

6500-T12/T24

6500 Packet-Optical Platform

With the ability to scale to Terabit/s switching per slot, Ciena's 6500 T-Series Packet-Optical Platform addresses the growing need to maintain profitable delivery of converged multi-layer services on demand, for a superior customer experience.

As traffic demands continue to grow and become more unpredictable, providers need a more dynamic network that can scale and respond on demand, based on the applications and services running on top of it. Ciena's 6500 T-Series shelf configurations provide the capacity, flexibility, and resiliency to address today's unpredictable traffic patterns to drive ongoing efficiency and programmability required to realize the benefits of the Adaptive Network™.

Ciena's 6500 T-Series converges packet, Optical Transport Network (OTN), and advanced multi-layer routing protocols, including Segment Routing (SR) in a single platform helping service providers streamline operations and optimize footprint, power, and capacity to specific site requirements.

Capable of scaling to Terabit/s switching per slot, the 6500 T-Series shelves evolve from the 6500 S-Series (100 Gb/s per slot Packet/OTN switching) shelves to address high-capacity applications in a very dense and compact form factor. Inherent with the rest of the 6500 Family of Packet-Optical platforms, the 6500 T-Series offers the same programmability benefits for ultra-high-capacity switching sites in the network. These include OTN control plane and market-leading coherent optics, maximizing service availability, network bandwidth utilization, and return on investment.

The 6500-T12/T24 shelves, operate with the robust and feature-rich 6500 software, and support high-density, high-capacity hardware modules. The 6500 T-Series leverages the programmability of Ciena's industry-leading WaveLogic™ coherent technology, enabling operators to maximize fiber capacity and lower the cost of transport, to deliver switching of >100G wavelengths. The 6500-T12 supports switching capacities of 12 Tb/s in half a rack. To address ultra-high capacity applications, the 6500-T24, supports switching capacities of 24 Tb/s in 36RU.



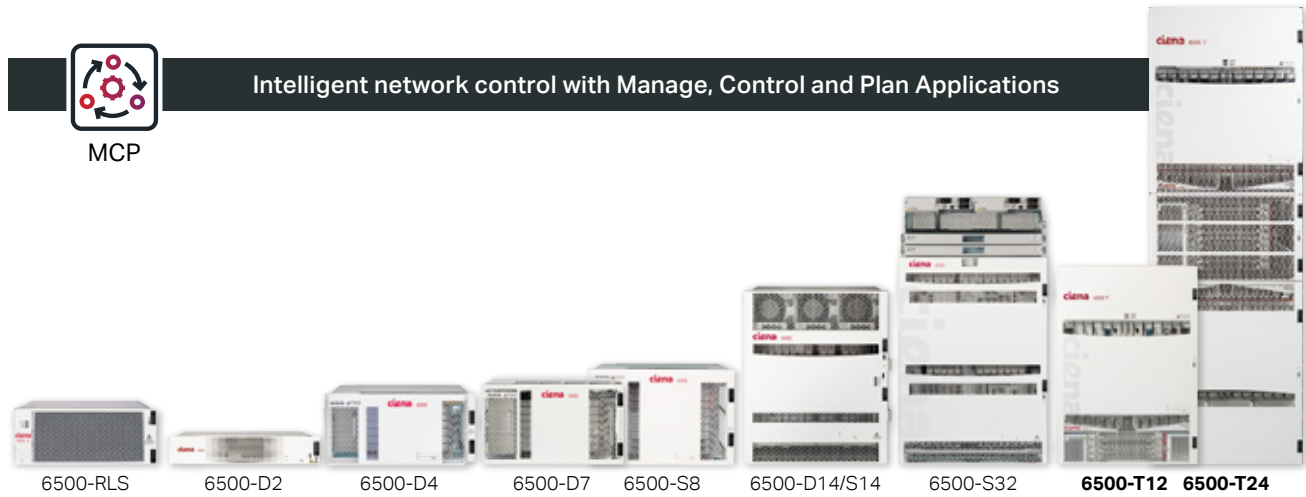
Features and Benefits

- Address ultra-high capacity requirements using less hardware via multi-layer capabilities and programmability in a single platform
- Gain significant power and space savings with support of 12 Tb/s of capacity in less than half a rack and 24 Tb/s per rack
- Respond to on-demand bandwidth needs with the most efficient use of network resources with fully non-blocking ODU0 granular switching and ODUFlex capabilities
- Leverage a wide breadth of SLA offerings with intelligent OTN control plane
- Benefit from industry-leading coherent technology with programmability required to build on-demand, programmable networks
- Deliver IP VPN and MPLS L2 VPN services, including VPWS and VPLS



MCP

Intelligent network control with Manage, Control and Plan Applications



Single converged platform addressing networking requirements from the edge to the core

Figure 1. 6500 Family

Key hardware modules include:

- Fully non-blocking, agnostic packet/OTN switch modules supporting 1 Tb/s switching capacity per slot
- Terabit packet/OTN service interface modules, provisionable from 100 percent packet to 100 percent OTN
- Terabit packet/OTN interface equipped with modular sub-slot hardware enabling a flexible mix of services and coherent tunability from 200G to 800G in 50G increments, with pay-as-you-grow benefits

Sub-slot hardware that leverages WaveLogic 5 Nano coherent pluggables to drive scalability and improved space/power efficiencies

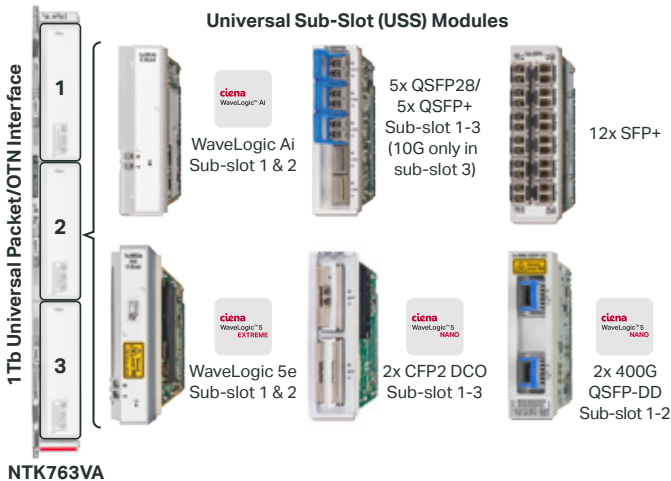


Figure 2. Flexible modular configurations to best meet customer requirements

Ciena's intelligent OTN control plane allows the network to automate and distribute many functions formerly performed through a combination of centralized management systems

and manual processes. Operators can leverage OTN control plane for several advantages, including:

- Accurate inventory of equipment and bandwidth resources
- Faster service provisioning and turn-up
- Tunable SLAs via flexible protection and restoration options
- Network optimization and maintenance

Advanced multi-layer protocol support

The 6500 T-Series supports a selection of flexible service offerings, including L2 and L3 services over a carrier-class infrastructure based on either a static (MPLS-TP) or a dynamically signaled MPLS data path.

Dynamic MPLS data path support includes Border Gateway Protocol Labeled Unicast (BGP-LU), Resource Reservation Protocol-Traffic Engineering (RSVP-TE), and SR-MPLS. These features offer seamless MPLS transport tunnels spanning multiple network domains with per-domain traffic engineering capabilities for strict SLA enforcement.

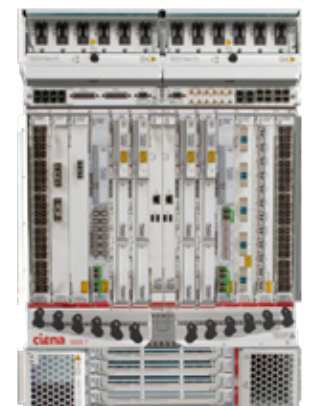


Figure 3. 6500-T12 shelf equipped with 1 Tb/s slot switching modules

With BGP Prefix Independent Convergence (BPG PIC), the 6500 T-Series can rapidly switch to an alternate Autonomous System Boundary Router (ASBR) in the event of an ASBR router or intra-domain failure (also known as BGP Fast Reroute (FRR)).

Support for RSVP-TE allows operators to interoperate with existing MPLS TE infrastructures. 6500 T-Series offers rich RSVP-TE capabilities including support for Explicit Path or Dynamic Constrained Shortest Path First (CSPF) through ISIS with bandwidth reservation, Shared Risk Link Groups (SRLGs) and Link Affinities, Make-Before-Break (MBB), FRR, and Facility Bypass (link and node protection) with SRLG awareness.

SR provides a highly scalable transport tunneling option with enhanced programmable traffic-engineering capabilities. SR simplifies network architecture and operations by eliminating the need for a dedicated protocol for signaling transport tunnels and managing their state. Topology Independent-Loop Free Alternate (TI-LFA) with Micro-loop Avoidance ensures rapid failover to a pre-computed backup path in the event of a local network failure.

6500 T-Series supports dynamically signaled Ethernet Pseudowires (PW) for L2 services, statically signaled PWs for TDM services, and BGP signaled Layer 3 VPN services. These services can flexibly ride over a variety of transport tunnel options. Comprehensive OAM capabilities such as EVC ping, LSP ping, and trace route offers operators the necessary tools to effectively troubleshoot and manage services over dynamic MPLS infrastructure.

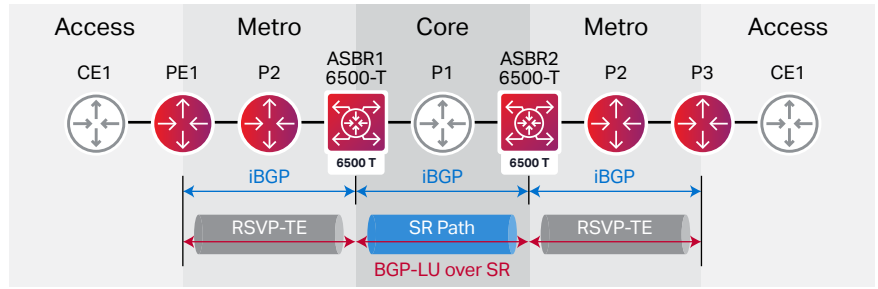


Figure 4. BGP-LU over Segment Routing

Additionally, Ciena’s Manage, Control and Plan (MCP) domain controller provides end-to-end network and service lifecycle management across Ciena’s packet-optical infrastructure. Through software-defined control, MCP provides a unified interface—GUI or open REST APIs—with which operators can rapidly plan, provision, turn up, and troubleshoot multi-layer services.

The 6500 T-Series extends the functional integration, flexibility, and programmability benefits of the 6500 to new levels of densities and scale to address today’s unpredictable traffic patterns and drive toward the Adaptive Network.

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Technical Information

6500 T-Series Shelf	6500-T12	6500-T24
Physical Dimensions	17U 754 mm (H) x 498 mm (W) x 433 mm (D) 29.7 in (H) x 19.6 in (W) x 17.0 in (D)	36U 1590 mm (H) x 498 mm (W) x 433 mm (D) 62.6 in (H) x 19.6 in (W) x 17.0 in (D) Shelf 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)
Mounting Options	ETSI, EIA 23 in.	Pre-mounted in EIA 23 in. rack
Cooling	Energy-efficient, variable speed, redundant, and field-replaceable shelf fan modules	
Power	<ul style="list-style-type: none"> • Redundant, field-replaceable power input modules • Operational input voltage: -40V to -75Vdc 	
Control and Timing Module	Redundancy supported	
Switch Modules	<ul style="list-style-type: none"> • 1 Tb/s switching per slot, up to 12 Tb/s per T12 shelf and up to 24 Tb/s per T24 shelf • 500 Gb/s switching per slot, up to 6 Tb/s per T12 shelf and up to 12 Tb/s per T24 shelf • Agnostic for both OTN and packet switching • Non-blocking OTN switching, ODU0 granularity – ODU0 to ODU4, including ODUFlex • Quality of Service (QoS)-aware packet switching with 8 Classes of Service (CoS) • Redundant equipment protection: 3:1 for the T12 and 8:1 for the T24 	

Service Interfaces	<ul style="list-style-type: none"> • 1Tb 3x Universal Sub-Slot (USS) packet/OTN Interface • 500G 2x Universal Sub-Slot (USS)/2x QSFP28 packet/OTN Interface • Universal Sub-Slot (USS) Modules <ul style="list-style-type: none"> - 800G WaveLogic 5e USS Module: coherent tunability from 200G to 800G in 50G increments - 2 x 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 - 2x QSFP-DD - gray or AOC, including WaveLogic 5 Nano QSFP-DD variants - 2x CFP2-DCO WL5n, including WaveLogic 5 Nano CFP2-DCO variants • 40 x 10G SFP+ packet/OTN Module – 10GbE, OC-192, STM-64, OTU2, OTU2e • 5 x 100G / 12 x 40G QSFP28/QSFP+ packet/OTN Module – 10GbE, 40GbE, 100GbE, OTU3, OTU4 • 5 x 100G WaveLogic 3 Nano CFP2 coherent DWDM packet/OTN Module – OTU4 	
Networking Protocols	<ul style="list-style-type: none"> • BGP Prefix Independent Convergence draft-ietf-rtgwg-bgp-12 • RFC 792 Internet Control Message Protocol • RFC 826 An Ethernet Address Resolution Protocol • RFC 2205 RSVP • RFC 2439 BGP Route Flap Damping • RFC 2474 Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers • RFC 2961 RSVP Refresh Overhead Reduction Extensions • RFC 2918 Route Refresh Capability for BGP-4 • RFC 3031 MPLS architecture • RFC 3107 Support BGP carry Label for MPLS • RFC 3209 RSVP-TE: Extensions to RSVP for LSP • RFC 3392 Capabilities Advertisement with BGP-4 • RFC 3784 ISIS TE support • RFC 3942 Reclassifying Dynamic Host Configuration Protocol version 4 (DHCPv4) Options • RFC 3985 Pseudo Wire Emulation Edge-to-Edge (PWE3) Architecture • RFC 4090 Fast Reroute Extensions to RSVP-TE for LSP tunnels • RFC 4124 Protocol Extensions for Support of Diffserv-aware MPLS Traffic Engineering • RFC 4206 Label Switched Paths (LSP) Hierarchy with Generalized Multi-Protocol Label Switching (GMPLS) Traffic Engineering • RFC 4271 A Border Gateway Protocol 4 (BGP-4) • RFC 4272 BGP Security Vulnerabilities Analysis • RFC 4360 BGP Extended Communities Attribute • RFC 4364 BGP/MPLS IP Virtual Private Networks (VPNs) • RFC 4385 Pseudowire Emulation Edge-to-Edge (PWE3) Control Word for Use over an MPLS PSN" • RFC 4447 Pseudowire Setup & Maintenance using Label Distribution Protocol (LDP) • RFC 4448 Encapsulation Methods for Transport of Ethernet over MPLS Networks (PW over MPLS) • RFC 4456 BGP Route Reflections: An Alternative to Full Mesh Internal BGP (IBGP) • RFC 4664 Framework of L2VPN (VPLS/VPWS) • RFC 4665 Service Requirement of L2 VPN • RFC 4724 Graceful Restart Mechanism for BGP • RFC 4762 VPLS (Virtual Private LAN Service) and Hierarchical VPLS (H-VPLS) • RFC 4893 BGP Support for Four-octet AS Number Space 	<ul style="list-style-type: none"> • RFC 4906 Transport of Layer 2 Frames Over MPLS • RFC 5036 LDP Specification • RFC 5085 Pseudowire Virtual Circuit Connectivity Verification (VCCV): A Control Channel for Pseudowires • RFC 5287 Control Protocol Extensions for the Setup of Time-Division Multiplexing (TDM) Pseudowires in MPLS Networks • RFC 5291 Outbound Route Filtering Capability for BGP-4 • RFC 5292 Address-Prefix-Based Outbound Route Filter for BGP-4 • RFC 5301 Dynamic Hostname Exchange Mechanism for IS-IS • RFC 5303 Three-Way Handshake for IS-IS Point-to-Point Adjacencies • RFC 5305 IS-IS Extensions for Traffic Engineering • RFC 5493 BGP capabilities advertisement • RFC 5586 Generic Associated Channel Label • RFC 5654 MPLS-Transport Profile (TP) • RFC 5880 Bidirectional Forwarding Detection • RFC 5884 LSP Bidirectional Forwarding Detection (BFD) via GAL/G-Ach channels • RFC 6215 MPLS Transport Profile User-to-Network and Network-to-Network Interfaces • RFC 6391 Flow-Aware Transport of Pseudowires over an MPLS Packet Switched Network • RFC 6426 MPLS On-demand Connectivity Verification and Route Tracing • RFC 6428 LSP and PW Connectivity Verification and Trace Route • RFC 7130 Bidirectional Forwarding Detection (BFD) on Link Aggregation Group (LAF) Interfaces • RFC 7311 The Accumulated IGP Metric Attribute for BGP • RFC 7490 Remote Loop-Free Alternate (LFA) Fast Reroute (FRR) • RFC 7911 Advertisement of Multiple Paths in BGP • RFC 8102 Remote-LFA Node Protection and Manageability • RFC 8214 Virtual Private Wire Service Support in Ethernet VPN • RFC 8333 Micro-Loop Prevention by introducing a Local Convergence Delay • RFC 8402 Segment Routing Architecture • RFC 8660 Segment Routing with MPLS Data Plane • RFC 8667 IS-IS Extensions for Segment Routing • Segment Routing Policy Architecture draft-ietf-spring-segment-routing-policy-08
Environment Characteristics	<p>Normal Operating Temperature +5°C to +40°C (+41° F to + 104° F)</p> <p>Short Term Operating Temperature -5° C to +50° C (+23° F to +122° F)</p> <p>Normal Operating Humidity 5% to 85% RH</p> <p>Earthquake/seismic Zone 4</p>	