RICi-16

Ethernet over Bonded PDH Network Termination Unit

Connects Fast Ethernet LANs transparently over TDM infrastructure

Ether Access

- Ethernet traffic delivery over 16 bonded E1 or T1 ports or two clear channel T3 ports using Ethernet over NG-PDH protocols
- MEF 9/MEF 14 certified product supporting EPL and EVPL services with flexible mapping of user traffic into Ethernet flows
- Enhanced QoS mechanism and flow-based provisioning (service multiplexing) with advanced traffic management
- Monitoring and diagnostic tools for quick fault isolation on TDM and Ethernet ports
- Complete Ethernet OAM solution based on IEEE 802.3-2005 (formerly 802.3ah), IEEE 802.1ag and ITU T Y.1731

RICi-16 is a state-of-the-art Network Termination Unit (NTU) connecting Fast Ethernet LANs over up to 16 bonded E1/T1 lines or up to two clear-channel T3 circuits. Alternatively, RICi-16 transports Ethernet over bonded and TDM T1s using a single channelized T3 as uplink.

This enables service providers to supply high-capacity Ethernet services to remote locations, and transparently connects corporate LANs over existing PDH infrastructure.

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Increases bandwidth capacity of available infrastructure with scalable bonding, bridging the bandwidth gap between E1/T1 rates and E3/T3 rates

An essential part of RAD's EtherAccess™ portfolio, RICi-16 features Carrier Ethernet attributes, that include 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.

MARKET SEGMENTS AND APPLICATIONS

Typical applications include:

- IP DSLAM, cellular IP, and WiMAX base station backhauling
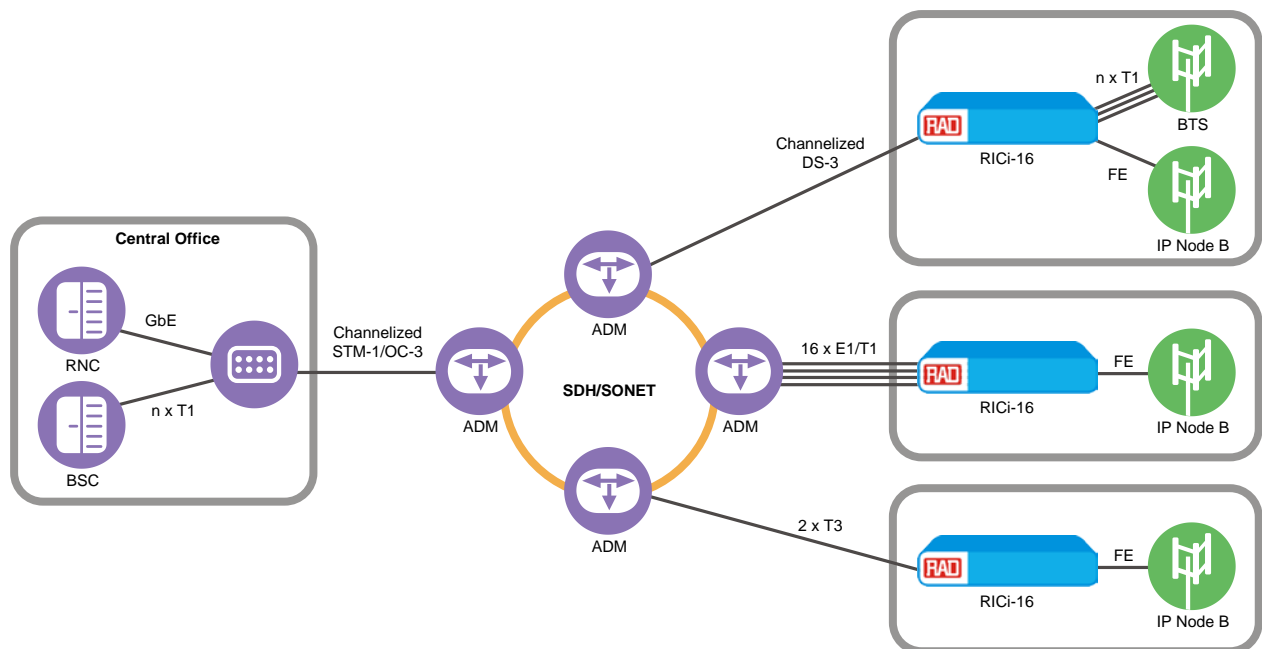- Interoffice or enterprise LAN connection.

Figure 1. Ethernet Cellular Backhauling over PDH/SONET/SDH

ETHERNET

Certified by the Metro Ethernet Forum (MEF) for the following services:

- MEF 9: EPL, EVPL
- MEF 14: EPL, EVPL.

Encapsulation and Bonding

RICi-16 employs Ethernet over NG-PDH technologies, such as Generic Framing Procedure (GFP G.8040), Virtual Concatenation (VCAT G.7043) and Link Capacity Adjustment Scheme (VCAT G.7042). NG-PDH solutions improve overall network availability by reducing latency and optimizing line utilization and throughput.

The unit supports up to 16 GFP VCAT groups (VCG), allowing the connection of up to 16 different customers per site.

Traffic Management

Traffic is mapped to the Ethernet flows (EVCs) using the following per-port criteria:

- Port-based (All-to-one bundling)
- CE-VLAN
- CE-VLAN priority
- DSCP
- IP precedence
- CE-VLAN + CE-VLAN priority
- CE-VLAN ID + IP precedence (user to network only)
- CE-VLAN + DSCP (user to network only)
- Non-IP
- CE-VLAN + non-IP
- Untagged.

VLAN stacking and stripping at ingress and egress enables transporting user traffic transparently, keeping the user VLAN settings intact. In addition, the management traffic can be tagged with a different VLAN, fully separating user traffic from management data.
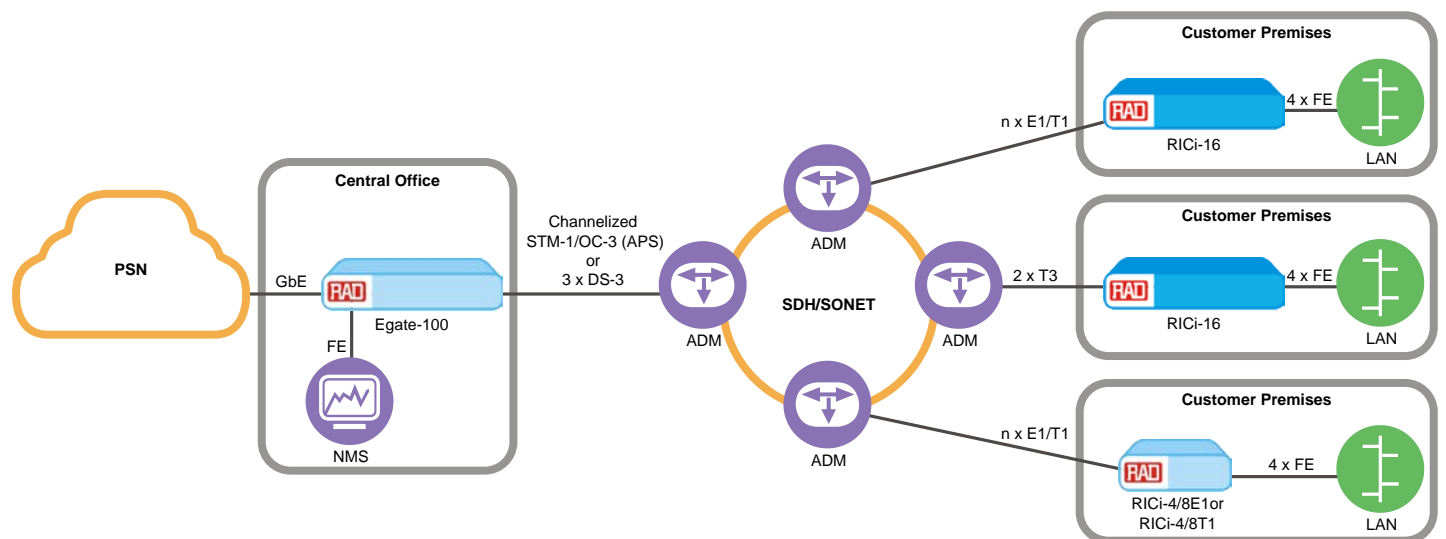

Figure 2 Ethernet Services over PDH/SONET/SDH Using Egate-100

Quality of Service (QoS)

Different service types require different levels of QoS to be provided end-to-end. QoS can be defined per subscriber as well as per service. QoS has two aspects: rate limitation and traffic prioritization.

Two policing mechanisms are applied per flow. The policing mechanisms operate according to the dual leaky bucket mechanism (CIR + CBS, EIR + EBS: two rates, three colors).

RICi-16 prioritizes user traffic, by using up to four separate queues for traffic with different service demands, such as real-time, premium, or best-effort data.

OAM

Two types of Ethernet OAM are provided:

- Single segment (link) OAM according to IEEE 802.3-2005 (formally 802.3ah) for remote management and fault indication

- OAM Connectivity Fault Management (CFM) based on IEEE 802.1ag and ITU-T Y.1731 enabling Ethernet service providers to monitor their services proactively, measure end-to-end performance, and guarantee that customers receive the contracted SLA.

Layer-2 Control Protocols

RICi-16 can be configured to transport Layer-2 control frames across the network, to peer supported protocols traffic (OAM.ah), or to discard the L2CP frames.

Minimizes service disruptions via fault propagation and hitless restoration
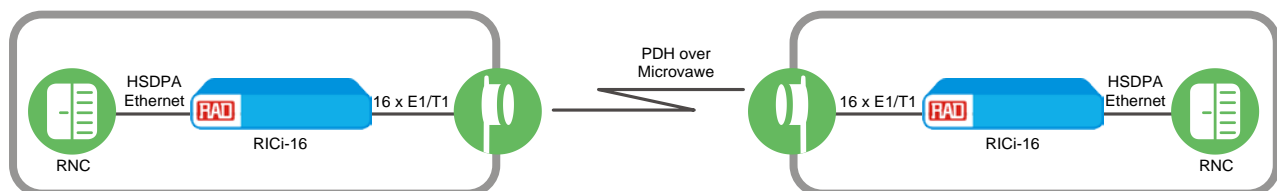

Figure 3. Next-Generation Mobile Connectivity over PDH Microwave Links

TIMING AND SYNCHRONIZATION

Simple Network Time Protocol (SNTP)
RICi-16 uses Simple Network Time Protocol (SNTP) to synchronize to an accurate time from an NTP server at user-selectable intervals.

MANAGEMENT AND SECURITY

- Remote inband management via the network ports using Telnet, Web browser or RADview, RAD's SNMP-based management system
- Out-of-band management via one of the user data ports that can be configured as a management port
- Local management via an ASCII terminal connected to the RS-232.

To provide a high level of client-server communication security, the following security protocols are supported:

- SNMPv3
- RADIUS authentication
- SSL for Web-based management
- SSH for Secure Shell communication.

RESILIENCY

Fault propagation
The unit features a user-configurable bidirectional fault propagation mechanism that notifies local and remote equipment of faulty conditions.

This enables routers and switches on both ends of the link to reroute traffic.

Extends service reach for out-of-footprint subscribers, enabling service providers to rapidly grow their customer base
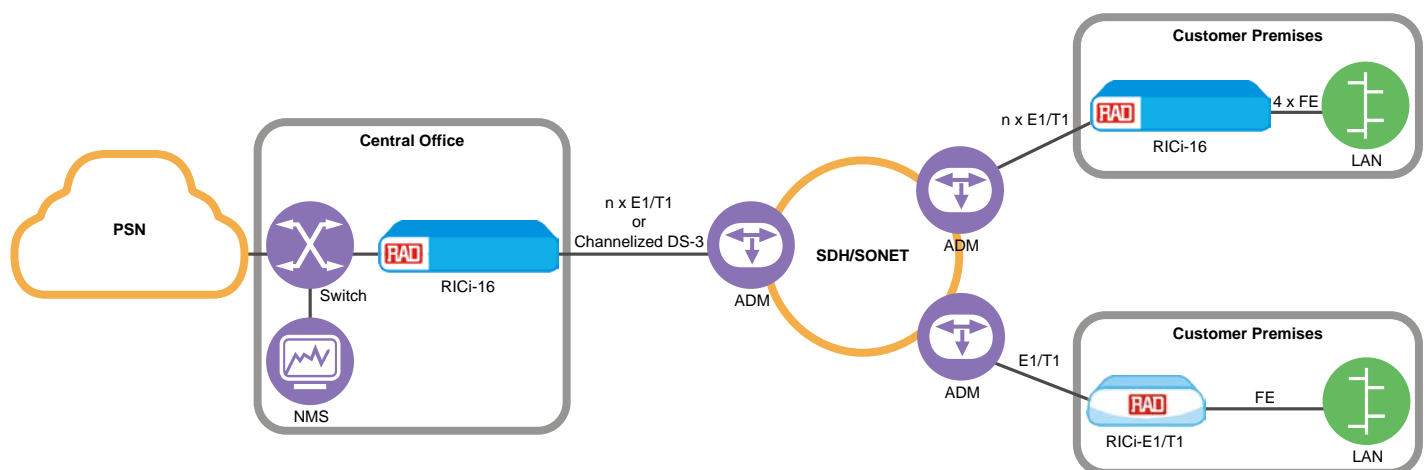

Figure 4. Ethernet Services over PDH/SONET/SDH Using RICi-16 as Aggregator

Specifications

E1 INTERFACES

Number of Ports
4, 8, or 16

Compliance
G.703
G.704

Data Rate
2.048 Mbps

Line Code
HDB3, AMI

Framing
Framed (G732N with CRC)

Line Impedance
120Ω, balanced
75Ω, unbalanced (via adapter cable)

Connector
RJ-45, balanced

System Clock
Internal or loopback timing

T1 INTERFACES

Number of Ports
4, 8, or 16

Compliance
T1.403

Data Rate
1.544 Mbps

Line Code
B8ZS, AMI

Framing
ESF

Line Impedance
100Ω, balanced

System Clock
Internal or loopback timing

Connector
RJ-45

T3 INTERFACES

Number of Ports
2

Port Operation Mode
Channelized: 1 port is operational
Clear-channel: both ports are operational

Compliance
T1.102, T1.107

Data Rate
44.736 Mbps

Line Code
B3ZS

Framing
M23 or C-bit parity

Line Impedance
75Ω, unbalanced

System Clock
Internal or loopback timing

Connector
BNC

LINE INTERFACE

Encapsulation
GFP (G.7041)
GFPoPDH (G.8040)

Bonding
VCAT (G.7043) – Up to 16 VCAT groups
LCAS (G.7042)

Delay Compensation
Up to 250 ms (E1/T1 ports)
Up to 217 ms (clear channel T3 ports)

FAST ETHERNET INTERFACE

Standard Compliance
IEEE 802.3 and 802.3u, relevant sections

Number of Ports
3 or 4

Type
10/100 Mbps, autonegotiation, full/half
duplex, flow control

Port Combinations
4 built-in electrical
2 built-in electrical + 1 fiber optic SFP (for
transceivers, see *Ordering*)

Max Frame Size
1700 bytes

SFP Transceivers
For full details, see the SFP Transceivers
data sheet at http://www.rad.com

Note: *It is strongly recommended to order this
device with **original** RAD SFPs **installed**. This will
ensure that prior to shipping. RAD has performed
comprehensive functionality quality tests on the
entire assembled unit, including the SFP devices.
RAD cannot guarantee full compliance to product
specifications for units using non-RAD SFPs. For
detailed specifications of the SFP transceivers, see
the SFP transceivers, see the SFP Transceivers data
sheet.*

BRIDGE

LAN Table
Up to 2018 MAC addresses (learned) and 30 static addresses

Operation Mode
VLAN-aware, VLAN-unaware

Filtering and Forwarding
Transparent or filtered

GENERAL

Management
SNMPv1, SNMPv3

Telnet

RADview-EMS (ordered separately)

ASCII terminal via V.24 (RS-232) DCE port

Diagnostics
Remote loopbacks on E1, T1, T3

Indicators
PWR (green, per power supply) – Power status
TST (yellow) – Self test status
ALM (red) – Alarm status

Power
Wide-range AC/DC:
100–240 VAC, 50/60 Hz or
48/60 VDC nominal (40–72 VDC)

Power Consumption
13W max

Physical
Height: 43.7 mm (1.7 in) 1U
Width: 440.0 mm (17.3 in)
Depth: 240.0 mm (9.4 in)
Weight: 3.0 kg (6.6 lb)

Environment
Temperature:

Standard enclosure:
0 to 50°C (32 to 122°F)

Temperature-hardened enclosure:
-22° to 65°C (-7.6° to 149°F)

Humidity: Up to 90%, non–condensing

RICi Family Product Comparison Table

Feature	RICi-E1, RICi-T1 (Ver. 2.1)	RICi-E3, RICi-T3 (Ver. 1.1)	RICi-4E1, RICi-4T1 RICi-8E1, RICi-8T1 (Ver. 2.0)	RICi-16 (Ver. 2.5)
Protocol Type	RAD HDLC HDLC IS GFP (G.8040, G.7041/Y.1303)	RAD HDLC X.86 (LAPS)	MLPPP (BCP)	GFP (G.7041), GFPoPDH (G.8040) VCAT (G.7043) LCAS (G.7042)
Fault Propagation	Yes	Yes	Yes	Yes
MAC Address Table	512	512	2048	2048
QoS	VLAN priority (802.1p) IP Precedence	VLAN priority (802.1p)	VLAN priority (802.1p) DSCP Per port	VLAN priority (802.1p) IP Precedence DSCP Per port
QoS Mechanism	Strict	Strict	Strict	Strict
Host VLAN	Yes	Yes	Yes	Yes
VLAN Stacking	Yes	Yes	Yes	Yes

RICi-16

Ethernet over Bonded PDH Network Termination Unit

Ordering

RECOMMENDED CONFIGURATIONS

RICI-16/16E1
Ethernet over bonded PDH Network Termination Unit, 16 E1 ports

RICI-16/16T1
Ethernet over bonded PDH Network Termination Unit, 16 T1 ports

RICI-16/16T1/R
Ethernet over bonded PDH Network Termination Unit, 16 T1 ports, redundant power supply

RICI-16/4E1/R
Ethernet over bonded PDH Network Termination Unit, 4 E1 ports, redundant power supply

RICI-16/4T1
Ethernet over bonded PDH Network Termination Unit, 4 T1 ports

RICI-16/8E1
Ethernet over bonded PDH Network Termination Unit, 8 E1 ports

RICI-16/8T1
Ethernet over bonded PDH Network Termination Unit, 8 T1 ports

SPECIAL CONFIGURATIONS

RICi-16/B/@/*/#/!/|/$/?

Legend

B Number of PDH ports:
16E1	16 E1 ports
16T1	16 T1 ports
8E1	8 E1 ports
8T1	8T1 ports
4E1	4 E1 ports
4T1	4 T1 ports
2T3	2 T3 ports

Notes:

- *When RICi-16 is ordered with 16 E1/T1, only four E1 or T1 ports are activated by default. Additional E1/T1 ports can be activated using a software license. For 8E1/T1 and 4E1/T1 options, the device is supplied with all E1/T1 ports operational.*

- *When the 2T3 option is ordered, the unit is supplied with only two T3 ports (no T1 ports).*

@ T3 ports (Default=no T3 ports):
2T3   2 T3 ports

Note: The 2T3 option is applicable, when the RICi-16/16T1 option is ordered (see above).

* License pack for PDH link activation:
Pack 1	8 E1/T1 links
Pack 2	12 E1/T1 links
Pack 3	16 E1/T1 links

Note: Applicable only for units with 16 E1 or T1 ports.

Operation mode (Default=bridge mode):
EVPL   Enable Ethernet Virtual Private Line services using Ethernet flows

! Ethernet SFP port:
(Default=4 × Ethernet UTP ports)
NULL   SFP-ready slot

| Number of power supplies:
(Default=single power supply):
R   Dual power supply

$ E1 Interface type (Default=balanced):
U   Unbalanced E1 interface via RJ-45 to BNC adapter cable

? Temperature range (Default=normal temperature range, not NEBS compliant):
H   Temperature-hardened, compliant with NEBS level 3, types 2, 3, and 4

SFP Transceivers
SFPs for SDH/SONET and Ethernet interfaces are to be ordered separately.

For full details, see the SFP Transceivers data sheet at www.rad.com

LICENSE PACKAGES

Software packages for activating additional operation modes and E1/T1 ports

Legend

RICi-16-EVPL	Ethernet Virtual Private Line services using Ethernet flows
RICi-16-Pack 1	8 E1/T1 links
RICi-16-Pack 2	12 E1/T1 links
RICi-16-Pack 3	16 E1/T1 links

SUPPLIED ACCESSORIES

AC power cord
DC power connection kit

CBL-RJ45/2BNC/E1
RJ-45 to BNC adapter cable (if unbalanced E1 interface is ordered)

CBL-DB9F-DB9M-STR
Control port cable

RM-34
Hardware kit for mounting one RICi-16 unit in a 19-inch rack

OPTIONAL ACCESSORIES

WM-34
Hardware kit for mounting one RICi-16 unit on a wall

RICi-16-PS
Spare wide-range power supply module (100–240 VAC/–48 VDC)

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