

PRODUCT BROCHURE

# 6500 Packet-Optical Platform

Stay ahead of demand—today and into the future



**With Ciena's 6500 Packet-Optical Platform you can seamlessly expand your investment by sustainably evolving your network with more scalability, flexibility, and multi-layer programmability. The 6500 is a trusted platform deployed in over 750 networks across the globe.**

Today, providers need a more dynamic, responsive network—one that leverages a programmable infrastructure with intelligent network control to scale and respond on demand to meet changing customer expectations and unpredictable traffic requirements. Ciena's 6500 Packet-Optical Platform leverages the latest technology innovation—from 800G performance optics and 400G coherent pluggables to compact Reconfigurable Optical Add/Drop Multiplexers (ROADMs) and control plane automation—so that you can continually stay ahead of customer demands.

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Maximizing networking efficiencies, the 6500 converges multi-layer capabilities in a single platform—as well as across multiple shelf configurations—to help you streamline operations and optimize footprint, power, and capacity to specific site requirements. The system features sophisticated instrumentation and embedded intelligence across all layers, with the full suite of open APIs and modern data models needed for real-time network telemetry and advanced automation for simplified operations. Providers can leverage the flexibility and programmability of the platform with Ciena’s Manage, Control and Plan (MCP) domain controller to rapidly plan, provision, turn up, and troubleshoot multi-layer services from the metro edge, between data centers, along the backbone core, and across ocean floors.

### One platform, full flexibility

The flexibility of the 6500 platform starts with the variety of services it can deliver over a wide range of applications. A handful of interfaces support the full mix of Ethernet, OTN, SDH/SONET, Fibre Channel, video, and transparent DWDM services—from DS1/E1 to 100 GbE/OTU4 to 400GbE—for efficient service transport from the edge to the core and across submarine applications. Standards-based service interfaces ensure seamless multi-vendor interoperability.



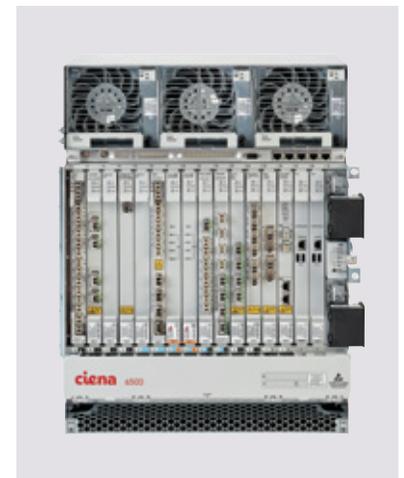
6500-D2 amplifier configuration

The network element can be customized for photonic/transponder applications that require line rates of 10G to 800G DWDM that scales to >1Tb/s single wave transmission in the future. It also supports flexible Add Drop Muxing (ADM) capabilities as well as muxponder card-based and central fabric-based packet/OTN switching. Additionally, various line and equipment protection options are available, enabling a range of differentiated service offerings for increased network availability.

Multiple 6500 chassis form factors are available—from a compact 2RU up to full-rack sizes—with the ability to scale from 100 Gb/s to 1 Tb/s per slot. The smaller 6500-D2, 6500-D4, and 6500-D7 shelf configurations offer both AC and DC power options, addressing a wide range of end-customer locations. An extended temperature solution is also available for uncontrolled outside plant environments with the 6500-D2 and -D4. A single management system and a comprehensive suite of service interfaces with pluggable optic options can be used across the full 6500 Family of D/S-Series shelves—enabling reduced standardization cycles and time to service, lower sparing expenses, and simplified network operations. Along with the ability to tailor the customer offering, the 6500 comes with proven five-9s (99.999 percent) reliability, ensuring the ability to meet the strictest customer requirements. fusce quis ligula tristique morbi, torquent habitasse urna vestibulum platea curabitur cubilia, fames placerat rhoncus turpis nostra eleifend integer.

### Features and benefits

- Evolve to a greener, on-demand network with programmable industry-leading coherent solutions that drive scalability and improved space/power efficiencies
- Cost-efficiently deliver a wide range of services with minimal equipment, leveraging a flexible mix of circuit packs with pluggable optics, reducing standardization and operational costs
- Continually increase capacity over your existing infrastructure with WaveLogic™ Coherent Optics that enable differentiated services with packet/OTN switching and proven control plane capabilities
- Rapidly plan, provision, turn-up, and troubleshoot services over multiple layers with Ciena’s MCP domain controller
- Optimize network performance with advanced software tools that use real-time analytics to increase programmability, visibility, and control of the optical network
- Leverage the full suite of open APIs for advanced programmability, automated provisioning, and streaming telemetry



6500-D14 transponder/muxponder configuration

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## Agile, intelligent optical layer

To address network provider requirements to quickly respond to unpredictable traffic demands, Ciena offers a fully instrumented, intelligent photonic layer composed of programmable coherent optics and flexible open line elements. This photonic system leverages embedded and discrete software tools combined with advanced analytics to offer better automation, control, and visibility of the optical network.

An important factor influencing business success is the ability to photonically interconnect sites quickly and economically; simplify network operations; and reduce costs, power, and latency associated with regenerators. The 6500 uses embedded Domain Optical Control (DOC) software to retrieve network information from the installed equipment and automatically adjust parameters, reducing error-prone manual operations and accelerating wavelength turn-up. This built-in intelligence allows for an elegant expansion of the network as operators can expand connectivity to additional sites with in-service ROADMs additions and channel add/deletions as needed.

With the 6500, you have access to the full range of photonic architectures, from passive fixed filters for simple metro service extensions and compact multi-degree ROADMs to Colorless, Directionless, Contentionless (CDC) and flexible grid ROADMs for the power to send any service anywhere in the network, dynamically.

With the 6500 flexible grid Colorless and Directionless (CD) and CDC solutions you gain an agile photonic foundation that is responsive to application needs—a critical requirement in the move towards a more adaptive network. The 6500 CDC solution further future-proofs the network, eliminating wavelength routing restrictions that have previously limited operators' ability to quickly turn-up new services. Reconfigurations such as wavelength defragmentation and route optimization can also be performed to scale the network for continued service growth. For maximum efficiencies, CD and CDC can operate with the L0 control plane for increased automation of operations as well as for support of automated photonic restoration.

Another key benefit of Ciena's agile, intelligent photonic layer is the support of integrated Optical Time Domain Reflectometer (OTDR) capabilities for both EDFA and Raman-amplified links, which provide unprecedented visibility from the NOC directly into

the fiber plant. These capabilities allow operators to quickly identify and localize high connector losses or reflections and ensure their fiber plant is conditioned for optimal performance. Ciena's smart Raman solution combined with integrated OTDR eliminates the pain points of traditional Raman deployments by providing simplified, controlled turn-up and fast, precise pinpoint of faults.

The 6500 Reconfigurable Line System (RLS) is a modular line system with advanced programmability and openness, that scales from the lowest to the highest bandwidth requirements. Despite its compact size, the 6500 RLS provides highly dense ROADM and amplifier configurations, offering pay-as-you grow flexibility as nodal capacity requirements increase. It is purpose-built with the flexibility to fit into a variety of disaggregated line system applications and offers the ability to double fiber capacity with the simplest L-band upgrades using its integrated ASE and integrated C&L-band architecture.



*6500-D4 Compact two degree ROADM  
with muxponder card configuration*

## A greener network with industry-leading coherent technology

An important benefit of the 6500 is that the same platform can be tailored to cost-effectively address applications from 10G to 800G DWDM and beyond—with market-leading coherent innovations that allow you to continually get more from your network investment. The 6500 provides an elegant evolutionary path to terabit channels and helps you evolve to a greener network through a significant reduction in footprint and power obtained with each generation of coherent technology introduced.

As the pioneer of coherent optical technology, Ciena offers a comprehensive high-capacity portfolio with programmable 100G-800G WaveLogic™ solutions to address edge, metro, regional, long-haul, and

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submarine applications, and development is well underway for 1600G technology to support customer networking requirements of the future. With support for state-of-the-art as well as multiple generations of coherent technology on the 6500, you can upgrade your network at your own pace, avoid costs associated with rip-and-replace practices, and maximize return on existing investments.

Ciena's latest generation of coherent technology, WaveLogic 5, offers 100G–800G solutions driving more scalability, intelligence, and programmability than ever before. WaveLogic 5 Extreme brings single-wavelength 800G and new levels of performance and efficiency to the industry for the first time, as well as footprint-optimized solutions with 100G–400G QSFP-DD and CFP2-DCO pluggables to optimize power/space efficiencies and extend WaveLogic scalability benefits to new, innovative applications.

With WaveLogic 5 Extreme you can optimize capacity across any path with unmatched programmable capacity from 200G to 800G in 50G increments, with selectable baud options up to 95G baud, enabling double the wavelength capacity and up to 33 percent higher spectral efficiency versus previous technologies. It provides operators the ability to evolve to 400G-interface routers with efficient 400GbE client connect across any distance—from across the metro to across the Pacific. Additionally, with Ciena's best-in-class SD-FEC and DSP algorithms, operators can deploy higher capacity channels over longer reaches and eliminate regens from the network.

With Ciena's WaveLogic 5 Nano (WL5n) 100G–400G coherent pluggables on the 6500, network providers benefit from the power, footprint, and granular capacity benefits associated with pluggables, as well as the photonic-layer integration and link-budget guarantees needed to accelerate and optimize network deployments. With support for a wide range of interoperable and high-performance transmission modes, you can deploy WL5n coherent pluggables with ease across access and aggregation, single-span Data Center Interconnect (DCI), and metro/regional transport over all types of photonic line systems.

For packet-optimized, interoperable transport, WL5n supports both OIF-compliant 400ZR for single-span DCI as well as Multi-Source Agreement (MSA) 400ZR+ for extended reach, multi-span transport. To meet longer reach requirements and challenging link environments, industry-leading high performance

PKT-MAX transmission modes leverage Ciena's Probabilistic Constellation Shaping (PCS) to deliver maximum span coverage for Ethernet transport. For metro ROADM networks, WL5n supports Optical Transport Network (OTN) modes for both ITU-T/FlexO and Open ROADM MSA-based interoperability as well as performance-enhanced OTN-MAX modes for maximum reach. In addition to using WL5n for network upgrades to 400G, network providers can also evolve and reduce energy consumption in existing 50GHz fixed-grid networks, using the lower baud transmission options (31.5GBaud and 35GBaud) of the product to deploy lower power, lower cost 100G/200G wavelengths.

### **24/7 in-flight data protection with optical encryption**

As part of Ciena's multi-layer security approach that ensures the confidentiality, integrity, and availability of data in the network, the 6500 offers advanced integrated AES-256 encryption capabilities, providing operators a simple way to safeguard all their in-flight data against breaches. Meeting the highest recognized security standards, which include Common Criteria and FIPS certification, these simple-to-deploy, protocol-agnostic, wire-speed encryption solutions address all infrastructure requirements—from 10G to 200G, from metro to submarine distances. Advanced security features include two distinct keys for authentication and data encryption functions, with hitless key rotation every second. A dedicated encryption management interface, MyCryptoTool, provides full control of security parameters to the end-user or security officer.

WaveLogic 5 Nano 100G-400G  
Transceivers

[Download now](#)

### **Packet and OTN efficiencies**

Ciena's 6500 supports both high-capacity muxponder and central fabric-based packet and OTN switching solutions. Operators can cost optimize the configuration based on traffic requirements, selecting to express wavelengths or aggregate and switch subrated ports where needed, without compromise.

The 6500 offers unrestricted, agnostic OTN and packet switching, enabling terabit-class scaling of packet and multi-protocol services. Operators can select the most flexible networking model, meaning the most suitable of packet and/or OTN switching and redundancy options as needed. The 6500 can operate



6500-S32 Packet/OTN switching configuration

as a full OTN or native packet switch with no capacity or functionality constraints. Alternatively, operators can offer a mix of both; for example, an operator offering OTN-switched services can introduce co-resident packet-switched services for new revenue streams.

The 6500 supports ODUFlex mapping, which allows for in service adjustable bandwidth containers, from 1G to 100G in 1.25G increments. Grooming of partially filled wavelengths and GbE/10GbE/100GbE ports ensures the most efficient bandwidth utilization and scaling of the network, resulting in the efficient transport of traffic across fewer connections using less network bandwidth.

OTN switching provides transparent transport of all native services, along with end-to-end management of these services over a single converged network. The 6500 also provides Tandem Connection Monitoring (TCM) for improved service assurance, giving service providers a better service fault correlation and troubleshooting capability when handling third-party traffic. Additionally, OTN future-proofs the network with built-in support for new clients, such as Flex Ethernet (FlexE) and line rates beyond 100G (B100G).

From a packet-switching perspective, 6500 supports several modules specializing in packet switching that leverage Ciena's Service-Aware OS (SAOS), which is available across the company's Routing and Switching Portfolio and deployed on more than 1.6 million platforms worldwide. This common technology implementation, shared across different devices, allows for rich functionality, implementation, and maximum operational efficiencies across an end-to-end service offering.

Advantages of Ciena's packet/OTN switched solutions include:

- Customized configurations based on connectivity requirements
- Very granular sub-wavelength and sub-GbE grooming for efficient utilization of network resources
- Unrestricted hybrid packet/OTN centralized switching, with the ability to tune for packet and/or OTN in any ratio
- Flexible protection options for all hardware options, enabling a tiered SLA offering

The 6500 Packet Transport System (PTS) configuration is designed to address the growing need to maintain profitable delivery of TDM services, while future-proofing investments toward an all-packet network modernization. The 6500 PTS supports replacement of massive legacy 3/1 DACS, enabling DS1 and VT1.5 level switching through a packet fabric equipped on the 6500-S8/S14 shelves. The same fabric also allows operators to replace and consolidate MSPP SONET/SDH platforms, with the ability to transport circuit switched Ethernet services using a variety of encapsulation protocols. Multiple Add-Drop Multiplexer (ADM) rings are also supported on the 6500 PTS, saving even more space and power. In addition, the 6500 PTS operates as a standard MPLS switch for transport and switching of Ethernet services and as a pathway to future IP services. With these capabilities, network operators can modernize their TDM network, enabling migration of TDM services to an MPLS protected core network.

[6500 T-Series](#)

[Learn more](#)

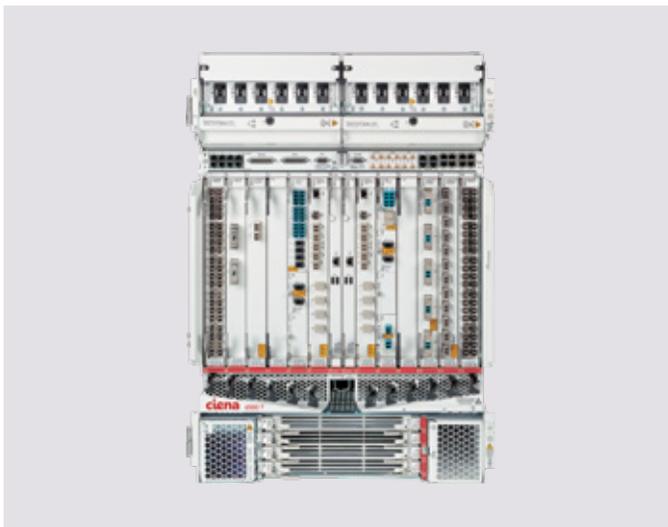
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## Highly resilient architecture with control plane intelligence

A control plane is another important component of next-gen optical networks, enabling a programmable network foundation that leverages advanced automation and intelligence to support changing service requirements and the bandwidth-on-demand type of services becoming prevalent with cloud and software-defined networks.

Ciena's intelligent control plane allows the transport network to automate and distribute many functions formerly performed through a combination of centralized management systems and manual processes. It provides the following key advantages:

- Real-time network topology to provide accurate and automated inventory of equipment and bandwidth resources
- Signaling to provide accelerated service provisioning and faster turn-up
- Tunable SLAs for revenue growth via flexible protection and restoration options



6500-T12 Packet/OTN switching configuration

Operators can leverage both photonic (L0) and OTN (L1) control planes to offer a wide range of SLA offerings and enable a highly resilient network architecture. SLAs can range from unprotected to 50 ms protection against any number of failures, and everything in between. For unprotected services, L0 control plane ensures Mean Time to Repair (MTTR) guarantees can be met at little incremental cost.

Another important benefit of the L0 control plane is it facilitates wavelength re-grooming, enabling operators to perform proactive network maintenance in a condensed maintenance window with fewer truck rolls. Wavelength re-grooming can also be used to reroute wavelengths onto shorter, more optimized paths to reduce regenerator ports and service latency and rebalance wavelengths to extend the life of the existing network.

Ciena was among the first to deploy control plane in DWDM systems and optical cross-connects. The innovative, feature rich control plane functionality—hardened with over 20 years of global field experience and scaling to networks of 1,000 nodes—places Ciena well ahead of the competition for robust and reliable optical control plane software.

## Multi-layer lifecycle network operations with MCP

Manage, Control and Plan (MCP) is Ciena's domain controller, unifying and automating lifecycle operations of Ciena's packet and optical infrastructure across domains (access, metro, core, and subsea). No longer do operators have to swivel-chair between legacy network management systems to execute time-consuming, error-prone processes. MCP synchronizes operations across multiple network protocol layers so operators can quickly create, activate, and troubleshoot end-to-end services deployed over the 6500 optical network, including OTN and Layer 2 services such as ELINE, ELAN and ETREE. In addition to its rich GUI visualization, MCP offers open REST APIs for ease of integration into adjacent systems, enabling automation of operational workflows. To facilitate API integration testing, Ciena's Emulation Cloud™ provides an open development environment with easy 24/7 access to MCP APIs and 6500 virtual infrastructure.

Ciena's PlannerPlus network planning and design tool is fully integrated with MCP, helping reduce the time horizon for capacity management, planning, device commissioning, and service provisioning. PlannerPlus leverages Ciena's extensive background in Layer 1 control plane planning and simulation, photonic system design, advanced algorithm research, and GUI development in an easy-to-use platform. PlannerPlus works with MCP's live view of the network state and network utilization, and correlates data from multiple network layers, allowing the network planner to easily see the association between customer services,

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facilities, and equipment on the 6500. This allows the planner to dynamically add new capacity, allocate and tune service bandwidth, and efficiently adjust service routes to satisfy customers' bandwidth and reliability demands.

### **A smarter optical network with Liquid Spectrum™**

Ciena's Liquid Spectrum analytics apps are a perfect complement to the 6500, combining the power of advanced analytics and automation with a highly instrumented, programmable photonic layer to help operators extract the most value from their existing network resources, across the various stages of the photonic network lifecycle. Value can be quantified as improved efficiency, increased capacity, stronger channel reach, increased service availability, or increased automation for faster time to market.

Integrated as part of MCP, Liquid Spectrum advanced software apps transform photonic network operations by abstracting complexity associated with flexible next-gen technologies and providing real-time visibility into network efficiency and optimization of the network. For example, with the app PinPoint OTDR, you gain proactive fiber monitoring and faster troubleshooting with the ability to quickly pinpoint the exact location of a problem in the fiber plant. Operators can also leverage the programmability of WaveLogic Coherent Optics to precisely match the capacity of a wavelength to the system margin required to traverse a specific path of the network, at any point in time. With Channel Margin Gauge, you have real-time visibility into channel performance, and can quickly assess if you can run your deployed optics at higher capacities. This means that you can mine available network margin and convert it to capacity on demand or improve service availability during a disaster recovery situation. The power of the Photonic Performance Gauge app brings complete visibility of

ongoing optical performance, even on paths where no wavelengths are deployed, a current 'blind spot' in the network. By combining this information with the Liquid Restoration app, you can maximize service availability by using available network resources to recover maximum traffic across any available path during a fiber cut, enabling a more resilient network.

With Liquid Spectrum, operators can address their optical networking challenges via sophisticated apps that drive actionable insights based on the current state of the network, enabling access to new revenue streams and the ability to maximize the value of deployed network assets.

### **Summary**

Deployed by more than 750 operators, the 6500 platform underpins service, content, and cloud provider; research and education; government; and enterprise networks around the globe. Its popularity hinges on several key factors:

- Can be tailored for an economic fit into a variety of applications
- Enables a greener network powered by coherent technology innovations that increase capacity while reducing footprint/power
- Efficiently delivers a wide range of services leveraging muxponder and central-fabric based packet and/or OTN switching
- Practically scales to elegantly handle step increases in capacity over existing infrastructure

In short, with the 6500, you can stay ahead of demand by leveraging state-of-the-art technology and new capabilities that allow you to continually maximize network efficiencies and offer customizable service delivery over any distance.

## Technical information

### Physical Dimensions

#### 6500-D2:

2U 88 mm (H) x 443 mm (W) x 280 mm (D)

2U 3.5 in. (H) x 17.4 in. (W) x 11.0 in. (D)

#### 6500-D4:

5U 222 mm (H) x 444 mm (W) x 283 mm (D)

5U 8.7 in. (H) x 17.5 in. (W) x 11.1 in. (D)

#### 6500-D7:

6U 266 mm (H) x 443 mm (W) x 280 mm (D)

6U 10.5 in. (H) x 17.4 in. (W) x 11.0 in. (D)

#### 6500-S8:

7U 310 mm (H) x 443 mm (W) x 280 mm (D)

7U 12.2 in. (H) x 17.4 in. (W) x 11.0 in. (D)

#### 6500-D14/S14:

13U 577 mm (H) x 443 mm (W) x 280 mm (D)

13U 22.7 in. (H) x 17.4 in. (W) x 11.0 in. (D)

#### 6500-S32:

22U 977 mm (H) x 498 mm (W) 280 mm (D)

22U 38.5 in. (H) x 19.6 in. (W) x 11.0 in (D)

#### 6500-T12:

17U 754 mm (H) x 498.0 mm (W) x 433 mm (D)

17U 29.7 in. (H) x 19.6 in. (W) x 17.0 in (D)

#### 6500-T24:

36U 1590 mm (H) x 498 mm (W) x 433 mm (D)

36U 62.6 in (H) x 19.6 in (W) x 17.0 in (D)

#### Shelf pre-mounted in 44RU EIA Rack:

2134 mm (H) x 660 mm (W) x 457 mm (D)

84.0 in (H) x 26.0 in (W) x 18.0 in (D)

#### 6500-R2:

2U 88 mm (H) x 440 mm (W) x 593 mm (D)

2U 3.5 in. (H) x 17.33 in. (W) x 23.35 in. (D)

#### 6500-R4:

4U 177mm (H) x 440mm (W) x 593mm (D)

4U 6.97in (H) x 17.33in (W) x 23.35in (D)

#### 6500-R8:

7.5U 330 mm (H) x 440 mm (W) x 281 mm (D)

7.5U 12 in. (H) x 17.3 in. (W) x 11.1 in. (D)

#### Capacity

Packet/OTN: 24 Tb/s

System: Up to 38.4 Tb/s

WDM: 2.5G to 800G DWDM

Packet/OTN XC: 600G to 24T

#### Photonics

Full suite of passive filters, 50GHz, 75GHz, 100GHz, flexible grid ROADMs

Colorless, Directionless, Contentionless

EDFAs, Smart Raman, Integrated OTDR, multi-degree ROADM on a blade

Liquid Spectrum Analytics

Apps: Planning Tool

Calibrator, Bandwidth

Optimizer, PinPoint OTDR,

Channel Margin Gauge,

Photonic Performance

Gauge, Liquid Restoration

#### Services

Ethernet: 10M, 100M, 1GbE, 10GbE, 40GbE, 100GbE, 400GbE

MEF CE 2.0-certified EPL, EVPL, EP-LAN, EP-LAN EPL-Access, and EVPL-Access services

OTN: OTU0 to OTU4, ODUFlex

FC100 to FC3200 (and FICON equivalents)

SONET/SDH: OC-3/STM-1 through OC-768/STM-256

Electrical: DS1, E1, DS3, E3, STM-1e

ESCON

DVB-ASI

10G CE LR

ISC3

### Coherent transponders/muxponders

#### WaveLogic 5 Extreme:

800G muxponder (Clients: mix of 100GbE, OTU4 and 400GbE) with coherent tunability from 200G to 800G in 50G increments

#### WaveLogic Ai

400G muxponder (Clients: 4x100GbE) with integrated OPS (Optical Protection Switch) and coherent tunability from 100G to 400G in 50G increments

400G flexible service transponder (34 client ports) with integrated OPS and coherent tunability from 100G to 400G in 50G increments

#### WaveLogic 5 Nano

200G muxponder (CFP2-DCO): 5 client ports (2x QSFP28/QSFP+, 3x QSFP+)

2x 100G muxponder (2xQSFP-DD or 2xQSFP28): 5 client ports (2x QSFP28/QSFP+, 3x QSFP+)

2xCFP2 OTN Flex muxponder (36 client ports) including coherent 100G/200G variants

#### WaveLogic 3 Extreme

100GbE/OTU4 transponder FIPS-certified AES-256 wire-speed 100G/200G encryption solution

#### Client cards:

- 200G card: 2x100GbE or 5x40GbE/10GbE

- 100G cards: 10x10GbE, 10x10G multi-rate, 2x40G+2x10G, 100GbE/OTU4 client

#### WaveLogic 3 Nano

100G muxponder (10x10G)

### Packet/OTN switched modules

1Tb 3x Universal Sub-Slot (USS) packet/OTN Interface  
500G 2x Universal Sub-Slot (USS)/2xQSFP28 packet/OTN Interface

### Universal Sub-Slot (USS) modules:

- 800G WaveLogic 5 Extreme USS Module: coherent tunability from 200G to 800G in 50G increments
  - 2x QSFP-DD USS Module: including coherent 100G-400G WaveLogic 5 Nano variants
  - 2x CFP2-DCO USS Module: including coherent 100G-200G WaveLogic 5 Nano variants
  - 400G WaveLogic Ai USS Module: coherent tunability from 100G to 400G in 50G increments
  - 12x SFP+ USS Module-10GbE, OTU2, OTU2e, OC192, STM64
  - 5x QSFP28/QSFP+ USS Module - 40GbE, OTU3 (4x 10GbE, 4x OTU2e, 4x OTU2, 4x OC192, 4x STM64), 100GbE, OTU4 40x10G packet/OTN  
5x100G/12x40G packet/OTN  
5x100G DWDM packet/OTN  
10x10G packet/OTN  
1x100G CFP2 + 2x40G packet/OTN  
1x100G QSFP28 + 2x40G packet/OTN  
100G DWDM packet/OTN  
16x2.7G OTN  
48xGbE  
Intelligent control plane  
Photonic, OTN
- ### Configurations
- Unprotected  
1+1/MSP linear  
1+1 OTN line-side  
LAG  
1+1 Enhanced Trunk Switch (ETS)  
1+1 Transponder Protection Tray  
1+1 Optical Protection switch (incl. fast coherent recovery times)  
ASNCP  
Mesh restorable control plane connections at L0 and L1  
MPLS-TP  
G.8032 Ethernet Ring Protection

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### Common Equipment

Full common equipment redundancy  
Field-replaceable units  
-48Vdc input voltage range:  
-40Vdc to -75Vdc  
24Vdc input voltage range:  
+20Vdc to +30Vdc  
AC input voltage range:  
90Vac to 264Vac

### Certifications

Common Criteria Network Device  
Collaborative Protection Profile  
FIPS 140-2 Level 2 and 3  
FIPS 197 AES-256  
BSI (German Federal Office of Information Security)  
IBM GDPS  
SAN environments: Dell/EMC, Brocade and Cisco switches

### Environmental Characteristics

6500-D2/D4 extended temperature solution: -40°C to 65°C (-40°F to 149°F)  
Normal Operating Temperature: +5°C to +40°C (+41°F to +104°F)  
Short Term Operating Temperature: -5°C to +55°C (+23°F to +131°F) for 6500-D2/D4/D7/S8/S14; -5°C to +50°C (+23°F to +122°F) for 6500-S32/T12/T24  
Normal operating humidity: 5% to 85% RH  
Earthquake/seismic: Zone 4

\* Extended temperature uncontrolled OSP Class 2 GR-3108- CORE variant also available.

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