Ciena’s 6500 Packet-Optical Platform converges three comprehensive networking layers into a single platform to provide customizable service delivery from the access edge, along the backbone core, and across ocean floors.

6500 systems support directionless and colorless ROADM functionality, which combine with Optical Transport Network (OTN)/packet switching and intelligent control plane to maximize the bandwidth efficiency and flexibility of the overall network. Complementing its many capabilities, the system also features full instrumentation and embedded intelligence across all layers, with an emphasis on automating and simplifying operations.

Features and Benefits

- Provides industry-leading 10G, 40G, and 100G coherent and control plane capabilities for scale and service differentiation
- Utilizes unconstrained OTN and packet switching technologies for the most efficient use of network resources
- Offers embedded and discrete software tools to increase programmability, visibility, and control of the optical network
- Adapts to a wide variety of requirements with a minimal set of equipment, reducing standardization and operational costs
- Maximizes operational efficiencies with the ability to tailor customer solutions via various chassis, power, and configuration options

One Platform, Full Flexibility

The flexibility of the 6500 platform starts with the variety of services it can support. 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—from metro to submarine applications. Standards-based service interfaces ensure seamless multi-vendor interoperability.

The network element can be customized to support 2.5G to 100G switched or DWDM applications as bandwidth and connectivity demands dictate. Various line and equipment protection options are available to help providers support a tiered Service Level Agreement (SLA) and differentiated service offerings that will enable expansion of the current customer base.

Four chassis form factors—6500-2, 6500-7, 6500-14, and 6500-32—are available, with the smaller variants offering both AC and DC power options. This flexibility results in cost-optimized configurations to best
match specific site capacity, space, and power requirements. One software load, one management system, and re-usable cards across the various shelves reduce standardization cycles and sparing expenses and simplify network operations. Along with the ability to tailor the customer offering, the 6500 comes with proven five-9s (99.999%) reliability, ensuring the ability to meet the strictest customer requirements.

Programmable Optical Layer
WaveLogic Photonics is Ciena’s fully instrumented, intelligent photonic system composed of WaveLogic coherent optics and flexible line elements that combine with embedded and discrete software tools to offer better automation, control, and visibility to 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 offers the full range of photonic architectures in one platform, from passive filters for simple metro service extensions to directionless, colorless, and flexible grid ROADMs for the power to send any service anywhere in the network, dynamically.

For smaller, simpler network configurations, passive photonics can be used for lowest capital expenditures. This architecture supports point-to-point, hubbed ring, multi-degree branching, and channel stitching. 6500 passive photonics supports inventory and equipment management for full network visibility.

For more meshed and complex configurations, the WSS-based Reconfigurable Add-Drop Multiplexer (ROADM) architecture offers full reconfiguration flexibility and simpler operations. Advanced software capabilities applied to ROADMs create the fully agile, end-to-end transport network. A full range of WSS cards and filters provides optimized performance and cost for varying degree branching sites, with software features focused on simplifying operations of a mesh network.

A unique benefit of Ciena’s WaveLogic Photonics is the support of PinPoint Advanced Fiber Analytics leveraging integrated Optical Time Domain Reflector (OTDR) capabilities directly into next-generation Raman and EDFA amplifiers. Operators can use this powerful tool to identify and localize high connector losses or reflections and ensure their fiber plant is conditioned for optimal performance. In particular, integrated OTDR eliminates the pain points of previous Raman deployments by providing simplified, controlled turn-up and fast, precise pinpoint of faults.

Finally, contrary to other ‘boxed-in’ vendor solutions, 6500’s advanced monitoring and software control features allow for an elegant expansion of the network. Operators are able to expand connectivity to additional sites with in-service ROADM additions and channel add/deletions as needed. Ensuring investment protection, the 6500 network can evolve to support directionless, colorless, and gridless architectures when appropriate economics are met for these new configurations.

Smarter, High-capacity Coherent Technology
An important benefit of the 6500 is that the same platform can be tailored to cost-effectively address applications from 2.5G to 100G DWDM and beyond. It also provides an elegant evolution path from 2.5G to 400 Gb/s, leveraging existing infrastructure investments.

As the pioneer of coherent optical technology, Ciena offers a comprehensive 40G/100G portfolio with hardware tailored to address metro, regional, long-haul, and submarine applications.

In addition to enabling new high-speed services, improving spectral efficiency and delaying new build-outs, Ciena’s coherent 40G and 100G solutions operate seamlessly alongside 10G wavelengths, maximizing the traffic-carrying capacity of the network. The strong performance of WaveLogic solutions translates to increased reach, with fewer regenerators in long-haul applications, as well as increased tolerance to cascaded ROADMs, which are prevalent in metro networks.

Field-proven DSP algorithms provide electronic dispersion compensation to eliminate fixed compensators and their associated amplifiers in the network. As a result, Ciena’s coherent solutions provide a more flexible and simpler network design with the ability to operate over mixed as well as challenged (high-PMD) fiber environments, even at 100 Gb/s and higher rates.
WaveLogic 3, the latest generation of Ciena’s family of coherent optical processors, is the industry’s first software-programmable coherent technology that scales from 100G to 400G. Through the use of innovative technologies such as soft-decision Forward Error Correction (FEC) and transmitter DSP-based programmable modulation, WaveLogic 3 provides the following additional benefits:

- Enables broader, more economical deployment of 100G across long-haul terrestrial and submarine global networks with fewer regenerators
- Doubles traffic-carrying capacity to 200 Gb/s per 50GHz channel
- Can be optimized for low-latency applications

Beyond reducing transport costs, WaveLogic 3-based transceivers can be programmed to quickly respond and adapt to changing requirements for capacity, reach, and latency. This programmability makes the optical layer more intelligent and responsive to application needs, an increasingly critical requirement in today’s dynamic, cloud-centric networks.

Packet and OTN Efficiencies

The 6500 offers integrated OTN and packet switching, for the most efficient utilization of network resources with the ability to scale to the highest-speed service.

A handful of 6500 OTN interfaces support a wide range of protocols, allowing for rapid response to service requests and faster time to revenue, even in an unpredictable environment. Sub-wavelength grooming ensures the most efficient bandwidth utilization and scaling of the network.

OTN switching on the 6500 allows for transparent transport of all native services, along with end-to-end management of these services, all over a single converged network. 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.

From a packet-switching perspective, 6500 supports several E-Suite modules, a set of product offerings specializing in packet switching across Ciena’s solutions portfolio. All E-Suite modules leverage Ciena’s Service Aware OS (SAOS), which is available across the company’s Packet Networking portfolio and deployed on more than 400,000 platforms worldwide. This common technology implementation, shared across different devices, allows for rich functionality implementation and maximum operational efficiencies through equipment interoperability.

Ciena’s 6500 supports both muxponder- and central fabric-based packet and OTN switching solutions; the configuration can be cost-optimized for specific service connectivity requirements. Muxponder-based solutions are best suited for predictable point-to-point connectivity or when the DWDM line system is being used for simple interconnection of switch or router devices. Central fabric-based switching is best suited for architectures requiring any-to-any connectivity flexibility. Ciena offers network planning and modeling services to help operators determine the optimal configurations for different network scenarios.

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

- Customized configurations based on connectivity requirements
- Unrestricted hybrid packet/OTN central switching, with the ability to tune for packet and/or OTN in any ratio
- The ability to double Ethernet or OTN switching capacity on muxponders via backplane connectivity and the simple addition of a second module
- Flexible protection options for all hardware options, enabling a tiered SLA offering

Integrated Photonic and OTN Control Plane Intelligence

A distributed control plane can be an important component of software-defined networks, enabling a programmable network foundation that can support changing service requirements and the bandwidth-on-demand type of services becoming prevalent with cloud and software-defined networks.
Ciena’s OneConnect control plane allows the transport network to automate and distribute many functions formerly performed through a combination of centralized management systems and manual processes. In particular, OneConnect provides the following advantages:

- Uses real-time network topology to provide accurate and automated inventory of equipment and bandwidth resources
- Uses signaling to provide accelerated service provisioning and faster turn-up
- Offers tunable SLAs for revenue growth via flexible protection and restoration options

Operators can leverage both Photonic and OTN OneConnect control planes to increase network availability at lower cost and guarantee strict customer SLAs with less deployed equipment. SLAs can range from unprotected to 50ms protection against any number of failures, and everything in between. For unprotected services, Photonic OneConnect ensures Mean Time To Repair (MTTR) guarantees can be met at little incremental cost.

Another important benefit of OneConnect 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 control plane functionality—hardened with over 15 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.

**Full Network, Multi-layer Visibility and Optimization with OneControl and OnePlanner**

Ciena’s OneControl Unified Management System offers comprehensive network and service management for end-to-end Ciena networks. Through a unified GUI and common management model, Network Operations Center (NOC) operators can rapidly deploy new service offerings that cut across domains (access, metro, core, and subsea) and coordinate across network protocol layers (photonic, transport, and packet) to ensure efficient use of critical network assets and bandwidth optimization.

This efficiency provides comprehensive management and control, from the access customer hand-off points through the metro, into the intelligent core, and across subsea networks. The OneControl GUI allows NOC personnel to create and activate end-to-end services at the optical layer, including OTN/SONET/SDH and Layer 2 services such as E-LAN/E-Line. Once enabled, OneControl provides complete visualization of the entire end-to-end service with multi-layer correlation, facilitating proactive root-cause analysis and troubleshooting.

Ciena’s OnePlanner Unified Design System is an advanced, multi-layer network design and optimization tool that leverages Ciena’s extensive background in Layer 1 control plane planning and simulation, photonic system design, advanced algorithm research, and GUI development into a comprehensive and easy-to-use platform. OnePlanner correlates data from different network layers, allowing the network planner to easily see the association between services, facilities, and equipment.

**Summary**

Deployed by more than 400 operators, the 6500 underpins service provider, research and education, government, and enterprise networks around the globe. Its popularity hinges on several key factors:

- It can be tailored for an economic fit into a variety of applications
- It very efficiently delivers a wide range of services leveraging packet and/or OTN switching
- It practically scales to elegantly handle step increases in capacity over existing infrastructure

In short, with the 6500, operators are able to drive network transformation without restrictions or compromise, with room to grow.
Technical Information

Physical Dimensions

6500-2:
- 2U 89 mm (H) x 443.2 mm (W) x 281 mm (D)
- 2U 3.5 in. (H) x 17.5 in. (W) x 11.1 in. (D)

6500-7:
- 6U 267 mm (H) x 440.5 mm (W) x 281 mm (D)
- 6U 10.5 in. (H) x 17.3 in. (W) x 11.1 in. (D)

6500-14:
- 13U 577.1 mm (H) x 440.5 mm (W) x 277.5 mm (D)
- 13U 22.7 in. (H) x 17.3 in. (W) x 10.9 in. (D)

6500-32:
- 22U 977 mm (H) x 498.0 mm (W) x 277.5 mm (D)
- 22U 38.5 in. (H) x 19.6 in. (W) x 277.5 mm (D)

Capacity

SONET/SDH: 640 Gb/s
Packet/OTN: 3.2 Tbs/s
System: 96 Tbs/s
WDM: 2.5G/10G/40G/100G DWDM, 2.5G CWDM
Wavelength support: 96 wavelengths in C-band, full band tunable optics
SONET/SDH XC: 20G to 80G low order, 80G to 640G high order
Packet/OTN XC: 600G to 3.2T

Photonics

Full suite of passive filters, 50GHz, 100GHz, flexible grid ROADMs, EDFAs, smart Raman, and Channel Mux/Demux options

Services

Ethernet: 10M, 100M, GbE, 40GbE, 100GbE
OTN: OTU0 to OTU4
FC100 to FC1200
SONET/SDH: OC-3/STM-1 through OC-768/STM-64
Electrical: DS1, E1, DS3, E3, STM-1e
ESCON
DVB-ASI

Transponders/Muxponders

Coherent 100G line cards: metro, regional, long haul, ultra long haul, enhanced PMD, submarine, colorless
Coherent 100G client cards: 10x10GE, 10x10G multi-rate, 100GbE/OTU4 client
Coherent 40G line cards: metro, regional, long haul, ultra long haul, enhanced PMD, submarine, colorless
Coherent 40G client cards: 4x10G multi-rate, 40G multi-rate
10G, 4x10G multi-rate OTR
Ethernet: 200G eMOTR, 30G L2 MOTR
OTN modules: 8-port OTN Flex MOTR (10G), 1+8 port OTN Flex MOTR (20G)
SONET/SDH 10G ADM-on-a-blade: SuperMux

Packet/OTN switched modules

10x10G Packet/OTN
100G DWDM, OTU4
40G DWDM, OTU3
16x2.7G OTN

SONET/SDH switched modules

Ethernet: L2 service switch, PDH Gateway, EPL
Electrical: E1, DS1, DS3, EC-1, E3
Optical: OC-3/STM-1 through OC-192/STM-64

Distributed Control Plane

Photonic, OTN, SONET/SDH

Configurations

Unprotected
1+1/MSP linear
1+1 OTN line-side
1+1 LAG
1+1 Enhanced Trunk Switch (ETS)
1+1 Transponder Protection Tray
1+1 Optical Protection switch (incl. fast coherent switching)
2-Fiber BLSR/MS-SPRing
4-Fiber BLSR/MS-SPRing/HERS
UPSR/SNCP
ASNCNP
Mesh restorable control plane connections at L0 and L1
RPR layer 2 protection
G.8032 ERP

Common Equipment

Full common equipment redundancy
Field-replaceable units
-48Vdc input voltage range:
-40Vdc to -73Vdc
24Vdc input voltage range: +20Vdc to +30Vdc
AC input voltage range: 90Vac to 264Vac

Environmental Characteristics

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 6500-2/7/14, -5° C to +50° C (+23° F to +122° F) for 6500-32
Normal operating humidity: 5% to 85% RH
Earthquake/seismic: Zone 4

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