



6500 PACKET-OPTICAL PLATFORM

Features & Benefits

- Adjusts to site-specific requirements with three 6500 shelf variants, all operating on the same software load with interchangeable circuit packs
- Supports coherent 40G and 100G interfaces to maximize return on investment by delivering up to 10 times more traffic capacity on the existing network
- Electronically compensates for dispersion, eliminating the need for fixed compensators and associated amplifiers, while also simplifying engineering of the network
- Delivers a complete suite of integrated Wavelength- Selective Switch (WSS)-based ROADMs for flexible per wavelength add/drop/ passthrough per wavelength and per wavelength switching
- Supports OTN mapping, multiplexing, and transport for standards-based OTN management and networking
- Provides aggregation/statistical multiplexing on MEF-certified packet interfaces allowing the efficient delivery of packet services with with stringent SLAs
- Provides full OAM capabilities and the same carrier-grade capabilities across Layers 0, 1 and 2, while preserving the operational values of circuit-based networks and a familiar paradigm

The network is connecting an ever increasing number of devices. People want more— faster Internet speeds, higher bandwidth applications and better quality video. As the world becomes increasingly interlinked and traffic demands surge at an unpredictable growth rate, there is a compelling business case to continue to evolve the metro towards a scalable, adaptive packet-based infrastructure that moves through an agile all-optical long-haul network.

In this volatile and very competitive environment, what if there was one platform that could meet all functionality requirements for both the metro and long-haul sections of the network, simplifying the design to drive down costs in both the capital and operating infrastructure?

The 6500 Series consolidates layers of networking functions and platforms, addressing a wide variety of applications with a reduced number of nodes. The same platform can be employed for wireless backhaul, data center connectivity, or business services delivery, can act as an optical transit node with multi-way branching and is leading the market with 40G/100G wavelength transport.

Metro and Long-haul DWDM Infrastructure

With its integrated photonic capabilities, the 6500 offers an architecture with fewer network elements and simplified operations for faster deployment in

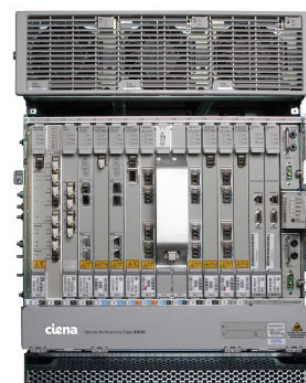


Figure 1. Service diversity and flexibility with 6500

metro, regional and long haul areas alike. Service providers and enterprises are able to reduce recurring OPEX through an overall reduction in managed network elements and a reduction in the cost of network management, equipment sparing, technician training, and document control.

WSS-based Reconfigurable Optical Add-Drop Multiplexers (ROADMs) are integrated into the shelf for flexible per wavelength add/drop/passthrough and per wavelength switching. Advanced software capabilities applied to ROADMs create the fully agile, end-to-end transport network. Direction-independent and coherent-enabled colorless ROADMs provide benefits such as optical restoration, increasing network availability at little added cost, and wavelength pre-planning simplification, where transceivers can be pre-deployed, and wavelengths can later be added on at the direction of interest with little or no pre-planning.

Multi-port, multi-protocol transponders with per-port service selectivity offer increased versatility and flexibility. Service providers and enterprises, for example, can deploy the 6500 to support their business continuity and data center connectivity needs through Fibre Channel or Infiniband, while continuing to offer a varying mix of TDM/WDM/Ethernet/OTN services over a single converged network.

Ciena offers unique network simplification benefits with its high-performance DWDM capabilities on the 6500, solving optical transmission complexity using advanced electronics and modem technology integrated into its equipment.

10 Gb/s and 10GbE transponders employ Electronic Dispersion Compensation (eDCO) that support per wavelength dispersion

compensation directly on the transmitting optical interfaces. Significant CAPEX and OPEX reduction is realized from extending wavelengths without any dispersion compensation equipment or the associated amplifiers and engineering that would otherwise be involved. Each individual wavelength may be routed through the network independent of distance, fiber type or number of intermediate add/drop nodes.



Figure 2. 6500 with integrated ROADM

Simplest Upgrades to 40G and 100G

As bandwidth demands continue to increase, operators can easily upgrade their 10G-engineered networks to both 40G and 100G. Ciena's 40G/100G Adaptive Optical Engine solutions deliver both 40G and 100G network capacity, enabling four or ten times the existing network throughput. This capacity equips operators to keep pace with dramatically increasing demand from bandwidth-sapping applications like high-speed Internet, IPTV, HD programming, and mobile video phones.

Ciena's 40G and 100G solutions are based on technologies such as coherent detection, Dual Polarization Quadrature Phase Shift Keying modulation, and advanced electronic digital signal processing techniques—all of which Ciena is the first vendor to successfully commercialize.

Ciena's field-proven coherent technology allows 40 Gb/s and 100 Gb/s operation over 10G-engineered networks and advanced digital signal processing automatically corrects for signal degradations caused by fiber impairments.

The 6500's 40G/100G can ride over numerous 50GHz-spaced ROADMs, allowing operators to gracefully integrate these next-generation solutions into a hybrid network with an incredible level of photonic layer scaling.

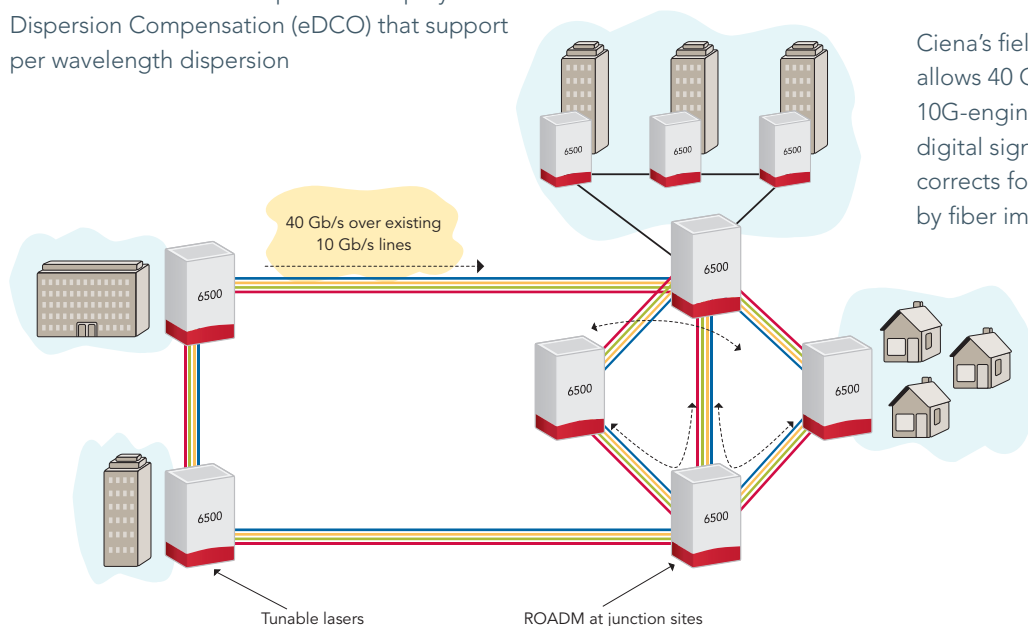


Figure 3. 40G Transport over existing 10G network designs and fiber

With integrated compensation capabilities for both chromatic and polarization mode dispersion, Ciena's 40G/100G solutions deliver economic and operational benefits by reducing and/or eliminating equipment—such as regenerators, RAMAN, and compensators—and allow the operator to use existing fiber.

40G ultra-long-haul interfaces are also available with the ability to span transoceanic distances (9,000km nominal) in submarine applications, allowing operators to upgrade their 2.5G/10G subsea links 16-fold and fourfold respectively.

Ethernet Aggregation Services

A key aspect of enabling the transition to a packet-based transport infrastructure is the ability to achieve aggregation/statistical muxing on packet interfaces. Ciena's 6500 offers various MEF-certified interfaces with Layer 2 switching capabilities. First, the Layer 2 Service Switch (L2SS) and L2 MOTR provide excellent Ethernet QoS and traffic management functionality on a per-customer flow basis and allow the delivery of services with stringent SLAs. Very granular customer flows of as low as 64 kb/s can be supported. Cost-effective and deterministic Ethernet protection is provided with G.8032 Ethernet Protection Ring technology support.

IEEE 802.17b-compliant Resilient Packet Ring (RPR) interfaces allow Ethernet switching over a packet-based ring, and have the same basic traffic management capabilities as the L2SS.

Ethernet Virtual Private LAN or Multicast/Broadcast Video Distribution Applications

Because they support any-to-any connectivity, the L2 interfaces on the 6500 can also be used for Ethernet Virtual Private LAN or multicast/broadcast video distribution applications, bringing the same values of statistical muxing, Ethernet QoS and traffic management to these applications.

For video broadcast applications, the 6500 affords carrier-grade resiliency with Ethernet Private Line drop-and-continue capability that includes differentiating equipment and facility protection. Alternatively, operators can cost-effectively architect their video

broadcasting networks using G.8032 Ethernet Protection Rings, with the 6500 interworking across other G.8032-compliant equipment in the access.

For high-bandwidth consumer service applications, such as Video on Demand (VoD), efficient transport is provided through native 10GE LAN PHY, 40GbE, and 100GbE interfaces.

Ethernet Services Over Existing Copper Network

Employing the 6500's PDH Gateway function, service providers can cost-effectively start delivering Ethernet services over their existing PDH-based (T1/E1/T3/E3) private line copper access infrastructures, without requiring any upgrades to the already-deployed access network. The PDH Gateway is based upon industry standard GFP, Virtual Concatenation (VCAT) and Link Capacity Adjustment Scheme (LCAS) technologies that can interoperate with any standards-compliant Customer Located Equipment (CLE). The 6500 can terminate hundreds of CLE Ethernet devices on a single shelf, resulting in a highly scalable and cost-effective solution for extending metro Ethernet service footprint and delivering Ethernet bandwidth in the range of 1 Mb/s to 50 Mb/s using bundled

T1/E1 or T3/E3 links. The fact that the Ethernet service is going over the existing leased line access network is completely transparent to the end customer—he is simply enjoying native Ethernet connectivity with the quality of service he needs and demands.

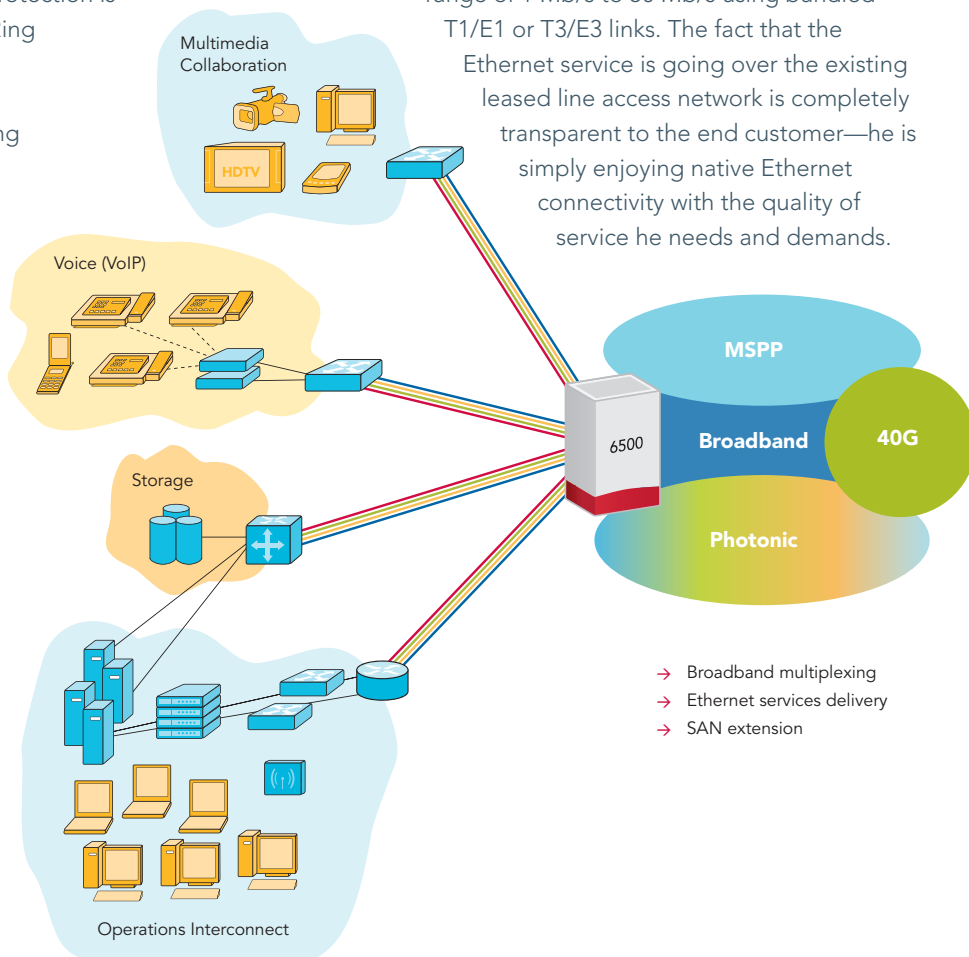


Figure 4. Delivering multiservice business solutions with a single platform

Full Support of TDM—Wireless Backhaul and Next-generation Cross-Connect Replacement

The 6500 supports established TDM services with excellent densities and flexibility. High-density copper services (DS1/E1, DS3/E3, EC-1/STS-1), modular and per-port selectable optical services (OC-3/STM-1, STM-1e, OC-12/STM-4, OC-48/STM-16, OC-192/STM-64, and 40G OC-768/STM-256 DWDM interfaces) provide carriers with a robust service offering and the peace of mind that comes with service forecast tolerance.

Unrestricted bandwidth management capabilities on the cross connect result in a more efficient use of the optical network and prevent premature overlays of equipment that result from limited grooming capabilities.

With unprecedented 80 Gb/s unconstrained single-stage (non-blocking) VT1.5/VC12 grooming and switching—along with its high optical (with short reach options) DS1/E1 and DS3/E3 densities in a compact frame—the 6500 offers maximum CAPEX and OPEX savings in DCS replacement and wireless backhaul applications. A 48-channel portless transmux interface provides conversion between DS3-channelized and E1/DS1 traffic, processing up to 5G of traffic in one slot, further reducing requirements for external digital cross connect equipment in the network. Full remote troubleshooting capabilities such as optical and electrical loopback, test access and test signal generation capabilities are integrated into the platform, ensuring it meets all operational requirements.

Simple Network Management

Underpinning its capabilities, the 6500 enhances the manageability of Ethernet networks by delivering a

comprehensive management solution that provides full OAM capabilities and the same carrier-grade options across Layers 0, 1 and 2, while preserving the operational values of circuit-based networks and a familiar paradigm.

Capabilities of the 6500 management system include:

- Automatic turn-up (SLAT - Service Line-up and Test)
- End-to-end provisioning, visualization and troubleshooting across Layer 0 through Layer 2
- Centralized fault, event and performance monitoring
- Historical query and reports
- Embedded IBM Tivoli product line to provide a Web-based client architecture as well as high-rate fault management
- Industry-standard XML and Corba northbound interfaces adhering to the TMF 814/854 (MTOSI 2.0) standards
- Optional and customizable service fault correlation and service management

In addition, a full suite of sophisticated design tools such as Optical Planner and Optical Modeler are available to customers to evaluate various deployment scenarios over multiple periods, comparing network cost, availability and utilization to decide on the best network architecture to evolve toward. Network resilience to single, dual and multiple failures can be simulated, providing the user with additional data points to compare network deployment scenarios. A powerful GUI interface allows the visualization of a large number of network parameters, such as bandwidth usage per segment, services routing before and after failure, system utilization using color schemes, etc. These graphical outputs are complemented by detailed reports that can be exported

for further analysis. Optical Modeler allows the user to simplify and accelerate photonic network design and expansion to provide an end-to-end photonic solution from planning to modeling to implementation. With Optical Modeler, the user can perform detailed photonic simulation, creating ready-to-deploy designs and guaranteed end-of-life designs. These tools provide an invaluable aid in the planning of customer moves, changes and migration to the latest optical and data networking technologies.

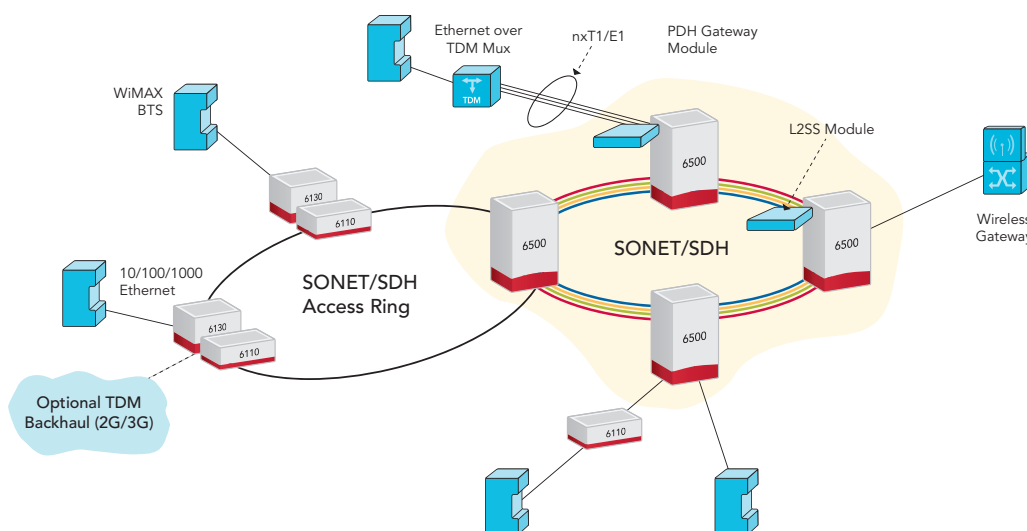


Figure 5. Adding flexibility and scalability to Wireless Backhaul

Many network applications. One platform.

Ciena's 6500 uses technology innovation to simplify networking for service providers and enterprises. With full integration of TDM, WDM and Ethernet capabilities into the platform, the 6500 provides the business model tolerance and service flexibility operators need to seamlessly evolve their networks toward resilient and optimized Ethernet-based infrastructures.

Technical Information

Capacity

Chassis: 640 Gb/s
System: 8.8 Tb/s
WDM: 2.5G/10G/40G/100G DWDM,
2.5G CWDM
Wavelength support: 88 wavelengths in
C-band, full band tunable optics
Channel spacing: 50GHz and 100GHz
spacing options
Cross Connects: 20G - 80G low order,
160G - 640G high order

Interfaces

Coherent 100G: Complete suite of line cards
(metro, regional, long haul, enhanced
PMD, submarine), 10x10GE client,
10x10G multi-rate client, 100GbE client
Coherent 40G: Complete suite of line cards
(metro, regional, long haul, ultra long haul,
enhanced PMD, submarine), 4x10-11.1G
client, 40G (OC-768/STM-256/OTU-3)
client, 40G XCIF
Photonics: full suite of WSS ROADMs,
amplifier, and Channel Mux/Demux
options
Ethernet: L2 service switch, RPR, PDH
Gateway, L2 MOTR, EPL
Electrical: E1, DS1, DS3, EC-1, E3
Optical: OC-3/STM-1 through OC-768/STM-
256, OTU-1 to OTU-3
Storage: Fibre Channel 100/200/400/800/1200,
FICON, FICON Express, 5G InfiniBand, IBM
ISC3, IBM STP
Transparent: Transparent SONET/SDH over
Ethernet

LO Capabilities

Network Topology Autodiscovery
Per channel power monitoring at photonic
amplifier output
Per channel power control
Dynamic power equalization per wavelength
Integrated CD compensation - 10G
Integrated CD/PMD compensation for 40G
and 100G

Ethernet Capabilities

Rate limiting increments of 64K, 1M, 10M,
and 100M
Policing per VLAN, each with COS level
having its own CIR, EIR, and Burst
rate limiting

Shelf Configuration

Converged optical, photonic, electrical,
Ethernet switching shelf
Each slot can be tributary, line, transponder,
photonic interface

System Configurations

Unprotected
1+1/MSP linear ASP
1+1 OTN line-side protection
1+1 Transponder Protection Tray
2-Fiber BLSR/MS-SPRing
UPSR/SNCP
Ethernet point-point, Ethernet
multipoint-multipoint, G.8032
Ethernet Protection Ring
Resilient Packet Ring
PDH Gateway
International Gateway

Bandwidth Management

VT1.5, VC12, STS1/LO VC3, STS-1/VC4
VC11, VT2, HO VC3
Contiguous Concatenation
Virtual Concatenation (VCAT): High Order
(STS1-nv/VC3-nv) and Low Order
(VT1.5-nv/VC11-nv, VT2-nv/VC12-nv)
Link Capacity Adjustment Scheme (LCAS),
both high and low order

Environmental Characteristics

Normal Operating Temperature: +5° C to
+40° C (+41° F to +104° F)
Short Term Operating Temperature (7/14-
slot): -5° C to +55° C (+23° F to +131° F)
Short Term Operating Temperature (32-slot):
-5° C to +50° C (+23° F to +122° F)
Normal operating humidity: 5% to 85% RH
Earthquake/seismic: Zone 4

Physical Characteristics

Dimensions:
6500 7-slot: 10.5" (6U) (H) x 17.3" (W) x 11.1" (D)
267 mm (H) x 440 mm (W) x 281 mm (D)
6500 14-slot: 22.7" (13U) (H) x 17.3" (W) x
11" (D), 577 mm (H) x 440 mm (W) x
280 mm (D)
6500 32-slot: 38.5" (22U) (H) x 19.6" (W) x
10.9" (D), 977 mm (H) x 498 mm (W) x
277 mm (D)

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Networks that change
the way you compete.

1201 Winterson Road
Linthicum, MD 21090
1.800.207.3714 (US and Canada)
1.410.865.8671 (outside US and Canada)
+44.20.7012.5555 (international)
www.ciena.com