9

Network Management

As the world becomes more dependent on advanced computerized systems for managing operations in real time, the demand for control and monitoring is surging. The existence of heterogeneous networks creates a challenge for network managers, who must manage networks consisting of many types of equipment from different vendors.

The result is that network management becomes an arduous and complex task for network administrators, and the effectiveness of managing the network is reduced.

RAD's network management portfolio meets these challenges, offering an integrated network and system management solution that adheres to TMN standards and operates in a multi-vendor system environment. RAD's management systems help the network manager supervise, monitor and provision RAD-based networks varying in size and product mix, as well as basic management of third-party devices, thereby reducing OpEx. The solution architecture is scalable, affordable for small installations, yet flexible to accommodate the network administrator's future needs.

TMN logical layers

ITU-T Telecommunications Management Network (TMN) defines a layered model where each layer is responsible for different management functions, while interfacing with underlying and overlying layers, to provide a complete and comprehensive set of tools (see Figure 2):

- NEL, Network Element Layer, implementing logical entities within a device
- EML, Element Management Layer, implementing device level configuration, fault and performance management functions
- NML, Network Management Layer, implementing path management, topology management and fault isolation
- SML, Service Management Layer, implementing mechanisms to assure service level agreements and maintaining QoS
- BML, Business Management Layer, implementing strategic enterprise management functions, such as budgeting and billing

RAD's network management portfolio

RAD's network management portfolio implements the first three layers of the TMN model (see Figure 1):

- Network Element Layer: SNMP agents, Telnet and HTTP services within manageable products
- Element Management Layer: element management systems supporting heterogeneous network management and implementing the FCAPS model
- Network Management Layer: service center applications capable of provisioning services and circuits in a user-friendly and powerful way, automating configuration tasks and minimizing network downtime

TMN FCAPS model

RAD's network management solution conforms to the ITU-T Telecommunications Management Network (TMN) recommendations for SNMP management systems and supports the following functions (also known as the FCAPS model):

- **Fault management** detects and correlates faults in network devices, isolates faults and initiates recovery actions
- **Configuration management** provides the ability to track changes and configure, install and distribute software across the network for all network devices
- **Administration management** manages individual and group user accounts and passwords, generating network usage reports to monitor user activities
- **Performance management** offers a continuous source from which to monitor network performance (QoS, CoS) and resource allocation
- **Security management** provides the ability to control the access to network resources

Network Element Layer

All RAD manageable products feature built-in SNMP agents, supporting relevant standard MIB and RFC, in addition to a RAD proprietary MIB. The RAD MIB is implemented in accordance with ASN.1 and can be compiled and incorporated into any SNMP platform to allow access to RAD devices via SNMP. Additionally, many RAD devices have a variety of management access protocols, including CLI or menu-driven Telnet, Web server and TFTP. Incorporated security features include Secure Shell (SSH), Web-based Secure Socket Layer (SSL), SNMPv3, and RADIUS, as well as management access control list (ACL).

Element Management Layer

RADview-EMS, RAD's flagship element management system, is based on the ITU-T Telecommunications Management Network (TMN) model with advanced FCAPS capabilities. It provides a Java-based, carrier-class element management system for deployment over Windows and UNIX environments. The system is designed for high scalability for easy expansion of new network elements and optimized load sharing. The client-server architecture provides multi-user support for network operations, maintaining a centralized database and network partitioning. RADview-EMS includes an open CORBA northbound interface, facilitating integration with third-party NMS or umbrella systems.

RADView-EMS provides security, configuration, fault, performance, and administration management, including extensive network level functions.

Network Management Layer

RADview-SC/Vmux is a powerful management tool for provisioning and monitoring compressed voice services, providing control and monitoring of end-to-end circuits for networks comprising the Vmux product family. RADview-SC/TDMoIP is a powerful management tool for provisioning and monitoring TDM over IP (TDMoIP) services, providing control and monitoring of end-to-end circuits for networks comprised of the IPmux family of products. RADview-SC/TDMoIP includes an open CORBA northbound interface, facilitating integration with third-party NMS or umbrella systems. RADview-SC/TDM is the cornerstone of the RAD family of network management solutions, simplifying service provisioning and end-to-end path management of MAP devices. The system includes automatic optimal path detection and configuration, as well as path protection and re-route upon network resource failure, thus automating network maintenance and minimizing downtime. RADview-SC/TDM includes an open CORBA northbound interface, facilitating integration with third-party NMS or umbrella systems. RADview-SC/TDM includes an SLA (service level agreement) module for checking that every provisioned service conforms to the SLA promised to the end user.

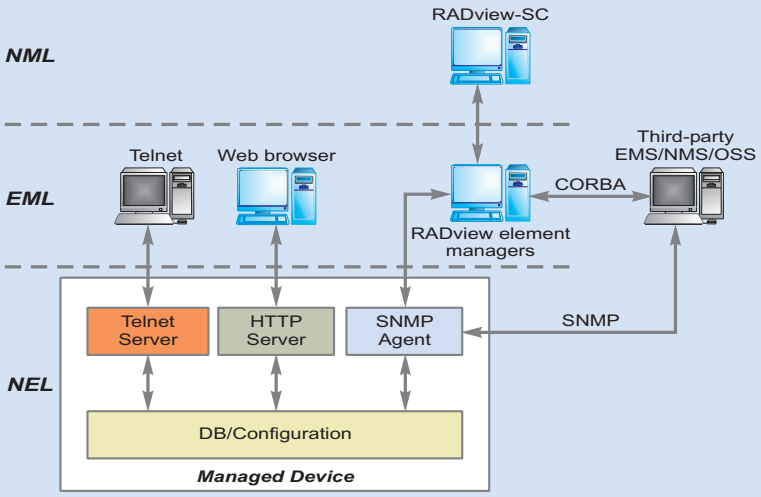

Figure 1: RAD management portfolio

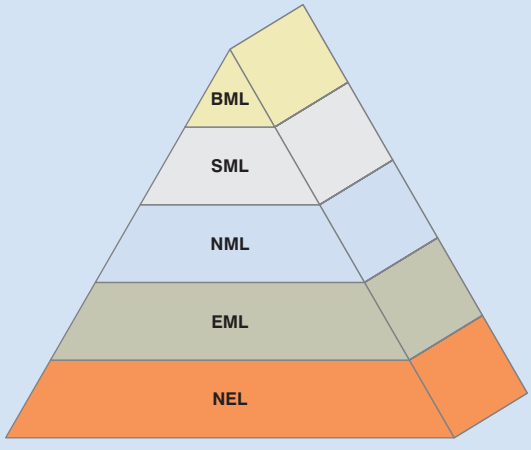

Figure 2: TMN layer model

RADview-EMS

Carrier-Class Element Management System

- **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**
- **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**
- **Supports multiple users simultaneously with seamless handover of user privileges**

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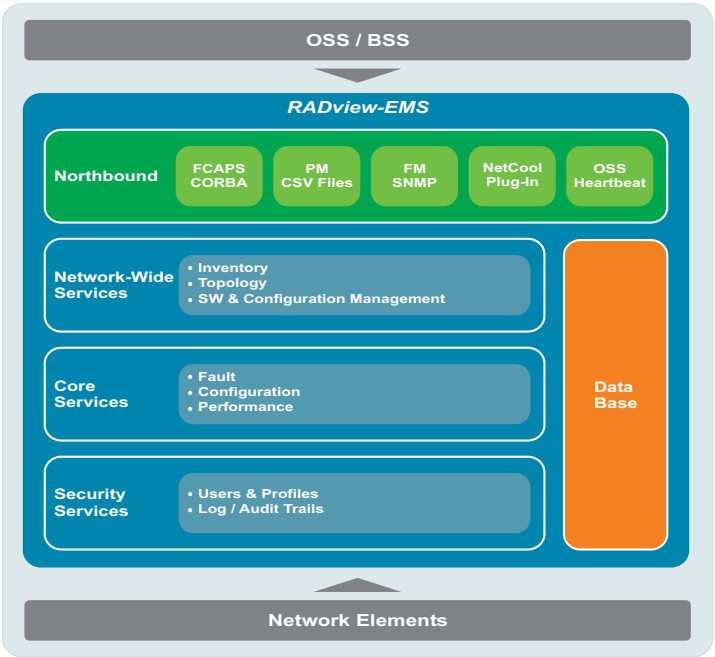
RADview-EMS main view

RADview-EMS is a Java-based, carrier-class element management system for Windows and UNIX environments. It manages RAD's devices (see management table on page 206) using a variety of access protocols, including SNMP, HTTP/S, TFTP and Telnet/SSH. In addition, it features third-party device monitoring capabilities.

Designed for high scalability, optimized performance and load sharing, it includes an embedded Oracle/Informix database that allows easy addition of new network elements as the network expands.

RADview-EMS operates optimally in standalone mode and enables visual network representation with an intuitive GUI, including map topology per region, network links, zoom-in to individual devices, and more. Alternatively, it can be integrated with SNMPc or HP OpenView NNM. The system is fully interoperable with third-party EMS/NMS applications from leading vendors.



RADview-EMS system architecture

Easy OSS integration

As a modular management system, RADview-EMS enables easy integration with OSS and umbrella systems. By serving as a mediation layer between the various network elements (NEs) and the umbrella system, RADview-EMS minimizes the integration costs associated with new NE additions and ensures synchronization of essential information between the NEs and OSS.

In addition to featuring a plug-in for **IBM Tivoli's Netcool®/OMNIbus™** fault management application, the system allows seamless communication with network-wide platforms for inventory (resource) management, performance management and service provisioning, as well as with carriers' proprietary OSS.

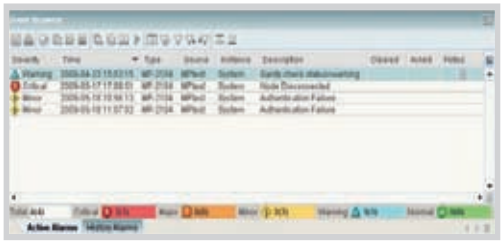
Supporting northbound interfaces, such as CORBA, SNMP and CSV, as well as OSS heartbeat mechanism, RADview-EMS smoothly interacts with higher management levels to communicate essential network information to service, operations and business management functions.

Advanced FCAPS functionality

RADview-EMS features advanced FCAPS (Fault, Configuration, Administration, Performance, and Security) capabilities based on the ITU-T Telecommunications Management Network (TMN) model. These capabilities are accessible via a Web- or an SNMP-based agent and provide, among others, actual device shelf view to allow easy configuration, troubleshooting, diagnostics and statistics reporting by remote operators.

Fault management: RADview-EMS detects and isolates faults in network devices, displaying a clear analysis of probable causes and suggested instructions for corrective measures. Following link failures, the system ensures all trap messages are synchronized as communication with the NE is restored*. In addition, RADview-EMS distributes alarm messages to other management entities in the network.

*Selected devices only

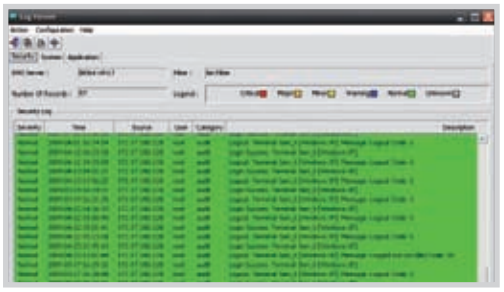


Event browser

Configuration management: The system enables operators to install and distribute software and configuration files to all devices across the network and to collect configuration files for backup and recovery. Easy device management and provisioning is supported by a user-friendly, point-and-click GUI, allowing operators to modify system, ports and alarms configuration, as well as to view diagnostics and status information.

Device shelf view

Administration management: RADview-EMS enables management of individual and group user accounts and passwords, generating network usage reports to monitor user activities. In addition, it provides audit trails for RADview-EMS' security, system and application activities, tracks and logs user activities performed in shelf-view, and manages server settings.

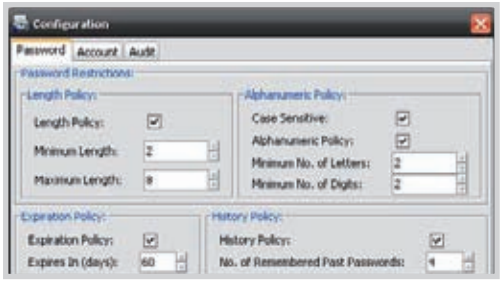


Audit trail

Performance management: RADview-EMS supports real-time monitoring of QoS (quality of service) per class of service (CoS) with 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 CSV ASCII files to OSS or third-party management systems.

Flow statistics

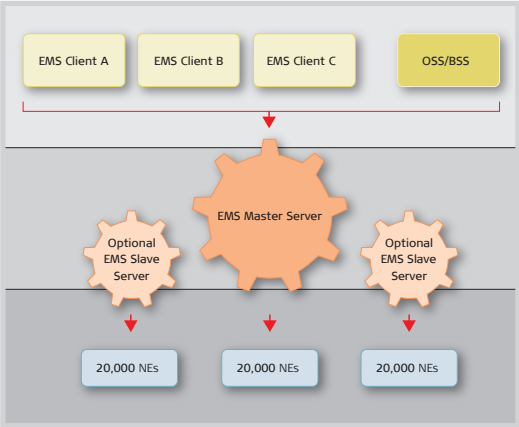
Security management: Using the security management console, network administrators can create an unlimited number of security profiles and groups and manage complex security access rights down to the parameter level. Access to network resources is controlled with a choice of security features, including SSH (Secure Shell), Web-based SSL (Secure Socket Layer), SNMPv3, RADIUS, and ACL (access control list).



Security policy

Distributed system architecture

RADview-EMS is based on distributed client-server architecture, which optimizes the use of network resources while improving overall system performance and resilience. Load sharing among master and slave servers enables flexible allocation of management tasks, according to specific needs without affecting user experience. The RADview-EMS client-server architecture offers an adaptable management solution fitting diverse network sizes, performance requirements and user volumes.



RADview-EMS server distribution

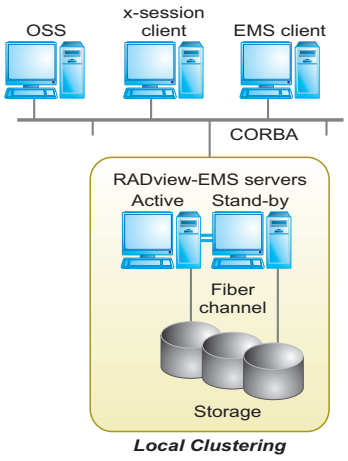
Business continuity

RADview-EMS provides the following scalable tools to ensure high system availability and optimized disaster recovery so that critical applications remain available to users at all times:

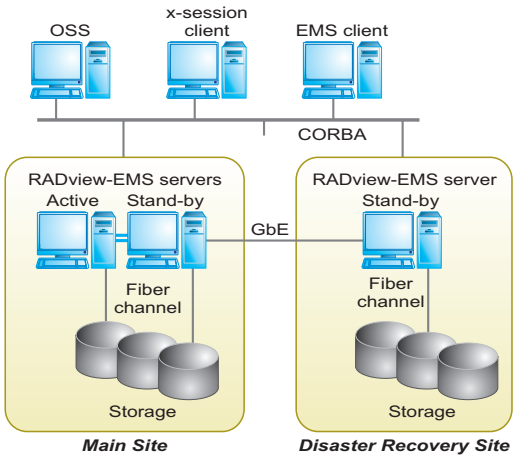
Cold Standby: This cost-effective solution requires no additional software tools or expensive storage equipment. Data is periodically backed up by the primary (active) NMS station via the RADview-EMS' Backup/Restore function. In the event of failure on the primary NMS station, the data can be restored on the secondary (standby) station.

Hot Standby:

- **High Availability (Local Clustering)** – This solution ensures the recovery of the RADview-EMS server in the event of operating system or hardware failure in a single site, using a single cluster of two nodes (active and standby) interconnected to external storage equipment. Automatic failover eliminates effects on service and minimizes loss of monitoring data.
- **High Availability-Disaster Recovery** – This solution provides the highest protection level. In addition to Local Clustering protection, data is replicated between data centers located at geographically separated sites. In the event of an outage at the primary site, all services can be readily moved to the backup site.



High Availability (Local Clustering)



High Availability-Disaster Recovery

RADview-SC/Vmux

Service Management Application for Voice Trunking Gateways

The RADview-SC/Vmux service center application is a powerful tool for provisioning and monitoring the Vmux family of voice trunking gateways (Vmux-2100, Vmux-110, Vmux-210, and Gmux-2000) using SNMP.

The intuitive GUI interface and easy-to-follow wizards increase the efficiency and accuracy of the service provisioning process. The application includes an element management and performance analysis solution that monitors the status, configuration and resource availability of the Vmux voice trunking gateways.

Running on either HP OpenView Network Node Manager (NNM) or on SNMPc, it enables simple integration with other vendors' management applications.

Automated service provisioning

The RADview-SC/Vmux voice trunking application performs automatic provisioning and deployment of the Vmux voice trunking gateways at their respective sites. The ability to perform automated service provisioning from a central site, rather than manual provisioning in the field, improves system uptime, reduces on-site visits and lowers customer support costs. RADview-SC/Vmux defines connections between Vmux voice trunking gateways at associated sites. Several intelligent termination options are provided for deactivating, disconnecting and removing services. Since the configuration information for a deactivated service remains in the RADview-SC/Vmux database, the circuit can be reactivated with a single mouse click.

- **Automatic node and configuration discovery**
- **Service association to network hierarchy level for ease of control and fault isolation**
- **Provisioning from a central workstation**
- **Java-based application enables platform independence (Windows or UNIX)**
- **Maintenance of configuration parameters in database allows for immediate reactivation of deactivated circuits**
- **User-friendly, intuitive graphical user interface**

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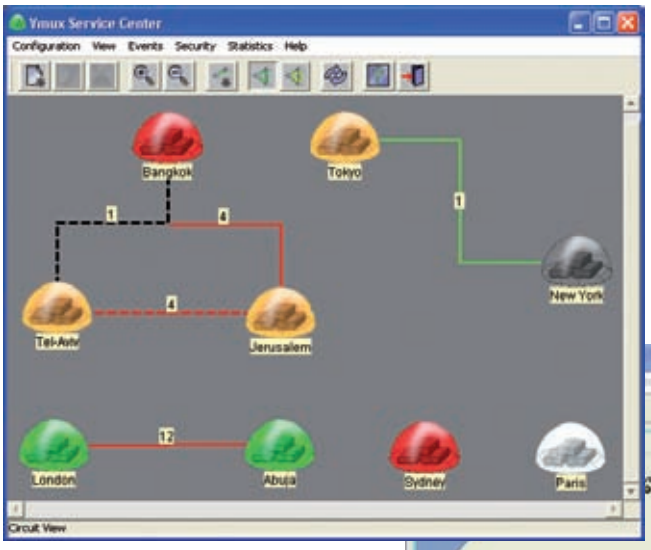

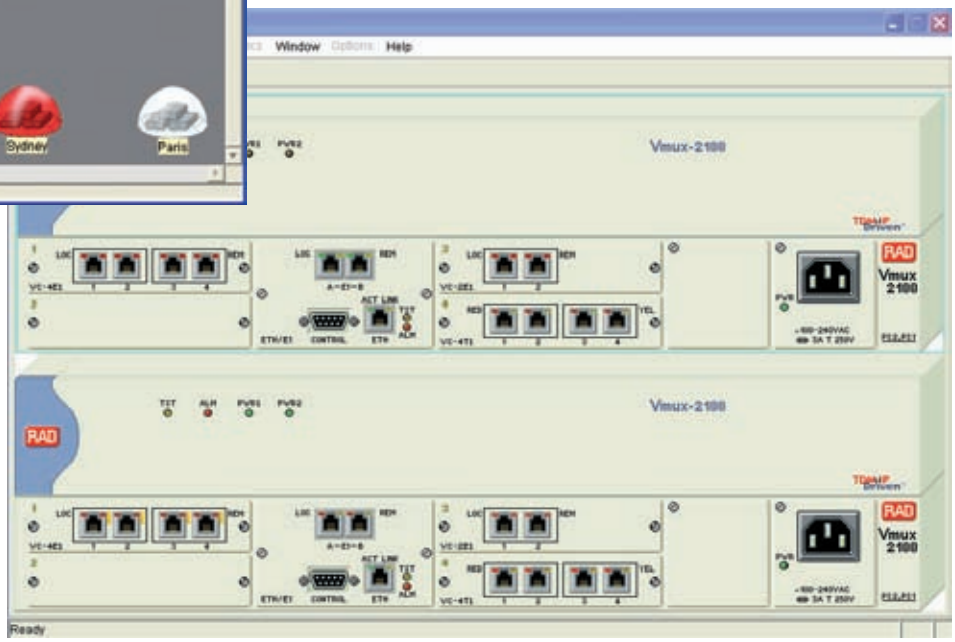

RADview-SC/TDM

Path Management MAP

- **End-to-end management over SDH/SONET and PDH networks**
- **Simplifies and automates service monitoring and provisioning for error-free and efficient bandwidth and inventory utilization**
- **Maximizes service assurance with application level protection**
- **Discovers network services and reports on SDH/SONET and PDH network configuration problems**
- **Embeds other vendor's devices via sophisticated network cloud**

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The RADview-SC/TDM enables end-to-end service management of RAD's Multiservice Access Platform (MAP) devices for simplified service provisioning. An intuitive GUI, "point-and-click" functionality, and easy-to-follow wizards facilitate provisioning and monitoring over combined SDH and PDH networks.

The open, scalable, multi-access management capabilities allow network operators to add new services while minimizing overall operating costs, reducing provisioning times and maximizing efficiency of the network infrastructure.

RADview-SC/TDM offers full interoperation with element management applications, using CORBA-based client-server architecture.

Network monitoring

RADview-SC/TDM displays graphic and alphanumeric network inventory representations from nodes up to services level. Dynamic network status indication and alarms are displayed per node, link, SDH/SONET trail, frames, and service. Only service-affecting alarms are displayed, focusing the user on relevant information.

Online maps display various types of parameters, including services, network nodes and links, clouds and CE equipment, logical PDH rings and SDH/SONET trails, faults on nodes and links, clock source flow, bandwidth utilization, and security authorizations.

Network discovery

The system's capability to discover existing network services, as well as potential network configuration conflicts, assures the best utilization of existing network resources and easy migration steps, in addition to generating network configuration problem reports for PDH and SDH/SONET levels.

Automated service management

RADview-SC/TDM supports automatic service routing based on efficient bandwidth resource analysis of user-configurable cost per link, service priority and protection level.

An intuitive GUI increases the efficiency and accuracy of the service provisioning process, aided by "point-and-click" functionality and easy-to-follow wizards, with tip and hint bubbles throughout the process.

Network uptime is maximized using Provision Carrier Class Service protection with PDH rings, SDH/SONET path protection, and automatic N:1 software service protection. In case of failure while provisioning a new configuration, full rollback to the original configuration is provided.

Automatic service rerouting ensures network resilience and maximizes the uptime of a critical service. This important capability enables the service provider to uphold service level agreements (SLAs) per provisioned service.

Service level reporting allows service providers to quickly and efficiently determine the uptime (in percentage) of a provisioned customer circuit.

For user-friendly maintenance, existing services can be edited and expanded, while simulator mode enhances network and service design, optimization and planning.

Fault management

RADview-SC/TDM fault management correlates incoming events to service and helps present the actual status of the provisioned services.

It includes a history log that allows the filtering of events according to event types and users.

To maximize integrity, faulty services are automatically and periodically self-healed and repaired using priority-based repair of multiple services and periodical attempts, in addition to manually initiated repairs.

Security

Network access security is based on authorization rights by access level (administrator, operator, technician, and monitor), device level and user-profile architecture.

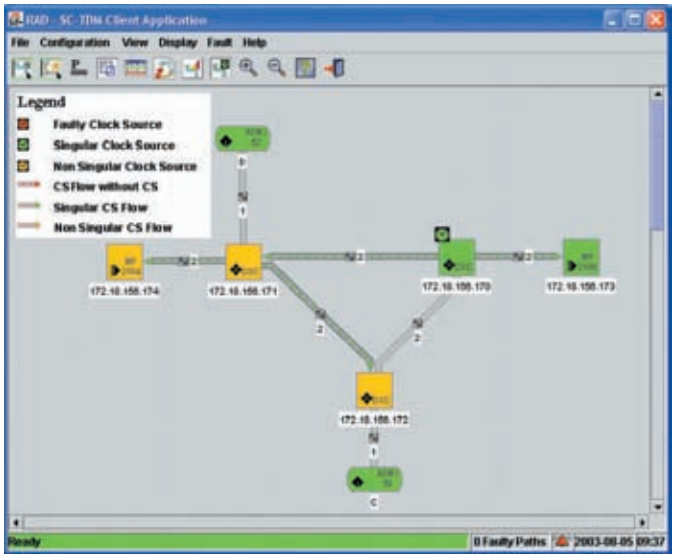
Third-party integration

RADview-SC/TDM uses CORBA-based architecture as a northbound interface that can be integrated with the carrier's front and back office systems and any third-party application.

All system events published as CORBA events allow an OSS application to listen for well-filtered and relevant events from one central system.

Network cloud

Third-party devices can be embedded using a special cloud node that can be set up to include various end points and linked to other MAP devices. A sophisticated cross connect wizard allows the replication of third-party device cross connect data.



RADview-SC/TDMoIP

Service Management Application for TDM over IP

The RADview-SC/TDMoIP is a powerful tool for provisioning and monitoring TDM over IP (TDMoIP) gateways using SNMP. The intuitive GUI interface and easy-to-follow wizards increase the efficiency and accuracy of the service provisioning process.

RADview-SC/TDMoIP includes an element management and performance analysis tool that monitors the status, configuration and resource availability of the TDMoIP gateways.

The application is based on an open, Java-based client-server architecture. Using CORBA-based APIs, the server application can be easily integrated with the carrier's front office and back office systems (any third-party application).

Running on either HP OpenView Network Node Manager (NNM) or on SNMPc, it enables simple integration with other vendors' management applications.

Automated service provisioning

The RADview-SC/TDMoIP application performs automatic provisioning and deployment of the TDMoIP gateways at their point of deployment. It supports two types of services: regular service, which consists of a hierarchy of central and branch sites; and mesh service, enabling any-to-any connections between gateways.

The ability to perform automated service provisioning from a central site, rather than manual provisioning in the field, improves time-to-market, reduces the number of required on-site visits and lowers customer support costs.

RADview-SC/TDMoIP detects all TDMoIP gateways installed on the specified sub-network, performs site association and defines circuits between TDMoIP gateways at associated sites. The application automatically generates a suggested configuration based on the parameters entered by the network manager.

Several intelligent termination options are provided for deactivating, disconnecting and removing circuits. Since the configuration information for a deactivated circuit remains in the RADview-SC/TDMoIP database, the circuit can be reactivated with a single mouse click.

- **Automatic node and configuration discovery**
- **Service association to network hierarchy level for ease of control and fault isolation**
- **Provisioning from a central workstation**
- **Open system design based on client-server architecture and CORBA APIs**
- **Java-based application enables platform independence (Windows or UNIX)**
- **Maintenance of configuration parameters in database allows for immediate reactivation of deactivated circuits**
- **User-friendly, intuitive graphical user interface (GUI)**
- **Easy integration with third-party NMS products via CORBA**

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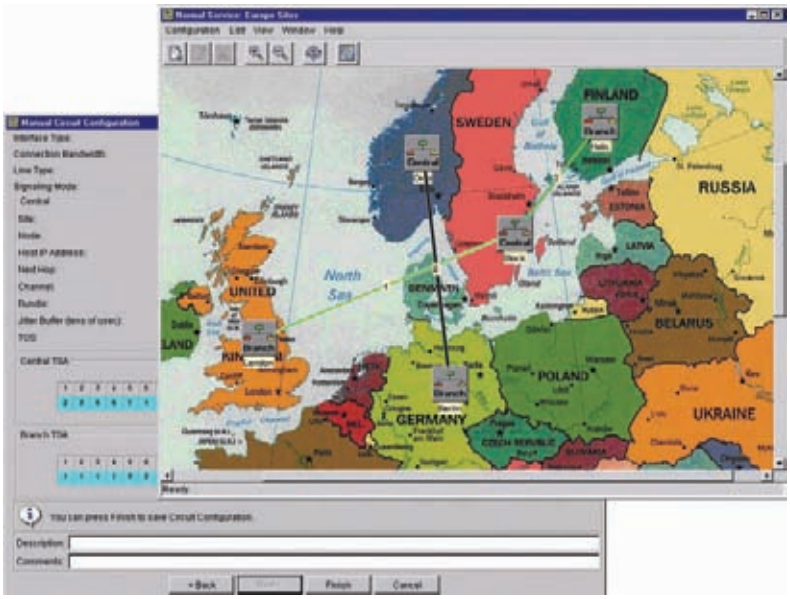

RADview Agent Compatibility

RADview-EMS		RADview-SC/Vmux	RADview-SC/TDM	RADview-SC/TDMoIP
ACE-52	IPmux-2L	Gmux-2000	DXC-100	IPmux-24
ACE-201	IPmux-24	Vmux-110	DXC family*	IPmux-216
ACE-202	IPmux-155L	Vmux-210	FCD-155	Gmux-2000
ACE-2002	IPmux-216	Vmux-2100	FCD-155E	
ACE-2002E	Kilomux-2100/4		FCD-E1A	
ACE-3100/3200	LA-110		FCD-E1L/T1L	
ACE-3400/3402	LA-210		FCD-E1LC/T1LC	
ACE-3600	LRS-16		FCD-IP	
Airmux	LRS-24		FCD-IPM	
APD#	LRS-102		Megaplex-2100/4	
APS#	Megaplex-104		Megaplex-4100	
ASMi-52/52L	Megaplex-2100/4		Optimux-45	
ASMi-54	Megaplex-4100			
DXC-100	Optimux-25			
DXC family*	Optimux-34			
Egate-20#	Optimux-45/45L			
Egate-100#	Optimux-106/108			
ETX-102/202	Optimux-1551/3			
ETX-202A	PRBm-20			
FCD-155/155E#	RIC-155GE#			
FCD-E1/T1	RICi-4E1/4T1#			
FCD-E1A	RICi-8E1/8T1#			
FCD-E1E	RICi-16			
FCD-E1L/T1L	RICi-E1/T1/E3/T3#			
FCD-E1LC/T1LC	SPS#			
FCD-IP				
FCD-IPM				
FOMi-E3/T3				
FPS#				
Gmux-2000				

* DXC-8R, DXC-10A, DXC-30

\# Web-based element manager