

ACE-3000 Family

ACE-3400

Aggregation Site Gateway



2G, 3G and HSDPA
cellular backhauling
over packet-switched
networks (PSNs),
SDH/SONET networks
and E1/T1 transport
links

ACE

- Pseudowire emulation of ATM UNI/IMA and TDM traffic over packet-switched networks, such as Layer-2, MPLS and IP
- Advanced pseudowire connectivity verification using VCCV-BFD messages
- End-to-end fault propagation between legacy and packet-switched networks
- Full ATM switching, scheduling 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-3400 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-3400 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 $N \times$ E1/T1, STM-1/OC-3c and Gigabit Ethernet interfaces.

Any-Service-Any-Port

The STM-1/OC-3c 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 E1/T1 ports is converted by ACE-3400 to either ATM (UNI or IMA), CES or SAT over PSNs, depending on the originating traffic type.

RAD

data communications
The Access Company

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ATM over Packet Capabilities

ACE-3400 allows up to 512 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-3400 allows single or multiple ATM cells to be encapsulated per frame.

Over L2 and L3 networks, ACE-3400 uses various encapsulation types: VLANs (virtual LANs), dynamic and static MPLS label assignment, and MPLS in IP.

TDM over Packet Capabilities

By allowing its E1/T1 interfaces to work in TDM mode (user-selectable), ACE-3400 allows 2G cellular traffic to be transported over PSNs.

Both structure-agnostic and structure-aware modes are supported, with up to 8 bundles per E1/T1 port or 128/300 bundles in total.

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 'draft-ietf-pwe3-cesopsn' requirements.

Using the Label Distribution Protocol (LDP)

ACE-3400 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 Capabilities

ACE-3400 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 according to CBR, VBR and UBR+.

ACE-3400 allows establishing up to 1024 VP and VC connections with full UNI/NNI VPI and VCI ranges.

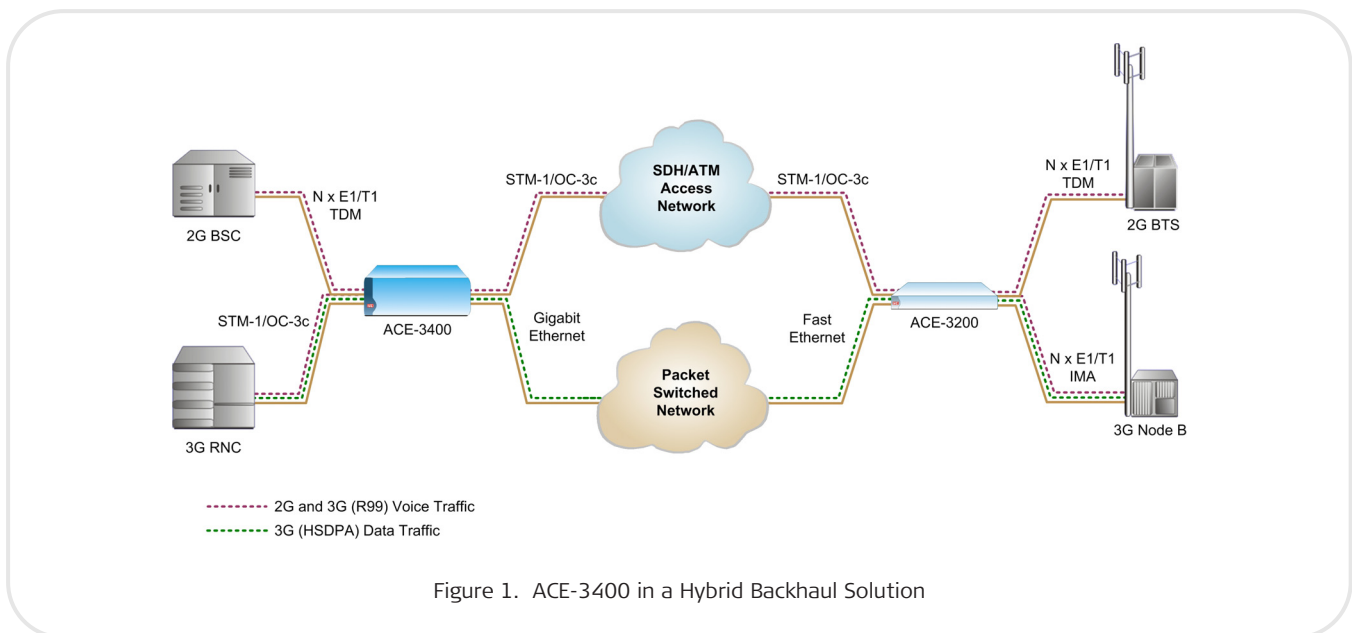
ACE-3400 supports inverse multiplexing over ATM (IMA) versions 1.0 and 1.1, allowing users to define up to 32 or 63 IMA groups.

Each of the unit's E1/T1 ports can be configured to work in ATM IMA, ATM UNI or TDM over ATM mode (structured/unstructured CES). The fiber optic STM-1/OC-3c interfaces operate in ATM UNI mode.

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-3400 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).

E1/T1 Interfaces

ACE-3400 includes 32 or 63 (as ordered) E1 or T1 multiservice ports that can be configured to work in ATM UNI/IMA or TDM mode, per user configuration. This Any-Service-Any-Port framework enables high flexibility in deployment within various backhaul solutions.

Optional patch panel adapters can be used to convert the E1/T1 ports terminated in six 64-pin Telco connectors. Each Telco connector supports up to 14 E1/T1 ports.

Interface Modules

The ACE-3400 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-3400 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 SDH or SONET operation mode is user-selectable.
- 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-3400 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-3400 affect the nature and overall functionality of the unit. Three 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
- Aggregating E1/T1 traffic (ATM UNI/IMA or TDM) over STM-1/OC-3c or GbE links.

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

System Redundancy

ACE-3400 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.

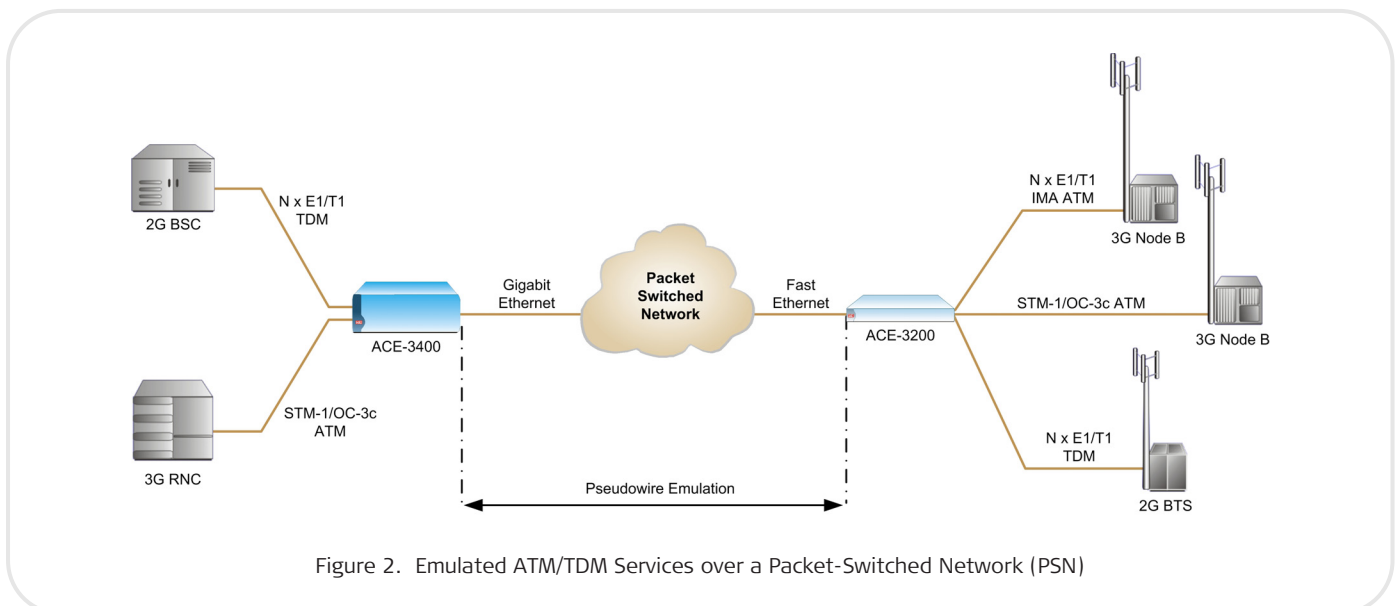


Figure 2. Emulated ATM/TDM Services over a Packet-Switched Network (PSN)

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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-3400 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/TDM connection of the specific PW. This allows complete monitoring over the pseudowire connections in real-time.

ATM/TDM and PSN port alarms are propagated over the packet-switched network from end to end. This includes the mapping of:

- Packet-switched network alarms to ATM alarms
- ATM/TDM alarms over the PSN to the remote customer equipment (CE)
- Physical failures of ATM/TDM 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 disorder) and packet delay variation (jitter), which are monitored and stored by the device.

ACE-3400 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-3400 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-3400 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).

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-3400 allows retrieval of the current date and time from a centralized location, by synchronizing with an SNTP (System Network Timing Protocol) server.

Software upgrades and configuration files can be downloaded/uploaded to/from ACE-3400 via TFTP or XMODEM.

Advanced Security Features

ACE-3400 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.

Modular Architecture

The modular architecture of ACE-3400 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-3400 ideal for carriers and service providers.

Specifications

TRIBUTARY E1/T1 INTERFACE

Number of Connectors

6

Number of Interfaces Per Connector

Up to 14

Connector Type

64-pin Telco connector

E1 INTERFACE

Number of Ports

32 or 63

Data Rate

2048 kbps

Compliance

G.703, G.704, G.732

Jitter Performance

Output and tolerance according to G.823
Transfer according to G.705

Operation Mode

ATM UNI, ATM IMA or TDM

Line Code

HDB3

Framing

MF, CRC-4 enabled
MF, CRC-4 disabled
Unframed

LIU Support

Short haul

Monitoring Support

Idle channel code insertion
Alarm detection and insertion
Errors statistics

Line Impedance

120Ω, balanced
75Ω, unbalanced

Connectors

RJ-45, balanced
BNC coaxial, unbalanced

Note: E1 and T1 connectors are provided via a dedicated patch panel adapter, connected to two tributary connectors. For more information, refer to the Patch Panel Adapters data sheet.

T1 INTERFACE

Number of Ports

32 or 63

Data Rate

1544 kbps

Compliance

ANSI T1.101, ITU-T G.703

Jitter Performance

According to AT&T PB-62411

Operation Mode

ATM UNI, ATM IMA or TDM

Line Code

B8ZS

Line Mode

DSU

Framing

ESF
Unframed

CRC-6 Calculation

According to G.704

Monitoring Support

Idle channel code insertion
Alarm detection and insertion
Errors statistics

Line Length

Transmit gain up to 655 ft

Line Impedance

100Ω

Connectors

RJ-45 (via a dedicated patch panel adapter; see previous note)

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

Note: Fiber optic Gigabit Ethernet modules require SFP transceivers that are fitted into the empty cage. For technical specifications and ordering information, refer to the SFP Transceivers data sheet.

ETHERNET CONTROL PORT

Type

100BaseTX, full-duplex

Compliance

IEEE 802.3

Connector

RJ-45

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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, four 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

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: 13.3 cm (5.2 in / 3U)
Width: 44.0 cm (17.3 in)
Depth: 25.0 cm (9.0 in)
Weight: 10.0 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

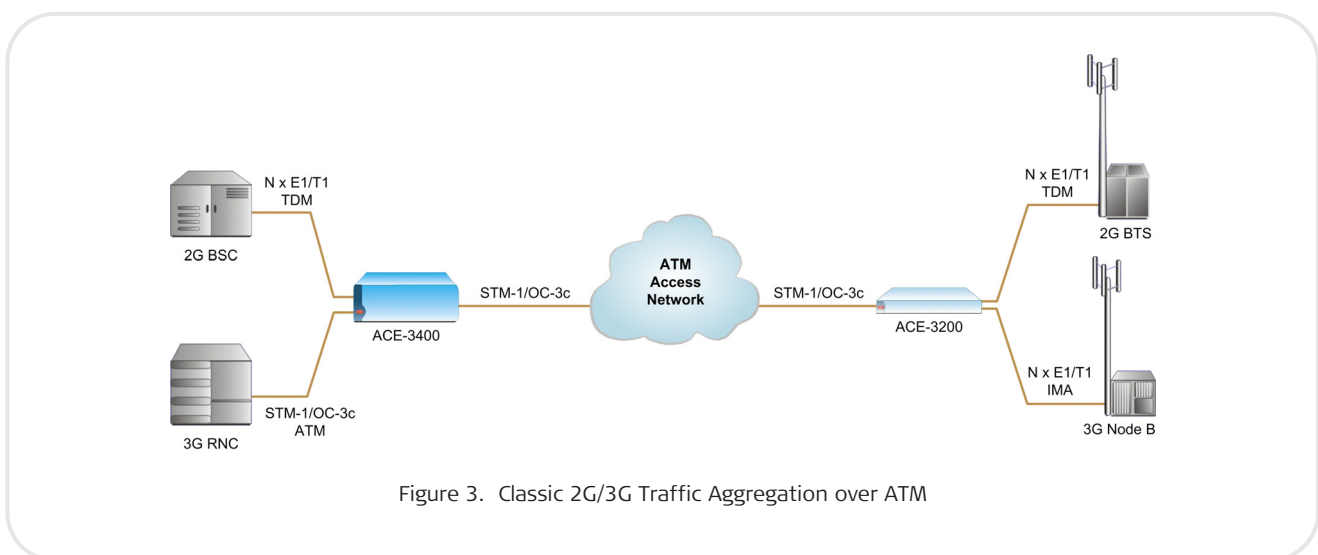


Figure 3. Classic 2G/3G Traffic Aggregation over ATM

ACE-3000 Product Family Comparison Table

	ACE-3600	ACE-3402	ACE-3400	ACE-3200	ACE-3100
E1/T1 traffic aggregation			✓	✓	✓
STM-1/OC-3c traffic aggregation	✓	✓	✓	✓	✓
Channelized STM-1/OC-3 traffic aggregation		✓	✓		
E1/T1 ports			32 or 63 using patch panels	8 or 16, built-in	0 or 4, built-in
ATM-155 ports	Up to 8, 4 per module	Up to 3, 1 per module	Up to 3, 1 per module	0 or 2, built-in	1 or 2, built-in
SFPs for ATM-155 ports	✓			✓	✓
Fast Ethernet ports	1 for OOB* management only	1 for OOB* management only	1 for OOB* management only	2 for PSN traffic and/or inband management	2 for PSN traffic and/or inband management
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				✓ (optional)	✓ (optional)
PSN clock distribution	✓	✓	✓	✓	✓
PSN clock recovery				✓	✓
APS on ATM-155 ports	✓	✓	✓	✓	✓
Ethernet redundancy	✓	✓	✓		
System redundancy	✓	✓	✓		
BSC/RNC-site gateway	✓ (RNC only)	✓ (BSC/RNC)	✓ (BSC/RNC)		
Cell-site gateway				✓	✓
Max. ATM VCCs	1024	1024	1024	128	128
Max. remote PSN peers	512	256	256	32	32
Modular unit	✓	✓	✓		
Power supply	Single/dual, hot-swappable	Single/dual, hot-swappable	Single/dual, hot-swappable	Single/dual, fixed	Single, fixed
Physical width	17.3"	17.3"	17.3"	17.3"	8.5"
Physical height	2U	2U	3U	1U	1U

* OOB = out-of-band

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Ordering

ACE-3400/#

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-3400 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
32E1B	32 balanced E1s to ATM STM-1/OC-3c or GbE
32E1U	32 unbalanced E1s to ATM STM-1/OC-3c or GbE
32T1	32 T1s to ATM STM-1/OC-3c or GbE
63E1B	63 balanced E1s to ATM STM-1/OC-3c or GbE
63E1U	63 unbalanced E1s to ATM STM-1/OC-3c or GbE
63T1	63 T1s 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 (leave empty for ATM network functionality):

PACK1	ATM and packet-switched network functionality, <u>not including</u> clock recovery over packet
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Note: For full system redundancy, order two main module units.

ACE-IF-155/^/&

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.

Note: It is strongly recommended to order the interface module 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-3400 units using non-RAD SFPs.

SUPPLIED ACCESSORIES

AC power cord or a DC power connection kit (if a DC-powered unit is ordered)

RM-39

Hardware kit for mounting one ACE-3400 unit into a 19-inch rack

CBL-RJ45/D9/F/STR

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

OPTIONAL ACCESSORIES

ACE-PPANEL/BNC/21

Patch panel adapter with 21 unbalanced BNC connectors

ACE-PPANEL/RJ45/28

Patch panel adapter with 28 balanced RJ-45 connectors

Note: For more information about the supplied Patch Panel kit, refer to the Patch Panel Adapters data sheet, available on RAD's Web site.

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-3400

Fan tray card (for replacement)

ACE-MC-SW/!

Software upgrade pack

! Software pack type:
PACK1 PW over PSN functionality
LDP LDP functionality

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