

# RICi-16

Ethernet over Bonded PDH Network Termination Unit



Connects Fast  
Ethernet LANs  
transparently over  
TDM infrastructure

**EtherAccess**

- 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.



# RICi-16

## Ethernet over Bonded PDH Network Termination Unit

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.

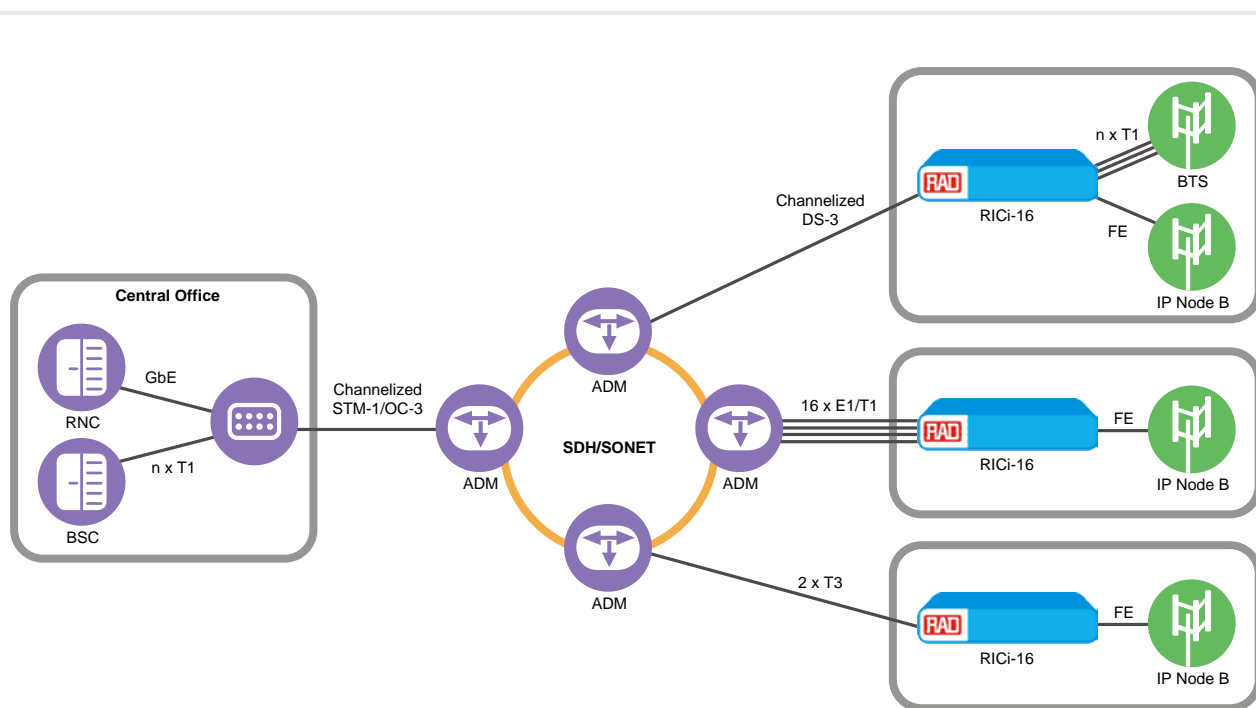


Figure 1. Ethernet Cellular Backhauling over PDH/SONET/SDH

## 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.

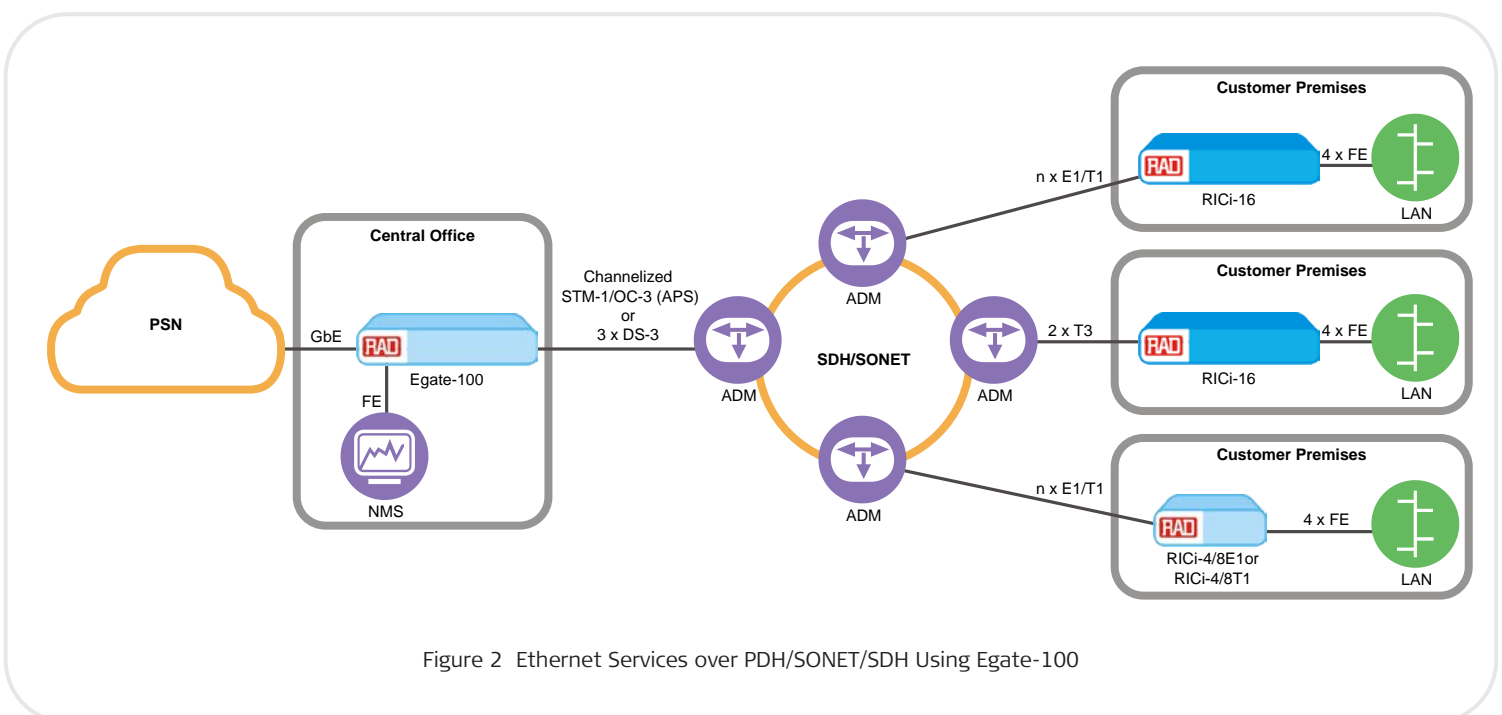


Figure 2 Ethernet Services over PDH/SONET/SDH Using Egate-100

# RICi-16

## Ethernet over Bonded PDH Network Termination Unit

### 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

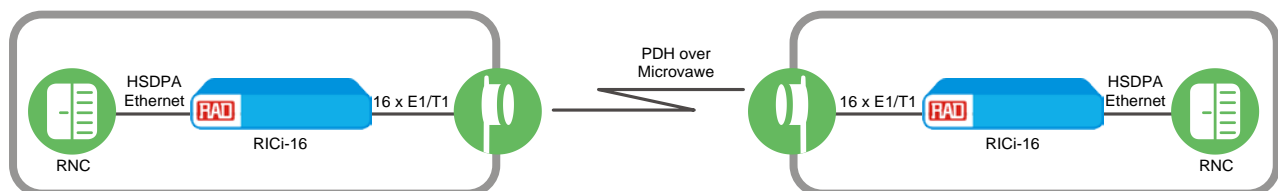


Figure 3. Next-Generation Mobile Connectivity over PDH Microwave Links

## 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

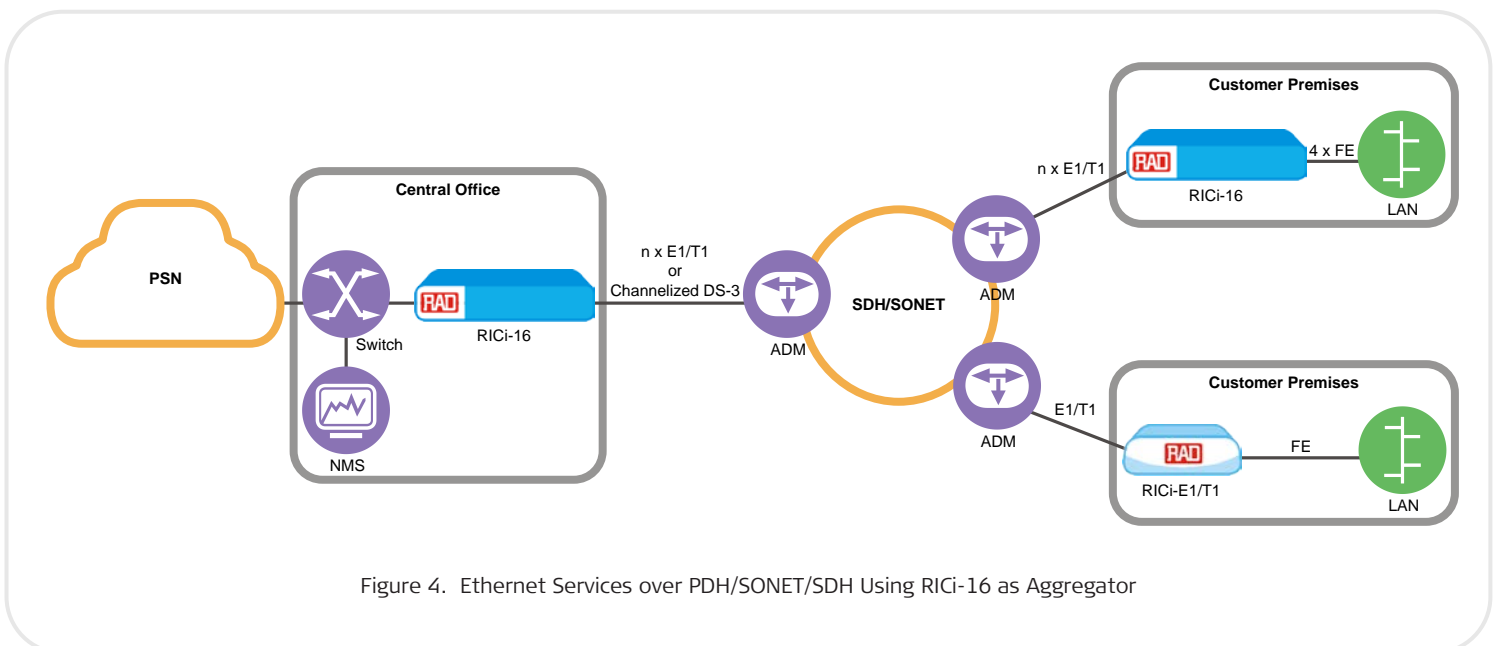


Figure 4. Ethernet Services over PDH/SONET/SDH Using RICi-16 as Aggregator

# RICi-16

## Ethernet over Bonded PDH Network Termination Unit

### 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>B</b>	Number of PDH ports:
<b>16E1</b>	16 E1 ports
<b>16T1</b>	16 T1 ports
<b>8E1</b>	8 E1 ports
<b>8T1</b>	8T1 ports
<b>4E1</b>	4 E1 ports
<b>4T1</b>	4 T1 ports
<b>2T3</b>	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:

<b>Pack 1</b>	8 E1/T1 links
<b>Pack 2</b>	12 E1/T1 links
<b>Pack 3</b>	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](http://www.rad.com)

#### LICENSE PACKAGES

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

#### Legend

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

**International Headquarters**  
24 Raoul Wallenberg Street  
Tel Aviv 69719, Israel  
Tel. 972-3-6458181  
Fax 972-3-6498250, 6474436  
E-mail [market@rad.com](mailto:market@rad.com)

**North America Headquarters**  
900 Corporate Drive  
Mahwah, NJ 07430, USA  
Tel. 201-5291100  
Toll free 1-800-4447234  
Fax 201-5295777  
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