



SHDSL/SHDSL.bis Product Guide

Enabling Broadband Access and Backhaul
over Existing Copper Infrastructure

SHDSL



data communications
The Access Company



Leveraging Copper's Service Reach for High Bandwidth Applications

Copper reaches everywhere. Industry sources estimate that between 80-90% of businesses today are served by business-grade copper. With the implementation of symmetrical high-bit-rate digital subscriber line (SHDSL/SHDSL.bis) technology, ordinary telephone lines can now be employed to deliver voice and broadband services, such as high speed data, Internet access and videoconferencing, with rapid deployment and simple provisioning over the same copper pair. Using SHDSL.bis copper loop bonding, carriers can turn existing copper wire into a multiservice, high capacity pipeline without the need to lay fiber or use high speed microwave lines. SHDSL's ability to deliver advanced services over existing access infrastructure

reduces OpEx while opening up new business opportunities for incumbents and alternative carriers alike. This includes offering DSL infrastructure as a lower cost alternative in mobile backhaul applications.

SHDSL and SHDSL.bis are standard ITU G.991.2 technologies that fulfill the broadband requirements of business users for symmetrical, two-way traffic, while providing the quality of service (QoS) they need for high bandwidth data transfer. SHDSL/SHDSL.bis extends transmissions farther than any other DSL technology, opening the door for service providers to deliver low cost, multiservice, broadband access to a wider subscriber base.

Widest Range of SHDSL/SHDSL.bis Solutions

There are many SHDSL products on the market, but no vendor can match RAD's wide selection of interfaces, flexibility and variety of product lines incorporating SHDSL/SHDSL.bis technology.

- Modems – 2-wire, 4-wire, 8-wire with copper bonding
- Modem racks – SHDSL concentrator and mixed copper/fiber rack with SNMP management
- SHDSL/SHDSL.bis repeater
- NG-MSAP
- Multiservice access concentrators
- Integrated access device
- EFM NTU with copper bonding
- Cell-site gateways

Advantages of SHDSL/SHDSL.bis Technology and RAD Products

- **Reach more customers:** The SHDSL/SHDSL.bis purely digital signal increases the range of DSL services by 30 percent. Adding RAD SHDSL/SHDSL.bis repeaters can extend this range.
- **Faster speeds:** SHDSL/SHDSL.bis typically delivers broadband services over existing 2-wire, 4-wire or 8-wire links at data rates of up to 22 Mbps.
- **Symmetrical technology:** SHDSL/SHDSL.bis delivers high data rates upstream as well as downstream, accommodating bandwidth-hungry business applications such as file transfers and videoconferencing.
- **Converge multiple services:** SHDSL/SHDSL.bis integrates multiple voice channels, data, LAN, and Internet access over a single link.
- **Standards-based:** RAD's SHDSL/SHDSL.bis products comply with ITU and ETSI SHDSL/SHDSL.bis standards and are interoperable with third-party equipment.
- **Diverse solutions:** RAD offers the widest variety of SHDSL/SHDSL.bis solutions for TDM networks and DSLAM access (ATM or EFM).
- **Proven DSLAM interoperability:** Although DSL is a standard technology, achieving full interoperability with DSLAM equipment is not a trivial matter. RAD products are field-tested for full interoperability opposite DSLAMs from vendors such as Alcatel-Lucent, ECI, Huawei, Nortel, and others.

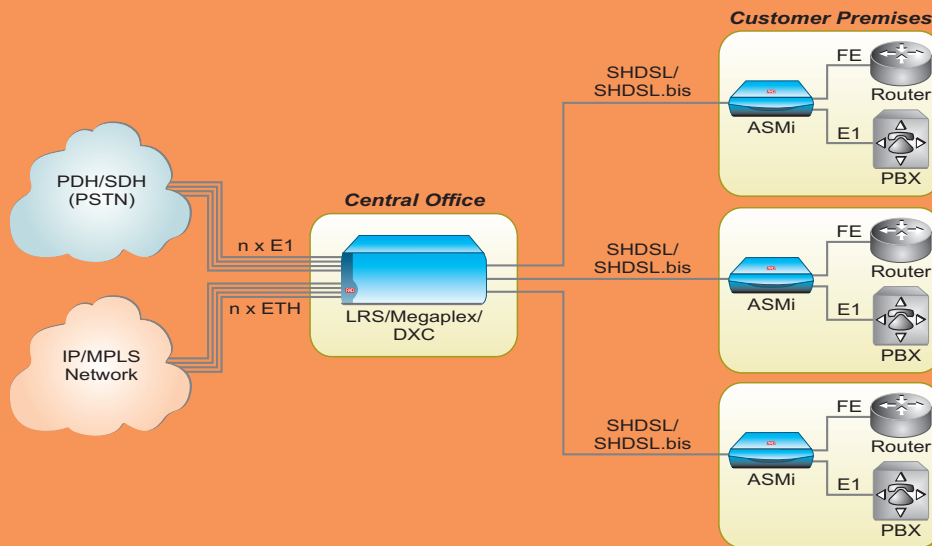


Solutions

TDM-Based Applications

An extremely reliable and ubiquitous technology, TDM is not likely to be replaced anytime soon. Services based on TDM in the access will continue to be in demand even as network operators deploy packet-based technology for their Metro transport and core networks to aggressively lower costs and offer more scalable bandwidth. RAD's TDM-based SHDSL/SHDSL.bis products offer aggregation, transmission and access for TDM and Ethernet services over single or multiple copper pairs. Featuring copper bonding, they empower service providers and users to maximize the use of existing infrastructure for higher bandwidth applications, thereby realizing significant cost savings and generating new revenue streams.

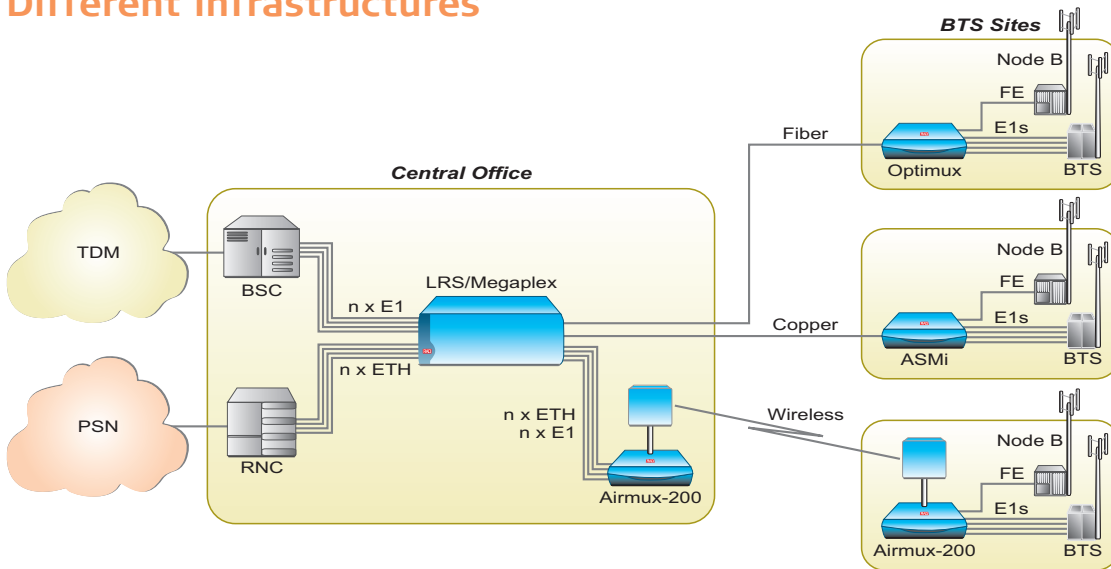
Multiservice Access over DSL



Benefits and Features:

- High port density for greater efficiency and profitability
- Saves expensive colocation costs
- Direct grooming for simpler single-unit solution
- Supports 2-wire or 4-wire SHDSL
- Supports 2-wire, 4-wire, or 8-wire SHDSL.bis up to 22 Mbps
- Complete and integrated NMS platform

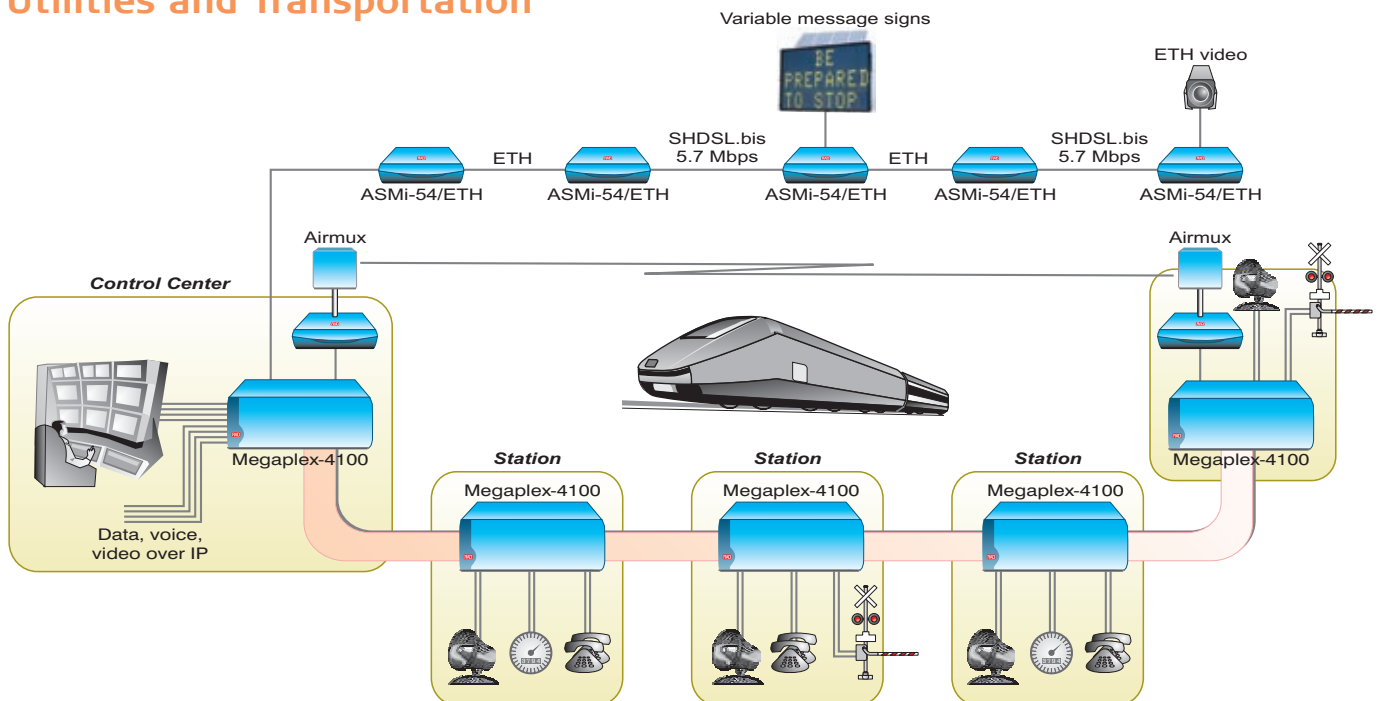
Extending Colocated 2G/3G Base Stations over Different Infrastructures



Benefits and Features:

- Reduces operating costs by aggregating multiple generations of mobile traffic over shared transport infrastructure
- Improves efficiency of transmission over any media, including fiber and wireless
- Flexible port configuration

Utilities and Transportation



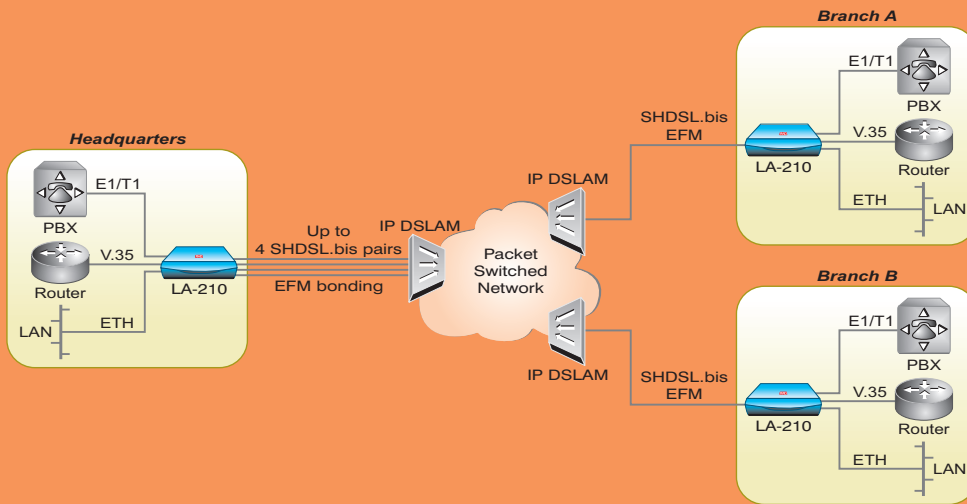
Benefits and Features:

- Supports a mix of equipment, including voice switches, video surveillance apparatus, Ethernet-enabled smart meters, ticketing machines, and legacy SCADA devices
- Allows for various topologies: star, ring, daisy chain
- Complete and integrated NMS platform



DSLAM Business Service Application

As demand for broadband continues to expand, service providers are looking for ways to leverage their DSLAM and MSAN deployments by offering multiservice solutions to business users over DSL links. RAD's integrated access device (IAD) and EFM NTU enable carriers and ISPs to deliver high speed Ethernet and TDM business services over both ATM and IP-based DSL infrastructure.

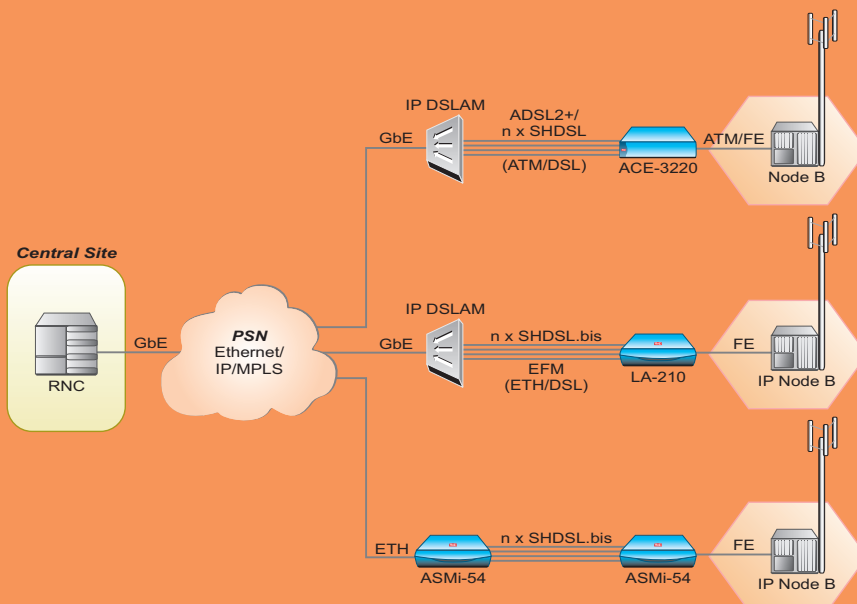


Benefits and Features:

- Mid-band Ethernet access up to 22 Mbps using EFM bonding
- End-to-end Ethernet OAM for performance monitoring and measurement
- Powerful traffic management capabilities for service differentiation, EVC.CoS
- Single access link for both Ethernet services as well as legacy E1/T1/serial data using pseudowire
- MEF-9 and MEF-14 certified for EPL and EVPL

Cellular Backhaul over DSL Application

With the introduction of HSPA broadband services, mobile operators are looking for ways to lower backhaul costs while supporting exponentially higher data rates than were required for 2G and 3G traffic. Mobile transport providers with extensive DSLAM deployments can offer profitable and economical backhaul solutions by using RAD's cell-site gateways, and aggregation-site gateways.



Benefits and Features:

- Flexible backhaul options over various DSL infrastructures
- Simultaneously supports ADSL2+ for HSPA and SHDSL.bis for R99 and GSM or data services with M-Pair, IMA or EFM bonding
- Full synchronization solution using ACR, 1588v2 or NTR
- Field-proven interoperability with Cisco 76xx ASG and Cisco management system ANA

Wide Range of SHDSL/SHDSL.bis Connectivity Products

TDM-Based Applications



ASMi-52, ASMi-52L

ASMi-54

S-RPT

2/4-Wire SHDSL Modems

SHDSL.bis Modem and Multiplexer

2/4-Wire SHDSL Repeater for Longer Reach

- Extends the range of digital interfaces at variable data rates from 56/64 kbps up to 2.3 Mbps (over 2-wire) or 4.6 Mbps (over 4-wire)
- High-end ASMi-52 available with optional multiplexer capability for integrating V.35, LAN and E1 over the same SHDSL link and compatibility with 2/4-wire repeaters
- ASMi-52 at the remote site works opposite another ASMi-52 unit, DXC, LRS-24, LRS-102 or third-party equipment at the central site

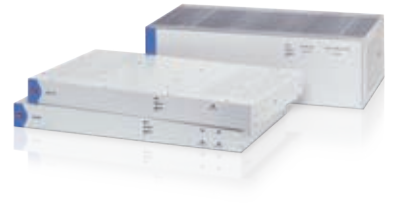
- Cost-effective, dedicated managed device for extending E1 and mid-band Ethernet services based on multi-pair bonding technology
- Uses TC-PAM 16 or TC-PAM 32 line coding SHDSL.bis technology for higher quality communications
- Operates in full duplex mode over 2-wire, 4-wire or 8-wire lines, achieving variable data rates up to 5.7 Mbps over 2-wire, 11.4 Mbps over 4-wire, and up to 22.8 Mbps over 8-wire

- Compact S-RPT repeater extends the range of standard SHDSL technology modems, such as the ASMi-52, ASMi-52L and ASMi-54, over 2-wire or 4-wire lines
- Supports point-to-point extended range DSL applications, such as links alongside highways, railways, pipelines or power lines; transport to remote concentrators in rural areas; or communications for military, construction or temporary field sites
- Available in both indoor and IP-67-protected outdoor versions, and can be powered either locally or remotely

Products



Central-Site Solutions



LRS-16

Managed SHDSL Modem Concentrator

- Cost-effective central-site solution for point-to-point extension of E1 services in the Local Loop
- Operates opposite 16 ASMi-52/ASMi-52L SHDSL modems at remote locations, providing E1 services over 2-wire lines
- Separate clocking for each one of the 16 fixed ports

LRS-102

Fiber and Copper Mux Rack with SNMP Management

- Modular central rack solution for RAD's Optimux fiber products or ASMi SHDSL/SHDSL.bis modems (ASMi-52, ASMi-52L and ASMi-54)
- Extends E1/T1, data and Ethernet traffic up to 120 km (74.5 miles) over fiber optic links, or up to 2.6 km (1.8 miles) over copper (5.7 Mbps over 26 AWG)
- LRS-102 fiber/copper multiplexer rack provides optional redundant power supplies, optional redundancy of the common logic and 12 I/O slots.
- 12 dual-port Optimux-108 and/or Optimux-106 modules support 24 remote units
- Works opposite up to eight remote units of ASMi-54 or ASMi-52 modems

Megaplex-4100

Next-Generation Multiservice Access Node

- High capacity multiservice concentrator supporting efficient access over PDH/SDH/SONET transport networks
- VCAT technology for better utilization of SDH/SONET bandwidth
- Highly effective IP/MPLS aggregator
- Supports up to 10 I/O modules, providing a flexible and scalable platform that meets a variety of user services, including E1, T1, SHDSL, SHDSL.bis, n x 64k high speed data, sub-DS0 low speed data, digital voice, and analog voice

DXC Family

Multiservice Access Concentrators

- Compact central-site solution at the carrier or service provider's central office (CO) or point-of-presence (POP) for the ASMi-52, FCD-IP, FCD-IPM, or third-party SHDSL CPE equipment
- High density, 8-port E1 over SHDSL module supports up to 72 SHDSL ports
- Multi-link groomer to E3 or STM-1
- Timeslot cross connect to any module

Products

DSLAM Business Service Applications



LA-110

Integrated Access Device

- Delivers voice, data and Ethernet to SMEs over a single access line
- Supports analog voice, ISDN S0 or E1 ports, a data port, and an additional 10/100BaseT LAN port
- Statistically multiplexes voice/TDM and data (Ethernet, packet data) into an SHDSL, ADSL, or E1/T1 ATM UNI WAN link
- Standardized to work opposite major vendors' DSLAMs and voice gateways
- IMA option (inverse multiplexing for ATM) enables service providers to offer Ethernet services to business customers over up to four copper pairs
- IMA over SHDSL achieves rates of up to 9.2 Mbps
- Backup between links for better service availability

LA-210

EFM DSL Network Termination Unit

- Ethernet in the First Mile DSL network termination unit offers Ethernet access rates of up to 22 Mbps over bonded SHDSL.bis copper lines
- 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
- Metro Ethernet Forum certified to deliver Ethernet Private Line (EPL) and Ethernet Virtual Private Line (EVPL) services per MEF-9 and MEF-14 specifications

Mobile Backhaul Applications



ACE-3105

Cell-Site Gateway

- Small form-factor; half 19"
- Standardized to work opposite major DSLAM vendors
- Cost-effective delivery of GSM, UMTS and HSDPA mobile broadband services over ATM, PSN or hybrid transport networks using widespread wholesale ADSL2+ and SHDSL.bis deployments over copper infrastructure
- Multi-standard pseudowire encapsulation (PWE) capabilities enabling carriers to transparently provision ATM, TDM and Ethernet services over IP DSLAMs and packet switched networks
- Highly accurate synchronization capabilities, such as 1588v2, Synch Ethernet, NTR, and adaptive clock recovery (ACR) to meet Node B synchronization requirements over DSL

ACE-3220

Cell-Site Gateway

- Best-of-breed cell-site gateway grooms GSM, UMTS, HSPA, and WiMAX traffic over ADSL2+ and SHDSL.bis (simultaneous transmission)
- Standardized to work opposite major DSLAM vendors
- Supports operators and mobile transport providers in their migration to all-IP radio access networks (RAN)
- Incorporates advanced pseudowire emulation (PWE) functionality
- Highly accurate synchronization capabilities, such as 1588v2, Synch Ethernet, NTR, and adaptive clock recovery (ACR) to meet Node B synchronization requirements over DSL

Comparison Tables

Central-Site Solutions for DSL Modems

Number of pairs	Max. rate over SHDSL	Max. rate over SHDSL.bis	Central solution for SHDSL	Central solution for SHDSL.bis	SHDSL modems	SHDSL.bis modems
1 pair	2.3 Mbps	5.7 Mbps	DXC, MP-2100, LRS-24, LRS-102	LRS-102, MP-4100	ASMi-52/ASMi-52L	ASMi-54
2 pair	4.6 Mbps	11.4 Mbps	LRS-24, LRS-102	LRS-102, MP-4100	ASMi-52/ASMi-52L	ASMi-54
4 pair	N/A	22.8 Mbps	N/A	LRS-102, MP-4100	ASMi-52/ASMi-52L	ASMi-54

DSL Modems

Feature	ASMi-52	ASMi-52L	ASMi-54
Technology	SHDSL	SHDSL	SHDSL.bis
1 pair	✓	✓	✓
2 pair	✓	✓	✓
4 pair	N/A	N/A	✓
E1	✓	✓	✓
ETH	N/A	✓	N/A
4 x ETH	✓	✓	✓
Serial ports (V35, X21)	E1 & ETH	✓	N/A
Mux	Serial port & ETH Serial port & E1" RJ-45	N/A	E1 & 4ETH
DSL line	✓	TB	RJ-45
Metal case	✓	N/A	✓
Plastic case	✓	✓	✓
Rail mount case	✓	✓	✓
Extended Temperature (-20 to 70°C)	✓	✓	✓

SHDSL/SHDSL.bis Technology

Feature	RAD SHDSL solutions	RAD SHDSL.bis solutions
Number of wires	2W, 3W	2W, 4W, 8W
Max. rate over one pair	2.3 Mbps	5.7 Mbps (2.6 km-26 AWG)
Max. rate over two pairs	4.6 Mbps	11.4 Mbps
Max. rate over four pairs	N/A	22.8 Mbps
Repeaters support	Yes	Yes
EFM	N/A	Comply
Classification	802.1p	802.1p&q
OAM	N/A	Soon
Multiplexer services over the same copper lines	Comply	Comply
Metal, plastic and rail mount unit	Comply	Comply
Extended temperature -20 to 70°C	Comply	Comply
Central solutions	Comply	Comply



Central Management Enhances Network Performance

Rad's SHDSL products include a built-in SNMP agent and can be managed inband via a dedicated TDM/ATM connection or out-of-band via a LAN port. The RADview SNMP network management system controls, monitors and configures RAD's SHDSL products from a central site. It is an integrated management solution that adheres to international standards and operates in multi-vendor environments.

RADview helps improve the setup time of new services while cutting costs, enabling the carrier or service provider to roll out services faster. It quickly identifies network faults and reduces network downtime, thereby boosting customer retention. In addition, RADview has a CORBA-based client-server architecture, and can be integrated into a higher layer management system or OSS.

Extensive SHDSL Deployment

RAD's SHDSL products have been successfully deployed in carrier and enterprise networks around the globe. RAD products are installed and supported by sales and technology partners in nearly 200 countries on five continents, backed by regional service offices in each region and a central support staff at company headquarters.

This provides RAD with truly international capabilities, placing the company in an ideal position to offer worldwide installation and management for even the most complex projects.

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