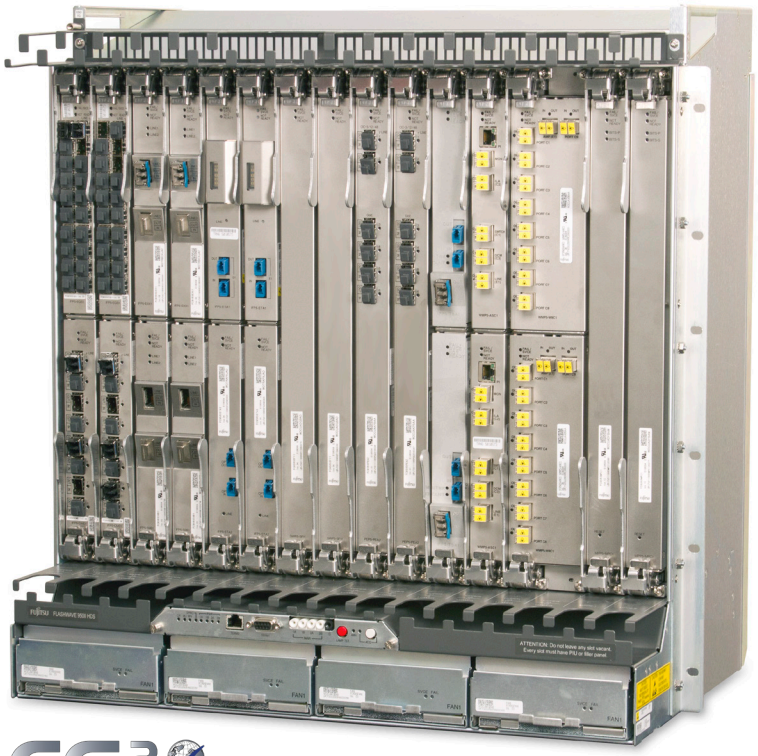
FUJITSU

Data Sheet

FLASHWAVE® 9500 Packet Optical Networking Platform

As the communications world transforms, demand for bandwidth and high-quality services is escalating. Residential and business customers have rising expectations and are more selective.

This shift in expectations challenges service providers to migrate to a packet optical infrastructure, enabling diverse, bandwidth-intensive services. Operators must also maintain existing revenue-bearing services efficiently, as the transition to packet optical networking takes shape. The underlying network architecture must therefore be highly reliable, manageable, and scalable to keep the lifetime cost below the revenue curve. The FLASHWAVE 9500 platform addresses these challenges using an innovative packet optical design.



CE 2.0 MEF CERTIFIED

Modular and Flexible

The FLASHWAVE 9500 Packet ONP delivers ROADM, OTN, Ethernet and TDM technologies for deploying optical ring, mesh, and linear add/drop topologies with 99.999% service availability. All plug-in cards, fans and chassis power distribution are designed for resilient operation with no single point of failure. The modular architecture enables carriers to select configurations for specific applications, whether ROADM-only, aggregation-only, or combinations of service aggregation and WDM on a single network element. The FLASHWAVE 9500 system reduces footprint, capital/operational expenses, and complexity by collapsing multiple technologies and network layers into a single, easy-to-use, modular platform.

Two Chassis Options

Two chassis options are available: the HDS for 23-inch racks and the SDS for 19-inch racks, where each model can be expanded to multiple chassis sharing the same node ID. This offers a highly modular and scalable system for packet optical networking. The internal packet and TDM switch capability maximizes service delivery efficiency through dedicated centralized packet, OTN and TDM switch fabrics.

The centralized fully redundant switch fabric provides any-to-any switching capability and aggregation for any service to any port on the platform. The switch fabric offers dedicated 100% OTN, along with 100% packet, 100% SONET/SDH operation, and the ability for interworking. This architecture minimizes stranded port capacity, allowing efficient modular scaling for interconnection between the FLASHWAVE 9500 platform and expensive core router interfaces. As a result, the number of ports needed for a given application is significantly reduced, lowering capex and minimizing first capital cost, while protecting the equipment investment.

Applications	Technologies
• Bandwidth optimization	• OTN
• Enterprise services	• 100G–1TB transport
• Mobile backhaul	• High-density ROADM
• OTN transport	• EoX gateway
• DCS replacement	• MEF Carrier Ethernet
• Multiservice provisioning	• Coherent Optical Networking
	• CDC ROADM

Features and Specifications

System Capacity

- 960 Gbps non-blocking SONET/SDH grooming
- 1.2 Tbps non-blocking packet grooming
- 2.4 Tbps OTN switch fabric w/ODU0, 1, 2, 2e, 3, 4 and ODU flex grooming
- 20 Gbps non-blocking VT grooming
- 8 degrees of ROADM connectivity/12 degrees asymmetric
- 88 x 10 Gbps/40 Gbps/100 Gbps wavelengths per ROADM degree
- Universal interface slots
  - SDS shelf: 16
  - HDS shelf: 24

Interfaces

100G (CFP)	LR4, SR10, 10x10-2 km, ER4
100G (CFP4)	LR4, SR4*, ER4*
40G (CFP)	LR4, SR4*, FR
10G (XFP)	10G (neg chirp) full band tunable
10G (SFP+)	SR1/LR, IR2/ER, LR2/ZR
10 GbE (XFP)	10 GbE Base-LR/LW, 10 GbE Base-ER/EW, 10 GbE Base-ZR, CWDM, DWDM
Gigabit Ethernet (SFP)	1000Base-T, 1000Base-SX, 1000Base-LX, 1000Base-ZX, CWDM
Fast Ethernet (SFP)	10Base-T, 100BaseTX, 100Base-FX, 100Base-LX
OC-768/STM-256	VSR
OC-192/STM-64 (XFP)	SR-1, IR-2 , LR-2, CWDM, DWDM
OC-48/STM-16 (SFP)	SR-1, IR-1, LR-1, LR-2, CWDM, DWDM
OC-12/STM-4 (SFP)	SR-1, IR-1, LR-1, LR-2
OC-3/STM-1 (SFP)	SR-1, IR-1, LR-1, LR-2
10G Fibre Channel (XFP)	FC12LL, FC12CBL
1G/2G/4G Fibre Channel (SFP)	FC1SN, FC2SN, FC4SN, FC1LC, FC2LC, FC4LC
OTU1 (SFP)	SR-1, IR-2 , LR-2, CWDM
OTU2, 2e (XFP)	SR-1, IR-2 , LR-2, CWDM, DWDM

** Planned for future availability*

Fabric Support

- Sub-wavelength (electronic) universal switch fabric:
  - SDS shelf 640 Gbps SONET/SDH + 800 Gbps packet + 1.6 Tbps OTN
  - HDS shelf 960 Gbps SONET/SDH + 1.2 Tbps packet + 2.4 Tbps OTN
- Wavelength (photonic) fabric:
  - SDS/HDS WSS-based 44 or 88 channels per direction
- Optional VT switch fabric
  - SDS/HDS 20 Gbps non-blocking VT grooming with full TSI

Number of Service Interfaces

Interface	Ports/ Card	SDS Ports/Shelf	HDS Ports/Shelf
100G/OTU4	2	16	24
40G/OTU3	1	3	6
OTU2	1	16	24
OC-768/STM-256	1	8	12
OC-192/STM-64/10 GbE 88-channel NBO	1	12	24
OC-192/STM-64/10 GbE/OTU2, 2e 88-channel NBO	10	80	120
OC-192/STM-64/10 GbE	2	24	48
OC-3/OC-12/OC-48; STM-1/STM-4/STM-16 Gigabit Ethernet	8	96	192
Fast Ethernet; Gigabit Ethernet	20	240	480
10G Fibre Channel	1	16	24
4G Fibre Channel	6	96	144
1G/2G Fibre Channel	12	192	288
OTU2, 2e, OC-192, STM-64, 10 GbE, 10 FC (OTN mapped)	4	64	96
GbE, OC-3, OC-12, STM-1, STM-4 (OTN mapped)	20	320	480
OC-48, STM-16, OTU1 (OTN mapped)	10	160	240

FLASHWAVE 9500 Packet ONP Family Shelf Options

	HDS	SDS Rear Access	SDS Front Access
Common system software	✓	✓	✓
Common MPU hardware	✓	✓	✓
Common interface modules	✓	✓	✓
19" rack mountable		✓	✓
23" rack mountable	✓	✓	✓
1.6 Tbps universal switch fabric		✓	✓
2.4 Tbps universal switch fabric	✓	✓	✓
Number of interface slots	24	16	16

Synchronization

- DS1/E1 Building Integrated Timing Supply (BITS) primary and secondary clock input/output
- Line timing
- Synchronization Status Messaging (SSM)
- Internal Stratum 3 timing source

Features and Specifications

Network/Client Protection Architectures

- Optical Channel Dedicated Protection Ring (OCh-DPRING)
- Optical Y-cable rack- and kit-mount options
- SONET/SDH protection architectures (1+1, UPSR, SNCP, BLSR, MSPRING)
- ITU-T G.8031 Ethernet Protection Switching (EPS) over any topology
- ITU-T G.8032 Ethernet Protection Switching
- IEEE 802.3ad Ethernet Link Aggregation (LAG)
- ITU G.873.1 OTN protection (SNC/I, SNC/S, SNC/Ne)

Equipment Protection

- Universal fabric 1:1
- Management complex 1:1
- Interface card 1:1

ROADM Functions

- 8-degree ROADM configuration in a single shelf or distributed across multiple shelves (split-hub ROADM)
- Asymmetric multi-TID 12-degree hub support
- 8-degree x 88-channel Wavelength Selectable Switch (WSS)
- Colorless, directionless, contentionless (CDC) ROADM
- Multihaul amplifiers plus Raman
- Operator-selectable ITU-T wavelengths support 50 GHz ITU-T grid
- ROADM full-band tunable interface units
  - 10G universal transponder
  - 40G transponder
  - 12-port multirate muxponder
  - 100G transponder/muxponder
- 10G/40G/100G wavelength support
- Per-channel optical channel monitoring
- Narrowband direct connect
- SONET SDCC and OTN GCC support
- OCh-DPRING optical protection

Operations

- TL-1
- SNMP
- NETSMART 500 Element Manager
- NETSMART 1500 Management System
- NETSMART 2000 Design and Planning Tool
- TCP/IP to OSI operations gateway
- Software download and remote memory backup/restore
- IPv4 and IPv6
- OSMINE support

Control Plane

- MCN/SCN separation
- LMP discovery
- RSVP-TE signaling
- Centralized topology and path computation
- Unprotected and 1+1 protected services

Ethernet Functions

- Connection-based forwarding
  - IEEE 802.3 Ethernet
  - Static forwarding based on IEEE 802.1q and 802.1ad VLAN tags
  - Single and dual VLAN tag push, pop and translation
  - In-band management VLAN
  - Per-VLAN MTU with jumbo frame support
- Flow-based traffic management
  - Provisioned service delimiters: port, C-VLAN, S-VLAN, Q-in-Q, stacked S-VLAN
  - Bandwidth reservation with Connection Admission Control (CAC)
  - QoS/CoS classification: 802.1p, DSCP, priority code point, DE
  - Ingress policing: 2-rate 3-color MEF 10.1
  - Hierarchical egress shaping: class, logical port, port
  - Per-flow queuing with WRED
- Ethernet OAM
  - ITU-T G.8031 1:1
    - Per service or group of services
    - 3.3 ms and 10 ms CCM support
    - Operates over ring, mesh, and point-to-point topologies
  - ITU-T G8032v2
    - Ethernet ring protection
    - Sub-ring support
  - Ethernet Performance Monitoring (PM)
    - On-demand (binned) throughput, packet size, average packet sent PM every five seconds
  - IEEE 802.3ad Link Aggregation
    - Cross-card support
    - 1:1 and 0:N with configurable hashing options
  - IEEE 802.3ah link OAM
    - Link discovery, monitoring and identification
    - Link critical event and fault messages
    - Ethernet loopback
  - IEEE 802.1ag/Y.1731 service OAM
    - Ethernet continuity check
    - Ethernet link trace
    - Ethernet loopback
  - Y.1731 Performance Measurements
    - Loss
    - Delay
    - Delay variation
  - Ethernet over TDM to Ethernet service interworking
    - Encapsulation of native Ethernet frames into GFP-F and X.86
    - GFP-F over SONET/SDH Low-Order and High-Order Virtual Concatenation (LO/HO-VCAT) groups with LCAS
    - GFP-F over bonded DS1/E1s with LCAS
    - GFP-F over single DS3/E3
    - X.86 option for DS3 encapsulation

Features and Specifications

SONET/SDH Functions

- STS/STM cross connects
- Ethernet over SONET/SDH (with GFP, VCAT, LCAS)
- GR-1093 state model

Environmental Compliance

- UL-certified
- GR-1089 compliant
- NEBS Level 3 compliant
- IEC 60825-1
- IEC 60950-1
- FDA CDRH
- RoHS
- ANZEMC
- CE
- WEEE

Operating Environment

• Normal operating temperature	5 to 40 °C (41 to 104 °F)
• Short term operating temperature	–5 to 50 °C (23 to 122 °F)
• Storage temperature	–40 to 70 °C (–40 to 158 °F)
• Normal operating humidity	5 to 85%
• Short term operating humidity	5 to 90%

Maximum Power Consumption (Heat Dissipation)

	SDS	HDS
Nominal system power*	800 W (2,731 BTU/hr)	800 W (2,731 BTU/hr)
Maximum power per system	3,034 W (10,356 BTU/hr)	4,266 W (14,561 BTU/hr)
Expected input	–40 to –57 V DC	–40 to –57 V DC

** Actual power varies with configuration.*

Physical Characteristics

	SDS	HDS
Shelf dimensions (H x W x D)**	22.75 x 17.4 x 14.8" (578 x 442 x 376 mm)	22.75 x 22.5 x 15" (578 x 571 x 380 mm)
Weight (empty shelf)	73 lb (33 kg)	95 lb (43.1 kg)

*** Shelf depth measurement includes all covers and cabling.*

Innovative Features of the FLASHWAVE 9500 Packet ONP

- Modular architecture designed for 99.999% availability and dense, cost-effective scaling
- Industry-leading 100G coherent optics transport technology
- Integrated ROADM with 88 wavelengths of 10G, 40G and 100G transport
- Industry-best 100G density lowest-power transponder
- Multihaul amplifiers for LH applications
- 8-degree ROADM hub enables mesh optical networks
- Next-generation colorless, directionless, contentionless (CDC) ROADM
- Multishelf distributed ROADM degrees for increased reliability and flexible growth
- Centralized Ethernet, OTN, and SONET/SDH switch fabric offers any-to-any connectivity and efficient aggregation
- MEF 2.0-certified platform offering deterministic high-performance service delivery
- NETSMART® point-and-click GUI simplifies end-to-end network management
- EoX gateway for packet mapping from multiple EoX streams to a native Ethernet service
- VT switch fabric for DCS replacement applications

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