


Alcatel-Lucent 1870 Transport Tera Switch (TTS)

Addressing the *exaflood* challenge

Alcatel-Lucent 





The Alcatel-Lucent 1870 Transport Tera Switch (TTS) defines the next generation of optical core switching platforms. Bringing terabit capacity and uniquely intelligent Optical Transport Network (OTN) capabilities to the core, it allows providers to meet the exaflood challenge of explosive service and bandwidth growth while transporting traffic at the lowest cost per bit. Leveraging the latest silicon innovation, the Alcatel-Lucent 1870 TTS integrates the strengths of OTN, GMPLS and carrier Ethernet into a high-density, all-optical switch with 40G/100G support and up to 8 terabit-per-second capacity. An essential component of Alcatel-Lucent's High Leverage Network™— Converged Backbone Transformation solution, it offers a flexible range of IP traffic grooming options at the OTN layer — including port-level and sub-port-level grooming. This enables efficient core router traffic offload onto the optical network as well as IP backbone scaling at a controlled cost. In addition to providing the greatest possible quality assurance, resiliency, availability, advanced operational automation across the optical and IP layers along with unparalleled power efficiency, the Alcatel-Lucent 1870 TTS reduces the total cost of network ownership — making it an ideal platform for operators seeking to build a scalable and efficient converged backbone infrastructure as they transition to OTN.



INTELLIGENCE FOR THE OTN



The huge increase in Internet traffic, multimedia applications and consumer IP services is stressing today's network infrastructures, driving up costs for service providers without yielding a proportional increase in revenue. This convergence of pressures, commonly known as the *exaflood* phenomenon, is forcing operators to invest heavily in their backbone network infrastructure to boost capacity — but this raises operating expenses, resulting in what's come to be called the cost-capacity crunch.

The next-generation Optical Transport Network (OTN) architecture provides the framework for achieving an optimal combination of optical transport and routing technologies, enabling effective bandwidth management at the lowest cost per bit and supporting emerging ultra high-rate services. With an OTN, service providers can scale their IP backbone infrastructures and respond to huge traffic demands without incurring extra costs from expensive routing capacity upgrades.

Alcatel-Lucent has developed a unique approach to the OTN — at the heart of which is the Alcatel-Lucent 1870 Transport Tera Switch (TTS), the industry's first intelligent OTN tera switch for a scalable IP core.



Where providers feel the pressure

Today, backbone networks typically include an IP routing layer as well as an optical SDH/SONET and WDM infrastructure for transport capacity. Service level agreement (SLA) assurance in the backbone network depends on the consolidation of IP traffic into large-scale pipes for efficient transport over long distances, with most backbone traffic traveling through multiple core routers en route to its destination.

As bandwidth demands rise, these core routers are shouldering an ever-heavier burden. Some operators are adding new routers and ports; others are upgrading their core routers to multi-chassis configurations and adding corresponding WDM wavelength transport just fast enough to manage traffic growth. These adaptations are expensive, however, and still do not present an economically efficient and scalable alternative for addressing the exaflood phenomenon. Instead, providers' costs are growing proportionally with traffic — misaligned with revenue growth and profitability.





AS A CONSEQUENCE, TODAY'S PROVIDERS ARE SEEKING TO:

SOLVE THE COST-CAPACITY CRUNCH BY EFFICIENTLY SCALING THE IP CORE

- Supporting traffic growth while controlling costs using a highly efficient backbone network architecture, and optimally combining transport and routing capabilities to manage traffic explosion at the most economical layer.
- Leveraging an OTN infrastructure that provides the most efficient bandwidth management capabilities for traffic up to 40 Gbps and 100 Gbps, scales to multi-terabit capacity, and optimizes the transport of router traffic via multiple forwarding options (at the wavelength and sub-wavelength levels) according to service mix and traffic destination. This enables core router traffic offload onto the optical layer, supports the individual management of traffic flows for quality assurance and optimizes overall network utilization, performance and cost.
- Ensuring maximum granularity by enabling a range of grooming options at multiple levels (port, sub-port) for lowest-cost-per-bit transport, eliminating unnecessary transit traffic in the IP layer and optimizing port efficiency.

MAXIMIZE BANDWIDTH MONETIZATION

- Improving revenues per transported bit with advanced automation and intelligence that maximize the reuse of available transport resources, freeing bandwidth for new, paying traffic.

ENSURE HIGH AVAILABILITY AND QUALITY ASSURANCE

- Enabling SLA assurance and high availability with advanced control plane based network protection and restoration capabilities.
- Extending consolidated transport-grade operations, administration and maintenance (OAM) monitoring and fault management tools to new, higher bit rates and enhanced end-to-end SLA assurance and fault sectionalization capabilities for multi-carrier/multi-domain networking scenarios.

SIMPLIFY OPERATIONS AND REDUCE TOTAL COST OF OWNERSHIP

- Leveraging intelligence and automation to optimize network operations across the optical and IP layers and accelerate time to service.
- Reducing overhead costs by managing traffic efficiently and with maximum scalability.
- Relying on consolidated transport network operational models to reuse existing operational skills.
- Minimizing the number of transport entities necessary for each transported service.
- Easing the pressures and costs associated with maintaining an always-on network by minimizing the need for on-site interventions during failures.
- Utilizing the network optimally and ensuring maximum power efficiency by provisioning services automatically across the most economical resources in the network.

BUILDING CAPACITY WHILE CONTROLLING TCO

The Alcatel-Lucent 1870 Transport Tera Switch (TTS) provides the foundation for a scalable, flexible backbone network architecture that manages the traffic explosion at the most economical layer. By enhancing OTN networking with GMPLS intelligence, the Alcatel-Lucent 1870 TTS supports traffic growth in a cost-controlled manner, offering a scalable and sustainable transport framework for the next-generation IP backbone infrastructure.

Leveraging the latest 65 nanometer silicon innovation, the platform scales up to 8 Tbps and down to 1 Tbps in a single chassis with multiple deployment options according to providers' scalability requirements and specific traffic growth conditions. Building on a unique universal switch matrix that switches packet and circuit traffic in their native formats, the platform is ideal for multi-service transport.

PUTTING PROVEN PRACTICES TO NEW USE

For maximum efficiency, the Alcatel-Lucent 1870 TTS converges the multi-technology transport architectures that support OTN, carrier Ethernet — including MPLS-TP — and SDH/SONET.

Greater efficiencies for IP backbone transport

The OTN networking capabilities of the Alcatel-Lucent 1870 TTS provide today's most efficient sub-wavelength bandwidth management for transport line rates of 10 Gbps, 40 Gbps and up-coming 100 Gbps. As traffic flows generated in the IP routing layer typically represent only a fraction of the capacity of such line rates, multiple traffic grooming options are available for efficient, individual transport of IP traffic flows according to their specific service mixes and destinations — for instance, hub and spoke or any-to-any. Traffic from router ports and sub-ports, such as VLANs within the same port, can be mapped to the most optimal transport granularity — a wavelength (optical channel — Och), a fixed-rate virtual container (optical data unit — ODU) or a variable-rate virtual container (ODUflex) — and individually forwarded and managed across the optical layer with the highest reliability and quality assurance.

These highly-granular flow-management options allow service providers to focus their routing resources on *high-touch* services that require more sophisticated treatment while moving transit traffic efficiently and seamlessly across lower-cost optical infrastructures.

The Alcatel-Lucent 1870 TTS provides a flexible OTN infrastructure for IP transport, one that maximizes overall efficiency and utilization of backbone network resources, avoids under-utilization or overbuild of optical and routing assets, and ultimately achieves the lowest cost per bit transported (see Figure 1).

LEVERAGING THE EXPERIENCE OF SONET/SDH BANDWIDTH MANAGEMENT, THE ALCATEL-LUCENT 1870 TTS SUPPORTS THE OTN EXTENSION OF TRANSPORT-GRADE OAM AND NETWORK PROTECTION TOOLS TO MULTI-CARRIER NETWORKING AND NEW, HIGHER BIT RATES, SIMPLIFYING OPERATIONS, REUSING SKILL SETS AND OPTIMIZING OVERALL TCO. SONET/SDH NETWORKING SUPPORT ENSURES SEAMLESS INTEGRATION WITH EXISTING ASSETS, PAVING THE WAY FOR INCREMENTAL EVOLUTIONARY UPGRADES TOWARDS HIGH-SPEED 40 GBPS AND 100 GBPS OPTICAL TRANSPORT INFRASTRUCTURES.

The GMPLS control plane intelligence of the Alcatel-Lucent 1870 TTS includes multiple restoration options, minimizing the need to use available bandwidth for resilience. Spare bandwidth can instead be repurposed and monetized, extracting the maximum economic benefit from available resources. Sophisticated GMPLS restoration mechanisms also offer differentiated degrees of SLA and quality assurance, enabling a new breed of service options for end users.

Simpler operations, reduced OPEX

The Alcatel-Lucent 1870 TTS incorporates — and adds to — the established strengths of SDH/SONET transport networks, maximizing efficiency and reliability. GMPLS intelligence provides automated tools for improving network performance and availability, and GMPLS cross-layer automation enables dynamic provisioning via the most economical resources in the network, optimizing network utilization and power efficiency.

Figure 1. Optimized bandwidth management with Alcatel-Lucent 1870 TTS

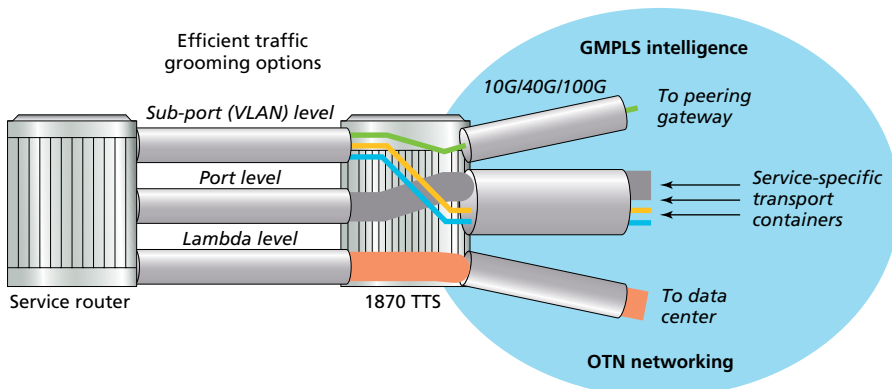




Table 1. Advantages of the Alcatel-Lucent 1870 TTS

FEATURE	BENEFIT
<ul style="list-style-type: none"> • 8 Tbps, 4 Tbps, 2 Tbps and 1 Tbps universal switching platform 	<ul style="list-style-type: none"> • Supports huge traffic growth in a cost-controlled manner, providing capacity and networking flexibility for scalable and sustainable delivery of next-generation IP services at the lowest cost per bit
<ul style="list-style-type: none"> • OTN with multiple transport networking options including optical transport hierarchy (OTH), carrier Ethernet and SDH/SONET. Universal any-rate cards for flexible and efficient provisioning of multiple traffic types 	<ul style="list-style-type: none"> • Most efficient sub-wavelength bandwidth management capabilities for high bit rate traffic flows up to 40 Gbps and 100 Gbps • Shifts transit traffic-handling burdens away from core routers through lambda-, port- and sub-port-level IP-traffic grooming options, helping reduce the cost of transport • Leverages SDH/SONET assets and operational models for smooth evolutionary transport network upgrades
<ul style="list-style-type: none"> • GMPLS control plane intelligence for cross-layer automation, highly resilient transport and dynamic bandwidth provisioning across multiple transport networking layers 	<ul style="list-style-type: none"> • Automated network and service provisioning enable bandwidth-on-demand services. Highly available networks are resilient to multiple failures, and GMPLS provides flexible restoration options for service differentiation and SLA support. Also increases network monetization, as fewer resources are required for protection, freeing bandwidth for revenue-producing traffic
<ul style="list-style-type: none"> • Energy-efficient, high-density chassis, leveraging innovative 65 nanometer silicon technology 	<ul style="list-style-type: none"> • Reduces OPEX by lowering power per transported bit, and streamlines operations and maintenance with GMPLS automation and restoration

Evolving the network: The Alcatel-Lucent 1870 TTS

Optical cross connects are widely deployed in service providers' existing SDH/SONET backbones. By increasing the efficiency of traffic grooming, enabling central office consolidation and delivering automated intelligence, cross connects significantly improve service quality and help reduce OPEX.

Managed by the Alcatel-Lucent 1350 Optical Management System (OMS), the Alcatel-Lucent 1870 TTS optical core switching platform carries these benefits forward into the next generation of transport networks — enhanced by a high-density, power-efficient architecture, OTN networking and GMPLS cross-layer automation. The Alcatel-Lucent 1870 TTS also provides the flexibility to split growing traffic among any combination of OTN, SDH/SONET and carrier Ethernet.

Key element of the Alcatel-Lucent Converged Backbone Transformation solution

The Alcatel-Lucent 1870 TTS shifts traffic-handling burdens away from core routers through OTN based lambda-, port- and sub-port-level IP-traffic grooming, helping reduce the cost of transport according to a service provider's specific traffic mix and approach to network integration. In combination with the Alcatel-Lucent 7750 Service Router (SR) and Alcatel-Lucent's portfolio of photonic switches and optical cross-connects, the Alcatel-Lucent 1870 TTS supports the Converged



OPTICAL NETWORKING WITH EXTRA 'FLEX'

Integral to the Alcatel-Lucent solution is ODUflex, a flexible optical data unit (ODU) container that facilitates flexible-rate virtual channeling for mapping traffic flows (e.g., VLANs or pseudowires) within 10 G, 40 G and 100 G Ethernet interfaces. ODUflex allows providers to interconnect routers in ways that enable efficient incremental bandwidth growth — in steps as granular as 1 Gbps. This eliminates the need for allocating a full fixed-rate ODU container to each connection and instead allows bandwidth to be increased as needed, maximizing the efficiency of network assets.

Backbone Transformation solution, a key component of Alcatel-Lucent's High Leverage Network strategy. It offers a flexible range of traffic grooming options that enable efficient core router traffic offload onto the optical network and help scale the IP backbone, facilitating transport at the lowest cost per bit (see Figure 2).

Deliver service quality assurance and simplify operations

The Alcatel-Lucent 1870 TTS brings intelligence to the transport network through its integrated GMPLS control plane. GMPLS enables dynamic bandwidth provisioning at the most efficient level, makes the network resilient to multiple failures, and provides intelligent restoration mechanisms. Through protection schemes that switch traffic to protected pipes when failures are detected, GMPLS restoration supports SLA assurance with minimum resource allocation, freeing up bandwidth for additional paying traffic and removing the need for manual interventions.

In addition, the Alcatel-Lucent 1870 TTS simplifies infrastructures that offer capacity services, such as transparent SDH/SONET or wavelength services, to other carriers or service providers. Building on OTN's wide range of fault

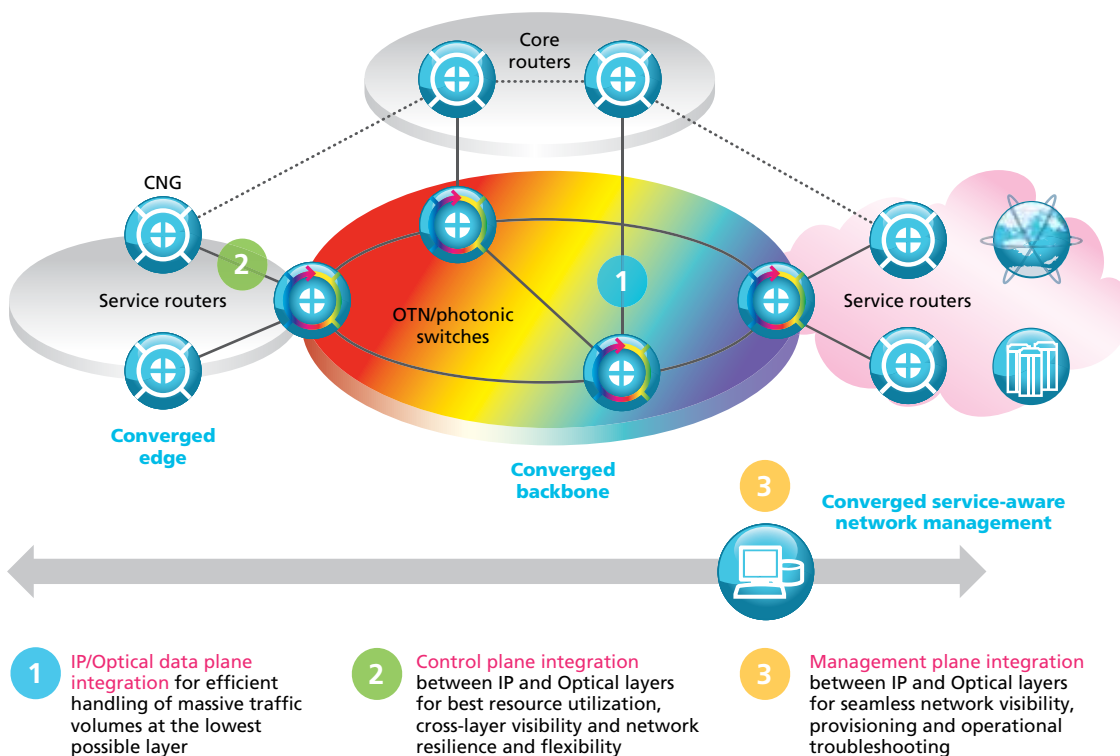
management, multi-level connection monitoring and SLA verification tools, the Alcatel-Lucent 1870 TTS enables both intra-carrier and inter-carrier end-to-end monitoring capabilities that increase service quality assurance, facilitate operations and lower network costs in multi-carrier/multi-domain networking scenarios.

Integrate the control plane

For maximum scalability, rapid service provisioning and increased resiliency, information must be exchanged between the IP and optical layer control planes. Alcatel-Lucent's GMPLS User Network Interface (UNI) protocol enhancements facilitate cross-layer information sharing between the optical and the IP networks. Their benefits include:

- Simplified provisioning of optical paths between trusted IP nodes
- Fully redundant paths with no common failure elements
- Coordinated multi-layer resiliency
- Notification of remote alarms
- Coordinated multi-layer multicast
- Exchange of network change notifications (e.g., bandwidth and latency changes)
- Notification of maintenance events

Figure 2. Alcatel-Lucent's High Leverage Network – Converged Backbone Transformation solution



ALCATEL-LUCENT: CREATING THE NEXT GENERATION

Alcatel-Lucent is uniquely positioned to facilitate the transition to next-generation OTN and help service providers reap greater value from their networks. With its industry-leading position in both IP and optical networking, a record of technological innovation, and a clear vision for the future, Alcatel-Lucent has the experience and leadership to deliver practical, economical and forward-looking solutions to today's network challenges.

The Alcatel-Lucent 1870 TTS provides the foundation for the converged backbone transport infrastructure, leveraging OTN networking, terabit switching, IP core offload and GMPLS innovations to ensure maximum profitability for service providers.



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