FLASHWAVE® 7500
Multifunction ROADM/DWDM Platform

The FLASHWAVE 7500 platform offers advanced DWDM, optical hubbing, ROADM, and network capabilities to deliver and manage growing metro and regional networks. The system supports both ANSI and ETSI-certified solutions, with flexible configurations to optimize metro and regional networks.

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Building the Metro Backbone

Metro and regional optical networks are entering a period of dramatic expansion, driven by demand for high-speed data services, legacy TDM services, and high-bandwidth video services. Competing successfully requires a network architecture that consolidates and manages all high-bandwidth services over a single core optical transport network. The FLASHWAVE 7500 system provides a high-capacity ROADM platform for metro and regional networks, improving operational efficiency, reducing operations expenses, and lowering overall network costs.

Flexible Architecture, Deployed Worldwide
Chosen by major service providers worldwide, the FLASHWAVE 7500 platform is deployed in North America, Europe and Asia. American National Standards Institute (ANSI) and European Telecom Standards Institute (ETSI)-certified versions allow operation in any global environment. The platform aggregates TDM, SONET, Ethernet, and video services onto a single core optical transport infrastructure, improving efficiency, flexibility, and cost-effectiveness.

Field-Proven Technology
As the industry-leading metro ROADM platform, thousands of FLASHWAVE 7500 nodes are in operation with dozens of carriers worldwide, providing proven real-world performance. In addition, the systems go through rigorous internal system testing and verification prior to each software release. The FLASHWAVE 7500 platform has also been extensively tested by numerous outside facilities. These include customer test labs, NEBS, UL, Telcordia OSMINE, in addition to federal government testing and certification by the U.S. Defense Information Systems Agency (DISA)-sanctioned Joint Interoperability Test Command (JITC).

Recent Product Enhancements
New FLASHWAVE 7500 features and enhancements improve network performance, enable new applications, and offer DWDM network and operational efficiencies. These new capabilities deliver significant capital and operational cost benefits.

OTN Muxponder
Optical Transport Network (OTN) technology has been used for years in DWDM equipment, implemented as G.709 digital wrapper for wavelengths. OTN provides a common frame structure, optical layer Operations, Administration and Maintenance (OAM), General Communications Channel (GCC0), and Forward Error Correction (FEC) for improved performance.

Carriers are adopting OTN for sub-wavelength multiplexing and aggregation applications, in addition to its role as a digital wrapper for wavelengths. OTN multiplexing offers several benefits over other techniques, including universal containers supporting any signal type, transparent aggregation of signals, an industry-standard multiplexing scheme, and robust OAM.
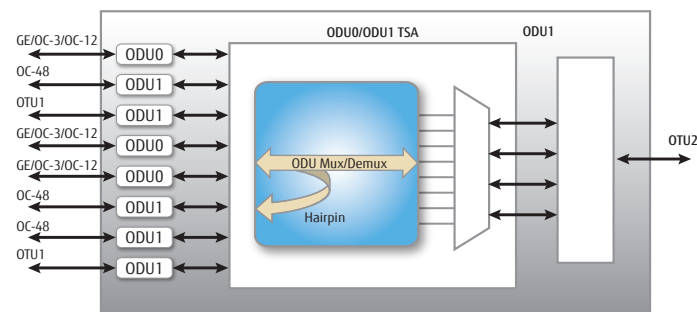
With the introduction of the OTN muxponder unit on the FLASHWAVE 7500 platform, carriers can enable OTN multiplexing and services on existing ROADM networks. Supporting eight client ports of OC-3, OC-12, OC-48, GbE, and OTU1 services, the OTN muxponder maps all services into standard OTN containers and a 10G OTU2 network interface. In addition to the OTN muxponder unit, Fujitsu is adding 40G OTU3 support to the existing 40G transponder cards. OTN is transforming optical transport networks—with Fujitsu leading the way.

FLASHWAVE 7500 and 9500 Integration
Carriers can now have the best of both worlds, with the ability to mix and match transponders and muxponders from either the FLASHWAVE 7500 or 9500 platforms, over a common FLASHWAVE 7500 ROADM network.
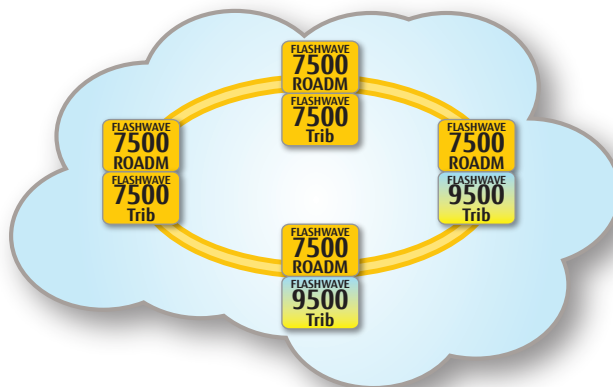
Reduce OPEX and Troubleshooting Time

With thousands of FLASHWAVE 7500 nodes deployed, existing carriers and networks can upgrade to the latest technologies and advancements, such as the Fujitsu 100G transponder and 100G muxponders, all running over their existing ROADM infrastructure. FLASHWAVE 7500 and 9500 integration enables carriers to expand and enhance their network without the need for costly overbuilds.

40G Improves Network Utilization

The FLASHWAVE 7500 system supports 10G, 40G, and 100G (via 9500 trib) wavelengths with a wide array of transponder and muxponder service units.

Recently, 40G units have become increasingly popular and widely deployed, providing carriers with a fourfold improvement in capacity. Fujitsu supports both coherent and non-coherent 40G units. The non-coherent 40G units are based on Adaptive Dual Phase Shift Keying (ADPSK) and provide a cost-effective method for expanding capacity in metro and regional DWDM networks. However, these 40G ADPSK units are not applicable on high Polarization Mode Dispersion (PMD) fiber spans.

PMD is an optical impairment with some older fibers that limits both transmission speeds and span distances. The 40G coherent transponders enable deployment and operation over high PMD routes, which were previously limited to 10G operation. Carriers reap substantial savings by eliminating the need to remove and replace problematic high-PMD routes.

Sub-Wavelength Aggregation Reduces Capex

The Flexponder unit is an 8-port multirate, multiservice unit that integrates SONET STS-1 aggregation and switching along with WDM on a single card. Commonly referred to as a "Multiservice Provisioning Platform (MSPP)-on-a-blade," these cards perform the functions previously performed by standalone SONET MSPPs, saving equipment costs, space, and power.

STS grooming reduces capital outlay
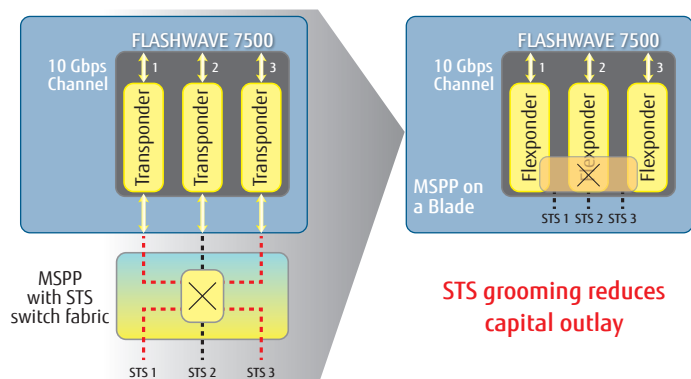
The flexponder can be used as a single unit, supporting eight multirate, multiservice ports along with an integrated 20G STS-1 switch fabric for traffic grooming, or with multiple units. When using multiple flexponders, the system provides sub-wavelength aggregation and grooming across all units installed in a shelf with a 160G STS-1 distributed switching matrix.

Stacked Muxponders Reduce Remote Costs

The FLASHWAVE 7500 Extension Shelf provides a low-cost method of extending services to customer premises or remote locations. Instead of a full ROADM node at the remote location, the Extension Shelf can be deployed with a single transponder or muxponder, utilizing the network-side optical interface as a single-channel transport system. The limitation of this approach is that many remote sites require more low-speed aggregation ports than available on a single 10G muxponder unit. By combining multiple 10G muxponder cards with a 40G muxponder card in a stacked configuration, carriers can efficiently aggregate remote services and transport them over a single 40G channel, without the cost of a full ROADM node.

A similar application is to provide capacity expansion and fiber relief on fully filled DWDM networks. By upgrading to 40G wavelengths, carriers can expand their network capacity by a factor of four, without costly network overbuilds. Existing 10G muxponders, providing low-rate client OC-3/12/48 or GbE services, can be combined with the 40G muxponder unit in a stacked configuration to enable 40G or even 100G DWDM transport.

Enhanced Software Operational Features

Several operational features and enhancements have been incorporated to improve performance and reduce operation time and costs.

Capability/Feature	Value
Security Enhancements	Added protection for user passwords and network ports ensures the utmost security from network compromise for the most demanding, secure network environments
Enhanced alarm storage for WSS & amplifier modules	Additional storage of PM values aids in network troubleshooting and prevention
Client-side DWDM XFPs	Reduces costs by eliminating the need for back-to-back transponders when interconnecting WDM networks (FLASHWAVE 7210 or 9500)
Multiple IS-IS instances	Enables OSI management area to be subdivided, specifically within optical hub nodes, as networks grow and expand in size. Improved network management and scalability

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Versatile Configurations

As a unified, scalable platform, the FLASHWAVE 7500 system offers flexible configurations to support a wide range of applications, including:

- FLASHWAVE 7500 WSS ROADM (1–12 degree optical hubbing)
- FLASHWAVE 7500 2-degree ROADM
- FLASHWAVE 7500 Extension Shelf for low-cost, remote nodes
- FLASHWAVE 7500 In-Line Amplifier (ILA)

The FLASHWAVE 7500 optical line cards and software are common to all configurations, reducing operational costs for engineering, training, installation and spare parts. Chassis options include a 23-inch North American version, a 19-inch version, and a 500 mm front-access ETSI version.

The FLASHWAVE 7500 system also supports managed service extensions with the FLASHWAVE CDS Micro Packet Optical Networking Platform (Packet ONP) and FLASHWAVE 7120 Access CWDM/DWDM platform. The FLASHWAVE CDS is a compact 2RU customer premises platform that provides advanced Ethernet services and legacy SONET services. The FLASHWAVE 7120 provides a small, cost-effective WDM solution for transporting multiple wavelengths in access applications.

The FLASHWAVE 7500 platform supports both mixed 10G and 40G wavelengths on the same network, enabling carriers to efficiently and cost-effectively upgrade their WDM capacity, without the need for expensive overbuild networks.

FLASHWAVE 7500 WSS ROADM

The FLASHWAVE 7500 wavelength selective switch (WSS) ROADM provides a powerful and cost-effective solution for metro and regional networks. Supporting up to 40 channels and capacity up to 1.6 Tb, the system provides an ideal solution for consolidated core optical networks, eliminating costly multiple overlay networks for each service type. Advanced features, such as automatic power balancing, optical hubbing, and A-Z wavelength provisioning, reduce operational expenses and improve service implementation times. Configurations range from simple 2-degree ROADMs to multidegree optical hub nodes supporting complex mesh network architectures.
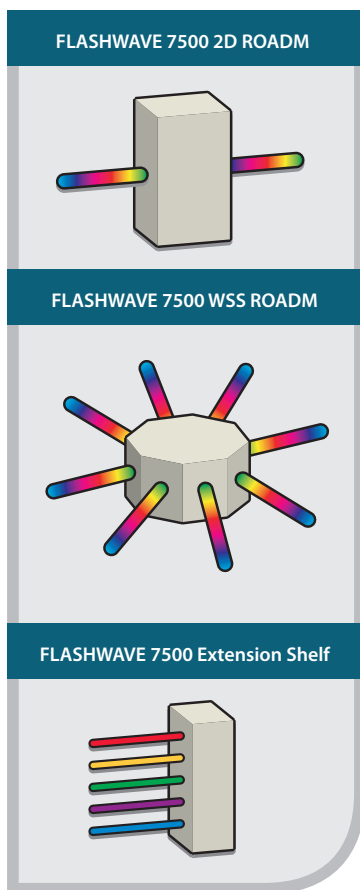
FLASHWAVE 7500 2D ROADM

An economical choice for locations only requiring two degrees of connectivity, as opposed to multidegree hubbing, the FLASHWAVE 7500 2D ROADM can be deployed alone or in mixed applications along with FLASHWAVE 7500 WSS optical hub nodes. The 2D ROADM provides full 1–40 channel support, ring, linear, and terminal configurations, and utilizes all of the same optical line cards for client-side service interfaces. In addition, the 2D ROADM supports up to eight transponder slots on the same shelf as the ROADM switch/muxponder and amplifier cards, enabling single-shelf deployments for low channel-count sites. Additional tributary shelves can always be added when additional slot capacity is required.

FLASHWAVE 7500 2D ROADM

FLASHWAVE 7500 WSS ROADM

FLASHWAVE 7500 Extension Shelf

FLASHWAVE 7500 Extension Shelf

The FLASHWAVE 7500 Extension Shelf is a non-ROADM standalone configuration designed to extend individual services to customer premises. Primarily intended for single-channel extensions, the system offers very low-cost service delivery without the need for DWDM layer amplifiers, optical switches, and multiplexer/demultiplexer units.

FLASHWAVE 7500 ILA

Large optical networks require amplification every 60–100 Km, depending on the fiber type, data rates, and service mix. At those midpoints where service or wavelength drops are not required, the FLASHWAVE 7500 ILA offers a very economical solution to re-amplify the WDM signal and extend the network reach. If service or wavelength drops are ever needed at an ILA location, the FLASHWAVE 7500 ILA can be upgraded in-service to a full ROADM node.

A Wide Range of Applications

Core Transport Infrastructure

As a high-capacity optical transport platform, the FLASHWAVE 7500 ROADM is ideal for aggregating large, high-bandwidth services over a single optical core network. Previously, carriers typically deployed separate transport networks for each service type and network layer. The FLASHWAVE 7500 consolidates TDM, SONET, Ethernet, and video services into a single DWDM infrastructure, providing substantial savings and streamlining the network architecture, while providing additional capacity for future network growth.

Collapsed Network Functions

The FLASHWAVE 7500 system is more than just a pure optical transport platform, as it also supports sub-wavelength grooming and aggregation for legacy SONET services. In a typical network, SONET MSPPs provide STS-1 grooming and aggregation for OC- 3/12/48 interfaces, with an OC-192 interconnection to the DWDM layer. Most DWDM locations also have many subtending SONET MSPPs, providing STS-1 level aggregation, grooming, and switching.

The FLASHWAVE 7500 Flexponder unit eliminates the need for subtending SONET MSPPs, by integrating SONET physical interfaces, STS-1 switching, and SONET protection switching into a single unit along with DWDM. The FLASHWAVE 7500 Flexponder supports eight multirate, multiservice ports that can be individually provisioned for OC-3/12/48 or GbE services, with a high-speed, full-band tunable OTU2 (10G DWDM) network interface. The Flexponder can be used as a

single unit providing eight multirate ports along with an integrated 20G STS-1 switch fabric. It can be deployed in pairs, functioning as a SONET MSPP on a blade with SONET 1+1 and UPSR protection switching, along with the integrated STS-1 fabric. Finally, multiple units can be deployed supporting up to 160G of STS-1 switching and aggregation across all ports in the shelf.

High-PMD Routes

For optical routes with high polarization mode dispersion (PMD), the FLASHWAVE 7500 platform supports both 10G and 40G transponders superficially designed for problematic high-PMD fiber. The 40G coherent transponder and muxponder units utilize advanced DP-QSPK modulation and coherent optical receivers, which improves performance over high-PMD fiber.

Video Distribution

Perfectly suited for video applications in the cable and IPTV industry, the FLASHWAVE 7500 platform lets service providers distribute both broadcast and VoD video streams over large metro and regional networks from headend offices to video serving offices or distribution hubs.

Private Network Applications

As the backbone infrastructure for large private network applications, the FLASHWAVE 7500 system ensures that financial institutions, educational consortiums and federal government installations can accommodate traffic growth without costly network upgrades.

The ideal high-capacity optical transport vehicle
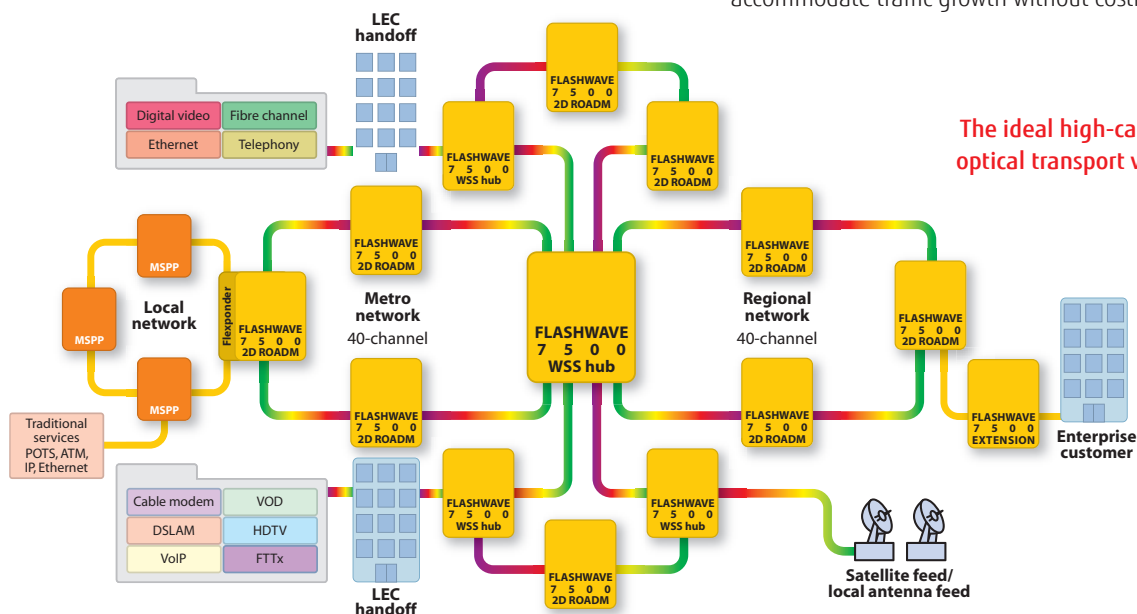
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Network Life Cycle Services

Fujitsu offers a broad selection of professional services to assist at every stage in a network's evolution and operation. From planning through deployment and ongoing maintenance to future enhancements, Fujitsu Network Life Cycle Services are available whenever needed. Our comprehensive range of services includes network and system design, training, customized deployment, craft interface software, migration planning and more. Your Fujitsu sales representative can guide you in selecting the right service options for your business.

Popular planning and deployment services for the FLASHWAVE 7500 multifunction ROADM/DWDM platform include:

Fiber characterization – Fujitsu offers comprehensive analysis of installed fiber to improve current network performance, prepare for new growth and identify potential issues.

Onsite mentoring – Our experts provide full training and knowledge transfers.

Design services for DWDM networks – Our professional design staff works with you to prepare a complete, custom roadmap for success.

Fujitsu Maintenance and Support Program

For a complete professional maintenance solution, the Fujitsu Maintenance and Support Program has the right combination of flexibility and comprehensive assurance. Choose the level and types of service you need to supplement your own resources. The Maintenance and Support Program helps keep your network running smoothly, provides critical care and protects the longevity of your investment.

Network Operations Center

With a full range of vendor-independent network fault and performance monitoring features, the Fujitsu Network Operations Center (NOC) offers guaranteed, round-the-clock system protection. Our reliable NOC facility is available as a primary or supplemental operations resource. This service not only helps you control costs and maintain high levels of customer satisfaction, it also provides trustworthy and reliable after-hours and emergency coverage.

Features and Specifications

Architectures	• Optical hubbing (up to 12 degrees) • Ring • Mesh • Linear add/drop • Point-to-point • In-Line Amplifier (ILA)
Network Capacity	• 1.6 Tbps (40 wavelengths at 40 Gbps each) • Up to 1200 Km reach without regeneration • WSS-based optical switch fabric (1 to 12 degrees) • 2D-only ROADM option • Optional Raman amplifiers for extended-reach spans • FLASHWAVE 7500 Extension Shelf for low-cost remote services
Optical Line Cards	• Transponders/regenerators for 10G and 40G services • Muxponders including 4x1 10G, 4x1 2.5G, and 8x1 10G • OTN muxponder 8-port for OC-3/12/48/GbE and OTU1 services • Flexponder 8x1 SONET MSPP-on-a-blade for OC-3/12/48 and GbE services • Full C-band tunable narrowband optics at 10G, 40G, and 100G • G.709-compliant digital wrappers with RS-FEC, Ultra FEC (U-FEC and enhanced FEC (E-FEC) • SFP/XFP pluggable client-side optics

Optical Line Cards

40G transponder	• OC-768/STM-256 • OTU3
40G muxponder (4 x 10G)	• OC-192/STM-64 • 10 GbE • OTU2
10G universal transponder	• OC-192/STM-64 • 10 GbE • OTU2
10G muxponder (4 x 2.5G)	• OC-48/STM-16
OTN mupxonder (8-port)	• OC-3/12/48 • STM1/STM4/STM16 • GbE • OTU1
10G Flexponder (8-port)	• OC-3/12/48 • STM1/STM4/STM16 • GbE
Gbe muxponder (8-port)	• GbE
Multirate 2.5G transponder (1-port)	• Multirate transponder 100 Mbps–2.7 Gbps for any service type

System Features	• Automatic per-channel power balancing • A-Z wavelength provisioning • Sub-wavelength grooming and aggregation (160G) per shelf • Optical hubbing for ring and mesh network interconnections • ILA upgrades to full ROADM node in-service
Operations	• TL1 over TCP/IP • TL1 over OSI • SNMP (alarms) • Remote software updates • Remote memory backup/restore • NETSMART® 500 Element Manager • NETSMART 1500 Management System • NETSMART 2000 Network Design and Planning Tool
Monitoring and Alarms	• Optical per-channel and WDM monitoring • Wavelength management • Optical layer (OTN) PM • SONET/SDH PM • Gigabit Ethernet PM

Power Consumption/ Heat Dissipation		
	• Optical/hub shelf	<360W (1228 BTU/hr)
	• Tributary shelf	<630W (2150 BTU/hr)
	• ILA	<360W (1228 BTU/hr)

Operating Environment		
	• Temperature	−5 to 50 °C (23 to 122 °F)
	• Humidity	5 to 95% (non-condensing)
	• Power input	−48 V DC
	• NEBS Level 3 compliant	

	• FLASHWAVE 7500 ETSI system meets the following requirements for CE marking:
	  • EMC Directive 2004/108/EC
	  • UL/ IEC 60950
	  • IEC/EN 60825-1 and IEC/EN60950-1 requirements for a Class 1 laser product
	  • Restriction of Hazardous Substances Directive 2002/95/EC
	  • Waste of Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC	

Physical Characteristics		
	Dimensions (H x W x D)	23" Shelf: 22.5 x 21.5 x 11.5" (572 x 546 x 292 mm)
		19" Shelf: 22.5 x 17.3 x 11.5" (572 x 439 x 292 mm)
		ETSI shelf: 30.2 x 19.3 x 11.5" (767 x 490 x 292 mm)
	Weight (fully loaded shelf)	<145 lb (66 kg)

FLASHWAVE® 7500
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Available in ANSI and ETSI
Shelf Configurations

FLASHWAVE 7500 ANSI Shelf

FLASHWAVE 7500 ETSI Shelf

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