LAN-ATM Switching

Centillion

ATMSpeed Switch Modules

Data Sheet

Ethernet and Token Ring LAN-ATM Integration

Mission-Critical Network Availability

Network Application Intelligence

Plug-and-Play ATM

Comprehensive Investment Protection

Certified Year 2000 Compliant

Delivering unparalleled availability, functionality and scalability to campus LANs and enterprise networking environments, Centillion* ATMSpeed* Swith Modules also deliver high-performance metropolitan and wide area network access.

Ideal for deployment across the enterprise, the Centillion 50, Centillion 100, and System 5000BH LAN-ATM Switches provide a unified, consistent solution that offers resilient, mission-critical performance, and eliminates the need to constantly redesign growing networks.

ATMSpeed Switch Modules are a family of high-performance ATM media modules that enable the flexible interconnection of Centillion 50/100 and System 5000BH LAN-ATM Switches with the Centillion 1000 family of Multiservice ATM Switches, via multiple high-speed, full duplex ATM links. Together with Centillion Switching Software, ATMSpeed modules offer powerful ATM connectivity solutions that are very rich in functionality, highly resilient and highly scalable.

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For the System 5000BH switches, ATMSpeed modules are available in six configurations:

- Model 5720M ATM MDA MCP Module, with 32 MB DRAM, pre-loaded Advanced Centillion Switching Software and slots for two 2-port MDAs (Media Dependent Adapters)
- Model 5720M ATM MDA MCP Module, with 16 MB DRAM, no preloaded software and slots for two 2-port MDAs
- Model 5720 ATM MDA Switch Module, with slots for two 2-port MDAs
- Model 57622M-MM ATM MCP Module, with one 622 Mbps multimode fiber port
- Model 57622M-SM ATM MCP Module, with one 622 Mbps single-mode fiber port
- Model 57622-MM ATM Switch Module, with one 622 Mbps multimode fiber port.

For the Centillion 50/100 switches, ATMSpeed modules are also available in six configurations:

- ATMSpeed MDA MCP Module, with 32 MB DRAM, preloaded Advanced Centillion Switching Software, and slots for two 2-port MDAs
- ATMSpeed MDA MCP Module, with 16 MB DRAM, no preloaded software, and slots for two 2-port MDAs
- ATMSpeed MDA Switch Module, with slots for two 2-port MDAs
- ATMSpeed 622 Mbps MCP Module, with one multimode fiber port
- ATMSpeed 622 Mbps MCP Module, with one single-mode fiber port
- ATMSpeed 622 Mbps Switch Module, with one multimode fiber port.

Master Control Processor

All modules are generically referred to as ATMSpeed modules.

Modules without an MCP designation do not have Master Control Processor (MCP) capability.

At least one MCP module, loaded with the appropriate version of Centillion Switching Software, must be present in a chassis for Centillion LAN-ATM Switch activation. MCP modules provide ATM Private Network Node Interface (PNNI) call signaling and routing, switched and permanent Virtual Channel Connections (VCCs), LAN Emulation (LANE) services, Multi-Protocol Over ATM (MPOA) services, RFC 1483 Multi-Protocol Encapsulation over ATM AAL-5 services, and network control and management on a switch-wide basis, while also providing ATM switching capabilities. Dual MCP modules can be installed to increase overall switch resiliency.

Switch modules with no MCP designation have no MCP capabilities, and simply provide lower-cost device switch connectivity.

Each of the Models 5720, 5720M, ATMSpeed MDA MCP and ATMSpeed MDA Switch Modules (except the 622 Mbps modules) provides two slots for flexible, mix-and-match installation of up to two 2-port MDAs, with total switching bandwidth of 1.4 million cells per second. These modules deliver a choice of simultaneous full-duplex 155 Mbps OC-3c, DS3, or E3 connectivity on all ports at full line rates.

Media Dependent Adapters

MDAs are available in the following five types and are identical for installation in both the Centillion 50/100 and System 5000BH switches:

- 2-port 155 Mbps SONET/SDH MMF MDA
- 2-port 155 Mbps SONET/SDH SMF MDA
- 2-port 155 Mbps SONET/SDH UTP (Unshielded Twisted Pair) MDA
- 2-port 45 Mbps DS3 WAN MDA
- 2-port 34 Mbps E3 WAN MDA.

ATM Campus Solution

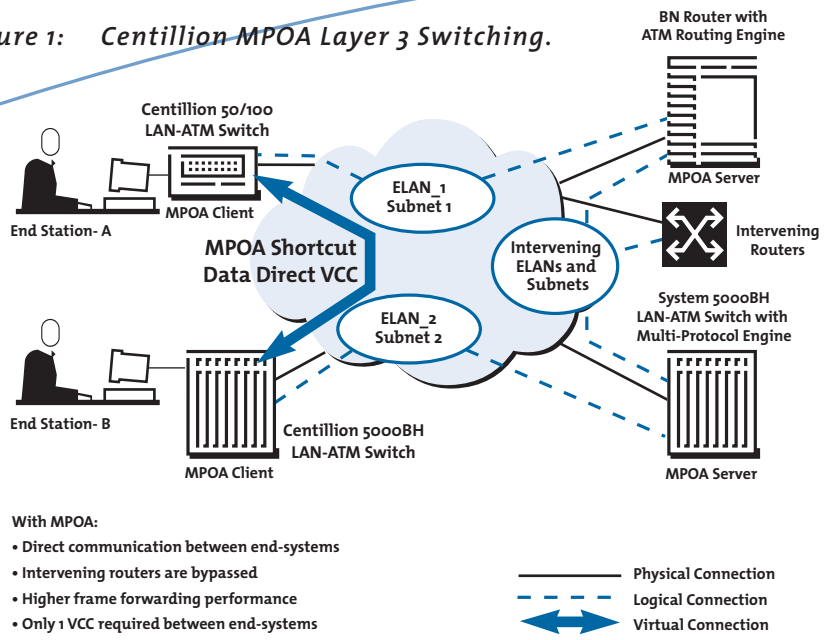
Each 622 Mbps SONET/SDH OC-12 ATM module provides one fixed port for multimode or single-mode fiber connectivity between switches in enterprise networking environments. The multimode fiber (MMF) modules facilitate high-bandwidth intra-campus links between Centillion LAN-ATM Switches and other ATM switches. The single-mode fiber (SMF) modules provide equivalent connectivity over longer-range campus-to-campus links. These modules also deliver total switching bandwidth of 1.4 million cells per second. They do not have slots for MDAs.

The Centillion 50/100 and System 5000BH can be connected to metropolitan and wide area networks using DS3, E3 and SONET/SDH OC-3 Mbps MDAs, or SONET/SDH OC-12 modules. VLANs can be extended across the MAN/WAN using RFC 1483 permanent virtual connections. Traffic shaping can be configured for each module and shaping enabled for each port to ensure that traffic rates do not exceed subscribed facility rates. Traffic shaping is also available for MAN and WAN interconnection via the Nortel Networks Model 5782 Centillion Multiprotocol Engine, the BN* (Backbone Node*) router's ATM Routing Engine, or via Centillion 1000 Multiservice ATM Switches.

ATMSpeed Switch Modules are a critical component of the overall Nortel Networks ATM strategy. A standards-compliant solution, all modules interoperate with the Centillion 1000 Multiservice ATM Switches, BN routers, and with all other standards-compliant ATM devices. ATMSpeed modules may be used to construct multihomed, multigigabit backbones that maximize information availability, bandwidth, and scalability, while also providing high-speed connectivity to servers and ATM virtual network routers. Switch interconnection is simplified using standards-based Private Network Node Interface (PNNI) dynamic topology services.

When used in conjunction with EtherSpeed* and TokenSpeed* switching modules as a high-speed extension of the Centillion LAN-ATM backplane, ATMSpeed modules scale Ethernet, Fast Ethernet, and Token Ring port density, and provide switching performance and system reliability that is unmatched in the industry. Centillion LAN-ATM Switches also support standards-based Layer 3 network application acceleration, with clients using distributed Multi-Protocol over ATM (MPOA) services. ATMSpeed modules ensure the smooth integration of desktop media environments into high-availability, high-performance switched ATM enterprise networks.

Figure 1: Centillion MPOA Layer 3 Switching.



Benefits

Superior Performance and Scalability

Whether used for backbone connectivity or for supporting high-performance servers and power desktops, ATMSpeed modules improve overall network performance and application response times. Each ATMSpeed module delivers local cell switching at 1.4 million cells per second, and supplies connectivity to the internal backplane fabric (dual 3.2 Gbps backplanes in the System 5000BH switch, and a single 3.2 Gbps backplane in the Centillion 50/100 switches).

Unlike competing solutions with proprietary backplanes, traffic flows across the Centillion ATM backplane to the ATMSpeed ports without repeated protocol translation or reformatting overhead. Each intermediate link adds a fixed-switch latency of only 10 microseconds, minimizing end-to-end network delay, and delay variation, to provide consistent performance, even as the network expands.

As a totality, Centillion hardware and software creates a solution that scales seamlessly to provide the performance and guaranteed availability to the largest and most critical ATM enterprise networks, and is capable of supporting architectures of 200 or more switches and upwards of 10,000 user connections.

Network Application Intelligence

With the explosion of network applications, dramatically increasing volumes of IP traffic are traversing overburdened routers. Every router along the path must process the same packet, and this type of hop-by-hop processing causes the network traffic to experience delay and jitter.

Centillion LAN-ATM Switches provide a standards-based solution to router bottlenecks through implementation of the ATM Forum's MPOA specification. MPOA allows direct forwarding of inter-subnet traffic between ATM edge switches, bypassing overloaded routers and dramatically improving the intranet's overall IP performance of the network.

Offloading the IP data forwarding function to ATM edge switches frees routers to process other protocols, including IPX, DECnet, and AppleTalk, relieving the Layer 3 traffic congestion for legacy applications. MPOA is fully backward compatible, and can be deployed in any existing LANE-based network. In essence, MPOA transforms an ATM network, with all its ATM-attached routers and edge switches, into a single distributed router, with each destination a maximum of one hop away (see Figure 1).

Centillion LAN-ATM Switches also provide ATM Quality of Service (QoS) support for mission-critical and delay-sensitive applications such as voice over IP, videoconferencing, and video-on-demand. High priority traffic, such as CBR, rt-VBR and nrt-VBR ATM cells, are assigned to the high-priority queue, thus ensuring that they are forwarded without delay. ATM UNI and PNNI signaling are also forwarded via the high-priority queue. All other traffic is forwarded as UBR traffic.

Mission-Critical Network Availability

Networks constructed with Centillion LAN-ATM Switches deliver highly available and resilient networks that are unique in the industry. To connect wiring closet clients to network center servers, Centillion LAN-ATM Switches can use NNI riser links that deliver multihomed, load-sharing and resilient bandwidth from 310 Mbps to 2.4 Gbps. Link and switch failures are rapidly detected, and mission-critical traffic can be rapidly rerouted using Interim InterSwitch Signaling Protocol (IISP) link groups, or via PNNI dynamics onto alternate paths. PNNI can be implemented from the edge to the core of the network — a capability offered only by Nortel Networks — delivering vastly improved end-to-end network availability.

Instead of traditional Permanent Virtual Connections (PVCs), soft PVCs may be used to increase resiliency. Soft PVCs are reestablished automatically over alternate paths if an existing path fails. Soft PVCs also provide scalability as they need only be configured at the ingress switch, without configuration at each intermediate switch in the network.

Centillion LAN-ATM Switches provide distributed and co-operating LANE services to guarantee LAN Emulation client (LEC) connectivity, resiliency and performance. Centillion Switching Software also boosts overall system availability by supporting dual, redundant ATMSpeed MCP modules with fast failover in a single chassis. All ports on the secondary ATMSpeed MCP are fully functional, maximizing the utility of all chassis slots.

Ethernet and Token Ring LAN-ATM Integration

Adding the powerful capabilities of cell-switched Centillion solutions to existing Ethernet and Token Ring LANs dramatically enhances network performance. The distributed switching capabilities of the EtherSpeed and TokenSpeed modules, combined with the extensive ATM switching fabric offered by the Centillion LAN-ATM Switches, eliminate the data bottlenecks and bandwidth contention typical of legacy networking systems.

Together, ATMSpeed Switch Modules and Centillion Switching Software deliver the industry's most comprehensive LANE implementation. Centillion LANE provides straightforward and highly interoperable connectivity between LAN-attached desktops, file servers, and routers, and high-performance ATM networks. Ethernet and Token Ring LANE clients, and fault-tolerant, co-operating LANE services, are supported with minimal management intervention.

Plug-and-Play ATM

PNNI enables ATM networks to dynamically and automatically negotiate and configure system-wide topologies, and eliminates the need to manually configure the paths between ATM switches. In large enterprise networks, PNNI simplifies deployment and enhances system performance and reliability. Augmenting the labor-intensive IISP approach with high-performance PNNI greatly reduces the day-to-day burden on the administrators of large networks. Centillion PNNI is unique in the ability to be implemented through the entire network, from the wiring closet edge to the network core. Mixed PNNI, soft PVCs and IISP environments are also supported, providing additional network design flexibility.

Network management is simplified in Centillion ATM environments through Optivity*, the industry-leading management solution from Nortel Networks. A key component of Optivity Enterprise,* the Optivity NETarchitect* application features system-level ATM management and provides an intuitive, object-oriented interface to simplify detailed management tasks.

Features such as rules-based configuration, automatic addressing, and the ability to edit configurations of groups of switches dramatically reduce the time required to manage the network. In addition, by automating sophisticated switch configuration and image file management tasks, the administration of ATM networks is optimized, and any potential for error is greatly reduced.

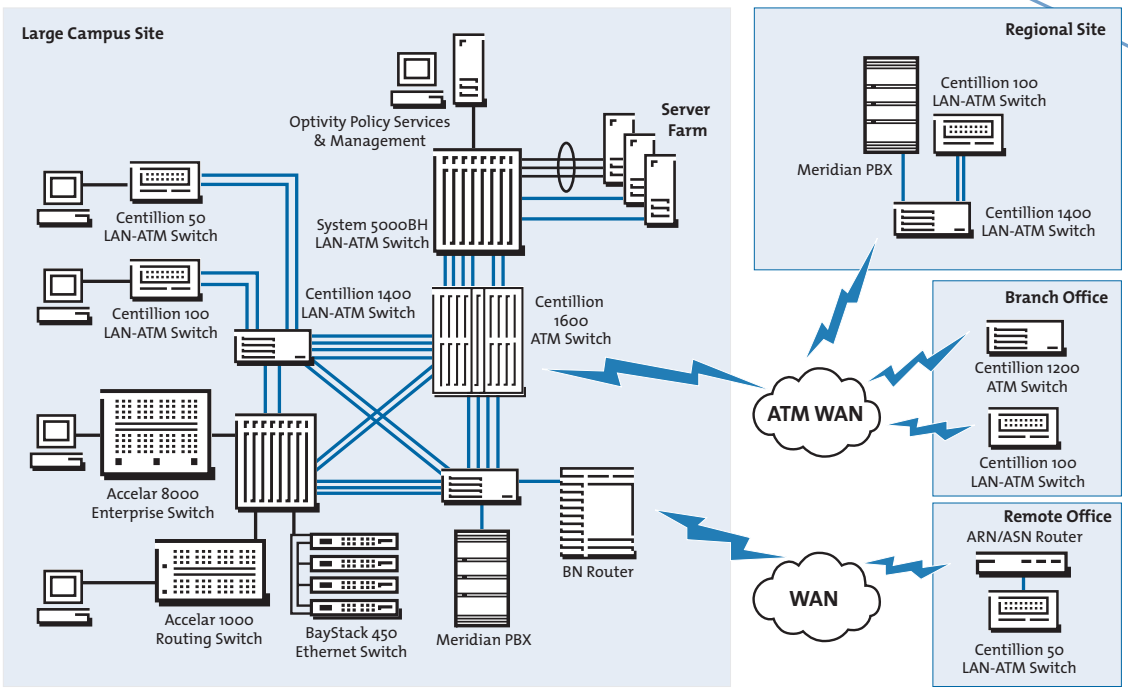
Comprehensive Investment Protection

ATMSpeed Switch Modules reduce overall equipment costs in Centillion environments by allowing mix-and-match connectivity of multiple media types on the same module. Network managers can configure the modules with any combination of 2-port unshielded twisted pair, multimode fiber, single-mode fiber, DS3, or E3 media dependent adapters, eliminating the need to replace hardware as the network topology evolves. By fully leveraging the ATM capabilities of each switch, ATMSpeed modules deliver high-speed connectivity at a fraction of the cost of other ATM edge switches.

In medium- to large-sized networks, Centillion LAN-ATM Switches can be directly interconnected via ATMSpeed modules, lowering total equipment costs by eliminating the need for separate ATM switches at the core of the network. Investments in existing LAN systems are leveraged by the Centillion architecture's unparalleled ability to integrate frame-based Ethernet, Token Ring, and cell-switched ATM technologies in a single, high-performance platform.

As networks grow, and powerful Centillion 1000 Multiservice ATM Switches are deployed at the network core, existing Centillion LAN-ATM Switches are readily redeployed to wiring closets or frame-based server farms. The Centillion solution's incremental integration strategy facilitates the deployment of powerful ATM technology with minimal disruption, eliminating costly and time-consuming network redesigns.

Figure 2: Centillion 50/100 and System 5000BH LAN-ATM Campus Solution.



Applications

Centillion LAN-ATM Switches offer a single, consistent architecture across all facets of the network. This unified approach ensures maximum network availability, minimal network training, maximum efficiency, and interoperability across the full range of ATM applications.

The size of the network governs both switch selection and switch deployment. In medium- to large-sized networks, the Centillion 100 and System 5000BH switches are ideal for network center installations. In the largest enterprise environments, these switches can be used for high-density wiring closet installations, with high-speed riser connections to Centillion 1000 Multiservice ATM Switches located in the network center. And in networks of all sizes, the Centillion 50 switch is ideal for deployment in lower-density wiring closets or workgroup environments (See Figure 2).

Enterprise Network Center Applications

The Centillion 100 and System 5000BH switches are both well suited for deployment in medium-to-large network centers and wiring closets. When equipped with ATMSpeed modules, both platforms are ideally suited for deployment in networking environments where multiple switches can be interconnected via PNNI and/or IISP to build a scalable, high-performance backbone network. Single-mode and multimode fiber, UTP, DS3,

and E3 connectivity is supported for maximum flexibility, enabling switches to be installed in network centers or other locations across the campus backbone.

Existing networking environments can be smoothly integrated into the ATM environment. As additional bandwidth, wide area, and voice demands increase, the Centillion 1000 family of Multiservice ATM Switches provides a scalable path for expanded ATM network center services.

Wiring Closet Applications

A fully-configured Centillion 100 or System 5000BH LAN-ATM Switch supports extremely high 10/100 Ethernet and Token Ring switching densities (up to 240 ports per chassis), offering an exceptional concentration of large workgroup and desktop populations. Centillion 50 workgroup switches are readily deployed in smaller closets. The full benefits of switching at the workgroup are realized in environments where high-capacity connections to the backbone are required to access corporate resources. As shown in Figure 2, Centillion technology delivers multiple load-balancing ATM links, providing an integrated solution for switched Ethernet or Token Ring connectivity with fast-failover NNI (network-to-network interface) links to the ATM backbone. PNNI is implemented from the edge to the network core, to automatically determine the optimal path between switches, and the Centillion solution provides for accelerated Layer 3 performance via a straight-forward and cost effective software migration to MPOA.

Centillion switching can be configured to support single or multiple, cooperating, fault-tolerant instances of LANE services, including LAN Emulation Configuration Server (LECS), LAN Emulation Server (LES), and Broadcast and Unknown Server (BUS).

MAN and WAN Applications

For metropolitan or wide area connectivity, a Centillion LAN-ATM Switch can have an ATMSpeed module with DS3, E3, or SONET/SDH OC-3 MDAs, or an ATMSpeed module with a SONET/SDH OC-12 port installed. This allows connectivity over the MAN/WAN at rates ranging from 34 Mbps to 622 Mbps. Traffic shaping per ATMSpeed module is supported, allowing a shaping rate to be configured for a given module, and a port to be enabled or disabled to enforce the configured rate. Each port enabled for traffic shaping will ensure that the traffic transmitted over the MAN/WAN does not exceed subscribed facility rates. Connectivity over public data networks can also be achieved using the Nortel Networks Model 5782 Multiprotocol Engine (MPE) installed in a System 5000BH switch, or using the BN router's ATM Routing Engine module. In both latter cases, traffic shaping is also available.

Alternatively, deployment of Centillion 1200 Multiservice ATM Switches integrates regional and branch office environments into corporate ATM private networks via public carrier services. This capability enables organizations to consolidate traditionally separate voice, video, and data traffic onto a common network infrastructure, dramatically lowering the cost of WAN connectivity.

With support for RFC 1483 Multi-Protocol Encapsulation over ATM AAL-5, PVCs can now be used to establish connectivity over the MAN/WAN for the increasing number of Internet subscribers, telecommuters and small office/home office power users. Internet Service Providers (ISPs) can now deploy Nortel Networks DSL-based 1-Meg Modems for its subscribers, and RFC 1483 at its Points of Presence (POPs), to provide high-speed access up to 1.28 Mbps over existing telephone lines to web server sites. RFC 1483 support also enables the extension of corporate LANs across the MAN/WAN via Point-to-Point Bridging, and cost-effective communication between VLANs across the MAN/WAN via VC Bridging.

Figure 3: Centillion PNNI Scalability.

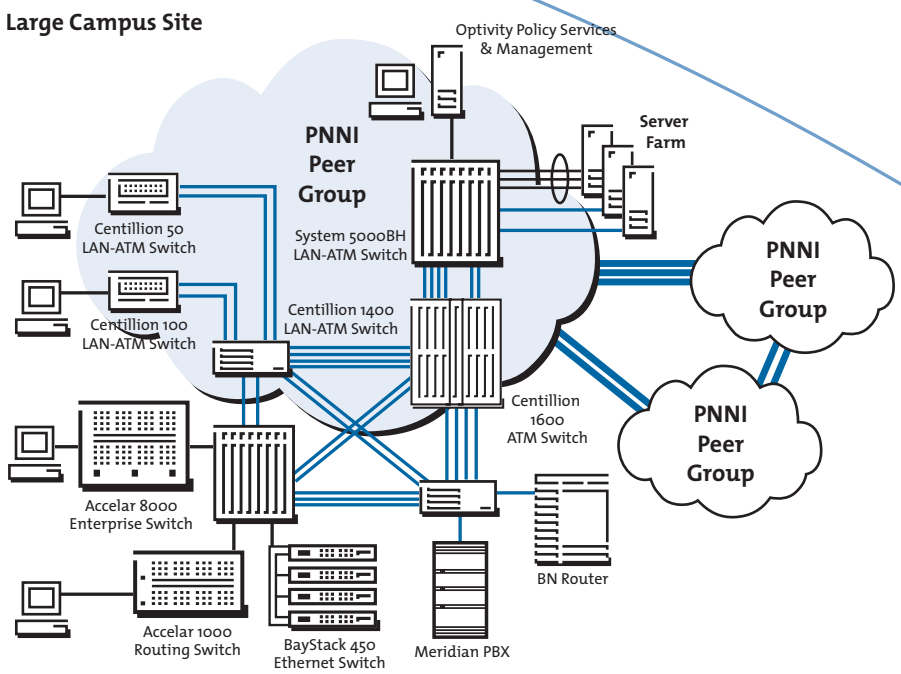
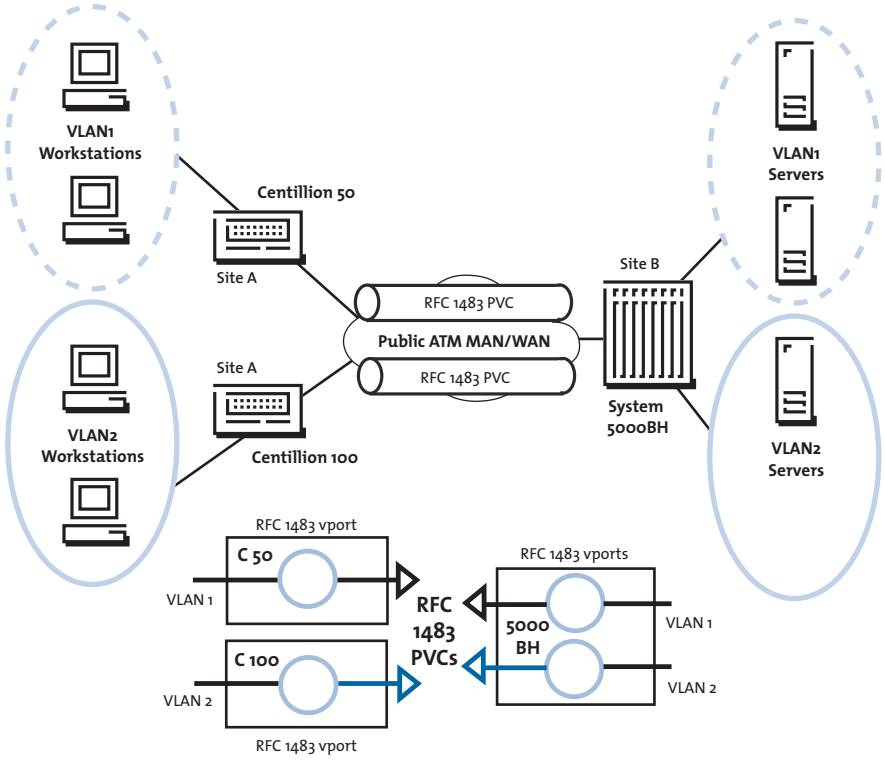


Figure 4: RFC 1483 Point-to-Point Bridging.



Features

Private Network Node Interface (PNNI)

PNNI is an ATM call routing and signaling protocol that enables switches in large ATM networks to dynamically find optimum paths when establishing virtual connections. Building its topology database from information exchanges between Centillion LAN-ATM Switches, PNNI eliminates the need to manually configure and update paths between these switches. PNNI also communicates metrics to ensure path selection is optimized according to each application's Quality of Service (QoS) requirements: bandwidth, latency, burstiness, and jitter.

PNNI supports ATM networks of any size, scaling from campus deployments to global infrastructures. With support for multi-level Designated Transit List, the Centillion LAN-ATM Switches can now participate in hierarchical peer group networks. This further enhances scalability by minimizing the amount of information exchange between peer groups (see Figure 3).

To increase resiliency using alternate routing, the Centillion LAN-ATM Switches support soft PVCs. Soft PVCs allow a PVC to a target destination to be configured at the ingress switch, without the need to configure the PVC at every intermediate switch, thus greatly increasing scalability by eliminating the tedium of repetitive configuration. If the existing path fails, a soft PVC will also automatically reestablish itself over an alternate path. Availability is further provided by Centillion LAN-ATM Switches through exceptionally fast convergence around network outages.

Powerful, Distributed Architecture

Centillion ATMSpeed, EtherSpeed, EtherSpeedII and TokenSpeed modules are designed and built on a distributed, parallel switching engine that enables switch modules of any type to be integrated into a Centillion 50/100 or System 5000BH chassis. Unlike other LAN switches, the Centillion LAN-ATM architecture uses ATM as a common fabric over which both cell and frame switching can be implemented. This internal ATM switch fabric is transparent to users on frame-switched networks, but its presence greatly simplifies the addition of ATM ports to Ethernet- and Token Ring-based switches. Centillion LAN-ATM Switches provide local switching on a per-card and per-switch basis. When ATMSpeed modules are installed, Centillion switches are able to forward LAN and ATM traffic locally and, when necessary, over the ATM backplane.

The ATMSpeed modules' powerful 1.2 Gbps onboard CellManager* switching engine handles local switching. Traffic flowing from one port to another within a switch module is forwarded locally in native mode by a high-performance RISC engine, reserving the ATM core bandwidth for cross-module traffic only. In addition, a separate 400 Mbps control bus ensures that essential ATM signaling messages do not interfere with data transport. High-capacity parallel switching between the ATM core and packet processor hardware delivers exceptionally high throughput.

Standards-Based ATM Support

All ATMSpeed Switch Modules support the full complement of ATM Forum standards, including UNI, PNNI, IISP, LANE and MPOA, providing standards-based ATM connectivity in multivendor environments. Centillion Switching Software also supports SVCs, PVCs and RFC 1483 Multi-Protocol Encapsulation over ATM AAL-5, enabling a wide variety of multivendor ATM configurations, including interoperation with routers, servers and switches with ATM interfaces. Centillion LAN-ATM Switches support both UNI 3.0 and UNI 3.1 signaling protocols, and translate between the two versions, allowing connections to any standards-based ATM switch.

ATMSpeed modules offer several important advantages at the network edge. Unlike other edge switches that use UNI interfaces, the ATMSpeed modules support redundant, load-sharing ATM links using IISP and/or PNNI, greatly increasing network availability and performance.

ATMSpeed modules also feature the industry's most comprehensive implementation of the ATM Forum's LANE specification, providing a standards-based method for connecting LAN-attached file servers, desktops, and routers directly to the ATM network. Both Ethernet and Token Ring LANE clients and redundant LANE services are supported, preserving investments in existing technology, while increasing bandwidth and improving network availability.

Network-Wide Virtual LANs

Virtual LAN (VLAN) capabilities are common across all Centillion switching platforms. The ATMSpeed modules support network-wide VLANs to further enable network partitioning and provide integration between devices. Up to 64 VLANs are supported in each Centillion switch, with each VLAN a broadcast domain based upon either physical switch port or protocol type. A LAN Emulation client (LEC) represents each VLAN to facilitate the creation of network-wide Emulated LANs (ELANs) when LANE services are enabled in local or remote Centillion switches.

Management in Switched Environments

The Centillion LAN-ATM Switches can be configured, monitored, and controlled through the Nortel Networks Optivity and the SpeedView* management applications.

Optivity provides access to complete activity information on every segment. When LAN- and ATM-switched networks are combined on the Centillion LAN-ATM platform, network managers can monitor traffic patterns from almost any perspective, and proactively address networking problems from the management console. Based entirely on industry standards such as SNMP, HTTP, AToM MIB (RFC 1695), RMON, and RMON2, Optivity delivers an open solution for monitoring and controlling multivendor enterprise networks from a single management station.

Optivity looks at the relationship between the network's primary building blocks — hubs, switches, routers, and end-stations — to provide a global view of the enterprise. Featuring design and analysis tools that leverage the embedded instrumentation present in all Nortel Networks equipment, Optivity provides the optimum solution for managing the transition from shared media to a switched network infrastructure and beyond. Optivity supports all popular management platforms, such as Tivoli NetView for AIX, HP OpenView Network Node Manager, and Sun Microsystems Solstice Domain Manager.

SpeedView provides network managers with an easy-to-use, graphical tool to configure and monitor networks of Centillion LAN-ATM Switches. SpeedView can be used to configure ATM signaling, call routing, PVP/PVCs, PNNI, soft PVCs, RFC 1483 PVCs, ATM traffic shaping, MPOA clients, LAN Emulation services including LECS, LES/BUS and LECs, and redundancies. It also provides extensive capabilities to configure system and LAN-related functions such as VLANs, Spanning Tree Groups, IP Multicast, switching modes, and network management.

In Windows environments, SpeedView operates as a standalone application. It is also included with the Optivity Campus* management software. In UNIX environments, SpeedView is now a component of Optivity Enterprise. Both versions deliver rich statistical displays that are complemented by simple, intuitive utilities for configuring switching parameters, enabling performance to be finely tuned to meet varying network conditions.

Centillion Switching Software

ATMSpeed MCP modules utilize Centillion Switching Software to support network topologies scaling to 200 or more switches and thousands of user ports. Centillion Switching Software leads the industry in facilitating the deployment of highly redundant topologies based on multihomed, load-sharing risers between Centillion 50/100 and System 5000BH LAN-ATM Switches, and Centillion 1000 Multiservice ATM Switches.

Centillion Switching Software enables customers to overlay fully interoperable, port- or protocol-based VLANs with IEEE 802.1Q VLAN Tagging over the physical network topology, facilitating the creation of logical topologies to meet customers' Internet or intranet requirements. In addition, the software provides key system performance and resiliency features, including redundant and load-sharing Multi-Link Trunking, cooperating LECS, LES and BUS services, Internet Group Management Protocol (IGMP) control of multicast traffic, extensive filtering and conversation steering, redundant MCP services, and automatic external clock failover.

In larger networking environments, where overall scaling, management and application intelligence are even greater considerations, the software supports key ATM Forum PNNI, MPOA, RFC 1483 encapsulation, ATM traffic shaping, and QoS capabilities. PNNI enables switches to dynamically determine and maintain a system-wide awareness of the network topology. In so doing, PNNI eliminates the need to manually configure static routes, while enhancing network scaling

and resiliency, and providing more efficient bandwidth utilization. QoS support enables applications to utilize the intelligence of ATM constant bit rate (CBR), variable bit rate (VBR), and unspecified bit rate (UBR) services to guarantee bandwidth availability and prioritization for mission-critical applications and latency-sensitive traffic.

ATMSpeed MCP modules do not include Centillion Switching Software, which normally require a separate purchase. Customers preferring the convenience of ATMSpeed MCP modules, preloaded with Centillion Switching Software, have that option. Although current releases of Centillion Switching Software will operate smoothly on ATMSpeed MCP modules with 16 MB of DRAM, preloaded ATMSpeed MCP Modules are fitted with 32 MB of DRAM to ensure support for future software functionality enhancements.

Network applications and server centralization are heightening demand for Layer 3 IP bandwidth. Centillion Switching Software provides MPOA Client (MPC) services to vastly increase the Layer 3 forwarding capability of existing switching hardware, such as the high-density EtherSpeed and TokenSpeed switching modules. This new feature will enable the

Layer 3 capacity of Centillion networks to scale to millions of packets per second.

Year 2000 Compliance

The Centillion ATM switch product line, including the System 5000BH LAN-ATM switch, has been tested and certified by Nortel Networks to be Year 2000-compliant according to the test cases identified in the Nortel Networks Year 2000 Test Strategy/ Plan (see http://www.nortelnetworks.com/corporate/year2000/bay/plan.html). The testing verifies that the products in this product line function correctly when dealing with dates/times, and date/time related data in the following manner:

- The Centillion ATM switches accurately process date/time data from, into, and between the 20th and 21st centuries and the years 1999 and 2000, including leap year calculations. Processing includes (but is not limited to), calculating, comparing, and sequencing functions.
- When used in combination with information technology products from other vendors, the Centillion ATM switches accurately process date/time data to the extent that the other vendor's information technology products (used in combination with the Centillion ATM switches), are capable of exchanging conforming date/time data with the Centillion ATM switches.
- The Centillion ATM switches do not contain or create any logical or mathematical inconsistency, do not malfunction, and will not cease to function when processing date/time data.

Technical Specifications

Table 1: ATMSpeed Switch Modules Technical Specifications

Microprocessors	
All ATMSpeed MCP Modules	64 bit MIPS 4700 series processor, 133 MHz
Memory	
DRAM (ATMSpeed MDA MCP Module)	16 MB
DRAM (ATMSpeed 622 MCP module and preloaded ATMSpeed MDA MCP module)	32 MB
Flash (All ATMSpeed MCP modules)	4 MB
Cell buffer pool (All ATMSpeed modules)	16 K cells
Electrical Specifications	
Power Consumption	40 W (max w/MDAs)
Thermal Rating	136 Btu/hr. (max w/ MDAs)
Physical Specifications	
Centillion 50/100	
Dimensions	(L) 10.5 in. x (W) 12.5 in. x (H) 1.0 in. [(L) 26.7 cm x (W) 31.7 cm x (H) 2.5 cm]
Weight	2.5 lb. (1.1 kg)
System 5000BH	
Dimensions	(L) 18.875 in. x (W) 1.188 in. x (H) 11.625 in. [(L) 47.94 cm x (W) 3.01 cm x (H) 29.52 cm]
Weight	4.5 lb (2.04 kg)
Environmental Specifications	
Operating Temperature	5° to 40°C (41° to 104°F)
Storage Temperature	-25° to 70°C (-13° to 158°F)
Operating Humidity	85% maximum relative humidity, non-condensing
Storage Humidity	95% maximum relative humidity, non-condensing
Operating Altitude	10,000 ft. (3,000 m) max
Free Fall/ Drop	ISO 4180-s, NSTA 1A
Vibration	IEC 68-2-6/34
Shock/Bump	IEC 68-2-27-29

Table 1: ATMSpeed Switch Modules Technical Specifications (continued).

Electromagnetic Emissions	
Meets requirements of	FCC Part 15, Subpart B, Class A
	EN 55 022 (CISPR 22:1985), Class A
	VCCI Class 1 ITE
Electromagnetic Susceptibility	
Electrostatic Discharge (ESD)	EC 801-2, Level 2
Radiated Electromagnetic Field	EC 801-2, Level 2
Electrical Fast Transient/Burst	EC 801-4, Level 2
Electrical Surge	IEC 801-5, Levels 1 and 2
Safety Agency Approvals	
Approvals	UL listed (UL 1950)
	UL/CUL listed (UL 9K66)
	TUV licensed (EN 60 950)
	Meets UL-94-V1 flammability requirements
ATMSpeed 622 Mbps Module	
Industry and Protocol Standards	ATM Forum AF-PHY-0046.000, ATM
	Forum Technical Committee
	622.08 Mbps Physical Layer Specification
Maximum Receive Sensitivity	
Multimode fiber Rx saturation	-14 dBm
Single-mode fiber Rx saturation	-8 dBm
Optical Specifications (Single-mode Fiber)	
Wavelength	1310 nm Class 1 Laser
Fiber size	Duplex 9/125 micron fiber
Connector type	Duplex SC connector
Mean launched power	-8 to -15 dBm
Min receive sensitivity	-28 dBm
Link budget	13 dB
Run length (max.)	15 km (intermediate reach)

Table 1: ATMSpeed Switch Modules Technical Specifications (continued).

Optical Specifications (Multimode Fiber)	
Wavelength	1310 nm LED
Fiber size	Duplex 62.5/125 micron fiber
Connector type	Duplex SC connector
Mean launched power	-20 to -14 dBm
Minimum receive sensitivity	-26 dBm
Link budget	6 dB
Run length (max.)	500 meters
2-port 155 Mbps MDA	
SONET STS-3c/SDH STM-1 Multimode Fiber	155.52 Mbps NRZ line code 1300 nm LED Duplex 62.5/125 micron fiber, 500 MHz KM minimum bandwidth (FDDI standard) Duplex SC connector
Mean Launched Power	-20 to -14 dBm
Minimum Receive Sensitivity	-30 dBm
Link budget	10 dB
Run length (nominal)	1.24 mile (2 kilometer)
SONET STS-3c/SDH STM-1 Single-mode Fiber (Intermediate Reach)	155.52 Mbps, NRZ line code 1310 nm Class 1 Laser Duplex 9/125 micron fiber Duplex SC connector
Mean Launched Power	-15 to -8 dBm
Minimum Receive Sensitivity	-28 dBm
Link budget	13 dB
Run length (nominal)	12.4 mile (20 kilometer)
Unshielded Twisted Pair	155.52 Mbps, NRZ line code Category 5 UTP; two pairs RJ-45 connector Up to 328 feet (100 meters) run length

Table 1: ATMSpeed Switch Modules Technical Specifications (continued).

2-port WAN MDA	
DS3	44.736 Mbps 75 Ohm coaxial cable BNC connector Up to 450 feet (137 meters) run length
E3	34.368 Mbps 75 Ohm coaxial cable BNC connector Up to 450 feet (137 meters) run length

Ordering Information

Table 2: ATMSpeed Switch Modules Ordering Information.

Order Number	Description
Centillion 50 and Centillion 100 Switches	
AS1312001	ATMSpeed MDA MCP Module (32 MB DRAM, pre-loaded with Advanced Centillion Switching Software, accepts two 2-port MDA)
AS1304008	ATMSpeed MDA MCP Module (16 MB DRAM, accepts two 2-port MDA)
AS1304009	ATMSpeed MDA Switch Module (accepts two 2-port MDA)
AS1304010	ATMSpeed 622 Mbps MCP Module MMF (1-port SONET OC-12c)
AS1304011	ATMSpeed 622 Mbps MCP Module SMF (1-port SONET OC-12c)
AS1304012	ATMSpeed 622 Mbps Switch Module MMF (1-port SONET OC-12c)
AA0011008	16 MB DRAM upgrade for ATMSpeed MDA MCP Module, giving total 32 MB DRAM

Table 2: ATMSpeed Switch Modules Ordering Information (continued).

Order Number	Description
System 5000BH Switch	
CL1312001	Model 5720M ATM MDA MCP Module (32 MB DRAM, pre-loaded with Advanced Centillion Switching Software, accepts two 2-port MDA)
CL1304013	Model 5720 ATM MDA Switch Module (accepts two 2-port MDA)
CL1304014	Model 5720M ATM MDA MCP Module (16 MB DRAM, accepts two 2-port MDA)
CL1304015	Model 57622M-SM 622 Mbps ATM MCP Module SMF (1-port SONET OC-12c)
CL1304016	Model 57622M-MM 622 Mbps ATM MCP Module MMF (1-port SONET OC-12c)
CL1304017	Model 57622-MM 622 Mbps ATM Switch Module MMF (1-port SONET OC-12c)
Media Dependant Adapters for Centillion 50/100 and System 5000BH	
CL1333001	2-port 155 Mbps SONET/SDH MMF ATM MDA
CL1333002	2-port 155 Mbps SONET/SDH UTP ATM MDA
CL1333003	2-port 155 Mbps SONET/SDH SMF ATM MDA
CL1333004	2-port 45 Mbps DS3 ATM MDA
CL1333005	2-port 34 Mbps E3 ATM MDA

Acronym Glossary

ATM	**Asynchronous Transfer Mode**
AToM	**Asynchronous Transfer Mode Management Information Base**
BUS	**Broadcast and Unknown Server**
CBR	**Constant Bit Rate**
DRAM	**Dynamic Random Access Memory**
ELAN	**Emulated LAN**
ESD	**Electrostatic Discharge**
FDDI	**Fiber Distributed Data Interface**
HTTP	**HyperText Transport Protocol**
IGMP	**Internet Group Management Protocol**
IISP	**Interim Interswitch Signaling Protocol**
IP	**Internet Protocol**
IPX	**Internet Packet Exchange**
LAN	**Local Area Network**
LANE	**LAN Emulation**
LEC	**LAN Emulation Client**
LECS	**LAN Emulation Configuration Server**
LED	**Light Emitting Diode**
LES	**LAN Emulation Server**
MAN	**Metropolitan Area Network**
MCP	**Master Control Processor**
MDA	**Media Dependant Adapter**
MIB	**Management Information Base**
MIPS	**Millions of Instructions Per Second**
MPC	**MPOA Client**
MPE	**Multi-Protocol Engine**
MPOA	**Multi-Protocol Over ATM**
NNI	**Network-to-Network Interface**
NRZ	**Nonreturn to Zero**
PNNI	**Private Network-to-Network Interface**
PVC	**Permanent Virtual Connection**
QoS	**Quality of Service**
RFC	**Request for Comment**
RISC	**Reduced Instruction Set Computer**
RMON	**Remote Monitoring**
SNMP	**Simple Network Management Protocol**
SVC	**Switched Virtual Connection**
UBR	**Unspecified Bit Rate**
UNI	**User Network Interface**
UTP	**Unshielded Twisted Pair**
VBR	**Variable Bit Rate**
VLAN	**Virtual LAN**
WAN	**Wide Area Network**

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