Ciena's 6500 Packet Transport System (PTS) addresses the growing need to maintain profitable delivery of TDM services while future-proofing investments toward an all-packet network modernization.

To this day, network providers continue to add to their Time Division Multiplexing (TDM) infrastructure—an investment that is getting more expensive to run and operate. Clearly doing more of the same only increases OPEX due to expensive spares and higher maintenance, hard-to-find legacy skill sets, and manual operations.

Today's operators have transitioned toward packet-based architectures as the means to access and scale connectivity to legacy services. This is becoming critical to maintaining productivity while reducing costs.

As service providers approach the end-of-life of their legacy equipment, one clear objective is to maintain the profitable delivery of TDM services.

The 6500 PTS is purpose-built to save significant central office footprint and power and maintain substantial customer mission-critical private line services. It enables new IP and Carrier Ethernet services and allows simple customer TDM-to-Ethernet service migration as needed, without having to replace the platform or the transport network.

Ciena's 6500 PTS enables network providers to consolidate Digital Access Cross-connect System (DACS), Multi-Service Provisioning Platforms (MSPPs), and packet switching and transport functions, all in the same platform.

**Enabling packet and TDM over the same network**

Migration of TDM services can be complex and difficult, as not all TDM services can be replaced or shut down. In some cases, regulatory restrictions may exist for critical services, and in other cases, end-customers are reluctant to migrate even in the face of rising costs. Maintaining contractual and regulatory commitments while meeting new packet-based demand using two different networks is inefficient and adds cost.

With massive and unpredictable bandwidth demands, network operators need to manage, consolidate, and modernize TDM assets (Figure 1).

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**Features and Benefits**

- Exceptional DS1, DS3, E1, E3, OC-3/12/48/192, STM-1/4/16/64, and 10/100/1GbE/10GbE, 40GbE/100GbE density to address space constraints
- Preserves TDM service, no change to customer end or revenue, customer experience, and tariffs
- Launches new Packet and CE services, including MEF CE 3.0-certified for E-Tree, E-Line, E-LAN, E-Access, and E-Transit
- Features hardware-assisted packet OAM capabilities for guaranteed SLA differentiation
- Offers Zero-Touch Provisioning (ZTP) for rapid, secure, and error-free turn-up of packet services
- Includes advanced packet synchronization
- Integrates line-rate Service Activation Testing capabilities
- Includes Ciena's MCP multi-layer provisioning support for end-to-end network management control and planning
- Offers flexible low-power configuration options with redundant power supply (DC) and fan modules
Ciena’s 6500 PTS effortlessly supports replacement of massive legacy 3/1 DACS, enabling DS1 and VT1.5 level switching through a packet fabric. 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.

As an MPLS switch, network operators can modernize their TDM network, enabling migration of TDM services to an MPLS-protected core network. In addition, the 6500 PTS operates as a standard MPLS switch for transport and switching of Ethernet services and a pathway to future IP services.

**Scalable, dense capacity**

Native TDM networks are becoming obsolete, operationally expensive, difficult to maintain, power- and space-inefficient, and unable to handle packet traffic efficiently.

Using 6500 PTS provides a high-density TDM and native Ethernet on-ramp to a next-generation packet optical network. As services transition from TDM to packet, the same 6500 PTS can be used to support packet services and seamlessly transport the legacy TDM services.

Addressing TDM migration by expanding the use of legacy equipment is not a sustainable business model. As shown in Figure 2, traditional legacy 3/1 DACS equipment can take up to ten times the space and five times the power as the 6500 PTS.

Using advanced packet technology and packet switching fabric, the 6500 PTS delivers unprecedented scale and density.

**Differentiation through service velocity**

Service velocity has become a critical competitive advantage for network operators. In many cases, service velocity is the determining factor in winning new service sales. The 6500 PTS implements Ciena’s unique and secure Zero-Touch Provisioning (ZTP) capabilities, allowing network operators to rapidly deploy packet-based services in a completely automated manner. With no human intervention required, manual provisioning errors are eliminated. Most importantly, ZTP improves service deployment velocity and offers significant competitive advantages.

**Rich packet OAM capabilities**

As network operators and their customers increasingly rely on new packet-based networks, providers must maintain the reliability and deterministic behavior of the legacy TDM services. Packet networks must support a broad array of packet Operations, Administration, and Maintenance (OAM) capabilities to ensure network operators can proactively and reactively maintain and report on the ongoing health of their metro Ethernet networks and services. The 6500 PTS supports a comprehensive set of hardware-assisted packet OAM capabilities—including per-service Ethernet fault (IEEE 802.1ag) and performance monitoring (ITU-T Y.1731), and embedded line-rate Service Activation Test (RFC2544 and Y.1564 KPI’s)—to help guarantee and manage strict, market-differentiating SLAs.
Link Aggregation Group (LAG), Distributed-LAG (D-LAG), MPLS-TP, or MPLS alternate path capabilities provide redundancy and resilience by addressing single-point-of-failure concerns and maintaining high levels of customer satisfaction.

**Simplified multilayer management and control**

Ciena’s Manage, Control and Plan (MCP) domain controller software offers a unique and comprehensive solution for the administration of mission-critical networks that span access, metro, and core domains, and provides unprecedented multi-layer visibility from the photonic to the packet layers. With this innovative management approach, MCP returns control of the metro packet network and services directly to the network operator. By providing a unified view of the network from the photonic layer to the packet layer, MCP ensures network operations are simple, secure, and highly cost-effective.

**Advanced timing and synchronization options**

The heartbeat of any circuit-based network is timing. The 6500 PTS supports a flexible arrangement of timing modes of operation including an internal clock, BITS, Line, Synchronous Ethernet, and 1588v2-Grand Master, boundary, and ordinary clock support.

**Flexible service delivery configurations**

The 6500 PTS supports a flexible menu of service offerings ranging from MEF-compliant E-Line/E-LAN/E-Tree/E-Access/E-Transit, to L3 services over a carrier-class, connection-oriented infrastructure using MPLS, MPLS-TE, and MPLS-TP.

**Advanced QoS support**

The 6500 PTS supports fine-grained SLA monitoring and enforcement techniques to help operators deliver successfully on tight SLA guarantees. Hierarchical QoS permits delivery of a wide range of traffic types including management, timing/synchronization, multiple customer-prioritized, and best-effort service traffic, without interference or degradation. These capabilities enable greater revenue generation by utilizing available network resources more efficiently.

Sophisticated VLAN tag manipulation and control allow innovative customer traffic separation approaches and a rich set of classification of service flows through the switch. Hierarchical ingress metering can be configured for sub-port services, offering the ultimate in flexible flow control based on L2, L3, and L4 classification. In addition, egress bandwidth shaping on a per-EVC basis is built to allow fine-tuning delay and buffering efficiency within the device.

**Multiservice-capable circuit emulation**

In addition to its industry-leading Ethernet capabilities, the 6500 PTS supports multiservice transport over Ethernet networks, allowing traditional TDM, ATM, and native Ethernet traffic to be carried over metro backhaul and core data networks.

- Structured Agnostic TDM access (T1/E1 – SAToP)
- Structured Aware TDM access (nxDS0/E0- CESoPSN)
- Full support of IETF Pseudowire Emulation Edge-to-Edge (PWE3) over Ethernet and MPLS networks

The 6500 PTS takes circuit emulation to the next level, allowing the service to be carried as a co-routed, route-diverse protected service adhering to strict deterministic and restoration needs.

**Advanced multi-layer protocol support**

Making liberal use of a packet fabric to support TDM circuit emulation Ethernet, IP, and MPLS technologies, the 6500 PTS can support any number of new network architectures.

The 6500 PTS supports a flexible selection of service offerings, including L2 and L3 services over a carrier-class, connection-oriented infrastructure using MPLS and Segment Routing (SR). Using SR policy, different source-routed domains and their services, including L2VPN, TDM-PW, and L3VPNs, can be selected for a path to upstream routers. Ciena’s 6500 PTS supports coexistence of SR and other signaling protocols, including Resource Reservation Protocol-Traffic Engineering (RSVP-TE), enabling seamless MPLS connectivity and scalability of intra domain SR paths.
6500 PTS supports Border Gateway Protocol (BGP); Exterior Gateway Protocol (ERP); BGP-Labeled Unicast (BGP-LU) multiprotocol extensions; BGP Route Reflectors (BGP RR) to learn available routes without creating loops; and BGP Prefix Independent Convergence (BPG PIC) performance enhancements to decrease PE path convergence time should an Interior Gateway Protocol (IGP) or edge PE router fail and switch to a different PE router.

Dedicated, Virtual Routing Forwarding (VRF) instances per L3VPN or IPVPN can be provided on the 6500 PTS over MPLS transport (RSVP-TE or SR) to take advantage of MPLS resiliency such as FRR/TI-LFA, etc.

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**Technical Information**

<table>
<thead>
<tr>
<th>Description</th>
<th>6500-S8</th>
<th>6500-S14</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H x W x D (mm)</strong></td>
<td>7U 310 x 440.5 x 281</td>
<td>13U 577.1 x 440.5 x 280</td>
</tr>
<tr>
<td><strong>H x W x D (inches)</strong></td>
<td>7U 12.2 x 17.3 x 11.1</td>
<td>13U 22.7 x 17.3 x 11.0</td>
</tr>
<tr>
<td>Chassis Per Rack</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Weight (Max)</td>
<td>33Kg</td>
<td>56Kg</td>
</tr>
<tr>
<td>DC Input</td>
<td>1x 50A</td>
<td>2x 50A</td>
</tr>
<tr>
<td>Power Consumption (Watts@ 25°C/ -48vDC, no optics)</td>
<td>1333W (Typical)</td>
<td>1960w (Typical)</td>
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<tr>
<td>Operating Temp.</td>
<td>Normal: 41° F to 104° F (5° C to 40° C)</td>
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</tr>
<tr>
<td>Storage Temp.</td>
<td>-40° F to 158° F (-40° C to 70° C)</td>
<td></td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>5% to 85% RH (normal operating humidity)</td>
<td></td>
</tr>
<tr>
<td>Air Flow</td>
<td>Front to back, front to front, and right to left</td>
<td>Front to front, and front to back</td>
</tr>
</tbody>
</table>

**Tributary Service Interfaces**

**PDH Modules:**
- PTS PDH I/F 2xDSiM: 16xDS1/E1 ports or 48xDS3/E3/EC1 CEM
- PTS PDH I/F 10x DIM 1:N PROTECTION: up to 1.5 PDH protection
- 84xDS1/E1 DIM
- 24xDS3/E3/EC1 DIM

**MRO Module:**
- PTS MRO I/F 2xSFP+/14xSFP: 16x SFP (16xOC-3/12/STM-1/4, 8xOC-48/STM-16, 2xOC192/STM-64, or 16x100FX/GbE (10/100/1000BaseT), or 2x10Gbe ports

**Ethernet Module:**
- PTS ETH I/F 40G 16 PORT (4x SFP+/16X CSFP) CIRCUIT PACK
- 4xSFP+ (4x10GE)
- 16xSFP (16x 10/100BaseT/ 100FX/ GE)
- 16xCSFP (32 GE ports)
- PTS ETH I/F 100G 12 Port (2x QSFP28/10xSFP+) Circuit Pack
- 1xQSFP+ (1x40GE, 4x10GE)
- 1xQSFP+/QSFP28 (1x100GE, 1x40GE, 4x10GE)
- 10xSFP+ (10x10GE)

**DWDM Module:**
- OTR WL3n Enh: 1xQSFP28
  - Any module; any slot

**Control Timing & Fabric Switch Modules**

**Shelf Processor**
- SP2: local craft access, security, event history, alarms, and controls

**Fabric switch**
- X-CONN 800G PTS: 1x QSFP28/QSFP+, 2x SFP+

**Ethernet**
- Hierarchical Quality of Service (HQoS)
- including Ingress Metering/Egress shaping
- IEEE 802.1ad Provider Bridging (Q-in-Q) VLAN
- full S-VLAN range
- IEEE 802.1 D MAC Bridges
- IEEE 802.1p Class of Service (CoS) prioritization IEEE 802.1Q VLANs
- IEEE 802.1Q VLANs
- IEEE 802.3 Ethernet
- IEEE 802.3ab 1000Base-T via Copper SFP
- IEEE 802.3ad Link Aggregation Control Protocol (LACP)
- IEEE 802.3ba-2010 40Gbe & 100Gbe
- IEEE 802.3u Fast Ethernet
- IEEE 802.3z Gigabit Ethernet
- Jumbo Frames to 9,600 bytes
- Layer 2 Control Frame Tunneling
- Link Aggregation (LAG): Active/Active; Active/ Standby
- MEF 10.2 Egress Bandwidth Shaping per EVC per COS
- Per-VLAN MAC Learning Control
- Private Forwarding Groups
- VLAN tunneling (Q-in-Q) for Transparent LAN Services (TLS)
Technical Information

MEF CE 3.0 Compliant
- E-Transit: Transit E-LINE, Transit E-LAN
- E-Access: Access EPL, Access EVPL
- E-LAN: EP-LAN, EVP-LAN
- E-LINE: EPL, EVPL
- E-Tree: EP-Tree, EVP-Tree

Carrier Ethernet OAM
- EVC Ping (IPv4)
- IEEE 802.1ab Link Layer Discovery Protocol (LLDP)
- IEEE 802.1ag Connectivity Fault Management (CFM)
- IEEE 802.3ah EFM Link-fault OAM

Synchronization
- ITU-T G.781
- ITU-T G.813
- ITU-T G.823/G.824
- ITU-T G.8262 Synchronous Ethernet
- ITU-T G.8262/G.8264 EEC option1 and option2
- ITU-T G.8261

Networking Protocols
- Stratum 3
- Line Timing Interfaces:
  - 1GbE/10GbE/40GbE/100GbE In and Out
  - OC-n/STM-n In and Out
- External Timing Interfaces:
  - BITS in or out (T1: 1.544Mb/s, E1: 2.048MHz and 2.048Mb/s, 64kHz CC (SDH-J)

Network Management
- Alarm Management & Monitoring Configuration
- Comprehensive Management via OneControl Enhanced CLI
- Integrated Firewall
- IPv4 & IPv6 Management Support Local Console Port
- Per-VLAN Statistics Port State Mirroring
- RADIUS Client and RADIUS Authentication
- Remote Auto configuration via TFTP, SFTP
- Remote Link Loss Forwarding (RLLF)
- RFC 959 File Transfer Protocol (FTP)
- RFC 1035 DNS Client
- RFC 1213 SNMP MIB II
- RFC 1493 Bridge MIB
- RFC 1573 MIB II interfaces
- RFC 1643 Ethernet-like Interface MIB
- RFC 2131 DHCP Client
- RFC 2137 Alarm MIB
- RFC 4291 – IPv6 addressing (for Management Plane)
- RFC 4443 – ICMPv6
- RFC 4862 – Stateless address auto-configuration
- RFC 5905 NTP Client

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 4271 A Border Gateway Protocol 4 (BGP-4)
RFC 4272 A Border Gateway Protocol 4 (BGP-4)
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 4760 MultiProtocol Extensions for BGP-4
RFC 4762 VPLS (Virtual Private LAN Service) and Hierarchical VPLS (H-VPLS)
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 5493 BGP capabilities advertisement
RFC 5654 MPLS-Transport Profile (TP)
  - LSP Static provisioning
  - LSP Dynamic provisioning
  - 1:1 Tunnel protection
RFC 5884 LSP Bidirectional Forwarding Detection (BFD) via GAL/G-Ach channels
RFC 5905 NTP v4
RFC 6192 Protecting the Router Control Plane
RFC 6215 MPLS Transport Profile User-to-Network and Network-to-Network Interfaces
RFC 6426 MPLS On-demand Connectivity Verification and Route Tracing
RFC 7310 Bidirectional Forwarding Detection (BFD) on Link Aggregation Group (LAG) Interfaces
RFC 7311 The Accumulated IGP Metric Attribute for BGP
RFC 7490 Remote Loop-Free Alternate (LFA) Fast Reroute (FRR)
RFC 8102 Remote-LFA Node Protection and Manageability
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
RFC 959 File Transfer Protocol (FTP)
RFC 1035 DNS Client
RFC 1213 SNMP MIB II
RFC 1493 Bridge MIB
RFC 1573 MIB II interfaces
RFC 1643 Ethernet-like Interface MIB
RFC 2131 DHCP Client
RFC 3877 Alarm MIB
RFC 4291 – IPv6 addressing (for Management Plane)
RFC 4443 – ICMPv6
RFC 4862 – Stateless address auto-configuration
RFC 5905 NTP Client
Technical Information

Network Management continued
Secure File Transfer Protocol (SFTP)
Secure Shell (SSHv2)
SNMP v1/v2c/v3
SR-MPLS TI-LFA Topology Independent
Fast Reroute using Segment Routing
draftietfrtgwg-segment-routing-ti-lfa-03
SNMP v3 Authentication and Message Encryption
Software upgrade via FTP, SFTP
Syslog with Syslog Accounting
TACACS + AAA
Telnet Server
Virtual Link Loss Indication (VLLI)
Zero Touch Provisioning

Service Security
Broadcast Containment Egress Port Restriction
Hardware-based DOS Attack Prevention
Layer 2, 3, 4 Protocol Filtering
User Access Rights

Agency Approvals
- Australia C-Tick (Australia/New Zealand)
- CE mark (EU)
- EMC Directive (2014/30/EU)
- LVD Directive (2006/95/EC)
- RoHS2 Directive (2011/65/EU)
- GR-1089 Issue 6 – NEBS Level 3
- GR-63-CORE, Issue 4 – NEBS Level 3, Zone 4 Earthquake
- NRTL (NA)
- VCCI (Japan)

Standards Compliance
Emissions:
- CISPR 22 Class A
- CISPR 32 Class A
- EN 300 386
- EN 55022
- EN 55032
- FCC Part 15 Class A
- GR-1089 Issue 6
- Industry Canada ICES-003 Class A
- VCCI Class A

Environmental:
- RoHS2 Directive (2011/65/EU)

Immunity (EMC):
- CISPR 24
- EN 300 386
- EN 55024
- GR-1089 Issue 6

Power:
- ETSI EN 300 132-2
- ETSI EN 300 132-3

Safety:
- ANSI/UL 60950-1 2nd edition 2007
- CAN/CSA C22.2 No. 60950-1-07
- EN 60950-1
- IEC 60950-1

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Answer your questions