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 migration may not be an option. The 6500 PTS is designed to handle these scenarios, ensuring that network providers can maintain their investment in TDM services while transitioning to packet-based architectures.
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).

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. Without 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 TWAMP), 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 Blue Planet Manage, Control and Plan (MCP) software suite 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, Blue Planet 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, Blue Planet 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.

![Figure 3. Hierarchical QoS supports multiple services](image.png)

**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
- MEF8 Circuit Emulation

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.

**Future-proof service delivery**
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 like seamless MPLS or Segment Routing to create a modern-scale adaptive packet network.
Technical Information

<table>
<thead>
<tr>
<th>Description</th>
<th>6500-S8</th>
<th>6500-S14</th>
</tr>
</thead>
<tbody>
<tr>
<td>H x W x D (mm)</td>
<td>7U 310 x 440.5 x 281</td>
<td>13U 577.1 x 440.5 x 280</td>
</tr>
<tr>
<td>H x W x D (inches)</td>
<td>7U 12.2 x 17.3 x 11.1</td>
<td>13U 22.7 x 17.3 x 11.0</td>
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<tr>
<td>Chassis Per Rack</td>
<td>6</td>
<td>3</td>
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<tr>
<td>Weight (Max)</td>
<td>33Kg</td>
<td>56Kg</td>
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<tr>
<td>DC Input</td>
<td>1x 50A</td>
<td>2x 50A</td>
</tr>
<tr>
<td>Power Consumption (Watts@ 25degC/C-/48vDC no optics)</td>
<td>1333W (Typical)</td>
<td>1960w (Typical)</td>
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<tr>
<td>Operating Temp.</td>
<td>Normal: 41deg F to 104deg F (5deg C to 40deg C)</td>
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<tr>
<td>Storage Temp.</td>
<td>-40deg F to 158deg F (-40deg C to 70deg 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>

- 1xQSFP+/QSFP28 (1x10GE, 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 802.3a-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

Multi Chassis-LAG (MC-LAG): Active/Active Per-VLAN MAC Learning Control

Private Forwarding Groups

VLAN tunneling (Q-in-Q) for Transparent LAN Services (TLS)

**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

ITU-T Y.1564 Ethernet Service Activation Test Methodology

ITU-T Y.1731 Performance Monitoring (SLM; DM)

RFC 2544 Benchmarking Methodology for Network Interconnect Devices

RFC 5618 TWAMP Responder and Receiver TWAMP Sender

**Synchronization**

GR-1244

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

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)

**Networking Protocols**

Alarm Indication Signaling (AIS) with Link Down Indication (LDI) and Remote Defect Indication (RDI)

Automatic Pseudowire Reversion

Layer 2 Control Frame Tunneling over MPLS Virtual Circuits

MPLS Label Switch Path (LSP) Tunnel Groups

MPLS Label Switch Path (LSP) Tunnel Redundancy

MPLS Multi-Segment Pseudowires

MPLS Virtual Private Wire Service (VPWS)

OSPF/IS-IS for Dynamic MPLS-TP Control Plane RFC 2205 RSVP

RFC 3031 MPLS architecture

RFC 3209 RSVP-TE: Extensions to RSVP for LSP

RFC 3630 OSPF-TE

RFC 4447 Pseudowire Setup & Maintenance using Label Distribution Protocol (LDP)
### Networking Protocols continued
- RFC 4448 Encapsulation Methods for Transport of Ethernet over MPLS Networks (PW over MPLS)
- RFC 4664 Framework of L2VPN (VPWS/VPLS)
- RFC 4762 VPLS (Virtual Private LAN Service) and Hierarchical VPLS (H-VPLS)
- 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 6215 MPLS Transport Profile User-to-Network and Network-to-Network Interfaces
- RFC 6426 MPLS On-demand Connectivity Verification and Route Tracing
- RFC 6428 LSP and PW Connectivity Verification and Trace Route
- Static ARP and MAC Destination Address Resolution
- VCCV (Virtual Circuit Continuity Check) Ping and Trace Route
- Multicast
- IGMP over MPLS-TP
- IGMPv3 with SSM

### Circuit Emulation:
- RFC 4553 Structure Agnostic TDM over Packet
- RFC 4842 SONET/SDH Circuit Emulation over Packet
- RFC 5086 Circuit Emulation Service over Packet Switched Network
- MEF 3 Circuit Emulation Service Definitions, Framework and Requirements in Metro Ethernet Networks
- MEF 8 Implementation Agreement for the Emulation of PDH Circuits over Metro Ethernet Networks

### 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 1757 RMON MIB - including persistent configuration
- RFC 2021 RMON II and RMON Statistics
- 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
- RFC 1350 Trivial File Transfer Protocol (TFTP)
- Secure File Transfer Protocol (SFTP)
- Secure Shell (SSHv2)
- SNMP v1/v2c/v3
- SNMP v3 Authentication and Message Encryption
- Software upgrade via FTP, SFTP
- Sylog with Sylog Accounting
- 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)
- ETSI 300 019 Class 1.2, 2.2, 3.1E
- 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

#### 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