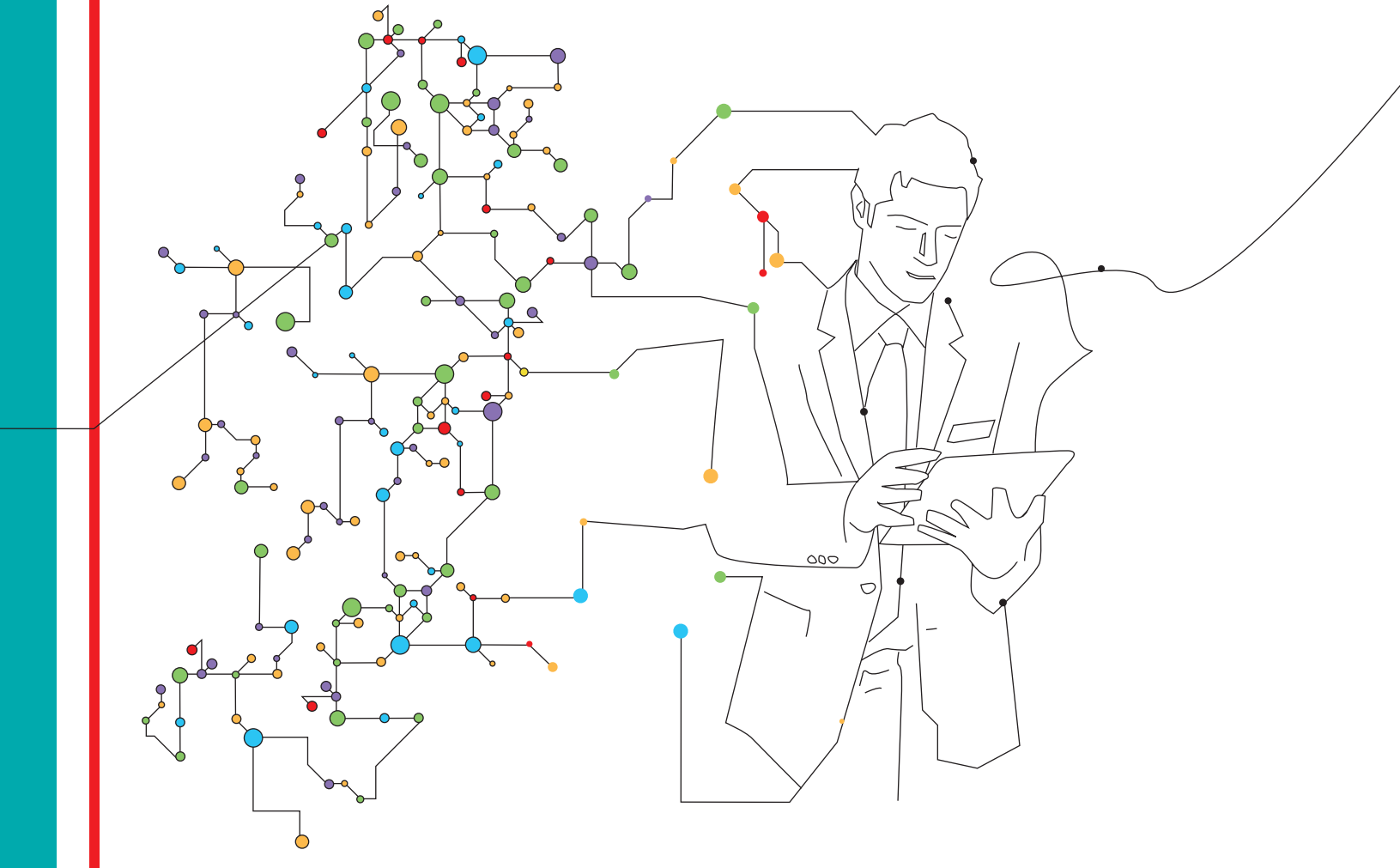
Simplifying Access Solutions



Solutions Catalog 2013

RAD

data communications

The Access Company

Simplifying Access Solutions

RAD Data Communications offers carriers, service providers, mobile operators, and enterprise users a wide range of access products and network aggregation solutions to enable the fast and easy deployment of multiple services, while controlling OpEx and CapEx and minimizing end-user outlays for new and existing communications requirements.

The company's product portfolio gives both public and private telecommunications providers a comprehensive, integrated and interoperable access and aggregation solution, with service management capabilities, at a competitive price, which is designed to deliver long-term value.

Carriers & Service Providers

Deploy Carrier Ethernet services and transport networks with end-to-end quality of service for SLA assurance. Roll out and extend multiple legacy and next-generation services over any topology and infrastructure: fiber, PDH/SDH/SONET, DSL, and wireless.

Government & Enterprise

Support disaster recovery, public safety and homeland security applications with tailored access and backhaul solutions for TETRA, video surveillance, secure fiber, and encrypted wireless networks.

Transportation & Utilities

Support diverse applications ranging from mission-critical control data, video surveillance and voice traffic, to Internet access, LAN, and industrial Ethernet over various network topologies across their own communications grid or facilities leased from service providers. Manage the transition from existing access and transport infrastructure to the Smart Grid and new packet-based networks.

Mobile Backhaul

Enable high capacity intelligent demarcation, backhaul and aggregation of 2G, 3G, HSPA, and LTE traffic over packet-based or legacy networks. Extend mobile services to underserved rural or sparsely populated areas with low-cost fiber, copper and wireless modems and multiplexers.

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Company Profile

Celebrating more than 30 years of innovation, quality and commitment, RAD Data Communications is an award-winning manufacturer of cost-effective access and backhaul solutions for service providers, wholesale carriers, mobile operators, public utilities, transportation systems, and private networks operated by enterprises, government agencies and educational institutions around the world.

Its expertise in international markets, strict adherence to quality standards, environmentally friendly operations and green manufacturing ethos, together with a corporate culture that encourages long-term relationships with customers, channels, suppliers, and employees, combine to make RAD the perfect partner for all your telecommunications and data communications projects.

Fast Facts

- Established in 1981, privately held RAD Data Communications is the anchor of the RAD Group of companies, with revenues exceeding $1 billion
- RAD maintains 31 offices on six continents, supporting 300 sales channels serving 165 countries
- Approximately 30 percent of RAD's 1,000 employees are engaged in R&D
- RAD has a distinguished record of leadership in industry bodies such as the International Telecommunications Union (ITU), IEEE, Metro Ethernet Forum (MEF), Broadband Forum, the Internet Engineering Task Force (IETF), and CELTIC, a EUREKA cluster that is the only European research and development program dedicated to end-to-end telecommunications solutions
- RAD has a global installed base of more than 12 million units

Lower Total Cost of Ownership Facts

- RAD developed in-house its own Carrier Ethernet ASIC, which lowered the investment required by operators to mass deploy Ethernet NTUs and MDDs, winning Frost & Sullivan's Price Performance Value Leadership award, and two Carrier Ethernet awards
- RAD's all-in-one solutions reduce CapEx and OpEx by combining diverse access technologies and functionalities in a single device, mitigating the need for excess inventory and simplifying operations
- RAD's future-proof AXCESS+ portfolio enables easy service migration to next-generation networks and services without any forklift upgrades
- RAD's integrated solutions for end-to-end monitoring of data networks lower CapEx by reducing implementation time and slash OpEx by enabling faster and more detailed fault diagnoses and reduced mean-time-to-repair
- RAD has inaugurated a new generation of energy-saving devices, beginning with an optical multiplexer that consumes far less electricity than similar solutions in the market

Innovation Facts

- RAD was the first vendor in the industry to win a large-scale deployment of a demarcation device with Sync-E and to demo 1588-2005 in an incumbent carrier's test lab
- RAD was the first vendor to integrate a 1588 Grandmaster into a Carrier Ethernet service aggregation platform
- RAD was the first vendor to miniaturize an interface converter and pseudowire gateway into an SFP and has now become the first to offer a flow-based SFP-NTU
- RAD's pioneering TDMoIP® technology, which it introduced to the market over a dozen years ago, was the forerunner of today's widely deployed pseudowire solutions
- RAD was the originator of Single IP, which enables multiple users to share a common IP address for Internet access

Leading Customers

RAD is a preferred solutions provider for more than 150 carriers around the world, from Tier-1 service providers to mobile operators, city carriers, ISPs, and rural service telcos.

Customers include the industry's global leaders, from **AT&T** to **Bell Canada, Bharti Airtel, British Telecom (BT), CenturyLink, China Mobile, China Telecom, Deutsche Telekom, Embratel, France Telecom/Orange, Hutchison, KDDI, KPN, SingTel, SoftBank, Sprint, Telefónica, TeliaSonera, Telstra, TELUS, T-Mobile**, and **Verizon**.

Beyond its strong ties with telecom providers, RAD maintains extensive relationships with enterprise network professionals in the banking, commercial, energy, financial, insurance, and manufacturing sectors.

Worldwide Brand Recognition

EtherAccess
Carrier Ethernet Solutions

System on an SFP
Miniaturized Intelligent Network Devices

SyncToP
Timing Synchronization Technology

AXCESS+
Multiservice and First Mile Solutions

TDMoIP Driven®
TDM Pseudowire Technology

RADcare Professional Services
Comprehensive Service and Training Programs

RADVIEW
Integrated Management Systems

ACE
Aggregation and Cell-Site Gateways

AIRMUX®
Airmux Sub-6 GHz Radios

Carrier & Service Provider Solutions

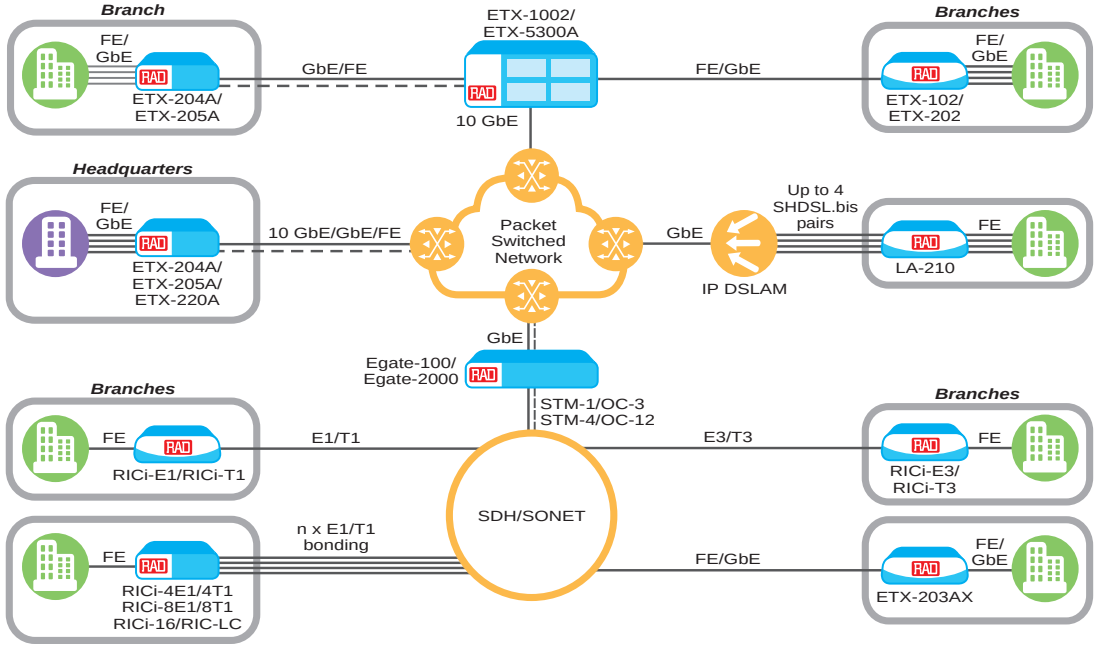
RAD offers a variety of access technologies to deliver new Carrier Ethernet services and Layer 2/Layer 3 demarcation while cost-effectively supporting traditional applications and ensuring seamless service delivery over diverse access infrastructure.

RAD's solutions enable providers to maximize service reach over regional, national and global segments by leveraging investments in advanced network platforms, with a full range of service rates up to 10 Gbps.

Carriers can offer uniform service attributes across multiple provider networks using effective service management tools for maintaining end-to-end SLAs with class of service (CoS) consistency and complete visibility.

In addition to supporting business retail and carrier-to-carrier solutions, RAD's portfolio enables wholesale transport providers and mobile operators to optimize and reduce backhaul costs of 2G, 3G and LTE voice and data communications over any infrastructure, easily accommodating increased bandwidth requirements from new service deployments and ensuring quality of service guarantees with combined demarcation and Timing over Packet synchronization.

Intelligent Ethernet Demarcation for PSN Networks



Description:

Ethernet demarcation for EPL, EVPL, E-LAN and E-Access services with SLA assurance over fiber, bonded circuits, and DSL access.

Benefits & Features:

- **Consistent service delivery over any access with MEF-9 and MEF-14 certified products**
- **Complete service lifecycle management and end-to-end SLA assurance with test-head functionalities: RFC-2544, 802.3ah, 802.1ag, Y.1731, L2/L3 loopbacks, and more**
- **Hierarchical QoS for multi-priority CIR and EIR traffic; packet delivery performance with latency, jitter, loss and availability guarantees on a per-flow basis**
- **Hardware-based OAM enables ultra-fast processing of hundreds of OAM sessions, highly accurate measurements and live-traffic testing**
- **High availability and service continuity with link redundancy, linear EVC path protection and ring topology**

Products Included in this Solution:

ETX-205A
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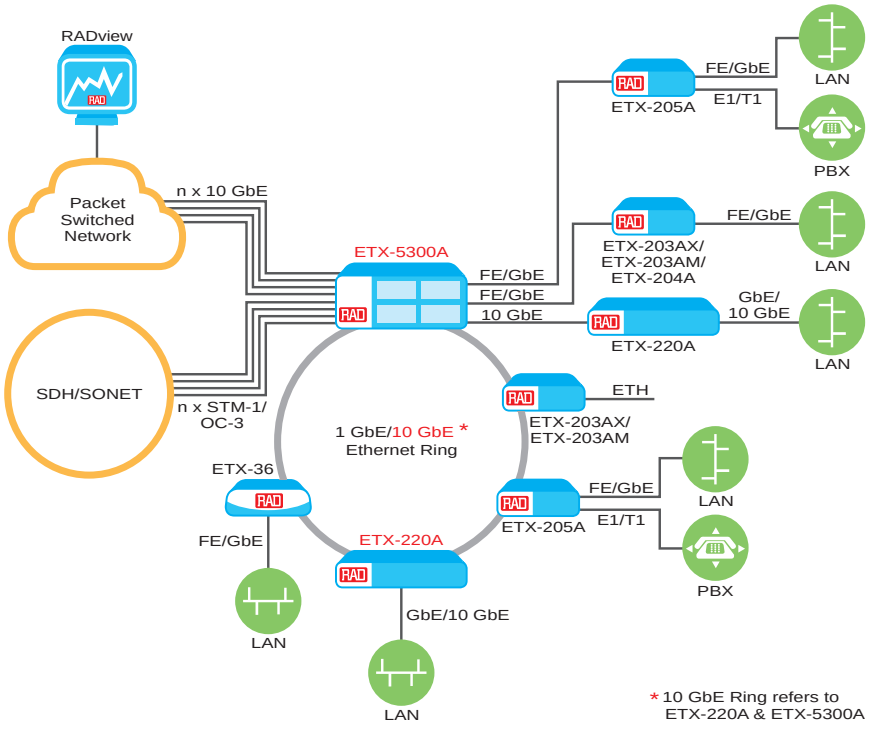
And: **Egate-100** P. 64 | **Egate-2000** P. 65 | **ETX-102/202** P. 67 | **ETX-203AX** P. 68 | **ETX-204A** P. 68 | **ETX-220A** P. 69 | **ETX-1002** P. 70 | **ETX-5300A** P. 70 | **RADview** P. 87-89 | **RIC-LC** P. 91 | **RICi-4E1/4T1** P. 91 | **RICi-8E1/8T1** P. 91 | **RICi-E1/T1** P. 92 | **RICi-E3/T3** P. 92 |

Fiber Ethernet Access and Aggregation



Description:

A complete Carrier Ethernet access solution, including smart demarcation and Ethernet service aggregation using linear and ring topologies.

Benefits & Features:

- **Carrier Ethernet access ecosystem from a single source**
- **Versatile deployment topologies in the access, including star, mesh and Ethernet ring (G.8032) connectivity**
- **Allow both Ethernet and TDM E1/T1 service delivery to the end user over the same access link**
- **Incremental Ethernet service rates up to 10 Gbps**

Products Included in this Solution:

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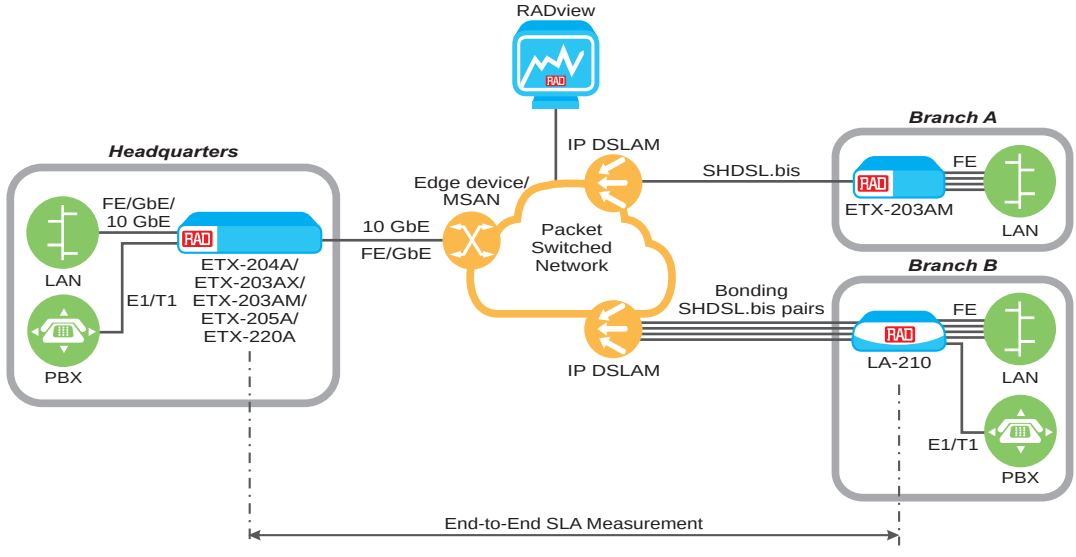
And: **ETX-203AM** P. 67 | **ETX-204A** P. 68 | **ETX-205A** P. 69 | **ETX-220A** P. 69 | **RADview** P. 87-89

Mid-Band and High Speed Ethernet Services over Fiber and DSL



Description:

Provide Layer 2 VPN (virtual private network) services to business users with consistent service attributes over fiber and SHDSL.bis access.

Benefits & Features:

- **Up to 22.8 Mbps over EFM-bonded SHDSL.bis pairs and 10 Gbps over Ethernet fiber**
- **Deliver SLA-based Ethernet Private Line (EPL), Ethernet Virtual Private Line (EVPL) and Ethernet LAN (E-LAN) services**
- **Provision differentiated services across diverse access links with Ethernet OAM, performance monitoring and advanced traffic management capabilities**
- **Provide legacy E1/T1 services over the same Ethernet access link (fiber or DSL) using pseudowire technology**

Products Included in this Solution:

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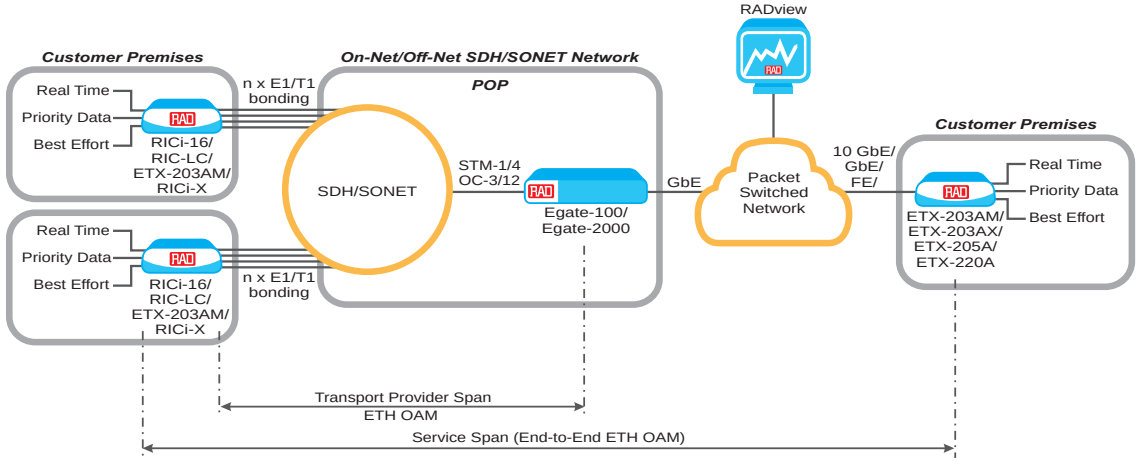
And: **ETX-203AX** P. 68 | **ETX-204A** P. 68 | **LA-210** P. 76 | **RADview** P. 87-89

Carrier Ethernet Service over SDH/SONET



Description:

Utilize leased TDM lines to reach customers for Ethernet services, while ensuring consistent service attributes and end-to-end SLA control across different networks and provider domains.

Benefits & Features:

- **Extend Ethernet service reach over third-party networks without affecting user experience or service quality**
- **End-to-end service control and performance measurements using Ethernet Service OAM allow SLA verification across the access provider's network**
- **Provide same service definition for on-net and off-net customers**
- **Higher bandwidth rates with Ethernet over NG-PDH/SDH encapsulation and bonding standards (GFP, VCAT, LCAS) ensure service quality with hitless restoration, flexible access rate granularity and multi-vendor interoperability**
- **Use all-in-one ETX-203AM to provide Ethernet services over both PDH circuits and fiber Ethernet access lines**

Products Included in this Solution:

Egate-100
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ETX-203AM
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RICi-16
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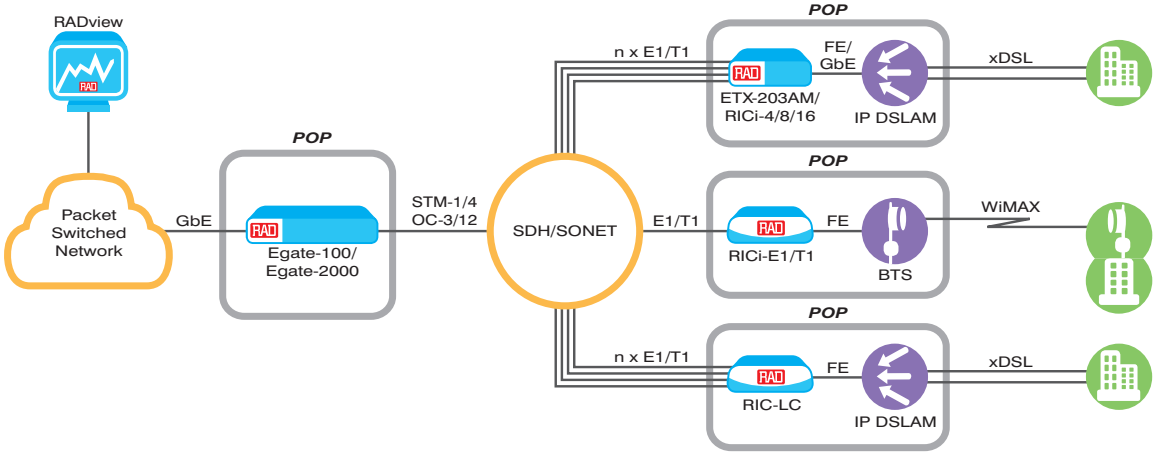
And: **Egate-2000** P. 65 | **ETX-203AX** P. 68 | **ETX-205A** P. 69 | **ETX-220A** P. 69 | **RADview** P. 87-89 | **RIC-LC** P. 91 | **RICi-4E1/4T1** P. 91 | **RICi-8E1/8T1** P. 91 | **RICi-E1/T1** P. 92 | **RICi-E3/T3** P. 92

IP DSLAM and WiMAX Backhauling over SDH/SONET



Description:

Provide broadband access by backhauling traffic from IP DSLAMs and WiMAX base stations over PDH and SDH/SONET transport with seamless hand-off to a packet switched network.

Benefits & Features:

- **A variety of access bandwidth rates up to 1 Gbps using GFP, VCAT and LCAS bonding and encapsulation protocols**
- **Seamless extension and aggregation of Ethernet/IP-based broadband services over TDM infrastructure**
- **Fast deployment of broadband services**
- **Reduce OpEx and CapEx by leveraging existing transport infrastructure**

Products Included in this Solution:

Egate-100
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ETX-203AM
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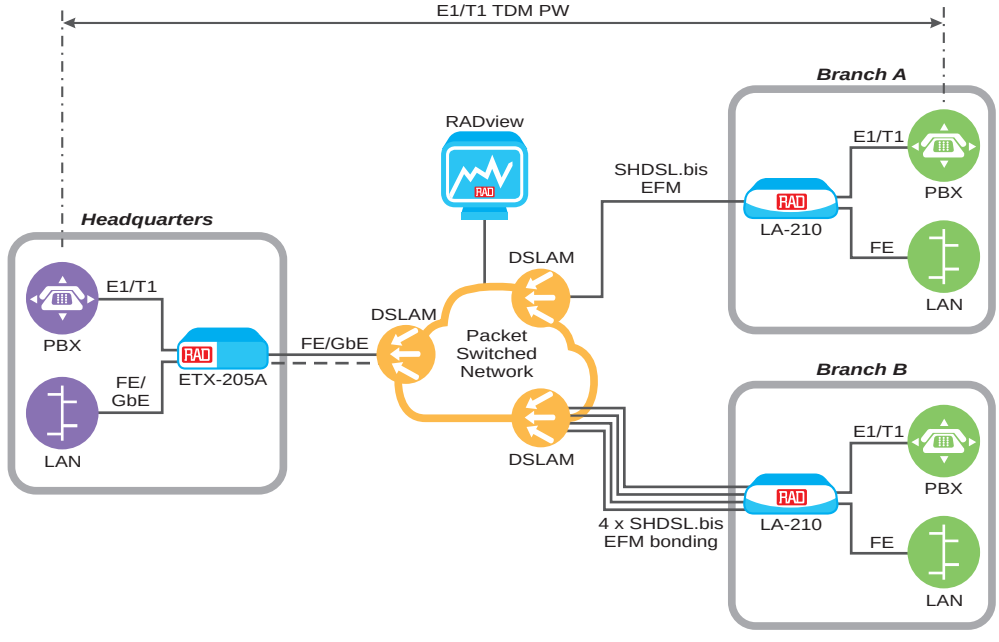
And: **Egate-2000** P. 65 | **RADview** P. 87-89 | **RICi-4E1/T1** P. 91 | **RICi-8E1/T1** P. 91 | **RICi-16** P. 92 | **RICi-E1/T1** P. 92

Carrier Ethernet and E1/T1 Services over Ethernet Access



Description:

Service providers can take advantage of their IP DSLAM infrastructure to deliver both Carrier Ethernet services and E1/T1 services using the same access link. Service rates can reach up to 22.8 Mbps over EFM-bonded SHDSL.bis pairs.

Benefits & Features:

- **Single access link for both Ethernet and E1/T1 services**
- **Ensure legacy service quality and transparent delivery over packet transport with standards-based TDM pseudowire emulation, MPLS and UDP/IP encapsulation and highly accurate clock synchronization**
- **End-to-end SLAs and service control by employing IEEE 802.1ag and Y.1731 Ethernet OAM mechanisms**

Products Included in this Solution:

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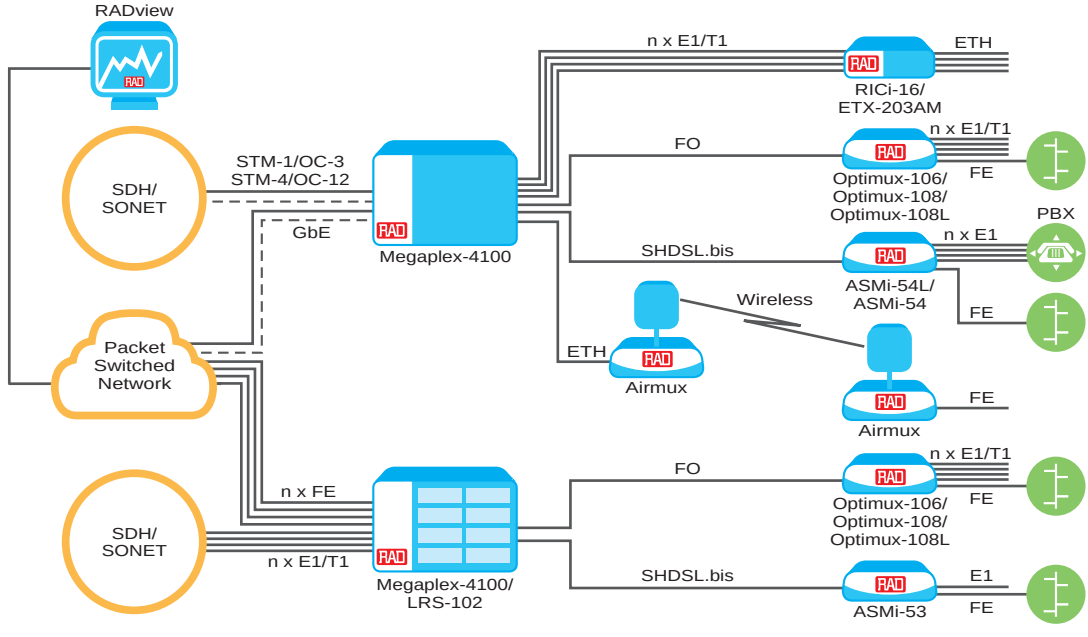
First Mile Connectivity and Service Extension



Description:

Extend legacy leased lines, TDM (E1/T1) services and new Ethernet services over E1/T1, fiber optic, SHDSL.bis and wireless First Mile connections, with multiservice aggregation and simultaneous hand-off to SDH/SONET and packet cores.

Benefits & Features:

- **Increase service coverage and customer reach over any access; introduce new Ethernet services to remote locations**
- **Flexible aggregation and grooming with high granularity from DS0 to STM-4/OC-12**
- **Cost-efficient migration path from legacy TDM to next-generation PSN**
- **Rich offering with the AXCESS+ portfolio: Multiservice multiplexers and access nodes, ADMs, cross connects, DSL/fiber modems and wireless radios**
- **Unified RADview management system for all CPE and central-site devices applicable for both PSN and SDH/SONET networks**

Products Included in this Solution:

Airmux-400
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ASMi-54
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Optimux-108
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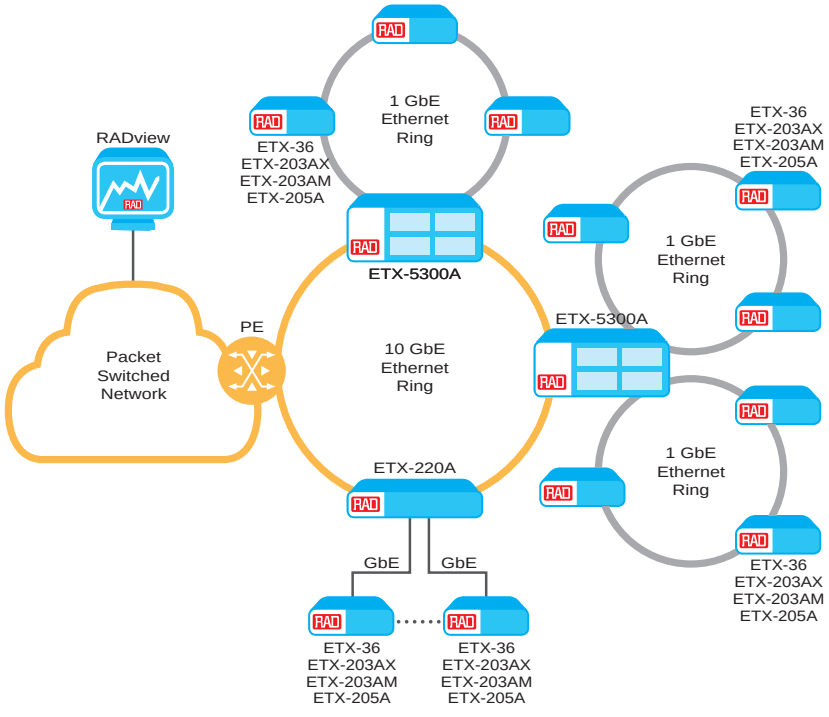
And: **Airmux-5000** P. 60 | **ASMi-53** P. 61 | **ASMi-54L** P. 62 | **ETX-203AM** P. 67 | **LRS-102** P. 77 | **Megaplex-4100** P. 78 | **Optimux-106** P. 81 | **Optimux-108L** P. 81 | **RADview** P. 87-89 | **RICi-16** P. 92

Ethernet Access Rings



Description:

Aggregate SLA-based Carrier Ethernet services in access and metro networks using standard G.8032 Ethernet ring topology to ensure a high level of resiliency and reliability.

Benefits & Features:

- **Scalable 1-GbE and 10-GbE Carrier Ethernet fiber rings with sub-50 ms switchover**
- **Protection for high availability and service continuity**
- **Deliver Ethernet and E1/T1 services over Ethernet rings**
- **Connect multiple rings to a single ETX-5300A access aggregator**
- **The provider edge (PE) device can participate in the same ring (if it supports G.8032 standard)**

Products Included in this Solution:

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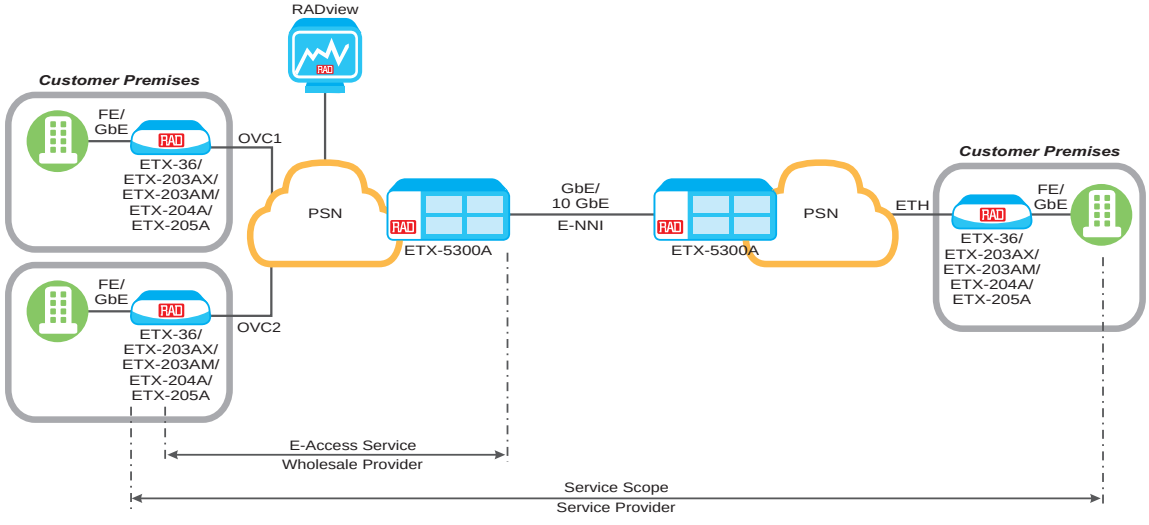
Inter-Carrier Demarcation with E-NNI



Description:

Provide E-NNI demarcation between two operators.

Benefits & Features:

- **1-GbE and 10-GbE E-NNI interfaces with optional redundancy**
- **Support E-Access service with single-CoS and/or multiple-CoS EVC/OVC**
- **Provide high capacity fully redundant aggregation device with E-NNI interface**

Products Included in this Solution:

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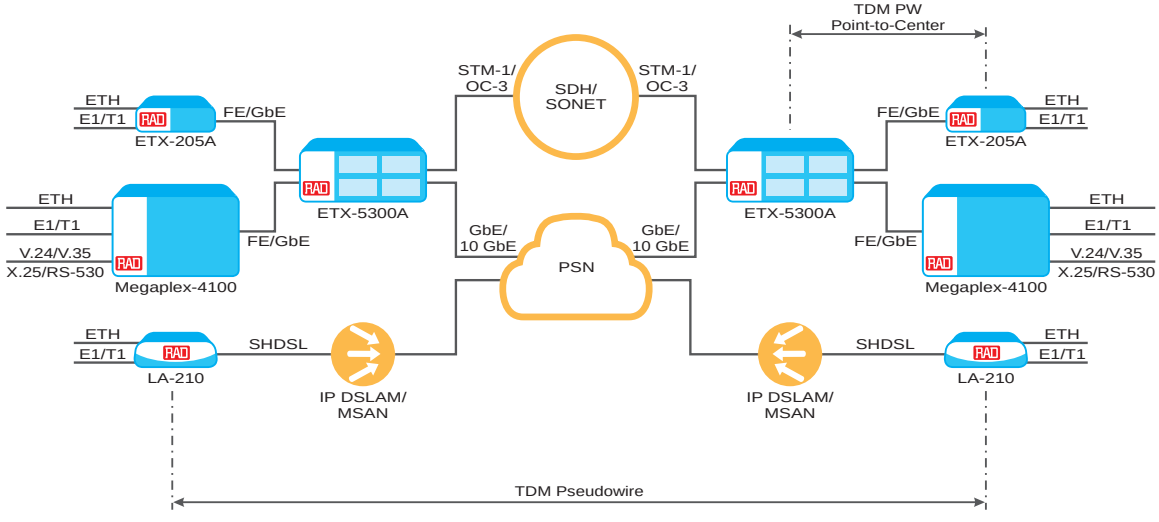
Migrating Legacy Services over Packet



Description:

Use circuit emulation to seamlessly deliver leased line services (TDM and serial data) and LAN traffic over new Ethernet and packet transport. Quick, low-cost and non-disruptive migration of PSTN access and PBX backhaul to economical packet switched networks with RAD's TDM pseudowire solutions.

Benefits & Features:

- **Reduce network operating costs by streamlining all carrier services over economical PSNs, while maintaining support of existing customer legacy equipment**
- **A full range of circuit emulation CPEs support legacy services including analog voice, serial data and n x E1s/T1s, as well as new MEF-certified services**
- **High port density, small footprint and low power consumption reduce POP/CO costs**
- **TDM service quality with standards-compliant pseudowire emulation per TDMoIP, CESoPSN and SAToP; high precision clock recovery for minimal latency and ring protection for service resiliency**
- **Ethernet QoS, traffic management and end-to-end OAM**

Products Included in this Solution:

ETX-205A
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LA-210
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Megaplex-4100
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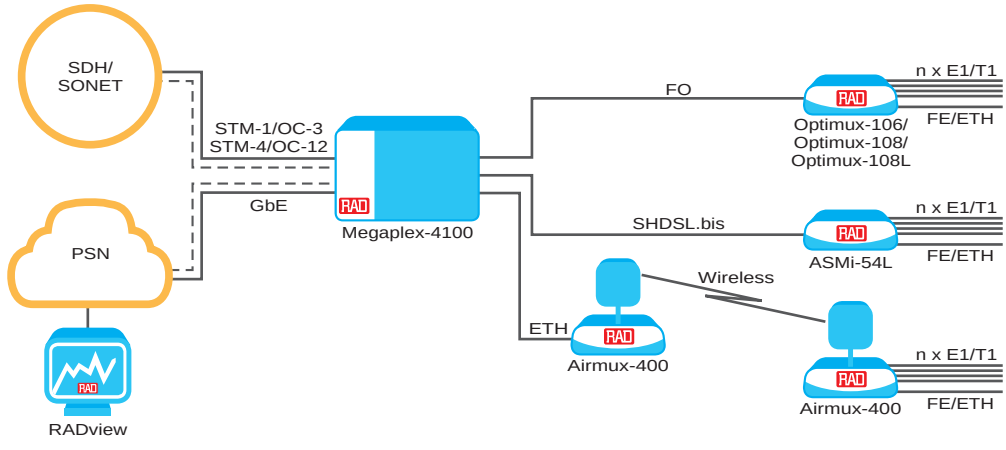
Migrating Legacy Access Networks to Packet



Description:

Economical migration path to next-generation networks and services with future-proof AXCESS+ solutions. Multiservice CPEs feature TDM and Ethernet support, while the same aggregation devices remain in place during and after the migration from SDH/SONET to packet transport.

Benefits & Features:

- **Introduce new Ethernet services for revenue growth**
- **Deliver TDM and Ethernet services over SDH/SONET and PSN with copper, fiber and wireless access**
- **Native Ethernet and TDM traffic delivery minimizes transmission delays**
- **Reduce costs and increase efficiency by combining legacy services with new Ethernet applications over the same link**
- **Ensure service continuity for legacy applications over packet with TDM circuit emulation, clock recovery functionality, differentiated quality of service, and end-to-end OAM**

Products Included in this Solution:

ASMi-54L
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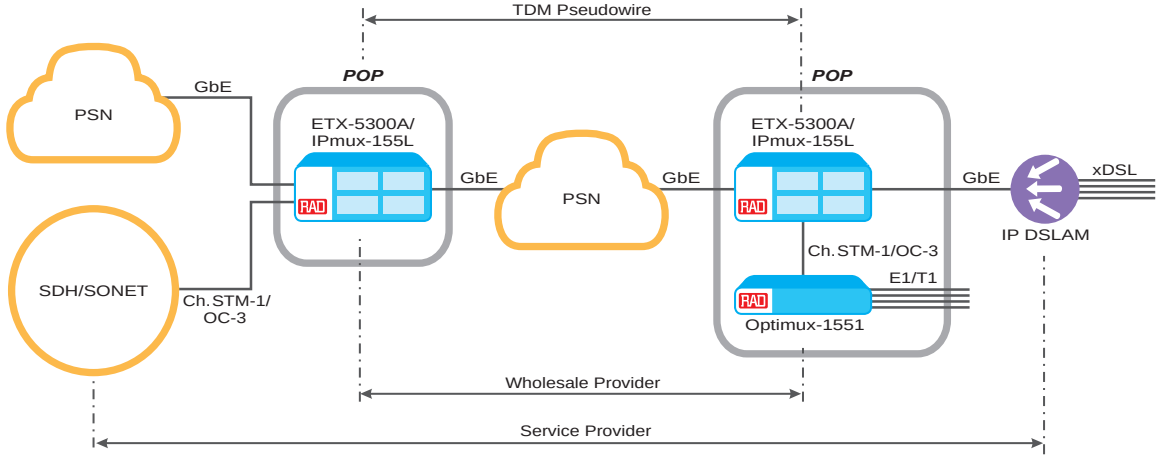
TDM Trunking over Ethernet Leased Lines



Description:

Use cost-effective GbE instead of STM-1/OC-3 leased lines to deliver carrier services.

Benefits & Features:

- **Allow alternative providers to use cost-effective GbE leased lines to transport off-net TDM services, especially if GbE leased lines are already available at the POP for IP DSLAM backhauling**
- **Provide port redundancy for both the STM-1/OC-3 and GbE ports**

Products Included in this Solution:

ETX-5300A
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IPmux-155L
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Optimux-1551
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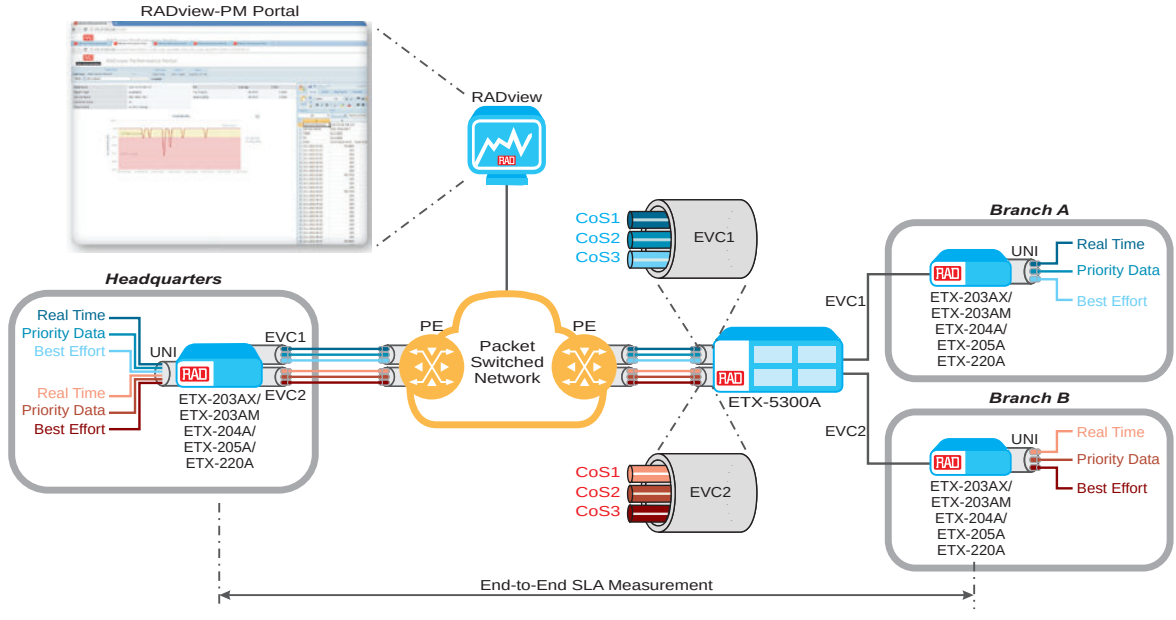
Multi-CoS Carrier Ethernet Services with SLA Measurement and Performance Portal



Description:

Monitor, measure and report service connectivity and performance parameters for SLA-based Carrier Ethernet services with multiple classes of service, using the RADview-PM merformance monitoring portal.

Substantially lower OpEx with remote end-to-end connectivity verification based on connectivity fault monitoring (CFM) at service turn-up and on an ongoing basis, as well as for effective troubleshooting during service outages.

Benefits & Features:

- **Enable end-to-end SLA verification per Ethernet virtual connection (EVC) and class of service (CoS) within each EVC, based on actual performance metrics including delay, delay variation (jitter), frame loss, and availability**
- **Hardware-based performance monitoring and connectivity fault monitoring, ensuring maximum precision and ultra-fast results**
- **Standards-based measurements per IEEE 802.1ag, ITU Y.1731, MEF-30 and MEF-35**
- **Intuitive GUI, easy-to-use performance threshold management and report generation**

Products Included in this Solution:

ETX-203AM
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ETX-205A
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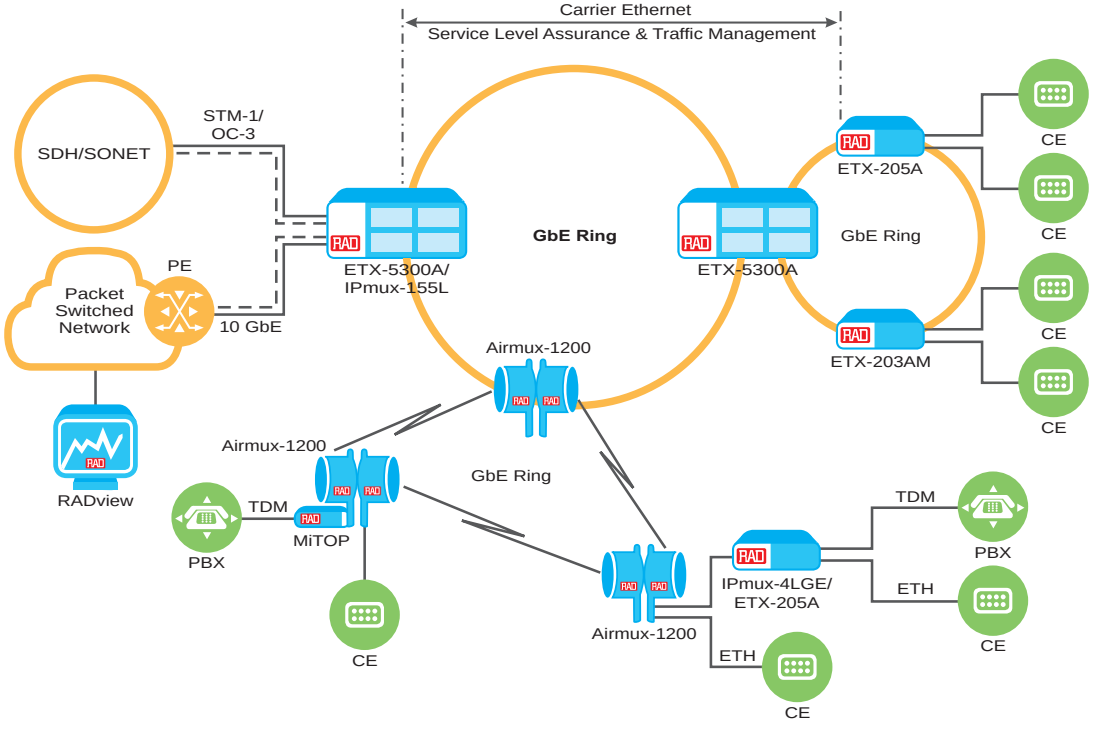
Carrier Ethernet Access Using High Speed Microwave



Description:

With exponential growth in mobile data traffic, high capacity microwave is an essential solution to complement fiber coverage and extend service reach. RAD provides a low-cost, high speed E-band radio, supporting a distance of up to 4.5 km (2.8 miles). The all-outdoor system fully supports Carrier Ethernet functionality, including G.8032 Ethernet Ring Protection Switching, traffic management and service assurance capabilities.

Benefits & Features:

- **High capacity microwave solution**
- **Small form factor, all-outdoor solution**
- **Full support of Carrier Ethernet**
- **TDD/FDD support in the 70/80 GHz spectrum**
- **Complements ETX line for fiber and microwave Carrier Ethernet connectivity**

Products Included in this Solution:

Airmux-1200
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ETX-203AM
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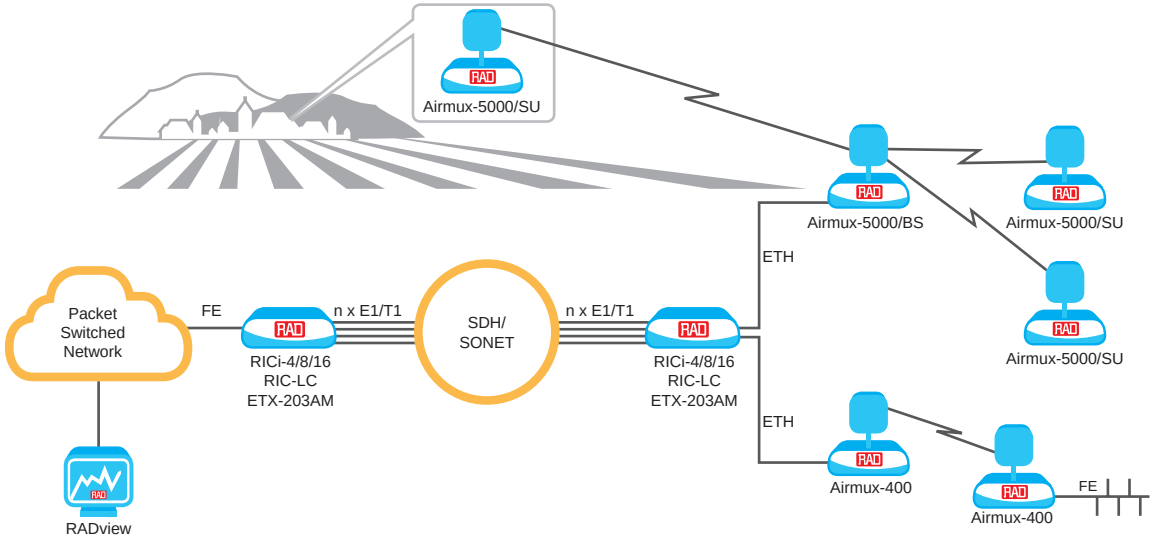
Wireless Access over SDH/SONET



Description:

Backhaul Ethernet services from wireless tail-ends over SDH/SONET transport.

Benefits & Features:

- **Easy and simple extension of Ethernet services to remote customers in rural areas**
- **Point-to-point and point-to-multipoint wireless connectivity**
- **Backhaul up to 32 bonded E1/T1 over an SDH/SONET network**

Products Included in this Solution:

Airmux-400
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Airmux-5000
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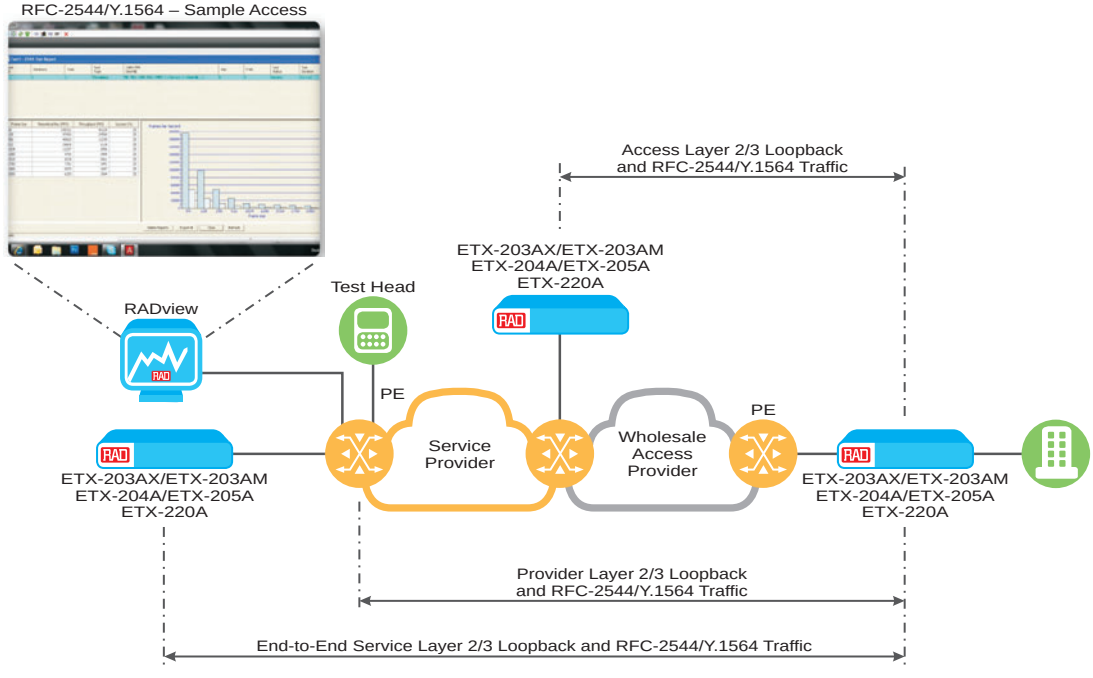
Ethernet Service Assurance with RFC-2544/Y.1564 and L2/L3 Loopbacks



Description:

Verify service connectivity and performance at service turn-up and commissioning using dedicated test suites and/or L2/L3 loopbacks.

Benefits & Features:

- **Test generator for RFC-2544/Y.1564, handling up to 1 Gbps of traffic to verify that service adheres to the commissioned SLA**
- **Use RFC-2544/Y.1564 test suites per VLAN without affecting other in-service EVCs**
- **Optionally perform several tests simultaneously on several EVCs**
- **L2 and L3 loopbacks with MAC/IP swap – a quick and simple way to verify connectivity**
- **Built-in testing capabilities in Ethernet service demarcation device eliminates the need for dedicated test heads**

Products Included in this Solution:

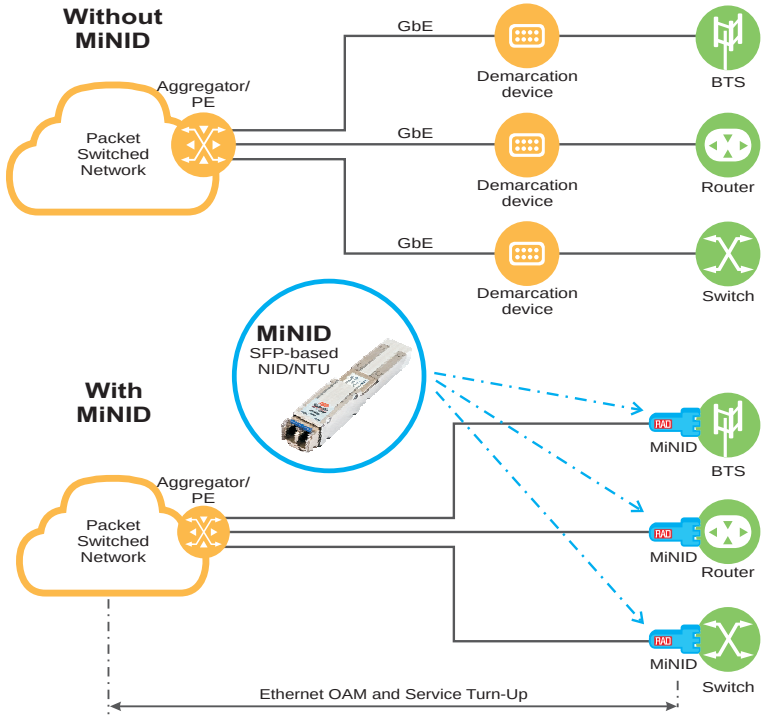
ETX-203AX
page 68

ETX-205A
page 69

ETX-220A
page 69

And: **ETX-203AM** P. 67 | **ETX-204A** P. 68 | **RADview** P. 87-89

Carrier Ethernet Services with Smart Demarcation SFP



Description:

Deliver cost-effective, Ethernet services in out-of-region deployments without direct customer access or point of presence, or in locations with space and power consumption constraints, using MiNID – RAD's miniature NID in an SFP form factor. Carriers and service providers can easily add Carrier Ethernet capabilities to devices lacking such functionality by seamlessly plugging it into their SFP port.

Benefits & Features:

- **Small form factor and low power consumption to accommodate applicative constraints and reduce OpEx**
- **Zero-touch Provisioning for fast and easy installation**
- **Port-based and flow-based Ethernet OAM, performance monitoring and L2/L3 diagnostic loopbacks for easy service turn-up and ongoing monitoring**
- **Supported by RADview-PM portal to provide per-flow performance monitoring statistics**
- **Modular design allows optics versatility**
- **Extremely easy to install and maintain without requiring dedicated training**

Products Included in this Solution:

MiNID
page 78

Transportation & Utilities Solutions

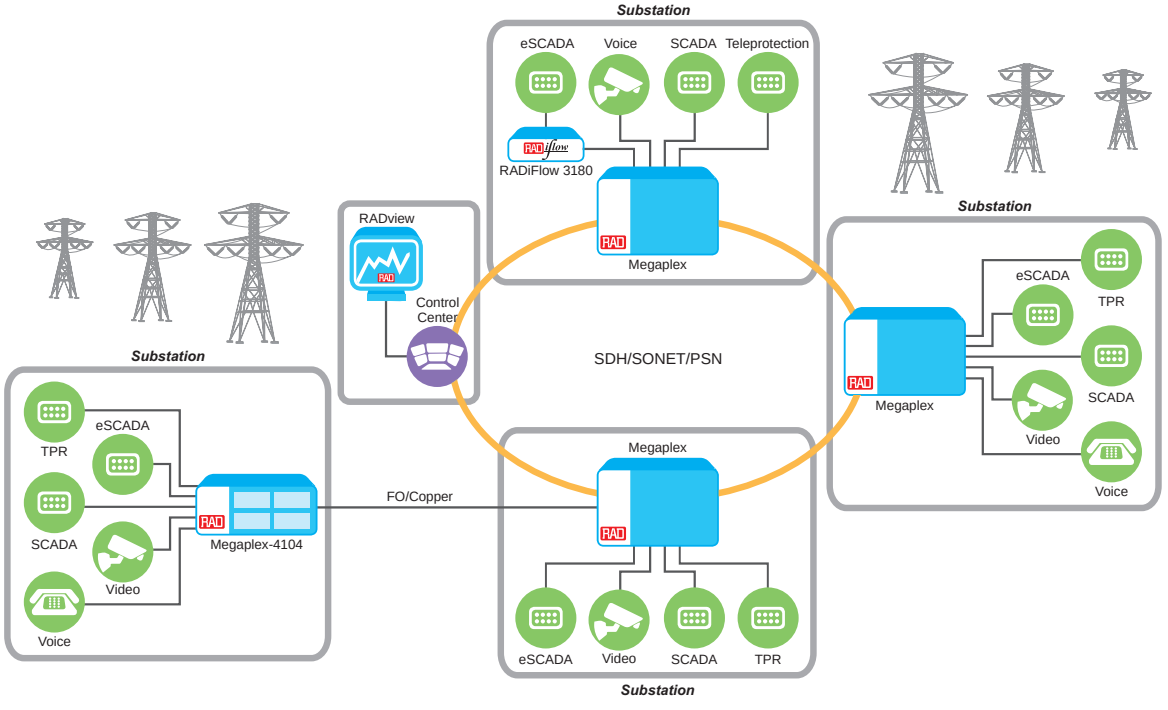
Public Utilities

RAD's products provide reliable transmission of mission-critical Teleprotection and SCADA applications for power and water utilities, while enabling smooth and secure transition to Smart Grid. They support a wide variety of voice, data and video surveillance applications with high reliability and resiliency.

Transportation

Solutions include reliable and efficient communications for a wide variety of applications for railways, motorways, air traffic control and maritime. They range from Omnibus voice, track signaling and control, to train schedule display panels and ticketing terminals in stations, as well as mobile Internet access. RAD also provides for efficient communications between control centers and on-road installations, such as digital message boards and video cameras. In addition, RAD products ensure error-free and resilient communications for airline, airport and air traffic control operations, as well as for reliable and efficient ship-to-shore or harbor communications for navigation data, voice, Ethernet, GSM connectivity applications, video surveillance, and maritime traffic control operations.

Service Multiplexing for Substations and Remote Locations



Description:

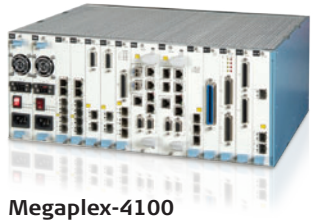
Reliable, accurate and immediate delivery of critical TDM and Ethernet traffic between central control and multiple remote locations over fiber optic, copper, or wireless connections. Ensure high availability and service resiliency with comprehensive redundancy and link protection options.

Benefits & Features:

- **Deliver SCADA, voice, video, LAN, and data traffic with multiservice single-box solutions**
- **DS0 cross connect for grooming of fractional E1/T1 links to full TDM fiber trunks**
- **Self-healing, multi-rate TDM and Ethernet ring support with rapid restoration provide NSPF (no single point of failure) resiliency and a cost-effective alternative to multi-link connectivity**
- **Carrier-class central management system offers easy integration with OSS and umbrella systems**
- **Small footprint saves rack space and power consumption, as well as cabling and cooling resources**
- **Cost-effective, easy migration to IP with single-box support for all types of legacy TDM and Ethernet-based substation communications**

Products Included in this Solution:

Megaplex-2100
page 77

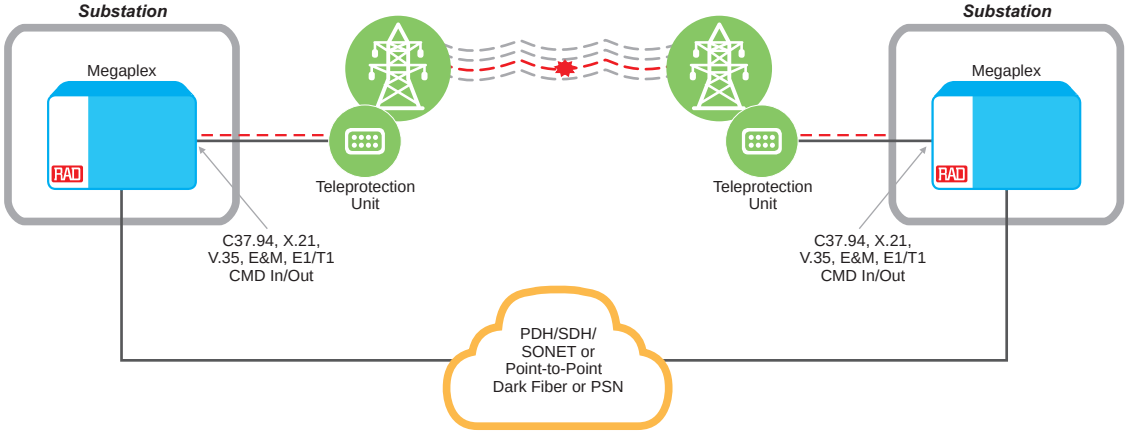


Megaplex-4100
page 78

RADiFlow 3180
page 86

And: **Megaplex-2104** P. 77 | **Megaplex-4104** P. 78 | **RADview** P. 87-89

Teleprotection Connectivity



Description:

Enable mission-critical accuracy for Teleprotection signal delivery over TDM or PSN (IP/MPLS) without requiring dedicated fiber.

Benefits & Features:

- **A wide variety of Teleprotection communication channel interfaces, including C37.94, X.21, E1/T1, E&M, and V.35 as well as CMD In/Out**
- **Reduce CapEx and OpEx with a single-box solution for all substation communications services, including Teleprotection signals**
- **Ultra-low end-to-end propagation delay supports immediate delivery of transfer trip commands from protective relay/ contact transfer to remote-end substations**
- **Maintain performance levels for mission-critical applications when migrating to packet networks with definitive QoS, high priority delivery and robust latency and jitter protection**

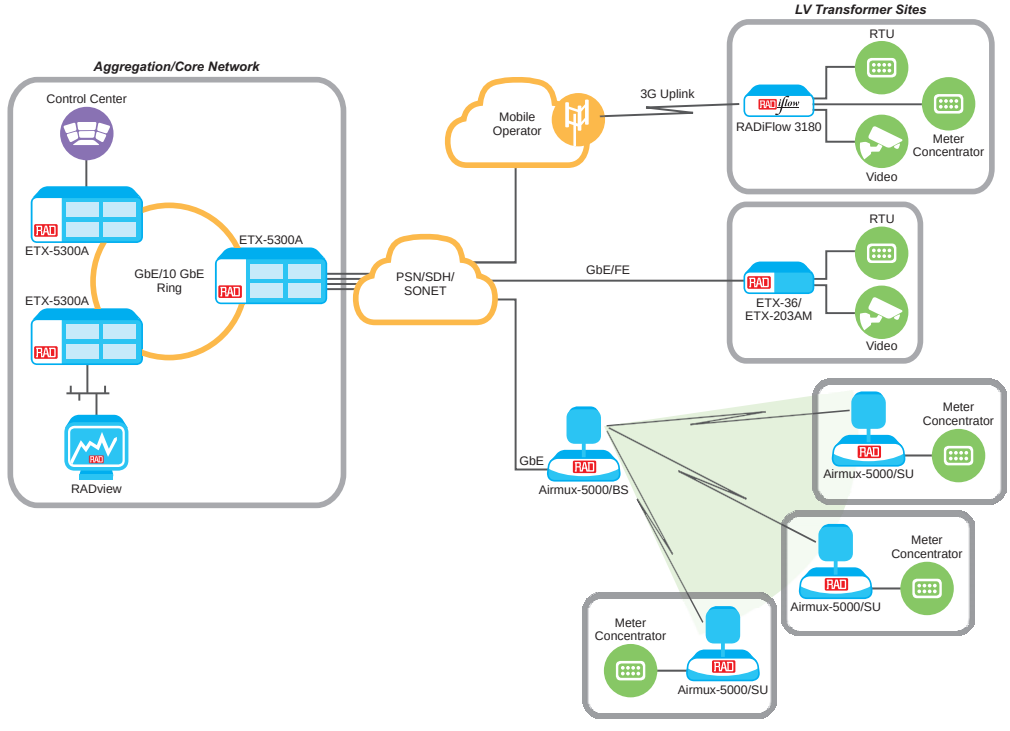
Products Included in this Solution:

Megaplex-4100
page 78

Megaplex-4104
page 78

And: **Megaplex-2100** P. 77 | **Megaplex-2104** P. 77

Transformer Site Backhaul



Description:

Reliably transport medium voltage (MV) and low voltage (LV) transformer site signals to central site aggregation over fiber, copper, wireless or mobile networks.

Benefits & Features:

- **MV/LV transformer site connectivity over SDH/SONET or Ethernet/IP/MPLS with end-to-end performance monitoring, fault management, timing synchronization, and full redundancy**
- **Full suite of traffic management, performance and link testing tools for communication assurance from the transformer sites to the control room**
- **No single point of failure with full path redundancy and ring protection**
- **Central network management for all devices reduces installation and operating expenses**
- **Secure connection with integrated firewall and encryption**

Products Included in this Solution:

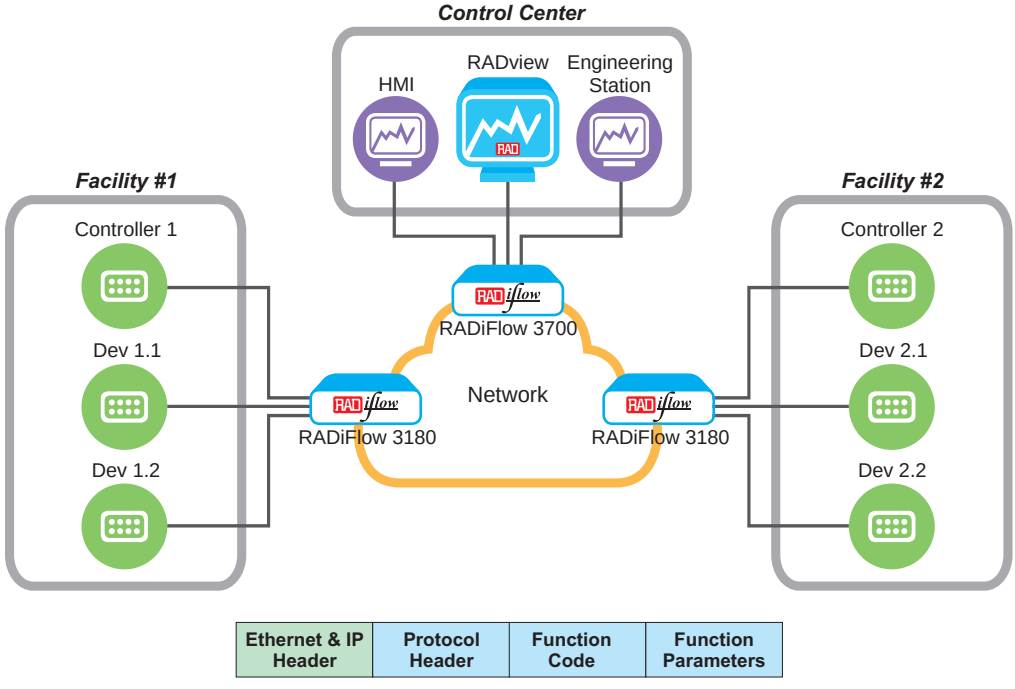
Airmux-5000
page 60

ETX-5300A
page 70

RADiFlow 3180
page 86

And: **ETX-36** P. 66 | **ETX-203AM** P. 67 | **RADview** P. 87-89

Smart Grid SCADA Security



Description:

Secure Ethernet-based and serial SCADA installations throughout the power grid to protect from cyber security threats using the RADiFlow Ethernet switches with built-in firewall/VPN. Monitor application traffic and stop unauthorized and potentially damaging activity.

Benefits & Features:

- **Full security functions in a single switch: Service validation, remote access, inter-site VPN and access control**
- **Ruggedized switch ensures operation in harsh environments, compliant with IEC 61850-3, IEEE 1613 EMI standards**
- **Integrated firewall on each port provides a network-based distributed security solution equivalent to the use of personal firewalls on each system in the network**
- **Service-aware inspection of traffic in every end-point and role-based validation of SCADA flows**
- **Built-in QoS to support mission-critical services**

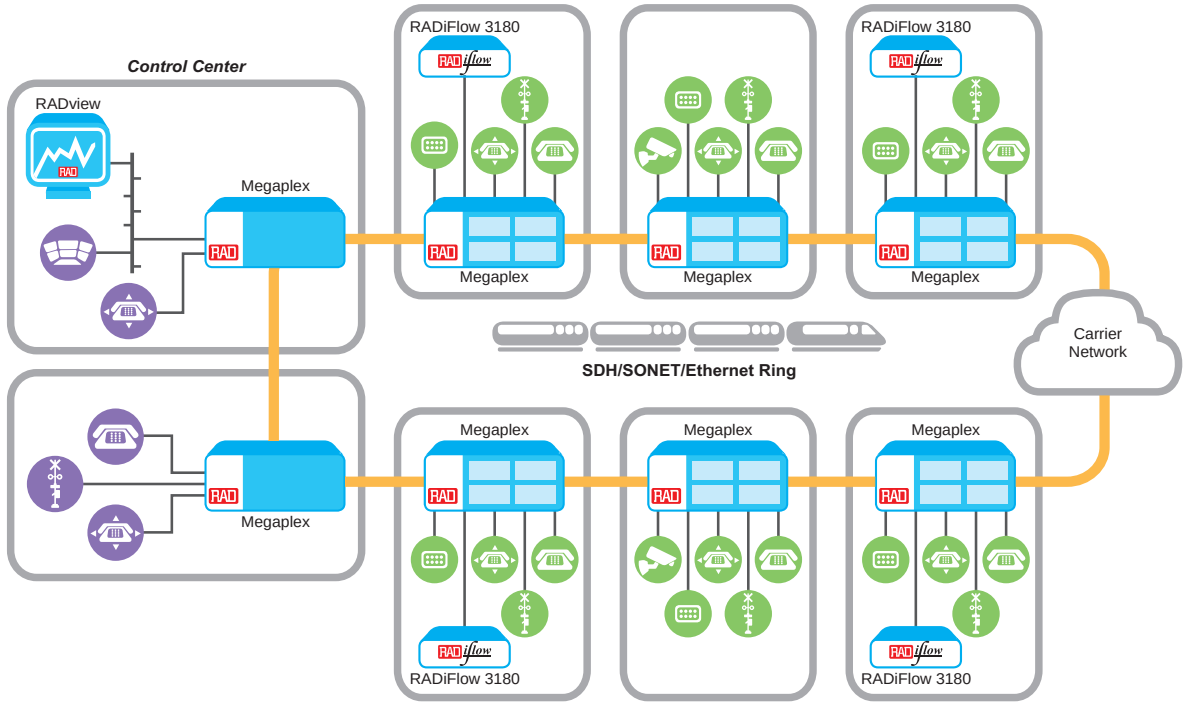
Products Included in this Solution:

RADiFlow 3180
page 86

RADiFlow 3700
page 86

RADview
page 87-89

Railway Protected Multi-Station Connectivity



Description:

Ensure protected connectivity for mission-critical railway applications, including automatic train supervision (ATS), centralized traffic control (CTC), SCADA, multi-party hotlines, and passenger information systems (PIS) between stations and control room using multidrop and ring topologies.

Benefits & Features:

- **Hybrid Ethernet and TDM architecture for smooth and cost-effective migration from TDM to PSN**
- **Provide no single point of failure (NSPF) resiliency for critical applications**
- **High ring granularity at E1/T1 or VC-12/VT 1.5 level allows bandwidth optimization over copper, dark fiber and SDH/SONET**
- **Carrier-grade Ethernet ensures service performance and ongoing KPI monitoring**

Products Included in this Solution:

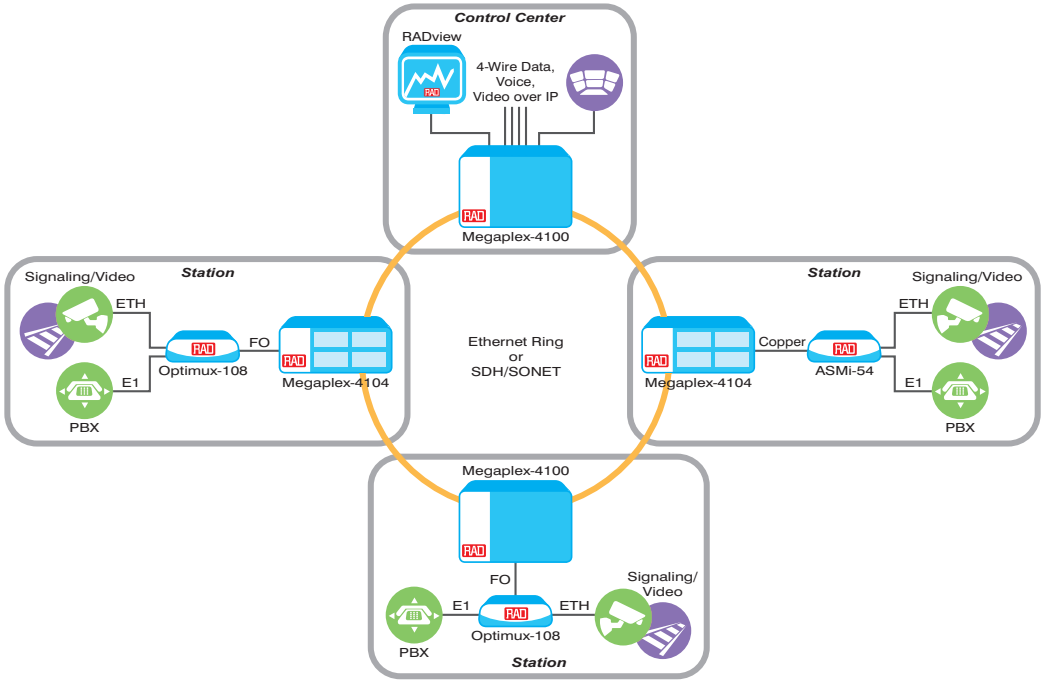
Megaplex-2100
page 77

Megaplex-4100
page 78

Megaplex-4104
page 78

And: **Megaplex-2104** P. 77 | **RADiFlow 3180** P. 86 | **RADview** P. 87-89

Railway Service Extension over DSL and Fiber



Description:

Enable service extension across long distances while reducing the costs associated with connecting geographically dispersed locations with multidrop (daisy-chain) installations. Easy implementation of ring topology when additional link/service protection is required.

Benefits & Features:

- **Connect remote devices and services, such as video surveillance cameras, signaling equipment and analog phones over E1/T1, DSL, fiber optic, or wireless connections**
- **Ensure reliable communications across long distances (10 km/ 6.2 miles over SHDSL or 120 km/74.5 miles over fiber) with data transmission rates of up to 22.8 Mbps (SHDSL) or 100 Mbps (FO/wireless)**
- **Ruggedized enclosures for outdoor deployments; dedicated devices for trackside deployments**
- **Multi-rate TDM and Ethernet ring support for sub-50 ms restoration and a cost-effective alternative to multi-link connectivity**

Products Included in this Solution:

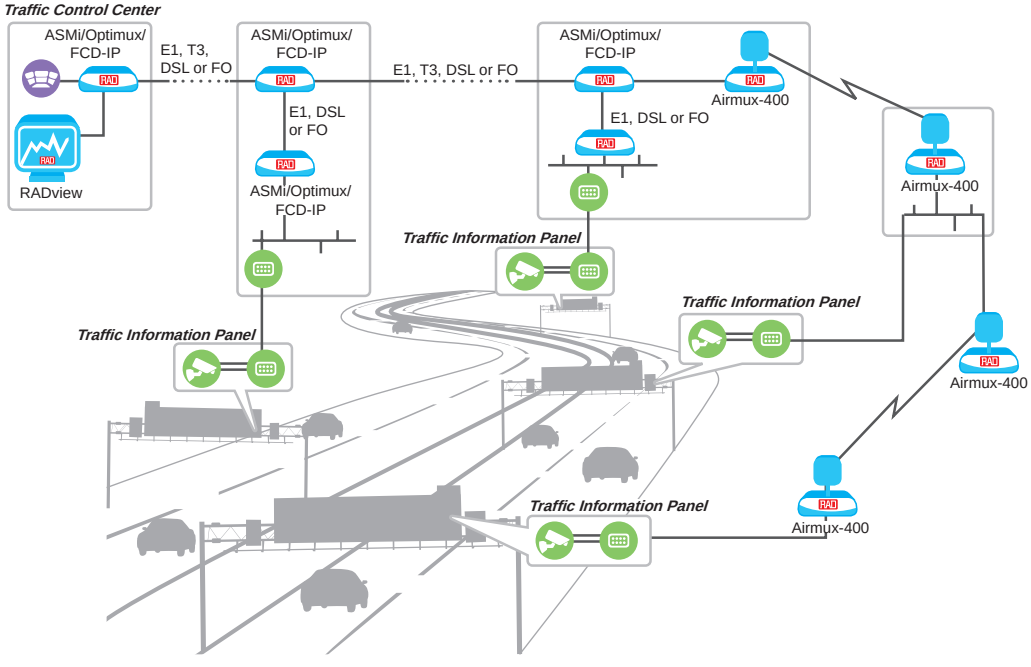
ASMi-54
page 62

Megaplex-4100
page 78

Megaplex-4104
page 78

And: **Optimux-108** P. 81 | **RADview** P. 87-89

Highway Communications



Description:

Connect communications from electronic highway message boards, IP video cameras, telephony equipment, and roadside signaling devices to traffic control centers over TDM, copper DSL, fiber optic, or wireless infrastructure.

Benefits & Features:

- **Multidrop connectivity solutions for cost-effective service extension over long distances**
- **Unified remote management for all devices**
- **Support license plate recognition and other applications requiring bandwidth-intensive transmissions with minimal latency**
- **Ideal for traffic regulation, accident detection and emergency response applications**

Products Included in this Solution:

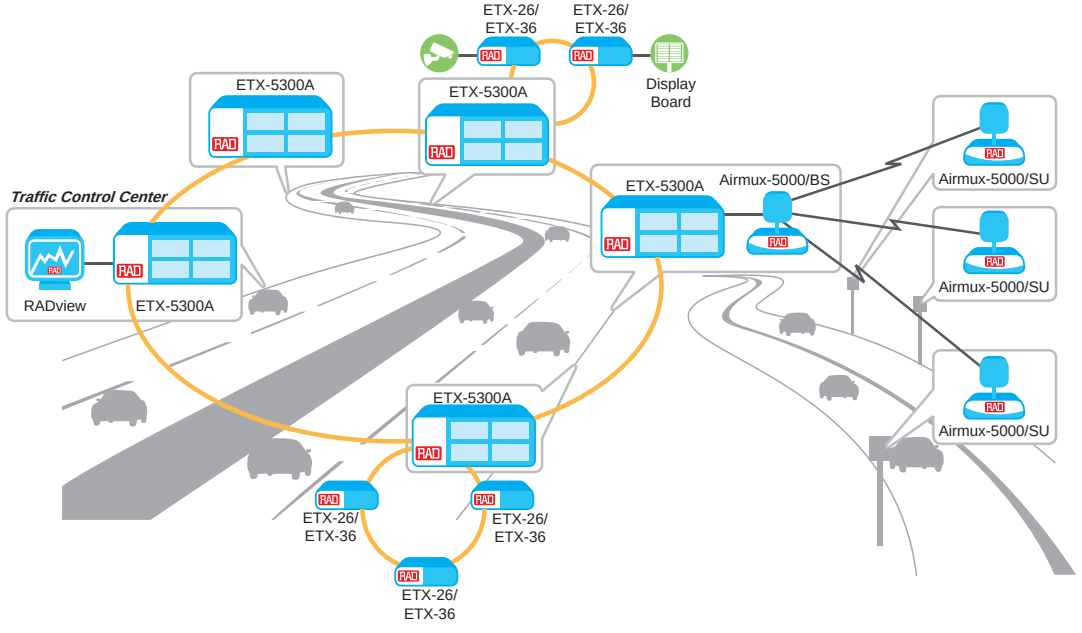
Airmux-400
page 59

ASMi-54
page 62

Optimux-108
page 81

And: **ASMi-53** P. 61 | **FCD-IP** P. 72 | **Optimux-106** P. 81 | **Optimux-108L** P. 81 | **RADiFlow 3180** P. 86 | **RADview** P. 87-89

Highway Security



Description:

Backhaul high definition video feeds from remote facilities and substations over fiber and high speed sub-6 GHz microwave links to a 10-GbE ring case. Enable quick deployments at minimal cost by operating at unlicensed radio bands.

Benefits & Features:

- **Monitor remote and unmanned facilities with point-to-point and point-to-multipoint broadband wireless multiplexers**
- **Net payload throughput of up to 100 Mbps and a maximum transmission distance of up to 120 kilometers (74.5 miles)**
- **Cost-optimized for megapixel camera transmissions with dedicated bandwidth per subscriber unit**
- **Economical use of available bandwidth**

Products Included in this Solution:

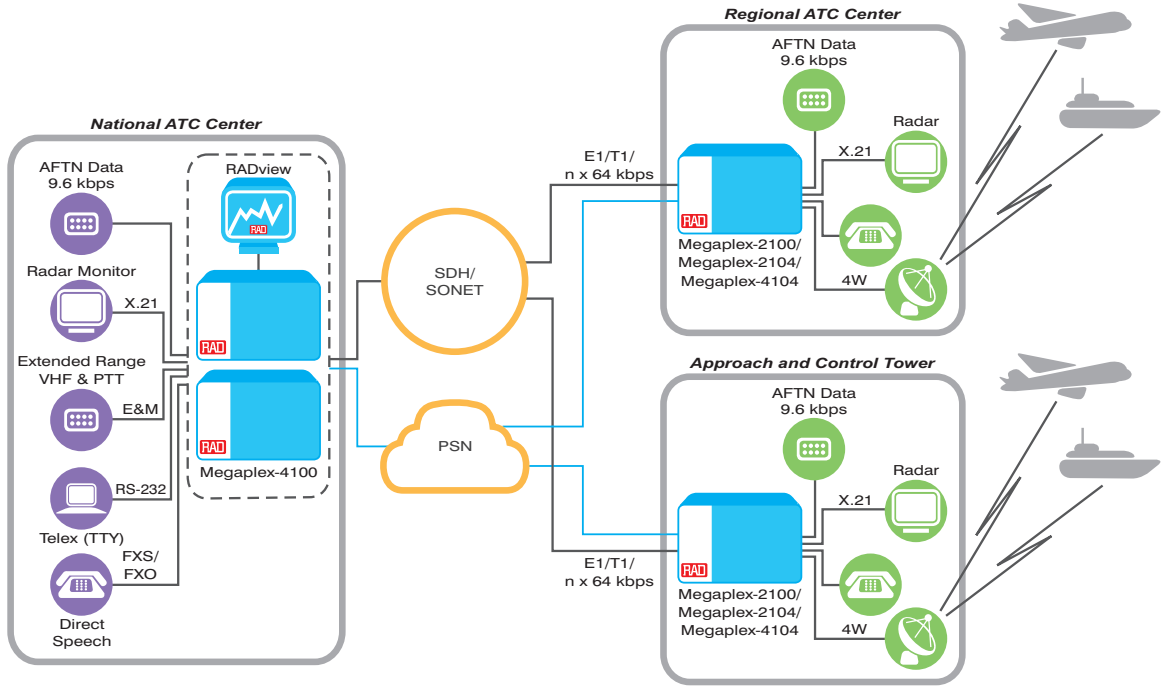
Airmux-5000
page 60

ETX-26
page 66

ETX-5300A
page 70

And: **ETX-36** P. 66 | **RADview** P. 87-89

Air Traffic Control and Maritime Communications



Description:

Ensure uninterrupted air-ground communications between aircrafts or vessels, control towers, and traffic control centers with RAD's multiservice connectivity solutions for air traffic control and maritime communications.

Benefits & Features:

- **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**
- **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:

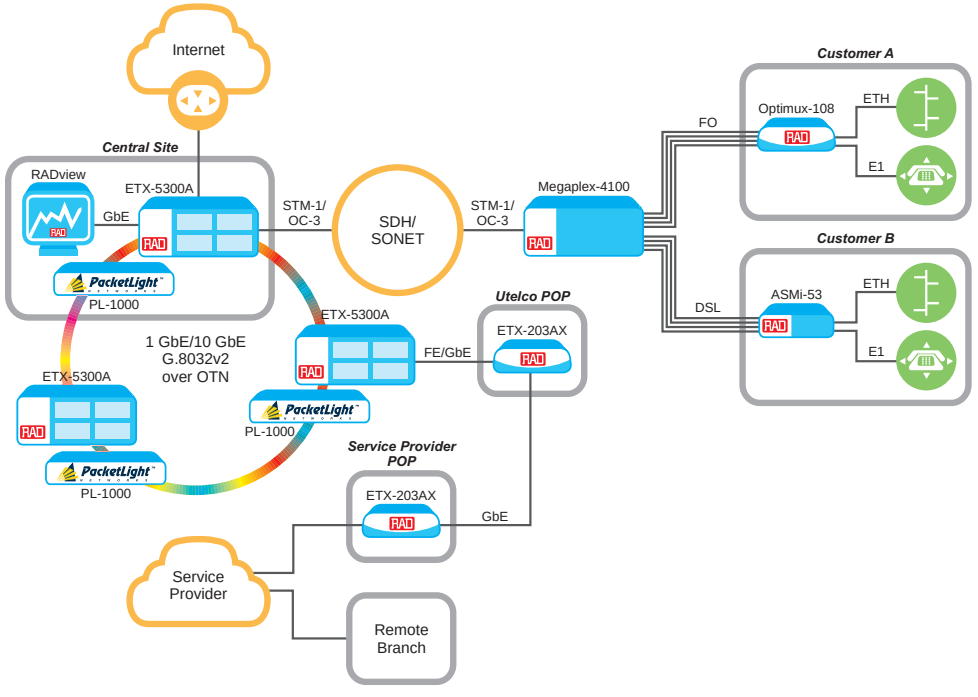
Megaplex-2100
page 77

Megaplex-4100
page 78

Megaplex-4104
page 78

And: **Megaplex-2104** P. 77 | **RADView** P. 87-89

Utelco Business Connectivity and Carrier-of-Carrier Services



Description:

Enable utility companies to easily and cost-effectively increase revenues by leveraging their footprint to provide competitive retail and wholesale communications services.

Benefits & Features:

- **Take advantage of increasing deregulation to deliver Internet access, voice, LAN extension, and SAN services to enterprise, with centralized management**
- **Intelligent devices support differentiated QoS with end-to-end visibility to distinguish between multiple network maintenance domains for leased bandwidth, shared access and other carrier-of-carrier (CoC) services**
- **PacketLight solutions: Transporting any traffic type over OTN**

Products Included in this Solution:

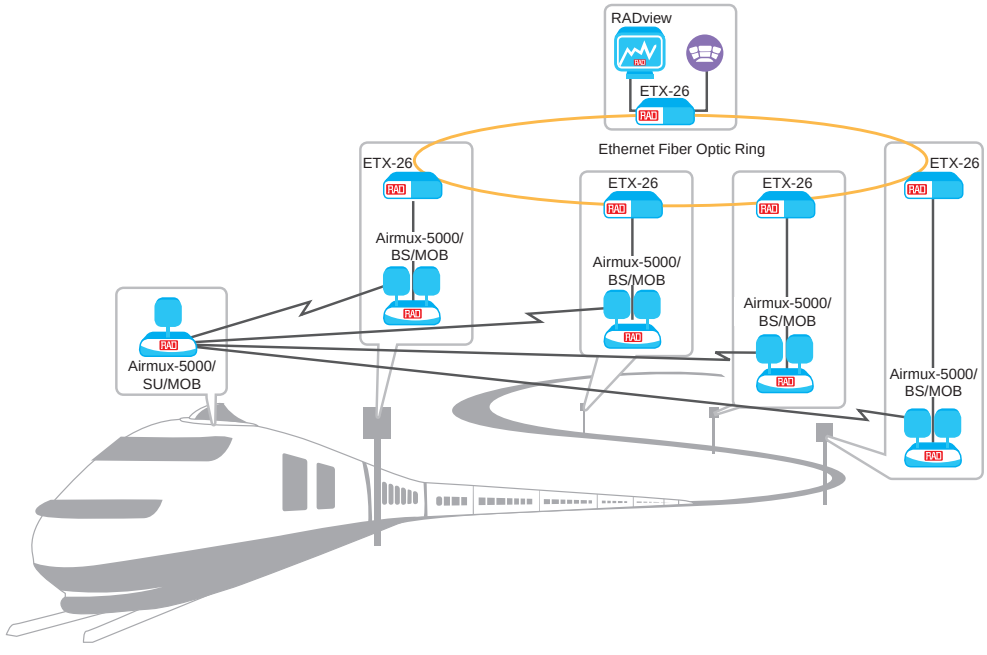
ASMi-53
page 61

ETX-5300A
page 70

Megaplex-4100
page 78

And: **ETX-203AX** P. 68 | **Optimux-108** P. 81 | **PacketLight-1000** P. 83 | **RADview** P. 87-89

Wireless Mobility Solutions



Description:

Support broadband connectivity for on-board video surveillance and Internet access in moving vehicles.

RAD's solution includes easy to deploy base stations and Ethernet access switches that guarantee high capacity connectivity to ruggedized mobile units mounted on vehicles, trains and vessels. Together, they enable unmatched capacity and range for mobile video and data connectivity at affordable total cost of ownership (TCO).

Benefits & Features:

- **Support connectivity on moving vehicles at up to 200 km/h**
- **Up to 100 Mbps total throughput**
- **Seamless handover**
- **Easy to deploy with ruggedized mobile units**
- **Reliable coverage over long distances**

Products Included in this Solution:

Airmux-5000
page 60

ETX-26
page 66

RADview
page 87-89

Government & Enterprise Solutions

RAD's solutions can help government, public safety and homeland security ICT managers realize fast and secure communications for TETRA networks, real-time applications and video surveillance, while supporting both legacy interfaces and leading-edge communications technologies.

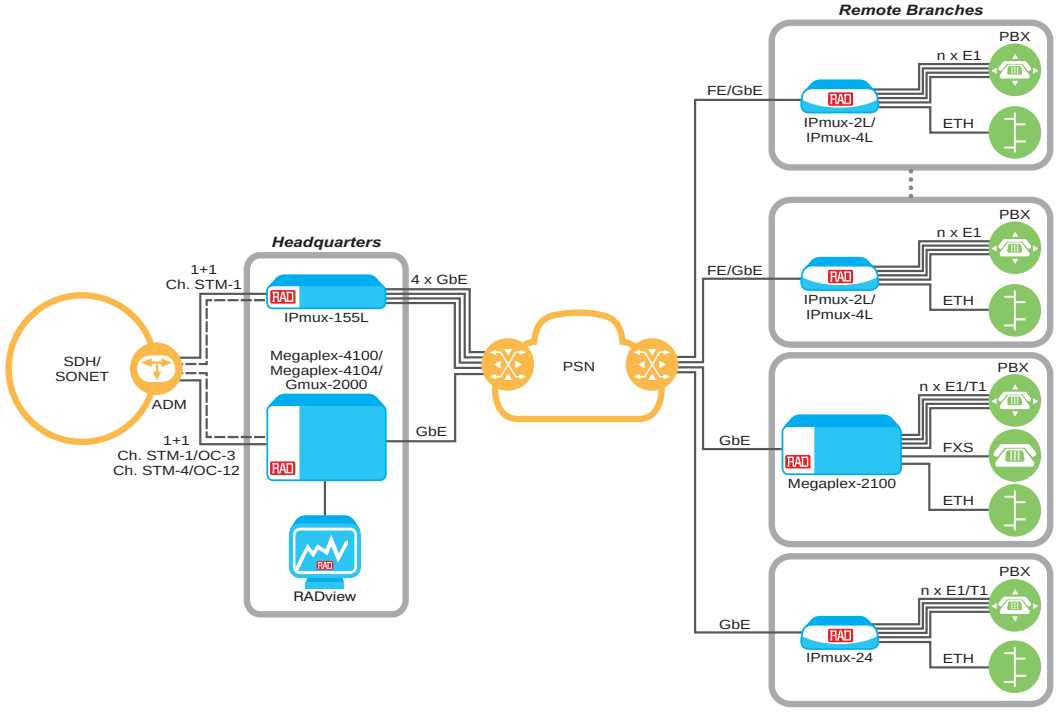
In the education sector, RAD is helping institutions seamlessly transform IT networks to support non-stop connectivity and greater flexibility on and off campus.

Financial services firms can benefit from RAD's solutions to ensure low latency and high availability for high capacity trading links, as well as support TDM-based trader turret connectivity over IP networks.

For healthcare applications, RAD offers high performance, real-time connectivity across multiple locations for medical imaging, telemedicine, regulatory compliance, pharmaceuticals management, and administrative requirements.

Mining, construction and pipeline applications can resort to RAD's highly efficient and cost-effective wireless connectivity solutions for remote locations ill-served by existing communications infrastructure.

PBX, Analog Voice and Data over Ethernet



Description:

Reduce the cost of traditional voice and Ethernet services for enterprises over packet switched access networks. Allow multi-site organizations to reduce their OpEx and simplify operations by seamlessly converging next-generation data applications and legacy PSTN services over packet.

Benefits & Features:

- **Support legacy TDM user equipment and services while reducing transport costs; transparent voice connectivity maintains all PBX features seamlessly**
- **Economical aggregation in small POPs with high port density, small footprint and low power consumption**
- **Same Ethernet service hand-off is used for both voice and data services**
- **Ensure TDM service quality over packet with a full range of standard TDM circuit emulation modes: TDMoIP, CESoPSN, SAToP, HDLCoPSN, and CESoEth (MEF-8)**

Products Included in this Solution:

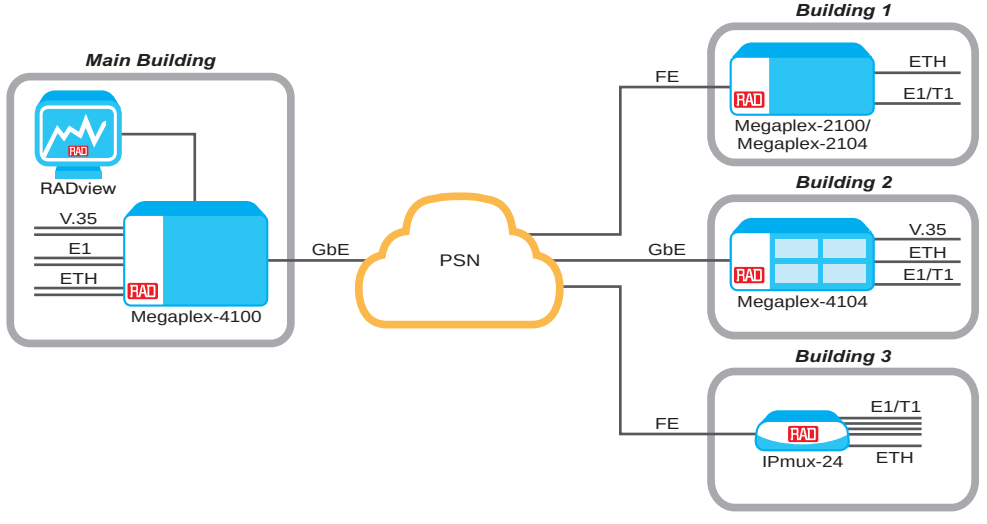
IPmux-4L
page 74

IPmux-155L
page 75

Megaplex-4100
page 78

And: **IPmux-2L** P. 73 | **IPmux-24** P. 74 | **Gmux-2000** P. 72 | **Megaplex-2100** P. 77 | **Megaplex-4104** P. 78 | **RADview** P. 87-89

Multiservice Campus Connectivity over Ethernet



Description:

Converge legacy services (voice, E1/T1, serial) and Ethernet traffic over private packet networks for high speed, low-cost intra-campus connectivity.

Benefits & Features:

- **Seamlessly transport TDM traffic over PSN with a full range of standard TDM circuit emulation modes: TDMoIP, CESoPSN, SAToP, HDLCoPSN, and CESoEth (MEF-8)**
- **Reduce costs of multi-building campus communications with efficient use of fiber infrastructure**
- **Enhance user experience by supporting next-generation broadband applications**

Products Included in this Solution:

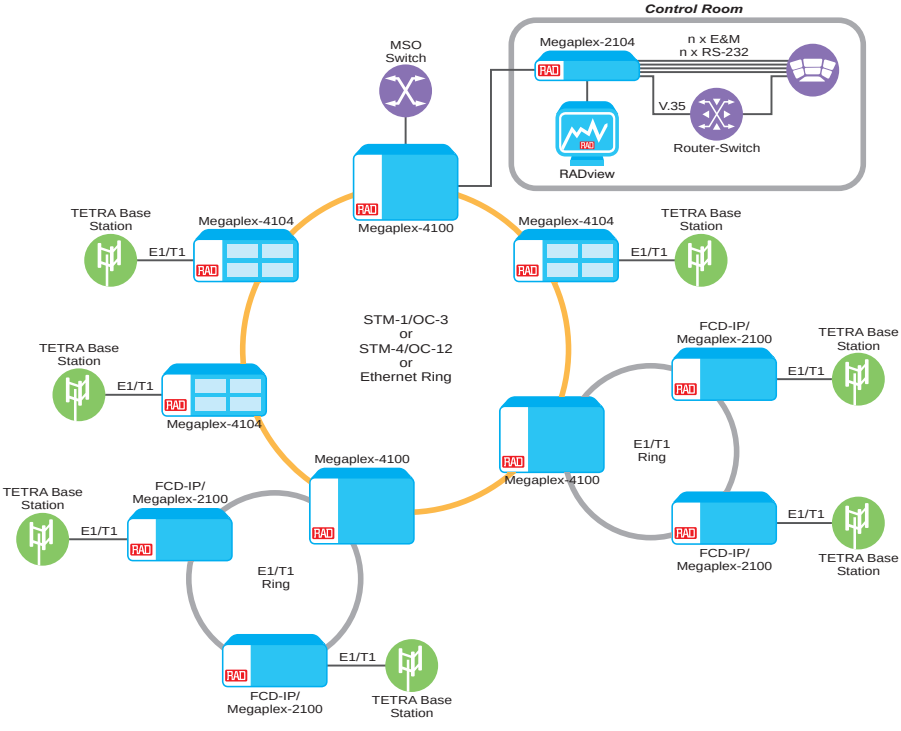
IPmux-24
page 74

Megaplex-2100
page 77

Megaplex-4100
page 78

And: **Megaplex-2104** P. 77 | **Megaplex-4104** P. 78 | **RADview** P. 87-89

TETRA and Two-Way Radio Backhaul



Description:

Connect remote dispatcher and TETRA (terrestrial trunked radio) control rooms with MSO (main switching office) sites and TETRA switches over TDM links, while ensuring service resiliency and high availability. Scalable capacity supports a bandwidth range from E1/T1 to STM-4/OC-12.

Benefits & Features:

- **Resilient ring topologies to ensure fail-safe communications of TETRA V+D (voice and data), high speed TEDS (TETRA enhanced data services) and PMR (professional mobile radio) traffic**
- **Future-proof systems eliminate the need for deploying new equipment as the network is upgraded from TDM to IP**
- **Extensive experience with TETRA radio equipment from major vendors to provide standards-based interoperability**
- **Simplify network monitoring and control with remote management**

Products Included in this Solution:

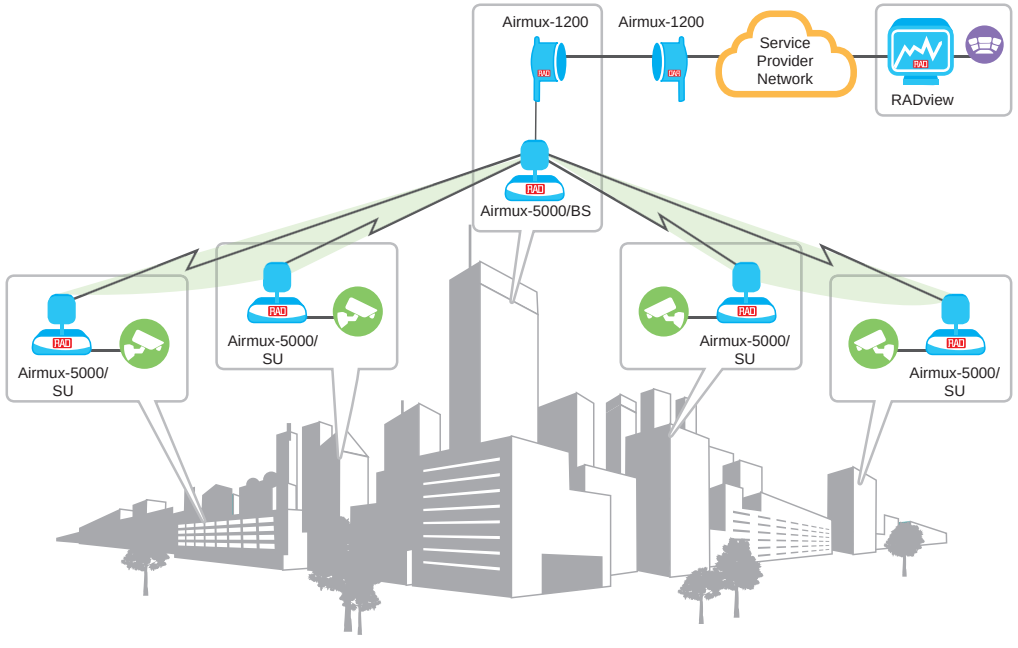
FCD-IP
page 72

Megaplex-2100
page 77

Megaplex-4100
page 78

And: **Megaplex-2104** P. 77 | **Megaplex-4104** P. 78 | **RADview** P. 87-89

Safe City – Wireless Video Surveillance Coverage



Description:

Cover city areas using point-to-point and point-to-multipoint wireless infrastructure. Allow connectivity between security cameras and sensors throughout the city.

Benefits & Features:

- **Backhaul bandwidth-intensive traffic from high definition IP cameras, while supporting real-time alerts, image analysis and face recognition applications**
- **Airmux-1200: Net payload throughput of up to 1 Gbps and a maximum transmission distance of up to 2.5 kilometers (1.5 miles)**
- **Enable fast and affordable deployments with license-exempt transmission**
- **Airmux-5000: Up to 32 remote subscriber units per base station, with dedicated SLA per user**
- **Up to 200 Mbps aggregated throughput per sector**

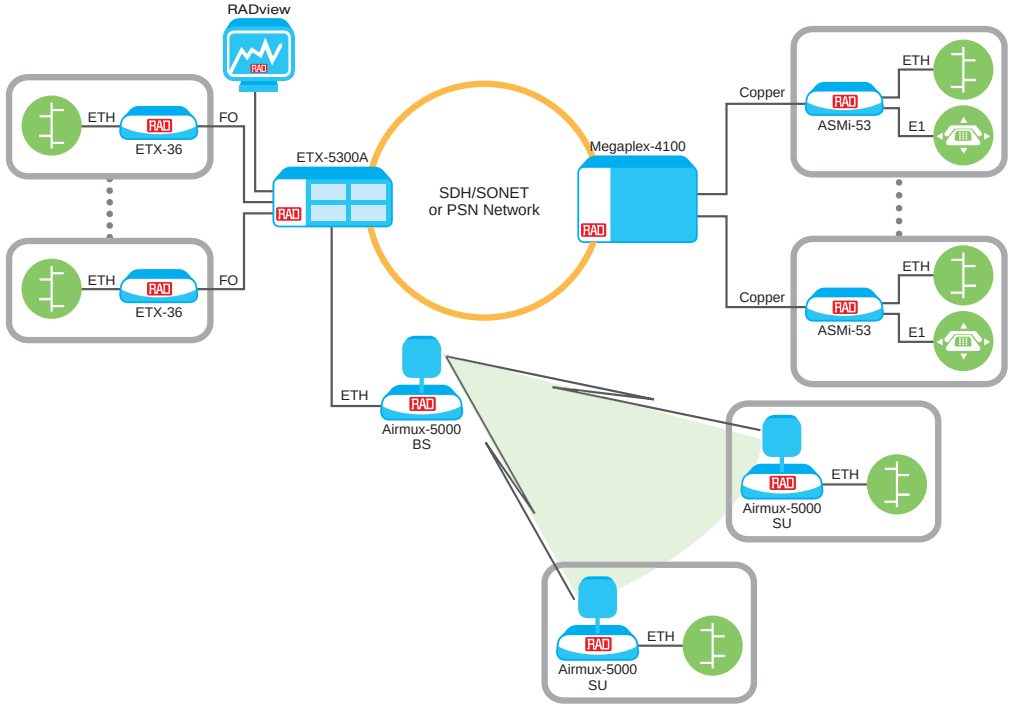
Products Included in this Solution:

Airmux-1200
page 59-60

Airmux-5000
page 60

RADview
page 87-89

Government/Military Remote Branch Connectivity over Fiber, Copper and Wireless



Description:

Connect a privately owned government/ military/public network to remote sites using diverse infrastructure.

Benefits & Features:

- **Support multiple services, including Ethernet, TDM and low speed data with same device**
- **Utilize existing SDH/SONET network or build a state-of-the-art L2-based backbone**
- **Wide variety of solutions to purpose build secure private network**

Products Included in this Solution:

Airmux-5000
page 60

ASMi-53
page 61

ETX-36
page 66

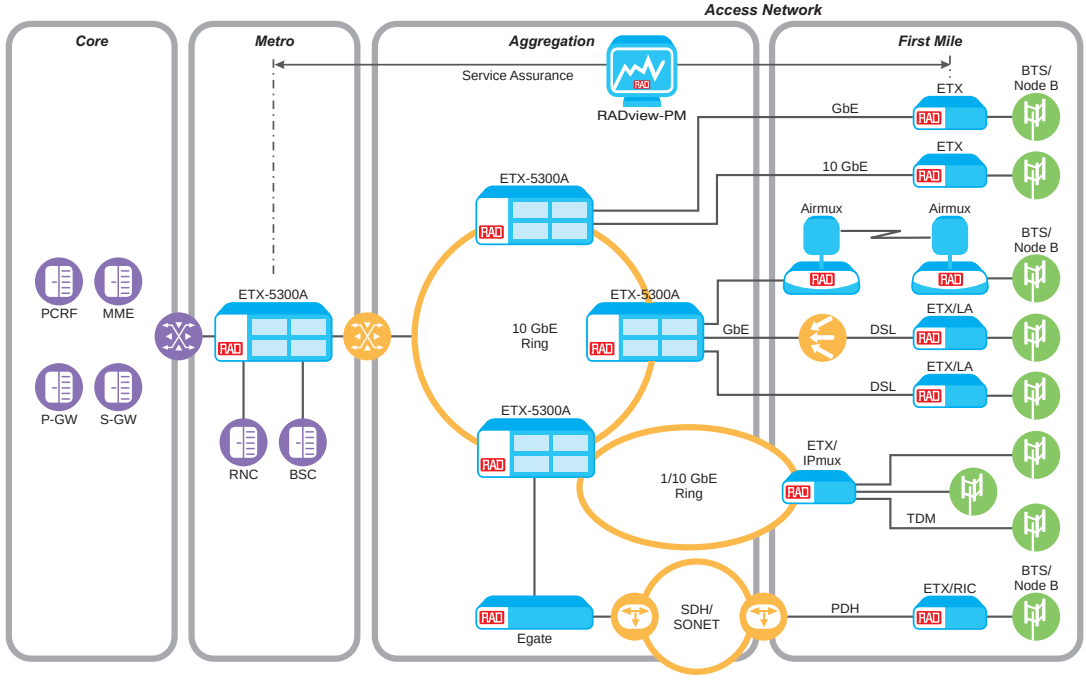
And: **ETX-5300A** P. 70 | **Megaplex-4100** P. 78 | **RADview** P. 87-89

Mobile Backhaul Solutions

RAD offers mobile operators and backhaul transport providers a best-in-class Carrier Ethernet service assurance and access aggregation platform. The platform incorporates sophisticated traffic management features to optimize bandwidth utilization and end-to-end service assurance capabilities, enabling complete control of the service lifecycle – from service activation, turn-up and performance validation to performance monitoring, fault detection and propagation. RAD's performance monitoring portal assures optimal visibility into network KPIs, providing real-time reporting or historic analysis. The platform also provides advanced Timing over Packet capabilities, which includes the industry's first LTE/1588 Grandmaster aggregator combo, boundary and transparent 1588v2 functionality as well as Sync-E, paving the way to smooth and cost-effective transition to an all-IP backhaul infrastructure.

RAD's flexible and modular Carrier Ethernet solutions are enhanced with standard TDM pseudowire support to enable the convergence of multiple generations of services over a unified network topology, reducing network costs.

Complete Access Solution for Mobile Backhaul



Description:

RAD offers a complete solution for backhauling multiple generations of base station traffic over any access technology and infrastructure: fiber, DSL, copper, and wireless. RAD's portfolio ranges from media converters, cell-site gateways and Ethernet radios, to mobile demarcation devices and hubs for Ethernet service aggregation with sophisticated timing synchronization and SLA assurance capabilities.

Benefits & Features:

- **Supports star, daisy-chain and ring topologies**
- **Cost-effective multi-flow access aggregation**
- **Robust performance management tools and monitoring portal**
- **Rapid deployment, turn-up and service troubleshooting**

Products Included in this Solution:

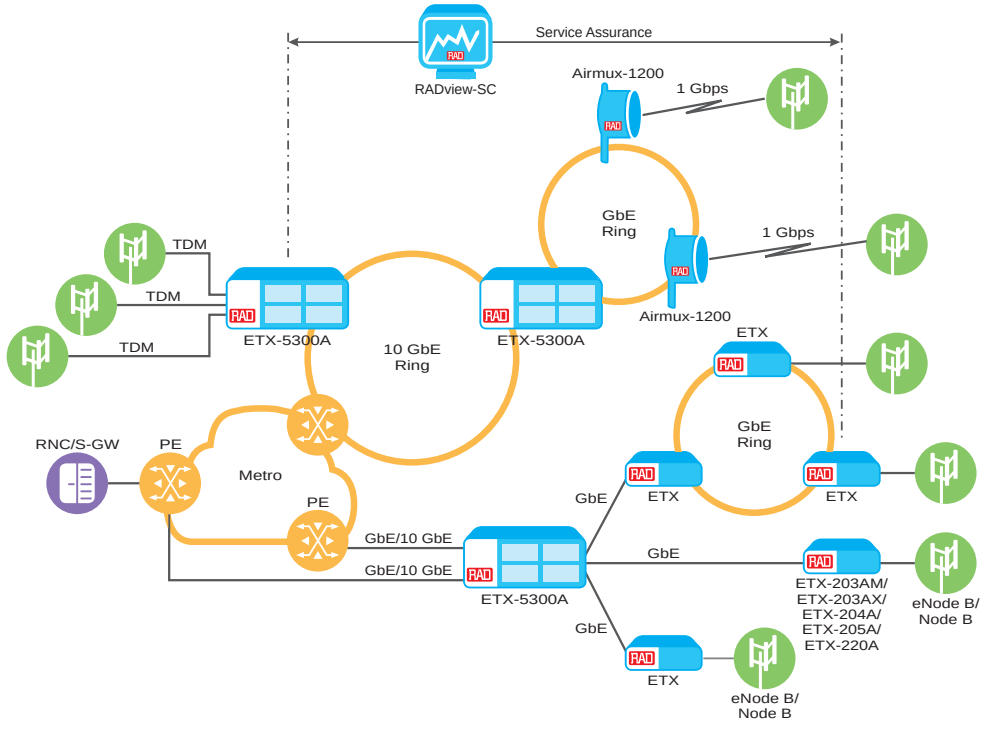
ETX-203AM
page 67

ETX-205A
page 69

ETX-5300A
page 70

And: **Airmux-400** P. 59 | **Airmux-5000** P. 60 | **Egate-100** P. 64 | **Egate-2000** P. 65 | **ETX-204A** P. 68 | **ETX-220A** P. 69 | **IPmux-4L** P. 74 | **IPmux-4LGE** P. 74 | **IPmux-16L** P. 74 | **IPmux-24** P. 74 | **IPmux-155L** P. 75 | **LA-210** P. 76 | **RADview** P. 87-89 | **RIC-LC** P. 91 | **RICi-4E1/4T1/8E1/8T1** P. 91 | **RICi-16** P. 92 | **RICi-E1/T1/E3/T3** P. 92

Access Aggregation



Description:

Deploy a Carrier Ethernet access aggregation network connecting 2G/3G/LTE Node Bs to the metro network with a complete ecosystem of mobile demarcation and aggregation platforms. Supporting both star and ring topologies, these solutions feature best-of-breed service creation and monitoring capabilities along with carrier-class protection and a variety of synchronization options.

Benefits & Features:

- **Ultra-high capacity enables simultaneous processing of thousands of service flows**
- **Carrier-class Layer 2 aggregation devices with high port density for space-restricted facilities**
- **Full system redundancy for service resiliency and high availability**
- **Hierarchical QoS, intelligent traffic management and end-to-end SLA assurance**
- **Extensive SyncToP functionalities include high performance 1588v2 and Synchronous Ethernet**
- **High speed microwave solution for aggregation of LTE sites**

Products Included in this Solution:

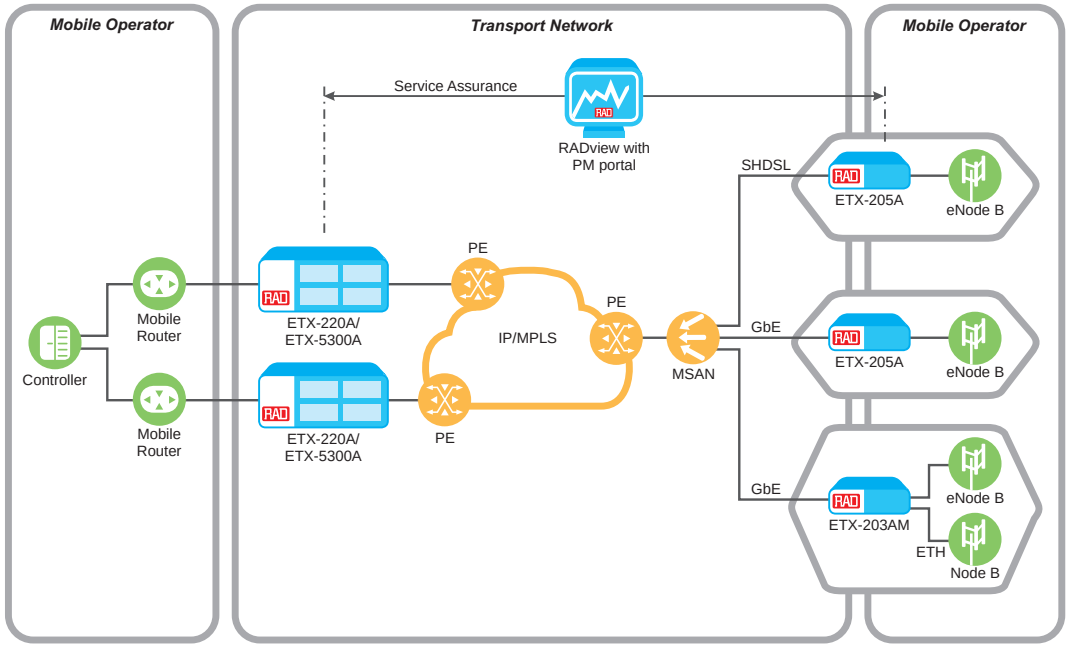
ETX-205A
page 69

ETX-220A
page 69

ETX-5300A
page 70

And: **Airmux-1200** P. 59-60 | **ETX-203AM** P. 67 | **ETX-203AX** P. 68 | **ETX-204A** P. 68 | **RADview** P. 87-89

Service Assurance with Mobile Demarcation



Description:

Support critical SLA (service level agreement) assurance in the transport network with RAD's ETX mobile demarcation portfolio, to effectively manage mobile broadband's huge increase in data traffic and meet LTE's strict network requirements. Allow mobile wholesale and transport providers to manage backhaul SLAs for operators with easy troubleshooting mechanisms and monthly performance reports, including real-time access to network KPIs.

Benefits & Features:

- **Fully featured, intuitive performance management portal, with SLA definition per customer and service, as well as dashboard support, and carrier and end-customer access**
- **Full Carrier Ethernet and performance management support for assuring full control of the service lifecycle**
- **Hardware-based OAM, diagnostic and performance measurements**

Products Included in this Solution:

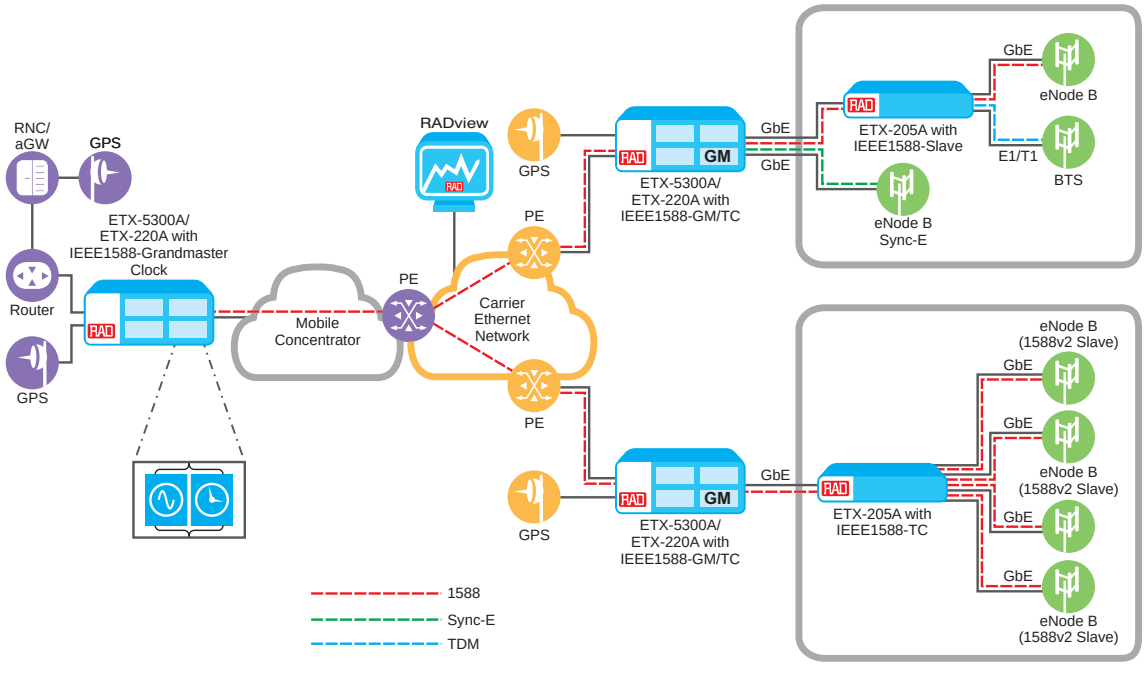
ETX-205A
page 69

ETX-220A
page 69

RADview-PM
page 88

And: **ETX-203AM** P. 67 | **ETX-5300A** P. 70

Synchronization Solution



Description:

Ensure high performance for mobile traffic with RAD's best-of-breed timing and synchronization over packet suite. Highly accurate phase and frequency synchronization for base stations and backhaul networks using standard IEEE 1588v2 and/or Sync-E technologies, integrated within access equipment to eliminate the need for costly dedicated devices.

Benefits & Features:

- **Full Synchronous Ethernet support**
- **1588-Grandmaster, transparent clock, boundary clock, and slave capabilities for both frequency and phase synchronization**
- **Bridging different timing technologies: Sync-E and E1/T1, 1588 and Sync-E, etc.**
- **Integrated GPS option, in/out GPS support (ETX-205A)**

Products Included in this Solution:

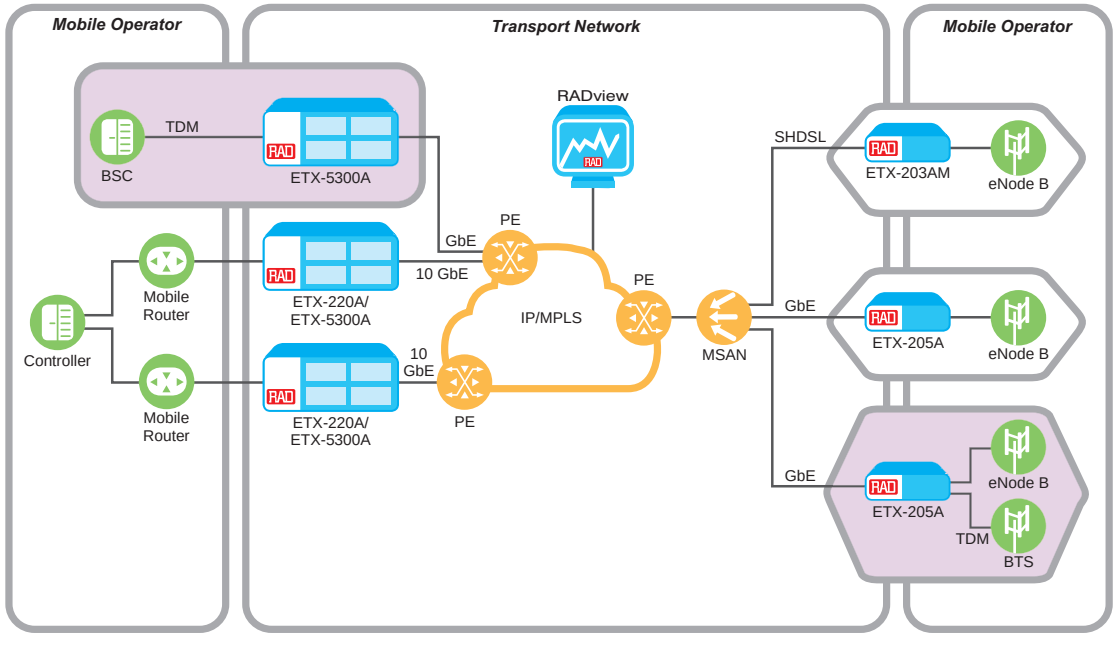
ETX-205A
page 69

ETX-220A
page 69

ETX-5300A
page 70

And: **RADview** P. 87-89

2G/3G/LTE Backhaul over a Single RAN



Description:

Converge legacy 2G traffic with IP Node B and eNode B traffic over packet backhaul to streamline network operations and reduce costs. Ensure service quality and transparent delivery of 2G services with the TDM pseudowire capabilities of RAD's ETX portfolio.

Benefits & Features:

- **Reduce backhaul costs with multi-generation support by a single device**
- **Advanced synchronization capabilities and comprehensive pseudowire functionality pioneered by RAD**
- **Bridge different timing technologies: Sync-E and E1/T1, 1588 and Sync-E, etc.**

Products Included in this Solution:

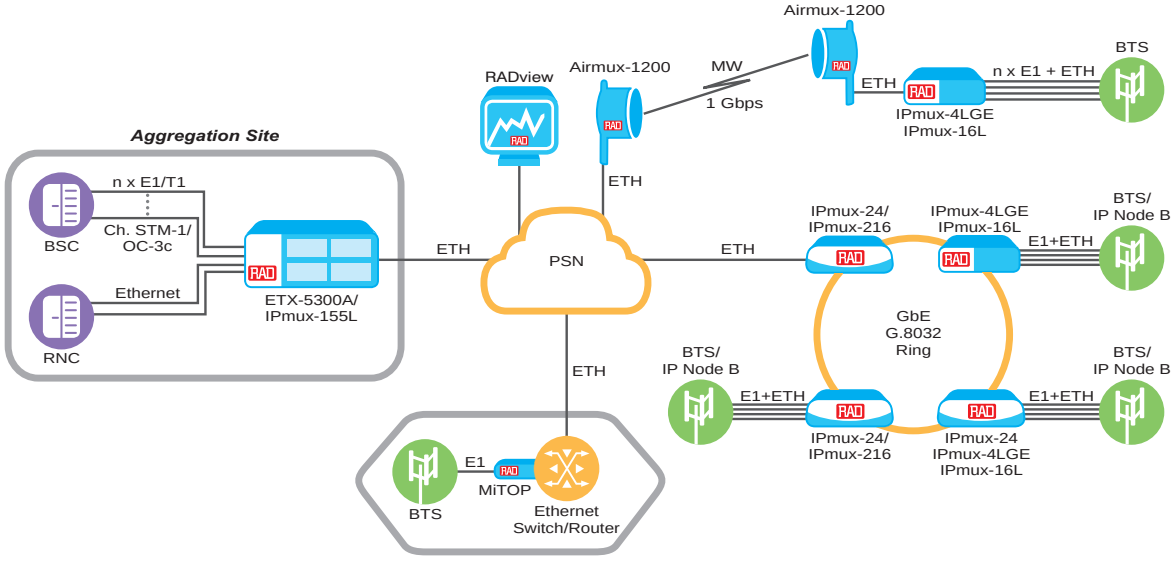
ETX-203AM
page 67

ETX-205A
page 69

ETX-5300A
page 70

And: **ETX-220A** P. 69 | **RADview** P. 87-89

Cost-Optimized Mobile Backhaul over Any Infrastructure



Description:

Enable economical service extension and low cost aggregation between 2G BTSs and 3G IP Node Bs and their controllers over fiber and wireless.

Benefits & Features:

- **G.8032 ring protection for service resiliency**
- **Deploy RAD's pseudowire gateways to easily transport mobile traffic over GPON**
- **SFP pseudowire gateways allow TDM-served base stations to quickly and cost-effectively connect over packet networks**

Products Included in this Solution:

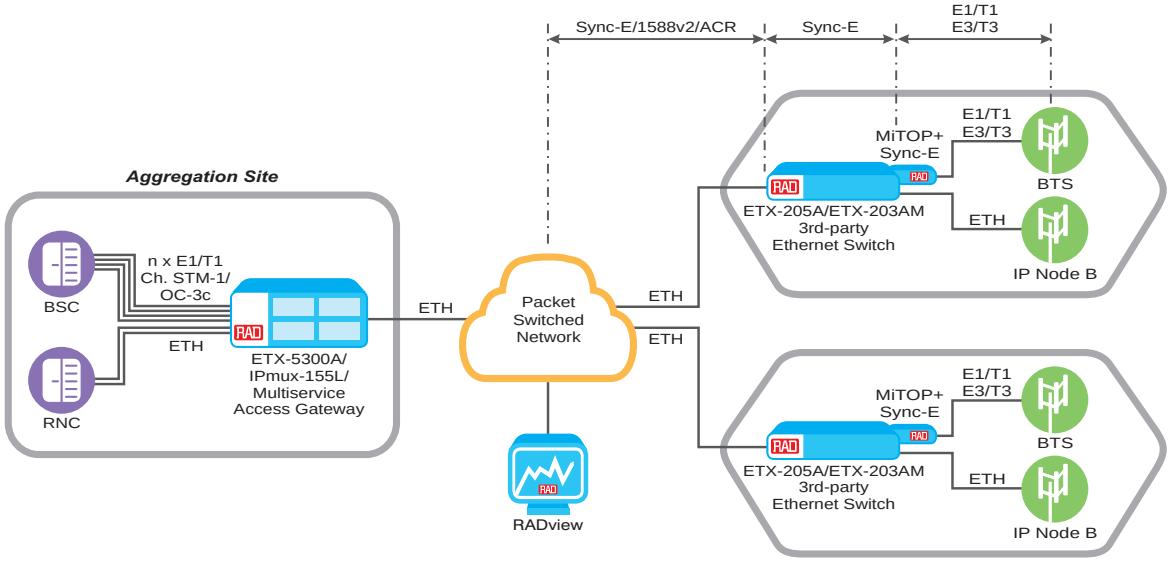
ETX-5300A
page 70

IPmux-4LGE
page 74

MiTOP
page 80

And: **Airmux-1200** P. 59-60 | **IPmux-16L** P. 74 | **IPmux-24** P. 74 | **IPmux-155L** P. 75 | **IPmux-216** P. 74 | **RADview** P. 87-89

Mobile Backhaul Using Smart SFP with Timing Capabilities



Description:

RAD's MiTOP can connect E1/T1 and E3/T3 traffic from base stations to RAD's ETX A-series Carrier Ethernet mobile demarcation devices or to MSA-compliant third-party Ethernet switch-routers. This allows operators and transport providers to use a single device to backhaul multi-generation traffic over packet-based transport.

Benefits & Features:

- **Multi-standard TDM pseudowire support with CESoPSN, SAToP, using MEF-8 or UDP/IP encapsulation**
- **Synchronous Ethernet capabilities ensure accurate clock distribution to the base station**
- **No need for dedicated power supply**
- **Central aggregation and termination of pseudowire with ETX-5300A or IPmux-155L or any standard TDM PWE device**

Products Included in this Solution:

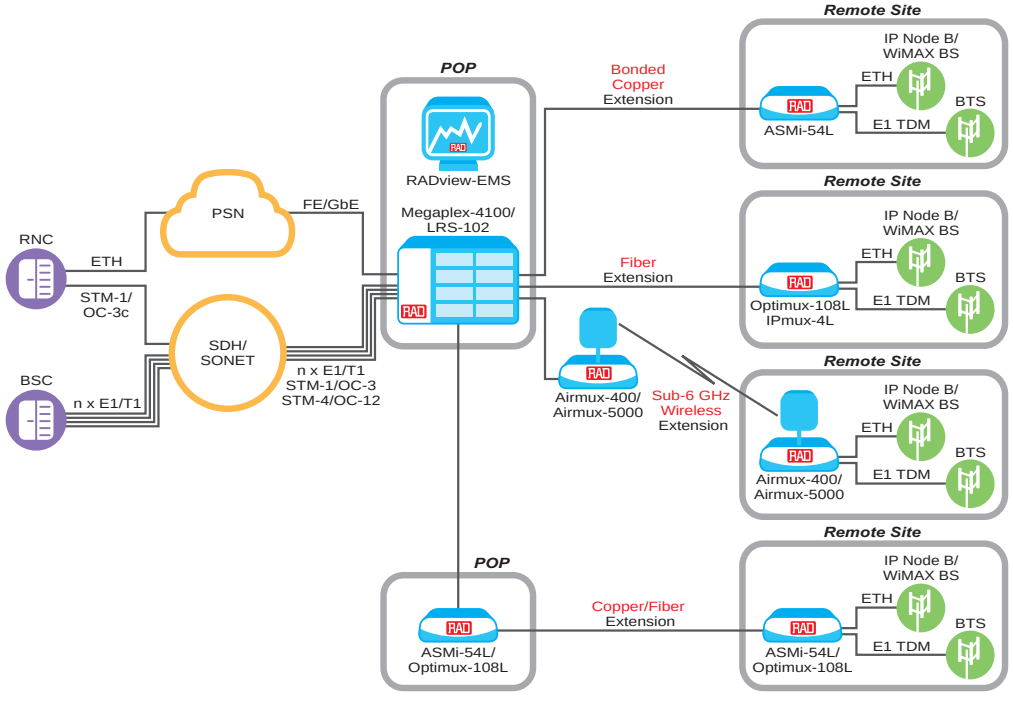
ETX-205A
page 69

ETX-5300A
page 70

MiTOP
page 80

And: **ETX-203AM** P. 67 | **IPmux-155L** P. 75 | **RADview** P. 87-89

Mobile Backhaul in Rural Areas



Description:

Extend coverage to underserved areas with affordable 2G, 3G and WiMAX backhaul solutions over copper, fiber or wireless infrastructure. RAD's portfolio ensures fast and simple service set-up, while driving down the rollout and maintenance costs associated with long-distance backhaul over varied terrains.

Benefits & Features:

- **Connect multi-generation base stations over a single access link to reduce OpEx and CapEx**
- **Point-to-point or point-to-multipoint service extension over fiber, SHDSL.bis and sub-6 GHz wireless links provides high flexibility in choosing the most cost-efficient transport alternative**
- **100 Mbps over wireless and fiber, or 22.8 Mbps over EFM bonded copper**
- **Wireless solutions ensure service coverage in difficult terrains and across geographic barriers**

Products Included in this Solution:

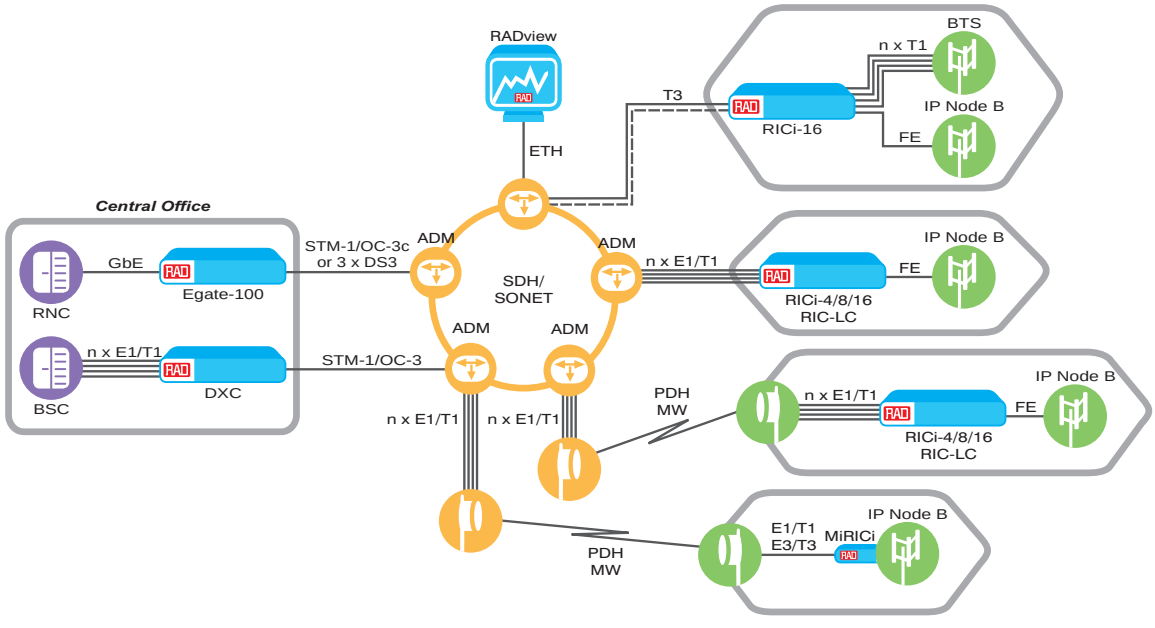
Airmux-400
page 59

ASMi-54L
page 62

Megaplex-4100
page 78

And: **Airmux-5000** P. 60 | **IPmux-4L** P. 74 | **LRS-102** P. 77 | **Optimux-106** P. 81 | **Optimux-108** P. 81 | **Optimux-108L** P. 81 | **RADview** P. 87-89

Mobile Backhaul over PDH/SDH/SONET



Description:

Transport IP Node B Ethernet traffic over PDH and SDH/SONET infrastructure, together with TDM aggregation and a seamless hand-off to the packet network. RAD's RICi demarcation devices enable operators to cost-effectively reduce their time-to-market and set-up costs for new service offerings by leveraging widely available TDM networks.

Benefits & Features:

- **Flexible bandwidth allocation up to 32 Mbps with circuit bonding**
- **CapEx reduction through leverage of existing SDH/SONET/PDH links where fiber is not available**
- **Standard Ethernet over NG-PDH (RICi-16) and NG-SDH/SONET (Egate-100), GFP, VCAT and LCAS protocols**
- **Reduce OpEx by using a single management system with flexible service provisioning**
- **Ethernet OAM and traffic management capabilities support MEF-defined Carrier Ethernet services**

Products Included in this Solution:

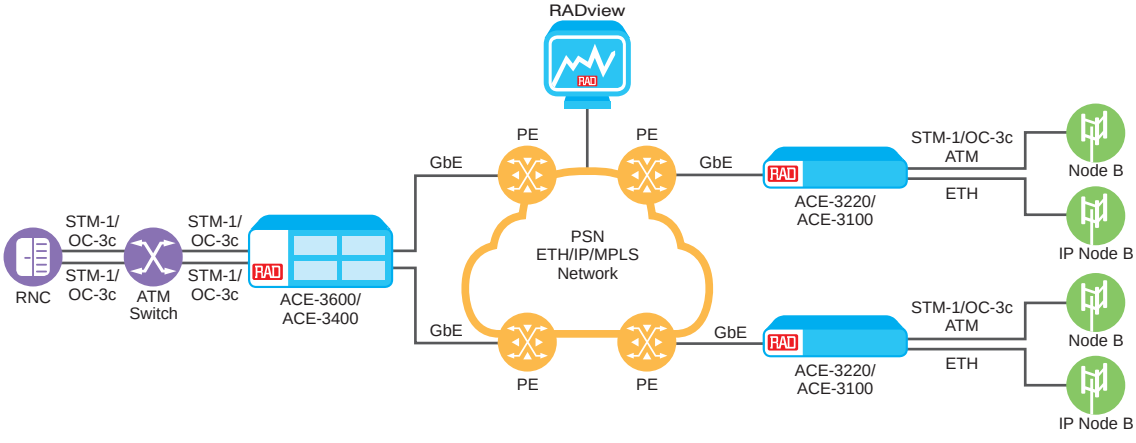
Egate-100
page 64

MiRICi
page 79

RICi-16
page 92

And: **DXC Family** P. 63 | **RADview** P. 87-89 | **RIC-LC** P. 91 | **RICi-4E1/4T1/8E1/8T1** P. 91

Connecting ATM Base Stations over Packet



Description:

Backhaul 3G traffic from ATM Node Bs and IP Node Bs over Ethernet, IP or MPLS transport, using the carrier-class ACE portfolio. RAD's ATM over packet solutions include cost-effective, small form factor cell-site gateways and fully redundant aggregation gateways – all highly reliable and easy to configure.

Benefits & Features:

- **Connect 3G ATM base stations served by STM-1/OC-3 links over packet switched networks**
- **Best cost-performance cell-site gateway with ATM PWE**
- **Robust Timing over Packet capabilities**
- **Widely deployed by Tier-1 carriers**

Products Included in this Solution:

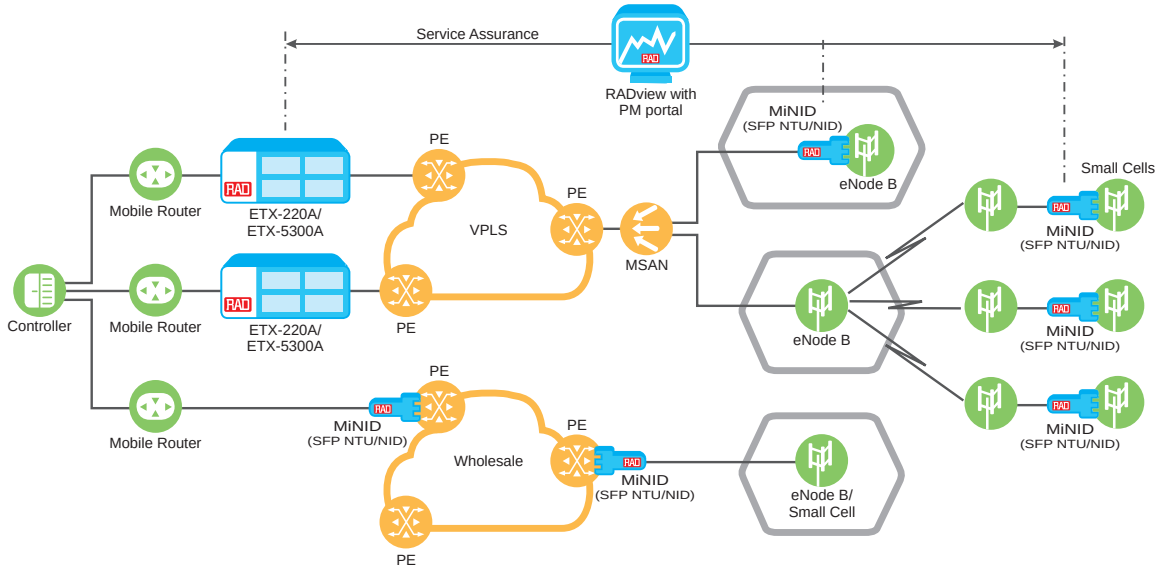
ACE-3100
page 57

ACE-3400
page 58

ACE-3600
page 58

And: **ACE-3220** P. 57 | **RADview** P. 87-89

Service Assurance with an Ethernet Demarcation SFP (MiNID)



Description:

Ensure maximum flexibility for service assurance in small-cell, pico- and macro-cell deployments, as well as for wholesale mobile backhaul services with MiNID – RAD's miniature Ethernet demarcation SFP.

The MiNID connects directly to any PE, eNode B or base station with standard SFP interfaces to eliminate the need for standalone demarcation devices, while allowing transport providers and mobile operators to receive real-time network/ service performance reports with per-CoS SLA definition.

Benefits & Features:

- **The most innovative end-to-end service assurance solution for small-cell, pico- and macro-cells**
- **Extremely easy to install and maintain without requiring dedicated training**
- **Supported by the fully featured, easy-to-use RADview-PM performance management portal with per-customer and per-service SLA definition, carrier and end-customer access options and dashboard support for easy configuration**
- **Lower CapEx and OpEx by using an SFP instead of an external device, while saving power consumption, space and installation costs**

Products Included in this Solution:

ETX-220A
page 69

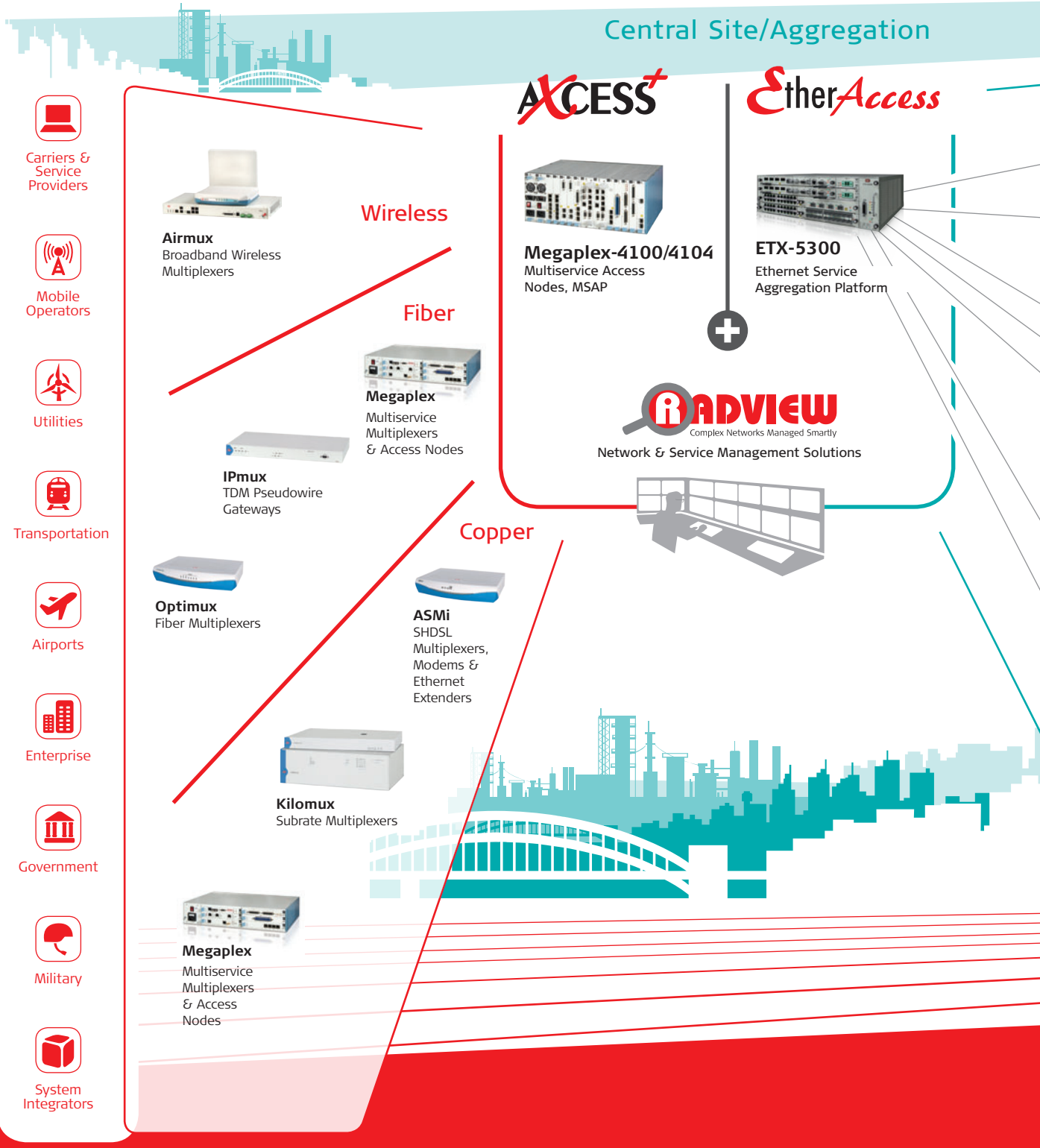
ETX-5300A
page 70

MiNID
page 78

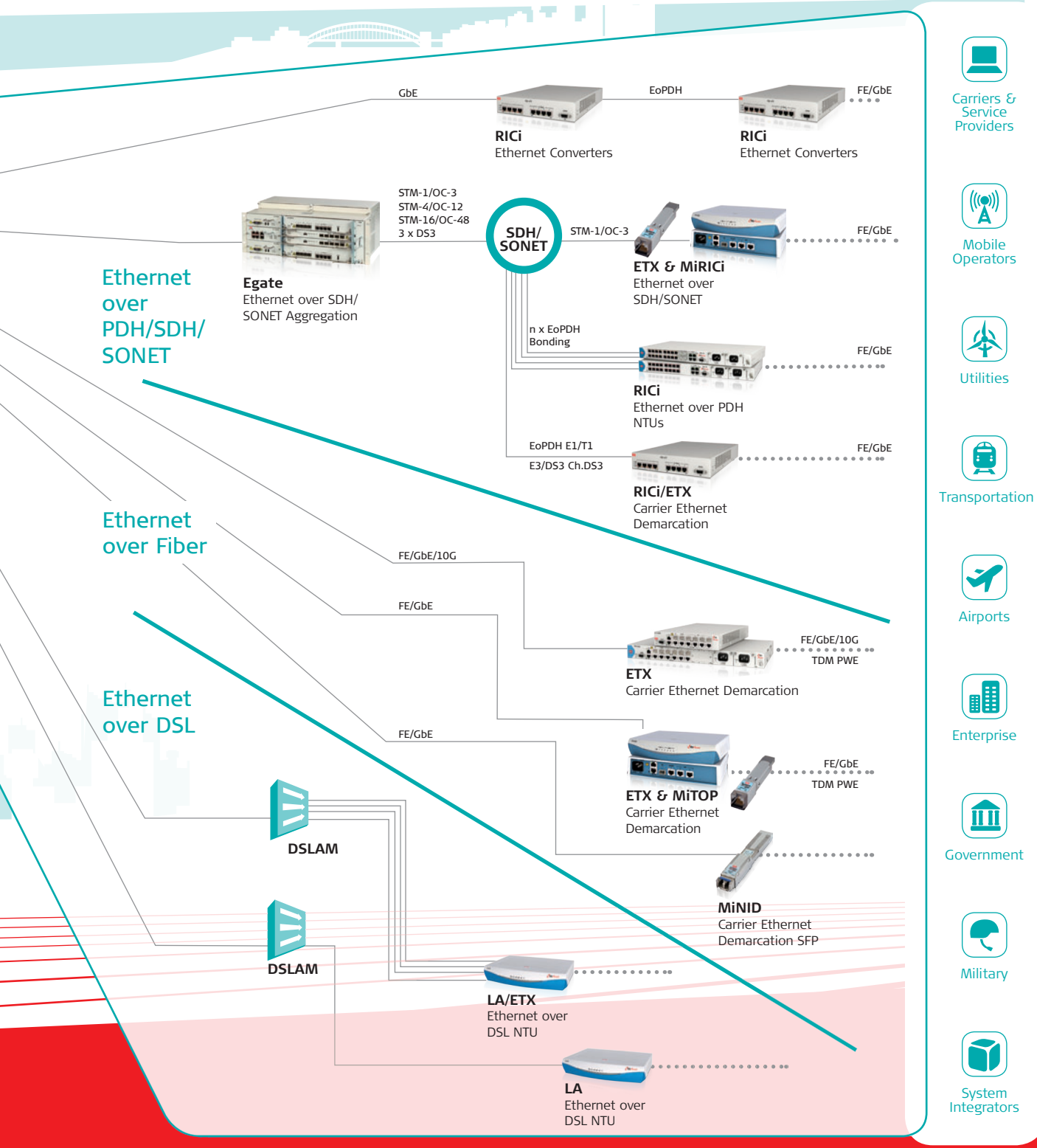
And: **RADview** P. 87-89

Broad Product Portfolio

Multiservice Access & First Mile Solutions



Carrier Ethernet Access Solutions



Carriers & Service Providers

Mobile Operators

Utilities

Transportation

Airports

Enterprise

Government

Military

System Integrators

Products A-Z

QR code scanning options

- Use the Scan option in **RAD's Catalog iPad application** to view product information.
- To view the **web product page**, use your regular QR scanner application on your mobile device

More information on RAD's iPad application can be found on the inside back cover of the catalog.

ACE-3100
Cell-Site Gateway

RAD's ACE-3100 multiservice cell-site gateway simplifies provisioning and control of mobile broadband services while enabling simultaneous delivery of GSM, UMTS and HSPA traffic over the same transport network. It works opposite the ACE-340x and ACE-3600 aggregation-site gateways, as well as opposite third-party multiservice aggregation devices, to leverage available infrastructure to access ATM, SDH/SONET and high capacity, economical packet switched transport networks.

The ACE-3100 incorporates flexible port configuration to allow aggregation of circuit-emulated (CES/SAToP) TDM E1/T1s, fractional E1/T1 UNIs or several IMA links into a single network interface. Various QoS schemes support the delivery of ATM and TDM traffic over Layer 2 and Layer 3 networks, while powerful synchronization capabilities ensure highly accurate timing for 2G and 3G traffic over packet backhaul.

- **Multiservice support for ATM, TDM and Ethernet traffic delivery over packet networks**
- **Up to four E1/T1 ports**
- **Up to two ATM-155 ports**
- **Two Fast Ethernet ports (UTP/SFP)**
- **Highly accurate clock regeneration using major industry standards**
- **ATM switching and traffic management**
- **Multi-standard pseudowire encapsulation over Ethernet, IP and MPLS networks**
- **Interoperable with BSS from major vendors**
- **SNMP management**

See p. 56 for scanning options

ACE-3220
Multiservice Cell-Site Gateway

RAD's ACE-3220 multiservice cell-site gateway is specifically designed to simplify provisioning and control of mobile broadband services while enabling simultaneous delivery of 2G-4G traffic over the same transport network. It grooms GSM, UMTS, HSPA and LTE traffic over a unified PSN (packet switched network) flow using diverse backhaul technologies, including ATM, ADSL2+, SHDSL.bis, and Gigabit Ethernet, as well as TDM and Ethernet microwave. Supporting operators and mobile transport providers in their migration to all-IP radio access networks (RAN), the ACE-3220 incorporates advanced pseudowire emulation (PWE) capabilities.

- **Eight or 16 built-in E1/T1 ports (UNI/IMA/CES); optional STM-1/OC-3 ATM port**
- **Four UTP/SFP Fast Ethernet ports; Gigabit Ethernet SFP/UTP combo port**
- **Up to two additional modular interfaces, including:**
  - Two ADSL2/2+ interfaces (Annex A, B)
  - Four SHDSL/SHDSL.bis interfaces (Annex A, B, F, G)
- **Flexible bonding options: SHDSL.bis EFM, IMA and M-Pair support**
- **Multi-standard Ethernet, TDM and ATM pseudowire encapsulation over PSNs**
- **Ethernet-to-Ethernet and Ethernet-to-ATM bridging capabilities to transport Ethernet traffic from the IP Node B**
- **PPPoE support for HSPA applications**
- **Remote management with RADview-EMS**

See p. 56 for scanning options

• A

ACE-3400, ACE-3402
Aggregation-Site Gateways

RAD's ACE-3400 and ACE-3402 Aggregation-Site gateways are carrier-class multiservice aggregators, specifically designed to optimize cellular backhaul by multiplexing various ATM or TDM services into a single IMA, STM-1/OC-3 or Gigabit Ethernet network interface. Typically located at hub sites or BSC/RNC sites, these devices ensure the most economical allocation of backhaul resources in delivering 2G, 3G and next-generation services over ATM and SDH/SONET transport networks. Moreover, the ACE-3400 and ACE-3402 incorporate advanced pseudowire emulation capabilities, supporting operators in their migration to cost-effective packet transport by enabling the use of wholesale DSL services and Ethernet, IP or MPLS backbones for the provisioning of delay-tolerant, as well as real-time services.

The ACE-3400 is a 3U device, while the ACE-3402 is 2U high. Both devices fit into 19-inch racks for easy installation in limited spaces.

- **32 or 63 x ATM UNI/IMA/CES, E1/T1 (ACE-3400)**
- **Channelized STM-1/OC-3 with up to 63 x VC-12 channels for SDH or 84 VT 1.5 channels with UNI/IMA/CES**
- **1+1 STM-1/OC-3c ATM ports**
- **1+1 Gigabit Ethernet uplink**
- **Up to 512 pseudowire connections with CESoPSN, SAToP and ATMoPSN support**
- **ATM and pseudowire OAM, QoS**
- **End-to-end fault propagation between legacy and packet switched networks**
- **+/-16 ppb frequency accuracy; high precision clock distribution**
- **RADview-EMS element manager compliant with any third-party NMS/OSS; Fast Ethernet management interface (ACE-3402)**

See p. 56 for scanning options

ACE-3600
RNC-Site Gateway

RAD's ACE-3600 RNC-site gateway is a multiservice, multi-generation aggregation device for cost-effective delivery of UMTS, HSDPA and next-generation 3GPP traffic over Ethernet, IP and MPLS backbones. Converging multiple STM-1/OC-3 links over Gigabit Ethernet, the ACE-3600 uses pseudowire encapsulation to transport real-time ATM traffic over packet technology, with accurate PSN synchronization and distribution schemes.

Typically located at RNC sites, the ACE-3600 RNC-site gateway is a small, modular unit with total front access design, working opposite cell-site gateways such as RAD's ACE-3100 and ACE-3200. Together, these solutions support service operators in their migration to all-IP RAN and enable optimized provisioning of mobile broadband and rich-media services.

- **Four STM-1/OC-3c ATM ports with full redundancy**
- **One Gigabit Ethernet port with full redundancy**
- **Up to 1024 PW (pseudowire) connections over a packet switched network**
- **ATM and pseudowire OAM, QoS**
- **Interface-based synchronization per ITU-T G.823/824, with unicast and multicast clock distribution**
- **Full ATM switching, including traffic scheduling and shaping**
- **VLAN tagging per 802.1Q with 802.1p scheduling for QoS over L2 networks**
- **APS per G.841 for full system protection**
- **RADview-EMS element manager compatible with any third-party NMS/OSS**

See p. 56 for scanning options

Airmux-400, Airmux-400L, Airmux-400LC

Broadband Wireless Radios

RAD's Airmux-400 series of carrier-class 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 provides aggregated throughput of up to 200 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

Airmux-400 is part of the AXCESS+ portfolio of multiservice access and First Mile solutions.

- **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, or 40 MHz channel bandwidth**
- **Up to 16 E1/T1 ports; up to two Gigabit Ethernet interfaces**
- **Net throughput: Up to 200 Mbps aggregated (Airmux-400), up to 50 Mbps aggregated (Airmux-400L), or up to 10/25 Mbps aggregated (Airmux-400LC)**
- **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 colocated 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

See p. 56 for scanning options

Airmux-1200F

Millimeter-Wave E-Band Radio (FDD)

The Airmux-1200F is a high capacity, millimeter-wave, all-outdoor Gigabit Ethernet radio that dramatically lowers the cost of wireless and Ethernet backhaul. Operating in the uncongested and inexpensively licensed 71-76 GHz/81-86 GHz E-band spectrum, the Airmux-1200F features a capacity of up to 1 Gbps with carrier-grade networking capabilities, as well as with enhanced adaptive bandwidth, coding and modulation for maximum spectral efficiency. Uniquely based on an all-silicon design, the highly economical system requires fewer components and offers greater reliability. Low power consumption and small size, as well as quick and easy installation that requires minimal site preparation, further reduce TCO (total cost of ownership), and make it ideal for mobile operators, business service providers and enterprises.

- **Operates in the 71-76 GHz/81-86 GHz E-band spectrum; 250/500 MHz channel bandwidth**
- **Supports FDD, OFDM air interface**
- **Symmetric aggregated capacity of 500 Mbps (250 MHz) and 1000 Mbps (500 MHz)**
- **Maximum link distance of 4500 m (14,765 ft)**
- **Full Carrier Ethernet support, including Ethernet OAM and performance monitoring, Ethernet Ring Protection Switching**
- **Advanced QoS classification, prioritization, shaping, and policing, supporting eight classes of service with SP, WFQ scheduling**
- **G.8262, G.8264 Synchronous Ethernet; IEEE 1588v2 transparent clock (TC)**
- **AES 128, AES 256 encryption**
- **1 ft, 2 ft antenna**

AIRMUX

See p. 56 for scanning options

• A

Airmux-1200T

Millimeter-Wave E-Band Radio (TDD)

The Airmux-1200T is a high capacity, millimeter-wave, all-outdoor Gigabit Ethernet radio that dramatically lowers the cost of wireless and Ethernet backhaul. Operating in the uncongested and inexpensively licensed 71-76 GHz E-band spectrum, the Airmux-1200T features a capacity of up to 1 Gbps with carrier-grade networking capabilities, as well as with enhanced adaptive bandwidth, coding and modulation for maximum spectral efficiency. Uniquely based on an all-silicon design, the highly economical system requires fewer components and offers greater reliability. Low power consumption and small size, and quick and easy installation that requires minimal site preparation, further reduce TCO (total cost of ownership), and make it ideal for mobile operators, business service providers and enterprises.

- **Operates in the 71-76 GHz E-band spectrum; 250/500 MHz channel bandwidth**
- **Supports TDD, OFDM air interface**
- **Symmetric and asymmetric aggregated capacity of 500 Mbps (250 MHz) and 1000 Mbps (500 MHz)**
- **Maximum link distance of 4,500 m (14,765 ft)**
- **Full Carrier Ethernet support, including Ethernet OAM and performance monitoring, Ethernet Ring Protection Switching**
- **Advanced QoS classification, prioritization, shaping, and policing, supporting eight classes of service with SP, WFQ scheduling**
- **G.8262, G.8264 Synchronous Ethernet; IEEE 1588v2 transparent clock (TC)**
- **AES 128, AES 256 encryption**
- **1 ft, 2 ft antenna**

AIRMUX

See p. 56 for scanning options

Airmux-5000

Point-to-Multipoint Ethernet Radio

RAD's Airmux-5000 carrier-class point-to-multipoint Ethernet radio system is 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 200 Mbps aggregated sector capacity and shared base station architecture, a single Airmux-5000 base station supports up to 32 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 colocated HD cameras

- **Multi-band operation over 2.5 to 2.7 GHz, 3.3 to 3.8 GHz and 4.8 to 6 GHz in a single device**
- **Up to 200 Mbps aggregated throughput per sector**
- **Up to 32 remote subscriber units per sector with aggregated throughput of 5, 10, 20 and 50 Mbps**
- **Supports nomadic and mobility applications**
- **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 – 4 to 10 msec typical under full sector load**

AIRMUX

See p. 56 for scanning options

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 LRS-102, 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**

AXCESS+

See p. 56 for scanning options

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. The device is part of the AXCESS+ portfolio of multiservice access and First Mile solutions.

- **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 (LRS-102/Megaplex-4100)**

AXCESS+

See p. 56 for scanning options

• A

ASMi-54
Multiport SHDSL.bis Modem

The ASMi-54 advanced SHDSL.bis modem is a managed device featuring high port density for extending E1 and mid-band Ethernet services over multi-pair bonded copper links. It enables high deployment flexibility by supporting drop-and-insert (daisy chain) and ring topologies, as well as point-to-point and hub-and-spoke connectivity. Ensuring reliable performance over poor quality or noisy lines, the device employs next-generation SHDSL technology and operates in full duplex mode over up to 8-wire lines to achieve variable data rates of up to 22.8 Mbps.

The ASMi-54 is ideal for carriers, service providers and mobile operators, as well as for enterprises, utilities and transportation companies. Part of the AXCESS+ portfolio of multiservice access and First Mile solutions, it can also function as a Pico-DSLAM to aggregate traffic from remote ASMi-54L units.

- **Up to four copper or fiber Fast Ethernet ports with an integrated switch; four optional E1 interfaces**
- **Standards-compliant SHDSL (ITU-T G.991.2 and ETSI 101524)**
- **Up to 22.8 Mbps over 8-wire (4 pairs)**
- **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**
- **Managed via SNMP, Telnet and ASCII terminal**
- **Compact, half 19-inch enclosure; optional rail-mountable metal enclosure for extreme temperatures**

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ASMi-54L, ASMi-54C
SHDSL.bis Modems

The ASMi-54L SHDSL.bis modem and ASMi-54C SHDSL.bis module are cost-effective, managed devices for extending 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 11.4 Mbps.

The ASMi-54L SHDSL.bis modem and ASMi-54C SHDSL.bis module are 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. The devices are part of the AXCESS+ portfolio of multiservice access and First Mile solutions.

- **Four 10/100BaseT ports with an integrated switch; optional E1 interface**
- **Standards-compliant SHDSL (ITU-T G.991.2 and ETSI 101524)**
- **Up to 11.4 Mbps over 4-wire (2 pairs) and 5.7 Mbps over 2-wire (1 pair)**
- **15 Mbps over 2-wire using RAD's high performance SHDSL technology (ASMi-54L)**
- **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 and switching; Ethernet OAM per IEEE 802.3-2005 (formerly 802.3ah); VLAN prioritization, rate limitation per port and Ethernet QoS support**
- **EOC (Embedded Operational Channel) management for repeater deployments**
- **Managed via SNMP, Telnet and ASCII terminal**

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ASMi-54LRT

SHDSL.bis Modem with Integrated Router

The ASMi-54LRT is a managed SHDSL.bis modem with integrated router for small and medium businesses (SOHO/SME users). Enabling cost-effective LAN-to-LAN connectivity, it transports Ethernet and E1 traffic over multi-pair copper links with data access rates of up to 22.8 Mbps (8-wire) using EFM bonding. In addition to its Ethernet bridging capabilities, the ASMi-54LRT features a built-in router to enable Internet connectivity and Layer 3 VPN services for small and medium offices without requiring an external router.

The ASMi-54LRT is ideal for carriers and service providers, as well as for enterprises, utilities and transportation companies looking for economical and secure delivery of voice and VPN data traffic over leased lines, or over public IP networks.

- **Four 10/100BaseT ports with an integrated bridge or router; optional E1 interface**
- **Standard SHDSL supports up to 5.7 Mbps over 2-wire, 11.4 Mbps over 4-wire or 22.8 Mbps over 8-wire**
- **Dual bearer mode for E1 and Ethernet HDLC over 2-wire and 4-wire lines**
- **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**
- **Static NAT/NAPT routing**
- **Solid Firewall™ protection for LAN and DMZ with ingress rate limitation**
- **IPsec VPN support**
- **Ethernet OAM per IEEE 802.3-2005 (formerly 802.3ah); VLAN prioritization and Ethernet QoS support; per port rate limitation**

AXCESS+

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DXC Family

Digital Cross Connects

RAD's DXC-8R, DXC-10A and DXC-30 provide digital access and cross-connect functionality for multiple services, supporting a wide range of applications for carriers, cellular operators, ISPs, utilities, transportation, campus networks, and enterprises. The point-to-multipoint devices can broadcast any traffic combination from a single input to numerous destinations and provide non-blocking cross-connect for up to 120 lines.

The DXC family modular digital cross-connect units support E1/T1 conversion, inverse multiplexing, signaling monitoring, grooming of fractional traffic, and transmission of T1 circuits over E1 lines.

- **Non-blocking cross connect up to 960 timeslots**
- **Traffic grooming**
- **Compact 1U or 3U-high enclosures**
- **Modular construction with four, five or 15 I/O slots**
- **Services supported: n x 56/64 kbps, ISDN, IDSL, SHDSL, E1, T1, E3, T3, and STM-1**
- **Optional common logic and power supply redundancy**
- **Optional link and/or hardware protection**
- **Integrated fiber optic, SHDSL and IDSL modems**
- **Built-in E1/T1 converter, including A-law/μ-law and signaling conversion for PCM timeslots**

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• E

Egate-20

Ethernet over TDM Aggregation Gateway

RAD's Egate-20 Ethernet over TDM aggregation gateway interconnects TDM and packet switched networks, providing advanced bridging of Ethernet traffic with channelized E1 or T1 links. Typically situated in a central location, the Egate-20 functions as a bridge over a PDH environment, connecting up to 248 remote LANs.
The Egate-20 Ethernet over TDM gateway aggregates traffic from remote devices, such as RAD's RICi Ethernet NTUs and FCD TDM access devices. Its ability to support a large number of remote sites with low data volumes, makes the Egate-20 ideal for backhauling low rate, high priority services such as management traffic.

- **Aggregates and switches Fast Ethernet traffic over eight E1 or T1 ports**
- **Connects up to 248 remote sites via fractional E1 or T1 lines**
- **Provides QoS utilizing four priority queues per 802.1p, DSCP and IP Precedence, or per port**
- **Loop detection of TDM ports to avoid Ethernet storms**
- **Enables transparent Ethernet services utilizing VLAN tagging and stacking**
- **SNMP management**

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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. Part of RAD's EtherAccess portfolio, 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 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**

EtherAccess

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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**

EtherAccess

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EtherAccess EchoVault

SLA Delivery System and Ethernet Service Monitoring

RAD's EtherAccess EchoVault is a standalone SLA delivery and service monitoring system, designed for carriers and service providers delivering Carrier Ethernet services over large networks. The system provides a service-centric end-to-end view of SLA performance per EVC.CoS (Ethernet virtual connection class of service) and collects KPI (key performance indicators) data from RAD's EtherAccess devices, as well as from third-party equipment with relevant API support. EtherAccess EchoVault integrates with existing OSS/BSS systems to provide service performance information required for billing and operations.

- **Standalone system for end-to-end SLA management**
- **Centralized KPI collection, reporting and integration to OSS/BSS systems**
- **Easy plug-and-play installation**
- **SLA testing per CoS: RFC-2544, Y.1731**
- **Includes RFC-2544 scheduler**
- **Threshold and tolerance alert management**
- **Optional customer portals**

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• E

ETX-26
Managed Ethernet Switch

ETX-26 is a managed Ethernet access switch featuring non-blocking architecture, small form factor and low power consumption. It is ideal for Ethernet Private Line connectivity and LAN-to-LAN interworking in campus deployments and for small to medium enterprises. In addition, the ETX-26 features proprietary power over Ethernet capabilities, to be used in conjunction with RAD's Airmux-400 broadband wireless radios as a single indoor device for Ethernet connectivity and ODU power feeding.

- **Three Gigabit Ethernet 1000BaseFX SFP ports**
- **Six Fast Ethernet 10/100BaseT UTP ports**
- **Ethernet bridging and switching per 802.1D, 802.1Q, 802.1Q-in-Q**
- **Four QoS priority queues with SP, WFQ scheduling**
- **ITU-T G.8032 Ethernet Ring Protection Switching (ERPS)**
- **Two proprietary Power over Ethernet ports for Airmux applications**
- **Wide range of AC/DC power supplies**
- **SNTP, Net Inventory and Dying Gasp support for management, configuration and diagnostics**
- **Extended temperature range**

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ETX-36
Ethernet Demarcation Switch

ETX-36 is an entry level Ethernet demarcation switch for service providers offering Ethernet connectivity services for business applications. Combining switch functionality with basic Ethernet demarcation capabilities, the ETX-36 enables quick, cost-effective service deployment to meet enterprise demand for Ethernet Private Line connectivity and LAN-to-LAN interworking.

The ETX-36 is deployed in hub-and-spoke or ring topologies and features Ethernet QoS, OAM and diagnostics to lower OpEx associated with service provisioning and monitoring. In addition, built-in switch functionalities allow local service provisioning within the organization, without the need to traverse the operator's network.

- **Six Gigabit Ethernet user/network ports**
- **Ethernet bridging and switching per 802.1D, 802.1Q, 802.1Q-in-Q**
- **Full Ethernet OAM and performance monitoring suite**
- **Six QoS priority queues with SP, WFQ scheduling and shaping**
- **ITU-T G.8032 Ethernet Ring Protection Switching (ERPS)**
- **RADview-EMS management; CLI configuration**

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ETX-102, ETX-201, ETX-202

Basic Ethernet Demarcation Devices

The ETX-102, ETX-201 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, ETX-201 and ETX-202 are part of RAD's EtherAccess portfolio, incorporating 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-EMS management**

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ETX-203AM

Universal Carrier Ethernet Demarcation Device

The ETX-203AM is a modular demarcation device, enabling operators to deliver Carrier Ethernet services over Gigabit Ethernet, TDM or SHDSL network connections, using a single device. This reduces carrier TCO and simplifies purchasing, homologation, training, service production, and management integration. As a feature-rich demarcation point for SLA-based Ethernet business services, it supports Ethernet Private Line (EPL) and Ethernet Virtual Private Line (EVPL) over the same physical link with IP VPN, VoIP, and dedicated Internet access, all with differentiated quality of service and end-to-end monitoring.

The ETX-203AM ensures carrier-grade performance and Five Nines (99.999%) reliability, and allows remote end-to-end service control. Part of the EtherAccess portfolio, it is ideal for carriers, service providers, and wholesale operators requiring advanced Ethernet functionality at customer premises and multi-tenant units (MTUs).

- **Complies with MEF Carrier Ethernet 2.0 specifications for EPL, EVPL, E-LAN services**
- **Four FE/Gigabit Ethernet user ports; GbE, E1/T1, T3, or SHDSL modular network ports**
- **Enhanced traffic management with multiple shapers and H-QoS per EVC/EVC.CoS**
- **Hardware-based Ethernet OAM, performance monitoring and built-in RFC-2544 tester capabilities; L2/L3 diagnostic loopbacks**
- **ITU-T G.8031 Ethernet Linear Protection Switching**
- **RADview-EMS management; CLI configuration**
- **Supported by RAD's performance management solutions**

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• E

ETX-203AX

Carrier Ethernet Demarcation Device

RAD's ETX-203AX delivers SLA-based Ethernet business services, such as Ethernet Private Line (EPL), Ethernet Virtual Private Line (EVPL) and bridged E-LAN to the customer premises over native Ethernet access. It handles up to 5 Gbps of user traffic at wire-speed with advanced traffic management and differentiated, per-flow quality of service (QoS) capabilities, to allow carriers to offer multiple services via the same physical port, while saving on service delivery costs.

The ETX-203AX ensures carrier-grade performance and Five Nines (99.999%) reliability, and allows remote end-to-end service control. Part of the EtherAccess portfolio, it is ideal for carriers, service providers, and wholesale operators requiring advanced Ethernet functionality at customer premises and multi-tenant units (MTUs).

- **Complies with MEF Carrier Ethernet 2.0 specifications**
- **Four FE/Gigabit Ethernet ports (total user and network)**
- **VLAN-aware and VLAN-unaware bridging**
- **Enhanced traffic management with multiple shapers and H-QoS per EVC/EVC.CoS**
- **Hardware-based Ethernet OAM, performance monitoring and built-in RFC-2544 tester capabilities; L2/L3 diagnostic loopbacks**
- **ITU-T G.8031 Ethernet Linear Protection Switching, G.8032 Ethernet Ring Protection Switching**
- **Synchronous Ethernet and 1588-TC support**
- **RADview-EMS management; CLI configuration; supported by RAD's performance management solutions**

EtherAccess

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ETX-204A

Carrier Ethernet/Mobile Demarcation Device

The ETX-204A is an advanced demarcation device for SLA-based Ethernet business services and mobile backhaul. It ensures carrier-grade performance and Five Nines (99.999%) reliability, and allows remote end-to-end service control. Part of the EtherAccess portfolio, the ETX-204A handles up to 1 Gbps of Ethernet user traffic at wire-speed with advanced traffic management and differentiated, per-flow quality of service (QoS) capabilities.

As a mobile demarcation device (MDD), the ETX-204A combines a cell-site gateway or a small hub device with Ethernet demarcation functionalities and is installed at cellular tower and controller sites to help backhaul and transport providers, as well as fixed-mobile carriers, guarantee differentiated SLAs for 3G, HSPA and LTE mobile operators. As an all-in-one device, it cuts down provider costs by minimizing equipment needed for timing and demarcation.

- **MEF-9/14 certified for EPL, EVPL services**
- **Multi-rate FE/GbE UTP/SFP combo ports with auto-detection**
- **Enhanced traffic management with multiple shapers and H-QoS per EVC**
- **Ethernet OAM, performance monitoring and built-in RFC-2544 tester capabilities; L2/L3 diagnostic loopbacks**
- **ITU-T G.8031 Ethernet Linear Protection Switching**
- **Sync-E, 1588v2 support**
- **RADview-EMS management; CLI configuration**

EtherAccess

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ETX-205A

Advanced Carrier Ethernet/
Mobile Demarcation Device

The ETX-205A is an advanced demarcation device for SLA-based Ethernet business services and mobile backhaul. It ensures carrier-grade performance and Five Nines (99.999%) reliability, and allows remote end-to-end service control. Part of the EtherAccess portfolio, the ETX-205A handles up to 5 Gbps of Ethernet and TDM pseudowire user traffic at wire-speed with advanced traffic management and differentiated, per-flow quality of service (QoS) capabilities.

As a mobile demarcation device (MDD), the ETX-205A combines a cell-site gateway or a small hub device with Ethernet demarcation functionalities and is installed at cellular tower and controller sites to help backhaul and transport providers, as well as fixed-mobile carriers, guarantee differentiated SLAs for 3G, HSPA and LTE mobile operators. As an all-in-one device, it cuts down provider costs by minimizing equipment needed for timing and demarcation.

- **Complies with MEF Carrier Ethernet 2.0 specifications for EPL, EVPL and E-LAN services**
- **Multi-rate FE/GbE UTP/SFP combo ports with auto-detection**
- **VLAN-aware and VLAN-unaware bridging**
- **Enhanced traffic management with multiple shapers and H-QoS per EVC**
- **Ethernet OAM, performance monitoring and built-in RFC-2544 tester capabilities; L2/L3 diagnostic loopbacks**
- **ITU-T G.8031 Ethernet Linear Protection Switching; ITU-T G.8032 Ethernet Ring Protection Switching**
- **TDM pseudowire per MEF-8, UDP/IP, MPLS static labeling in CESoP and SAToP modes**
- **Sync-E, 1588v2 support**
- **RADview-EMS management; CLI configuration; supported by RAD's performance management solutions**

EtherAccess

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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 applications. With a system throughput of up to 40 Gbps and extensive hardware-based tools for managing the service lifecycle seamlessly, it is optimized to address the performance needs of business Ethernet and wholesale services that require high capacity access pipes.

As a demarcation solution, the ETX-220A is used for managing the service hand-off at an enterprise headquarters handling a large volume of traffic, at carrier hotels, or between provider networks. Alternatively, it can also be used as an aggregation solution at the concentration point, where a single unit can support numerous services and concurrent OAM sessions.

- **Complies with MEF Carrier Ethernet 2.0 specifications for EPL, EVPL, E-LAN services**
- **Two redundant 10-GbE network ports and a 10-GbE user port**
- **Enhanced traffic management with multiple shapers and H-QoS per EVC/EVC.CoS**
- **Ethernet OAM, performance monitoring and built-in RFC-2544 tester capabilities; L2/L3 diagnostic loopbacks**
- **ITU-T G.8031 Ethernet Linear Protection Switching**
- **Designed to support Sync-E, 1588v2 slave and transparent clock (TC), 1 PPS**
- **Temperature-hardened enclosure; AC/DC redundancy**
- **RADview-EMS management; CLI configuration**

EtherAccess

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• E

ETX-1002

10-Gigabit Carrier Ethernet Aggregation Switch

The ETX-1002 grooms traffic from up to 24 Fast Ethernet or Gigabit Ethernet links over redundant 10-Gigabit Ethernet connections at wire-speed. The high capacity non-blocking edge switch provides a central aggregation solution for ETX Carrier Ethernet demarcation devices or third-party NTUs installed at the customer premises.

Deployed in hub-and-spoke or resilient ring topologies, the ETX-1002 is equipped with multi-priority traffic management capabilities on a per-port or per-flow basis. These, together with Ethernet OAM diagnostics, allow carrier-grade service delivery performance and SLA assurance, making it ideal for aggregation of business services and VPNs, triple-play and broadband aggregation, as well as for data center consolidation.

- **10-Gigabit aggregation point for L2/L3 transport and SLA-based business services**
- **Four 10-GbE XFP network ports; 24 Fast Ethernet or GbE SFP user ports**
- **MEF-9 and MEF-14 certified for EPL, EVPL services**
- **QoS with CIR/EIR rate limitation per user port or per flow**
- **Ethernet OAM per IEEE 802.1ag and IEEE 802.3-2005 (formerly 802.3ah)**
- **GbE ring support; uplink redundancy per IEEE 802.3ad with LACP**
- **Compact size for limited space installations**
- **Temperature-hardened enclosure for outdoor deployments**
- **Remote management; CLI configuration**

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ETX-5300A

Ethernet Service Aggregation Platform

The ETX-5300A reduces TCO (total cost of ownership) in delivering aggregated Ethernet and TDM pseudowire traffic from the access network to the PE (provider edge) over native 10-GbE links. Featuring the highest capacity-to-size ratio in the market and extremely low power consumption, it frees up expensive PE capacity, lowers price per link and saves on rack space and associated costs. The ETX-5300A conforms to emerging Carrier Ethernet 2.0 specifications and includes an extensive toolset to deliver and manage SLA-based services.

The ETX-5300A also features a comprehensive Timing over Packet synchronization toolset, including 1588 Grandmaster capabilities, eliminating the need for costly dedicated devices. Together with RAD's ETX demarcation devices, it offers a Carrier Ethernet access ecosystem from a single source and enables the convergence of business, wholesale and mobile network infrastructure.

- **Ethernet OAM termination and grooming**
- **3U device with high port density, delivering 100 Gbps throughput**
- **Extensive Sync-E, 1588v2 support, including 1588 Grandmaster**
- **Fully redundant system with modular design: Up to 16 x 10-GbE network/user ports;**
- **Up to 80 x 1-GbE ports; Up to 16 channelized STM-1/OC3 user/network ports**
- **Carrier Ethernet MEF compliant for MEF CE 2.0: E-Line, E-LAN, E-Tree, services; MEF-8; MEF-22: mobile backhaul; MEF-26: E-NNI**
- **Ethernet Ring Protection Switching: ITU-T G.8032**
- **Extensive TDM pseudowire support: CESoPSN, SAToP, CESoETH (MEF-8), UDP/IP encapsulation**
- **Extremely low power consumption; NEBS-compliant**
- **Supported by RAD's performance monitoring solutions**

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FCD-155

STM-1/OC-3 Terminal Multiplexer

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

- **Standard next-generation STM-1/OC-3 terminal utilizing GFP, VCAT, LCAS**
- **Grooms Ethernet and E1/T1/E3/T3 traffic over STM-1/OC-3 fiber or copper links**
- **Multiservice functionality in the same box:**
  - Two or six 10/100BaseT ports or one GbE port
  - Four or eight E1/T1 ports or one E3/DS3 port
- **SFP-based uplinks and Gigabit Ethernet interface**
- **Advanced management option including DCC and IP tunneling**
- **Available with standard protection on the main link**
- **Compact size**

AXCESS+

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FCD-155E

Ethernet over SDH/SONET ADM

The FCD-155E transports next-generation Ethernet and TDM traffic over STM-1/OC-3 fiber or copper links. It also supports E1, T1, E3, and T3 services. The traffic is mapped into the SDH/SONET frame and can be terminated at any point on the network. Used as an add/drop multiplexer on the SDH/SONET ring (or as a terminal multiplexer at the remote site), the FCD-155E 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.

Carriers and service providers deploy the product to leverage optical bandwidth for revenue-generating Ethernet services, while enterprises, utilities and campuses use the FCD-155E 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 or copper links**
- **Multiservice functionality in the same box:**
  - Two or six 10/100BaseT ports or one GbE port
  - Eight or 21 E1/28 T1 ports, one E3/DS3 port or 21 E1/28 T1 ports, one E3/T3
- **Optional dual power supply configuration**
- **SFP-based STM-1/OC-3 uplinks and Gigabit Ethernet interface (SFP and UTP)**
- **Advanced management option including DCC and IP tunneling**
- **Available with standard protection on the main link**
- **Compact size**

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• F/G

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 needing to integrate their voice and data traffic and access the Internet 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**

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Gmux-2000

Hub-Site Pseudowire Access Gateway

Gmux-2000 is a modular carrier-class TDM pseudowire and voice trunking gateway, typically located at large customer sites, points of presence (POPs), and carrier central offices. It works opposite TDM pseudowire CPEs such as IPmux to transport multiple TDM circuits over packet switched networks. Featuring a high density of TDM interfaces as well as standards-based pseudowire emulation capabilities, the Gmux-2000 is an ideal solution for PSTN access, as well as for PBX and mobile backhaul.

- **Transports up to 196 external E1/T1 links, seven channelized T3 or seven fully populated channelized STM-1/OC-3 over Gigabit Ethernet uplinks**
- **Multi-standard, hardware-based TDM pseudowire: TDMoIP, CESoPSN, SAToP, CESoETH, HDLCoPSN**
- **Fully redundant hardware, including all system and service modules**
- **QoS per 802.1p, ToS/DSCP or EXP**
- **VLAN tagging per 802.1Q, VLAN stacking (Q-in-Q)**
- **Ethernet OAM (CFM) per 802.1ag/ITU-TY.1731**
- **Secure management: SNMPv3, SSH and RADIUS**
- **Centralized SNMP-based remote management with RADView-EMS and/or RADview Service Center TDMoIP**

See p. 56 for scanning options

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-sized 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**

AXCESS+

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IPmux-2L

TDM Pseudowire Access Gateway

The IPmux-2L is a cost-effective TDM pseudowire access gateway, extending TDM, HDLC and LAN traffic over dark fiber, IP, MPLS, or Ethernet networks. In addition, it supports legacy serial data delivery over PSN. The device offers an ideal solution for economical PSTN access and TDM trunking over wired and radio packet access. Incorporating a multi-standard pseudowire ASIC, it enables transparent delivery of legacy user traffic over next-generation transport with minimal processing delay, making it ideal for supporting carriers in their migration of leased line services to NG networks. It also allows enterprises and utility companies to take advantage of new packet switched networks for legacy services transport, without replacing their existing equipment or affecting service quality.

- **Up to two E1 user ports**
- **Optional n x 64 serial user data port**
- **Three UTP/SFP Fast Ethernet ports**
- **Multi-standard, hardware-based TDM pseudowire: TDMoIP, CESoPSN, SAToP, HDLCoPSN, CESoETH**
- **QoS support with four priority queues**
- **Pseudowire OAM**
- **Optional Sync-E support**
- **Centralized SNMP-based remote management with RADView-EMS and/or RADview Service Center TDMoIP**

AXCESS+

See p. 56 for scanning options

IPmux-4L, IPmux-4LGE, IPmux-16L

TDM Pseudowire Access Gateways

The IPmux-4L, IPmux-4LGE 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-4L, IPmux-4LGE 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-2L, IPmux-24 and IPmux-216) and aggregation gateways supporting TDM pseudowire (such as ETX-5300A, Gmux-2000, IPmux-155L, and Megaplex-4100).

- **Up to four (IPmux-4L, IPmux-4LGE), eight or 16 (IPmux-16L) E1 user ports**
- **Three UTP/SFP Fast Ethernet user/network ports (IPmux-4L)**
- **Four UTP Fast Ethernet ports (IPmux-4LGE, IPmux-16L)**
- **One or three UTP/SFP Gigabit Ethernet network/user ports (IPmux-4LGE, 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-4LGE, IPmux-16L)**
- **Pseudowire OAM**
- **High precision clock recovery for 2G/3G cellular traffic over PSN**
- **Centralized SNMP-based remote management with RADView-EMS and/or RADview Service Center TDMoIP**

See p. 56 for scanning options

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**

See p. 56 for scanning options

IPmux-155L

Hub-Site Pseudowire Access Gateway

The IPmux-155L is a cost-effective access aggregator, delivering TDM pseudowires and Fast Ethernet user traffic over Gigabit Ethernet packet switched networks. Working opposite CPEs, such as the IPmux-24, IPmux-2L, IPmux-4L, and IPmux-4LGE, it functions as a pseudowire termination unit and sends TDM pseudowire bundles from remote units to SDH/PDH backbones while Ethernet traffic is directed to packet networks. Featuring multi-standard pseudowire capabilities and a wire-speed, non-blocking Ethernet switch, the IPmux-155L hub-site pseudowire access gateway allows enterprises to replace expensive leased lines with cost-effective packet transport and offers an ideal solution for economical PSTN access and PBX backhaul, including standards-based ring topology.

- **Multi-standard hardware-based TDM pseudowire: TDMoIP, CESoPSN, SAToP, CESoETH, HDLCoPSN**
- **Transports a fully populated channelized STM-1 stream or up to 32 E1 channels over PSN**
- **1+1 redundant STM-1 ports**
- **Aggregates 32 Fast Ethernet UTP/SFP connections into four Gigabit Ethernet links**
- **ITU-T G.8032 Ethernet Ring Protection Switching (ERPS)**
- **Secure management: SNMPv3, SSH/SSL and RADIUS**
- **Centralized SNMP-based remote management with RADView-EMS and/or RADview Service Center TDMoIP**
- **Compact 1U (STM-1 version) or 2U (32 E1 version), 19-inch enclosure**

AXCESS+

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Kilomux-2100, Kilomux-2104

Subrate Multiservice Multiplexers

The Kilomux subrate multiservice multiplexers provide an efficient and cost-effective solution for integrating data, voice, fax, and LAN traffic over digital data services, leased lines, ISDN, and other services. In addition, TDM traffic can be transparently delivered over IP or Ethernet-based networks using pseudowire technology. Especially suited for the satellite environment, the Kilomux-2100 subrate multiservice multiplexer contains an elastic buffer to deal with the long delay introduced by the wireless path. Supporting SCADA and legacy analog voice interfaces, the Kilomux devices are also ideal for utility companies and air traffic control applications.

The low overhead proprietary multiplexing, minimal end-to-end delay and allocated bandwidth of the Kilomux – together with voice compression – ensure quality of service while maximizing utilization of the available bandwidth.

- **Uplink data rates from 9.6 kbps to 1,536 kbps**
- **High quality, low bit rate analog voice/fax from 4.8 kbps to 14.4 kbps**
- **Digitally encoded toll-quality PCM/ADPCM analog voice/fax from 16 kbps to 64 kbps**
- **Low/high speed async/sync serial data interfaces**
- **Chassis capacity:**
  - **Kilomux-2100 with 12 I/O slots**
  - **Kilomux-2104 with four I/O slots**
- **Optional redundant power supply and uplink interface**
- **Drop-and-insert capability**
- **Ethernet bridge module for LAN connectivity**
- **Flexible timing options**

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• L

LA-110

Integrated Access Device

RAD's LA-110 delivers multiple services such as voice, Ethernet and Internet access over low-cost xDSL and ATM transport. Leveraging existing deployments of wholesale SHDSL services, it offers cost and coverage benefits for SMEs (small and medium enterprises) and is ideal for leased line, cellular backhaul, Frame Relay, and corporate IT applications. By extending end-to-end management up to the customer premises, the LA-110 enables service differentiation and QoS guarantees. Furthermore, the LA-110 integrated access device allows a bandwidth capacity increase up to 9.2 Mbps, with IMA bonding over four SHDSL pairs.

- **Network ports: SHDSL or E1**
- **Up to 9.2 Mbps, 8 km (5 miles) with IMA bonding over four × 2-wire SHDSL**
- **Built-in 10/100BaseT user interface**
- **Optional user ports:**
  - **E1/T1 TDM/ATM**
  - **ISDN BRI/PRI**
  - **Serial Frame Relay/X.21/V.35**
- **AAL1, AAL2, and AAL5 adaptation layers**
- **Up to 16 ATM virtual connections (VCs)**
- **Comprehensive pseudowire capabilities**
- **Advanced diagnostics and statistics per port, network layer and VC**
- **Bridge and router capabilities**

See p. 56 for scanning options

LA-210

EFM 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. As part of RAD's EtherAccess portfolio, 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-9 and MEF-14 EPL and EVPL 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**

See p. 56 for scanning options

LRS-102

Fiber and Copper Mux Rack

The LRS-102 is a cost-effective, modular central rack solution for RAD's Optimux fiber multiplexer or ASMi-54 SHDSL.bis products, extending E1/T1s, data and Ethernet traffic up to 120 km (74.5 miles) over fiber optic links, and TDM and Ethernet over SHDSL.bis with rates up to 22.8 Mbps over copper. A higher port density chassis occupying one-third of the space of the equivalent number of standalone units, the LRS-102 central solution saves on colocation costs and avoids multiple IP addresses in the network, resulting in a lower price per port. Typical LRS-102 applications include campus service sharing, Ethernet, data and voice range extension, cellular backhaul extension, video conferencing, and surveillance camera connectivity.

- **Modular chassis with 12 I/O slots**
- **Up to 24 Optimux-108 and/or Optimux-106 modems in a single chassis**
- **Up to 96 copper pairs in a single chassis**
- **Transports up to 96 E1 and 24 x 10/100BaseT Ethernet links**
- **Hot-swappable, redundant uplinks**
- **Supports single mode, multimode and single mode over single fiber (WDM)**
- **Redundant power supplies**
- **RADview SNMP management**

See p. 56 for scanning options

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, DSL, 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.

The Megaplex-2100 and Megaplex-2104 are part of the AXCESS+ portfolio of multiservice access and First Mile solutions.

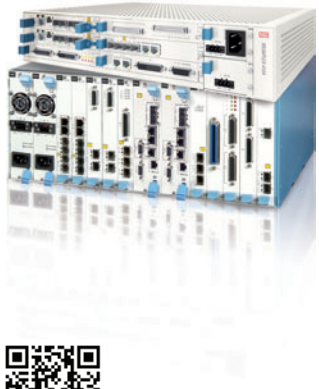
- **Multiple E1/T1 links, IP main link with TDMoIP support**
- **Deliver PSTN, ISDN and data services via:**
  - Multiple analog and compressed voice channels (FXS, FXO, E&M
  - Low speed data (V.24/RS-232, n x 64 kbps, G.703)
- **RFER – Resilient Fast Ethernet Ring or E1/T1 ring protection**
- **Multiple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

See p. 56 for scanning options

• M

Megaplex-4100, Megaplex-4104

Next-Generation Multiservice Access Nodes



AXCESS+

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RAD's Megaplex-4100 and Megaplex-4104 are carrier-class, high capacity multiservice access concentrators for delivering legacy and next-generation services over fiber or copper PDH/SDH/SONET, or over packet switched transport networks (PSN). Their 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 them an ideal core/edge solution for carriers and service providers. The devices also provide 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-4100 and Megaplex-4104 are part of the AXCESS+ portfolio of multiservice access and First Mile solutions and are used as central aggregation units for AXCESS+ CPEs.

- **Modular 4U (MP-4100) or 2U (Megaplex-4104), 19-inch units housing multiple I/O modules**
- **Hybrid Ethernet and TDM architecture, supporting TDM, PSTN, ISDN, data, and Ethernet services up to STM-4/OC-12, and Ethernet up to multi-GbE**
- **Carrier-class reliability with hardware, service and system redundancy**
- **Seamless migration to next-generation communications with service provisioning and end-to-end path management**
- **Complies with MEF Carrier Ethernet 2.0 with traffic management, performance monitoring and Ethernet OAM**
- **Non-blocking cross-connect for a high volume of DS0 channels**
- **Built-in support for distance and current Teleprotection for power utility applications**
- **Omnibus for teleconferencing**
- **Integral xDSL modems for subscriber and main link connections**

MiNID

Ethernet Demarcation SFP

EtherAccess

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MiNID is a fully functional network interface device (NID), housed in a smart SFP enclosure. Easily pluggable into SFP ports of switches and routers, it offers Carrier Ethernet demarcation and SLA assurance functionalities for remote service monitoring and fault isolation. Part of the EtherAccess portfolio, the MiNID handles up to 1 Gbps of Ethernet user traffic with per-port and per-flow OAM capabilities, as well as with performance monitoring counters, while providing remote end-to-end service control.

MiNID eliminates the need for standalone demarcation devices, while allowing service providers, mobile operators and wholesale carriers to receive real-time network/service performance reports with per-CoS SLA definition. Extremely easy to install and maintain, it does not require dedicated training and delivers substantial OpEx savings by lowering power consumption, space and installation costs.

- **Complies with MEF Carrier Ethernet 2.0 specifications for EPL, EVPL services**
- **Seamlessly hosts standard FE and GbE SFP modules**
- **Zero-touch Provisioning for fast and simple installation**
- **Ethernet OAM, performance monitoring and wire-speed RFC-2544 capabilities; L2/L3 diagnostic loopbacks**
- **Managed as a standalone device via CLI and web interfaces, or integrated into host equipment's management**

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**

EtherAccess

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MiRICi-E1/T1, MiRICi-E3/T3

Smart SFP Ethernet to E1/T1 or E3/T3 Remote Bridges

RAD's MiRICi-E1/T1 and MiRICi-E3/T3 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. 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 and MiRICi-E3/T3 are part of RAD's "System on an SFP" product line, providing 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 link**
- **Supports standard GFP, HDLC-like, and cHDLC 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**
- **Software download via TFTP**
- **Supports Ethernet OAM per 802.3-2005 (formerly 802.3ah)**

EtherAccess

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• 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)**

AXCESS+ EtherAccess

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Optimux-45, Optimux-45L

Multiplexers for 21E1/28T1 over Fiber or T3

Optimux-45 and Optimux-45L are managed multiplexers 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. They provide 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. In addition, the Optimux-45 can serve as a cost-effective alternative to high speed ADMs or large DACs.

- **Cross-connect capabilities for drop-and-insert and ring applications**
- **Multiplexes up to 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**

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Optimux-106, Optimux-108

Fiber Multiplexers for 4E1/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 (74.5 miles). 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.

The Optimux-106 and Optimux-108 are part of the AXCESS+ portfolio of multiservice access and First Mile solutions.

- **Up to four E1 or T1 ports; Fast Ethernet or V.35 user ports**
- **Full 100 Mbps Ethernet data rate (user)**
- **Simple plug-and-play installation**
- **Range extension up to 120 km (74.5 miles)**
- **Redundant uplink interfaces and power supplies**
- **Card versions for the LRS-102 modem rack and for the Megaplex-4100**
- **Management via ASCII terminal, Web server, Telnet or RADview-EMS**
- **Temperature-hardened enclosures**

AXCESS+

See p. 56 for scanning options

Optimux-108L

Fiber Multiplexer for 4E1 and Ethernet

The Optimux-108L is an entry-level, power-saving E1 and Ethernet fiber optic multiplexer. Working opposite another Optimux-108/108L unit or opposite RAD's LRS-102 or Megaplex-4100 central site solutions, it transparently delivers four E1 channels and Fast Ethernet traffic over a fiber optic link. In addition to its compact footprint, the Optimux-108L enables a 40% reduction in OpEx related to power consumption of network elements.

The Optimux-108L is an ideal solution for mobile backhaul over fiber of TDM and Ethernet traffic, as well as for multiservice aggregation over fiber by carriers and service providers. It also enables cost-effective connectivity of TDM and Ethernet services over dark fiber for enterprises, utilities and transportation companies.

The Optimux-108L is part of the AXCESS+ portfolio of multiservice access and First Mile solutions.

- **Up to four E1 ports; Fast Ethernet user ports**
- **Full 100 Mbps Ethernet data rate (user)**
- **Simple plug-and-play installation**
- **Range extension up to 120 km (74.5 miles)**
- **Management via ASCII terminal, Web server, Telnet or RADview-EMS**
- **Dedicated 10/100BaseT Ethernet management port or dual in-line package (DIP) switches for full or basic management capabilities**
- **Metal enclosure for outdoor deployments**

AXCESS+

See p. 56 for scanning options

• O

Optimux-1025, Optimux-1032

Fiber Multiplexers for 16 E1/T1 and Gigabit Ethernet

The Optimux-1032 and Optimux-1025 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 (74.5 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.

The Optimux-1032 and Optimux-1025 are part of the AXCESS+ portfolio of multiservice access and First Mile solutions.

- **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 (74.5 miles)**
- **Redundant hot-swappable uplink interfaces and power supplies**
- **Management via RADview-EMS, CLI, ASCII terminal, SNMPv3**
- **RADIUS, SSH**
- **Temperature-hardened enclosures**

See p. 56 for scanning options

Optimux-1551, Optimux-1553

Fiber Multiplexers for 63E1/84T1 or 3E3/T3 over STM-1/OC-3

The Optimux-1551 and Optimux-1553 are plug-and-play SDH/SONET terminal multiplexers, delivering multiple PDH tributary channels over a single STM-1/OC-3 (155 Mbps) link.

They combine 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 up to 80 kilometers (50 miles) to remote locations, the Optimux devices allow service providers to increase their customer reach, while avoiding the cost and complexity associated with deploying high-end ADMs. Furthermore, the Optimux-1551 and Optimux-1553 eliminate 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 (Optimux-1551) or three E3 or T3 user interfaces (Optimux-1553)**
- **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 or DS3 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-EMS**
- **Range up to 80 km (50 miles)**

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PacketLight

Complete Solutions for WDM and Dark Fiber Applications

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 include 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 wavelengths**
- **Amplification over long distances**
- **Performance monitoring**
- **Supports single or dual fiber**
- **Low latency connectivity**
- **Hot-swappable PSU and fan**
- **Integrated management**
- **Compact 1U devices**
- **Simple to install and maintain**
- **Cost-effective CPE device**
- **Integrated OTN Layer**

www.packetlight.com

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RADcare Global Professional Services

Peace of Mind, Where and When You Need It

RAD's new comprehensive package of service, support and training options provides authorized RAD Partners and you with expert consulting and troubleshooting assistance, online tools, regular training programs, and various equipment coverage options. All of these vital services are backed by a highly dedicated and professional team of regional support associates at internationally located TACs (Technical Assistance Centers), together with Project Management staff and international training professionals. In addition, authorized RAD Partners can consult with RAD's Pre-Sales Consulting team to benefit from their vast knowledge of current technology and hands-on experience with global market requirements.

When your product solution is covered by RADcare Global Professional Services, you increase your ability to profit from RAD's formidable wealth of industry expertise and international experience.

- **RADcare Technical Support**
- **RADcare Professional Training Center**
- **RADcare Project Management**

See p. 56 for scanning options

• R

RADcare Project Management

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. Once you've decided to purchase RAD products, RAD's proactive Project Management program can help you maximize the value of your capital investment throughout the project lifecycle. A single point of contact coordinates all project activities within RAD and employs advanced risk management techniques to identify and avoid potential conflicts before they become problems.

The Project Manager can also help you with all your on-site deployment activities including acceptance testing, site engineering service, customized documentation, site survey, installation, commissioning, NMS installation and administration, and on-site training.

- **Single point of contact**
- **Project coordination**
- **Risk management**
- **Periodic meetings**
- **Action item follow-up**
- **Regular progress reports**
- **Change management**
- **Project-specific documentation**
- **On-site services**

See p. 56 for scanning options

RADcare Technical Support

Follow-the-Sun Service Model

RADcare Technical Support

With three regional support centers – APAC, EMEA and the Americas – and a central monitoring staff at headquarters, the sun never sets on your RADcare service team. To ensure optimal customer satisfaction, all RADcare interactions are supervised from a central monitoring post at RAD headquarters. A rules-based system with automatic escalation to a global escalation team guarantees that every trouble ticket gets the attention it mandates, while all tickets – both regional and at headquarters – are kept in the same central CRM database for follow-up and cross-referencing purposes.

RADcare Technical Support offers five levels of tiered service plans, backed by trained staff in four regional support centers and covering such issues as hardware and software warranties, phone support, NBD spares shipment, and on-site spares inventory, among others.

- **Priority handling and escalation procedures**
- **On-site spares**
- **Replacement parts/products**
- **Access to eSupport system**
- **Software downloads**
- **24 x 7 emergency support**
- **Strict SLA commitments on response, service restore and resolution times**

See p. 56 for scanning options

RADcare Professional Training Center

End-User and Partner Training

RADcare Training

RAD's training programs are designed to keep your team up-to-date with the latest RAD products and technologies. We employ the latest thinking on blended learning, amalgamating different training tools and performing training needs analysis, enabling us to design a training solution that meets your customers' needs. RAD training ensures that your engineers gain the maximum benefit from the RAD solution you have implemented; your engineers will gain configuration and maintenance skills and will be confident in their handling of your network.

For the RAD Partner, we offer a complete range of services too, including seminars, "Train the Trainer" programs, courses in design fundamentals, and regular web-based training (WBT) and updates. With this training experience, you are in good hands with a RAD Partner.

- **Regional pre-sales and technical seminars**
- **Training-on-demand**
- **WBT: Web Based Training**
- **NEW: Telecom technology courses**
- **Partner sales training**
- **RAD certification**

See p. 56 for scanning options

For further details of RAD courses, please write to **training@rad.com**

RADiFlow iSIM

Intelligent Service Management Tool

The iSIM management tool supports the operation and maintenance of the industrial Ethernet network consisting of RADiFlow switches. Enabling network topology management with automatic discovery, it supports pre-configuration of RADiFlow devices to simplify deployment. The iSIM is a powerful tool for provisioning of service connections between the industrial end-devices, while configurable security matrix capabilities and diagnostic tools allow user-configuring of application-aware security rules and easy monitoring, respectively.

- **Automatic discovery of RADiFlow network switches**
- **Network topology management**
- **End-to-end service provisioning**
- **Security rules configuration**
- **Aggregated network fault monitoring**
- **Network performance analysis**
- **Operator authorization levels**

See p. 56 for scanning options

RADiflow

www.radiflow.com

• R

RADiFlow Switches 3080/3180

Compact Service-Aware Industrial Ethernet Switches

The compact RADiFlow 3080 and RADiFlow 3180 are ruggedized Ethernet switches with built-in security mechanisms designed specifically for SCADA applications. They combine functionalities that typically require separate devices and provide an efficient distributed security layer protecting from insider attacks. The devices monitor SCADA commands using deep packet inspection to validate their fit with the application logic for specific functions. These compact switches further integrate multiservice functionalities, such as cellular and SHDSL modems, to provide network access to remote sites, as well as serial interface connectivity of legacy user devices.

The RADiFlow Ethernet switches are ideal for utility companies and critical infrastructure organizations requiring distributed security, such as Smart Grid and intelligent transportation operators, water and gas utilities, as well as public safety and homE-LANd security agencies.

- **Multi-functional, compact and ruggedized systems**
- **Designed for harsh environments**
- **Advanced Ethernet and IP feature-set**
- **Ethernet interfaces with optional PoE support**
- **Serial interfaces with protocol gateway and tunneling**
- **Integrated 2G/3G cellular and SHDSL modems**
- **Integrated application-aware firewall for SCADA protocols**
- **Integrated L2/L3 VPN agent**

See p. 56 for scanning options

www.radiflow.com

RADiFlow Switches 3300/3700

Service-Aware Industrial Ethernet Switches

The RADiFlow 3300 and RADiFlow 3700 are high density, modular systems with built-in security mechanisms designed specifically for SCADA applications. They combine functionalities that typically require separate devices and provide an efficient distributed security layer protecting from insider attacks. The devices monitor SCADA commands using deep packet inspection to validate their fit with the application logic for specific functions. These ruggedized, modular switches provide a flexible platform with a combination of fiber and copper Ethernet ports, as well as serial interfaces for legacy devices.

The RADiFlow Ethernet switches are ideal for utility companies and critical infrastructure organizations requiring distributed security, such as Smart Grid and intelligent transportation operators, water and gas utilities, as well as public safety and homE-LANd 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 application-aware firewall for SCADA protocols**
- **Integrated L2/L3 VPN agent**

See p. 56 for scanning options

www.radiflow.com

RADview-EMS

Carrier-Class Element and Service Management System

RAD's RADview-EMS is a multi-platform system for configuration, provisioning, monitoring, and management of networks and end-to-end services. Fully compliant with the ITU-T Telecommunications Management Network (TMN) standards, the RADview-EMS management system features advanced fault, configuration, administration, performance, security (FCAPS) capabilities and supports the RADview-PM Ethernet performance monitoring portal for real-time monitoring of Ethernet service performance.

RADview-EMS manages both legacy TDM and next-generation RAD devices using an SNMP southbound interface, and also features third-party device monitoring capabilities. Its northbound interface enables integration into a third-party umbrella system (OSS).

- **Monitors device health, optimizes network operations and minimizes mean time to repair (MTTR)**
- **Fully compliant with TMN standards**
- **Client/server architecture with multi-user support and seamless handover of user privileges**
- **Advanced FCAPS functionality**
- **Wide range of northbound application programming interfaces (API)**
- **Interoperable with third-party NMS and leading OSS/umbrella systems**
- **IBM Tivoli's Netcool®/OMNIbus™ plug-in**
- **High Availability and Disaster Recovery support**
- **Automated change management**

See p. 56 for scanning options

RADview-SMS

Service Management for Ethernet Services

RADview-SMS provides end-to-end management of Ethernet services using RAD's EtherAccess portfolio. An intuitive GUI, "point-and-click" functionality and easy-to-follow wizards facilitate provisioning, monitoring, diagnostics and SLA assurance for Ethernet services, 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.

Service templates can be defined using the "catalog" application for fast and easy service provisioning, while customer management functionality enables carriers to associate customers to services and/or network resources. As a result, network faults are automatically correlated with impacted services and customers.

- **Unified rich client application for all EMS/NMS/SMS functionalities**
- **"Point-and-click" end-to-end service provisioning**
- **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**
- **Multi-platform Java-based solution supporting Windows and UNIX**
- **Standard TMF MTOSI northbound interface to third-party NMS/OSS systems**
- **GUI designed for management of very large networks**

See p. 56 for scanning options

• R

RADview-PM

Ethernet Service Performance Monitoring Portal

Complementing RAD's RADview network management suite, RADview-PM enables real-time monitoring of Ethernet service performance by collecting KPI (key performance indicators) data from RAD devices. It allows service providers to easily monitor and manage actual network and service performance over time and compare it to SLA (service level agreement) guarantees – a critical component of premium services to business, wholesale and mobile customers.

The RADview-PM enables immediate detection of service degradation, so that remedial actions are taken to quickly restore guaranteed performance levels. It also supports current and interval-based statistics reporting. Device statistics can be collected in a compressed format to minimize bandwidth usage for management traffic. The system retrieves data lost due to connection failures and exports standard CSV ASCII files to OSS or third-party management systems.

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

See p. 56 for scanning options

RADview-SC/TDM

Path Provisioning and Management for AXCESS+ TDM Services

RAD's RADview Service Center TDM path management system enables end-to-end management of RAD's TDM access products. An intuitive GUI, "point-and-click" functionality, and easy-to-follow wizards facilitate provisioning and monitoring over SDH/SONET and PDH networks.

Advanced programming provides 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 AXCESS+ 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**
- **Physical and logical graphic representation of network clouds, links, nodes, end-to-end services, and network status indication**
- **CORBA-based client-server architecture and northbound CORBA interface to umbrella systems (OSS)**
- **Java client and UNIX (Solaris)-based server**

See p. 56 for scanning options

RADview-SC/TDMoIP

Network Management System for TDMoIP Gateways

RAD's RADview Service Center TDMoIP is a network management system for RAD's TDM pseudowire gateways. An intuitive graphic user interface (GUI) and easy-to-follow wizards increase the efficiency and accuracy for end-to-end provisioning and monitoring of networks operating with RAD's IPmux and Gmux-2000 products. RADview-SC/TDMoIP includes an element management and performance analysis tool that monitors the status, configuration and resource availability of the TDMoIP gateways.

RADview-SC/TDMoIP includes an open CORBA northbound interface, facilitating integration with third-party NMS or umbrella systems (OSS).

- **Service association to network hierarchy level for ease of control and fault isolation**
- **"Point-and-click" provisioning from a central workstation**
- **Open system design based on client-server architecture and CORBA APIs**
- **Java-based application**
- **Maintenance of configuration parameters in database allows for immediate reactivation of deactivated circuits**
- **User-friendly, intuitive graphical user interface**
- **Automatic node and configuration discovery**

See p. 56 for scanning options

RIC-155GE

Gigabit Ethernet over STM-1/OC-3 NTU

The RIC-155GE bridges Gigabit Ethernet traffic over STM-1/OC-3 access or channelized OC-3 circuits, providing carriers and service providers with a migration path for connecting future-ready IP devices with GbE interfaces into existing SDH/SONET networks at 155 Mbps access rates. Typical applications include IP DSLAM and WiMAX base station backhaul, inter-POP connectivity or high bandwidth private line services. Using VLAN tagging and stacking, Ethernet traffic can be delivered transparently, while keeping user VLAN (CE-VLAN ID) settings intact.

- **Connects Ethernet traffic over STM-1/OC-3 or channelized OC-3 circuits**
- **VLAN tagging and stacking**
- **Four QoS levels**
- **SNMP-based fault management, Web-based element management**
- **16,000 MAC address table**
- **Secure Telnet and Web applications, SNMPv3 and RADIUS**

See p. 56 for scanning options

• R

RIC-155L

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

RAD's RIC-155L is a managed Ethernet converter for bridging Fast Ethernet or Gigabit Ethernet and STM-1/OC-3 connections. Enabling quality of service (QoS) management for multiple traffic types, as well as monitoring and diagnostics, the RIC-155L is ideal for extending Ethernet connectivity over TDM backbones in point-to-point applications, and for cost-effective backhaul of IP DSLAM and WiMAX base station traffic over SDH/SONET access networks.

- **Two GbE user ports (UTP & SFP)**
- **A single STM-1/OC-3 network port**
- **GFP (G.7041) encapsulation**
- **VLAN-aware and VLAN-unaware bridging**
- **Four QoS levels based on Strict Priority scheduling**
- **Remote and local, inband and out-of-band management**
- **TDM to Ethernet fault propagation**
- **Ethernet jumbo frames supported**

See p. 56 for scanning options

RIC-E1, RIC-T1

E1/T1, Serial and Ethernet Interface Converters

The RIC-E1 and RIC-T1 enable cost-effective conversion between standard serial or Ethernet data traffic to E1 or T1 channels. Ethernet options support transparent connection between remote LANs over unframed E1/T1 links with VLAN, diagnostic loopback and clocking capabilities. The devices support a range of up to 300 meters (1,000 ft) from the G.703 equipment over 24 AWG cable.

- **User ports: V.35, X.21, V.36, RS-530, or Fast Ethernet**
- **Network interface: Unframed E1 or T1 port**
- **Full duplex 2.048 Mbps (RIC-E1) or 1.544 Mbps (RIC-T1)**
- **Receive (from the G.703 interface), internal and external clocking options**
- **AC or DC power supply**

See p. 56 for scanning options

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.

- **One, four, eight, or 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**

See p. 56 for scanning options

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 Lines, 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**

See p. 56 for scanning options

• R

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**

EtherAccess

See p. 56 for scanning options

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-20, 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 G8040) 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**

EtherAccess

See p. 56 for scanning options

SFP/XFP Transceivers

Small Form-Factor Pluggable Transceivers

RAD's SFP/XFP (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 SFPs/XFPs 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 SFPs/XFPs.

- **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**

See p. 56 for scanning options

SFP-ER

Miniature Ethernet over Copper Range Extension Device

SFP-ER is an SFP Ethernet over copper extender that improves bandwidth capacity and service reach over existing copper lines. By enabling delivery of 100 Mbps beyond copper lines' distance limit of 100m (328 ft), it allows service providers and private network operators to deliver Ethernet connectivity without costly fiber installations from the POP, street cabinet, building basement, or campus communications to the customer premises or service end-points. Housed in a small form-factor pluggable (SFP) enclosure, the SFP-ER is designed for quick and simple insertion into any Fast Ethernet port with an MSA-compatible socket.

- **Point-to-point Ethernet connectivity with rates up to 100 Mbps**
- **Extends the distance limit for Ethernet connectivity over Cat5 or twisted pairs to up to 550m (1,804 ft)**
- **Full duplex transmission over 2-wire, 4-wire, or 8-wire copper lines**
- **Small form factor**
- **Pluggable into any Ethernet switch with MSA-compatible 100BaseFX ports or SGMII GE (for maximum data rates of 100 Mbps)**

See p. 56 for scanning options

• 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**

See p. 56 for scanning options

S-RPT, S-RPT/4W
SHDSL/SHDSL.bis Repeaters

RAD's S-RPT and S-RPT/4W extend 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, these SHDSL repeaters 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 and S-RPT/4W regenerate the received modem signal faultlessly. Multiple repeaters can be used, without introducing jitter or wander problems.

- **Based on the SHDSL standard for higher speeds and longer loop ranges**
- **Locally or remotely powered**
- **Available as a desktop unit or in IP-67 casing for installation in communication ducts**
- **Fully manageable via EoC link**
- **High quality, high performance**

See p. 56 for scanning options

RADview Agent Compatibility

RADview-SMS

- ETX-203AM
- ETX-203AX
- ETX-205A
- ETX-220A
- ETX-5300A

RADview-EMS

- ACE-3100
- ACE-3220
- ACE-3400
- ACE-3402
- ACE-3600
- Airmux-400
- Airmux-400L
- Airmux-400LC
- Airmux-1200F
- Airmux-1200T
- Airmux-5000
- ASMi-52
- ASMi-52L
- ASMi-53
- ASMi-54
- ASMi-54L
- ASMi-54LRT
- Egate-20
- Egate-100
- Egate-2000
- ETX-26
- ETX-36
- ETX-102
- ETX-201
- ETX-202
- ETX-203AM
- ETX-203AX
- ETX-204A
- ETX-205A
- ETX-220A
- ETX-1002
- ETX-5300A
- FCD-155
- FCD-155E
- FCD-IP
- IPmux-2L
- IPmux-4L
- IPmux-4LGE
- IPmux-16L
- IPmux-155L
- LA-110
- LA-210
- LRS-102
- Megaplex-2100
- Megaplex-2104
- Megaplex-4100
- Megaplex-4104
- MiNID
- Optimux-45
- Optimux-45L
- Optimux-106
- Optimux-108
- Optimux-108L
- Optimux-1025
- Optimux-1032
- Optimux-1551
- Optimux-1553
- PacketLight products
- RADiFlow 3080/3700
- RIC-155L
- RIC-LC
- RICi-4E1/4T1
- RICi-8E1/8T1
- RICi-16
- RICi-E1/E3
- RICi-T1/T3
- SPH-16

RADview-SC/TDM

- ASMi-52
- ASMi-52L
- ASMi-54
- ASMi-54L
- DXC Family
- FCD-155
- FCD-155E
- FCD-IP
- Megaplex-2100
- Megaplex-2104
- Megaplex-4100

RADview-SC/TDMoIP

- Gmux-2000
- IPmux-2L
- IPmux-4L
- IPmux-4LGE
- IPmux-16L
- IPmux-155L

Glossary

For the complete glossary see www.rad.com

#

1DM: One-way Delay Measurement Message

A

Access Ethernet Private Line: Access Ethernet Private Line (EPL) service uses a Point-to-Point OVC to associate one OVC End Point at a UNI and one OVC End Point at an ENNI. One UNI can support only a single instance of the Access EPL service

Access Ethernet Virtual Private Line: Access Ethernet Virtual Private Line (EVPL) service uses a Point-to-Point OVC to associate one OVC End Point at a UNI and one OVC End Point at an ENNI. One UNI can support one or more Access EVPL instances

Access Link: A link that represents connectivity to External Reference Points of the MEN

Access Provider: An Operator MEN that offers the Ethernet Access Service Type

AF: Adaptation Function

AIS: Alarm Indication Signal

All to One Bundling: A UNI attribute in which all CE-VLAN IDs are associated with a single EVC

ATS: Abstract Test Suite

Availability: A measure of the percentage of time that a service is useable

Availability flr: The Availability flr (in contrast with FLR) is the ratio of lost frames over a small interval of time Δt (e.g., 1 sec)

Availability Indicator: A binary indication of whether an interval Δt is available or not

Availability Performance: A measure of the percentage of time that a service is useable

Availability Window: A period of n consecutive intervals of Δt, used to determine whether the Availability state has been entered or exited

B

Bandwidth Profile: A characterization of Service Frame arrival times and lengths at a reference point (e.g., UNI) and a specification of the disposition of each Service Frame based on its level of compliance with the Bandwidth Profile

Bandwidth Profile per CoS ID: A Bandwidth Profile applied on a per-Class of Service Identifier basis

Bandwidth Profile per EVC: A Bandwidth Profile applied on a per-EVC basis

Bandwidth Profile per OVC End Point: A Bandwidth Profile applied on a per-OVC End Point basis

Bandwidth Profile per UNI: A Bandwidth Profile applied on a per-UNI basis

Bandwidth Profile per VUNI: A Bandwidth Profile applied on a per-VUNI basis

C

Carrier Ethernet: Carrier Ethernet is a ubiquitous, standardized, carrier-class Service and Network defined by five attributes that distinguish Carrier Ethernet from familiar LAN-based Ethernet. These are: Standardized Services, Scalability, Reliability, Quality of Service, Service Management

CE: Customer Edge, Customer Equipment

CEN: Carrier Ethernet Network (used interchangeably with Metro Ethernet Network, MEN)

CES: Circuit Emulation Services

CESoETH: Circuit Emulation Services over Ethernet

CE-VLAN CoS: Customer Edge VLAN CoS. The user-priority bits in the IEEE 802.1Q Tag in a Service Frame that is either tagged or priority tagged

CE-VLAN CoS ID: Customer Edge VLAN CoS. The Priority Code Point bits in the IEEE 802.1Q Customer VLAN Tag in a Service Frame that is either tagged or priority tagged

CE-VLAN CoS Preservation: An EVC attribute in which the CE-VLAN CoS of an Egress Service Frame is identical in value to the CE-VLAN CoS of the corresponding Ingress Service Frame

CE-VLAN ID: Customer Edge VLAN ID. The identifier derivable from the content of a Service Frame that allows the Service Frame to be associated with an EVC at the UNI

CE-VLAN ID/EVC Map: An association of CE-VLAN IDs with EVCs at a UNI

CE-VLAN ID Preservation: An EVC attribute in which the CE-VLAN ID of an Egress Service Frame is identical in value to the CE-VLAN ID of the corresponding Ingress Service Frame

CE-VLAN Tag: Customer Edge VLAN Tag. The IEEE 802.1Q Customer VLAN Tag in a tagged Service Frame

CFM: Connectivity Fault Management

CHLI: Consecutive High Loss Interval. A sequence of small time intervals contained in T, each with high Frame Loss Ratio

CIR-compliant: Service Frames that are compliant with the CIR of the Bandwidth Profile. CIR-compliant Service Frames are colored green

Circuit Emulation Service: A service that transports TDM-based traffic over a Metro Ethernet Network

Class of Service (CoS): A set of Service Frames that have a commitment from the Service Provider to receive a particular level of performance

Class of Service Frame Set: A set of Service or ENNI Frames that have a commitment from the Operator or Service Provider to a particular set of performance objectives

Class of Service Identifier (CoS ID): An indicator for a particular CoS instance. The mechanism and/or values of the parameters in the mechanism to be used to identify the CoS Name that applies to the Frame

Class of Service Identifier for EFO: The mechanism and/or values of the parameters in the mechanism to be used to identify the CoS Name that applies to the Frame at a given ENNI that maps to an OVC End Point

Class of Service Identifier for EFV: The mechanism and/or values of the parameters in the mechanism to be used to identify the CoS Name that applies to the Frame at a given ENNI that maps to a VUNI End Point

Class of Service Identifier For Service Frames: The mechanism and/or values of the mechanism to be used to identify the CoS Name that applies to the Frame at a given UNI. Information derivable from a) the EVC to which the Service Frame is mapped, b) the combination of the EVC to which the Service Frame is mapped and a set of one or more than one CE-VLAN CoS values, c) the combination of the EVC to which the Service Frame is mapped and a set of one or more than one DSCP values, or d) the combination of the EVC to which the Service Frame is mapped and a set of one or more than one tunneled Layer 2 Control Protocols

Class of Service Label: Each CoS Label identifies four Performance Tiers where each Performance Tier contains a set of performance objectives and associated parameters

Class of Service Name: A designation given to one or more sets of performance objectives and associated parameters by the Service Provider or Operator

Class of Service Performance Objective: An objective for a given performance metric

CLE: Customer Located Equipment

CM: Color Mode

Color-Aware: A Bandwidth Profile property where a pre-determined level of Bandwidth Profile compliance for each EI Frame is taken into account when determining the level of compliance for each Service or ENNI Frame

Color-Blind: A Bandwidth Profile property where a pre-determined level of Bandwidth Profile compliance for each EI Frame, if present, is ignored when determining the level of compliance for each EI Frame

Color Forwarding: An OVC attribute defining the relationship between the Color of an Egress ENNI Frame and the Color of the corresponding Ingress ENNI Frame or Service Frame

Color ID: Color Identifier. The mechanism and/or values of the parameters in the mechanism used to identify the Color that applies to the Frame at a given UNI

Color Identifier: The mechanism and/or values of the parameters in the mechanism used to identify the Color that applies to the Frame at a given UNI

Color Identifier for ENNI Frame: The mechanism and/or values of the parameters in the mechanism used to identify the Color that applies to the Frame at a given ENNI that maps to an OVC End Point. A particular Color ID value may indicate Color instance of green or yellow for an ENNI Frame. PCP may indicate both CoS Name and Color. Information derivable from a) a set of one or more S-Tag PCP values or b) DEI value

Color Identifier for Service Frame: The mechanism and/or values of the parameters in the mechanism used to identify the Color that applies to the Frame at a given UNI. A particular Color ID value may indicate Color instance of green or yellow for a Service Frame. PCP and DSCP may indicate both CoS Name and Color. Information derivable from a) a set of one or more C-Tag PCP values or b) a set of one or more DSCP values

Color Mode (CM): CM is a Bandwidth Profile parameter. The Color Mode parameter indicates whether the Color-Aware or Color-Blind property is employed by the Bandwidth Profile. It takes a value of Color-Blind or Color-Aware only

Committed Burst Size: CBS is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of Service or ENNI Frames sent at the EI speed to remain CIR-conformant

Committed Information Rate (CIR): CIR is a Bandwidth Profile parameter. It defines the average rate in bits per second of Service or ENNI Frames up to which the network delivers Service or ENNI Frames and meets the performance objectives defined by the CoS service attribute

Consecutive High Loss Interval: A sequence of small time intervals contained in T, each with a high Frame Loss Ratio

Controller MEP: The Controller MEP initiates SOAM PM PDUs, and in a single-ended session receives responses from the Responder MEP

CoS Frame Set: A set of Service or ENNI Frames that have a commitment from the Operator or Service Provider subject to a particular set of performance objectives

CoSID: Class of Service Identifier

CoS Label: A CoS Name that is standardized by MEF. Each CoS Label identifies four Performance Tiers where each Performance Tier contains a set of performance objectives and associated parameters

CoS Name: Class of Service Name. A designation given to one or more sets of performance objectives and associated parameters by the Service Provider or Operator

Coupling Flag: Coupling Flag (CF) is a Bandwidth Profile parameter. The Coupling Flag allows the choice between two modes of operation of the Bandwidth Profile algorithm. It takes a value of 0 or 1 only

CPE: Customer Premise Equipment

CPO: CoS Performance Objective. An objective for a given performance metric

CSP: Communication Service Provider

C-Tag: Customer (Subscriber) VLAN Tag

C-Tag Frames: IEEE 802.1ad Ethernet Frames with one tag:

C-Tag. The values of the C-VLAN IDs are in the range between 1 and 4094

Customer: The organization purchasing and/or using Ethernet services. Alternate term: Subscriber

Customer Edge: Equipment on the Subscriber side of the UNI

Customer Edge VLAN CoS: The Priority Code Point bits in the IEEE 802.1Q Customer VLAN Tag in a Service Frame that is either tagged or priority tagged

Customer Edge VLAN ID: The identifier derivable from the content of a Service Frame that allows the Service Frame to be associated with an EVC at the UNI

Customer Edge VLAN Tag: The IEEE 802.1Q Customer VLAN Tag in a tagged Service Frame

C-VLAN: Customer VLAN

D

DA: Destination Address

Data Service Frame: An Ethernet Frame transmitted across the UNI toward the Service Provider or an Ethernet Frame transmitted across the UNI toward the Subscriber. A Service Frame can have Unicast, Multicast, or Broadcast DA

DEI: Discard/Drop Eligibility Indicator

Delta T: A time interval much smaller than T

DM: Delay Measurement

DMM: Delay Measurement Message

DMR: Delay Measurement Response

Double-tagged Frames: IEEE 802.1ad Ethernet Frames with two tags. The outer tag is an S-Tag, the inner tag is a C-Tag

Down-MEP: An MEP in an IEEE 802.1 compliant Bridge that sends Frames away from the Bridge Relay Entity

DSCP: Differentiated Services (Diff-Serv) Code Point

Dual-ended: A type of process where an MEP sends measurement information to a peer MEP that will perform the calculations

Dual Rate Bandwidth Profile: A Bandwidth Profile that specifies both CIR/CBS and EIR/EBS

E

E-Access : Ethernet Service Type that use an OVC with at least one UNI OVC End Point and one ENNI OVC End Point

EAF: Ethernet Adaptation Function

EBS: Excess Burst Size

E-BWP: Egress Bandwidth Profile

ECID: Emulated Circuit Identifier

EEAF: Ethernet EC Adaptation Function

EEIF: Ethernet EC Interworking Function

EETF: Ethernet EC Termination Function

EFCF: Ethernet Flow Conditioning Function

EFD: Ethernet Flow Domain

EFM: Ethernet in the First Mile

EFO: ENNI Frame that maps to OVC End Point

EFT: Ethernet Flow Termination

EFTF: Ethernet Flow Termination Function

EFV: ENNI Frame that maps to a VUNI End Point

Egress Bandwidth Profile: A service attribute that specifies the length and arrival time characteristics of Egress Service or ENNI Frames at the Egress UNI or ENNI

Egress Frame: A Frame sent from the Service Provider network to the CE

Egress Service Frame: A Service Frame sent from within an MEN to an EI

EI: External Interface. Either a UNI or an ENNI

EIR: Excess Information Rate

EIR-compliant: Service Frames that are compliant with the EIR of the Bandwidth Profile. EIR-compliant Service Frames may be colored yellow

E-LAN: An MEF Ethernet LAN (E-LAN) Service Type is any Ethernet service that is based on a Multipoint-to-Multipoint Ethernet Virtual Connection (EVC)

E-Line: An MEF Ethernet Line (E-Line) Service Type is any Ethernet service that is based on a Point-to-Point Ethernet Virtual Connection (EVC)

E-LMI: Ethernet Local Management Interface

EMS: Element Management System

End Point Map: A mapping of specified S-Tag VLAN ID values to specified OVC End Point Identifiers

End Point Map Bundling: When multiple S-VLAN ID values map to a single OVC End Point in the End Point Map, and the OVC associating that OVC End Point is not a Rooted-Multipoint OVC

End Point Type: A parameter in the End Point Map

E-NNI/ENNI: External Network to Network Interface. A reference point representing the boundary between two Operator MENs that are operated as separate administrative domains

ENNI Frame: The first bit of the Destination Address to the last bit of the Frame Check Sequence of the Ethernet Frame transmitted across the ENNI

ENNI MTU: MTU of an ENNI Frame at the ENNI

ENNI-N: ENNI Network Functional Element

ENS: Ethernet Network Section

EPCF: Ethernet Provider Conditioning Function

EPL: Ethernet Private Line

EP-LAN: Ethernet Private LAN

EP-Tree: Ethernet Private Tree

ESCF: Ethernet Subscriber Conditioning Function

ESD: Ethernet Services Definition

ESM: Ethernet Services Model

ETF: Ethernet Termination Function

ETH-AIS: Ethernet Alarm Indication Signal

ETH-CC: Ethernet Continuity Check function

ETH-DM: Ethernet Frame Delay Measurement function

Ethernet Access Provider: Operator of the MEN providing the OVC-based Ethernet service between a UNI and an ENNI

Ethernet Frame: A data Frame on a wire from preamble to FCS

Ethernet LAN Service: An Ethernet Service Type distinguished by its use of a Multipoint-to-Multipoint EVC

Ethernet Line Service: An Ethernet Service Type distinguished by its use of a Point-to-Point EVC

Ethernet Network Section: A set of one or more MENs, each under a single or collaborative jurisdictional responsibility, for the purpose of managing CPOs

Ethernet Virtual Connection: An association of two or more UNIs that limit the exchange of Frames to UNIs in the Ethernet Virtual Connection

EtherType: Ethernet Length/Type

ETH FPP: An Ethernet Flow Point Pool that represents an Ethernet UNI or E-NNI

ETH-LB: Ethernet Loopback function

ETH-LCK: Ethernet Lock signal function

ETH-LM: Ethernet Frame Loss Measurement Function

ETH-LT: Ethernet Link Trace function

ETH-RDI: Ethernet Remote Defect Indication Function

ETH-SLM: Ethernet Synthetic Loss Measurement function

ETH-Test: Ethernet Test function

ETH-trail: An ETH-trail is an "ETH-layer entity" responsible for the transfer of information from the input of a trail termination source to the output of a trail termination sink

E-Tree: An MEF Ethernet Tree (E-Tree) Service Type is any Ethernet service that is based on a Rooted-Multipoint Ethernet Virtual Connection (EVC)

ETY: Ethernet Physical Layer

EVC: Ethernet Virtual Connection

EVC ID: The Identifier for an EVC

EVC-MA: Ethernet Virtual Connection Maintenance Association

EVC Maximum Transmission Unit Size: The maximum size Service Frame allowed for an EVC

EVC MTU Size: EVC Maximum Transmission Unit Size

EVPL: Ethernet Virtual Private Line

EVP-LAN: Ethernet Virtual Private LAN

EVP-Tree: Ethernet Virtual Private Tree

Excess Burst Size: Excess Burst Size (EBS) is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of Frames sent at the EI speed to remain EIR-conformant

Excess Information Rate: EIR is a Bandwidth Profile parameter. It defines the long-term average rate in bits per second of Frames up to which the network may deliver Frames but without any performance objectives

External Interface: A physical point of demarcation between either a UNI or an ENNI

F

FCS: Frame Check Sequence

FD: Frame Delay

FDR: Frame Delay Range. The difference between the observed percentile of delay at a target percentile and the observed minimum delay for the set of Frames in time interval T

FDV: Frame Delay Variation

FDX: Full Duplex

FE: Functional Element

FLR: Frame Loss Ratio

FM: Fault Management

FP/FPP: Flow Point/Flow Point Pool

Frame: Short for Ethernet Frame

Frame Delay: The time required to transmit a Service or ENNI Frame from Ingress EI to Egress EI

Frame Delay Performance: A characterization of the delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set

Frame Delay Range: The difference between the observed percentile of delay at a target percentile and the observed minimum delay for the set of Frames in time interval T

Frame Delay Range Performance: A characterization, based on Frame Delay Range, of the extent of delay variability experienced by different Service or ENNI Frames belonging to the same CoS Frame Set

Frame Delay Variation: The difference in delay of two Service Frames

Frame Delay Variation Performance: A measure of the variation in the delays experienced by different Service Frames belonging to the same CoS instance

Frame Loss Ratio Performance: Frame Loss Ratio is a characterization of the number of lost Service Frames or ENNI Frames between the Ingress EI and the Egress EI. Frame Loss Ratio is expressed as a percentage

G

GARP: Generic Attribute Registration Protocol

GbE: Gigabit Ethernet

GIWF: Generic Inter-working Function

GRE: Generic Routing Encapsulation

H

HDX: Half Duplex

H-FP: Hairpin Flow Point

High Loss Interval: High Loss Interval. A small time interval contained in T with a high Frame Loss Ratio

HLI: High Loss Interval

H-NID: Hybrid NID

I

IA: Implementation Agreement

I-BWP: Ingress Bandwidth Profile

IEEE: Institute of Electrical and Electronics Engineers

IETF: Internet Engineering Task Force

IFDV: Inter-Frame Delay Variation

Ingress: The direction from the CE into the Service Provider network

Ingress Bandwidth Profile: A characterization of Ingress Service or ENNI Frame arrival times and lengths at the Ingress UNI or ENNI and a specification of disposition of each Service or ENNI Frame based on its level of compliance with the characterization

Ingress ENNI Frame: An ENNI Frame sent from the ENNI into the Service Provider network

Ingress Frame: A Frame sent from an EI into the Service Provider network

Ingress Service Frame: A Service Frame sent from the CE into the Service Provider network

I-NNI: Internal NNI

Inter-Frame Delay Variation: The difference in delay of two Service or ENNI Frames of the same CoS Frame Set

Inter-Frame Delay Variation Performance: A characterization, based on Inter-Frame Delay Variation, of the variation in the delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set

IP: Internet Protocol. IPv4 is for version 4 (RFC 791) and IPv6 is for version 6 (RFC 2460)

IPSec: Internet Protocol Security

ITU: International Telecommunication Union

ITU-T: International Telecommunication Union – Telecommunication Standardization Sector

IWF: Interworking Function

L

L1: Layer One

L2: Layer Two

L2CP: Layer 2 Control Protocol

L2CP Frame: Layer 2 Control Protocol Service Frame

L2CP Tunneling: The process by which a Frame containing a Layer 2 Control Protocol is transferred between External Interfaces

LACP: Link Aggregation Control Protocol

LAG: Link Aggregation Group

LAN: Local Area Network

Layer 2 Control Protocol Service Frame: A Service Frame that is used for Layer 2 control, e.g., Spanning Tree Protocol

Layer 2 Control Protocol Tunneling: The process by which a Frame carrying a Layer 2 Control Protocol Service data unit is passed through the Service Provider or Operator network without being processed and is delivered to the proper EI(s)

LB: Loopback

LBM: Loopback Message

LBR: Loopback Reply

LCK: Lock. Used in reference to LCK PDUs

Leaf OVC End Point: An OVC End Point that has the role of Leaf

Link: An Ethernet link or TRAN link

Link OAM: OAM specific to a single link as per clause 57 of IEEE 802.3

Link Protection Mechanism: Any mechanism (e.g., LAG) used to protect traffic in the event of link failure across a multi-link EI

LM: Loss Measurement

LMM: Loss Measurement Message

LMR: Loss Measurement Reply

LOF: Loss of Frame Alignment

LOS: Loss of Signal

LTM: Link Trace Message

LTR: Link Trace Reply

M

MA: Maintenance Association

MAC: Media Access Control

MAID: Maintenance Association Identifier

Maintenance Association: A set of MEPs, each configured with the same MAID and MD Level, established to verify the integrity of a single service instance. This term is equivalent to a Maintenance Entity Group, or MEG, as defined by ITU-T Y.1731

Maintenance Association End Point: Maintenance Association End Point is equivalent to MEG End Point defined by ITU-T Y.1731. An actively managed SOAM entity associated with a specific service instance that can generate and receive SOAM PDUs and track any responses. It is an endpoint of a single MEG, and is an endpoint of a separate Maintenance Entity for each of the other MEPs in the same MEG

Maintenance Association Identifier: An identifier for a Maintenance Association, unique over the OAM Domain. The MAID has two parts: the MD Name and the Short MA Name. A MAID is equivalent to a MEG ID, as defined by ITU-T Y.1731

Maintenance Domain: The network or the part of the network for which faults in connectivity can be managed

Maintenance Domain Intermediate Point: Maintenance Domain Intermediate Point or equivalently MEG Intermediate Point defined by ITU-T Y.1731. A SOAM entity consisting of two MHFs

Maintenance Domain Level (MDL): An integer in a field in a SOAM PDU with a value in the range (0 - 7) that is used, along with the VID in the VLAN Tag, to identify to which Maintenance Domain among those associated with the SOAM PDU's VID, and thus to which MEG, a SOAM PDU belongs. The MDL determines the maintenance points a) that are interested in the contents of a SOAM PDU, and b) through which the Frame carrying that SOAM PDU is allowed to pass. Equivalent to MEG Level, defined in ITU-T Y.1731

Maintenance Entity: A point-to-point relationship between two MEPs within a single MA. This term is equivalent to a Maintenance Entity, or ME, as defined by ITU-T Y.1731

Maintenance Entity Group Identifier: Equivalent to Maintenance Association Identifier (MAID)

Maintenance Interval: A Maintenance Interval is a time interval agreed to by the Service Provider and Subscriber during which the service may not perform well or at all

Maximum Number of CE-VLAN IDs per OVC: An integer that indicates the quantity of CE-VLANs that can be mapped to a single OVC at that UNI. A value = 1 indicates that UNI can only map single CE-VLANs to an OVC. A value > 1 indicates that up to that limit can be mapped to a single OVC

Maximum Number of EVCs: The maximum number of EVCs that may be on a UNI

Maximum Number of OVCs per UNI: The maximum number of OVCs that may be on a UNI

Maximum Number of UNIs: The maximum number of UNIs that may be in an EVC

MD: Maintenance Domain

ME: Maintenance Entity

Mean Frame Delay: The arithmetic mean, or average of delays experienced by Service or ENNI Frames belonging to the same CoS Frame Set

Mean Frame Delay Performance: The arithmetic mean, or average of delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set

Mean Time to Restore: The mean time from when a service is unavailable to the time it becomes available again

Measurement Interval: A period of time during which measurements are taken. Measurements initiated during one Measurement Interval are kept separate from measurements taken during other Measurement Intervals

Measurement Interval Data Set: The collection of completed measurements that were initiated during a Measurement Interval

MEF: Metro Ethernet Forum

MEG: Maintenance Entity Group (equivalent to a MA)

MEG ID: Maintenance Entity Group Identifier

MEL: Maintenance Entity Group Level (equivalent to MD Level)

MEN: A Metro Ethernet Network comprising a single administrative domain

ME-NE: Metro Ethernet Network Element

MEP: Maintenance Association End Point

MEP ID: Maintenance Entity End Point Identification

Metro Ethernet Network: The Operator's or Service Provider's network providing Ethernet services. Synonymous with Carrier Ethernet Network (CEN)

Metro Ethernet Network Element (ME-NE): A Network Element supporting Metro Ethernet services

MFD: Mean Frame Delay

MHF: MIP Half Function

MIB: Management Information Base

MIP: Maintenance Domain Intermediate Point

MIP Half Function : A SOAM entity, associated with a single MD, and thus with a single MD Level and a set of VIDs, that can generate SOAM PDUs, but only in response to received SOAM PDUs

MTTR: Mean Time To Restore

MTU: Maximum Transfer Unit

MTU Size: The maximum sized Service or ENNI Frame allowed for an Ethernet service

Multicast Service Frame: A Service Frame that has a multicast destination MAC address

Multipoint-to-Multipoint EVC: An EVC with two or more UNIs

Multipoint-to-Multipoint OVC: An OVC that can associate two or more Root OVC End Points

N

Network Operator: The administrative entity of an MEN

NID: Network Interface Device

NI-NNI: Network Interworking NNI

NMS: Network Management System

NNI: Network to Network Interface

O

OAM: Operations, Administration and Maintenance

OAM Domain: See MD (Maintenance Domain)

On-Demand: OAM actions that are initiated via manual intervention for a limited time to carry out diagnostics. On-Demand OAM can result in singular or periodic OAM actions during the diagnostic time interval

One-way: A measurement performed in the forward or backward direction. For example from MEP A to MEP B or from MEP B to MEP A

Operator: The administrative entity of an MEN

Operator Virtual Connection: An association of OVC End Points

Ordered Pair of UNIs: A directional UNI pair of the form <Ingress UNI, Egress UNI>, selected from the UNI list for the EVC of interest

OSS: Operations Support System

OVC: Operator Virtual Connection

OVC End Point: An association of an OVC with a specific External Interface i.e., UNI, ENNI

OVC End Point Map at the UNI: An association of CE-VLAN IDs with OVCs at a UNI

OVC End Point Role: A property of an OVC End Point that determines the forwarding behavior between it and other OVC End Points that are associated with the OVC End Point by an OVC

OVC EP: OVC End Point

OVC Identifier: String that is unique among all OVCs in the Operator MEN

P

P2P: Point-to-Point

PCP: Priority Code Point

Performance Monitoring: Performance Monitoring involves the collection of data concerning the performance of the network

Performance Tier: An MEF CoS Performance Objective (CPO) set

PM: Performance Monitoring

PM Function: An MEP capability specified for Performance Monitoring purposes (e.g., Single-Ended Delay, Single-Ended Synthetic Loss)

PM Session: A PM Session is the application of a given PM Function between a given pair of MEPs and using a given CoS Frame Set over some (possibly indefinite) period of time

PM Solution: A PM Solution is a set of related requirements that when implemented allow a given set of performance metrics to be measured using a given set of PM Functions

PM Tool: A generic term used to discuss the application of a PM Function

Point-to-Point EVC: An EVC with exactly 2 UNIs

Point-to-Point OVC: An OVC that associates exactly two OVC End Points

Proactive: OAM actions that are carried on continuously to permit timely reporting of fault and/or performance status

PT: Performance Tier

PTP: Precision Time Protocol

Q

QoS: Quality of Service

Qualified Set of Service Frames: The set of Frames that comply with specific criteria, such as the arrival time at the Ingress UNI and Bandwidth Profile compliance, on which a performance attribute is based

R

RDI: Remote Defect Indication

Remote UNI: Remote UNI is a UNI serving as the UTA component consisting of a collection of service attributes in the UNI within an Operator's MEN. The Remote UNI is paired with a VUNI in a VUNI Provider's MEN. At the Remote UNI, Service Frames are exchanged between the Subscriber and the Network Operator MEN

Resiliency Performance: The number of High Loss Intervals and Consecutive High Loss Intervals in a time interval T

Responder MEP: In a single-ended session, the Responder MEP receives SOAM PM PDUs, from the Controller MEP, and transmits a response to the Controller MEP

RMI: Remote Management Interface

RMP: Rooted Multipoint

Rooted-Multipoint EVC: A Multipoint EVC in which each UNI is designated as either a Root or a Leaf. Ingress Service Frames at a Root UNI can be delivered to one or more of any of the other UNIs in the EVC. Ingress Service Frames at a Leaf UNI can only be delivered to one or more Root UNIs in the EVC

Rooted-Multipoint OVC: An OVC that can associate at least one Leaf or Trunk OVC End Point

Root OVC End Point: An OVC End Point with the role of Root

RSTP: Rapid Spanning Tree Protocol

RUNI-N: Remote UNI-N (Functional Element)

S

Scheduled Downtime: A time interval agreed upon by both the Subscriber and Service Provider during which a service may be disabled by the Service Provider

Service Frame: An Ethernet Frame transmitted across the UNI toward the MEN or an Ethernet Frame transmitted across the UNI toward the Subscriber

Service Level Agreement: The contract between the Subscriber or Operator and Service Provider specifying the agreed to service level commitments and related business agreements

Service Level Specification: The technical specification of the service level being offered by either the Service Provider to the Subscriber in the case of an EVC service or by an Operator to a Service Provider in the case of an OVC

Service Multiplexing: A UNI service attribute in which the UNI can be in more than one EVC instance

Service OAM: Service OAM is OAM used to monitor an individual service

Service Provider: The organization responsible for the UNI to UNI Ethernet service(s)

Single-Ended: A type of process where an MEP sends a measurement request and the peer MEP replies with the requested information so the originating MEP can calculate the measurement

Single Rate Service: A service that only specifies a CIR/CBS and no EIR/EBS

Sink MEP: In a dual-ended session, the Sink MEP receives SOAM PM PDUs, from the Controller MEP and performs the performance calculations

SI-NNI: Service Interworking NNI

SLA: Service Level Agreement

SLM: Synthetic Loss Measurement

SLR: Synthetic Loss Reply

SLS: Service Level Specification

SNI: Service Node Interface

S-NID: Service NID

SNMP: Simple Network Management Protocol

SNMP Agent: An SNMP entity containing one or more command responder and/or notification originator applications (along with their associated SNMP engine). Typically implemented in a network element

SNMP Manager: An SNMP entity containing one or more command generator and/or notification receiver applications (along with their associated SNMP engine). Typically implemented in an EMS or NMS

SOAM: Service Operations, Administration, and Maintenance

SOAM PDU: Service OAM Frame, or Protocol Data Unit. Specifically, those PDUs defined in IEEE 802.1ag, ITU-T Y.1731 or MEF specifications

SOAM PM CoS ID: CoS ID for SOAM PM Frames

SOAM PM PDU: Service OAM Protocol Data Unit specifically for Performance Measurement. Examples are LMM/LMR, DMM/DMR/1DM, SLM/SLR

SP: Service Provider

S-Tag: Service (Provider) Tagged Frame

S-Tag Frames: IEEE 802.1ad Ethernet Frames with one tag: S-Tag. The values of the S-VLAN IDs are in the range between 1 and 4094

STP: Spanning Tree Protocol

Subscriber: The organization purchasing and/or using Ethernet services. Alternate term: Customer

S-VLAN: Service VLAN (also referred to as Provider VLAN)

S-VLAN ID: The 12 bit VID field in the S-Tag of an ENNI Frame

Synthetic Frame: An Ethernet Frame created to emulate service traffic, carry additional information necessary to support calculating delay or loss and that is treated the same way as a Service Frame

Synthetic Traffic: SOAM traffic that emulates service traffic in order to measure the performance experience. Delay measurements must use Synthetic Traffic, because user traffic does not contain standardized timestamp fields. Other measurements, such as Frame Loss, may also use Synthetic Frames for certain advantages (e.g., ability to measure loss in multipoint services)

T

T: Time interval for SLS metrics. The time over which a performance metric is defined

Tag: An optional field in a Frame header. For Ethernet it is the 4-byte field that, when present in an Ethernet Frame, appears immediately after the Source Address, or another tag in an Ethernet Frame header and which consists of the 2-byte Tag Protocol Identification (TPID) field which indicates S-Tag or C-Tag, and the 2-byte Tag Control Information (TCI) field which contains the 3-bit Priority Code Point, and the 12-bit VLAN ID field

TF: Termination Function

T-FP: Trunk Flow Point

TFP: Termination Flow Point

TLV: Type, Length, Value

ToD: Time-of-day

Traffic Conditioning: A process that classifies the traffic units according to configured rules and ensures traffic is conformant before forwarding the traffic

Transport: A specific TRANS Layer technology

TrCP: Traffic Conditioning Point

Trunk OVC End Point: OVC End Point with the role of Trunk

TTF: Trail Termination Function

Two-way: A measurement of the performance of Frames that flow from the Controller MEP to Responder MEP and back again

U

UNI: User Network Interface. The physical demarcation point between the responsibility of the Service Provider and the responsibility of the Subscriber

UNI-C: A compound Functional Element used to represent all of the Functional Elements required to connect an MEN Subscriber to an MEN implementing a UNI-N

Unicast Service Frame: A Service Frame that has a unicast destination MAC address

UNI-MEG: UNI Maintenance Entity Group

UNI-N: A compound Functional Element used to represent all of the Functional Elements required to connect a MEN to an MEN Subscriber implementing an UNI-C

Unscheduled Downtime: A time interval not agreed upon by both the Subscriber and Service Provider during which the Service Provider determines that the service is not useable

UpMEP: An MEP in an IEEE 802.1 Bridge that sends Frames toward the Bridge Relay Entity

UP/PCP: User Priority/Priority Code Point

User Network Interface: The physical demarcation point between the responsibility of the Service Provider and the responsibility of the Subscriber

UTA: The UNI Tunnel Access (UTA) associates a VUNI and Remote UNI and is composed of VUNI and Remote UNI components and at least one supporting OVC

UTA Component: A specific set of capabilities which may be used as part of UTA

UTA OVC: An OVC in the Network Operator's MEN that provides an association of a Remote UNI with an ENNI in support of UTA

V

VID: VLAN Identifier

VLAN: Virtual LAN

VLAN ID: VLAN Identifier

VUNI: Virtual UNI (VUNI) is the component consisting of a collection of service attributes in the VUNI Provider's MEN. The VUNI is paired with a Remote UNI in a Network Operator's MEN. The main function of the VUNI is to map Frames between a set of one or more OVCs present in the VUNI Provider domain and a single UTA

VUNI End Point: An End Point at the VUNI Provider's side of a specific ENNI that associates the ENNI with a VUNI in support of UTA

VUNI-N: VUNI – Network (Functional Element)

VUNI Provider: The Operator MEN providing the VUNI

W

WAN: Wide Area Network

WTR: Wait to Restore

X

xSTP: Spanning Tree Protocol (multiple variations)

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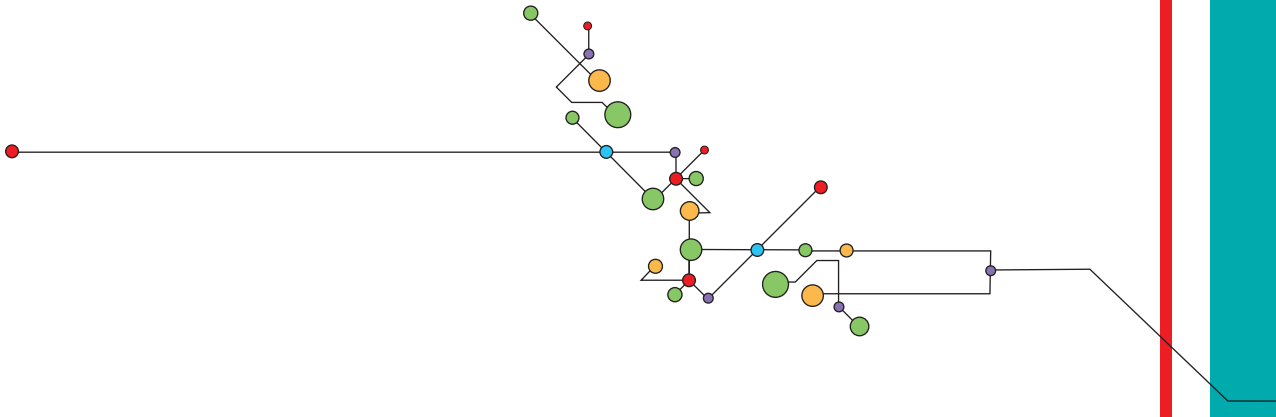

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