

# FLASHWAVE® 9500

## Packet Optical Networking Platform

*The FLASHWAVE® 9500 Packet Optical Networking Platform (Packet ONP) integrates OTN, 100G coherent optics, 88-channel pluggable ROADMs, MEF-certified Carrier Ethernet, SONET, SDH, and Layer 1/2 traffic interworking into a high availability carrier-class platform. This convergence of transport technologies speeds time to market for new services and provides greater agility in meeting evolving service provider needs.*



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## Efficient Support for Diverse, Bandwidth-Intensive Services

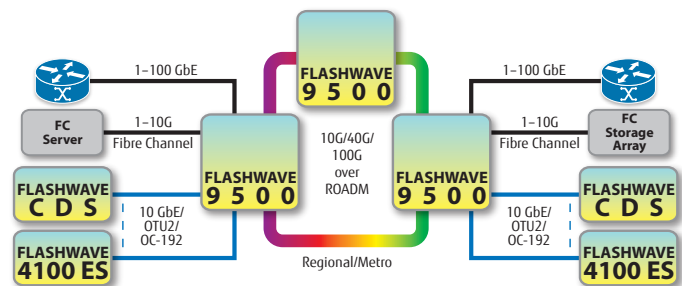
As the communications world transforms, demand for bandwidth and high-quality services is escalating. Residential and business customers have rising expectations and are more selective.

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.

### 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
- 12-degree ROADM hub enables mesh optical networks
- 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

### Flexible ROADM-based transport and service delivery



### 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% packet, 100% SONET/SDH operation, and the ability to interwork between the two. 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.

## High-Density Optical Design

### OTN and the Control Plane

While Fujitsu has been supporting OTN for a number of years, the network role of OTN has been changing from Digital Wrapper for WDM to a generic, protocol-agnostic container for switching and multiplexing. The need for larger capacity, protocol agnostic traffic, improved network efficiency, guaranteed end to end performance and well defined OAM are key drivers behind the addition of OTN to the WDM system.

In the core network infrastructure, OTN provides the convergence layer for bandwidth management over 10G/100G+, enables protocol-agnostic switching and, when coupled with the control plane, can provide network level grooming and mesh restoration.

In the metro network infrastructure, OTN use is driven by the need to scale SONET/SDH, GbE, fractional 10 GbE, and 10 GbE services and transport while providing cost advantages when combined with ROADM in comparison to ROADM-only architectures.

Furthermore, deploying OTN in the access network can provide the “on-ramp” to ROADM and/or OTN-ROADM networks for a standard, channelized handoff to other carriers and a fully transparent service interface.

The FLASHWAVE 9500 OTN switch fabric provides OTN switching, offering granular ODU0 switch capacity up to 2.4 Tb, further expanding packet and SONET/SDH switching capabilities.

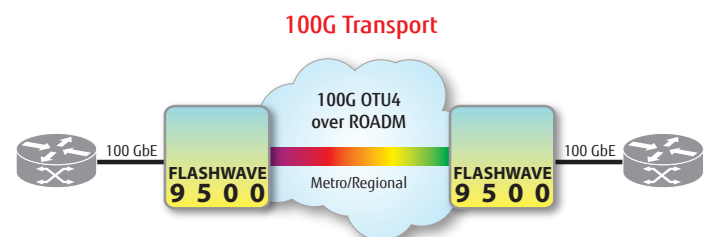
Fujitsu provides multiple solutions for OTN switching. These solutions begin with the FLASHWAVE CDS in the access network to provide ODU0 granularity and switching, and range to the FLASHWAVE 9500 platform with its scalable multiterabit switching fabric for the metro regional network. Fujitsu OTN solutions provide OTN switching at the right point in the network to drive down transport service costs.

To facilitate OTN functionality, the control plane supports the OTN layer. The Fujitsu optical layer control strategy is a combination of centralized and distributed control. Most control functions are implemented on a logically centralized controller. Distributed control is used to achieve high performance and scale.

Control functions handled by the centralized controller include:

- Service northbound requests from an OSS/NMS/EMS for network services
- Discovery of the optical layer topology
- Path computation and resource management

The distributed control plane functions include neighbor discovery, service establishment and fast restoration.



### 100 Gbps Transponder and Muxponder

The 100 Gbps transponder is central to customer fiber plant maintenance. Direct interconnect of core routers using 100 Gbps technology conserves both customer capex and opex while maintaining a flexible OTN DWDM-based core growth strategy. The 100G 10x10G muxponder enables DWDM transport of 10 GbE, OC-192/ STM-64, and OTU-2 client interfaces by aggregating them into the 100G full-band tunable coherent optical network interface. Both the 100G transponder and 10x10G muxponder plug-in cards utilize OTN G.709 digital wrapper with Soft Decision (SD) FEC and industry-standard DP-QPSK modulation. The SD-FEC improves optical performance and reduces regeneration equipment, which also reduces expenses. The 100G transponder and muxponder support core network element interconnection and fiber plant conservation applications. ITU and OIF-standard DP-QPSK modulation ensures investment protection.

# FLASHWAVE® 9500

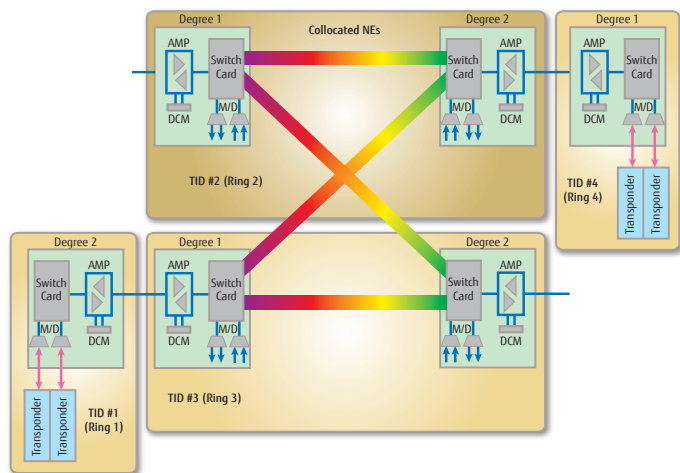
## Packet Optical Networking Platform

### Support for Wide-Ranging Technologies

#### High-Density 88-Channel Pluggable ROADM

The 88-channel pluggable ROADM provides per-channel add/drop capability. This offers flexibility and capacity scaling that enables service providers to address metro, regional and core networks now and into the future. The central switch fabric optimizes the ROADM technology through sub-wavelength grooming and aggregation. The flexibility of the ROADM allows a mix of services transported over 10G, 40G, 100G and future 400G rates onto any of the 88 channels. The FLASHWAVE 9500 system offers up to a 12-degree optical multi-TID hub for mesh network wavelength mapping. This higher density optical hub increases network interconnect capability while reducing transponder requirements through direct WSS interconnect between collocated network elements.

Collocated NEs



The FLASHWAVE 9500 platform incorporates a range of multirate, multiservice cards to offer high interface density per chassis slot and flexible port provisioning for Ethernet, OTN, SONET/SDH and Fibre Channel services on a single card type. Optional G.709 digital wrapper capability extends reach and offers tunable optics to provide direct connection to the ROADM, eliminating additional transponder cost. These flexible cards minimize spares inventory when deploying multiple services, service rates and wavelength types. Sub-wavelength grooming of Ethernet, OTN and SONET/SDH services using the central switch fabric enables efficient access to the ROADM layer.

#### EoX Gateway Reduces the Cost of Ethernet Service Delivery over Diverse Access Networks

The FLASHWAVE 9500 Packet ONP offers the EoX Gateway for:

- Seamless blending of Ethernet over SONET/SDH (EoS) and PDH (DS1/DS3) networks
- Aggregation using centralized packet and TDM switch fabrics
- Facilitates switching and delivery of Carrier Ethernet services across any type of access network (EoX) on a single Network Element (NE)

The EoX Gateway configuration dramatically increases the number of addressable customers for differentiated Ethernet and IP services. This benefits wholesale and retail service providers by leveraging existing access networks. The EoX Gateway accelerates time to revenue and significantly reduces the cost and space of hub Central Office (CO) equipment.

By deploying the EoX Gateway, service providers realize significant advantages, including:

- Converging disparate network elements and management systems
- Leveraging existing TDM, Ethernet and WDM access networks
- Enabling smooth transition to an optimal packet-centric infrastructure

#### Flexible MEF E-Line and E-Access Service Delivery Options

The FLASHWAVE 9500 is a MEF-certified platform that delivers E-Line and E-Access services over different transport network technologies using EoX Mapper functionality. This enables ultimate flexibility in deploying any point-to-point services over the optimal transport technology, whether Ethernet over fiber, SONET/SDH or PDH. The FLASHWAVE 9500 platform provides standards-based, deterministic, end-to-end guaranteed bandwidth with dynamic allocation for:

- Ethernet Virtual Connections (EVCs)
- Operator Virtual Connections (OVCs)
- EVC/OVC tunnels

Ethernet transport service provisioning is available for point-to-point, ring or mesh topologies. Resilient network facilities can use IEEE 802.3ad LAG or ITU-T G.8031 protection switching to provide sub-50 ms failover in the event of a span or card failure.

The 1:1 G.8031 protection provides diverse active and standby paths for an EVC (or OVC) or a tunnel of EVCs or OVCs. An EVC, OVC or Tunnel's standby path bandwidth can be used for other services. This maximizes throughput and makes efficient use of fiber assets.

# FLASHWAVE® 9500 Packet Optical Networking Platform

## Key Applications

### Maximum Bandwidth Utilization

Ethernet traffic is assigned a committed information rate (CIR) for a minimum bandwidth guarantee. Excess information rate (EIR) assignment enables maximum network utilization through bandwidth oversubscription and statistical multiplexing of best-effort traffic. If the traffic on a service consumes less bandwidth than its CIR, the FLASHWAVE 9500 system will dynamically allocate the unused bandwidth to other services, up to their pre-provisioned maximum rate, using its bandwidth reuse function. The maximum rate is the sum of CIR and EIR bandwidth allocations. If there is a link, node or card failure all protected services will fail-over to the pre-provisioned standby path in sub-50 ms and maintain their CIR guarantee.

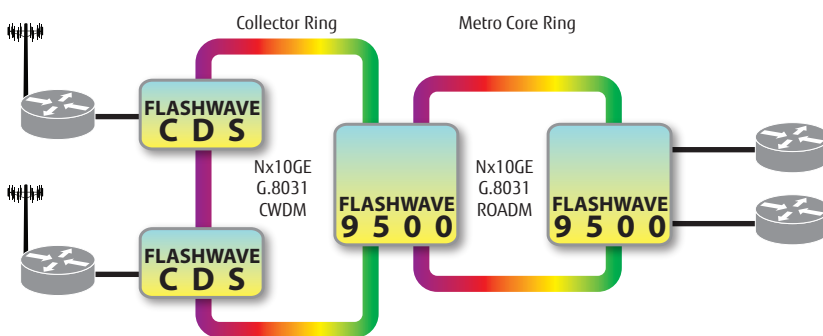
### Technology Convergence Enables Uniquely Flexible E-LAN Enterprise Service Delivery

E-LAN services are useful when the service provider needs to deliver an Ethernet service to interconnect three or more subscriber locations. In some cases, subscriber traffic requires “any-to-any” connectivity rather than connectivity directed towards a particular site. In this instance, E-LAN services are more suitable than a hub-and-spoke implementation using E-Line services. The FLASHWAVE 9500 system can be used to deliver E-LAN and E-Line services over the same physical interface via service multiplexing.

Additionally, using the EoX Mapper card, the FLASHWAVE 9500 system has the unique ability to deliver E-LAN services over SONET/SDH, PDH and native Ethernet transport—or any combination of these. This advanced capability offers the opportunity to leverage existing network assets to deliver E-LAN multipoint services.

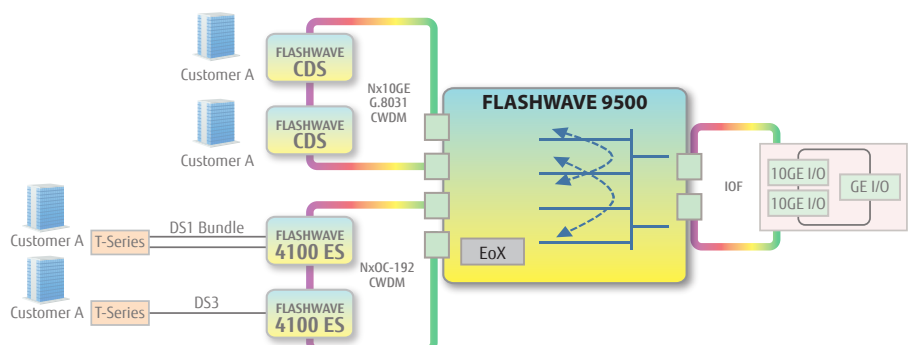
For example, an organization may have one location most cost-effectively reached over an existing SONET network. Another location may be off-net and accessible via a Type 2 PDH bonded PDH circuit or E-Access services from a partner provider. A third location might be reached using Ethernet over Fiber. The FLASHWAVE 9500 Packet ONP can bridge these three disparate networking technologies together where all three locations are interconnected as part of a common E-LAN service instance. New locations can be added to the E-LAN service using any combination of these transport network technologies to provide seamless connectivity between all locations.

### Mobile Backhaul Solution



Networks comprising router cores and aggregation networks make best use of the FLASHWAVE 9500 platform as a metro/regional traffic grooming and aggregation platform. An example is the mobile backhaul solution. Tunable DWDM optics with best-in-class ROADM technology eliminates incremental dark fiber costs as service bandwidth scales over the metro core. Similarly, for shorter reach requirements, collector ring capacity is increased using low-cost CWDM optics. This also maximizes fiber assets.

### E-Line / E-LAN Interworking



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### Key Applications

#### OTN and the Network Technology Mix

Existing metro networks have been built with a mix of technologies, including SONET OC-3 to OC-192 rings, switched Ethernet, native optical Ethernet, Ethernet over SONET, as well as a host of access technologies. Metro ROADM networks transport all of these legacy and next-generation services, as well as providing raw capacity provided by 40- or 88-channel ROADM platforms.

While many legacy service types exist in the network, most of the growth or new service connections are Ethernet. One of the challenges facing carriers is how to efficiently scale and transport thousands of Ethernet service connections across their metro networks. The FLASHWAVE 9500 and CDS platforms are an ideal solution to this flood of Ethernet service traffic.

While the Fujitsu implementation of Carrier Ethernet remains the preferred solution for most Ethernet traffic, very high rate, private-line services at GbE and above rates may be a better fit for OTN. As an example, a large financial institution may wish to purchase a full line-rate GbE service from a carrier to interconnect two locations. Since they want the full GbE service, as opposed to a partial-rate service, sophisticated packet aggregation and traffic grooming isn't applicable. For this type of customer and service, OTN provides an excellent technology to transport their Ethernet services. OTN benefits include:

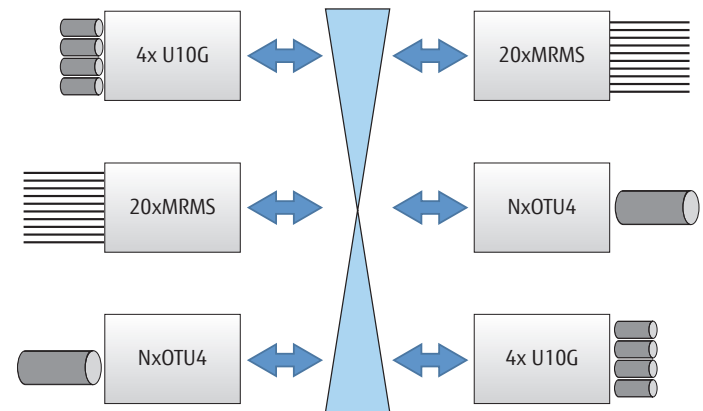
- Maximizing performance through deterministic delay and jitter for end-to-end SLAs (OTN layer)
- Robust end-to-end OTN OAM lowering operation expense
- Guaranteed service delivery and transparent support of all services

One application of OTN looks at core routers and the management of IP traffic across core networks. The majority of router interfaces continue to be 10 GbE with the volume of 10 GbE interfaces still growing exponentially with fiber assets still at a premium. OTN switching provides a cost-effective means to manage 10 GbE connectivity between router locations over a 100G+ infrastructure. This OTN layer reduces the need for expensive router ports and processes by utilizing router bypass or offload.

#### Adding OTN capabilities

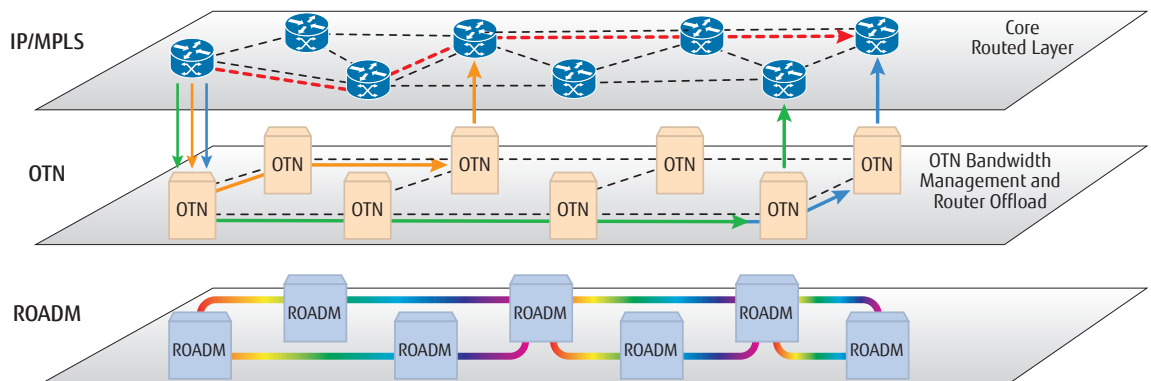
New OTN capabilities are added by upgrading the switch fabric and/or utilizing one or more of the OTN cards. The scalable SWF adds the new capability of switching ODU frames with a 2.4 Tb fabric and increases fabric capacity for SONET/SDH and packet services.

The new OTN cards (20-port MRMS, 4xU 10G or the nx100G) provides in-chassis muxponding between cards and can be used standalone, as a muxponder, or with the switching fabric. The 10G card also supports a local switch fabric when 40G grooming is needed.



OTN cards for the FLASHWAVE 9500 platform

#### Managing IP traffic across core networks



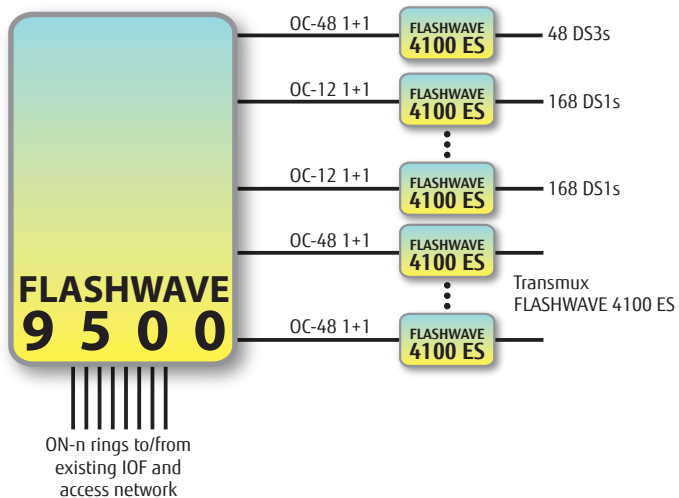
# FLASHWAVE® 9500 Packet Optical Networking Platform

## Key Applications

### Updating Legacy DCS Network Elements

Many large DCS network elements at the network core have been discontinued for many years. Support is terminated by the vendor; experienced staff on these devices is becoming rare; and replacement parts are difficult to find. Legacy DCS equipment consumes significant space and power—a premium in today's central offices. With its centralized switch fabric, the FLASHWAVE 9500 system offers a solution to this dilemma. The platform can be used in combination with the FLASHWAVE 4100 ES Micro Packet ONP to provide high-density DS1 and DS3 interfacing. The result is modernization of the 3/3 and 3/1 DCS environment using next-generation NEs and centralized Test Access Point (TAP) monitoring and split testing.

### DCS Network Modernization



### Multiservice Provisioning Platform (MSPP) Applications

Existing SONET services are added to the ROADM span using OC-192/10G and OC-768/40G transponders. The 2+12 multirate, multiservice muxponders offer one card type for aggregating OC-3/12/48 and GbE services over OC-192 or 10G using G.709 digital wrapper for direct OTN ROADM access—without an additional transponder. The ability to offer multiple service types on one card minimizes spares inventory and operational training.

The FLASHWAVE 9500 Packet ONP is equipped with a non-blocking SONET/SDH switch fabric. Using Generic Framing Protocol (GFP), this can encapsulate all Fiber Channel and Ethernet interfaces into the SONET/SDH payloads via standard bandwidth allocation techniques. SONET switch fabric support includes plug-in units for 480G of STS1 and 20G of VT1.5. The optional, non-blocking, fully meshed, VT switching solution supports unidirectional, bidirectional, drop-and-continue, and broadcast cross-connections with path selector switching. An integrated VT switch fabric in the FLASHWAVE 9500 system eliminates the need for external MSPP NEs traditionally used for VT grooming, thus reducing expenses.

SONET/SDH rates from OC3/STM-1 to OC192/STM-64 are supported over Unidirectional Path Switched Rings (UPSR) and Bidirectional Line Switched Rings (BLSR), using automatic protection switching (APS) mechanisms over the network facilities. Plug-in cards provide application flexibility.

This implementation includes access to all statistics associated with SONET/SDH capability. These range from errored-seconds counts to protection switches.

# FLASHWAVE® 9500

## Packet Optical Networking Platform

### 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
- Up to 8 degrees of ROADM connectivity
- 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*
40G (CFP)	LR4, SR4*, FR
10G (XFP)	10G (neg chirp) full band tunable
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

#### Number of Service Interfaces

Interface	Ports/ Card	SDS Ports/Shelf	HDS Ports/Shelf
100G/OTU4	1	3	6
40G/OTU3	1	3	6
OTU-2	1	16	24
OC-768/STM256	1	8	12
OC-192 /STM64/10 GbE 88-channel NBO	1	12	24
OC-192/STM64/10 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, STM4 (OTN mapped)	20	320	480
OC-48, STM16, 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	✓	✓	✓
240 Gbps universal switch fabric		✓	✓
480 Gbps universal switch fabric	✓	✓	✓
Number of interface slots	24	16	16

#### 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



# FLASHWAVE® 9500 Packet Optical Networking Platform

## Features and Specifications



### 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

### 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
- 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

- Asymmetric multi-TID 12-degree hub
- High-density 8-degree ROADM configuration in a single shelf or distributed across multiple shelves (split-hub ROADM)
- 8-degree x 88-channel Wavelength Selectable Switch (WSS)
- 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

### 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
  - 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
  - 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

### SONET/SDH Functions

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

# FLASHWAVE® 9500

## Packet Optical Networking Platform

### Features and Specifications

#### 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 VDC	-40 to -57 VDC

\* 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.



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