Blueprint for Utility Network Modernization

Ciena's 6500 PTS solves multiple TDM-to-packet migration challenges for investor-owned electric utilities

Investor-Owned (IO) utilities 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 They must evolve away from their outdated Time Division Multiplexer (TDM) networks, which are no longer sustainable, and migrate to modern systems that use Routing and Switching technologies.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 utility. And once the network is established, the utility can also use the infrastructure to offer new revenue-generating, carrier-grade broadband services to the customer base.

The utility industry has multiple reasons for technology migration, in particular the phase-out of many TDM-based technologies utilities use to monitor and control the grid and provision services. While market forces and technology benefits are driving the shift to routing and switching, utilities are motivated to make the transition. Routing and switching technologies will enable utilities to use automation and adaptive network techniques to improve Digital Access and Cross-connect System (DACS), Multiservice Provisioning Platform (MSPP), teleprotection, Supervisory Control and Data Acquisition (SCADA), smart grid, and other mission-critical services. The improvements will better enable utilities to minimize power line failures, isolate faults, and prevent cascading outages to ensure day-to-day reliability of electricity services.

Routing and switching is also versatile, offering capacity and advanced features utilities can use to modernize their networks to improve internal IT processes and diversify their businesses to create new revenue streams. Already, IO utilities in some regions are using their networks to offer IP and Ethernet services for residential and enterprise customers, and more utilities are expected to pursue similar strategies, using their new routing and switching infrastructure to offer broadband, cloud-computing, Data Center Interconnect (DCI), and other networking services.

Benefits

- Offers 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 IP/MPLS and CE services, including MEF CE 3.0-certified for E-Tree, E-Line, E-LAN, E-Access, and E-Transit

- Offers Zero-Touch Provisioning (ZTP) for rapid, secure, and error-free turn-up of services
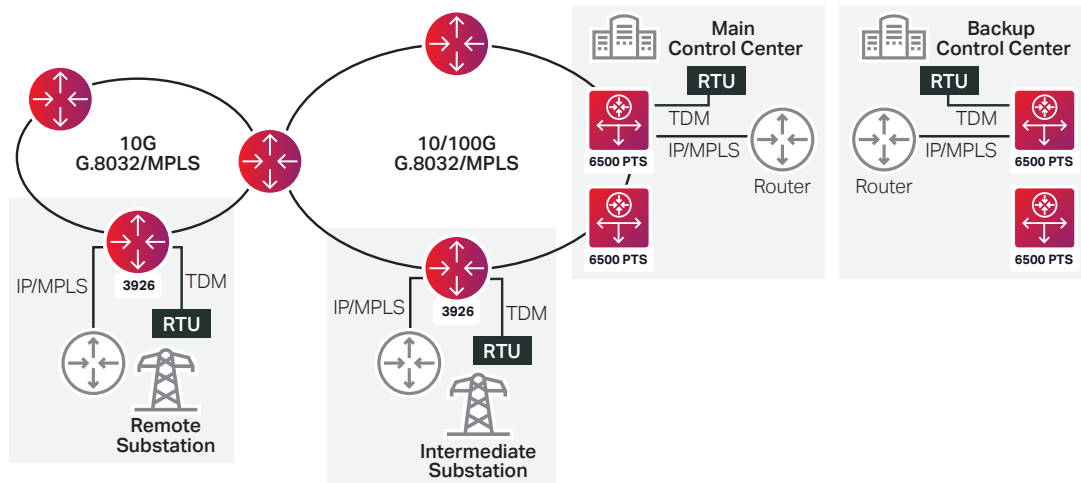
- Includes advanced synchronization

Figure 1. TDM-to-packet IO utilities modernization

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, IO utilities need a data transport system that can provide legacy and IP/MPLS services on a single, future-oriented, scalable foundation.

Ciena's 6500 Packet Transport System (PTS) is a platform that helps solve the challenge of modernizing a utility'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 IP/MPLS platform. The 6500 PTS is a major component of Ciena's TDM-to-packet solutions, which also includes TDM Small Form-factor Pluggable (SFP) devices, TDM modules, Ciena's Manage, Control and Plan (MCP) domain controller, and Ciena Services. The multiple platforms are available to help both large and small IO utilities transition DACS and MSPP services to IP/MPLS and deliver broadband services to the market.

6500 Packet Transport System
Learn more →

TDM obsolescence challenges: Equipment shortages and skills gaps

TDM technologies such as SONET, SDH, and PDH have served the utility 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 DACS and MSPP components are among the leading solutions impacted. IO utilities 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. IO utilities need convenient networking solutions and tools that can support both legacy and IP/MPLS technologies and allow the eventual migration with minimal disruption on the network.

1 IHS Optical Network Hardware Tracker Q1 2018 (subscription required)

Ciena's response for IO utilities: The 6500 PTS

Ciena's 6500 PTS is purpose-built to address the phase-out of TDM services with techniques that enable TDM-to-packet migration as well as Ethernet services. Its primary applications for utilities include DACS and MSPP replacement and network modernization. As soon as the platform is installed for either of these applications, IO utilities simplify their systems and gain high-performing IP/MPLS 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 services on a single, common platform. The solution allows both networking approaches to coexist as long as necessary while giving utilities the capability 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. Utilities can simply designate the preferred option when they remove their DACSs and MSPPs and deploy the 6500 PTS. The solution even allows a utility to use the existing local timing distribution for the legacy systems, so they can maintain the same clock they previously used.

IP/MPLS foundation: Built on Ciena's 6500 S-Series foundation, the 6500 PTS's key features include an 800G Ethernet/OTN switch fabric that uses the most advanced merchant silicon, as well as a family of circuit packs and circuit emulation modules that enable IO utilities to choose the services they want to offer. The platform can meet any IO utility's need for TDM-to-packet migration, providing connectivity for PDH, T1/T3, SONET/SDH, ADM/MSPP, 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 IO utilities reduce requirements for power and floor space.

One network, one management and control system: Ciena's MCP domain controller simplifies multi-layer management and control so engineers can plan, provision, and launch TDM, Ethernet, and IP 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.

Programmability and adaptive networking: 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, adaptive routing and switching networks.

Service velocity: Ciena's 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 (NOC). This improves efficiency and eliminates the need for on-site personnel or adjunct test equipment. IO utilities can roll out services faster at a lower cost.

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

- A true IP/MPLS solution: Ultra-dense 10/100/1GbE/10GbE, 40GbE/100GbE connectivity

- Key applications for utilities: DACS and MSPP replacement, network modernization

- 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 routing and switching

- 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, IP, and TDM-to-packet modernization

DACS replacement: Consolidating three components into one

One of the key applications for an IO utility's communications network is to transport sensor data between substations and control centers for teleprotection applications. Analog sensor data containing operational information about the power system is typically aggregated at each substation by Remote Terminal Units (RTUs) and sent via DS1 signals to the IO utility's primary and back-up control centers, where the traffic is groomed by a DACS solution and mapped onto higher-level SONET/SDH links for transmission to intended end-points on the network.
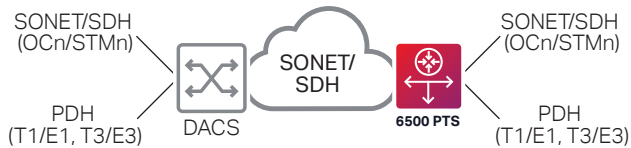

Figure 2. 6500 PTS DACS consolidation

With traditional DACS equipment discontinued by manufacturers or reaching end of life, IO utilities can adopt 6500 PTS as a standalone solution to perform DACS functions. For this application, the PTS uses circuit emulation to 'switch' the DACS services, perform low- and high-level grooming, frame the data on the 6500-switch fabric, and send it out over the utility's SONET/SDH network to RTUs at intended substations.

IO utilities already using Ciena's 6500-S8 or 6500-S14 Routing and Switching 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. The 6500 PTS shares the same 6500-S8, 6500-S14, and switch fabric card, making life simpler for technicians and encouraging cost-effective re-use of the equipment as spares.

In both new deployment and upgrade scenarios, IO utilities that use the 6500 PTS are able to eliminate three legacy DACS functions at each control center: 1) multiple DACS units that perform low- and high-level grooming; 2) TDM platforms used for DS-1 handoffs to DACS units; and 3) TDM platforms used to aggregate DS1 traffic from the network. The 6500 PTS can accommodate 1,000-2,000 DS1s depending on which chassis is used (8- or 14-slot).

IO utilities that adopt solution for DACS gain a future-oriented technology that will provide long-term value to the IO utility, even after the utility upgrades its RTUs to IP/MPLS. Better yet,

IO utilities 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.

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

IO utilities 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, IO utilities have used MSPPs to deliver TDM- as well as Ethernet-based services for a variety of teleprotection, SCADA, advanced meter reading, and other operational applications, 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 utilities 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 applications, whether the utility adopts the platform as an upgrade or new deployment. Utilities 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. Traffic can be created and terminated for a variety of encapsulation protocols, including GFP-F, PoS, FR, MLFR, and PPP. The 6500 PTS solution also supports end-to-end Ethernet services and transporting all traffic via the network to its destinations.

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, utilities that deploy the 6500 PTS platform can take advantage of its advanced technologies to offer high-performance broadband services to the market.

Figure 3. 6500 PTS MSPP consolidation

Network modernization: A future-proof platform for broadband services

The 6500 PTS is a foundation for network modernization. IO utilities that adopt the solution for DACS, MSPP, or both applications can adopt the platform to operate a next-generation network that can use IP/MPLS and Ethernet switching techniques and advanced routing capabilities. IO utilities 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.
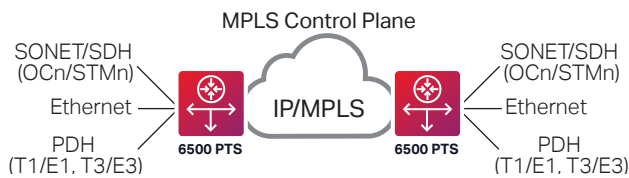

Figure 4. 6500 PTS network modernization

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.

IO utilities, too, will find that the modernized network will position 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. IO utilities that use the 6500 PTS to deploy broadband services can have confidence 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.

Solutions for smaller IO utilities

Smaller IO utilities 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.

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

Ciena implements PWE capability with SFP devices that are easily added to routing and switchingsolutions. 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 Ethernet and 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.
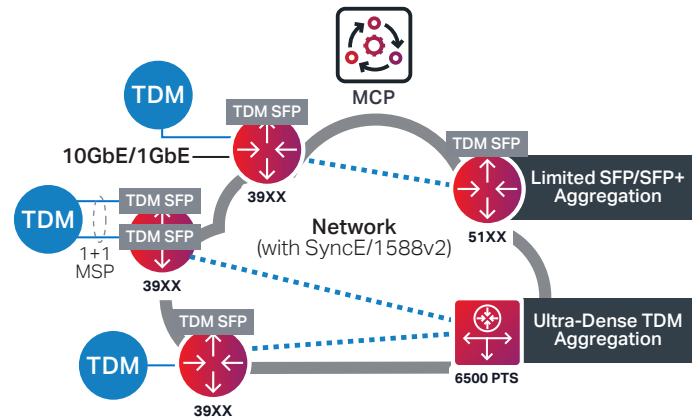

Figure 5. Ciena TDM-to-packet SFP edge solution

If more TDM end points are needed, Ciena's 3926 Platform 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 IO utility is ready, can provide distributed Virtual Network Functions (VNF) hosting on an Intel x86 server module.
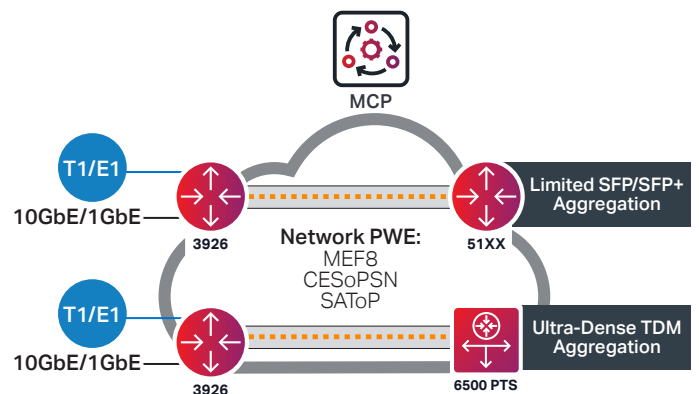

Figure 6. Ciena's 3926 platform

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, IO utilities must take particular caution when migrating from TDM and modernizing their infrastructures.

For utilities that do not have in-house expertise to engineer or plan their migration and modernization strategies, Ciena Services is available to help. The consulting team can perform audits to create a comprehensive view of the network, help the utility 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 DACS and MSPP equipment, utilities cannot continue maintaining legacy networks. As they grapple with the implications, utilities face another equally important issue: they must support newer interfaces and service bandwidth demands. Ciena's TDM-to-packet solutions, including the 6500 PTS, allow utilities to continue providing TDM business services, remove aging DACS and MSPP equipment, and modernize their networks to offer Ethernet residential and business services. Utilities 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 utilities 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 utility communications network.

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