

ciena.

Multiservice Optical Switching System

CoreDirector[®]



Offering new
services and
enhancing
service velocity

Transforms your network into a programmable service-delivery engine changing the way you compete

Network operators are faced with ever-increasing and uncertain traffic demands driven by new bandwidth-intensive applications, while revenue streams erode as the price per bit continues to fall.

Networks have become mission-critical tools as business, government, industry, and consumers demand newer, faster, and more flexible services. It is imperative that network operators create transparent, flexible, rapidly-provisioned, on-demand networks to meet end-user needs. To handle these new network demands profitably, network operators require the automation of key functions of the network through a programmable service-delivery engine.

A programmable service-delivery engine is a programmable set of network resources that can automatically activate any type of service between any set of endpoints with the most velocity and efficiency. It provides a low-touch ability to dynamically allocate, increase, and/or decrease network capacity in response to unpredictable demand curves.

It enables service providers to adapt and scale their networks to address emerging services, turn unpredictability in service demand into business opportunities, and eliminate barriers between creating and monetizing new services.

CoreDirector and the CN 4200® FlexSelect™ Advanced Services Family, combined with Ciena's ON-Center® Network and Service Management Suite, enable networks to become programmable service-delivery engines for cost-effective end-to-end managed services. As shown in Figure 1, a programmable service-delivery engine allows an operator to simply click on the two service endpoints, choose the bandwidth and service level, then activate.

Ciena's FlexSelect Architecture features a variety of versatile, adaptable network elements that provide flexible hardware and intelligent, embedded software—allowing the network to support multiple service types and manage individual services from the network's edge to its core.

One essential component of FlexSelect Architecture is the CoreDirector Multiservice Optical Switch. CoreDirector provides hardware flexibility by consolidating the functionality of multiples of MSPPs, DCSs, Ethernet, and Optical Transport Network (OTN) switches into a single, high-capacity intelligent switching system.

CoreDirector provides high-function Layer 1 and Layer 2 switching capabilities and is optimized to aggregate and forward multiple services—including Ethernet/TDM Private Line, Triple Play and IP—in core, regional, and metro portions of the network. CoreDirector mitigates the risk associated with migration to Ethernet by allowing network operators to leverage existing SONET/SDH networks while efficiently supporting Ethernet services.

CoreDirector supports TDM and Ethernet demands by using embedded intelligence to accelerate service fulfillment, sustain superior Quality of Service (QoS), automate resource management and simplify maintenance operations, while reducing overall network capacity requirements. CoreDirector's embedded software intelligence reduces operational and capital costs and adds value to TDM and Ethernet services through differentiation and improved service operations.

Intelligent Optical Mesh Networking

CoreDirector intelligence, based on industry standards for routing and signaling optical control planes, provides the foundation for CoreDirector mesh networks. When built with CoreDirector, mesh networks can reduce operational and capital costs by up to 85 and 70 percent, respectively. CoreDirector mesh networks have been proven to use less operational capacity and generate as much as 18 percent more revenue per employee while reducing the number of necessary operations personnel by over 40 percent.

Ciena has leveraged knowledge from over eight years of field experience and continued research and development to make CoreDirector intelligent software robust and highly functional.

Up to six-9s of field-measured availability is provided by CoreDirector in more than 30 networks worldwide and in networks of up to 350 nodes. Ciena has leveraged knowledge from over five years of field experience and continued research and development to make CoreDirector intelligent software robust and highly functional.

Ciena's embedded intelligent software, at the heart of the CoreDirector system, is specifically designed to:

- Automate provisioning, inventory and operations processes
- Provide the highest service availability for both TDM and Ethernet services
- Allow differentiation of service classes
- Offer architectures that simplify operations and reduce capacity requirements
- Integrate seamlessly into network operations environments

Each node on the CoreDirector intelligent network maintains a database of the network topology. Network nodes continuously update each other on additions or deletions of nodes, links, modules, and ports. This distributed intelligence provides reliability and scalability for carrier-class intelligent optical networks.

Process Automation

CoreDirector routing and signaling intelligence provides real-time resource inventory discovery and database synchronization, intelligent service request mapping to network resources, and fully-automated activation and deactivation of network resources. These functions automate backoffice processes and significantly reduce errors associated with tracking network resources, assigning

Major Benefits

- Transforms networks into a programmable service-delivery engine
- Consolidates TDM, OTN, and Ethernet switching functionality in a single, high-capacity multiservice optical switch, simplifying the network and reducing operational costs
- Supports TDM, OTN, and Ethernet traffic aggregation and forwarding in metro/regional hubs, saving 40 percent or more on equipment costs
- Uses high-capacity switching and more efficient mesh network architecture, reducing capital costs by as much as 70 percent
- Reduces operations costs by as much as 85 percent by automating and simplifying processes and network infrastructure with field-proven intelligent optical control plane functionality
- Automates resource inventory and service provisioning for rapid service-delivery and faster revenue-generation
- Supports multiple classes of service, facilitating differentiation of TDM, OTN, and Ethernet, for incremental revenue-generation
- Delivers greater than 99.9999 percent service availability with field-proven hardware and software
- Integrates Dense Wavelength Division Multiplexing (DWDM) capabilities, reducing the cost of connecting to the optical transport network

For example, "I need a 600 Mb/s Ethernet connection with protection level 1 from A-to-Z for the next three days"

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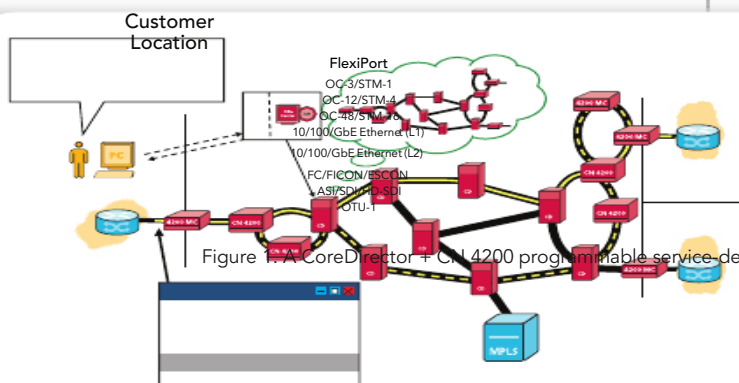
Customer Location

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- Provides proven interoperability with third-party vendor equipment



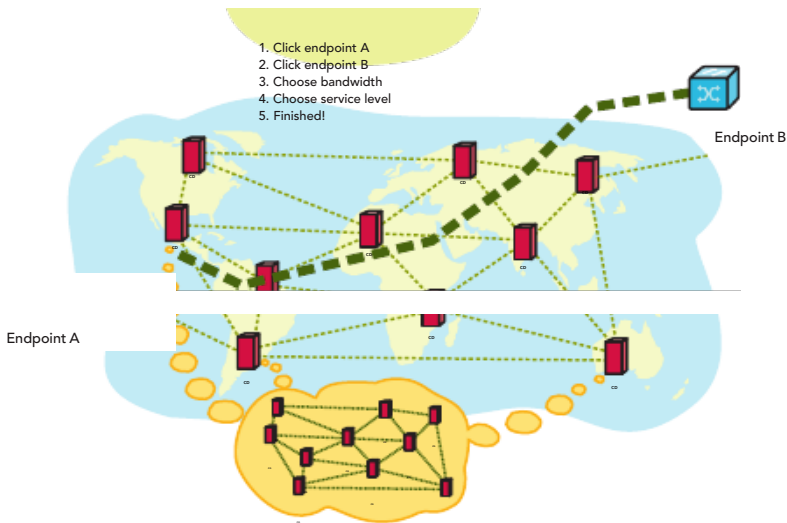


Figure 2. End-to-end automated service provisioning in CoreDirector's intelligent optical mesh network

to reroute TDM, OTN, and data services around a network failure, achieving service availability exceeding that of typical SONET/SDH ring and linear protection mechanisms. FastMesh is critically important during multiple failure scenarios, shown in Figure 3, which exceed the capability of line- and path-protection mechanisms to restore

these resources during service activation, returning them to network inventory upon service deactivation, and re-grooming their capacity during network optimization. CoreDirector intelligence simplifies TDM, OTN, and Ethernet service activation and deactivation to a simple point-and-click process, significantly decreasing response time for service requests, as shown in Figure 2. The intelligent operational software is complemented by CoreDirector Designer™ application software, an off-line tool for capacity planning, network optimization and validation, maintenance simulation, and node configuration.

High Service Availability

CoreDirector's proven, intelligent, connection-level FastMesh® restoration is unique. FastMesh allows providers to utilize any available network capacity

SONET/SDH line- and path-protection schemes to provide the highest level of service availability.

Class Of Service

CoreDirector software enables the intelligent mapping of service levels to network resources by combining protection and restoration flexibility with routing and signaling

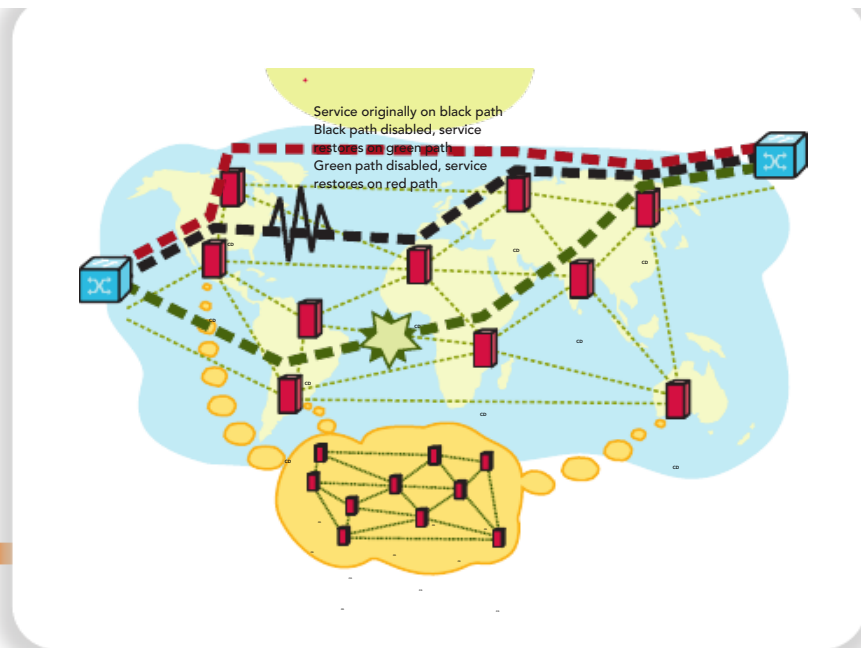


Figure 3. CoreDirector FastMesh restoration

intelligence. TDM, OTN, and Ethernet services may be configured individually in one of six service classes. Based on the assigned service class, the operating software restricts the service path to those network links with the appropriate level of protection and lowest cost, and prioritizes service restoration when FastMesh rerouting is enabled. The software also allows the configuration of an entire end-to-end service path in a mesh network with dedicated 1+1 path-level protection and mesh restoration as back-up in the event of multiple failures. With TDM, OTN, and data service-class differentiation, network operators can tailor network capacity so that higher-revenue premium services and lower-priority services share restoration bandwidth for maximum availability using minimum resources. This streamlining also allows mapping of revenue streams to network costs more efficiently.

Simpler And More Efficient Architectures

CoreDirector operating software allows networks to advance from standard SONET/SDH physical topologies to a simpler mesh architecture. Network operators can streamline planning, designing, and engineering processes by adding mesh network capacity on a link basis instead of a ring basis. FastMesh networks achieve higher availability using significantly less capacity than typical

SONET/SDH topologies. Users can add working assignments and/or SONET/SDH protection to the mesh architecture at any time by configuring assignments to the existing links, creating logical linear and ring protection. This capability allows SONET/SDH protection to be configured independently from existing physical topology, unlike typical SONET/SDH implementations, and simplifies the planning process, yielding a more efficient network.

Ethernet Services

CoreDirector's cost-effective, robust integrated data solutions and industry-leading intelligence and reliability facilitate convergence to a single data network, and generate new revenue with differentiated data service offerings.

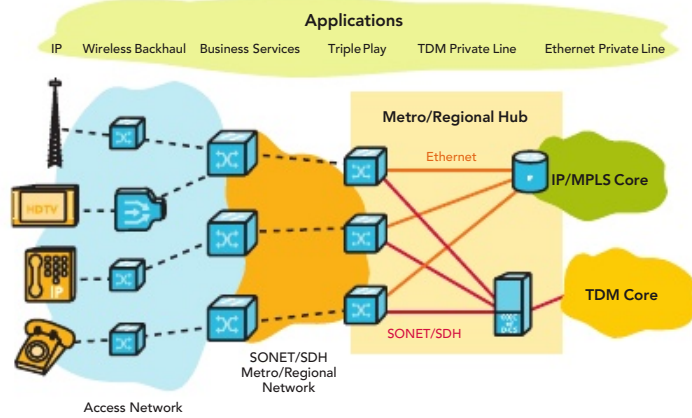


Figure 4a. Traditional solution

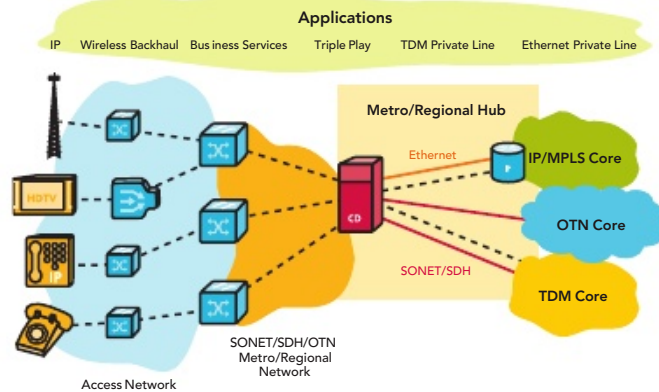


Figure 4b. CoreDirector solution

CoreDirector supports a suite of GbE and 10GbE data-aware solutions which efficiently transport Ethernet services over a highly reliable SONET/SDH infrastructure, utilizing Generic Framing Procedure (GFP), Virtual Concatenation (VCAT) and Link Capacity Adjustment Scheme (LCAS), and providing options for Layer 1 and Layer 2 switching. Per-flow Ethernet traffic management capabilities, based on MEF standards, are used to enforce Class of Service (CoS)/Quality of Service (QoS) for end-user SLAs.

Multiservice Hubbing

Using a combination of TDM, OTN, and Ethernet solutions, CoreDirector can be deployed as the gateway switch for aggregating TDM, OTN, and Ethernet traffic from metro/regional networks and forwarding the traffic to TDM, OTN or IP/MPLS cores or local services network elements. Traditionally, metro/regional network traffic aggregation and forwarding are supported by multiple next-generation MSPPs, DCSs and/or Ethernet switches, as shown in Figure 4a. In contrast, CoreDirector supports these applications with a single switch, saving 40 percent or more on equipment costs, as shown in Figure 4b.

Network Convergence and End-to-End Transparent Services with OTN

As the demand for IP- and Ethernet-based services increases, network operators with large existing infrastructures are looking for solutions that will enable them to support multiple service types efficiently, with minimal change to the existing infrastructure. Their search is made more difficult by the continued demand for TDM services, though this demand is expected to level out and eventually decrease. Traditionally, multiple overlay networks are built to support various groups of services offered by network operators. However, multiple overlay networks result in higher operational expenditures and duplication of some network elements. Network operators need a converged network that supports multiple service types, while leveraging the existing infrastructure.

In addition to the increase in demand for various service types, there is also an increase in demand for end-to-end transparency of services. More and more end-users or third-party service providers want control of certain aspects of a service being delivered to them, which can only be attained if the service is transported with 100 percent bit-for-bit transparency across the network.

Support of the emerging OTN switching capabilities, based on G.709 standards, in CoreDirector and other Ciena products enable the creation of a service-adaptable network that supports multiple service types. OTN encapsulation mechanism also supports the 100 percent transparency required for the service-adaptable network. In general, OTN promises the following benefits:

- Enhanced multiplexing, provisioning and switching of high-bandwidth (2.5 Gb/s and above) services, resulting in improved wavelength utilization
- Increased efficiency for transport and switching of non-SONET/SDH traffic, including OTN- and Ethernet-based traffic, resulting in a single converged optical infrastructure
- Improved monitoring and management of OTN, Ethernet, and other non-SONET/SDH data services
- Standardized optical handoffs for multiservice traffic between different optical transport elements, both within and between networks, to support the operational benefits of best-of-breed multi-vendor networks

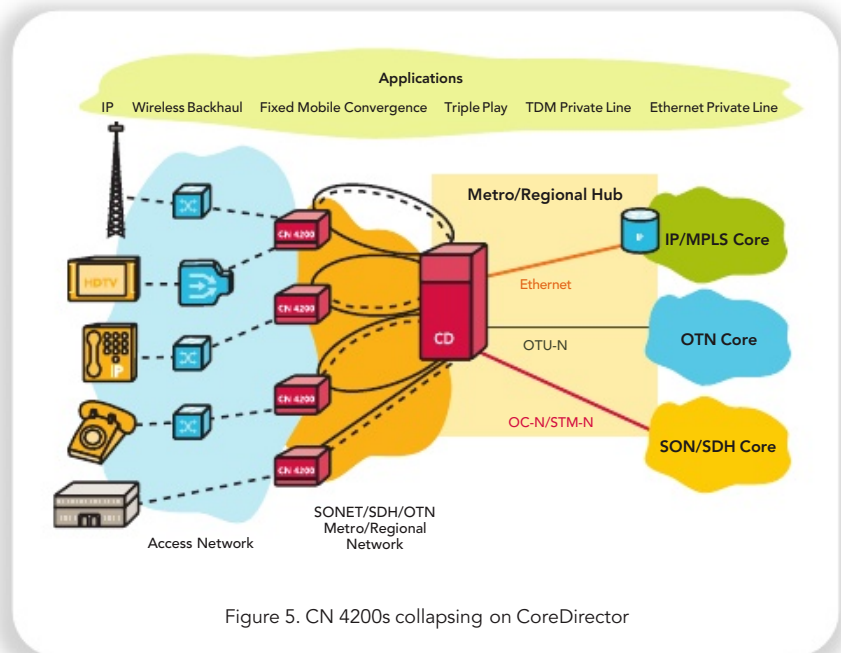


Figure 5. CN 4200s collapsing on CoreDirector

The CoreDirector architecture supports the functionality required for the basic benefits of OTN, which includes transparent mapping of 2.5G and above services into OTN frames for transport across the optical network. In addition to supporting the functionality for 2.5G and above wavelength services, CoreDirector architecture also supports functionality for transparent sub-wavelength services (down to 155 Mb/s) mapping. Sub-wavelength circuits are called Optical channel Payload Virtual Containers (OPVCs). OPVCs can be switched, multiplexed, and/or demultiplexed to higher bandwidth OTN circuits.

Switching, multiplexing and demultiplexing of OPVCs is also supported by Ciena's CN 4200 FlexSelect Advanced Services Platform Family, a field-proven system that cost-effectively supports client connections and transport for a suite of TDM and data services, including Ethernet, SONET/SDH, Fibre Channel, FICON®/ESCON®, Digital Video, and OTN.

CoreDirector and the CN 4200 combined provide an optimal solution for converged metro service aggregation and switching in response to increased demand for lost effective Ethernet service and Ethernet traffic support. As shown in Figure 5, the CN 4200 can be used to connect multiple service types (TDM, OTN, and Ethernet) to the network and provide an initial level of service aggregation. Sub-wavelength services are mapped by the CN 4200 to OPVCs or OTU-1s and muxed

to OTU-Ns for transport. CoreDirector terminates the OTU-Ns with Ethernet traffic bound for the SONET/SDH or IP/MPLS core networks, then de-encapsulates the Ethernet traffic and switches it towards the appropriate core network. Ethernet traffic bound for the IP/MPLS core will be switched natively and Ethernet traffic bound for the SONET/SDH core will be mapped to TDM frames before forwarding.

OTN also provides a means for delivering network services with 100 percent bit transparency. The network provides a set of overhead bits for performance monitoring and fault detection and isolation by digitally wrapping native transport protocols (such as SONET/SDH, Ethernet, and Fibre Channel) upon their ingress to the network. These OTN overhead bits are removed upon egress of the network. Since none of the native protocol bits are modified, the service is carried across the OTN transparently. As shown in Figure 6, CoreDirector can be combined with other Ciena solutions (such as the CN 4200 and CoreStream® Agility Optical Transport System) to support a next-generation network that transparently delivers multiple types of TDM and Ethernet wavelength and sub-wavelength services. Ciena's ON-Center® Network and Service Management Suite provides TDM and Ethernet service-level management from one end of the network to the other.

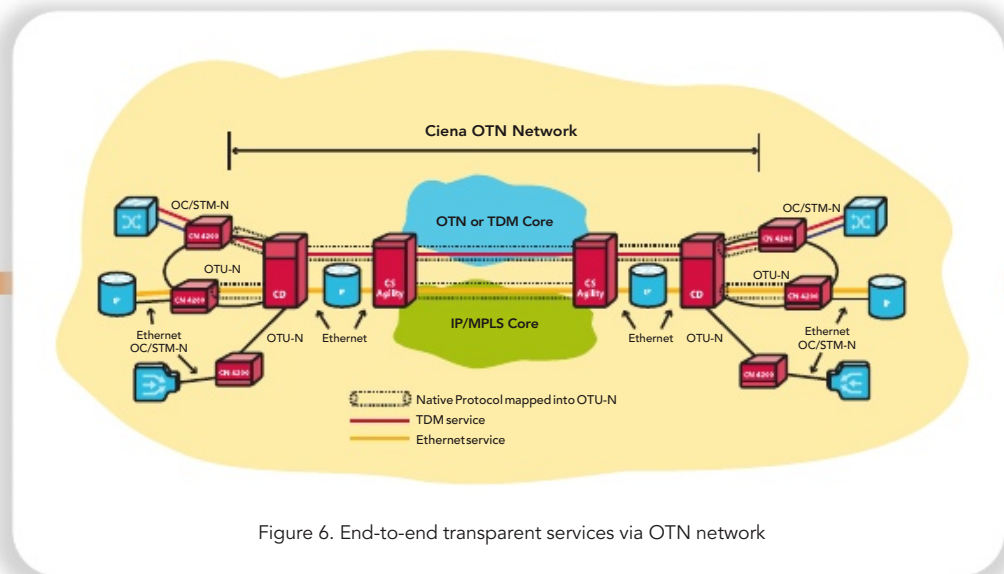


Figure 6. End-to-end transparent services via OTN network

CoreDirector Multiservice Switch Platforms

CoreDirector provides 640 Gb/s of nonblocking switching capacity in a single telco rack, and CoreDirector CI Multiservice Optical Switch, which has a smaller footprint, provides 160 Gb/s of non-blocking switching in one-half of a telco rack. CoreDirector and CoreDirector CI provide the flexibility to groom and switch traffic in granularities, ranging from wavelengths to individual STS-1s/VC-3s, and support switching for SONET/SDH (with translation), Ethernet, and OTN. CoreDirector and CoreDirector CI architecture support a mix of the following interfaces: 10G, 2.5G, and 155/622M SONET/SDH; GbE and 10GbE; OTU-1 and OTU-2; STM-1e electrical; and ITU 10G WDM. For core and metro transport applications, CoreDirector DWDM interfaces are interoperable with Ciena's CoreStream Agility and CN 4200, as well as third-party transport systems. The interfaces support a fully-integrated switching and transport solution that eliminates the need for back-to-back DWDM and switch interconnect transceivers. CoreDirector and CoreDirector CI share common modules, including timing, switch fabric, control, and interface modules. The systems also use a common software base, with all the same features supported by both systems.



Specializing in transition to
service-driven networks to help you
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