Experience. Outcomes.

PRODUCT BROCHURE

Converged Packet Optical Products

Using Technology Innovation to Maximize Network Scale and Programmability

Architected for network modernization, Ciena's Converged Packet Optical products integrate comprehensive Ethernet, TDM, and WDM capabilities in single platforms for cost-effective delivery of emerging and existing services, from the access edge, along the backbone core, and across ocean floors. The 5400 and 6500 packet-optical platforms can operate over a simple or colorless/directionless photonic layer, which combines with OTN/packet switching and an intelligent control plane to maximize the bandwidth efficiency and flexibility of the overall network. Complementing their many capabilities, the systems also feature full instrumentation and embedded intelligence across all layers with an emphasis on automating and simplifying operations.

Complete flexibility

The flexibility of Ciena's Converged Packet Optical products starts with the variety of services they 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 100GbE/OTU4—from metro to submarine applications. Standards-based service interfaces ensure seamless multi-vendor interoperability.

Network elements can be customized to support 2.5G to 100G switched or 200G DWDM applications as bandwidth and connectivity demands dictate. Various line and equipment protection options are available to help providers support a tiered SLA and differentiated service offering and enable expansion of the current customer base.

Six chassis form factors are available on the 6500, with another two larger chassis on the 5400 for an unprecedented flexibility of scale from tens of Gigabits to multiple Terabits of nodal capacity. The smaller shelf variants offer both AC and DC power options, supporting fit in all environments.

This flexibility results in the ability to cost-optimize configurations to best match site capacity, space, and power requirements. One management system and reusable cards across the various shelves reduce standardization cycles and sparing expenses, and simplify network operations. Along with the ability to tailor the customer offering, these products come with proven five-9s 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 condition for business success is the ability to photonically interconnect sites quickly and economically to simplify operations of the network and reduce costs, power, and latency associated with regenerators. Ciena's Converged Packet Optical products offer the full range of photonic architectures, 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 and simpler network configurations, passive photonics can be used for lowest capital expenditures. For more meshed and complex configurations, flexible grid ROADM architectures offer full reconfiguration flexibility and simpler operations. Advanced software capabilities applied to Ciena ROADMs create the fully agile, end-to-end transport network. A full range of WSS cards and filters provide optimized performance and cost for varying degree branching sites, with software features focused on simplifying operations.

A unique benefit of Ciena's WaveLogic Photonics is the support of PinPoint integrated Optical Time Domain Reflectometer (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, PinPoint eliminates the pain points of previous Raman deployments by providing simplified, controlled turn-up and fast, precise pinpoint of faults.

Features and Benefits

- Adapts to a wide variety of requirements with a minimal set of equipment, reducing standardization and operational costs
- Utilizes next-generation OTN/packet technologies for the most efficient use of network resources
- Provides industry-leading 10G, 40G/100G/150G/200G coherent and control plane capabilities for scale and service differentiation
- Enables fully featured Ethernet service management options enabling full Layer 2 functionality on packet-switching modules
- Maximizes operational efficiencies with the ability to tailor customer solutions via various chassis options

Finally, contrary to other 'boxed-in' vendor solutions, Ciena'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 Ciena network can evolve to support directionless, colorless, and gridless architectures when appropriate economics are met for these new configurations.

Smarter high-capacity coherent

As the pioneer of coherent optical technology, Ciena offers comprehensive 100G/200G products 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 100G/200G 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 silicon chips, 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:

- Broader, more economical deployment of 100G across long-haul terrestrial and submarine global networks with fewer regenerators
- Doubled spectral efficiency to 4bits/sec/Hz in metro/regional applications
- Low-latency applications optimization

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.

OTN/packet efficiencies

Ciena's Converged Packet Optical products offer integrated OTN and packet switching for the most efficient use of network resources as well as transport of higher speed services.

A handful of 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 allows for transparent transport of all native services, along with end-to-end management of these services, all over a single converged network. Ciena also provides OTN 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, Ciena offers packet switch modules on all form factors of the 6500 and 5400 products. All packet switch modules leverage Ciena's Service-Aware OS (SAOS), which is available across the company's Packet Networking products and deployed on more than 750,000 platforms worldwide. This common technology implementation shared across different devices allows for rich functionality implementation and maximum operational efficiencies through equipment interoperability.

Ciena's Converged Packet Optical products support both muxponder-based and central-fabric-based OTN/packet 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 OTN/packet switched solutions include:

- Customized configurations based on connectivity requirements
- Unrestricted hybrid OTN/packet central switching, with the ability to tune for OTN/packet and/or OTN in any ratio
- The ability to double Ethernet 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 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 Converged Packet Optical products support OTN, SONET/SDH and Photonic OneConnect control planes.

OneConnect allows the transport network to automate and distribute many functions formerly performed through the combination of centralized management systems and manual processes. In particular, OneConnect supports the following features:

- Uses real-time network topology to provide automated self-inventory
- 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 Service Level Agreements (SLAs) with less deployed equipment. SLAs can range from unprotected to 50ms protection against any number of faults and everything in between. And for unprotected services, Photonic OneConnect ensures Mean Time to Repair guarantees can be met at little additional cost.

Another important benefit of OneConnect is that 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 re-route wavelengths onto shorter, more optimized paths to reduce regenerator ports and service latency and rebalance wavelengths to extend the life of the existing network.

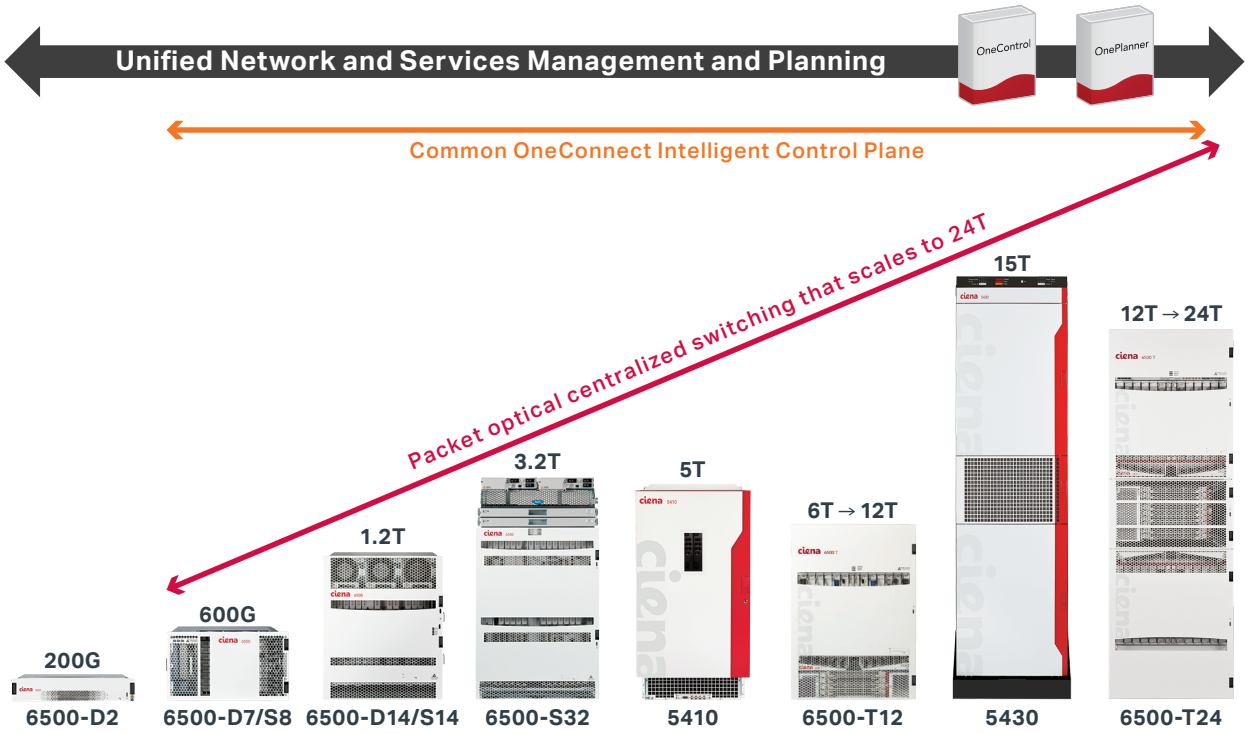


Figure 1. Ciena's Converged Packet Optical products

Ciena was among the first to deploy control plane in Dense Wavelength Division Multiplexing (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, multilayer visibility and optimization with OneControl and OnePlanner

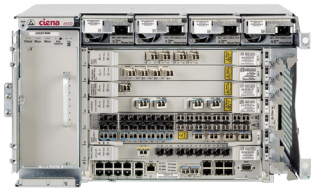
Ciena's OneControl Unified Management System offers comprehensive network and service management for end-to-end Ciena networks. Through a unified GUI and common management model, Network Operations Center (NOC) operators can rapidly deploy new service offerings that cut across domains (access, metro, 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—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.

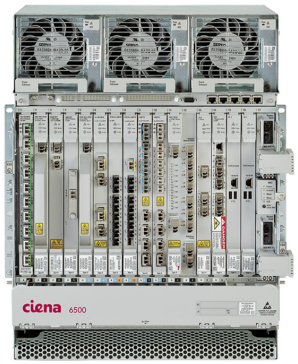
Ciena's OnePlanner Unified Design System is an advanced multi-layer network design and optimization tool that leverages Ciena's extensive background in Layer 1 control plane planning and simulation, photonic system design, advanced algorithm research, and GUI development into a comprehensive and easy-to-use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

OnePlanner's modular architecture enables use of design and engineering modules with all Converged Packet Optical products. These can be used autonomously for a specific layer, or simultaneously to plan, design, and model networks involving both Layers 0 and 1.

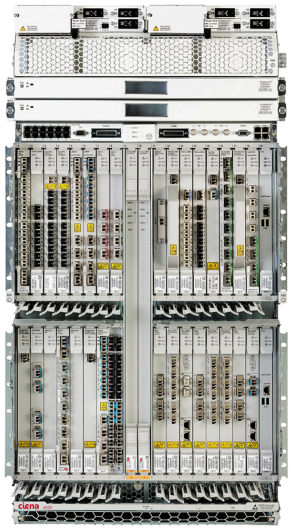
6500-D2 amplifier configuration



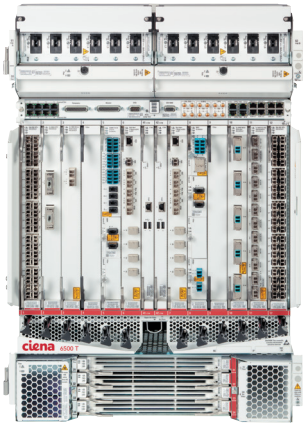
6500-D7 packet switching ROADM configuration



6500-D14 100G ROADM configuration



6500-S32 packet/OTN switch configuration



6500-T12 packet/OTN switch configuration

6500-T24 shelf

Figure 2. Configuration flexibility of Ciena's Converged Packet Optical products

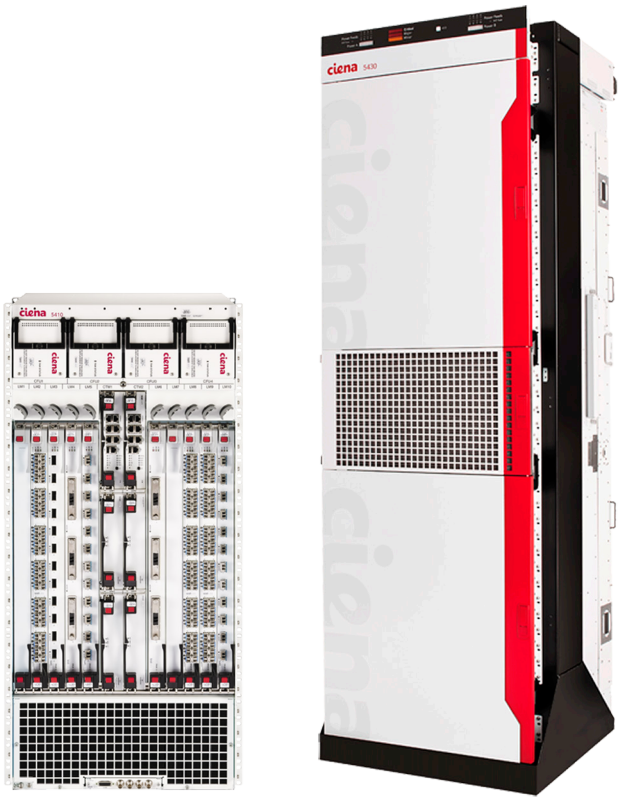


Figure 3. Multi-Terabit Packet Optical Switching Configurations

Summary

Deployed by more than 500 operators, Ciena's market-leading Converged Packet Optical products underpin service provider, research and education, government, and enterprise networks around the globe. The popularity of these products hinges on several key factors:

- They can be tailored for an economic fit into a variety of applications
- They very efficiently deliver a wide range of services leveraging packet and/or OTN switching
- They practically scale to elegantly and reliably handle step increases in capacity, to 100G and beyond, over existing infrastructure

With Ciena's Converged Packet Optical products, operators are able to drive their network transformation without restrictions or compromise—with room to grow.

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