



CN 2000™ Storage and Data Extension Platform Solution Description



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Table of Contents

CN 2000 Storage and Data Extension Platform Overview.....	3
Increased Performance Utilizing Available Transport Services.....	4
Maximized Throughput with Dynamic Layer 2 Flow Control.....	5
Optimized WAN Bandwidth using Data Compression.....	6
Flexible Control with Application Bandwidth Assignment	7
Static Bandwidth Assignment.....	7
Dynamic Bandwidth Assignment	7
CN 2000 Architecture Overview	8
Hardware Modularity.....	8
Software	9
Element and Network Management.....	9
Advanced Application and Transport Visibility	10
CN 2000 Deployment Example.....	12
Conclusion	13
More Information on Ciena.com:	13

List of Figures

Figure 1: CN 2000 Extends Data Center Applications and Protocols Across the MAN/WAN.....	3
Figure 2: CN 2000 Minimizes Protocol Conversion for Increased Throughput, Performance and Security	4
Figure 3: Example of interoperability testing with CN 2000	4
Figure 4: Flexible Flow Control Maintains Full Throughput Over Any Distance	5
Figure 5: CN 2000 is Qualified and Ceritifed with Major Vendor Equipment & Applications....	5
Figure 6: CN 2000 Makes Better Use of Network Connectivity.....	6
Figure 7: Common Data Type Compression Ratios	6
Figure 8: Multiple Application Ports Utilize Both Static and Dynamic Bandwidth Assignment ..	7
Figure 9: CN 2000 Modular Design	8
Figure 10: CN 2000 Manager Provides Data Center and Transport Visibility and Control.....	9
Figure 11: Sample Reports Generated Real Time or on a Daily, Weekly or Monthly Basis	11
Figure 12: Forcing SAN Extension over IP LAN Extension is Inefficient and Expensive.....	12

CN 2000 Storage and Data Extension Platform Overview

The CN 2000 is a leading storage and data over distance CPE solution targeted to large and medium sized enterprises. Designed to connect remote data centers, the CN 2000 enables enterprises to prove-in business cases and justify WAN bandwidth transport costs for applications including Business Continuity / Disaster Recovery, Remote backup, SAN/Mainframe island interconnect and/or LAN Extension.

The CN 2000 lowers capital costs by up to 80% compared with WDM or legacy channel extension solutions while lowering recurring bandwidth and maintenance costs by up to 70%.

The CN 2000 supports native full and sub-rate Fibre Channel (FC), ESCON®, FICON®, and Gigabit Ethernet (GbE) on the enterprise side. On the Network side (MAN/WAN), the CN 2000 supports industry standard transport services from DS3/E3 through OC-3/12/48/STM and Gigabit Ethernet Private Line, meeting the most demanding performance requirements with the flexibility to scale as application needs change. The CN 2000 Manager brings powerful service and network visibility through intuitive monitoring, reporting and management capabilities.

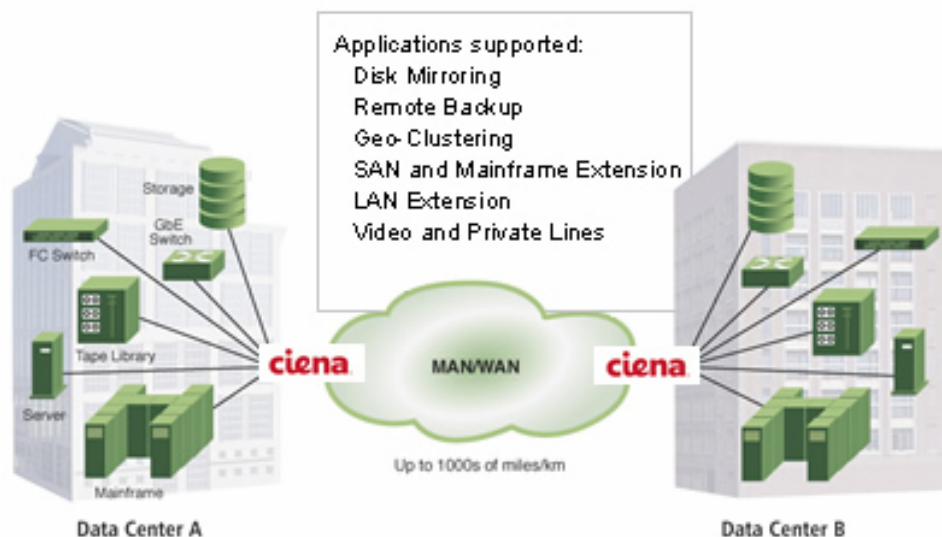


Figure 1: CN 2000 Extends Data Center Applications and Protocols Across the MAN/WAN

Increased Performance Utilizing Available Transport Services

The CN 2000 provides unmatched performance compared with competing solutions. The CN 2000 is a Layers 1 and 2 *hardware* based platform. Because the CN 2000 is designed to securely map SAN & LAN protocols onto a SONET payload, there is no encapsulation taking place at Layers 3 and 4 of the protocol stack. IP and ATM encapsulation require additional processing to handle packet and cell loss typical in IP routed and ATM QoS networks. IP and ATM also add network overhead of 10% and 20% respectively to the payload. This increases required bandwidth and adds critical latency to the applications greatly reducing performance. Performance, distance and application transparency are all optimized with a simplified, transport-centric approach.

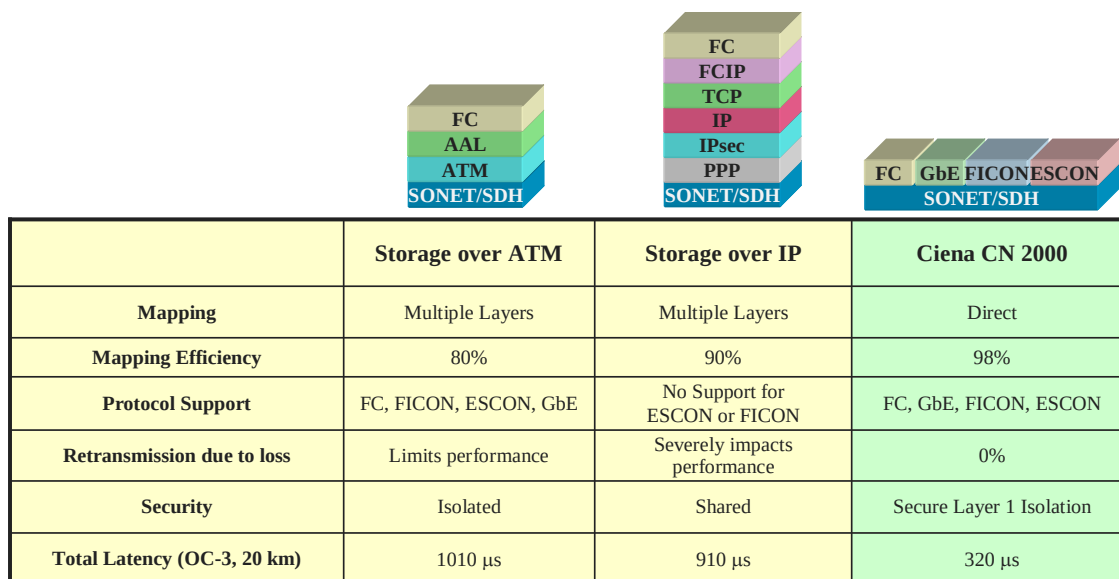


Figure 2: CN 2000 Minimizes Protocol Conversion for Increased Throughput, Performance and Security

The CN 2000 is fully interoperable with industry standard [GR-253](#) SONET, Gigabit Ethernet Private Line and [ITU DWDM](#) transport equipment as well as standard Data Center equipment. Below is an example of some of the interoperability testing that has been completed.

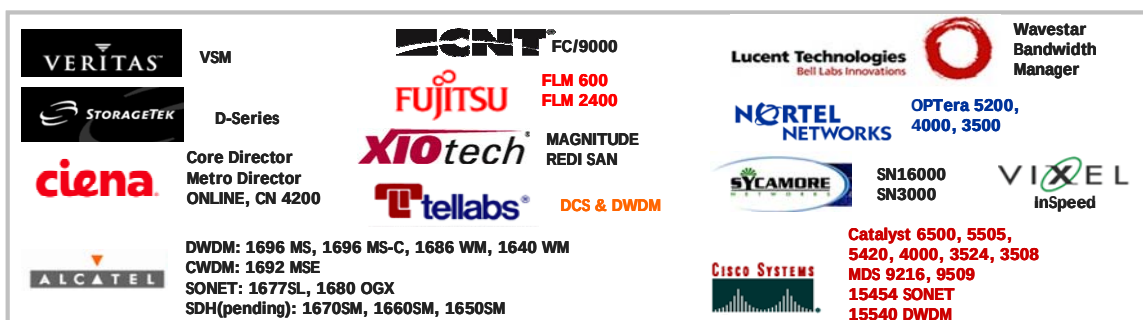


Figure 3: Example of interoperability testing with CN 2000

Maximized Throughput with Dynamic Layer 2 Flow Control

Most Fibre Channel devices and switches support distance extension through the use of a pre-provisioned number of buffer credits allocated from a fixed resource. This complicated and inflexible approach results in wasted resources as well as cumbersome and error-prone provisioning. This adds cost and unnecessary incremental bandwidth requirements to the extension solution.

The CN 2000 automatically determines the number of buffer credits based on the assigned throughput allowing the application to fully utilize the available bandwidth independent of distance. This eliminates the requirement to engineer buffer credits on the attached devices. Figure 4 shows the throughput impacts of distance when using fixed buffer credit devices.

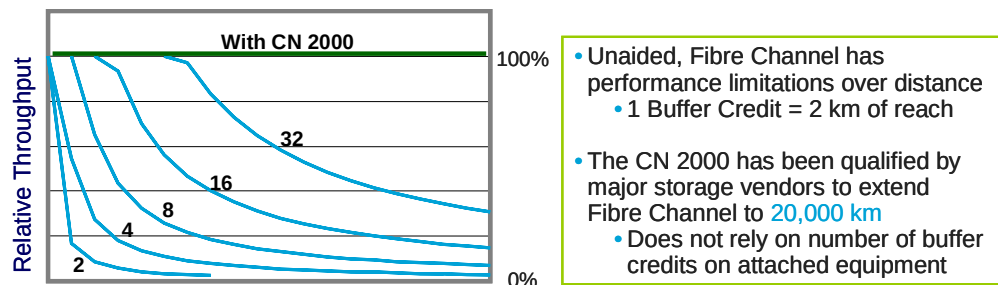


Figure 4: Flexible Flow Control Maintains Full Throughput Over Any Distance

Most legacy channel extenders do not support Layer 2 Fibre Channel Buffer Credit flow control, but instead resort to Layer 4 network-spoofing to “trick” the end devices into sending “presumed correct” data. The problem with this design is that corrupt data is only checked at the terminating location after the originating location has already begun sending the next round of data. If data is corrupt, flow control and pause frame corrective actions will only be initiated well after the problem is detected. Since Layer 4 “spoofing” is done in software, legacy channel extenders are extremely large and expensive with recurring application software licensing fees. They also add a great deal of equipment latency further reducing the performance and reach of the extension application. The CN 2000 has none of these limitations.

As an application-transparent transport centric device, the CN 2000 is interoperable with major data center equipment. It has completed certification and/or qualification with the following vendors’ equipment and applications. Actual application reach and performance will vary depending on the specific application, data center equipment tuning, total network latency and bandwidth and system configuration attributes. Data center equipment vendors, Service Provider engineers and/or Ciena can work with the project manager to determine individual solution performance and reach expectations.

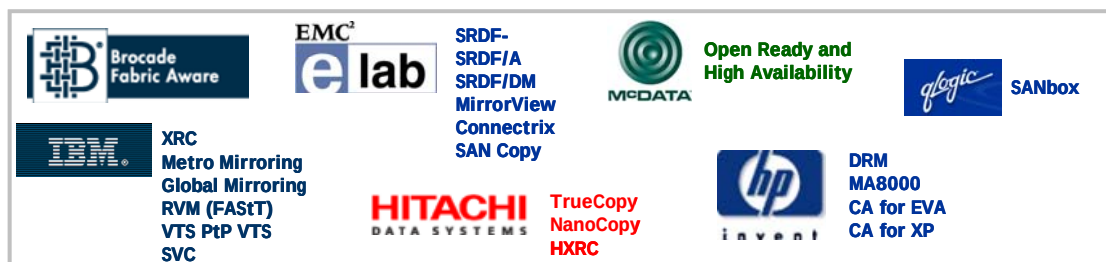
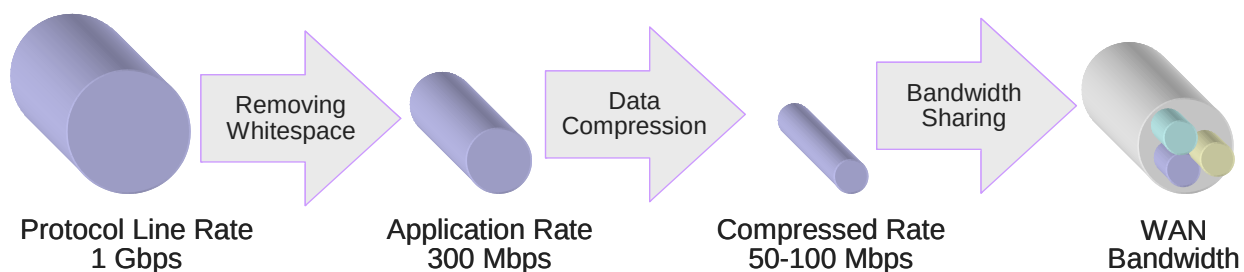


Figure 5: CN 2000 is Qualified and Certified with Major Vendor Equipment & Applications

Optimized WAN Bandwidth using Data Compression

One of the CN 2000's key features is its unique approach to data compression. Standard with the CN 2000 is the removal of white space (IDLE/PAUSE frames) from the data stream before the application is mapped to the wide area network.

When optional data compression is enabled, it is applied only to the application data with *dedicated* compression chips. Data compression for each data stream provides greater than 30% higher performance verses competing solutions that compress post-aggregated data on the egress network port. Once compression takes place, the data is mapped onto the line interface using Generic Framing Procedure (GFP). GFP delivers key advantages, notably the ability to dynamically define the amount of bandwidth used for a given circuit over any SONET network.



CN 2000 reduces WAN bandwidth consumption by

1. Removing unused portion of protocol line rate (whitespace)
2. Using dedicated compression chips on each client port to compress data 3x to 5x
3. Allowing multiple applications to share the same WAN facility

All these features are available for all client protocols and WAN interfaces

Figure 6: CN 2000 Makes Better Use of Network Connectivity

Example Data Type	Example Compression Ratios - only one application transmitting
Text files	3:1
Spreadsheet files	6:1
Graphics files	5:1
CAD files	7:1
Data base files (EDP)	3.5:1
Data base files (Oracle)	9:1
Data base files (Paradox)	1.2:1

Figure 7: Common Data Type Compression Ratios

Flexible Control with Application Bandwidth Assignment

Static Bandwidth Assignment

Static Bandwidth Assignment allocates ingress port traffic in various STS-1 (51 Mbps) timeslots within the SONET network service connected to the Network side of the CN 2000. This is useful for applications with largely static or non-bursty bandwidth needs. Once client side traffic is allocated to a timeslot, there is zero contention for that bandwidth, ensuring guaranteed throughput and low latency. Flow control techniques ensure that data is never lost when an ingress port bursts beyond its assigned bandwidth. The amount of bandwidth dedicated to any port can be changed on the fly and without network down time.

Dynamic Bandwidth Assignment

Dynamic Bandwidth Assignment (DBA) provides the capability for input ports to be grouped so they can share each other's bandwidth when available. Each port is assigned a minimum guaranteed percentage of the group's total bandwidth to be provided when all ports require their full bandwidth. Flow control techniques ensure that data is never lost when any ingress port bursts beyond available bandwidth.

DBA offers a powerful quality of service (QoS) element to multi-application transport since storage and LAN applications do not always use their peak bandwidth requirements at the same time. A common use is to group a work-day LAN Extension application port with a nightly-backup SAN application port. These ports will automatically optimize network bandwidth by providing bandwidth to the LAN traffic during the day and to the SAN traffic overnight without any manual intervention.

The CN 2000 offers two maincard options supporting either two or four DBA groups. Up to eight ports can be grouped into a single DBA group.

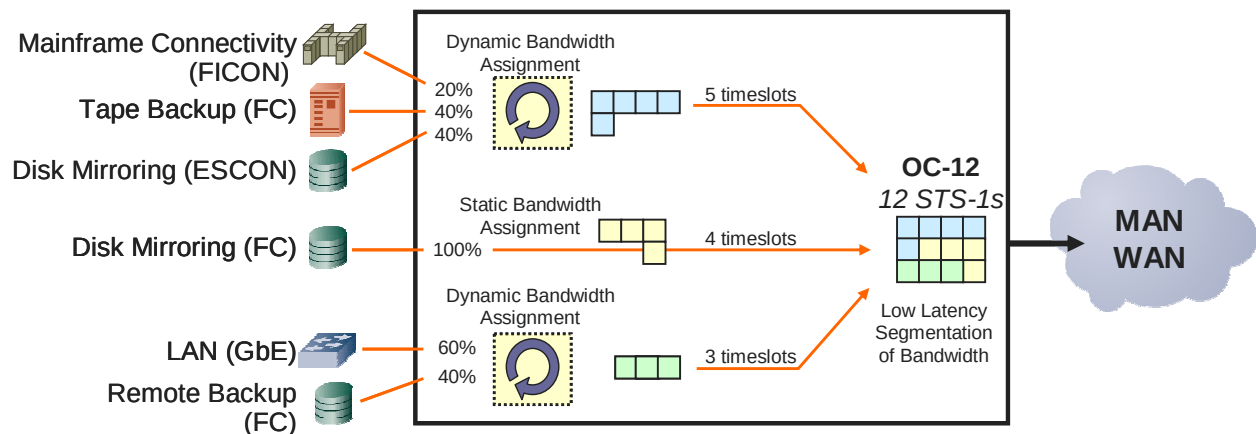


Figure 8: Multiple Application Ports Utilize Both Static and Dynamic Bandwidth Assignment

CN 2000 Architecture Overview

Hardware Modularity

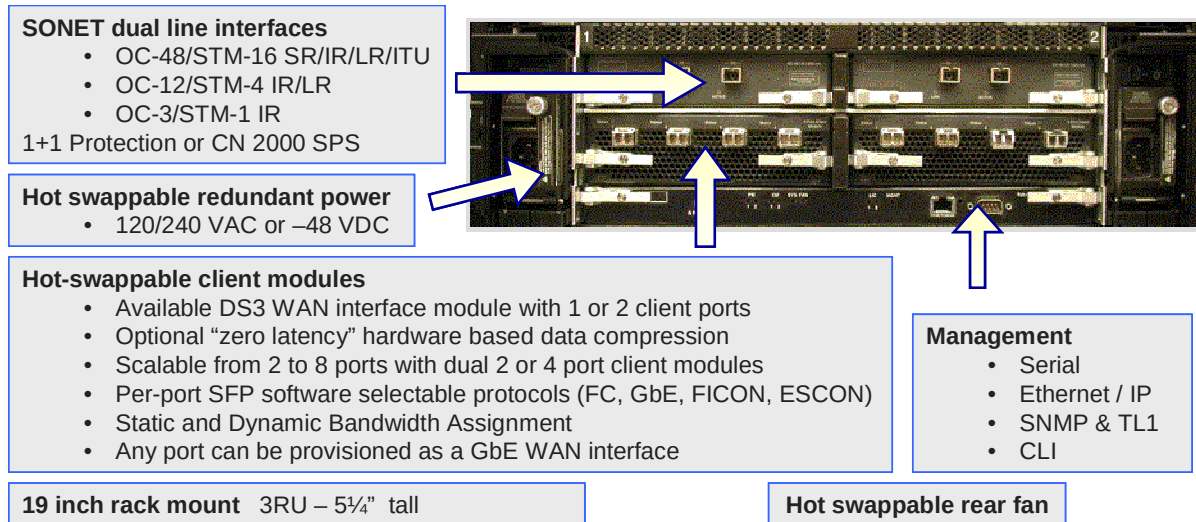


Figure 9: CN 2000 Modular Design

The CN 2000 chassis consists of two Line Interface Module (LIM) slots, two Client Interface Module (CIM) slots, a single Maincard slot with optionally redundant power supplies and a fan unit. Each hardware component in the CN 2000 is hotswappable and field replaceable.

Line Interface Modules may be OC-3/12/48, 1310nm dark fiber or ITU DWDM supporting SR, IR & LR reaches. Line Interface Modules are not needed for DS-3 or Gigabit Ethernet WAN services since they are supported by the Client Interface Modules. Line Interface Modules may be duplicated for a port protected WAN service or mixed for flexible and load sharing, working/protect service schemes.

Client Interface Modules are either two port or four port cards. Only one is required. Each active port requires an LX or SX SFP that may be provisioned for Fibre Channel, FICON or Gigabit Ethernet. An ESCON SFP is used for ESCON ports. The two-port DS-3 Client Module has two ports plus an integrated DS-3 interface, eliminating the need for a separate Client Interface Module. Gigabit Ethernet Private Line WAN Services may be connected directly to any GbE WAN provisioned port on a two or four port Client Module also eliminating the need for a separate Client Interface Module. Client port protocols can be changed at any time among: FC, GbE, FICON and ESCON. The CN 2000 seamlessly addresses protocol migration (e.g. ESCON to FICON or ESCON to Fibre Channel), without additional software fees, hardware or site visits.

Each of the three types of Client Modules (2 ports, 4 ports & 2 ports w/ DS-3) can be offered with or without data compression. Data compression typically increases throughput by 3 to 8 times depending on the data characteristics.

Ciena has simplified ordering with platform bundles that include all the equipment and software for typical deployments.

Software

The CN 2000 comes pre-loaded with software from the factory. From the CN 2000 Manager server or from an FTP server, each network element can be upgraded by downloading the desired version of software to an area of memory and making it the active version. Rebooting the system will load the active version, which takes less than a couple of minutes. NE software is stored on flash memory that is resident on each CN 2000. In the event there is a problem with the newly loaded software, the system can be downgraded to the older version still residing on flash memory.

The CN 2000 Manager software is supported on both Microsoft Windows (NT, 2000 or XP) and Sun Solaris (Ultra 10; Solaris 8 or 9) platforms.

Element and Network Management

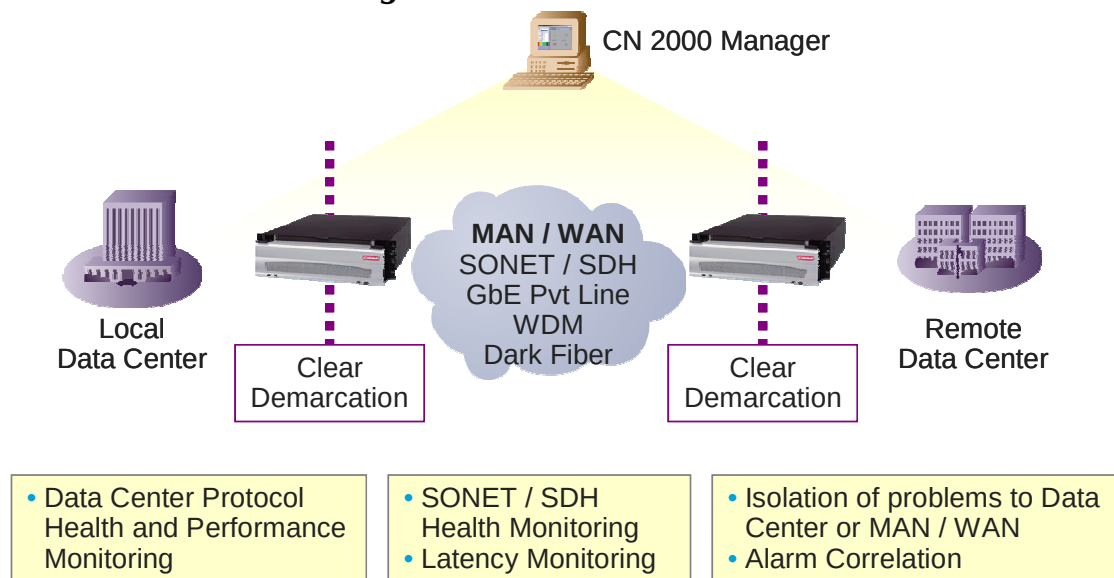


Figure 10: CN 2000 Manager Provides Data Center and Transport Visibility and Control

The CN 2000 Manager allows service providers, solution integrators and enterprises to optimize and monitor the CN 2000 locally or remotely. It provides an extensive set of critical data on the performance of both the SAN/LAN and WAN connectivity into the CN 2000. This unique capability aids in the rapid isolation and resolution of performance issues.

The CN 2000 Manager Graphical User Interface (GUI) enables enterprises to easily and rapidly provision new connections, review and change service parameters, view real-time performance and health metric graphs, track historical usage of network bandwidth and perform other important operational tasks via a simple point-and-click interface. Multiple, simultaneous client connections allow technical personnel to monitor and manage their CN 2000 network from anywhere in the world.

For non-GUI activity, Command Line Interface (CLI) sessions are performed using Telnet. FTP provides CN 2000 database backup and restore file transfer while SNMP is used to send fault alarms and system events to management stations.

The CN 2000 is managed with standard IP-based communication. Management access and communication is maintained between two devices either in-band utilizing OSPF routing messages in the SONET/SDH path overhead or out-of-band through standard IP network connectivity to each device.

Advanced Application and Transport Visibility

End-to-End Monitoring

The CN 2000 Manager delivers a real-time circuit monitor, allowing end users to monitor important health and performance metrics, such as end-to-end latency, frame counts, byte counts, CRC checks, and service occupancy.

Network problems in the WAN typically result in multiple related alarms by networking equipment. The CN 2000 Manager correlates these alarms, providing an instant impact analysis of equipment failures for specific users or circuits to assist technical personnel in tracking down and correcting problems as quickly as possible.

Rapid Fault Isolation

The CN 2000 Manager simplifies and accelerates fault isolation by providing a single point of access for the health and status of both data center and MAN/WAN networking equipment, allowing technical personnel to quickly assess and resolve service degradations and faults.

Network Optimization

The CN 2000 Manager gathers and stores performance statistics, which allow end users to analyze the amount of traffic generated by their key BC/DR, SAN, LAN, and mainframe applications. This ensures maximum bandwidth efficiency and application performance, reducing network bandwidth costs by eliminating waste and enabling intelligent planning to meet future requirements.

SLA Verification

A service provider will often provide a Service Level Agreement (SLA) as part of a service offering to an enterprise. The CN 2000 Manager collects key statistics and can generate reports that allow SLAs to be verified by an enterprise, ensuring a high level of confidence in the health and reliability of the service.

Sample Reports

On the following page are sample reports that can be generated between two CN 2000s. Reports can be produced in real time or historically on a daily, weekly, or monthly basis.

Daily Service Circuit Report

For January 25, 2003

Generated 2003-01-27 11:49 AM

192.168.1.123_FCcif4 -- 192.168.1.122_FCcif4

Inventory

End A NE IP: 192.168.1.123 End Z NE IP: 192.168.1.122

End A CIF: 4 End Z CIF: 4

Working VF: STS-48c: 192.168.1.122_OC48lif1#1 --
192.168.1.123_OC48lif1#1

Protection VF: none

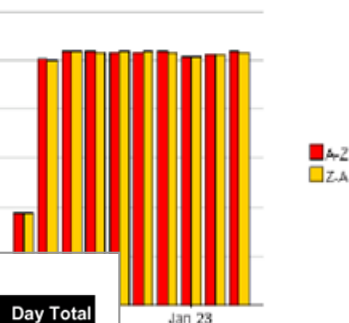
Type:

Historical Throughput

Availability



Availability
 Good: 100.0%
 Degraded: 0.0%
 Faulty: 0.0%
 Out-of-Service: 0.0%



Performance Summary

A-Z	Low	Average	Peak	Day Total
Throughput (MBytes/s)	23.5	24.0	24.4	2,074 GB
Occupancy (%)	36	37.2	38	
Latency (µs)	10	10.0	10	
Frame Count (frames/15 min)	2.038E7	2.083E7	2.12E7	2E9
Compression Ratio (15 min)	NA	NA	NA	

Z-A	Low	Average	Peak	Day Total
Throughput (MBytes/s)	23.6	24.0	24.5	2,073 GB
Occupancy (%)				
Latency (µs)				
Frame Count (frames/15 min)				
Compression Ratio (15 min)				

Occupancy



Daily Throughput



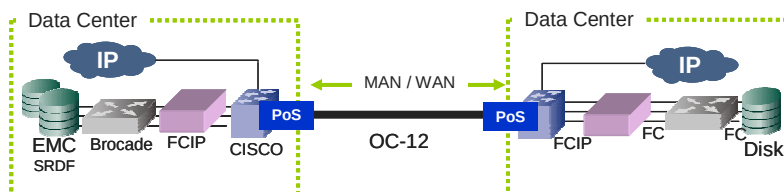
Figure 11: Sample Reports Generated Real Time or on a Daily, Weekly or Monthly Basis

CN 2000 Deployment Example

Often, an enterprise's SAN team is a sub-group of the IP-centric IT organization. IT managers are familiar with buying Packet over SONET (PoS) cards for their edge routers to be interconnected over distance. They don't often understand the requirements of data center storage applications, so their natural instinct is to force all applications to convert to IP and be transported by the edge router. While this is technically possible, it is highly inefficient from a cost, network bandwidth and performance perspective.

Option A: Inefficient & Expensive

Storage over IP over Router with PoS (Packet over SONET)



Option B: High Performance; Low Cost

Native FC & GbE over OC-3

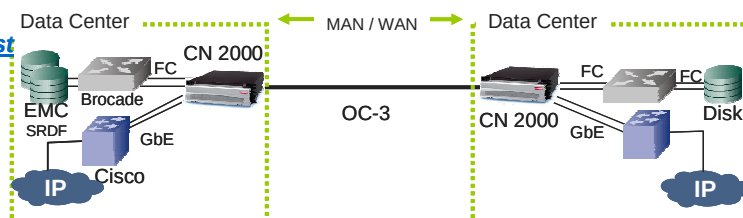


Figure 12: Forcing SAN Extension over IP LAN Extension is Inefficient and Expensive

In Option A, the company has purchased a Fibre Channel over IP (FCIP) device to feed into an edge router's LAN port. This router port is over-provisioned to minimize packet loss of the storage application while the IP/LAN port is under-provisioned to defer prioritization to the SAN port. This is required since SAN applications are not packet-loss tolerant. SAN applications are also not latency tolerant. The device delays of the Fibre Channel over IP box and the router with PoS card will severely impact the performance of the application resulting in higher effective bandwidth requirements and shorter distance reach.

Even if we ignore performance degradation, the Option A is often prohibitively expensive. Router PoS WAN cards are many times the cost of a basic Gigabit Ethernet WAN card while Fibre Channel to IP conversion devices are also costly.

In Option B, the data center manager has simplified the solution by eliminating the FCIP device and PoS card on the router. The cost savings here often make up for the cost of the CN 2000. The additional ongoing savings from the OC-3 service versus the OC-12 service makes Option B the clear choice. This solution offers the SAN extension applications performance and high bandwidth security while supporting the IP LAN equipment at appropriate service levels.

Other compelling examples include:

1. making feasible a middle tier enterprise BC/DR plan with DS-3 transport
2. replacing installed legacy channel extension platforms to lower recurring maintenance costs and increasing application performance
3. maximizing wavelength services by filling them more efficiently with multiple protocols
4. extending metro WDM reach across thousands of miles over SONET

Conclusion

The CN 2000 Storage and Data Extension Platform CPE is unique to the industry in its ability dramatically lower the costs of implementing data center interconnect projects while increasing the performance and reach of data transfer applications.

The field-proven CN 2000 provides unprecedented flexibility, leveraging carrier class transport with end user multi-application control and visibility. This allows the end-user to fine-tune and evolve applications without requiring network downtime or expensive professional service visits.

More Information on Ciena.com:

Making Quality, Secure Storage Extension Cost Effective

http://www.ciena.com/products/productsapps_storageextension_ent.htm

CN 2000 Product Information

http://www.ciena.com/products/products_1216.htm

CN 2000 Manager

http://www.ciena.com/products/oncentercn2000_1524.htm

CN 2000 Application Notes and Success Stories

http://www.ciena.com/products/cn2000_3345.htm

Ciena Service and Maintenance Offerings

<http://www.ciena.com/services/services.htm?src=nav>

Contact a Ciena Application Specialist Form

http://www.ciena.com/forms/contact_sales.aspx?source=Application%20Specialist