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

- 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, 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-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 × 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

ATM OVER PACKET CAPABILITIES

ACE-3400 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-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 RFC 5086 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 AND POLICING 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. ATM traffic policing allows operators to discard, tag or count non-conformant cells per configuration.

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.
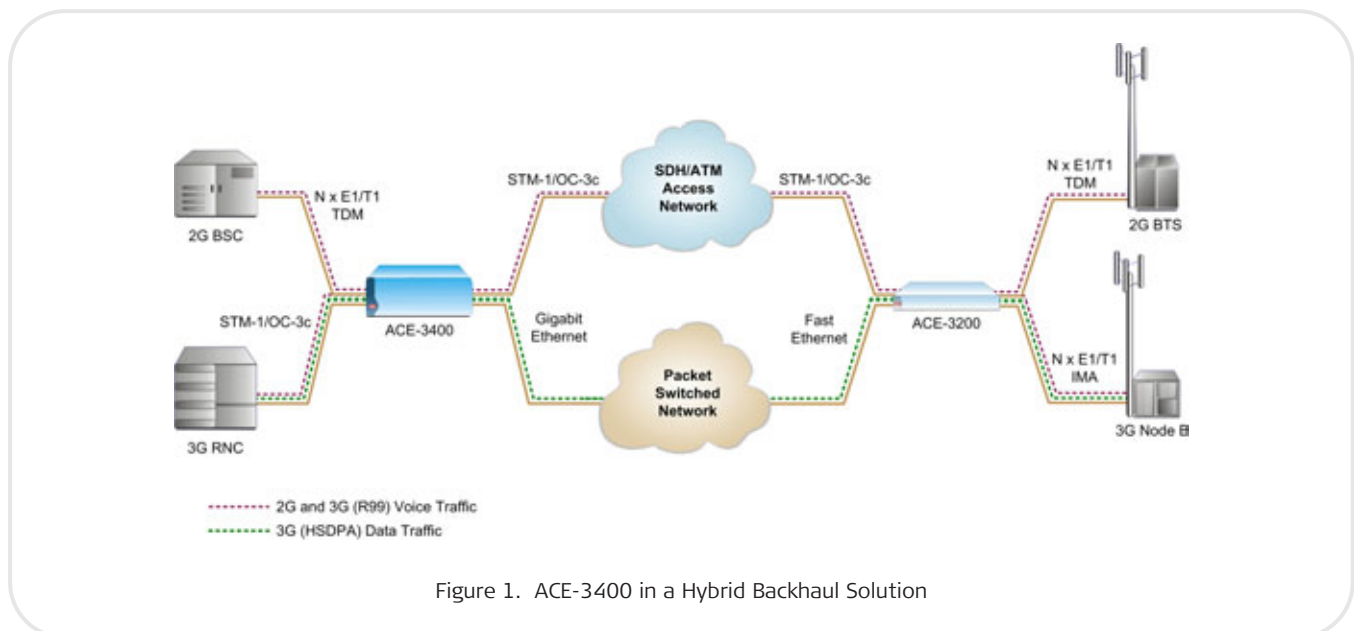

Figure 1. ACE-3400 in a Hybrid Backhaul Solution

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).

GENERIC ROUTING ENCAPSULATION (GRE)

ACE-3400 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.

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 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.
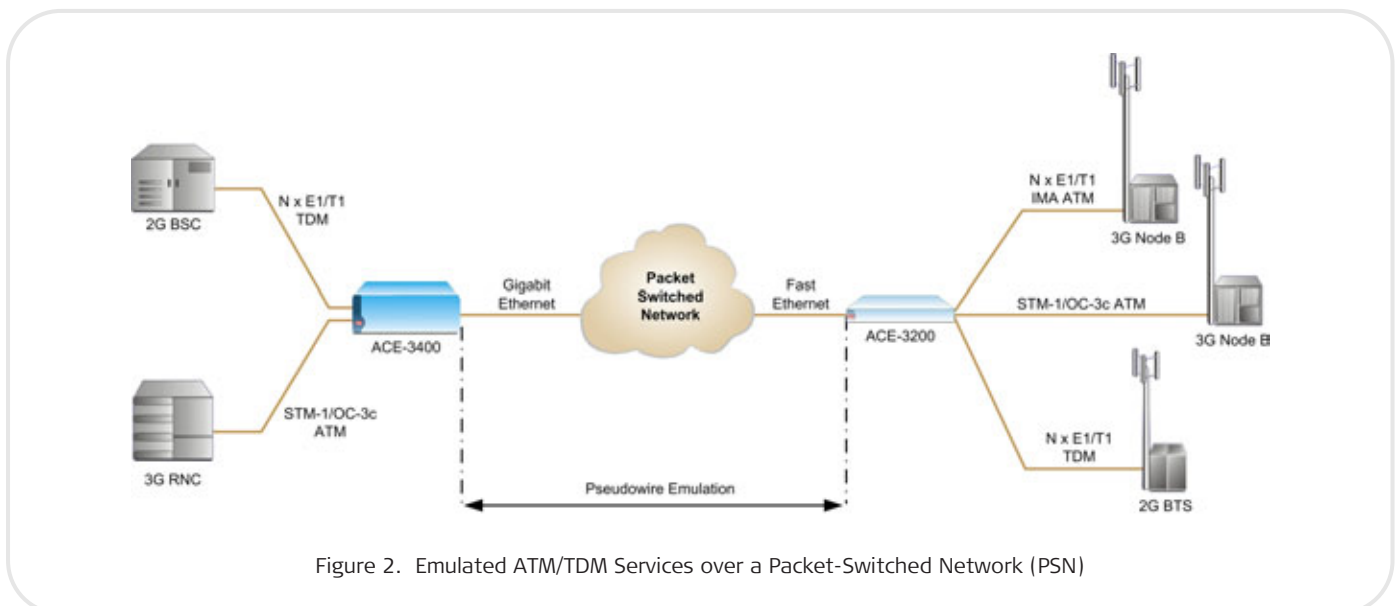

Figure 2. Emulated ATM/TDM Services over a Packet-Switched Network (PSN)

ACE-3400
Aggregation Site Gateway

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.

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 misorder) 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).

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

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.

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.

In addition, ACE-3400 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-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

SFPs
For full details, see the SFP Transceivers data sheet at 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, 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)
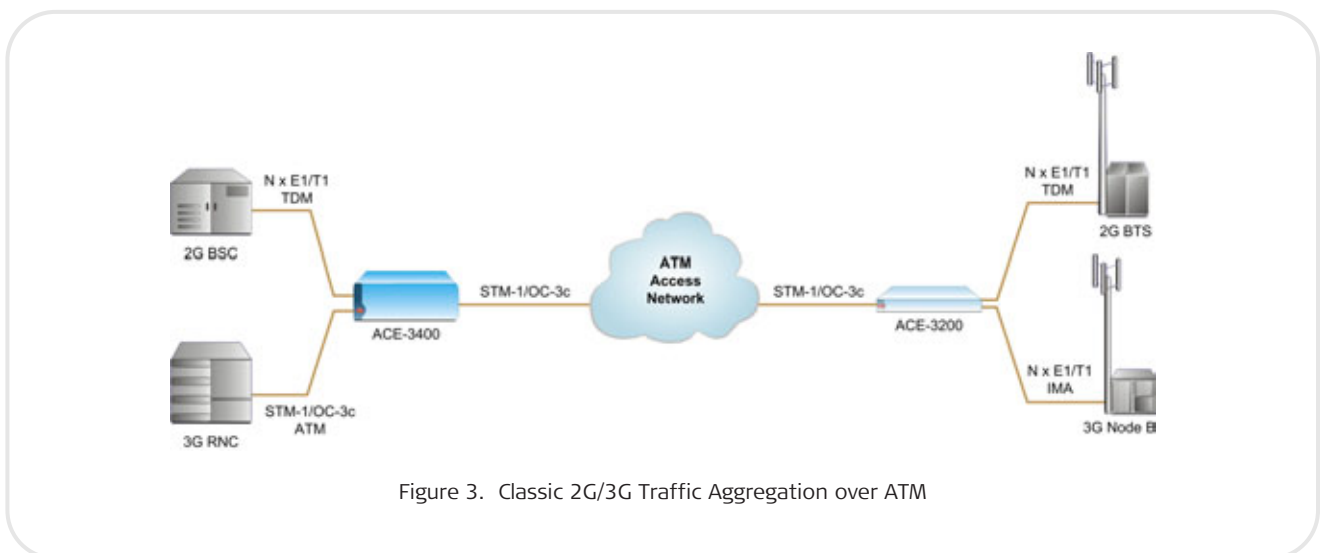 Storage: -20°–70°C (-4°–158°F)
Humidity: Up to 90%, non-condensing

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

ACE-3000 Product Family Comparison Table

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-3400
Aggregation Site Gateway

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 (Default= ATM network functionality):
  P1 ATM and PSN functionality, <u>not including</u> clock recovery over packet

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 (as 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:
  P1 PW over PSN functionality
  LDP LDP functionality

RAD
data communications
The Access Company