Solving the TDM-to-Packet Migration Challenge

Service providers have a networking challenge and opportunity. They must evolve away from their outdated Time Division Multiplexer (TDM) networks, which are no longer sustainable, and migrate to modern systems that use routing and switching technologies. Fortunately, the transition can be smooth and convenient for a service provider. Ultimately, when the end customer migrates to an Ethernet service, the migration is much simpler.

The service provider industry has multiple reasons for technology migration, in particular the phase-out of many TDM-based technologies service providers use to deliver switched voice, video, and data services. While market forces and technology benefits are driving the shift to IP/MPLS networks, service providers are motivated to make the transition. Routing and switching technologies will enable service providers to use automation and adaptive network techniques to improve Add-Drop Multiplexer (ADM), Digital Access and Cross-connect System (DACS), Digital Cross-connect System (DCS), and Multiservice Provisioning Platforms (MSPPs) locations (large and/or small). The improvements will better enable service providers to maintain very profitable high ARPU TDM services with no control when business customers transition to IP/MPLS, as their infrastructure rusts.

Routing and switching is also versatile, offering capacity and advanced features service providers can use to modernize their networks to improve internal IT processes and diversify their businesses to create new revenue streams. Service providers already use networks to offer IP and Ethernet services for residential and enterprise customers for broadband, voice, cloud-computing, mobile backhaul, data center interconnects, and other networking services.

Traditional, legacy SONET and SDH approaches cannot fulfill these needs because the technology cannot scale to support IP/MPLS services, whether for TDM replacement or new networking services. Yet running parallel networks to meet both requirements is costly and complicated. For operational and business efficiencies, service providers need a data transport system that can provide legacy and IP/MPLS services on a single, future-oriented, scalable foundation.

Ciena's 6500 PTS for TDM-to-packet migration and service modernization

- **A true packet-optical solution:** Ultra-dense 10/100/1GbE/10GbE, 40GbE/100GbE connectivity

- **Key applications for service provider:** ADM consolidation, DACS and MSPP replacement, network modernization, TDM to Ethernet gateway

- **Hardware:** 800G Ethernet/OTN switch and a portfolio of ultra-dense Ethernet and optical/Ethernet circuit packs, PDH circuit emulation modules, and PDH circuit packs

- **Programmable and adaptive:** Advanced merchant silicon, supporting next-generation IP/MPLS routing

- **Service velocity:** Ciena's ZTP to simplify deployment and Ciena's MCP tools that facilitate software controls and automation

- **Efficient:** Up to 5 times lower power consumption and 10 times space savings, depending on the application

- **High capacity:** Up to 4 times more TDM circuit emulation capacity than competing solutions

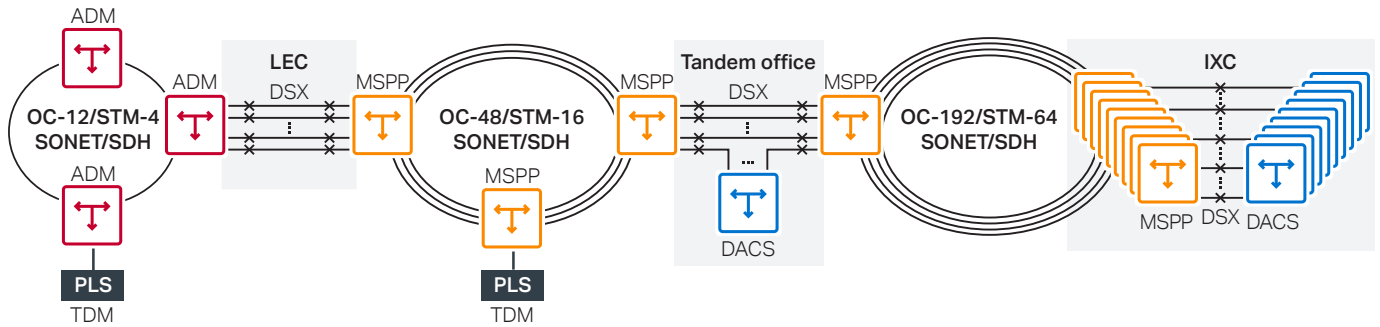- **Future-proof:** Supporting TDM business, Ethernet, and TDM-to-packet modernization

Figure 1. Service provider TDM network

Ciena's 6500 Packet Transport System (PTS) is a platform that helps solve the challenge of modernizing a service provider's network with a graceful evolution plan. The 6500 PTS is an ultra-high-density Plesiochronous Digital Hierarchy (PDH), SONET, SDH, and GbE/10GbE aggregation packet-optical platform. The 6500 PTS is a major component of Ciena's TDM-to-packet solutions, which also include TDM Small Form-factor Pluggable (SFP) devices, TDM modules, a common domain controller, and Ciena Services. The multiple platforms are available to help both large and small service providers transition ADM, DCS, DACS and MSPP services to IP/MPLS and to deliver broadband services to the market.

TDM obsolescence challenges

Equipment shortages and skills gaps in TDM technologies such as SONET, SDH, and PDH have served the service provider industry for years, but the equipment is often decades old and nearing end of life. With equipment vendors building only IP/MPLS technologies, replacements and spare parts for TDM products are often difficult to obtain. Vendor consolidation—often followed by manufacturing discontinuation of complete product lines—has left very few, if any, options to fill empty equipment slots or maintain old hardware. To make matters worse, legacy products require different types of control software that can be hard to update and impossible to integrate with new solutions.

As a result of these trends, the SONET/SDH optical hardware market, robust a decade ago, will be largely phased out by 2022, according to IHS Markit[1], and ADM, DCS, DACS and MSPP components are among the leading solutions impacted. Service providers are already feeling the brunt of discontinued technologies. In-house engineers who are experts in the legacy technologies are older and retiring, leaving skills gaps among technical teams who operate and maintain the

equipment. Service providers need convenient networking solutions and tools that can support both legacy and routing and switching technologies and allow the eventual migration to IP/MPLS with minimal disruption on the network.

Ciena's response for service providers

The 6500 PTS is purpose-built to address the phaseout of TDM services with techniques that enable TDM-to-packet migration as well as Ethernet services. Its primary applications for service providers include ADM, DACS, and MSPP replacement, TDM to Ethernet gateway, and network modernization. As soon as the platform is installed for either of these applications, service providers simplify their systems and gain high-performing packet-optical networks that are also ready to deliver next-generation broadband services.

Converged solution

One key value of the 6500 PTS is its ability to deliver TDM, Ethernet, and IP/MPLS services on a single, common platform. The solution allows both networking approaches to coexist as long as necessary while giving service providers the ability to offer advanced IP and routing capabilities when they are ready to migrate. The converged approach simplifies the network and minimizes transition costs.

Advanced timing and synchronization

The heartbeat of any circuit-based network is timing. The 6500 PTS supports several timing modes, including an internal clock, BITS, Line, Synchronous Ethernet, and 1588v2-Grand Master, boundary, and ordinary clock support. Selecting a timing solution is a straightforward and convenient process. Service providers can simply designate the preferred option when they remove their DACSs and MSPPs and deploy the 6500 PTS. The solution even allows service providers to use the existing local timing distribution for the legacy systems, so they can maintain the same clock previously used.

1 IHS Optical Network Hardware Tracker Q4 2019 (subscription required)

Packet-optical foundation

Built on Ciena's 6500 S-Series foundation, the 6500 PTS's key features include an 800G Ethernet/OTN switch that uses the most advanced merchant silicon, as well as a family of circuit packs and circuit emulation modules that enable service providers to choose the services they want to offer. The platform can meet any service provider's need for TDM-to-packet migration, providing connectivity for PDH, T1/T3, SONET/SDH, ADM/MSPP, DCS, and DACS 3/3 and 3/1 while supporting Ethernet and IP protocols. It is energy-efficient and highly scalable in a compact unit, helping service providers reduce requirements for power and floor space.

One network, one management and control system

Ciena's Manage, Control and Plan (MCP) domain controller simplifies multi-layer management and control so engineers can plan, provision, and launch both TDM, Ethernet, and IP/MPLS services. It includes software control and automation tools that leverage data collected from the network, predictive analytics, and network policies to constantly assess operating needs and conditions. MCP removes chaos, returning control of the network and services back to the operator, making network operations simple, secure, and highly cost-effective with a single unified approach.

A programmable network that adapts

The 6500 PTS is programmable and adaptive, making use of an advanced Ethernet/OTN switch fabric to support TDM circuit emulation, Ethernet, IP, and MPLS technologies. The 6500 PTS can support any number of new network architectures such as seamless MPLS or segment routing, which are essential capabilities for modern, scalable, routing and switching networks that are responsive to change.

Service velocity

Ciena's Zero-Touch Provisioning (ZTP), also available with the 6500 PTS, simplifies device deployment and system and service turn up and enables performance testing to be run from the network operations center. This improves efficiency and eliminates the need for on-site personnel or adjunct test equipment. Service providers can roll out services faster at a lower cost.

Ciena's 6500 PTS
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ADM replacement, less power, more space

Service providers use SONET/SDH to bundle all T1/E1, T3/E3 connections on one continuous optical fiber infrastructure for small and large remote offices to company headquarters, using three components:

1. **Links—**Interoffice facilities, local access, and alternate wire centers

2. **Access ports—**Central Office (CO) facility used to enter/exit the ring, including DS1/E1, DS3/E3, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OC-192/STM-64

3. **Node—**SONET/SDH add-drop multiplexers, located on premise or central office

Using an ADM as the on/off ramp, multiple customers were multiplexed into a single beam of light, carried to the local office/exchange, demultiplexed, and electrically terminated to a patch panel for connection to the high-speed network. Given the popularity, it is not surprising to see many ADM rings of various speeds and vendors. Historically, private or leased-line services didn't scale efficiently with the only option of going from T1/E1 to T3/E3 or going from 1.544 Mb/s to 44.736 Mb/s. With no low-order grooming, only multiplexing, most of these connections did not utilize all the bandwidth, transmitting empty time slots.
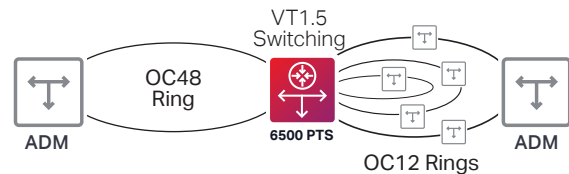

Figure 2. 6500 PTS ADM consolidation

With traditional ADM equipment discontinued by manufacturers or reaching end of life, service providers can adopt 6500 PTS as a standalone solution to perform ADM functions. For this application, the 6500 PTS consolidates ADM optical rings of various sizes, performs low-level grooming, and sends it out over the service provider's SONET/SDH high-speed network to the switching center.

MSPP replacement: Centralized processing on a flexible, high-capacity IP/MPLS foundation

Service providers have used SONET/SDH-based MSPP solutions for years to consolidate services from different types of networks on the same infrastructure. Depending on the their particular operational and business services requirements, service providers have used MSPPs to deliver TDM- as well as Ethernet-based services for a variety services, including TDM private line service for voice, video, and data as well as broadband services and mobile backhaul.

For the past two decades, MSPP technologies have typically been deployed at the edge of the metropolitan network. Most of these systems are aging and have discontinued hardware with outdated software. They also take up a lot of space and use a lot of power. Letting these platforms continue to rust is not viable. It also increases risk, because service providers may not have the ability to update the legacy security software to protect the network against modern, sophisticated security attacks.

Ciena's 6500 PTS can provide a convenient, secure replacement for this MSPP application, whether the service provider adopts the platform as an upgrade or new deployment. Service providers can consolidate multiple MSPPs on the 6500 PTS, saving even more space and power, while providing a central point for grooming and managing all traffic. The 6500 PTS solution also supports end-to-end Ethernet services and transporting all traffic via the network to its destinations.

Figure 3. 6500 PTS MSPP consolidation

The 6500 PTS can consolidate substantial volumes of MSPP traffic, ensuring the capacity to support multiple services and scale capacity to meet growing demand. Along with providing MSPP services, service providers that deploy the 6500 PTS platform can take advantage of its advanced technologies to offer high-performance broadband services to the market.

DACS replacement: Consolidating three components into one

One of the key applications for a service provider's communications network is to aggregate and transport private line services or copper-based pairs to the local exchange and then to the switching or data center. DACS, commonly referred to as Integrated Services Digital Network (ISDN), is used to digitize voice, text, e-mail, and video data transfer over the same copper pairs between the customer and switching center.

With traditional DACS equipment being discontinued by manufacturers or reaching end of life, service providers can adopt 6500 PTS as a standalone solution to perform DACS functions. For this application, the 6500 PTS uses circuit emulation to 'switch' the DACS services, perform low- and high-level grooming, packetize the data on the 6500-switch fabric, and send it out over the service provider's SONET/SDH network to the switching center.
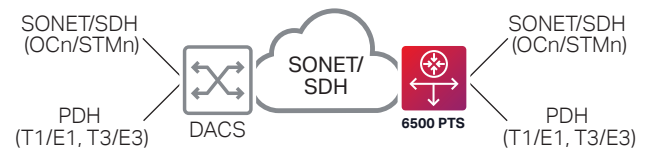
Figure 4. 6500 PTS DACS consolidation

Service providers already using Ciena's 6500-S8 or 6500-S14 Packet-Optical Platform with available slots in the chassis can perform the DACS functions on the unit they already have simply by upgrading the existing switch fabric card and adding optical and PDH circuit packs to the 6500 unit.

In both new deployment and upgrade scenarios, service providers that use the 6500 PTS are able to eliminate three legacy DACS functions at each switching center:
1. Multiple DACS units that perform low- and high-level grooming
2. TDM platforms used for DS-1 handoffs to DACS units
3. TDM platforms used to aggregate DS1 traffic from the network

The 6500 PTS can accommodate 1,000-2,000 DS1s/E1s, hundreds of DS3/E3s depending on which chassis is used (8- or 14-slot).

Service providers that adopt this solution for DACS gain a future-oriented technology that will provide long-term value, even after the service provider upgrades TDM business services to IP/MPLS. Better yet, service providers will be able to use the Ethernet/OTN fabric provided with the 6500 PTS to build a carrier-grade infrastructure immediately, establishing the capability to offer Ethernet-based WAN services for new, revenue-generating opportunities.

TDM to Ethernet gateway

Transcode multiplexing Ethernet services are transported over SONET/SDH networks using GFP-F or Packet over SONET/SDH (PoS) mapping. Similarly, other legacy protocols such as PPP, MLPPP, FR, and MLFR are used for transport over DS1/E1. In all cases, the payload is Ethernet. The 6500 PTS can terminate these protocols, extract the original Ethernet payload, and perform routing and switching onto a native IP/MPLS transport. Book-ended solutions are no longer required in order to support these legacy protocols, when used with a transport system.
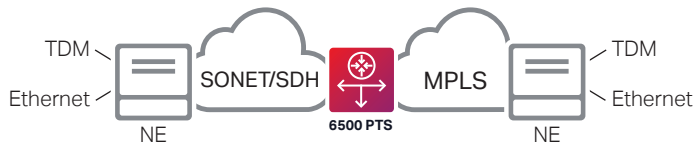

Figure 5. 6500 PTS TDM to Ethernet gateway

Service providers that adopt solution for TDM to Ethernet gateway gain a future-oriented technology that will provide long-term value, even after the service provider upgrades its legacy equipment. Better yet, service providers will be able to use the Ethernet/OTN fabric provided with the 6500 PTS to build a carrier-grade infrastructure immediately, establishing the capability to offer Ethernet-based WAN services for new, revenue-generating opportunities.

Network modernization: A future-proof platform for broadband services

The 6500 PTS is a foundation for network modernization. Service providers that adopt the solution for ADM, MSPP, DACS, TDM to Ethernet gateway, or all applications can adopt the platform to operate a next-generation packet-optical network that can use MPLS and Ethernet switching techniques and advanced routing capabilities. Service providers can use the MPLS switch to modernize their TDM networks, enabling migration of TDM services to an MPLS-protected core network. The 6500 PTS operates as a standard MPLS switch for transport and switching of Ethernet services and a pathway to future IP services.
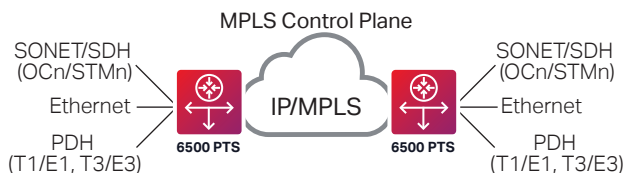

Figure 6. 6500 PTS network modernization

As most telecommunications operators have demonstrated, the transition to IP/MPLS architectures offers a means to access and scale connectivity for legacy services. This is becoming a critical capability for those who need to maintain productivity while reducing costs and enabling delivery of TDM services.

Service providers, too, will find that the modernized network positions their organizations to offer carrier-grade, revenue-generating WAN services—including high-quality gigabit broadband services for residential and enterprise customers, cloud services, Data Center Interconnect (DCI) services, voice, video, and even mobile backhaul. Service providers that use the 6500 PTS to deploy broadband services can be confident they will be able to offer standards-based, commercially competitive services without restrictions or compromise. They will have to evolve with the market and capacity to grow their businesses.

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Solutions for smaller service providers

Smaller service providers that may not need the capacity of the 6500 PTS for current or future services can use various Ciena TDM-to-packet solutions to keep their legacy networks up and operating as they migrate to IP/MPLS.

For example, Pseudowire Emulation (PWE) technologies can be used to continue TDM services alongside Ethernet and IP/MPLS services until the legacy technology is no longer necessary.
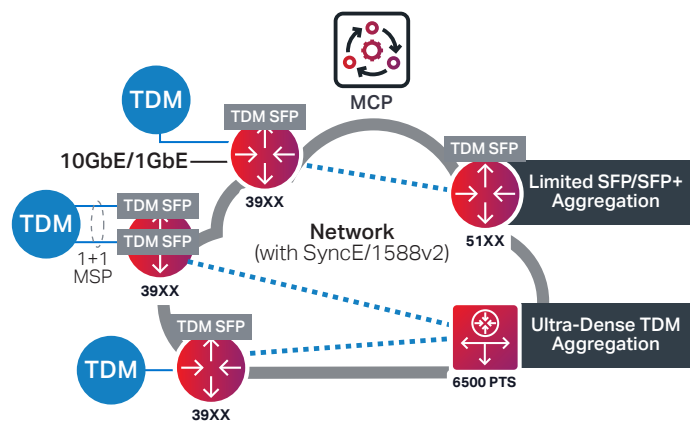

Figure 7. Ciena TDM-to-packet SFP packet edge solution

Ciena implements PWE capability with SFP devices that are easily added to routing and switching solutions. The SFP devices make use of PWE to create a virtual, dedicated lane for TDM services—such as teleprotection traffic—on the infrastructure that can also carry IP/MPLS traffic for video surveillance and other newer applications. The pluggable devices are useful when legacy traffic requires just a few ports at a given service end point.
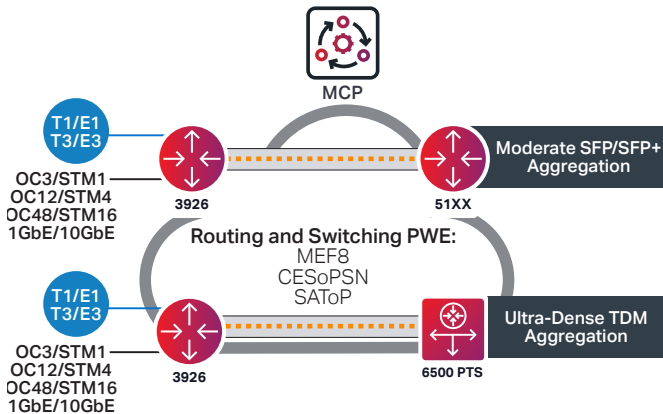

Figure 8. Ciena's 3926 Platform

If more TDM end points are needed, Ciena's 3926 offers 82 Gb/s of non-blocking capacity in a compact one rack unit (1 RU) platform. The 3926 future proofs the edge with a field replaceable module for TDM service and, when the service provider is ready, can provide distributed Virtual Network Functions (VNF) hosting on an Intel x86 server module.

Both of these solutions, as well as the 6500 PTS, minimize OPEX and accelerate service velocity with Ciena's ZTP for service turn up while providing line-rate, built-in service activation testing with no additional cost or equipment.

Ensuring a smooth migration with Ciena Services

Given the critical nature of their infrastructure, service providers must take particular caution when migrating from TDM to IP/MPLS and implementing infrastructure modernization.

For service providers that do not have in-house expertise to engineer or plan their migration and modernization strategies, Ciena Professional Services is available to help. The consulting team can perform audits to create a comprehensive view of the network, help the service provider develop a new network design and migration plan, and craft a strategy for deploying new equipment and migrating to new services. Ciena can also provide staff and training to help company teams learn how to operate and manage their new infrastructure and services.

Summary

In light of their out-of-date ADM, MSPP, DACS, and transmux equipment, service providers cannot continue maintaining legacy networks. As they grapple with the implications, service providers face another equally important issue: they must support newer interfaces and service bandwidth demand. Ciena's TDM-to-packet solutions, including the 6500 PTS, allow service providers to continue providing TDM business services, remove aging ADM, MSPP, DACS, and transmux equipment, and modernize their networks to offer Ethernet residential and business services. Service providers can leverage Ciena Services for a comprehensive audit revealing what is in their network, migration planning and deployment services, and even maintenance assistance, if needed.

Ciena provides both the technology foundation as well as the tools service providers need to solve their most pressing TDM-to-packet evolution challenges. Contact Ciena to learn how you can get started today on the path to a modern and versatile service provider communications network.

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