Lucent Technologies
Bell Labs Innovations

WaveStar™ ADM 16/1

The 2.5 Gbps SDH Multiplexer and Transport System

Lucent Technologies, leader in optical networking, offers the industry's widest range of high-quality communications systems. Intelligent multiplexers, flexible high-capacity transport systems and associated management systems form the building blocks of today's networks. Using these building blocks, customers are provided with equipment to meet their requirements for services, capacity and quality. The WaveStar™ ADM 16/1, is a member of the WaveStar family of Lucent Technologies optical networking products.

INTRODUCTION

The WaveStar ADM 16/1 is a high-capacity intelligent multiplexer and transport system able to multiplex PDH, SDH, SONET and EtherNet bit rates to higher levels up to 2.5 Gbps (STM-16). Because of this wide range in capacity, this system is a key element in building efficient and flexible networks.

The main strengths of the product are:

· Massive add/drop capacity directly from the STM-16 level e.g. 504 x E1, 96 x DS-3, 64 x 10/100 BASE-T, 32 x STM-1 etc.

· Compact design (single row).

· Easy installation & maintenance.

· Flexibility in applications.

· Advanced protection mechanisms allowing state-of-the-art SDH network design.

These outstanding features make the WaveStar ADM 16/1 one of the most cost-effective future-proof network elements. The system can be deployed with other Lucent Technologies optical networking products, making the WaveStar ADM 16/1 one of the main building blocks of future SDH networks.

The WaveStar ADM 16/1 is controlled and managed by Lucent Technologies Integrated Transport Management (ITM), a user-friendly network and element level management system with in-service upgrade facilities.
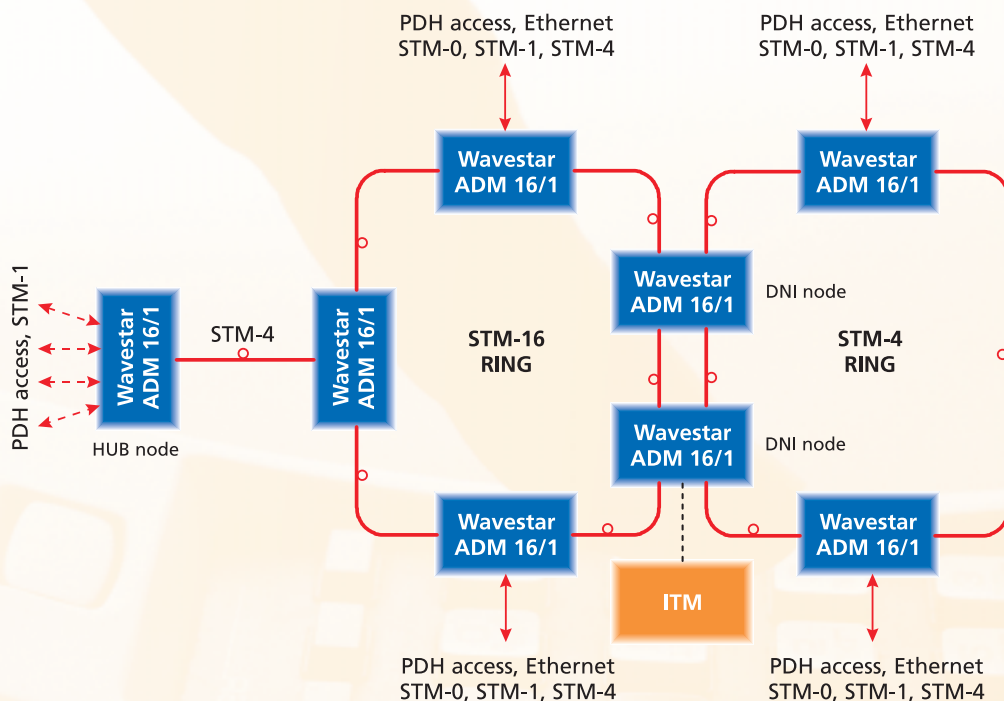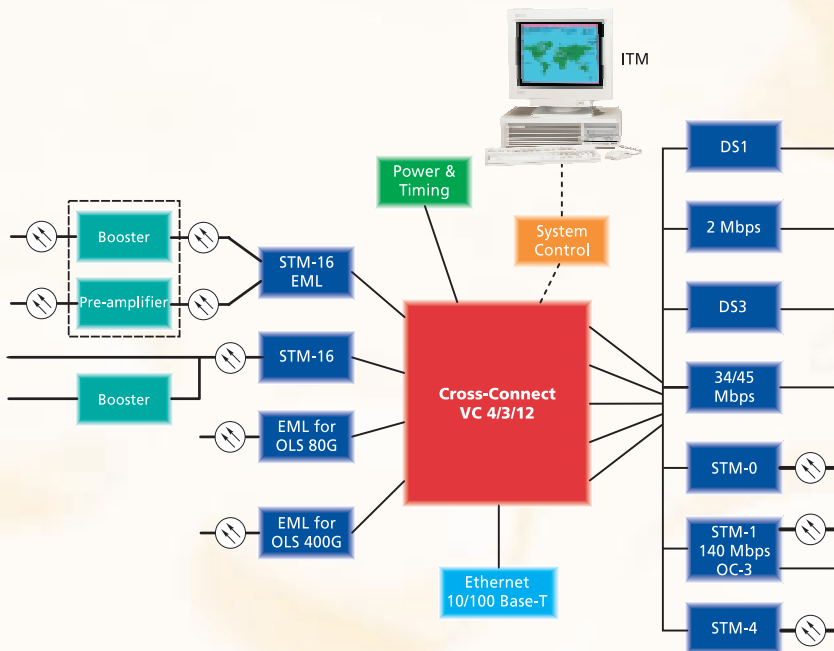

Figure 1: WaveStar ADM 16/1 Network Application

Figure 2: Basic Architecture of the WaveStar ADM 16/1

FEATURES AND BENEFITS

One of the main features of the WaveStar ADM 16/1 is the ability to add/drop and flexibly cross-connect directly from the STM-16 level. Signals that can be connected are: 1.5 (DS-1), 2 (E1), 34 (E3), 45 (DS-3), 51.8 (STM-0), 140 (E4), 155 (STM-1/OC-3) and 622 (STM-4/OC-12) Mbps. Unique to the system is that it supports the advanced protection mechanisms MS-SPRing, VC-SNC/N and Dual Node Interconnection as well as the conventional MSP. To reduce overall installation and test time, pre-fabricated cabling is used.

Summary of main features and benefits:

· Protection mechanisms
   supported: MS-SPRing,
   SNC/N, MSP and DNI.
· VC-4, VC-3 and VC-12 cross-
   connect capability.

· Single product platform for
   STM-16 and STM-4
   applications.

· Single network element for
   interconnection of STM-16,
   STM-4 and STM-1 rings
· TransLAN™-functionality
   based on ML-PPP at 8 x
   10/100 BASE-T for each
   circuit pack.
· The system architecture allows
   a broad range of applications:
   add/drop, terminal, local
   cross-connect.
· Support of ETSI
   Synchronization Status
   Message (SSM) protocol.
· AU-3 / TU-3 to AU-4
   conversion.
· Full Time Slot Assignment
   (TSA) for port interface signals
   and Time Slot Inter-change
   (TSI) for through channels.
· Support of PDH signals: E1, E3
   and E4.
· Support of SONET Signals:
   DS-1, DS-3, OC-3 & OC-12.

Figure 3: ADM 16/1 open shelf

Figure 4: WaveStar ADM 16/1 Shelf in rack

- Support of SDH signals: STM-0, STM-1, STM-4 & STM-16.
- Mixing of various payload types.
- In-shelf optical booster or booster/pre-amplifier.
- Remote maintenance and management by Lucent Technologies ITM network management system.
- Compact self-supporting single shelf design and easy installation.
- Duplication of critical circuit racks in the shelf.

APPLICATIONS

The WaveStar ADM 16/1 is a single product platform for STM-16, STM-4 and STM-1 applications. Based on its flexibility with regard to interface units and cross-connect capabilities, the system supports applications for bandwidth access, service-on-demand and network protection.

The WaveStar ADM 16/1 can be applied in two tiers of the network: access & regional networks. The system allows for growth and changing service needs by supporting in-service conversions and upgrades. Inherent to its basic design, the WaveStar ADM 16/1 operates equally well within fully synchronous as well as asynchronous environments and provides a flexible link between the two.

The WaveStar ADM 16/1 supports a large variety of configurations for various network applications (see Figure 1):
- Terminal for point-to-point connections.
- Ring add/drop multiplexer or STM-4 and 16 rings.
- Access mux to DWDM, 10G, cross-connect & SONET.
- Hub mux of STM-1 and STM-4 rings to STM-16.
- Grooming of lower-order VCs.
- PDH front-end for digital cross-connect systems.
- Single ADM 16/1 for interconnection of STM-16, STM-4 and STM-1 rings (Ring Closure on tributary side).
- TransLAN-functionality for 10/100 BASE-T Ethernet signals.

Traffic can be protected by:
- Path protection: VC-n SNC/N.
- Section protection:
  - MS-SPRing, MSP.
- Dual Node Interconnection (DNI).

PRODUCT DESCRIPTION

This flexible product resulted from a big step forward in technology. Due to the high level of integration at the circuit pack level, it is possible to add/drop up to 504 x E1/DS1, 48 x E3, 64 x 10/100 BASE-T, 96 x DS3/STM-0, 32 x E4/STM-1/OC-3 or 8 x STM-4/OC-12 using only one subrack. One rack with a height of 2400 and 2600 mm, can accommodate two subracks. The heart of the WaveStar ADM 16/1 system is the Cross-Connect, which has connections with all interface cards (see Figure 2). The Cross-Connect is the core of the system.

It enables the flexible routing of VC-4, VC-3 and VC-12 between:
- Aggregate and aggregate.
- Aggregate and tributary.
- Tributary and tributary.

To contribute to overall system reliability and availability, the Cross-Connect can be protected by an accompanying unit. If required, interface redundancy can be provided. The flexible design of the WaveStar ADM 16/1 makes it possible to place interface units in almost any interface slot position of the subrack. The System Controller (SC) unit controls all major functions of the WaveStar ADM 16/1 and communicates with the centralized management system (ITM). Communication is established via the Data Communication Channels within the STM-N section overhead signals or via one of the Q-interfaces of the system. The ITM-SC manages the WaveStar ADM 16/1 at the element level and the ITM-NM can manage the system at the network level. The ITM-Craft Interface Terminal (ITM-CIT) is used for managing small networks and for maintenance purposes.

The system is synchronized by an optionally duplicated Power and Timing generator circuit pack. Both 2048-kHz and 2048-kbps synchronization interfaces are supported. References can be selected by and prioritized from among the synchronization interfaces, STM-N interfaces and 2-Mbps tributary interfaces. Reference protection is possible by enabling the ETS 300 417-6 compliant synchronization message protocol which uses the S1-byte information (SSM support).

Technical Data

Interfaces

Compliant with the ITU-T Recommendations:

General	G.707 (includes G.708 and G.709)
Equipment	G.781, G.782, G.783, G.784, G.813
Physical interface	G.957 & G.691 for optics and G.703 for electrical interfaces.
Performance requirements	G.823, G.825, G.826
Mapping Structure	AU4, AU-3 to TU-3, TU-3 & TU-12 (TU-11), VC-4, VC-3 and VC-12

Electrical Interfaces

1.5 Mbps a-synchronous/byte-synchronous	63 (DS-1) interfaces per circuit pack
2 Mbps a-synchronous/byte-synchronous	63 (E1) interfaces per circuit pack
34 / 45-Mbps and 45 Mbps a-synchronous	12 (E3/DS-3) interfaces per circuit pack
140 Mbps/STM-1 electrical intra-station	4 (E4/STM-1) interfaces per circuit pack

Optical Interfaces

Ethernet 10/100 BASE-T & (ML-PPP) 8 interfaces per circuit pack	
STM-0 (51840 kbps) interface	12 x interfaces per circuit pack
STM-1/OC-3 (155520 kbps) interface	4 x (S-1.1 & L-1.2) interfaces per circuit pack
STM-4/OC-12 (622080 kbps) interface	1 x (S-4.1 & L-4.2) interface per circuit pack
STM-16 (2 488 320 kbps) interfaces	1 x (L-16.1, L-16.2 & L-16.3) interface per circuit pack
Optical Booster/Pre-amplifier	1 x (U-16.2/3) interface per circuit pack
Optical Booster	1 x (V-16.2/3) interface per circuit pack
OLS 80G (DWDM) interworking	1 x interface per circuit pack, 16 different wavelengths (1549 - 1559 nm)
OLS 400G (DWDM) Interworking	1x interface per circuit pack, 80 different wavelengths (1530 - 1565 nm)

Data interfaces:

Six user selectable datachannels	User can select out of E1, E2, F1, F2 and NU bytes (4xG.703 and 2xV.11)
Standard External clock interfaces	Two programmable Input/Output station clock interfaces: 2048 kHz (G703.10) or 2048 kbps (G703.6), 75 or 120 Ω

Bandwidth Management

System capacity:	VC-12: 504 x 1.5 Mbps, 504 x 2 Mbps, VC-3: 48 x 34 Mbps, 96 x 45 Mbps, 96 x STM-0, VC-4: 32 x 140 Mbps, 32 x STM-1 or 8 x STM-4

Complete VC-4 Cross-connecting
Higher Order Cross-connect size 64 x 64 VC-4
Lower Order Cross-connect currently 16x16 and 32 x 32 VC-4
Fixed Cross-Connect for 0x1 and 0x2 Terminal Applications
Uni & Bi-directional Cross-connecting
Broadcast connections type VC-n
VC-4-4c Continuos Concatenation
Higher Order and Lower Order broadcast functionality 1:N (N£9)

Protection access (LPT) on	MS-SPRing
Scalable MS-SPRing	
Drop & Continue	

Performance requirements

Jitter on STM-N interfaces	G.813, G.825
Jitter on PDH interfaces	G.823, G.783
Error Performance	G.826
Performance monitoring	G.784, G.826

Performance Monitorings

Trail Termination Points	Equipment
VC-12	for each DS1 and E1 port
VC-3	for each DS3, E3 and STM-0 interfaces
VC-4	for each E4 interface and on the Cross-Connect
MS-0	Multiplex Section on the STM-0 interfaces
MS-1	Multiplex Section on the STM-1 interfaces
MS-4	Multiplex Section on the STM-4 interfaces
RS-16	Regenerator Section of the 2.5 Gbps interfaces
MS-16	Multiplex Section of the 2.5 Gbps interfaces
Non-Intrusive Monitoring	on VC-4, VC-3 & VC-12 trails & VC- 4- 4c
Severity setting for alarms	on each TP instance
Enhancements	compliant 24 hr counters Unavailable period storage
History bin:	every 15 minutes (16 bins + 4 hour storage time)
	Every 24 hours (1 bin + 1 day storage time)
Threshold reports	

Supervision and alarms

Plug-in circuit pack Indication	LED continuously on: diagnostic error
	LED flashing: transmission signal error
System Controller indicators/buttons:	
LED indicators	Power, Prompt and Deferred alarm
	Abnormal, Info, Suppressed, UseCIT,
	and Disconnect
Push-buttons	Suppress, Disconnect
CIT connector F-interfaces	V.10/RS-232
Station alarm interface outputs	Floating
Miscellaneous Discretes	8 inputs and 8 outputs
Q-LAN interface	to connect to EMS or other Network
	Elements

Protection and redundancy

Tributary Level Redundancy:
1:N Equipment protection on 1.5 Mbps & 2 Mbps Interface circuit packs (N= max. 8)
1+1 Equipment protection on 34/45 Mbps, 45 Mbps Interface circuit packs
1:N Equipment protection on 140/STM1e (N= max. 4)
1+1 Equipment protection on Cross-connect circuit pack and Power & Timing circuit pack

SNC/N protection:
      VC-4 level
      VC-12, VC-3 level
      Programmable hold-off times

Dual Node Interworking (DNI):
      between two MS-SPRings
      between MS-SPRing and LO-SNC protected SubNetworks
      Support of VC-4-4c Concatenation

MSP:
      1+1 MSP on optical STM-0 (G.783 Annex B), STM-1 (G.783 Annex A & B) and
      STM-4 (G.783 Annex A & B) tributary Interface signals
      1+1 MSP on optical Line Interface circuit packs STM-16 (G.783 Annex A)

MS-SPRing:
      MS-SPRing in two fiber ring Add/Drop applications
      Selective MS-SPRing

Cascading of protection schemes in one Network Element
Programmable hold-off times
Maximum of 50 ms switching time for all protection mechanisms

Timing and Synchronization

Built-in oscillator Standard	Accuracy 4.6 ppm acc.G.813 option 1
Built-in oscillator Stratum-3	Accuracy 4.6 ppm acc.G813 option 1, Stability 0.37 ppm/ first 24 hours
Timing modes:	
Free running mode	Accuracy 4.6 ppm
Hold-over mode	
Locked mode with reference to- one of the external sync. inputs	
	- one of the 2 Mbps tributary inputs
	- one of the STM-N inputs
Automatic reference signal switching	Compliant with ETSI ETS 300 417-6
Support of Synchronization Status Message	on STM-N interfaces, 2 Mbps and at 2048 kbps external clock interface
Retiming	on 2 Mbps

Network Management

Fully manageable by ITM-NM and ITM-SC	
Local Workstation (ITM-CIT) via RJ-45 connections	V.10(RS-232 compatible) / F-interface
Access to Embedded Communication Channels via in-station Q-LAN interface	G.773-CLNS1 / 10-Base-T and 10-Base-2 Interfaces
ITM-CIT for small network management	CIT-Q connector / V.10

Physical design

Subrack dimensions	750 x 500 x 545 mm (H x W x D) In accordance with ETSI
Recommendation	ETS 300 119-4 for wide racks
Rack Types	2000 mm Earthquake proof (zone 4) 2200 mm ETSI (D700) rack 2600 mm ETSI (D700) rack
Connectors-Optical	Standard universal build-out optical connector (FC/PC, SC) on the STM-4 and STM-16 interfaces LC connectors on STM-0 and LC or SC connectors on STM-1 interfaces
Connectors-Electrical	Choice out of: SUB-D, DIN Coax, APT Coax, Modular Jack, BT43, ISC 1.5/5.6
Connectors-Ethernet	RJ-45
Station power input (Battery)	-48 or -60 V DC (Range: -40,5. .. -72 V DC)
Power Consumption	310 Watt for an average configuration

Environmental conditions

Acc. ETSI Requirement Class	3.1 Environment:	3.1 extended (3.1E)
	Temperature range	Humidity
Normal operation	+5°C to + 45°C	up to 90%
Short term operation	0°C to + 50°C	up to 80%*
Storage-	25°C to + 55°C	up to 100%

*Short term conditions last at most 72 hours per year during at most 15 days

EMC

EC Declaration of Conformity per ETS300 386-1 & -2: "EMC requirements for Public Telecommunication Network Equipment" which covers:

Radiated emission	EN 55022
Conducted emission	EN 55022
Electro-static discharge	IEC 801-2,3,4,
Radiated immunity	IEC 1000-4-x series
Conducted immunity:	
- Electrical fast transients	IEC 1000-4-x series
- Surges	IEC 1000-4-x series
- Continuous wave	IEC 1000-4-x series
Compliant with LVD	EN 60950

To learn more about our comprehensive portfolio and the new WaveStar™ ONG Series, please contact your Lucent Technologies Sales Representative or call +33 49 23 83 333 Visit our web site at http://www.lucent-optical.com

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