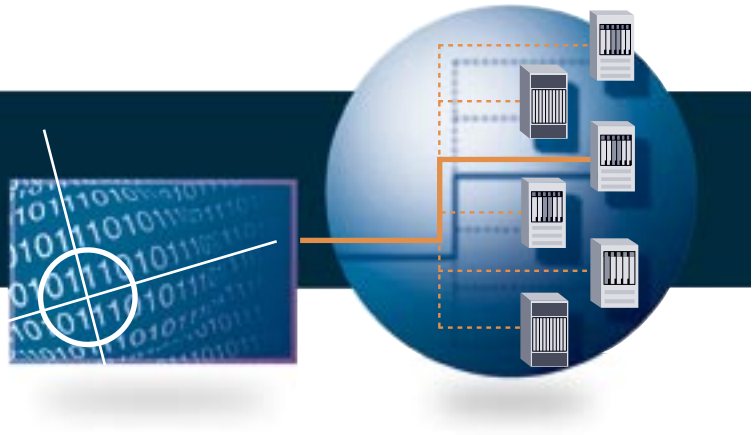
IP Navigator



IP Navigator

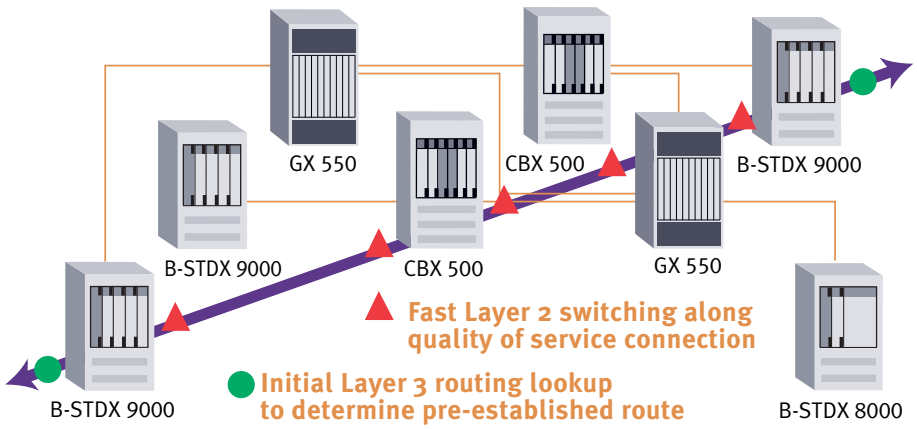
IP Navigator™ provides a full range of IP services to the carrier-class B-STDX 8000/9000, CBX 500 and GX 550 multiservice WAN switches, merging connectionless (Layer 3) with connection-oriented (Layer 2) Frame Relay and ATM services. With IP Navigator the switches can achieve superior performance while enhancing reliability, reducing latency, and scaling to over 200,000 routes. IP Navigator uses the devices' fully-distributed switching capabilities to provide guaranteed bandwidth, predictable service and end-to-end Quality of Service (QoS) for IP traffic. As more users are added to the network, end-to-end QoS is critical to differentiate among users and to provide appropriate service levels.

IP Navigator delivers exciting new services

IP Navigator provides a technical foundation to allow service providers to offer a range of exciting revenue-generating services, such as Virtual Private Networks (VPNs) and IP multicast. Advanced traffic management capability gives service providers the tools to build networks that support next generation technical and service requirements for their customer base. Additional benefits include the following:

- End-to-end QoS capability
- Multiple service level support for a variety of applications
- Integrated IP routing with carrier-class switching
- Reduced latency for WAN IP communications
- Additional IP services for existing Frame Relay or ATM networks
- Infrastructure investment protection
- Reduced operational costs

Topology-based Integrated Routing to Determine Direct Switched Path to Destination



ASCEND

IP Navigator Features and Functionality

Innovative use of existing technologies provides scalability, subnets and direct switched paths

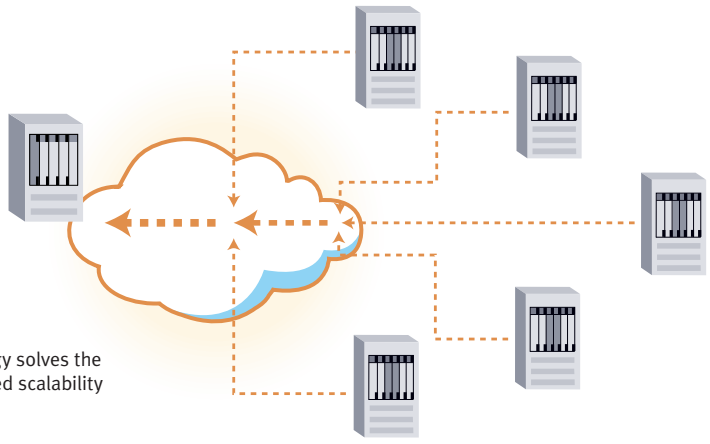
IP Navigator uses Ascend's existing Frame Relay and ATM Interfaces and provides a multiservice environment for switching IP, utilizing pre-established direct virtual switched paths between all edge switches in the network. Ascend has implemented true native IP routing protocols on the switch; OSPF, BGP-4, RIP-2, TCP/IP and static routing for communication with other IP devices and/or networks. OSPF areas have been implemented for scalability and creating subnetworks. Traffic filters are enabled for source/destination addresses and protocol filtering. And, IP Navigator is extremely scalable—capable of supporting more than 200,000 routes, which is impressive given that today's Internet is under 50,000 routes.

Connection-oriented topology provides virtually unlimited scalability

A fully-meshed, connection-oriented topology is the key to Ascend's ability to scale and support large IP networks with end-to-end QoS capability. *Ascend's Multipoint-to-Point Trees (MPT) is a technology breakthrough that allows virtually unlimited scaling.*

Instead of requiring a separate physical connection between all edge switches, IP Navigator creates a number of multicast trees, each one rooted in the destination node. To receive traffic from other switches in the network, each destination switch advertises a single multicast address that all other switches send to. Since MPT runs on each switch, all switches are notified of the appropriate multicast circuit to reach every other switch in the network. This information is kept in the Virtual Network Navigator™ (VNN) link state database. This approach allows the addition of incremental switches to the network without requiring N^2 number of additional links to be added to the network. This results in linear growth for network connections, rather than exponential growth in the number of network links required for incremental routers.

IP Navigator: IP Scaling for Carrier-Class Networks



Ascend's patent pending MPT technology solves the N^2 scaling problem for virtually unlimited scalability

An Architecture for Building Large, Seamless IP WANs

IP Navigator is based on Ascend's VNN, an OSPF-based networking architecture with years of proven experience in the world's largest Frame Relay and ATM networks. In VNN, OSPF has been refined and extended to add support for ATM, SMDS, ISDN, SNA, and now a full suite of IP protocols, including a robust implementation of BGP-4, to the Ascend family of multiservice WAN switches. VNN is a connection-oriented technology that provides IP Navigator with the ability to map paths through the network to satisfy specific QoS requirements. Integrated IP routing ensures that all packets are immediately directed to the appropriate Switched Virtual Path (SVP) through the WAN. No additional delay occurs determining whether the packet should be switched or routed and no additional time is taken to set up a Switched Virtual Circuit (SVC) for the packets.

Advanced Services Delivery

Connection-oriented topology creates a virtual path for fast packet processing creating a “one hop routed” network

At network startup time, fully meshed connection-oriented virtual paths are established between all edge switches (edge of WAN). The edge switch receives IP packets, where a very fast Layer 3 routing lookup is done on the I/O card to determine the path to the destination IP address, using Frame Relay or ATM switch technology to transport IP quickly through the network. There is no need to examine the IP header at intermediate nodes. Once the appropriate direct virtual path has been determined, no further Layer 3 lookup is required within the WAN—creating in effect a "one hop routed" network.

- Reduces dependencies on external routers and expedites IP route selection
- Eliminates bottlenecks and contention for single network interface to external route server
- Ensures no time is wasted to set up paths when traffic is waiting, because paths are dynamically pre-established
- Offers proven scalable hardware and software for carrier networks
- Allows large number of IP routes through its connection-oriented technology
- Ensures high performance through fast route selection, reduced hops and latency
- Allows the use of paths that meet specific end-to-end QoS requirements

Advanced features enable virtual private networks

IP Navigator supports advanced features that enable the delivery of premium services. For example, using the same VNN-based technology that allows IP Navigator to provide different qualities of service for IP, service providers can overlay multiple virtual private networks over a single physical infrastructure.

VPNs are closed user groups for different users that are completely separated from all other user networks. VPNs use separate routing tables to ensure that traffic is kept completely separate from other private networks. Service providers can use the QoS features of IP Navigator to tailor VPNs to meet specific end user networking requirements.

In addition, a single customer connection can support IP and Frame Relay or IP and ATM. This is a significant business and incremental revenue opportunity for service providers, as more end-user companies are considering migration from private networks to public service providers networks.

Multicast protocols support facilitates deployment of new services

Significant market demand is anticipated for multicast-based applications such as broadcast video and distance learning. Using IP Navigator’s multicast protocols, which include Distance Vector Multicast Routing Protocol (DVRMP), Multicast Open Shortest Path (MOSPF), and Protocol Independent Multicast (PIM), service providers can deploy new multicast services to meet these needs.

Superior port densities for edge routing

IP Navigator, combined with the industry-leading port density of Ascend's WAN switching platforms, is the ideal solution for offering cost-effective leased line connections. Superior performance is maintained at these densities due to a high-speed architecture, which distributes route tables to each I/O card.

Edge routing and core switching reduce operational costs

Layer 2 switched networks simplify provisioning, accounting, scalability and fault management. Fault isolation and packet loss are easier to identify in a connection-oriented network than in a connectionless network. All Layer 3 functions are moved to the edge, reducing overall operational costs.

Ascend multiservice switches provide high-speed IP switching

IP Navigator switches IP packets over Ascend's multiservice Frame Relay or ATM switches at up to OC48/STM-16 speeds. A single core network infrastructure can support IP, ATM and Frame Relay services, providing superior investment protection and efficient utilization of resources.

High scalability allows incremental network growth

Ascend’s patent pending MPT technology supports high scalability for incremental network growth, unlike traditional router-based solutions. The use of Ascend’s proven VNN and MPT trees as a technology base for IP Navigator ensures a scalable, reliable solution for building large IP WANs that interoperate seamlessly with existing routed networks and Ascend switched networks.

Unified management for all services

NavisCore and NavisXtend, Ascend’s powerful network management system, allow service providers to provision, manage, monitor and provide billing for all services such as IP, Frame Relay, and ATM via a single management platform. The result is reduced operational costs and diminished complexity.

Specifications

Protocols supported

- Border Gateway Protocol-4 (BGP-4)
- Open Shortest Path First (OSPF)
- Routing Information Protocol (RIP), Routing Information Protocol-2 (RIP-2)
- Static Routing
- Internet Protocol (IP)
- Transmission Control Protocol (TCP), User Datagram Protocol (UDP)
- Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP)
- Inverse Address Resolution Protocol (IARP)
- File Transfer Protocol (FTP), Telnet Protocol (Telnet)
- Internet Control Message Protocol (ICMP)
- Internet Group Multicast Protocol (IGMP)
- Distance Vector Multicast Routing Protocol (DVMRP)
- Multicast OSPF (MOSPF)
- Protocol Independent Multicast (PIM)

Management

- Configuration and monitoring built on the Navis™ family of network management products
- Telnet, Asynch console access to individual switches
- Software download and bulk stat upload using FTP
- MIB-II, OSPF MIB, BGP MIB, Routing table MIB
- Industry-standard command line interface

Equipment requirements for IP Navigator

- Minimum B-STDX Release 5.0, Network Management System (NMS) Release 3.0
- Minimum CBX 500 Release 2.5 (if used as network transport node for IP Virtual Paths)

Control processor requirements:

- CP Model 40 for up to 256K IP routes
- CP Model 50 for up to 512 IP routes

I/O processor requirements

- IOP+ for IP networks up to 10K IP routes
- IOP16 for up to 200K IP routes

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