

ACE-3000 Family  
**ACE-3402**  
Aggregation Site Gateway



2G, 3G and HSDPA  
cellular backhauling  
over packet-switched  
networks (PSNs)  
and SDH/SONET  
networks



- Pseudowire emulation of ATM UNI/IMA and channelized STM-1/OC-3 (VC-12/VT1.5) traffic over Gigabit Ethernet
- Advanced pseudowire connectivity verification using VCCV-BFD messages
- End-to-end fault propagation between legacy and packet-switched networks
- Full ATM switching, scheduling, policing and shaping for separation of HSDPA and voice services
- Full system redundancy and modular hot-swappable architecture for replacing the interface, power and main modules while maintaining service continuity

ACE-3402 is a multiservice carrier-class gateway, designed for cost-effective backhauling of 2G/3G voice and HSDPA data traffic over multi-generation access networks, such as Ethernet and SDH/SONET.

ACE-3402 uses advanced pseudowire (PW) technology to deliver cellular and legacy traffic services (ATM, TDM) over next-generation PSNs (packet-switched networks), including Layer-2, MPLS and IP.

Typically located at the RNC/BSC site, the unit converts and aggregates traffic using channelized STM-1/OC-3, ATM STM-1/OC-3c and Gigabit Ethernet interfaces.

**ANY-SERVICE-ANY-PORT**

The SDH/SONET and Gigabit Ethernet interfaces operate as user or network ports, per user configuration and depending on the required application.

In addition, ATM or TDM traffic received via the channelized STM-1/OC-3 ports is converted by ACE-3402 to either ATM (UNI or IMA), CES or SAT over PSNs, depending on the originating traffic type.



# ACE-3402

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### ATM OVER PACKET CAPABILITIES

ACE-3402 allows up to 512 data pseudowire connections to be established over a packet-switched network.

The following encapsulation methods are supported according to RFC 4717:

- 1-to-1 VC/VP – Each VCC/VPC is mapped to a single pseudowire connection
- N-to-1 VC/VP – Several VCs or VPs can be encapsulated to a single pseudowire connection.

ACE-3402 allows single or multiple ATM cells to be encapsulated per frame.

Over L2 and L3 networks, ACE-3402 uses various encapsulation types: VLANs (virtual LANs), dynamic and static MPLS label assignment, and MPLS in IP.

### TDM OVER PACKET CAPABILITIES

By allowing its channelized STM-1/OC-3 interfaces to work in TDM mode (user-selectable), ACE-3402 allows 2G cellular traffic to be transported over PSNs.

To compensate for the jitter caused by the packet-switched network, each TDM stream has a jitter buffer of up to 32 milliseconds.

The encapsulation of TDM traffic complies with the RFC 4553 and RFC 5086 requirements.

### USING THE LABEL DISTRIBUTION PROTOCOL (LDP)

ACE-3402 uses the MPLS label distribution protocol (LDP) to automatically assign and distribute pseudowires and tunnel labels between MPLS peers.

*Note: The LDP functionality requires a software license. For more information, refer to the Ordering section.*

### ATM SWITCHING AND POLICING CAPABILITIES

ACE-3402 provides full ATM switching capabilities, including scheduling and shaping of ATM-based traffic.

Operators can assign each virtual connection (VC) or virtual path (VP) to a service class, define the QoS parameters and shape the ATM egress traffic. ATM traffic policing allows operators to discard, tag or count non-conformant cells per configuration.

ACE-3402 allows establishing up to 1024 VP and VC connections with full UNI/NNI VPI and VCI ranges.

ACE-3402 supports inverse multiplexing over ATM (IMA) versions 1.0 and 1.1.

### QUALITY OF SERVICE (QOS) OVER PSN

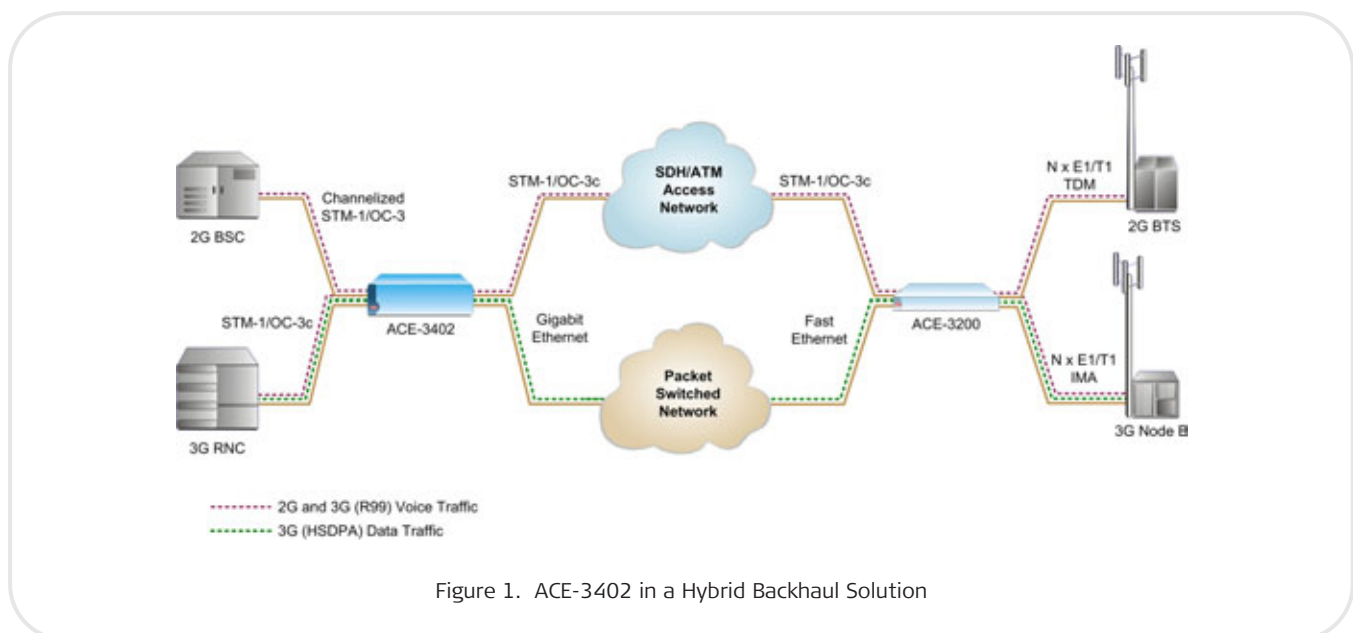
Over packet-switched networks, QoS is provided according to the network type:

- Layer-2 network – outgoing pseudowire packets are assigned a dedicated VLAN ID according to 802.1Q and marked for priority using 802.1p bits
- MPLS network – outgoing pseudowire packets are assigned to a specific MPLS tunnel and marked for priority using EXP bits
- IP network – outgoing pseudowire packets are marked for priority using ToS or DSCP bits.

### CLOCK SYNCHRONIZATION

ACE-3402 provides robust clock synchronization and flexible timing modes, including:

- Interface-based synchronization – the clock is recovered from the RX traffic of a selected interface, in accordance with G.823 and depending on the network's SLA
- Unicast clock distribution – the master clock is distributed with a dedicated stream towards up to 256 remote PSN peers



- Multicast clock distribution – the master clock is distributed towards the PSN using a single IP multicast clock stream (IGMPv2 host).

### GENERIC ROUTING ENCAPSULATION (GRE)

ACE-3402 encapsulates MPLS packets over GRE to establish point-to-point tunnel connection over an IP network. This tunneling service is used to transfer MPLS packets over an IP network without using the IP addressing scheme.

### INTERFACE MODULES

The ACE-3402 chassis provides slots for installing up to **four** hot-swappable interface modules in total. An interface module's type can be either SDH/SONET or Gigabit Ethernet.

### SDH/SONET INTERFACES

ACE-3402 supports up to three STM-1/OC-3c UNI interfaces, or up to two channelized STM-1/OC-3 interfaces:

- The STM-1/OC-3c UNI interfaces map physical layer and ATM cells into STM-1/OC-3c (ATM-155) according to ITU I.432
- The channelized STM-1/OC-3 interface provides up to 63 VC-12 or 84 VT1.5 channels. Each channel can be set to ATM UNI/IMA or TDM mode.

Two SDH/SONET ports of the same type can be configured to work in automatic protection switching (APS) mode, to provide 1+1 protection according to G.841 Annex B.

### GIGABIT ETHERNET INTERFACES

ACE-3402 supports up to two Gigabit Ethernet ports, used for pseudowire (PW) connectivity, user connections and inband management access over a single link.

To allow reliable and uninterrupted service over packet-switched networks, two Gigabit Ethernet interfaces can be set to work in the 1:1 or 1+1 automatic protection switching modes, according to IEEE 802.3ad.

### MAIN MODULES

The main modules of ACE-3402 affect the nature and overall functionality of the unit. Two distinct functionality types are available:

- Delivering ATM traffic over fiber optic STM-1/OC-3c links and packet-switched networks
- Aggregating VC-12/VT1.5 circuits over channelized STM-1/OC-3 or GbE links.

Accordingly, the main modules can be replaced in order to fulfill different backhauling tasks.

### SYSTEM REDUNDANCY

ACE-3402 allows two identical main modules to work in redundancy mode, which protects the unit's data matrix and main CPU in cases of unexpected module reset. One main module is set as the active module, while the second is in standby mode, ready to work in place of the active one at any moment.

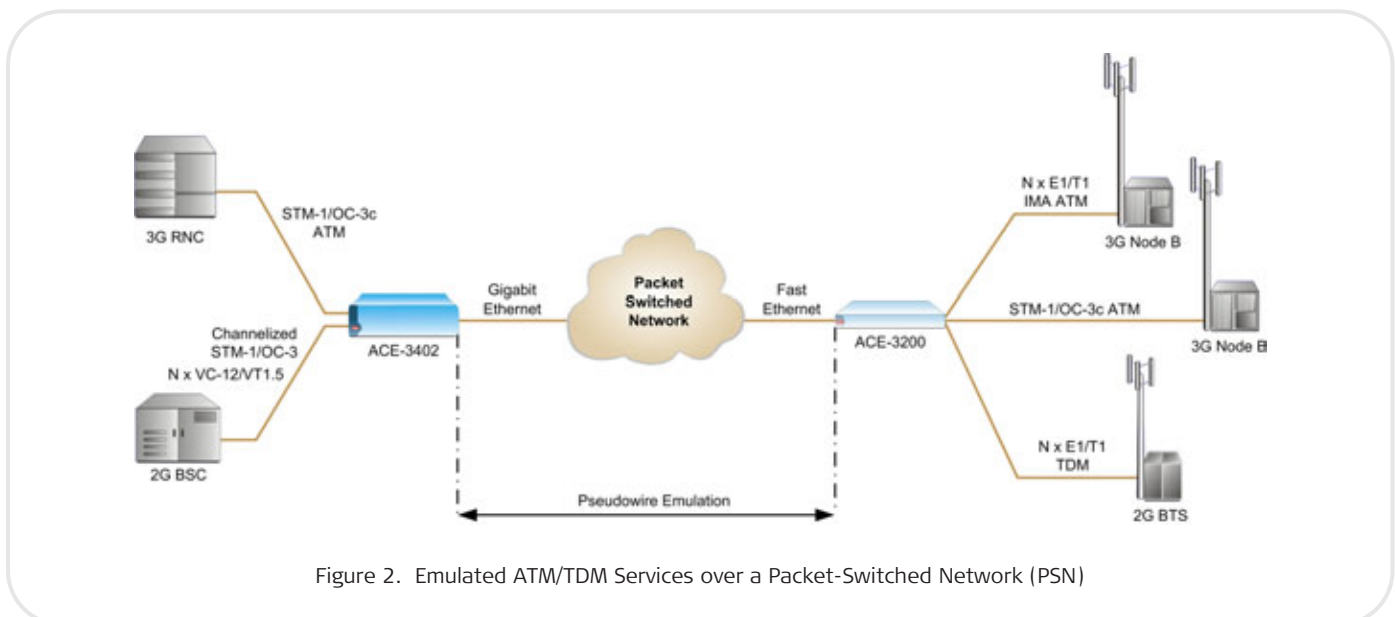


Figure 2. Emulated ATM/TDM Services over a Packet-Switched Network (PSN)

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### OAM AND DIAGNOSTICS

Comprehensive monitoring and diagnostic capabilities include:

- Pseudowire connectivity check
- External and internal physical loopbacks on STM-1/OC-3c/OC-3 ports
- Cell test towards the ATM connections.

ACE-3402 periodically verifies the connectivity status of pseudowire connections, using VCCV-BFD messages according to the 'draft-ietf-bfd-base' requirements. If a failure is detected, a notification is sent to both the remote peer and the ATM connection of the specific PW. This allows complete monitoring over the pseudowire connections in real-time.

SDH/SONET and PSN port alarms are forwarded over the packet-switched network from end to end. This includes the mapping of:

- Packet-switched network alarms to ATM/TDM alarms
- ATM/TDM alarms over the PSN to the remote customer equipment (CE)
- Physical failures of SDH/SONET ports, over the packet-switched network towards both the local and remote CE.

For conventional ATM cross-connects (XCs), OAM is supported according to ITU I.610 requirements:

- F4 and F5 OAM
- Configurable OAM mode per connection point
- Segment/intermediate mode for user connections and end-to-end mode for the management connection
- AIS and RDI cell detection and generation upon physical layer and ATM layer failures
- CC cell generation and LOC state detection per VP/VC
- Loopback location ID and configurable loopback source ID per device.

Performance monitoring is provided by Ethernet and IP-layer network condition statistics, such as packet sequence errors (loss or misorder) and packet delay variation (jitter), which are monitored and stored by the device.

ACE-3402 collects statistics per physical port and per connection for 15-minute intervals. Statistics for the last 6 hours are stored in the device and can be retrieved at the network management station.

For diagnostics purposes, ACE-3402 maintains a cyclic event log file that stores up to 4096 time-stamped events. In addition, an internal system log agent can send all reported events to a centralized repository or remote server.

### MANAGEMENT

ACE-3402 can be managed using different access methods, via:

- A dedicated RS-232 or 10/100BaseT port
- Dedicated VC defined on any ATM port
- Gigabit Ethernet uplink port, using IP-based connection (raw IP or over PW).

Software upgrades and configuration files can be downloaded/uploaded to/from ACE-3402 via TFTP or XMODEM.

The following applications can be used for management:

- Menu-driven terminal utility via an ASCII terminal connection
- Telnet via an IP-based connection
- Secure Shell (SSH) via any secure client/server application
- ConfiguRAD, Web-based element management tool via an IP-based connection
- RADview-EMS, RAD's CORBA-based element management access system, providing a dedicated PC/Unix-based GUI for controlling and monitoring the unit from a network management station.

The unit can be managed by and report to up to 16 different users simultaneously. Accounts of existing and new users can be defined/changed remotely, using a dedicated RADIUS server.

ACE-3402 allows retrieval of the current date and time from a centralized location, by synchronizing with an SNTP (System Network Timing Protocol) server.

### ADVANCED SECURITY FEATURES

ACE-3402 supports the Secure Socket Layer (SSL) protocol for enabling secure Web access to the unit. If enabled, the SSL protocol encrypts the data between the TCP and HTTP Web layers.

Telnet-like management can be secured using a Secure Shell (SSH) client/server program. Instead of sending plain-text ASCII-based commands and login requests over the network, SSH provides a secure communication channel.

In addition, ACE-3402 supports SNMP version 3, providing secure access to the device by authenticating and encrypting packets transmitted over the network.

### MODULAR ARCHITECTURE

The modular architecture of ACE-3402 allows hot-swappable modules to be replaced in the field while maintaining uninterrupted service. The unit is fully accessible from the front panel.

The unit's full hardware redundancy features (fans, power supplies, modules) ensure a fail-safe, continuous operation, making ACE-3402 ideal for carriers and service providers.

## Specifications

### STM-1/OC-3c/OC-3 INTERFACE

#### Number of Ports

Up to 4 (field-replaceable modules)

#### Data Rate

155 Mbps

#### Operation Mode

SDH or SONET, ATM UNI, VC-12/VT1.5

#### Compliance

Physical layer and ATM mapping into STM-1/OC-3 according to I.432

Automatic protection switching (APS) according to G.841 Annex B (1+1, bidirectional)

#### Jitter Performance

Output according to G.825  
Tolerance according to G.823  
Transfer according to G.783

#### Fiber Optic Interface Type

1310 nm – multimode, single mode or single mode long haul

#### Fiber Optic Connector

SC

### GIGABIT ETHERNET INTERFACE

#### Number of Ports

Up to 2 (field-replaceable modules)

#### Data Rate

1000 Mbps

#### Compliance

IEEE 802.3z, 802.1Q, 802.1p

#### Max. Frame Size

1600 bytes

#### Operation Mode

Full-duplex

#### Connector

Small Form-Factor Pluggable (SFP),  
fiber optic  
RJ-45, electrical

#### SFPs

For full details, see the SFP Transceivers data sheet at [www.rad.com](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 functional 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.*

### ETHERNET CONTROL PORT

#### Type

100BaseTX, full-duplex

#### Compliance

IEEE 802.3

#### Connector

RJ-45

### TERMINAL CONTROL PORT

#### Type

RS-232/V.24 (DCE)

#### Data Rate

9.6, 19.2, 38.4, 57.6 or 115.2 kbps,  
user-configurable

#### Connector

RJ-45 (RJ-45 to DB-9 adapter cable is supplied)

### STATION CLOCK INTERFACE

#### Type

Balanced E1, unbalanced E1 (via an adapter cable) or T1

#### Impedance

Balanced E1: 120Ω  
Unbalanced E1: 75Ω (via an adapter cable)  
T1: 100Ω

#### Connector

RJ-45

### GENERAL

#### Fan Tray

Field-replaceable, two independent cooling fans

#### Power

One or two hot-swappable AC or DC:  
AC: 100 to 240 VAC, 47–63 Hz  
DC: -48 VDC nominal (-41 to -71 VDC)

*Note: AC and DC power supplies cannot be installed together in the same unit.*

#### Power Consumption

100W max

#### LED Indicators

POWER (green/red) –

Green: power supply is OK

Red: power supply failure

SYS ALM (green/red) –

Green: no system alarm is detected

Red: at least one system alarm has been detected

FAN (green/red) –

Green: all the fans are working properly

Red: at least one fan is not working properly

RDY (green) –

On: self-test completed successfully

Blinking: self-test failed

ACTIVE (green) –

On: this main module is in Active mode

Off: this main module is not in Active mode

STANDBY (green) –

On: this main module is in Standby mode

Off: this main module is not in Standby mode

ATM-155 SYNC 1–3 (green) –

On: the port's physical link is synchronized

Off: the port's physical link is not synchronized

Blinking: RDI has been detected

ATM-155 ATM 1–3 (green) –

On: ATM cells are being received or transmitted

Off: ATM cells are not being received or transmitted

ETH 1/2 LINK (green) –

On: Gigabit Ethernet link is detected

Off: Gigabit Ethernet link is not detected

ETH 1/2 ACT (green) –

On: Frames are being received or transmitted

Off: Frames are not being received or transmitted

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MNG-ETH LINK (green) -

On: Ethernet link is detected

Off: Ethernet link is not detected

MNG-ETH ACT (yellow) -

On: ETH frames are being received or transmitted

Off: ETH frames are not being received or transmitted

STATION CLK SYNC (green) -

On: E1/T1 physical link is synchronized

Off: E1/T1 physical link is not synchronized

### Physical

Height: 8.7 cm (3.4 in / 2U)

Width: 44.0 cm (17.3 in)

Depth: 25.0 cm (9.0 in)

Weight: 8.0 kg (22.0 lb)

### Environment

Temperature:

Operating: 0°-50°C (32°-122°F)

Storage: -20°-70°C (-4°-158°F)

Humidity: Up to 90%, non-condensing

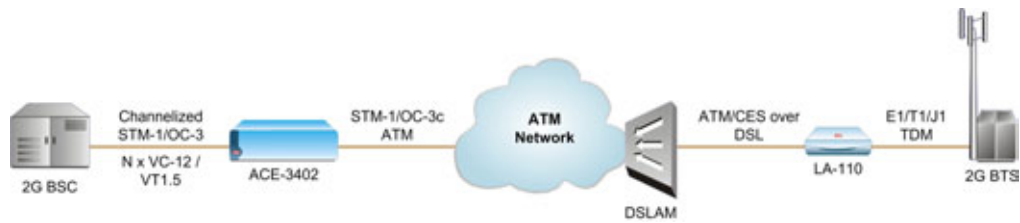


Figure 3. 2G Backhauling over ATM Network

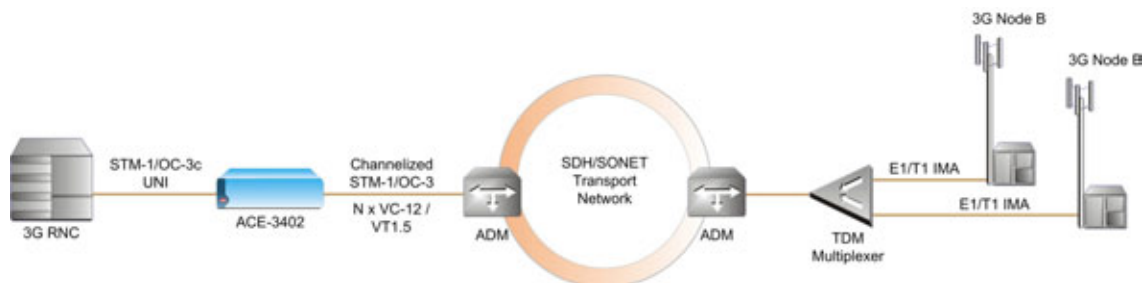





Figure 4. 3G Backhauling over SDH/SONET Network

ACE-3000 Product Family Comparison Table

Features			
	ACE-3600	ACE-3402	ACE-3400
E1/T1 traffic aggregation			✓
STM-1/OC-3c traffic aggregation	✓	✓	✓
Channelized STM-1/OC-3 traffic aggregation		✓	✓
E1/T1 ports			32 or 63 via patch panels
ATM-155 ports	Up to 8, 4 per module	Up to 3, 1 per module	Up to 3, 1 per module
SFPs for ATM-155 ports	✓		
Fast Ethernet ports	1 for OOB* management only	1 for OOB* management only	1 for OOB* management only
Gigabit Ethernet ports	Up to 2, 1 per module	Up to 2, 1 per module	Up to 2, 1 per module
SFPs for GbE ports	✓	✓	✓
SFPs for FE ports			
PSN clock distribution	✓	✓	✓
APS on ATM-155 ports	✓	✓	✓
Ethernet redundancy	✓	✓	✓
System redundancy	✓	✓	✓
BSC/RNC-site gateway	✓ (RNC only)	✓ (BSC/RNC)	✓ (BSC/RNC)
Max. ATM VCCs	1024	1024	1024
Max. data PW links	1024	512	512
Max. remote PSN peers	512	256	256
Modular unit	✓	✓	✓
Power supply	Single/dual, hot-swappable	Single/dual, hot-swappable	Single/dual, hot-swappable
Physical width	17.3"	17.3"	17.3"
Physical height	2U	2U	3U

\* OOB = out-of-band

## ACE-3402

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## Ordering

## ACE-3402/#

## Legend

- # Power supply type and redundancy:
- AC** Single 100 to 240 VAC
  - DC** Single -48 VDC
  - ACR** Dual 100 to 240 VAC
  - DCR** Dual -48 VDC

## ACE-MC/\*/~

ACE-3402 main module (main card)

## Legend

- \* Main module type:
- 155** STM-1/OC-3c to GbE
  - 155-CH** Channelized STM-1/OC-3 to ATM STM-1/OC-3c or GbE
- Note: The 155 option (STM-1/OC-3c to GbE) is available only with the **PACK1** software license.*
- ~ The required software license pack (Default=ATM network functionality):
- P1** ATM and PSN functionality, not including clock recovery over packet

*Note: For full system redundancy, order two main module units.*

## ACE-IF-155/^/&amp;

SDH/SONET interface module

## Legend

- ^ Fiber type:
- 13L** Single mode, 1310 nm
  - 13LH** Single mode, 1310 nm, long haul
  - 13M** Multimode, 1310 nm
- & Connector type:
- SC** SC connector

*Note: For interface redundancy (APS), order two interface modules.*

## ACE-IF-GbE/@

Gigabit Ethernet interface module

## Legend

- @ Port type:
- SFP** SFP cage (empty)
  - UTP** 1000BaseT, electrical

*Note: For interface redundancy (APS), order two interface modules. The fiber optic Gigabit Ethernet ports require SFP transceivers that are fitted into the empty cage. For technical specifications and ordering information, refer to the SFP Transceivers data sheet, available on RAD's Web site.*

## SUPPLIED ACCESSORIES

AC power cord or a DC power connection kit (as ordered)

## RM-36

Hardware kit for mounting one ACE-3402 unit into a 19-inch rack

## CBL-RJ45/D9/F/STR

Control port adapter cable (RJ-45 to DB-9)

## OPTIONAL ACCESSORIES

## SFP Transceivers

- SFP-1** 1310 nm, multimode LED, up to 2 km (1.2 miles), LC
- SFP-2** 1310 nm, single mode laser, up to 15 km (9.3 miles), LC
- SFP-3** 1310 nm, single mode laser, up to 40 km (24.8 miles), LC
- SFP-4** 1550 nm, single mode laser, up to 80 km (49.7 miles), LC
- SFP-5** 1000BaseSX GbE, LC connector
- SFP-6** 1000BaseLX10 GbE, LC
- SFP-9G** 1000BaseT GbE, RJ-45

*Note: For the complete and detailed list, refer to the SFP Transceivers data sheet. It is strongly*

*recommended to order ACE-3402 with original RAD SFPs installed. This will ensure that prior to shipping, RAD has performed comprehensive functional quality tests on the entire assembled unit, including the SFP devices. RAD cannot guarantee full compliance to product specifications for ACE-3402 units using non-RAD SFPs.*

## CBL-RJ45/2BNC/E1/X

Adapter cable for converting a balanced E1 RJ-45 station clock connector to a pair of BNC connectors (if unbalanced E1 station clock source is used)

## ACE-PS/\*

ACE hot-swappable power supply unit (for replacement)

- \* Power supply type:
- AC** 100 to 240 VAC
  - DC** -48 VDC

## ACE-FTC/ACE-3402

Fan tray card (for replacement)

## ACE-MC-SW/!

Software upgrade pack

- ! Software pack type:
- P1** PW over PSN functionality
  - LDP** LDP functionality