

ACE-3000 Family
ACE-3100
 Cell-Site Gateway

2G, 3G and HSDPA cellular traffic 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
- High accuracy clock recovery and distribution over PSN

Ace

ACE-3100 is a multiservice cellular-site 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-3100 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 BTS or Node B site, the unit converts and aggregates traffic using $N \times$ E1/T1, STM-1/OC-3c and Ethernet (10/100BaseT) interfaces.

ANY-SERVICE-ANY-PORT

The STM-1/OC-3c and 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-3100 to either ATM (UNI or IMA), CES or SAT over PSNs, depending on the originating traffic type.

RAD

data communications

The Access Company

ACE-3100

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ATM OVER PACKET CAPABILITIES

ACE-3100 allows up to 32 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-3100 allows single or multiple ATM cells to be encapsulated per frame.

TDM OVER PACKET CAPABILITIES

By allowing its four E1/T1 interfaces to work in TDM mode (user-selectable), ACE-3100 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 32 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.

LAN-TO-LAN BRIDGING

In addition to ATM and TDM backhauling, ACE-3100 supports LAN-to-LAN bridging to allow backhauling of Ethernet traffic originating from the cellular site/Node B.

USING PPP OVER ETHERNET (PPPOE) AND VIRTUAL MAC ADDRESSES

To allow HSDPA connectivity in a variety of DSL-based cellular backhaul applications, ACE-3100 initiates PPPoE sessions for acquiring IP addresses for all data, voice and management connections.

When working with multiple sessions of PPPoE or other dynamic entities, ACE-3100 provides virtual MAC addresses in addition to the standard ones that are provided for each physical port.

USING THE LABEL DISTRIBUTION PROTOCOL (LDP)

ACE-3100 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-3100 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-3100 allows establishing up to 128 VP and VC connections with full UNI/NNI VPI and VCI ranges.

ACE-3100 supports inverse multiplexing over ATM (IMA) versions 1.0 and 1.1, allowing users to define up to 4 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:

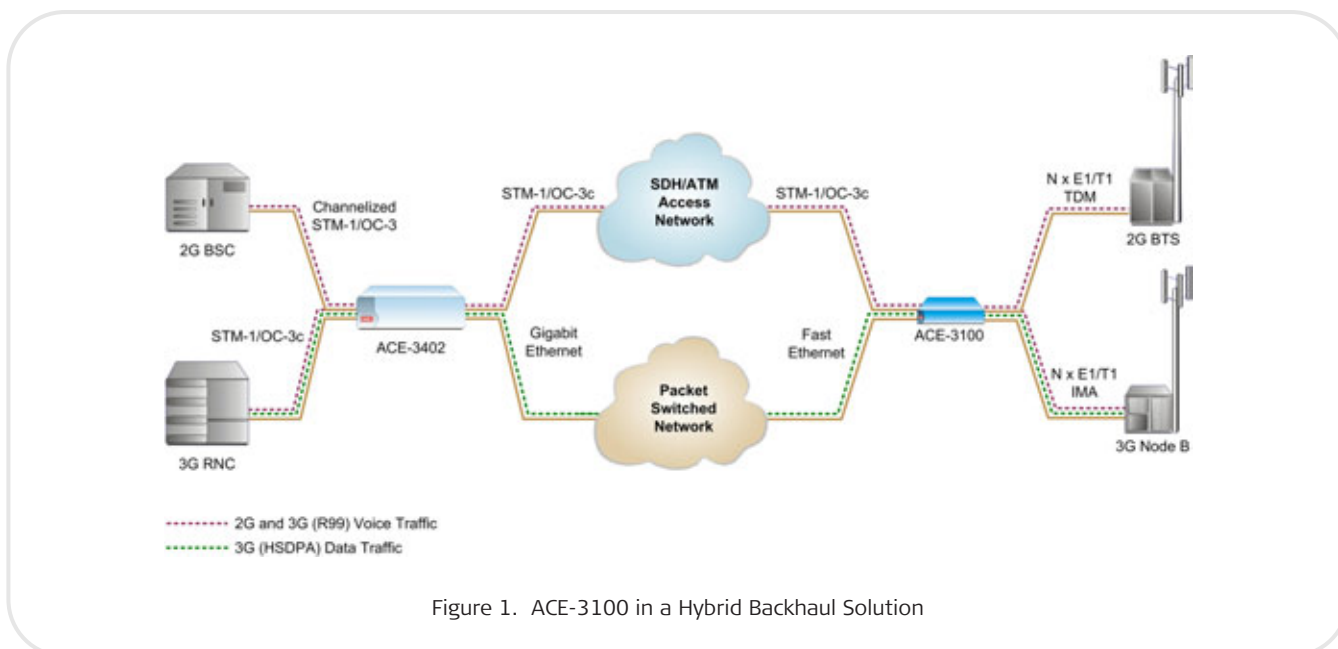


Figure 1. ACE-3100 in a Hybrid Backhaul Solution

- 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.

GENERIC ROUTING ENCAPSULATION (GRE)

ACE-3100 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.

CLOCK SYNCHRONIZATION

ACE-3100 provides robust clock synchronization and flexible timing modes, including:

- Clock recovery – a dedicated clock recovery module (optional) allows ACE-3100 to adaptively recover the clock from a source device that distributes the ATM clock over a packet-switched network, according to G.8261.

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

Note: For the clock recovery feature, ACE-3100 must be ordered with the "A" suffix. For more information, refer to the Ordering section.

STM-1/OC-3c INTERFACE

The STM-1/OC-3c fiber optic interface performs physical layer and ATM mapping into STM-1/OC-3c according to I.432. The SDH or SONET operation mode is user-selectable.

The two STM-1/OC-3c ports (if ordered) can be configured to work in automatic protection switching (APS) mode, to provide 1+1 protection according to G.841 Annex B.

When required, rate limiting can be applied to the STM-1/OC-3c traffic.

The STM-1/OC-3c interface utilizes industry-standard SFP (Small Form-Factor Pluggable) hot-swappable optical transceivers that allow using different fiber optic port types.

E1/T1 INTERFACE

ACE-3100 includes four E1 or T1 multiservice ports (if ordered) 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.

The E1 ports are available with balanced or unbalanced interfaces (via an optional RJ-45 to BNC adapter cable).

Note: ACE-3100 can be ordered without E1/T1 ports. For more information, refer to the Ordering section.

ETHERNET INTERFACE

ACE-3100 includes two Fast Ethernet (10/100BaseT) ports, used for pseudowire (PW) connectivity, user connections and inband management access.

The Ethernet ports are also used for out-of-band management in applications that do not utilize an Ethernet uplink.

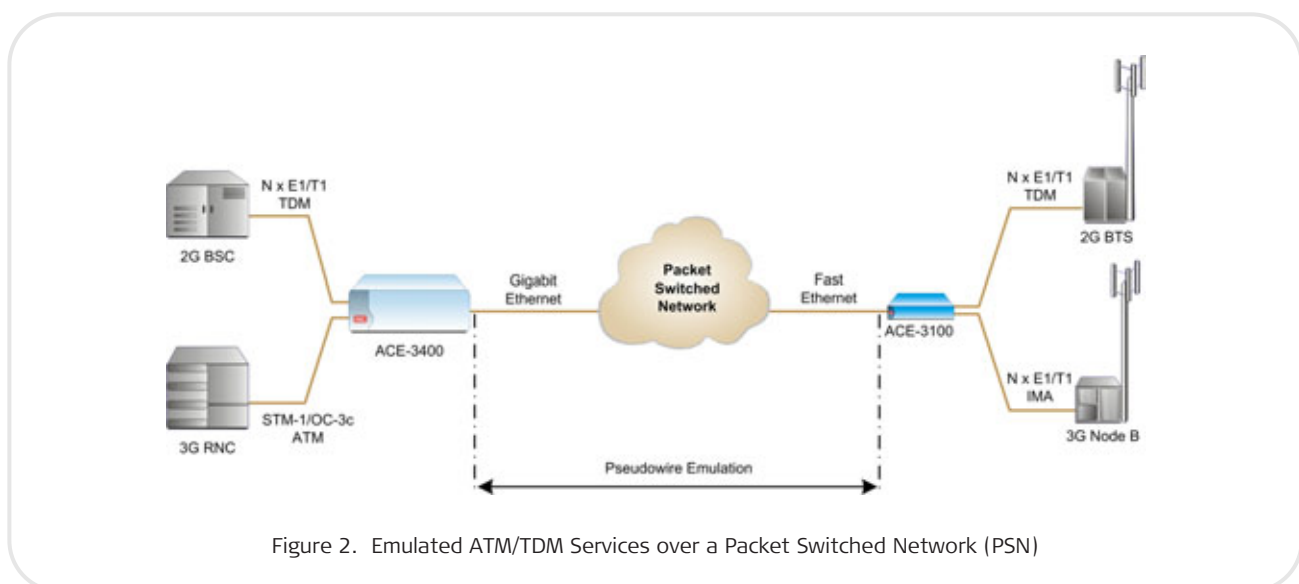


Figure 2. Emulated ATM/TDM Services over a Packet Switched Network (PSN)

ACE-3100

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The Ethernet interfaces can be ordered as electrical (RJ-45) or fiber optic ports. The fiber optic ports utilize hot-swappable Ethernet-compliant SFPs, which are identical in structure to the STM-1/OC-3c SFPs.

Note: For more information, refer to the SFP Transceivers data sheet and to the Ordering section.

OAM, DIAGNOSTICS AND MONITORING

Comprehensive monitoring and diagnostic capabilities include:

- Pseudowire connectivity check
- External and internal physical loopbacks on STM-1/OC-3c, E1 and T1 ports
- Cell test towards the ATM ports.

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, towards both the BTS/Node B side and the BSC/RNC side. 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 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-3100 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-3100 maintains a cyclic event log file that stores up to 2000 time-stamped events. In addition, an internal system log agent can send all reported events to a centralized repository or remote server.

MANAGEMENT

ACE-3100 can be managed using different access methods, via:

- Dedicated RS-232 or 10/100BaseT ports
- Dedicated VC defined on any ATM port
- 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.

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.

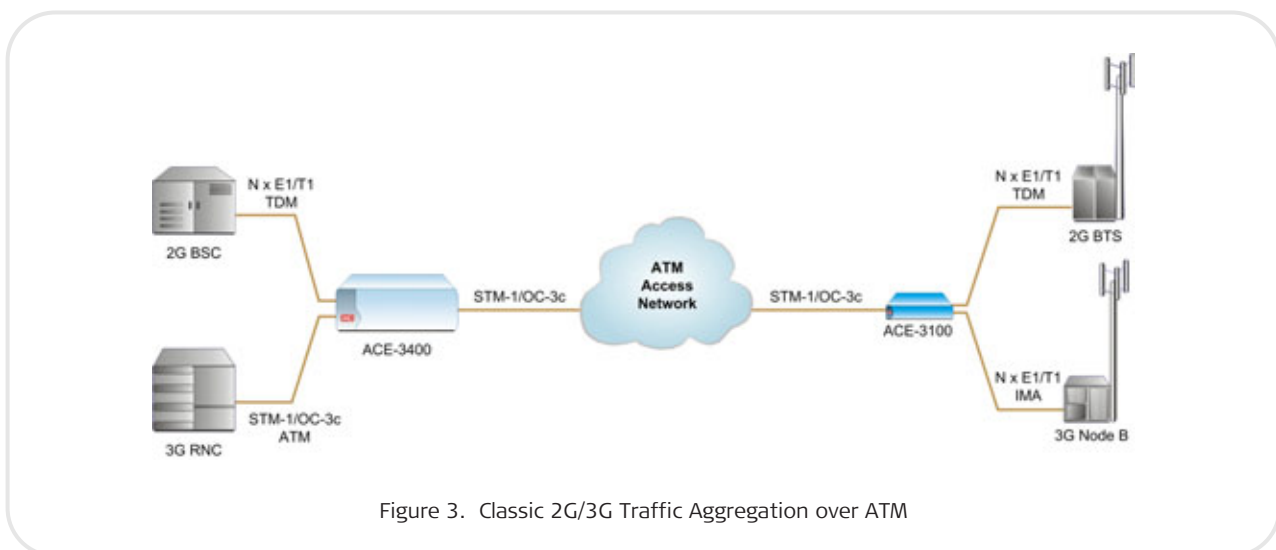


Figure 3. Classic 2G/3G Traffic Aggregation over ATM

ACE-3100 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-3100 via TFTP or XMODEM.

ADVANCED SECURITY FEATURES

ACE-3100 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-3100 supports SNMP version 3, providing secure access to the device by authenticating and encrypting packets transmitted over the network.

INDUSTRIALLY HARDENED UNIT

ACE-3100/H is an industrially-hardened version of the unit, capable of withstanding higher temperature environments.

Specifications

STM-1/OC-3c INTERFACE

Number of Ports
1 or 2 (as ordered)

Data Rate
155 Mbps

Operation Mode
UNI, SDH or SONET

Interface Type
Fiber optic, via Small Form-Factor Pluggable (SFP) transceiver

Note: For detailed specifications of the SFP transceivers supported by ACE-3100, refer to the SFP Transceivers data sheet. SFPs are ordered separately.

Jitter Performance
Output: according to G.825
Tolerance: according to G.823
Transfer: according to G.783

Compliance
Physical layer and ATM mapping into STM-1/OC-3c according to I.432
Automatic protection switching (APS) according to G.841 Annex B (1+1, bidirectional)

E1/T1 INTERFACE

Number of Ports
4 (as ordered)

Data Rate
E1: 2.048 Mbps
T1: 1.544 Mbps

Compliance
E1: G.703, G.704, G.732
T1: G.703, ANSI T1.403

Framing
E1: MF CRC-4
T1: ESF

Line Code
E1: HDB3
T1: B8ZS

Line Mode
E1: N/A
T1: CSU or DSU

Operation Mode
ATM UNI, ATM IMA or TDM

Jitter Performance
E1: Output and tolerance according to G.823, transfer according to G.705
T1: According to AT&T TR-62411

LIU Support
E1: Short haul
T1: N/A

CRC-6 Calculation
E1: N/A
T1: According to G.704

Line Impedance
E1: 120Ω (balanced), 75Ω (unbalanced, via an adapter cable)
T1: 100Ω (balanced)

Connector
E1/T1 balanced: RJ-45
E1 unbalanced: RJ-45, via an RJ-45 to BNC adapter cable

ETHERNET INTERFACE

Number of Ports
2

Type
10/100BaseT, full or half duplex, autonegotiation

Data Rate
10 Mbps, 100 Mbps

Max. Frame Size
1600 bytes

Compliance
IEEE 802.1Q
RFC 4717 (ATM over PSN)
Draft-ietf-pwe3-cell-transport
RFC 5086 (CES over PSN)
RFC 4553 (SAT over PSN)
Draft-ietf-pwe3-vccv
Draft-ietf-pwe3-bfd-base
Draft-ietf-pwe3-oam-msg-map
ITU G.8261 (PSN clock recovery)

Connector
RJ-45 or via SFP transceiver

Note: For more information, refer to the SFP Transceivers data sheet and to the Ordering section.

ACE-3100

Cell-Site Gateway

TERMINAL CONTROL INTERFACE

Type
RS-232/V.24 (DCE)

Bit Rate
9.6, 19.2, 38.4, 57.6 or 115.2 kbps
(user-selectable)

Connector
9-pin, D-type, female

GENERAL

LED Indicators

Chassis -

- PS (green): Power supply status
- RDY (green): Self-test result
- ALM (red): Alarm condition

STM-1/OC-3c ports -

- SYNC (green): Synchronization status
- ATM (green): ATM traffic indication

E1/T1 ports -

- SYNC (green): Physical layer synchronization status

Ethernet ports -

- LINK (green): Ethernet link status
- ACT (yellow): Ethernet traffic indication

Fans

One internal cooling fan in the industrially hardened unit (ACE-3100/H)

Power

AC: 100 to 240 VAC ($\pm 10\%$), 50/60 Hz
DC: -48 VDC nominal (-41 to -71 VDC)

Power Consumption

24W max

Physical

Height: 4.37 cm (1.7 in)
Width: 21.59 cm (8.5 in)
Depth: 30.0 cm (11.8 in)
Weight: 2.4 kg (5.29 lb)

Environment

Temperature: ACE-3100: 0° to 50°C
(32° to 122°F)
ACE-3100/H: -20° to 65°C
(-4° to 149°F)

Storage: -20° to 70°C (-4° to 158°F)

Humidity: Up to 90%, non-condensing

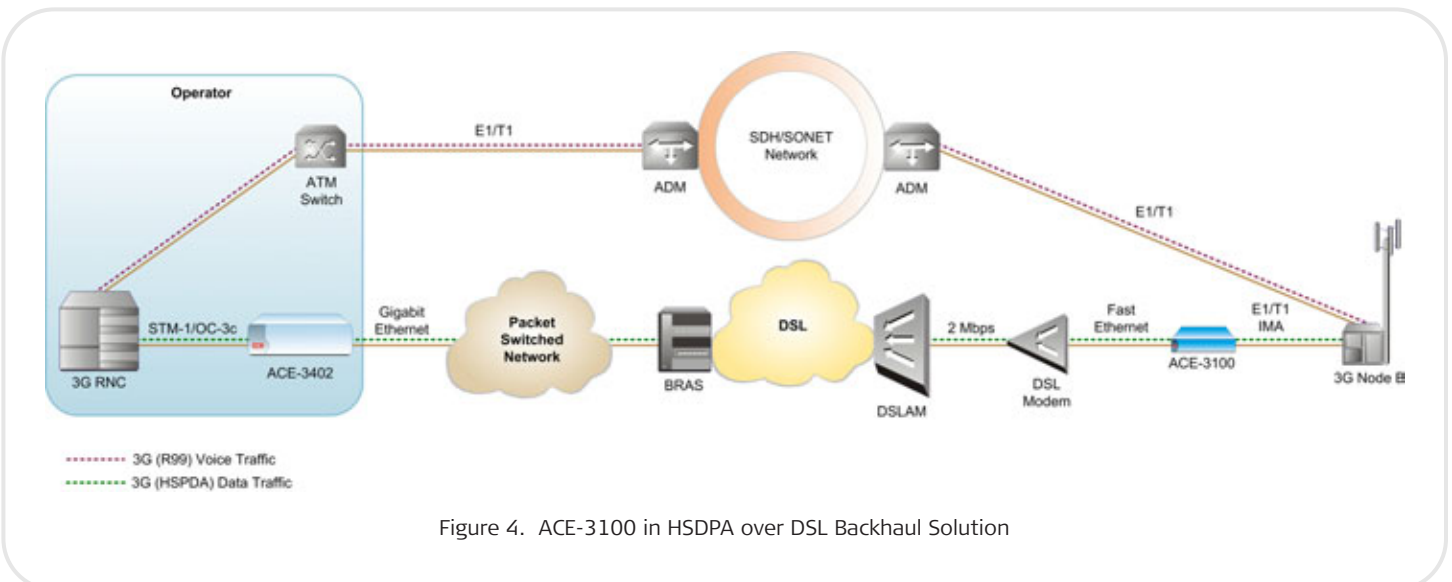






Figure 4. ACE-3100 in HSDPA over DSL Backhaul Solution

ACE-3000 Cell Site Gateway Comparison Table

Features				
	ACE-3205	ACE-3105	ACE-3200	ACE-3100
E1/T1 traffic aggregation	✓	✓	✓	✓
STM-1/OC-3c traffic aggregation			✓	✓
E1/T1 ports	8 or 16, built-in	0 or 4, built-in	8 or 16, built-in	0 or 4, built-in
ATM-155 ports	None	None	0 or 2, built-in	1 or 2, built-in
ADSL2+ port	2	1		
SHDSL ports	4	4		
NTR clock recovery	✓	✓		
SFPs for ATM-155 ports			✓	✓
2 Fast Ethernet ports for PSN traffic and/or inband management	✓	✓	✓	✓
SFPs for FE ports	✓ (optional)		✓ (optional)	✓ (optional)
PSN clock distribution	✓	✓	✓	✓
PSN clock recovery	✓	✓	✓	✓
Cell-site gateway	✓	✓	✓	✓
PPPoE functionality	✓	✓	✓	✓
Abis optimization	✓	✓	✓	
LAN-to-LAN bridging	✓	✓	✓	✓
Max. ATM VCCs	128	128	128	128
Max. data PW links	32	8	32	32
Max. remote PSN peers	32	32	32	32
Power supply	Single/dual, fixed	Single wide range, fixed	Single/dual, fixed	Single, fixed
Physical width	17.3"	8.5"	17.3"	8.5"
Physical height	1U	1U	1U	1U

* OOB = Out-of-band

ACE-3100

Cell-Site Gateway

Ordering

ACE-3100/#/@/\$/&/*/~/~/?

Legend

Power supply type:

AC Single 100 to 240 VAC

DC Single -48/-60 VDC

@ Number of STM-1/OC-3c ports:

S1 One STM-1/OC-3c port

S2 Two STM-1/OC-3c ports

Note: For interface redundancy (APS), order two ports. **S1** is available only if no E1/T1 ports are ordered (see below). **S2** is available only if four E1/T1 ports are ordered.

Note: SFP transceivers for the STM-1/OC-3c ports are ordered separately. For more information, refer to *Optional Accessories* and to the *SFP Transceivers* data sheet.

\$ Number of E1/T1 ports (Default=E1/T1 ports):

4E1 Four E1 ports

4T1 Four T1 ports

Note: Unbalanced E1 interface is provided via an adapter cable, which can be ordered separately (see *CBL-RJ45/2BNC/E1/X* in *Optional Accessories*).

& Type of Ethernet ports (Default=two built-in electrical RJ-45 ports):

SE Two empty SFP cages

Note: Fiber optic Ethernet ports require SFP transceivers that are fitted into the empty cages.

* The required **software** license pack (Default= ATM network functionality):

P1 ATM and PSN functionality, not including clock recovery over packet

P2 Complete functionality, including clock recovery over packet

~ Optional clock recovery **hardware** component:

A Clock recovery hardware component

Note: For activating the clock recovery hardware, the **P2** software license pack is required. It is possible, however, to order the hardware only, for future software upgrade.

? Enclosure type:

H Industrially hardened enclosure

Note: By default, ACE-3100 is supplied with a regular enclosure. The /H version requires temperature-hardened SFP transceivers.

SUPPLIED ACCESSORIES

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

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

Note: For the complete list of SFPs, refer to the *SFP Transceivers* data sheet. It is strongly recommended to order ACE-3100 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-3100 units using non-RAD SFPs.

CBL-LC/#/&

LC to SC/ST/FC fiber optic converter cable for operation with multimode or single mode fibers. The cable is 2m (6.5 ft) long.

Connector type:

SC SC connector

ST ST connector

FC FC connector

& Fiber type:

MM Multimode fiber

SM Single mode fiber

CBL-DB9F-DB9M-STR

Standard DB-9 to DB-9 control port cable

CBL-RJ45/2BNC/E1/X

Interface adapter for converting a balanced E1 RJ-45 connector to a pair of BNC unbalanced connectors (if unbalanced E1 interface is ordered)

RM-35/@

Hardware kit for mounting one or two ACE-3100 units into a 19" rack

@ Rack mounting kit type:

P1 Fitting one unit

P2 Fitting two units

WM-35

Hardware kit for wall-mounting one unit

ACE-3100-SW/!

Software upgrade pack

! Software pack type:

P1 PW over PSN functionality

P2 Clock recovery functionality

LDP LDP functionality

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