time video surveillance transmissions and internet access, as well as data and VoIP feeds.

- Coverage range of 11 km (6.8 miles)
- Integrated Wi-Fi access point (802.11b/g/n) for video transmissions
- Built-in GPS for vehicle tracking
- Direct DC power from the vehicle (10 to 36 VDC), power consumption <25W
- Up to 750 Mbps total available throughput from the base station
- Up to 100 Mbps total available throughput for vehicle/vessel subscriber units
- SNMPv3
- AES 128
- IP67 rating for severe outdoor conditions

• Airmux-5000RT

RAD's Airmux-5000RT delivers the highest throughput for on-board communications with guaranteed bandwidth to each railway vehicle, even on subways and monorail lines. It offers bi-directional and asymmetrical train-to-track bandwidth with per-train quality of service (QoS) guarantees. This allows always-on communications between trains and control and operations centers for critical services such as information displays, panic buttons, PTT (push-to-talk), telemetry, ticketing machines, and video streaming. Offering multi-band support in a single box, the Airmux-5000RT offers customization capabilities to address special frequencies, architectures, and more. It is fully compliant with railway environmental standards, which are prerequisite for all equipment installed on railways and metros.

- High capacity sector base station – up to 750 Mbps aggregated throughput with guaranteed bandwidth per train
- Extended coverage for each base station
 - Up to 1 km (0.6 miles) underground
 - Up to 5 km (3 miles) above ground
- High speed – up to 300 km/h (190 mph)
- Configurable asymmetric uplink/downlink traffic
- Supports up to 3x3 MIMO/Diversity
- Seamless handover below 50 msec
- Over the air QoS, enabling prioritization of multiple services
- Low and fixed latency and jitter
- IP67 rating for severe outdoor conditions
- Supports railway standards: EN 50155, EN 61373, EN 50121
- Air link performance monitoring (ALPM) for system and air interface analysis and reporting

• A

ASMi-52, ASMi-52L SHDSL Modems



The ASMi-52 SHDSL multiplexer and ASMi-52L SHDSL modem transmit E1, Ethernet or serial data streams on an SHDSL link at various data rates of up to 4.6 Mbps. Incorporating TC-PAM technology for extending the transmission range, the SHDSL modems enable carriers to cost-effectively reach more users with copper lines at higher data rates over longer distances in the First Mile. The devices address the data transmission and Ethernet extension needs of enterprise users. Typical users include municipalities, utilities, corporate connectivity, and cellular backhaul providers.

- **ASMi-52: two user ports supporting combinations of E1, V.35/X.21/RS-530, and 10/100BaseT**
- **ASMi-52L: single user port of E1, V.35/X.21/RS-530 or 10/100BaseT, or four Fast Ethernet ports with an integrated switch**
- **Data rates between 2.3 Mbps and 4.6 Mbps**
- **Complies with ITU-T G.991.2 and ETSI 101524 standards for SHDSL**
- **Operates opposite RAD's DXC and Megaplex modules as well as third-party equipment**
- **Managed by SNMP, Telnet or ASCII terminal**
- **Available as a 1U half-19" plastic or metal enclosure, or as an EN 50121-4 compliant rail mount**

ASMi-53 SHDSL.bis CPE Modem



The ASMi-53 SHDSL.bis CPE modem is a cost-effective device for extending V.35, E1 and mid-band Ethernet services over multi-pair bonded copper links. Ensuring reliable performance over poor quality or noisy lines, the ASMi-53 SHDSL.bis CPE modem operates in full duplex mode over 2-wire or 4-wire lines, achieving variable data rates of up to 11.4 Mbps.

The ASMi-53 is ideal for carriers, service providers and mobile operators, as well as for enterprises, utilities and transportation companies looking for economical delivery of voice and broadband data traffic in point-to-point or hub-and-spoke communications.

- **E1, V.35 and Fast Ethernet extension over multiple SHDSL.bis lines**
- **Standards-compliant SHDSL (ITU-T G.991.2 and ETSI 101524)**
- **Up to 11.4 Mbps over 4-wire**
- **EFM (Ethernet in the First Mile) bonding per IEEE 802.3-2005; M-Pair bonding for HDLC per G.991.2**
- **TC-PAM 16 or TC-PAM 32 line coding**
- **Ethernet bridging**
- **VLAN prioritization and Ethernet QoS support**
- **SHDSL EOC management channel (inband)**
- **Functions as CPE opposite central devices (Megaplex-4)**
- **Optional remote power feed from DSL line**

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ASMi-54 Family SHDSL.bis Modems



The ASMi-54 line includes the multi-port ASMi-54 advanced SHDSL.bis modem, the cost-effective ASMi-54L SHDSL.bis modem and the ASMi-54LRT managed SHDSL.bis modem with integrated router. The devices support point-to-point and hub-and-spoke connectivity, while the ASMi-54 also supports drop-and-insert (daisy chain) and ring topologies over copper and fiber.

The managed SHDSL.bis modems extend E1 and mid-band Ethernet services over multi-pair bonded copper links. Ensuring reliable performance over poor quality or noisy lines, the devices employ next-generation SHDSL technology and EFM bonding to achieve variable data rates of up to 22.8 Mbps. The ASMi-54 family is ideal for service providers, mobile operators, enterprises, utilities, and transportation companies. The devices feature a compact, half 19-inch enclosure, with optional rail-mountable metal enclosure for deployment in extreme temperature environments.

- Up to four Fast Ethernet ports with an integrated switch or router (ASMi-54LRT); optional one (ASMi-54L, ASMi-54LRT) or four (ASMi-54) E1 interfaces
- ITU-T G.991.2, ETSI 101524; TC-PAM 16 or TC-PAM 32
- ASMi-54, ASMi-54LRT: up to 22.8 Mbps over 8-wire (4 pairs)
- ASMi-54L: up to 11.4 Mbps over 4-wire (2 pairs), 5.7 Mbps over 2-wire (1 pair), or up to 30 Mbps over 4-wire using RAD's high performance SHDSL technology
- EFM bonding per IEEE 802.3-2005; M-Pair bonding for HDLC
- VLAN prioritization, rate limitation per port and Ethernet QoS support; Ethernet OAM per IEEE 802.3-2005 (formerly 802.3ah)
- Static NAT/NAPT routing; Solid Firewall™ protection for LAN and DMZ with ingress rate limitation; IPsec VPN support (ASMi-54LRT)
- Managed via SNMP, Telnet and ASCII terminal

DXC-5000 High Capacity Hybrid Cross Connect

Hot Product



RAD's DXC-5000 enables a seamless migration to next-generation operational networks. It provides multiservice, high capacity core and edge aggregation over TDM, hybrid and all-packet transport. The DXC-5000 reduces operational costs by using a single platform for all service requirements. Critical infrastructure network operators choose the DXC-5000 as it coexists with legacy cross connects, then seamlessly replaces them when they reach end-of-life status, allowing the addition of new services and bandwidth capacity. DXC-5000's transport flexibility ensures that services are matched to the best technology to meet their requirements. By performing service multiplexing over packet and DS1-level TDM switching in the same device, it reduces the transport cost per bit and ensures mission-critical reliability with minimal latency.

- High density Ethernet/SDH/SONET platform available in 2U and 5U high form factors
- High capacity: from E1/T1 to STM-64/OC-192, 10 GbE with a variety of connectivity options including Carrier Ethernet and PDH/SDH/SONET
- Non-blocking SDH/SONET switch capabilities
- TDM circuit emulation
- Carrier Ethernet 2.0-certified including Ethernet OAM, QoS
- Sub-50 ms protection: 1:1, 1+1 APS, BLSR, PW, ERPS, LAG
- Synchronization: BITS, Sync-E, ACR

• E

Egate-100

Gigabit Ethernet over TDM Aggregation Gateway



RAD's Egate-100 Gigabit Ethernet over TDM gateway transports Gigabit Ethernet traffic over channelized STM-1/OC-3 or over three DS3 lines. It leverages widely available PDH/SDH/SONET networks to deliver carrier-class Ethernet Private Line (EPL) services at granular rates, from a fractional E1/T1 to bonded n x E1/T1 channels. The Egate-100 supports NG-PDH encapsulation and bonding standards, such as generic framing procedure (GFP), virtual concatenation (VCAT) and link capacity adjustment scheme (LCAS).

The Egate-100 Gigabit Ethernet over TDM gateway is typically deployed in a central location to aggregate Ethernet user traffic received from a large number of remote units, such as RAD's RICI Ethernet demarcation devices, providing a complete access solution from the service provider's central site to the customer premises.

- Supports MLPPP, as well as GFP (G.8040, G.7041/Y.1303), VCAT (G.7043) and LCAS (G.7042) standards
- MEF-certified for EPL services per MEF-9 specifications
- Ethernet OAM per IEEE 802.3-2005 (formerly 802.3ah)
- Four priority queues per VLAN priority (802.1p), DSCP and IP Precedence; traffic policing per flow and per EVC.CoS
- Gigabit Ethernet and STM-1/OC-3 port protection
- Secure Telnet and web applications, SNMPv3 and RADIUS
- NEBS-compliant
- Optimized for IP DSLAMs and WiMAX base station backhaul applications

Egate-2000

Gigabit Ethernet Aggregator over PDH, SDH/SONET Access



RAD's Egate-2000 is a carrier-grade, high capacity Ethernet over SDH/SONET aggregation device that provides MEF-compliant Ethernet services over channelized STM-16/OC-48 connections. It is typically deployed in a central location to aggregate traffic from remote devices, such as RAD's RICI Ethernet over TDM smart NTUs. Together, they form a complete Carrier Ethernet over TDM access solution from the service provider central site to the customer premises.

Ideal for IP DSLAM and WiMAX base station backhaul applications, the Egate-2000 leverages existing PDH/SDH/SONET infrastructure to deliver carrier-class Ethernet services to sites where native Ethernet is not available.

- Five channelized SDH/SONET ports supporting a combination of STM-16/OC-48, STM-4/OC-12 and STM-1/OC-3
- Eight Gigabit Ethernet interfaces (UTP and SFP)
- GFP (G.8040, G.7041/Y.1303), VCAT (G.7043) and LCAS (G.7042) encapsulation
- Non-blocking switching with VC-12/VT 1.5 granularity
- MEF-9 and MEF-14 compliant for EPL, EVPL, E-LAN
- Enhanced Ethernet traffic management with multiple shapers and hierarchical QoS
- ITU-T G.8032 Ethernet Ring Protection Switching
- Full system redundancy; CE and NEBS-compliant

ETX-102, ETX-202
Basic Ethernet Demarcation
Devices




The ETX-102 and ETX-202 deliver up to 1 Gigabit of user throughput over the fiber Local Loop, from the customer premises to the network's edge. This allows service providers to extend their reach using low-cost Ethernet as the access technology. The devices perform service demarcation for MEF-defined Ethernet Private Line (EPL) services. Alternatively, they provide transport demarcation to SLA-based Layer 3 business services, such as IP VPN, VoIP and dedicated internet access, converging voice and data services over a unified Ethernet, IP or MPLS network.

The ETX-102 and ETX-202 incorporate advanced Ethernet OAM features and QoS (quality of service) capabilities such as rate limitation and traffic prioritization per port and per service, to enable remote service provisioning and end-to-end SLA control.



- **User/network demarcation point for L2/L3 transport and SLA-based business services**
- **Up to two Fast Ethernet or GbE network ports; up to four user ports**
- **MEF-9 and MEF-14 certified for EPL services**
- **VLAN-unaware and VLAN-aware bridging**
- **QoS with rate limitation per user port**
- **Ethernet OAM, performance monitoring and in-service/out-of-service loopback testing**
- **Uplink redundancy**
- **Fault propagation**
- **RADview management**




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» See page 73
for more details

vAccess by RAD

Virtualized network function to seamlessly manage RAD's pluggable physical network functions (P-PNFs) with additional data-plane functionalities, such as MLPPP and more...

Upgrades any white box to carrier-grade with active measurements and reporting of VNF performance.



• E



ETX-2i
IP and Carrier Ethernet
Demarcation with D-NFV

Hot Product



Part of RAD's Service Assured Access solutions, the ETX-2i line of next-generation NID/NTUs offers advanced demarcation for SLA-based, L2 and L3 business services, wholesale services and mobile backhaul. The ETX-2i is MEF Carrier Ethernet 2.0-certified and offers a complete service life-cycle toolset.

The ETX-2i also serves as a Universal CPE (uCPE), Whitebox+, which enhances a pluggable x86 server module with Physical Network Functions (PNFs) to enable superior performance for vCPE applications. It is supported by RADview management and orchestration.

• **ETX-2i: IP and Carrier Ethernet Demarcation Device with D-NFV**



Available as a modular demarcation device, the ETX-2i enables operators to deliver the most advanced Carrier Ethernet services, IP VPNs and vCPE functionalities over any network connection. In addition, the ETX-2i combines advanced timing functionalities for LTE/LTE-A.

- Up to eight GbE combo ports
- Integrated wire-speed switch/router
- Modular network interfaces: FE/GbE (combo), E1/T1, T3, VDSL2, or SHDSL
- Flexible synchronization offering Sync-E, IEEE 1588v2 slave, BC and TC for frequency and phase synchronization in mobile networks
- Hot-pluggable x86 D-NFV server module for hosting virtual functions
- NEBS-compliant and environmentally hardened enclosure options
- 3U device with six GbE combo ports and 64 x E1/T1, offering high scale, cost-effective TDM over packet services

• **ETX-2i-B: IP and Carrier Ethernet Demarcation Device with D-NFV for SMBs**



ETX-2i-B is a demarcation device optimized for remote branches and SMBs over native Ethernet access. It is ideal for carriers, service providers, and wholesale operators requiring advanced Ethernet L2/L3 functionality at customer premises and multi-tenant units (MTUs).

- 1U device with up to six GbE ports
- 2U device with up to 10 GbE ports, ideal for cost-effective small-cell aggregation
- Integrated 6-Gbps switch/router
- Pluggable x86 D-NFV server module for hosting virtual functions (1U device)

• **ETX-2i-10G: 10G Carrier Ethernet Demarcation/Aggregation Device**



The ETX-2i-10G combines intelligent, high bandwidth demarcation and aggregation capabilities for enterprise headquarters and mobile backhaul operators. As an aggregation solution at the concentration point, a single unit can support numerous services and concurrent OAM sessions.

- 19" unit with up to four 10-GbE and up to 24 GbE ports in various combinations
- Half-19" unit with up to four 10-GbE and up to eight GbE ports in various combinations
- Flexible synchronization offering Sync-E, IEEE 1588v2 slave, BC and TC for frequency and phase synchronization in mobile networks
- ITU-T G.8032 Ethernet Ring Protection Switching
- NEBS-compliant and environmentally hardened enclosure options

ETX-2v
Open vCPE White Box Platform

Hot Product



The ETX-2v is a carrier-grade white box, installed at the customer premises – either at headquarters or in remote branch sites. It supports a wide range of business customers and user scenarios, from small offices to large sites, using a variety of bandwidth and processing power options.

- **White box appliance for virtual CPE, SD-WAN and NFV featuring a powerful x86 processor**
- **Supports any application and deployment scenario**
- **Hardware-based security featuring a Trusted Platform Module (TPM)**
- **Flexible SFP/UTP connectivity with optional interfaces including:**
 - Pluggable PNFs – VDSL, GPON, ETHoPDH, PWE, and more
 - LTE and Wi-Fi
- **Supports a range of CPU technologies (Rangeley, Denverton and XEON-D) and a number of cores, as well as different RAM and storage options**

ETX-2i/ETX-2v vCPE Applications



The ETX-2i and ETX-2v feature an x86-based D-NFV module for hosting virtual functions (VFs) and applications. The D-NFV module runs on vCPE-OS, which includes standard KVM hypervisor and OpenStack compute node to support third-party applications. RADview D-NFV Orchestrator enables easy VF download.

Supported applications include:

SD-WAN

Software-defined control of WAN connections with secure overlay tunnels for business services

Router

Virtual router for hosted public clouds and branch CPE deployments

Cryptography

Standard AES 256-bit cipher encryption/decryption of L2-L4 traffic

Firewall

Unified threat management for provider-managed SMB services

Session Border Controller (SBC)

Manages VoIP signaling and media flows

Packet Analyzer

Troubleshooting on demand from the customer edge using a packet sniffer VF

WAN Optimization

Eliminates content duplication, handles compression and optimizes latency

Contact your local RAD distributor for additional/new application information.

• E

ETX-2
Carrier Ethernet
Demarcation

Hot Product



The ETX-2 line of Carrier Ethernet NID/NTUs offers demarcation for SLA-based business services, wholesale services and mobile backhaul. The ETX-2 is MEF Carrier Ethernet 2.0-certified for E-Line, E-LAN, E-Tree, and E-Access services, as well as delivering TDM pseudowire over packet networks. Supporting high capacity service provisioning per EVC/EVC.CoS, flexible classification and H-QoS traffic management, it also performs accurate and scalable service testing and performance monitoring. The ETX-2 is supported by RADview management and enables a variety of protection mechanisms. It also offers NEBS-compliant and environmentally hardened enclosure options.

• **ETX-203AX: Carrier Ethernet Demarcation Device**



ETX-203AX is ideal for carriers, service providers, and wholesale operators requiring advanced Ethernet functionality at customer premises and multi-tenant units (MTUs).

- **Six FE/GbE ports; flexible selection of SFP and copper interfaces**
- **Optional E1 network port for cost-effective Ethernet over PDH services**
- **Optional SHDSL network port**
- **for cost-effective Ethernet over SHDSL service**
- **Optional LTE modem for management and backup of EVC services over cellular network**
- **Wide-range AC/DC power supply**

• **ETX-203AM: Universal Carrier Ethernet Demarcation Device**



Available as a modular demarcation device, the ETX-203AM enables operators to deliver Carrier Ethernet services and L2 VPNs over any network connection.

- **Four FE/GbE Ethernet user ports**
- **Modular network interfaces: FE/ GbE (combo), E1/T1, T3, VDSL, or SHDSL**

• **ETX-205A: Carrier Ethernet/ Mobile Demarcation Device**



The ETX-205A provides advanced Carrier Ethernet demarcation and offers combo interfaces and power supply redundancy. For LTE/LTE-A mobile backhaul, the ETX-205A is installed at cellular tower and controller sites to guarantee differentiated SLAs.

- **L2 VPN service demarcation with superior traffic management and monitoring capabilities**
- **Flexible synchronization offering Sync-E, IEEE 1588v2 slave, BC and TC for frequency and phase synchronization in mobile networks**
- **Distributed Grandmaster architecture integrating built-in GPS receiver with IEEE 1588v2 Grandmaster functionality for cost-optimized LTE deployments**
- **E1/T1 pseudowire services per MEF-8, UDP/IP, MPLS static labeling in SAToP and CESoP modes, and with CAS**

• **ETX-220A: 10G Carrier Ethernet Demarcation/Aggregation Device**



The ETX-220A combines intelligent demarcation and aggregation capabilities to deliver SLA-based Carrier Ethernet services for enterprise and carrier-to-carrier E-Access applications.

- **Up to four 10-GbE ports and up to 20 x 1-GbE ports in various combinations**
- **Flexible synchronization offering Sync-E, IEEE 1588v2 slave, BC and TC for frequency and phase synchronization in mobile networks**

ETX-5
Ethernet Service
Aggregation Platform



The ETX-5 is a leading CE 2.0 access aggregation switch, successfully deployed worldwide in many large networks. It delivers aggregated Ethernet and TDM pseudowire traffic from the access network to the PE (provider edge) over 10-GbE links. Part of RAD's Service Assured solutions for service providers and critical infrastructure, the ETX-5 is ideal for first-level aggregation at the POP, E-NNI inter-carrier demarcation and as a pseudowire gateway for seamless migration to packet networks.

For an enhanced user experience, the ETX-5 is supported by the new RADview management and orchestration system, featuring an intuitive UI/UX to simplify configuration and enable zero-touch service provisioning end-to-end. The ETX-5 is Carrier Ethernet 2.0-certified and includes an extensive toolset to deliver and manage SLA-based services.



- **MEF Carrier Ethernet 2.0-certified:** E-Line, E-LAN, E-Tree services, E-Access; MEF-8; MEF-22: mobile backhaul; MEF-26: E-NNI
- **Ethernet Ring Protection Switching:** ITU-T G.8032v2; supports 40-GbE ring over LAG, virtual rings
- **Extensive TDM pseudowire support:** CESoPSN, SAToP, CESoETH (MEF-8), UDP/IP encapsulation
- **Ethernet OAM termination and grooming;** ITU-T Y.1564 generator/responder
- **16 x 10-GbE network/user ports;** 80 x 1-GbE ports; 16 channelized STM-1/OC-3 user/network ports; four channelized STM-4/OC-12 user/network ports with redundancy
- **Fully redundant, modular system** designed for high availability
- **Supported by RADview Service Manager and RADview Performance Monitoring portal**
- **AC or DC power feed redundancy;** NEBS-compliant industrial-grade enclosure withstands extended temperature range



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» See page 55 for more details

Meet Megaplex-1



Multiservice Pseudowire Access Gateway

- Seamless service migration to PSN
- Comprehensive multiservice support for data, voice and Teleprotection
- Maximum service uptime and reliable resiliency



• F

FCD-155E

Ethernet over SDH/SONET ADM



The FCD-155E transports Ethernet traffic over SDH or SONET networks, enabling carriers and service providers to provide LAN connectivity and internet access while continuing to support E1, T1, E3, or T3 traffic. Installed at the customer site, or used as an add/drop multiplexer on the SDH/SONET ring, this device improves bandwidth efficiency by supporting Ethernet over SDH/SONET encapsulation and framing to enable IP channel bandwidth configuration in increments up to 100 Mbps wire-speed.

The FCD-155E is widely deployed by carriers and service providers to leverage their optical bandwidth for revenue-generating Ethernet services, while enterprises, utilities and campuses use it to provide LAN services over existing fiber optic infrastructure.

- **Standard next-generation STM-1/OC-3 ADM utilizing GFP, VCAT, LCAS**
- **Grooms Ethernet and E1/T1/E3/T3 traffic over STM-1/OC-3 fiber**
- **Multiservice functionality in the same box:**
 - Two or six 10/100BaseT ports
 - Up to 21 x E1/28 x T1 ports, one E3/DS3 port, or 21 x E1/28 x T1 ports and one E3/T3 port
- **SFP-based uplinks**
- **Optional dual power supply configuration**
- **Advanced management option including DCC and IP tunneling**
- **Available with standard protection on the main link**
- **Compact size**

FCD-IP

E1/T1 Access Unit with Integrated Router



RAD's FCD-IP access unit with integrated router is an E1/T1 or fractional E1/T1 access device that enables service providers to bundle data, voice and IP access services over a single E1 or T1 access line. It supports WAN services such as E1 or T1, Frame Relay with auto-learn and ISDN BRI for data backup. An integrated router supports IP routing and transparent bridging.

The FCD-IP is an ideal solution for small to medium-size companies requiring voice and data connectivity and internet access via low rate TDM lines.

- **One or two independent Ethernet ports or an integrated four-port switch (10/100BaseT)**
- **Data interfaces: V.35, RS-530, V.36/RS-449, V.24, X.21**
- **Three optional sub-E1/T1 ports or four analog ports (FXS, FXO, E&M) for PBX/phone connectivity**
- **IP/IPX routing and transparent bridging; OSPF support**
- **Supports Frame Relay (RFC 1490) and PPP protocols**
- **Self-healing ring and drop-and-insert capabilities**
- **Fail-safe sub-E1/T1 ensures uninterrupted service**
- **Dial backup over ISDN/PSTN**

IPmux-1E

TDM Pseudowire Access Gateway



RAD's IPmux-1E TDM pseudowire gateway is customer located equipment (CLE), extending TDM-based services over dark fiber, IP, Ethernet, and MPLS networks. Using TDM pseudowire technology, it delivers ISDN BRI, echo-cancelled E1/T1 or FXS/FXO/E&M services over packet transport, in addition to enabling transparent LAN bridging. The IPmux-1E supports carriers in their migration to next-generation networks by allowing them to continue generating revenues from their ongoing legacy services over PSNs. The ease of installation and support for legacy and next-generation Ethernet and IP-based services make it ideal for small and medium-size enterprises (SMEs).

- **Transmits TDM-based services over Ethernet, IP or MPLS networks**
- **Analog, ISDN BRI or E1/T1 user ports with echo cancellation**
- **Transparent LAN bridging over packet switched networks**
- **Fiber and copper Fast Ethernet uplink interfaces**
- **QoS support**

IPmux-2L, IPmux-4L, IPmux-16L

TDM Pseudowire Access Gateways



The IPmux-2L, IPmux-4L and IPmux-16L are cost-effective TDM pseudowire access gateways, extending TDM, HDLC and LAN traffic over dark fiber, IP, MPLS, or Ethernet. The devices provide an ideal solution for circuit emulation and legacy leased line services, as well as for PBX backhaul, PSTN access, TDM trunking over packet transport, and cellular backhaul. Incorporating a multi-standard pseudowire ASIC, they enable transparent delivery of legacy user traffic over next-generation transport with minimal processing delay.

IPmux-2L, IPmux-4L and IPmux-16L support point-to-point and hub-and-spoke network topologies, offering a complete migration solution when combined with other TDM pseudowire CPEs (such as IPmux-24 and IPmux-216) and aggregation gateways supporting TDM pseudowire (such as ETX-5 and Megaplex-4).

- **Up to two (IPmux-2L), four (IPmux-4L), eight or 16 (IPmux-16L) E1 user ports**
- **Optional n x 64 serial user data port (IPmux-2L)**
- **Three UTP/SFP Fast Ethernet user/network ports (IPmux-4L)**
- **Four UTP Fast Ethernet ports (IPmux-16L)**
- **One or three UTP/SFP Gigabit Ethernet network/user ports (IPmux-16L)**
- **Multi-standard TDM pseudowire ASIC: TDMoIP, CESoPSN, SAToP, CESoETH, HDLCoPSN**
- **QoS support with four priority queues**
- **Ethernet Ring Protection Switching (ERPS) per ITU-T G.8032 supporting up to 16 nodes per ring (IPmux-16L)**
- **Pseudowire OAM**
- **High precision clock recovery for 2G/3G cellular traffic over PSN; optional Sync-E support (IPmux-2L)**
- **Centralized SNMP-based remote management with RADview**

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**IPmux-24,
IPmux-216**TDM Pseudowire
Access Gateways

The IPmux-24 and IPmux-216 extend TDM, HDLC and Ethernet services over packet transport using standard pseudowire encapsulation over Fast Ethernet or Gigabit Ethernet access. The devices' compact design, ease of installation, and advanced traffic management capabilities enable carriers to extend their services from legacy backbones over greenfield packet networks, without affecting customer experience or replacing existing end-user equipment. They also allow service providers to add traditional leased line services to their Layer 2 portfolio and permit enterprises to reduce their IT expenses on PSTN connectivity and branch-to-branch communications. In addition, they support cellular operators in migrating their services to economical packet switched backhaul while maintaining the mobile network's stringent synchronization requirements.

- Up to four (IPmux-24), eight or 16 (IPmux-216) E1 or T1 TDM user ports
- Three SFP-based fiber or copper Fast Ethernet or Gigabit Ethernet interfaces
- Multi-standard hardware-based TDM pseudowire: TDMoIP, CESoPSN, SAToP, HDLCoPSN, CESoETH
- ITU-T G.8032 Ethernet Ring Protection Switching (ERPS) for sub-50 ms restoration; Ethernet link and TDM pseudowire redundancy
- Ethernet OAM: IEEE 802.3-2005 (formerly 802.3ah), 802.1ag/ITU-T Y.1731 (CFM)
- High precision clock recovery for 2G/3G cellular traffic over PSN
- QoS per 802.1p, ToS/DSCP, EXP
- MEF-9, MEF-14 certified for EPL, EVPL services

LA-210EFM DSL Network
Termination Unit

The LA-210 enables service providers to deliver mid-band Ethernet and high speed Ethernet where fiber is not present, by offering Ethernet access rates of up to 22 Mbps over bonded SHDSL.bis copper lines based on standard EFM (Ethernet in the First Mile) technology. Installed at the customer premises, it delivers Ethernet services, such as inter-office LAN connectivity, internet access and virtual private networks (VPNs), as well as legacy TDM service, using pseudowire emulation. The LA-210 features Carrier Ethernet attributes, including Ethernet OAM for proactive SLA monitoring, quality of service (QoS) per Ethernet flow and advanced traffic management capabilities – all starting at the service hand-off points. The LA-210 is certified by the Metro Ethernet Forum to deliver Ethernet Private Line (EPL) and Ethernet Virtual Private Line (EVPL) services per MEF-9 and MEF-14 specifications.

- Mid-band Ethernet access up to 22 Mbps using EFM bonding
- Up to four pairs of EFM bonded SHDSL.bis uplink lines
- Up to four Fast Ethernet user ports
- Pseudowire support for E1, V.35 or X.21 traffic
- MEF CE 2.0-certified
- Advanced QoS mechanism per EVC/EVC.CoS
- Ethernet link and service OAM with performance monitoring for end-to-end SLA control
- Multi-standard pseudowire support for legacy services over PSN

Megaplex-1

Multiservice Pseudowire Access Gateway

Hot Product



RAD's Megaplex-1 is a compact, highly reliable multiservice access node that transports analog and TDM traffic originating from legacy circuit-switched devices, over packet switched networks (PSNs). It is specifically designed to address the needs of critical infrastructure network operators who are migrating to next-generation Ethernet, IP or MPLS communications. This includes utilities, transportation operators and government agencies. It enables seamless service migration with a scalable TDM over packet pseudowire engine and comprehensive multiservice support for PDH, high and low speed data, analog voice, and Teleprotection devices.

- **Grooming and transmitting analog voice and TDM-based services over packet using standard pseudowire technology**
- **Wide range of services: E1/T1, FXS/E&M, IEEE C37.94, programmable serial ports and more**
- **PWE redundancy per tunnel for ultra-fast hitless restoration ensures maximum service uptime**
- **Bridge functionality with two optical/copper GbE uplinks and up to four FE user interface ports**
- **1U 19-inch fanless enclosure with redundant, wide-range power supply (AC/DC)**

Megaplex-2100, Megaplex-2104

Multiservice Access Multiplexers



The Megaplex-2100 and Megaplex-2104 are designed to groom, aggregate and transport multiple broadband and narrowband data and voice services over copper, fiber, wireless, or satellite circuits – all in a single-box solution. They are especially suitable for use as economical, compact remote multiservice nodes for utilities and transportation. In addition, the Megaplex-2100 and Megaplex-2104 are ideal for small to mid-size business entities, providing mixed data and voice services for both business and residential customers. They can be deployed at the carrier's point-of-presence in the exchange, as well as at a remote distribution node, such as in an office building's basement.

- **Multiple E1/T1 links, IP main link with TDMoIP support**
- **Delivers PSTN, ISDN and data services via:**
 - Multiple analog and compressed voice channels (FXS, FXO, E&M)
 - Low speed data (V.24/RS-232, n x 64 kbps, G.703)
- **RFER – Resilient Fast Ethernet Ring or E1/T1 ring protection**
- **Multiple alternative routing schemes in the event of trunk failure**
- **IEEE C37.94 interface for Teleprotection**
- **Omnibus for teleconferencing**

• M

Megaplex-4

Next-Generation
Multiservice Access
Node

Hot Product



RAD's Megaplex-4 is a carrier-class, high capacity multiservice access concentrator for delivering legacy and next-generation services over PDH/SDH/SONET and packet switched transport networks (PSN). Its ability to handle a broad range of Ethernet, data and voice services, as well as a large variety of network technologies, in a single compact managed node, makes it an ideal aggregation solution for carriers and service providers.

The device also provides a perfect fit for large enterprises, utilities and transportation companies who require an efficient way to transport and provision multiple legacy and next-generation services over their high capacity pipes. Megaplex-4 can be used as a central aggregation unit for CPEs carrying TDM and Ethernet services over various access link technologies, e.g., HSDSL and SDH/SONET.

The Megaplex-4 is available with a cable management solution to reduce storage space and handling, and eliminate cable waste.

- **Modular 4U or 2U 19-inch units housing multiple I/O modules**
- **Carrier-class reliability with hardware, service and system redundancy**
- **Hardened and certified for IEEE 1613, including fanless operation for power utilities and EN 50121-4 for Railways**
- **Integrated MPLS switch and IP router**
- **MEF Carrier Ethernet 2.0-certified with traffic management, performance monitoring and Ethernet OAM**
- **Hybrid Ethernet and TDM architecture supporting various services up to STM-4/OC-12 and multi-GbE**
- **Three-tier built-in cyber security, including 802.1x and MACsec**
- **Non-blocking cross connect for a high volume of DS0 channels**
- **Built-in support for distance and differential Teleprotection for power utility applications**
- **Integral xDSL copper modems and fiber multiplexer cards**
- **Voice compression, terminal server, serial multiplexer and Omni voice conferencing modules**
- **Pluggable x86 D-NFV server module for hosting virtual functions and applications**
- **Interoperability with existing TDM equipment (Nokia, Newbridge)**

Megaplex-4 Virtualization Applications



The Megaplex-4 offers an x86 D-NFV module for hosting virtual functions (VFs) and applications. The virtualization module runs RAD's vCPE-OS, which includes a standard KVM hypervisor to support RAD VFs and third-party applications. RADview D-NFV Orchestrator enables easy VF download. An OpenStack compute node is also available.

Supported applications include:

Router

Virtual router for hosted public clouds and branch CPE deployments

Cryptography

Standard AES 256-bit cipher encryption/decryption of L2-L4 traffic

Firewall

Unified threat management for provider-managed SMB services

Session Border Controller (SBC)

Manages VoIP signaling and media flows

Packet Analyzer

Troubleshooting on demand from the customer edge using a packet sniffer VF

WAN Optimization

Eliminates content duplication, handles compression and optimizes latency

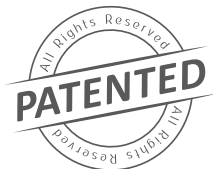
Contact your local RAD distributor for additional/new application information.

MiCLK
1588 Grandmaster on an SFP with Built-In GNSS



RAD's MiCLK® is the world's first Grandmaster on an SFP, allowing easy upgrades for existing base stations and backhaul equipment to support IEEE 1588 for LTE/LTE-A. Easily plugged into service routers to simultaneously distribute frequency and time, the patented MiCLK eliminates the need to install GPS/GNSS antennas at every cell site while providing highly accurate timing distribution with full network coverage – even in underground and in-building installations. It is also ideal for 4G small-cell deployments.

The field-proven MiCLK allows service providers to avoid spoofing and jamming risks, and dramatically reduces installation and engineering costs by eliminating the need for additional space or power requirements.



- Fully-featured standard IEEE 1588 Grandmaster including phase/Time of Day (ToD) to meet stringent LTE Advanced requirements
- Built-in GNSS receiver
- Robust GNSS backup – time holdover when GNSS reception is lost, using Sync-E or 1588 frequency reference from the network (Assisted Partial Timing Support) to deliver continuous and accurate synchronization to the base station
- Miniature pluggable device fits in any standard SFP port
- Scalable solution supports over 256 slaves
- Part of RAD's vCPE offering

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Your Network's Edge®

» See page 56 for more details



MPLS Software Appliance for Critical Infrastructure Communications

On-demand IP/MPLS, MPLS-TP transport with RAD's Megplex-4

• M

MiNID
Miniature Programmable
Network Interface Device

Hot Product



• **MiNID SFP**



• **MiNID Sleeve**



• **MiNID Standalone**



• **MiNID Standalone for Outdoor Installations**



MiNID® is a field-programmable miniature L2/L3 network interface device (NID), available in a variety of form factors. Part of RAD's vCPE and white box solution portfolio, it enriches the Service Assured Access offering with software-defined functionalities for enhanced demarcation, remote monitoring and fault isolation, as well as remote packet capture and micro-burst measurement capabilities.

MiNID also provides instant upgrades for legacy switches and routers, as well as for vCPE platforms and COTS servers to help service providers, mobile operators and wholesale carriers introduce new services quickly and with better quality of experience (QoE) while increasing operational efficiency and lowering costs. Remotely managed via CLI, web interface and SNMP, it features zero-touch provisioning for fast and simple installation and does not require dedicated training.

The MiNID SFP is easily pluggable into SFP ports of switches and routers and eliminates the need for standalone demarcation devices. It delivers substantial OpEx savings by eliminating additional power, space and cabling expenses.

- **Plug-and-play installation**
- **Fits small cells, macro cells, switches, routers, DSLAMs, COTS servers and more**
- **Variety of optical options**
- **LC connectors**
- **Extended temperature range**

The MiNID Sleeve is easily pluggable into SFP ports of switches and routers and seamlessly hosts standard FE and GbE SFP modules.

- **Compatible with standard fiber and copper SFPs in a variety of ranges**
- **Reduces inventory by reusing existing SFPs**

The MiNID is also available in a miniature standalone enclosure, with a variety of user and network port options for maximum interface flexibility. Optional bypass-relay functionality ensures fail-safe operation and Power over Ethernet (PoE) support eliminates the need for an additional power supply.

- **Two ports with flexible user or network functionalities**
- **Combo ports automatically select between fiber and copper/RJ-45**
- **Internal bypass relay for copper interfaces offers service continuity in the event of power failure**
- **Bypass PoE enables powering both the MiNID and the end device**

For outdoor installations, the MiNID Standalone is also available in a hardened enclosure.

- **No fans**
- **Wall and pole mount included**
- **Extended temperature range**
- **SFP interfaces**
- **Fits outdoor installation (IP65)**

MiRiCi-155
Smart SFP Gigabit Ethernet over STM-1/OC-3 Converter



RAD's smart SFP MiRiCi-155 connects Gigabit Ethernet LANs over wireline or wireless STM-1 or OC-3 links. The miniature Ethernet over STM-1/OC-3 converter provides TDM connectivity to any Ethernet device with an SFP (small form-factor pluggable) compatible GbE port. Hot-swappable and software-configurable, the intelligent SFP converter is a fully managed device supporting standard GFP encapsulation. It delivers a complete Ethernet over SDH/SONET solution in a finger-sized SFP enclosure and enables a quick rollout of new Ethernet services over legacy TDM infrastructure. The MiRiCi-155 is part of RAD's "System on an SFP" product line.

- Delivers Gigabit Ethernet traffic over a single STM-1/OC-3 link
- Supports standard GFP encapsulation
- Hot-insertion SFP-format plug, MSA-compliant
- User-configurable
- Enhanced management of control, status and monitoring
- Out-of-band management through I²C
- Supports full duplex flow control
- Fault propagation from WAN to LAN link
- Part of RAD's vCPE offering

MiRiCi-E1/T1
MiRiCi-E3/T3
MiRiCi-ML/E1,T1
Smart SFP Ethernet to E1/T1 or E3/T3 Remote Bridges



RAD's MiRiCi-E1/T1, MiRiCi-E3/T3 and MiRiCi-ML/E1,T1 connect Fast Ethernet or Gigabit Ethernet LANs over framed or unframed E1 or T1 circuits, or over framed T3 links. The smart SFP miniature remote bridges provide TDM connectivity to any Ethernet device with an SFP (small form-factor pluggable) compatible Fast Ethernet or GbE port. Hot-swappable and software-configurable, the intelligent SFPs are fully managed devices supporting standard GFP encapsulation, as well as HDLC and cHDLC. MiRiCi-ML supports PPP and ML-PPP, with the vAccess VNF as the virtualized service engine. They deliver a complete Ethernet over PDH solution in finger-sized SFP enclosures and enable a quick rollout of new Ethernet services over legacy TDM infrastructure. The MiRiCi-E1/T1, MiRiCi-E3/T3 and MiRiCi-ML are part of RAD's vCPE Toolkit. They provide simple and cost-effective alternatives to external, standalone bridge units or conversion cards for user devices, saving on space, cabling and power consumption, and simplifying management.

- Supports framed and unframed E1/T1, E3/T3
- Supports standard GFP, HDLC-like, and cHDLC encapsulation
- Supports PPP and ML-PPP with vAccess VNF
- Hot-insertion SFP-format plug, MSA-compliant
- User-configurable
- Enhanced management of control, status and monitoring
- Out-of-band management through I²C
- Supports full duplex flow control
- Fault propagation from WAN to LAN link
- Software download via TFTP
- Supports Ethernet OAM per 802.3-2005 (formerly 802.3ah)
- Part of RAD's vCPE offering

• M/O

MiTOP-E1/T1, MiTOP-E3/T3

Smart SFP-Format TDM
Pseudowire Gateways



RAD's MiTOP-E1/T1 and MiTOP-E3/T3 transport framed or unframed E1/T1 or E3/T3 traffic, respectively, over Ethernet, IP and MPLS networks. Featuring multi-standard pseudowire support and Synchronous Ethernet (Sync-E) in a finger-sized enclosure, the smart SFP devices provide an ideal solution for service providers, utility companies and enterprises wishing to ensure highly accurate timing synchronization for their legacy services while migrating to packet switched transport.

Part of RAD's "System on an SFP" portfolio, the MiTOP-E1/T1 and MiTOP-E3/T3 are designed for quick and simple insertion into any Fast Ethernet or Gigabit Ethernet port with an MSA-compatible socket.

- Transmits TDM-based services over Ethernet, IP or MPLS networks
- Standard pseudowire encapsulation: CESoPSN, SAToP
- Single E1/T1 or E3/T3 TDM user port
- Transparent to all signaling protocols
- Hot-insertion SFP-format plug, MSA-compliant
- Selectable clock source
- Basic management of control, status and monitoring
- Supports Synchronous Ethernet (Sync-E)
- Part of RAD's vCPE offering
- Supports fractional E1/T1
- Supports CESoPSN CAS
- Up to eight pseudowire tunnels per E1/T1

Optimux-106, Optimux-108, Optimux-108L

Fiber Multiplexers for 4 E1/T1
and Ethernet or Serial Data



The Optimux-106 and Optimux-108 fiber multiplexers deliver TDM and Fast Ethernet or serial data traffic over a fiber optic link, providing a simple, low-cost solution for point-to-point and point-to-multipoint connectivity up to 120 km (75 miles).

The Optimux-108L is an entry-level, power-saving E1 and Ethernet fiber optic multiplexer, enabling a 40% reduction in OpEx related to power consumption of network elements. Typical users include transportation and utility companies, universities and governments, internet service providers (ISPs), and carriers extending data and voice from SDH/SONET networks or backhauling cellular traffic.

- Up to four E1 or T1 ports and a Fast Ethernet user interface; optional V.35 user port (Optimux-106, Optimux-108)
- Full 100 Mbps Ethernet data rate (user)
- Simple plug-and-play installation
- Range extension up to 120 km (75 miles)
- Redundant uplink interfaces and power supplies (Optimux-106, Optimux-108)
- Card versions for the Megaplex-4
- Management via ASCII terminal, web server, Telnet or RADview
- Temperature-hardened enclosures
- Dedicated 10/100BaseT Ethernet management port or dual in-line package (DIP) switches for full or basic management capabilities (Optimux-108L)

Optimux-1025, Optimux-1032

Fiber Multiplexers for 16 E1/T1
and Gigabit Ethernet



The Optimux-1025 and Optimux-1032 provide a cost-effective solution for transparently delivering Gigabit Ethernet traffic, as well as multiple E1 or T1 links, over a fiber optic link for distances up to 120 km (75 miles). The single-box solutions for fiber TDM and Ethernet connectivity offer CapEx and OpEx savings with “pay-as-you-grow” flexibility by supporting initial deployments at partial capacity, with license-based upgrades when needed. The plug-and-play functionality allows carriers, service providers, mobile operators, and large organizations to extend their service reach at lower costs.

- Up to 16 E1 or T1 ports; up to three Gigabit Ethernet user ports
- Total fiber uplink capacity of 1,000 Mbps
- Simple plug-and-play installation
- Range extension up to 120 km (75 miles)
- Redundant hot-swappable uplink interfaces and power supplies
- Management via RADview, CLI, ASCII terminal, SNMPv3
- RADIUS, SSH
- Temperature-hardened enclosures

Optimux-1551

Fiber Multiplexer for
63 E1/84 T1 over
STM-1/OC-3



The Optimux-1551 is a plug-and-play SDH/SONET terminal multiplexer, delivering multiple PDH tributary channels over a single STM-1/OC-3 (155 Mbps) link.

It combines the high capacity associated with SDH/SONET add/drop multiplexers (ADMs) with the simplicity and low cost of a terminal multiplexer to significantly reduce OpEx and CapEx. Extending point-to-point services over coax or fiber to remote locations, the Optimux allows service providers to increase their customer reach, while avoiding the cost and complexity associated with deploying high-end ADMs. Furthermore, the Optimux-1551 eliminates the need for deploying PDH multiplexers at customer sites by consolidating traffic at the edge of the SDH/SONET network. This enables service providers to save the cost of fiber deployment and multiple ports on the ADM.

- Up to 63 E1 or 84 T1 tributary channels
- Channelized STM-1/OC-3 main link with standard fiber optic (single mode, multimode and WDM) or coaxial interface
- 1+1 unidirectional automatic protection switching (APS) on STM-1/OC-3 uplink; 1+1 protection on DS1 tributaries and power supply modules
- Provides a demarcation point between the carrier and private networks
- Full management support for fault, configuration, performance, and security via RADview
- Range up to 80 km (50 miles)

• O/P

Optimux-45L

Multiplexer for 21 E1/28 T1 over Fiber or T3



Optimux-45L is a managed multiplexer transporting multiple E1 and T1 links, as well as a combination of E1 and T1 (according to ITU G.747), over a standard T3 or fiber link. It provides flexible solutions to meet the specific requirements of a broad range of applications and topologies, including campus ring, drop-and-insert for cellular backhaul, point-to-point over wireless links, and point-to-point over SDH/SONET.

- Cross-connect capabilities for drop-and-insert and ring applications
- Multiplexes 21 E1 or 28 T1 channels over a single T3 (45 Mbps) or fiber link
- Simultaneous multiplexing of E1 and T1 channels (according to G.747 standard recommendations)
- T3 transmission over coax, fiber optic
- Self-healing ring capabilities
- Range up to 110 km (68 miles)
- Optional redundant power supply and uplink interface
- Full management support for fault, configuration, performance, and security via RADview – RAD's network management system

PacketLight

Complete Solutions for WDM/OTN and Dark Fiber Applications Layer 1 Encryption



PacketLight's product suite offers the flexibility to build a cost-effective, highly efficient optical network infrastructure for CWDM/DWDM, OTN and dark fiber connectivity, while addressing challenges faced by service providers and organizations.

PacketLight solutions are ideal for a variety of vertical markets, such as carriers, ISPs, dark fiber providers, data centers, storage facilities, utility companies (railway and power companies), and financial institutions.

The wide range of PacketLight xWDM and dark fiber solutions includes multi-rate sub-10G CWDM/DWDM platforms, 10G CWDM/DWDM and 100G solutions with built-in OTN options, muxponders, amplification and booster solutions, WSS-based ROADMs, 10 x 1-GbE muxponders, and passive multiplexing solutions.

- Multi-rate transponders, 2 Mbps to 100 Gbps
- Muxponder for high wavelength utilization; scales to 44/96 wavelengths
- Layer-1 encryption for GbE, 10 GbE, 4G FC, 8G FC, and 16G FC
- Long-distance solutions by amplification and DCM
- Performance monitoring
- Supports single or dual fiber
- Low latency connectivity
- Hot-swappable PSU (AC/DC) and fan
- Integrated management
- Compact 1U integrated devices
- Simple to install, maintain and configure
- Cost-effective CPE device
- Integrated OTN layer (with FEC)



PM Controller
Performance Monitoring
Generator

The PM Controller is a high capacity, central generator for always-on performance monitoring (PM), on-demand testing, diagnostics and troubleshooting of mobile backhaul networks, as well as for premium Carrier Ethernet and IP business services. It uses a wide variety of standard tools to provide deep visibility into network and service performance and to ensure optimal quality of experience in LTE/LTE-A networks, typically characterized by rapid small-cell deployment. Part of RAD's Service Assured Access offering, the PM Controller works opposite routers, switches, mobile base stations, or third-party responders, as well as opposite RAD's ETX and MiNID NIDs. As a non-disruptive add-on, the PM Controller is an ideal solution for existing heterogeneous networks. It enables top line PM and testing in a dynamic environment regardless of the capabilities of the underlying installed base.

• **PM Controller Standalone Appliance**



- **Four FE/GbE combo ports**
- **Monitors and troubleshoots backhaul performance**
- **Service activation tests (Y.1564) over L2/L3, opposite RAD devices or third-party responders**
- **Continuous connectivity and service performance monitoring sessions using TWAMP, ICMP and UDP Echo**
- **Connects to the RADview Performance Monitoring portal for SLA and quality of experience (VoLTE mean opinion score) reporting with aggregated and drill-down views per PM session**

• **PM Controller Virtual Network Function (VNF)**

RAD's PM Controller is also available as a VNF that can be downloaded to third-party servers and central-site appliances, as well as to the x86 server within RAD's vCPE devices, using the RADview D-NFV Orchestrator.



PMC VNF

The PMC VNF provides central generation of always-on performance monitoring over Layer 3 networks.

Contact your local RAD distributor for additional/new application information.

• R

RADview
Network Management
and Orchestration

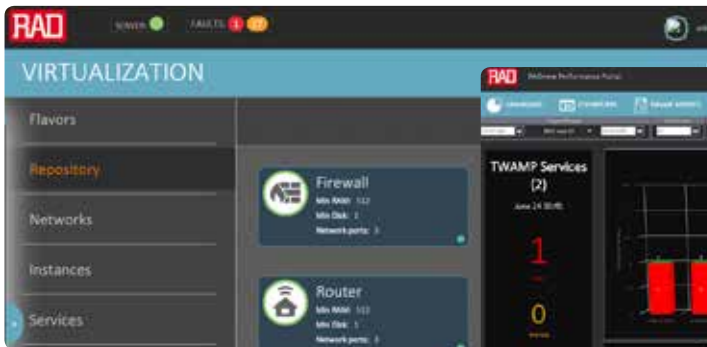
RADview is a modular network management and edge domain orchestration suite for RAD's Service Assured Access and Service Assured Networking solutions. It enables configuration, provisioning, monitoring, and management of networks and services, and includes the following management tools:

- Network element manager
- Performance monitoring portal for ongoing monitoring of Ethernet and IP services
- D-NFV orchestrator for virtual machines and application services at the customer edge
- End-to-end service manager for planning and activation of Carrier Ethernet services
- Service center for managing TDM services

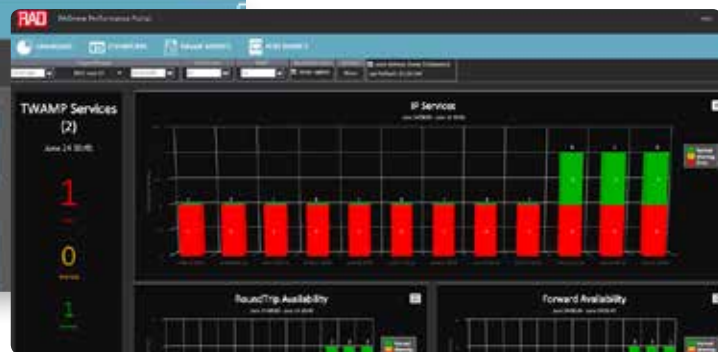
RADview is fully compliant with the ITU-T Telecommunications Management Network (TMN) standards, and features advanced fault, configuration, administration, performance, security (FCAPS) capabilities. Using an SNMP southbound interface, it also includes third-party device monitoring capabilities. RADview's northbound interface enables integration into a third-party umbrella system (OSS).

- **Monitors device health, optimizes network operations and minimizes mean time to repair (MTTR)**
- **Client/server architecture with multi-user support and seamless handover of user privileges**
- **Zero-touch and auto-discovery capabilities**
- **Firewall configurator for remote clusters and devices**
- **Wide range of northbound application programming interfaces (APIs)**
- **Firewall configurator for remote clusters and devices**
- **Interoperable with third-party NMS and leading OSS/umbrella systems**
- **Multi-platform Java-based solution supporting Windows and Linux**
- **IBM Tivoli's Netcool®/OMNibus™**

Intuitive, HTML 5 UI/UX:



RADview D-NFV Orchestrator



RADview Performance Monitoring



RADview Service Manager



• RADview Performance Monitoring



The RADview Performance Monitoring module enables ongoing monitoring of Ethernet and IP service performance by collecting KPI (key performance indicator) data from RAD devices. Part of RAD's Service Assured solutions, it allows service providers and network operators to easily monitor and manage actual network and service performance over time and compare it to service requirements and SLA (service level agreement) guarantees.

The RADview Performance Monitoring module enables immediate detection of service degradation, so that remedial actions are taken to quickly restore guaranteed performance levels. The system retrieves data lost due to connection failures and exports standard CSV ASCII files to OSS or third-party management systems.

- Collects, stores, analyzes and presents KPIs from RAD devices
- In-service bandwidth utilization measurements
- Actual performance metrics based on ITU-T Y.1731:
 - Frame delay (latency)
 - Frame delay variation (jitter)
 - Packet delivery ratio
 - Availability
- TWAMP-based L3 performance monitoring for IP services
- SLA threshold policy management
- Performance dashboard with aggregated and drill-down views
- Monthly and real-time SLA statistics reporting

• RADview D-NFV Orchestrator



The RADview D-NFV Orchestrator uses the OpenStack framework to manage the physical and virtual resources required for effectively running vCPE services and for delivering service agility at the customer edge. It installs, configures and manages virtual machines on the x86 D-NFV module residing within RAD's customer-edge devices. In addition, it manages the repository of RAD-certified VF (virtual function) applications and is used to download the applications to the device.

Featuring a web client with state-of-the-art user interface (UI), the RADview D-NFV Orchestrator enables fast and easy service creation of value-added applications and provides status and utilization reports of the x86 D-NFV modules.

- Configuration and monitoring using OpenStack control node
- Manages application repository with data on vendor, usage and system requirements for each VF
- Downloading and provisioning multiple VFs by the D-NFV module
- x86 inventory management and utilization reporting
- DNFV-OS deployment; ongoing OS and application software updates
- Web client with intuitive UI





- **RADview Service Manager**



The RADview Service Manager module is part of the RADview management suite and provides end-to-end management of MEF-based Carrier Ethernet services for Service Assured Access. An intuitive GUI, "point-and-click" functionality and easy-to-follow wizards facilitate planning, provisioning, monitoring, diagnostics, and SLA assurance, so that network operators can add new service offerings, as well as minimize overall operating costs, reduce provisioning times and maximize the efficiency of the entire network.

- **Offline resource optimization and capacity planning simplifies pre-deployment stages**
- **"Point-and-click" end-to-end service provisioning and OAM settings**
- **Automatic correlation of network faults with impacted services and customers**
- **Security management supporting user access profiles and allowing network partitioning**
- **Graphic representation of network clouds, links, nodes, end-to-end services, and network status indication**
- **Standard northbound interfaces to third-party OSS systems**
- **GUI designed for management of very large networks**

- **RADview Service Center**



The RADview Service Center path management system enables end-to-end management of RAD's TDM access products, while easy-to-follow wizards facilitate provisioning and monitoring over SDH/SONET and PDH networks. Supported capabilities include automatic path routing, automatic re-routing of protected paths, physical and logical representation of the network links, and more. The system allows network operators to add new service offerings while minimizing overall operating costs, reducing provisioning times and maximizing the efficiency of the entire network.

- **"Point-and-click" provisioning from a central workstation for networks of RAD products**
- **Automatic periodic self-healing of faulty services**
- **Service security management, supporting user network access profiles and allowing network partitioning**
- **Service availability report**
- **Dynamic filter displays service and network link-related alarms**
- **Windows-based client and Linux-based server**

RIC-155L

Managed Gigabit Ethernet to STM-1/OC-3 Converter



The RIC-155L delivers Gigabit Ethernet traffic over STM-1/OC-3 or channelized OC-3 links at 155 Mbps access rates. Enabling quality of service (QoS) management for multiple traffic types, as well as monitoring and diagnostics, it is ideal for extending Ethernet connectivity over TDM backbones. Other typical applications include IP DSLAM backhaul, inter-POP connectivity or high bandwidth private line services.

- Two UTP and SFP GbE user ports
- STM-1/OC-3c network ports
- VLAN-aware and VLAN-unaware bridging
- G.7041/Y.1303 GFP encapsulation
- Four QoS levels based on Strict Priority scheduling
- Remote and local, inband and out-of-band management, secure Telnet and web applications, SNMPv3 and RADIUS
- Ethernet jumbo frames supported

RIC-LC

Ethernet Converter for Multiple PDH Circuits



RAD's RIC-LC is a Fast Ethernet over E1 converter that provides simple, efficient and cost-effective Ethernet connectivity over up to 16 bonded E1 links. As an Ethernet converter for multiple PDH circuits, the RIC-LC enables service providers to supply high capacity Ethernet services to remote locations over existing TDM infrastructure. Deployed in point-to-point or hub-and-spoke topologies, it operates opposite Ethernet over TDM demarcation devices and aggregators, such as RAD's RICi-16, Egate-100 and Egate-2000, as well as opposite third-party gateways that support Ethernet over NG-PDH encapsulation and bonding techniques.

The RIC-LC is an ideal solution for Ethernet Private Line and Ethernet Private LAN services, inter-office connectivity, and IP DSLAM, IP Node B and WiMAX base station backhaul over PDH access networks.

- Up to 16 E1 network interfaces
- Four Fast Ethernet UTP/SFP user ports
- GFP (G.8040), VCAT (G.7043), LCAS (G.7042)
- VLAN-aware and VLAN-unaware bridging; VLAN stacking
- Four QoS levels; SP and WFQ scheduling; CIR (committed information rate) support
- Remote and local, inband and out-of-band management
- Dual in-line package (DIP) switches for activating diagnostic loopback tests
- TDM to Ethernet fault propagation

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RICi-4E1, RICi-4T1, RICi-8E1, RICi-8T1

Ethernet over Four or Eight E1 or T1 NTUs



RAD's RICi-4E1, RICi-4T1, RICi-8E1 and RICi-8T1 deliver mid-band and Fast Ethernet services over up to eight bonded E1 or T1 circuits. Employing various standard bonding technologies to create a scalable, virtual channel from individual E1 or T1 circuits, these devices improve overall network availability by reducing latency and optimizing line utilization and throughput. RAD's RICi NTUs support a large variety of applications, including transparent inter-LAN connectivity, direct internet access and Ethernet Private Line, as well as IP DSLAM and WiMAX base station backhaul.

The devices are deployed in point-to-point or hub-and-spoke topologies, providing a cost-effective, high performance solution for mid-band and Fast Ethernet services over legacy PDH/SDH/SONET backbones.

- Four or eight E1/T1 ports
- Up to four 10/100BaseT user ports
- Circuit bonding using MLPPP
- Metro Ethernet Forum certified for MEF-9 EPL services
- Four QoS levels according to VLAN priority (802.1p), DSCP, and per-port priority schemes, per application requirements
- Ethernet OAM per 802.1ag and performance monitoring per ITU Y.1731 for end-to-end SLA control
- Secure Telnet and web applications; SNMP and RADIUS

RICi-16

Ethernet over Bonded PDH NTU



The RICi-16 connects Fast Ethernet LANs over multiple bonded PDH links, enabling service providers to extend high capacity Ethernet-based services to remote locations. It is also ideal for backhauling Ethernet traffic from IP Node Bs, IP DSLAMs and WiMAX base stations over copper-based or microwave PDH connections. Employing standard Ethernet over NG-PDH technology, the RICi-16 improves overall network availability by reducing latency and optimizing line utilization and throughput.

The RICi-16 is MEF-certified for Ethernet Private Line and Ethernet Virtual Private Line services. It is equipped with advanced Ethernet SLA capabilities for handling multi-priority traffic, ensuring latency, jitter and packet delivery performance on a per-flow basis. The RICi-16 features a "pay-as-you-grow" license model, allowing the addition of E1/T1 links according to evolving bandwidth requirements.

- Up to 16 E1/T1 ports; two bonded clear channel T3 ports or a single channelized T3 port
- Up to four 10/100BaseT user ports
- Circuit bonding using standard GFP, VCAT and LCAS with multi-VCG support
- Metro Ethernet Forum certified (MEF-9, MEF-14) for EPL, EVPL services
- Hierarchical QoS with configurable Strict Priority and WFQ (weighted fair queuing) scheduling, EVC shaping
- Color-sensitive P-bit re-marking
- Ethernet OAM per 802.3-2005 (formerly 802.3ah), 802.1ag and performance monitoring per ITU Y.1731 for end-to-end SLA control
- Secure Telnet and web applications; SNMPv3 and RADIUS

RICi-E1, RICi-T1, RICi-E3, RICi-T3

Fast Ethernet over E1/T1 or E3/T3 NTUs



The RICi-E1, RICi-T1, RICi-E3 and RICi-T3 are network termination units (NTUs) connecting Fast Ethernet over framed or unframed E1/T1 or E3/T3 circuits.

The devices are deployed in point-to-point or hub-and-spoke topologies, working opposite RAD's RICi-16, Egate-100, and Egate-2000 Ethernet over TDM gateways. This enables carriers and service providers to extend their customer reach and utilize legacy PDH infrastructure in delivering new Ethernet services. Typical applications include Ethernet access, backhauling network management traffic and connecting inter-office or enterprise LAN segments.

- 10/100BaseT user port
- Single E1, T1, E3, or T3 network port
- PDH to Ethernet fault propagation and TDM loop detection
- Interoperable with third-party devices:
 - RICi-E1/T1 supports standard GFP (ITU-T G.8040) and HDLC
 - RICi-E3/T3 supports X.86 (LAPS)
- QoS priority queues
- Plug-and-play functionality using DHCP client
- Remote diagnostic tools on TDM and Ethernet ports
- Managed via SNMP, web server or Telnet

ROC-19/19L Outdoor Cabinet



ROC-19/19L is a self-contained outdoor cabinet for housing a single 19"-wide RAD unit and a cabling system for various telecom services. Constructed for outdoor use, the enclosure is powered from a DC power source and is ideal for service providers that require efficient environmental isolation for their equipment.

The ruggedized IP56 (ROC-19) and IP66 (ROC-19L) NEMA-4-rated construction includes a rain hood, offering full shielding and protection against dust, rain and ice. Efficient ventilation is assured by an intake fan with replaceable air filters (ROC-19) or passive convection (ROC-19L). Secure, efficient maintenance and access are offered by a 2-point (ROC-19L) or 3-point (ROC-19) door locking mechanism, as well as an integrated fiber cable splicer/guide system, intrusion detection and over-current protection.

- Outdoor cabinet for one 19"-wide RAD unit, with integrated fiber splicer and guides
- IP56-66/NEMA-4-rated metal enclosure
- 24 VDC- or 48 VDC-powered
- Effective grounding and over-current protection
- 2- or 3-point door locking
- Intake fan with replaceable filters, or passive cooling
- Wall or pole mounting options

• S

SecFlow-1

Ruggedized SCADA-Aware Gateway

Hot Product



The compact SecFlow-1 is a ruggedized multiservice gateway, featuring built-in security mechanisms designed for applications controlling mission-critical operations. It is ideal for industrial IoT backhaul, enabling fast, secure and economical deployment of new IoT sites. Allowing secure connectivity over wireless or fiber networks – either public (e.g., cellular) or private, it connects all types of industrial devices, including RTUs, smart meter aggregation devices, IoT base stations or concentrators, CCTV cameras, point of sale devices, Wi-Fi base stations, and more.

SecFlow-1 is also used for operational WANs, providing reliable and secure Layer 2 and Layer 3 communications for power utilities, water and gas utilities, public safety and homeland security agencies, as well as intelligent transportation operators.

- **Multiservice support: Fast Ethernet/GbE, Serial RS-232/485**
- **Connectivity to remote and isolated sites using a dual SIM cellular modem for 2G/3G/HSPA+/HSDPA/LTE uplink supporting flexible connectivity methods such as encrypted L3 DMVPN, IPsec VPN, L2 VPN, NAT**
- **Advanced Ethernet and IP feature-set**
- **Cyber security suite: 802.1X, IPsec encryption with automated PKI, ACL, stateful firewall**
- **Serial protocol handling with transparent tunneling/protocol conversion/terminal server feature-set for IEC-60870-5-101, IEC-60870-5-104, Modbus RTU to Modbus TCP, and DNP3.0 RTU to TCP**
- **Complies with IEC-61850-3 and IEEE 1613**
- **Form factor and functionalities address various installation needs for small stations, data collection sites, and high density aggregation sites**
- **Fault management and reporting, bulk software upgrade, and database management using RADview**

SecFlow-2

Ruggedized SCADA-Aware Ethernet Switch/Router



The compact SecFlow-2 is a ruggedized Ethernet switch/router with built-in security mechanisms designed for applications controlling mission-critical operations. It is ideal for industrial IoT backhaul, enabling fast, secure and economical deployment of new IoT sites. Allowing secure connectivity over wireless or fiber networks – either public (e.g., cellular) or private, it connects all types of industrial devices, including RTUs, smart meter aggregation devices, IoT base stations or concentrators, CCTV cameras, point of sale devices, Wi-Fi base stations, and more.

SecFlow-2 is also used for operational WANs, providing reliable secure Layer 2 and Layer 3 communications for power utilities, water and gas utilities, public safety and homeland security agencies, as well as intelligent transportation operators.

- **Multiservice support: Fast Ethernet/GbE, Serial RS-232/485, Power over Ethernet (PoE)**
- **Connectivity to remote and isolated sites using a dual SIM cellular modem for 2G/3G/HSPA+/HSDPA/LTE uplink supporting flexible connectivity methods such as encrypted L3 DMVPN, IPsec VPN, L2 VPN, NAT**
- **Advanced Ethernet and IP feature-set**
- **Cyber security suite: 802.1X, IPsec encryption with automated PKI, ACL, stateful firewall**
- **Serial protocol handling with transparent tunneling/protocol conversion/terminal server feature-set for IEC-60870-5-101, IEC-60870-5-104, Modbus RTU to Modbus TCP, and DNP3.0 RTU to TCP**
- **Complies with IEC-61850-3 and IEEE 1613**
- **Form factor and functionalities address various installation needs for small stations, data collection sites, and high density aggregation sites**
- **Fault management and reporting, bulk software upgrade, and database management using RADview**

SecFlow-4

Modular Ruggedized
SCADA-Aware Ethernet
Switch/Router

Hot Product



The SecFlow-4 is a high density, modular system with built-in security mechanisms designed specifically for SCADA applications. It combines functionalities that typically require separate devices and provides an efficient distributed security layer protecting from insider attacks. This ruggedized, modular switch/router provides a flexible platform with a combination of fiber and copper Ethernet ports, as well as serial interfaces for legacy devices.

The SecFlow-4 modular ruggedized SCADA-aware Ethernet switch/router is ideal for utility companies and critical infrastructure organizations. These include Smart Grid and intelligent transportation operators, water and gas utilities, as well as public safety and homeland security agencies.

- High density, modular and ruggedized system
- Designed for harsh environments
- Advanced Ethernet and IP feature-set
- Ethernet interfaces with optional PoE support
- Serial interfaces with protocol gateway and tunneling
- Integrated L2/L3 VPN agent

SFP/XFP/SFP+ Transceivers

Small Form-Factor Pluggable
Transceivers



RAD's SFP/XFP/SFP+ small form-factor pluggable transceivers are hot-swappable, input/output transceiver units converting optical and electrical media. Providing a wide range of detachable interfaces to multimode/single-mode optic fibers and UTP/coaxial electrical cables, RAD's miniature transceiver units enable significant savings in system maintenance and upgrade costs, as well as facilitate efficient design of host devices and flexible network planning.

It is strongly recommended to order RAD devices with original RAD SFP/XFP/SFP+ transceivers installed, to ensure that the entire assembled unit has undergone comprehensive functional quality tests. RAD cannot guarantee full compliance to product specifications for units using non-RAD SFP/XFP/SFP+ pluggable transceivers.

Optical SFPs

- MSA (multi-source agreement) compliant
- Built-in DDM (digital diagnostic monitoring) function
- 64-to 2016-byte frames, including VLAN-tagged frames
- LOS (loss of signal) fault propagation
- Flow control mechanism

Smart SFPs

- GPON OLT in an SFP
- VDSL2 SFP

• S

SPH-16
SFP Patch Hub

The SPH-16 is a managed SFP patch hub that connects up to 16 Fast Ethernet (100 Mbps) and Gigabit Ethernet (1000 Mbps) copper sockets (RJ-45) to any standard SFP device. Compatible with any standard Ethernet switch featuring RJ-45 connectors, it can act as a multi-port media converter enabling carriers to maintain a unified service over fiber and copper infrastructure. The SPH-16 houses RAD's special "System on an SFP" devices, including the MiRiCi-E1/T1 and MiRiCi-E3/T3 miniature Ethernet over TDM remote bridges, as well as the MiTOP-E1/T1 and MiTOP-E3/T3 SFP-format TDM pseudowire gateways.

- **Converts standard Ethernet copper (RJ-45) ports to SFP sockets**
- **Fully transparent Layer 1 conversion at wire-speed**
- **Supports any standard SFP device, bypassing the vendor's specific SFP port protection**
- **Auto-discovery of Fast Ethernet and Gigabit Ethernet**
- **Optional dual power supplies with full redundancy**
- **Fault propagation from WAN to LAN**

S-RPT/4W
SHDSL/SHDSL.bis Repeater

RAD's S-RPT/4W extends the transmission distance of SHDSL or SHDSL.bis modems operating on 2-wire or 4-wire lines, respectively. Employing TC-PAM 16/TC-PAM 32 technology, this SHDSL repeater can double the transmission distances. Typical applications include DSL links alongside highways, railways, pipelines, power lines, and waterways, as well as DSL transport to remote concentrators in rural or remote areas, and communication lines to military, construction or temporary field camps and sites.

Installed between two SHDSL modems, the S-RPT/4W regenerates the received modem signal faultlessly. Multiple repeaters can be used, without introducing jitter or wander problems.

- **Ethernet in the First Mile (EFM) bonding**
- **Based on the SHDSL standard for higher speeds and longer loop ranges**
- **Locally or remotely powered**
- **Available as a desktop unit or in IP67 casing for installation in communication ducts**
- **Fully manageable via EoC link**
- **High quality, high performance**

vAccess
Pluggable PNF
Management

Hot Product



Part of RAD's vCPE Toolbox, vAccess is a state-of-the-art virtualized network function (VNF). It provides control and management for RAD's pluggable PNFs, as well as additional data-plane functionalities and service assurance capabilities.

vAccess upgrades any white box to a carrier-grade level with the following functions:

- **Packet over TDM (E1/T1/E3/T3)**
 - PPP and MLPPP in a vCPE environment
- **Control and management of RAD's pluggable devices**
- **Active measurement and reporting of VNF connectivity, performance and delay/delay variation (PDV):**
 - Supports performance monitoring for SLA compliance of the service function chain
 - Detects and reports VNF freeze and performance degradation to ensure fast resolution

Your Network's Edge®

Hit the
Cloud Running

For details, contact market@rad.com

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vCPE-OS

Open Carrier-Class Operating System for Network Edge Virtualization

Hot Product



Part of RAD's Service Assured Access (SAA) solutions, the Linux-based, carrier-class vCPE-OS runs on any white box server and is pre-loaded in RAD's virtual CPE (vCPE) platforms. It combines powerful networking capabilities with virtualization for hosting SD-WAN and any other value-added virtual network function (VNF) applications from any vendor.

- **Slim, high performance operating system for optimized vCPE**
- **Open solution, compatible with any VNF (networking, security and IT), orchestrator and SDN controller**
- **Any access with advanced transport/networking capabilities: LTE, Wi-Fi, Carrier Ethernet, xDSL, PON, and TDM**
- **High Availability: performance monitoring, troubleshooting and self healing: TWAMP, ICMP Echo, UDP Echo**
- **Any hardware: RAD's white box, gray box platforms, third-party servers, and RAD's pluggable PNFs**
- **Comprehensive management and security suite**
 - NETCONF/YANG, CLI, Syslog, alarms, and more
 - SNMPv3, SSH, SFTP, Access Control, TACAS+, RADIUS
 - Zero-touch and call-home provisioning

vCPE-OS Virtualization Applications



The vCPE-OS includes standard KVM hypervisor and OpenStack compute node to support third-party applications. RADview D-NFV Orchestrator enables easy virtualized function download.

Supported applications include:

SD-WAN

Software-defined control of WAN connections with secure overlay tunnels for business services

Router

Virtual router for hosted public clouds and branch CPE deployments

Cryptography

Standard AES 256-bit cipher encryption/decryption of L2-L4 traffic

Firewall

Unified threat management for provider-managed SMB services

Session Border Controller (SBC)

Manages VoIP signaling and media flows

Packet Analyzer

Troubleshooting on demand from the customer edge using a packet sniffer VF

WAN Optimization

Eliminates content duplication, handles compression and optimizes latency

Contact your local RAD distributor for additional/new application information.



RAD Services





RADcare Global Services

Peace of Mind, Where and When You Need It

RAD's Service Assured Access (SAA) and Service Assured Networking (SAN) solutions are all about enabling service providers and network operators to deliver the best possible service experience and seamlessly migrate to next-generation networks – all while increasing operational efficiency and reducing TCO.

Complementing these offerings are RADcare Global Services, a great resource developed specifically to help our customers receive the full benefits of our solutions with real-time service guidance, planning and preventive maintenance.

RADcare Global Services provide expert consulting and troubleshooting assistance, online tools, regular training programs, and various equipment coverage options – all designed to enable seamless installations and faster service rollouts. Moreover, our RADcare programs help service providers to meet their SLAs and avoid penalties while private network operators can rely on full support for their mission-critical applications.

These vital services are available from authorized RAD Partners and backed by a highly dedicated and professional team of regional technical assistance centers, together with project management staff and international training professionals.

RADcare Global Services



- Project Assured
- Guidance throughout design and rollout
- High- and low-level network design
- Support service migration and network upgrades
- On-site services



- Strict SLA commitments on response, service restore and resolution times
- 24x7 support, priority handling and escalation procedures
- RADcare Online portal for software updates and upgrades
- Optional multi-year blanket coverage



- Training-on-demand
- Regional sales, pre-sales and technical seminars
- RAD certification



- Project coordination
- Single point of contact
- Periodic meetings and progress reports
- Project-specific documentation

Partner Benefits

- Strict service level agreements (SLAs): receive response, restore service and resolve issues within a known and guaranteed time frame
- Move to the head of the queue with priority handling by RAD support centers and round-the-clock access to RAD's experts
- Free access to RADcare Online, including regular software updates and patches, online/remote configuration assistance and RAD's FAQ knowledge base

Customer Benefits

- Ensure optimal quality of experience for your customers by maintaining a high quality network
- Meet your SLAs and avoid penalties by minimizing service outages and enabling fast recovery
- Plan ahead to limit your spending on support and eliminate hardware repair costs related to old equipment
- Shorten time to market (TTM): rely on RADcare to support your operations so you can turn up new services faster



RADcare Professional Services

RADcare Professional Services encompass all relevant aspects of the pre-installation design and rollout stages to get the new network up and running as quickly and as seamlessly as possible while providing additional vital benefits.

RADcare Professional Services include the following valuable elements:
Planning • Staging • Site Survey • Equipment and Management Installation
• Acceptance Testing and Commissioning • Resident Engineer

RADcare Project Assured Service

Enjoy full Project Assured service led by certified RAD engineers who are committed to your project's success from start to finish. RAD offers different Project Assured packages which include:

- High-level design (HLD): thorough review of the physical topology, required hardware and software, and network management
- Low-level design (LLD): a definitive reference for system and network implementation, including detailed configuration instructions for devices, network management system and interfaces
- Configuration and testing performed by RAD experts to ensure ideal turn-up time
- Full documentation of your system's installation requirements for easier maintenance and future changes
- Commissioning design and execution so that the entire network can be certified before sign-off



RADcare Project Management

RAD's professional Project Management staff ensures that your project will have a timely and smooth implementation from the planning stage through completion.

- A single point of contact (Project Manager) within RAD supervises all logistical, technical and commercial aspects of the implementation of all network solutions under your contract
- Periodic status meetings
- Detailed project plan procedures and documentation, regular progress reports, and management of all project aspects



RADcare Training Center

RAD's training programs are designed to keep your team up-to-date with the latest RAD solutions.

- Technical seminars, web-based training and project-based training: a variety of on-site and remote interactive training options to ensure your engineers master your RAD equipment
- Course materials include a carefully balanced mix of lecture, demonstration and hands-on experience
- Topics include theory, configuration and troubleshooting





RADadvantage
Partners Program



Welcome to the RADadvantage Partners Program

Commitment. Trust. Respect. Partnership. These are just some of the values that comprise the essence of RADadvantage, RAD's channel partner program. Ultimately, the success of a partnership is measured by the benefits that are enjoyed by all parties:

the vendor, its partners, and their respective end-users. That's why RAD places immense value on its network of channel partners and aims to make selling RAD products and services both easy and lucrative.

Shared Interests and Commitments

RAD and its channel partners embrace a set of fundamental guiding principles, including:

- Work together to deliver the highest quality products, solutions and services that create loyal end-users
- Aim to maximize profitability for both parties
- Conduct business in an atmosphere of trust and mutual respect
- Resolve problems with candor and good judgment
- Cooperate to win new business and improve existing opportunities

RADadvantage Program Highlights

The RADadvantage Partners Program is designed to incrementally reward partners based on achievements in annual revenues, service level accreditation and commitment. Designated partnership levels are reviewed and adjusted annually.

RADadvantage partners enjoy benefits such as:

- Industry-leading margins
- Joint business development efforts
- Online and face-to-face sales and technical training programs
- Discounted demo gear
- Support for co-branded marketing activities
- Official acknowledgement of Partner relationship

Check out the new RADacademy »



RADacademy

RAD Group

RAD is the anchor of the RAD Group, an affiliation of ICT manufacturing companies often cited as one of the world's premier generators of hi-tech innovation. A unique business philosophy distinguishes the RAD Group, which has no holding company but is guided by its founders. Each company in the RAD Group operates autonomously under a common strategic umbrella. This decentralized approach maximizes the advantages inherent in small business units, such as flexibility, entrepreneurial spirit and management focus. A new company is established when a market opportunity is identified – requiring a technology, marketing approach or corporate culture that does not exist in any of the other companies. Four RAD Group companies are currently traded on the Nasdaq Stock Market in the US, while the others are privately held by the Group's founders and various venture capital firms.

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