Product information begins on page 2.

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WHITE PAPER

MultiVPN from Ascend Communications:

Breaking Down the Barriers to VPNs

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1. Executive Summary

Already the leader in Virtual Private Network (VPN) solutions, Ascend is the first vendor to break down the remaining barriers to widespread VPN adoption in a strategy to match enterprise-wide needs with carrier-class VPN solutions that service providers can deploy profitably. Ascend's enabling MultiVPN™ strategy, with its visionary provider/subscriber approach and broad interpretation of VPNs, has three equally important dimensions:

- Creating the industry's first comprehensive set of fundamental VPN architectures
- Addressing the concerns organizations have regarding enterprise-wide VPNs
- Satisfying the needs of service providers responsible for the infrastructure

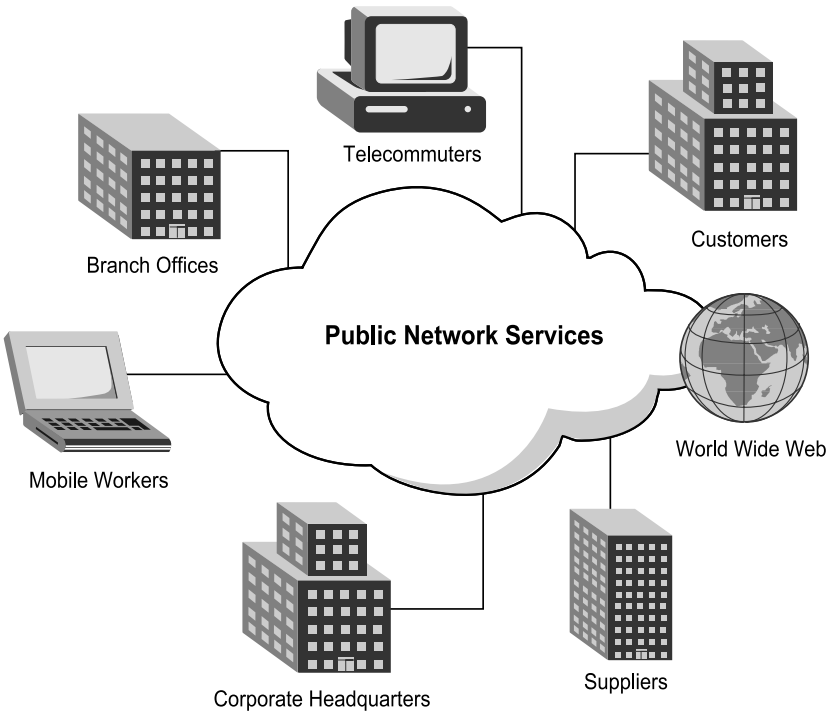

Figure 1 – Ascend's MultiVPN strategy makes VPNs suitable for all networking applications – from simple remote LAN access to sophisticated enterprise-wide internetworking.

Some vendors believe tunneling in the Internet alone defines a VPN. Ascend's MultiVPN architectures support tunneling, or Virtual Private Remote Networking (VPRN), as the appropriate solution for Internet-based remote LAN access, then adds two other much-needed ways of constructing VPNs using IP, Frame Relay and ATM services: Virtual Private Trunking (VPT) and Virtual IP Routing (VIPR). VPT delivers the performance and reliability of a leased line, the lifeblood of today's private networks using VPN technologies. VIPR employs Ascend's IP Navigator to extend IP private routing environments into the public network seamlessly and securely while delivering "Absolute"™ QoS. The capability and flexibility afforded by all three MultiVPN architectures enables – for the first time – production, enterprise-wide VPN deployment. These three MultiVPN components are tied together by a Navis™ network management architecture that integrates service management and enterprise management worlds.

When implementing VPNs in an enterprise, it takes more than a firewall or some encryption capabilities to build a VPN. Ascend's MultiVPN solution delivers iron-clad security and addresses the three other enterprise concerns: compatibility with existing applications, availability and manageability. With Ascend in the infrastructure, enterprise users get compatibility through a choice of VPRN, VPT and VIPR architectures delivered in MultiVPN products, services or a combination of both. No vendor has satisfied the needs of service providers – until now. Strategic partnerships with the world's leading service providers gives Ascend a privileged perspective on their three top VPN needs: high availability, service management and customer network management. MultiVPN integrates these three capabilities, and more, into Ascend's carrier-class switching, routing and access systems. The high performance and inherent redundancy of Ascend's multiservice platforms allow service providers to offer QoS and SLA availability guarantees profitably – and with confidence. Service management delivers optimal network utilization at minimal cost for maximum return on investment. And Customer Network Management – a service offering in itself – lets service providers share VPN-specific network information with their enterprise subscriber customers 24 hours a day.

Individually, MultiVPN's three dimensions enhance the state-of-the-art for VPNs. Collectively, they eliminate all of the obstacles remaining to the profitable deployment and cost-saving utilization of the public network infrastructure for private enterprise-wide VPNs. The next three sections outline each dimension of Ascend's MultiVPN strategy. A fourth and final section highlights Ascend's MultiVPN product line.

The Ascend Advantage

Ascend has established early and strong leadership in the burgeoning VPN marketplace. The pioneers of enterprise-wide VPNs are demonstrating a strong preference for Ascend solutions in both the public network infrastructure and at the customer premises. Ascend's VPN leadership derives from the company's many strengths and achievements:

- *Broadest experience in the deployment, utilization and management of public networking solutions with nearly 5 million ports installed*
- *Most comprehensive family of field-proven VPN products with industry-leading features and international certification for worldwide interoperability*
- *Highest degree of integration, including built-in firewall and IPSec protections, to simplify installation, operation and management*
- *Greatest flexibility with a choice of VPN architectures, equipment configurations, security provisions, performance guarantees and management techniques*
- *Quality of Service (QoS) and Service Level Agreement (SLA) assurances that guarantee all three dimensions of availability: throughput, latency and uptime*
- *Genuine Customer Network Management (CNM) that lets service providers and their enterprise subscribers jointly, completely and securely manage the end-to-end VPN*
- *Delivery of "multimedia" VPNs that integrate voice, fax, video and data communications, including the any-to-many capability of IP multicast*

2. MultiVPN: A Comprehensive Approach to VPNs

MultiVPN affords the industry's most comprehensive choice of fundamental architectures for enterprise-wide VPNs. No other vendor offers such a complete solution with these three powerful options:

- Virtual Private Remote Networking (VPRN) with tunneling for remote LAN access
- Virtual Private Trunking (VPT) to establish the equivalent of leased lines among major facilities
- Virtual IP Routing (VIPR) to internetwork branch offices or establish extranets with closed user groups

Each MultiVPN architecture provides the physical and/or logical paths through the public network that replace the many long-distance leased or switched links in a private network. All three architectures can be employed individually or in combination, providing unparalleled flexibility for the configuration, operation and management of VPNs.

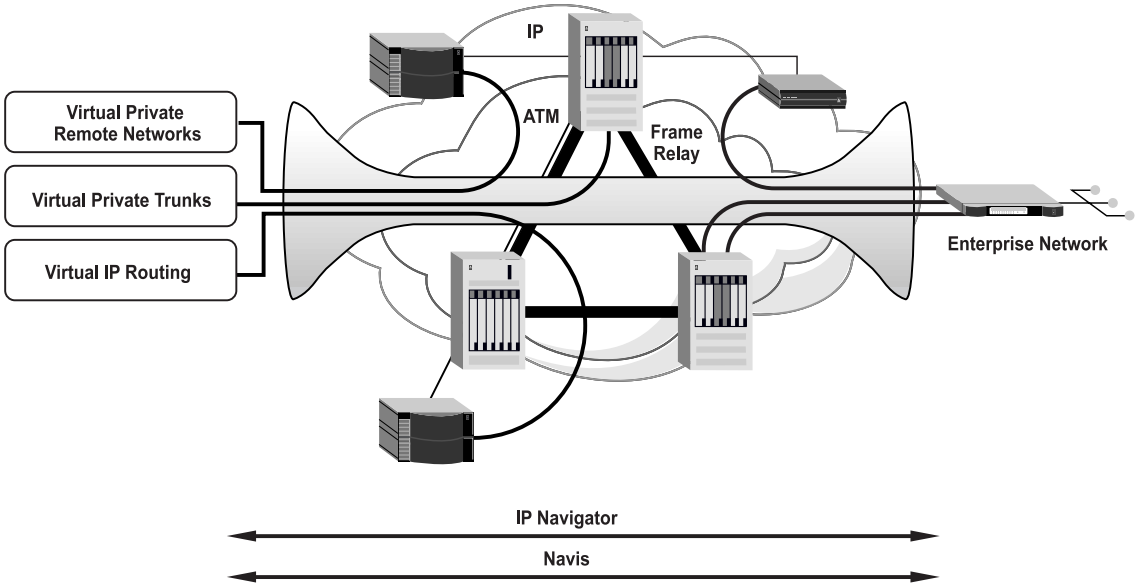

Figure 2 – MultiVPN's three architectures provide the industry's most comprehensive and flexible foundation for configuring, operating and managing VPNs.

Virtual Private Remote Networking (VPRN)

VPRN's multiprotocol tunneling is the best choice for transporting private client/server traffic over public IP networks like the Internet. Ascend's VPRN – via both the MAX™ family of WAN Access Switches with its True Access™ Operating System (TAOS) and the Pipeline® family of remote access routers – adds SLA assurances, QoS as well as multiprotocol capabilities to IP. This multiprotocol support lets enterprise customers connect remote sites, telecommuters and road warriors to local Internet POPs, thereby eliminating the expense of long distance charges. For the service provider, this means they can easily leverage their existing architecture to deliver high value, managed services.

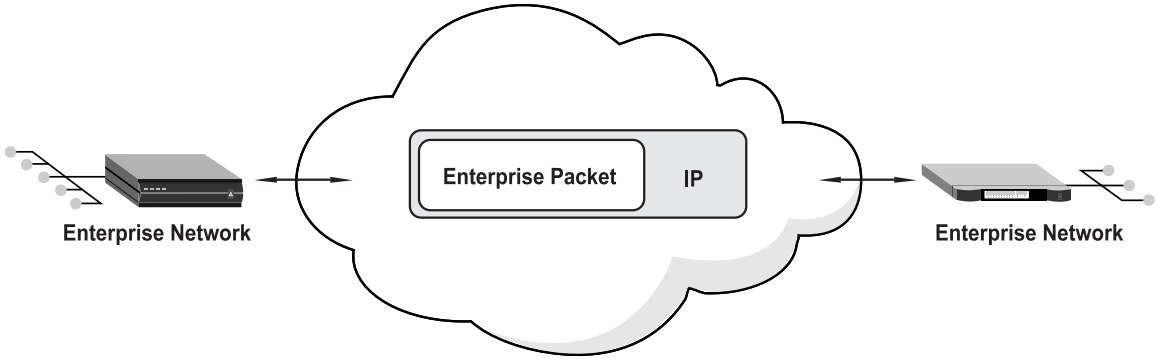

Figure 3 – Virtual Private Remote Networking with multiprotocol tunneling allows the Internet to be used for remote LAN access by client PCs.

Virtual Private Trunking (VPT)

VPT makes the powerful capabilities of Ascend's core Frame Relay and ATM multiservice switches (B-STDX, CBX 500 and GX 550) available directly to the enterprise VPN. VPT goes beyond traditional permanent and switched virtual circuits to provision trunk lines and/or bandwidth in a way that both optimizes resource utilization and guarantees performance. Dedicated bandwidth in the form of reserved lines or capacity might be used to link major enterprise facilities, while shared bandwidth would more efficiently internetwork numerous branch offices. Ascend permits use of the full spectrum of underlying Frame Relay and ATM traffic profiles, with their respective price/performance attributes, for tuning VPN configurations to customer requirements. Organizations concerned about using the public network for private enterprise applications will find trunking's inherent security and performance particularly appealing.

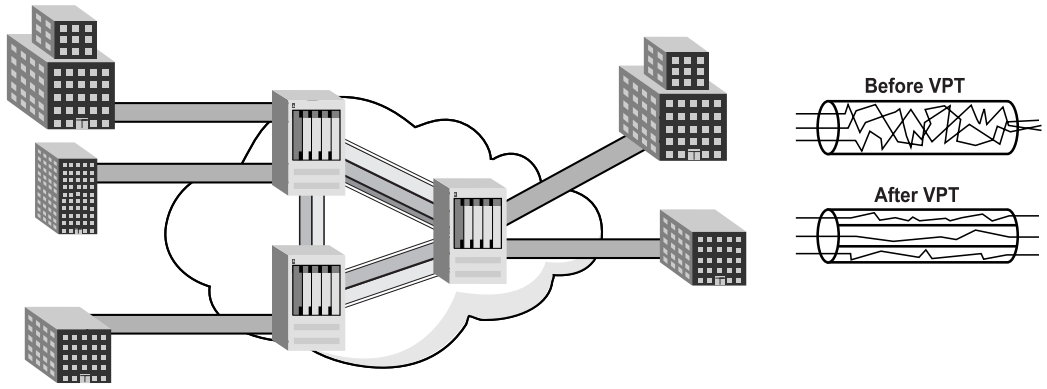

Figure 4 – Virtual Private Trunking makes the power of the public Frame Relay/ATM infrastructure available directly to the enterprise-wide virtual private network.

Virtual IP Routing (VIPR)

VIPR extends private route tables and address spaces from the enterprise into the service provider's routing/switching infrastructure using Ascend's IP Navigator. Essentially, a virtual IP router is a logical partition of a physical IP router or switch in the infrastructure. IP Navigator is a feature of Ascend's core Frame Relay and ATM multiservice switches, and soon in the MAX WAN Access switch family. Of particular appeal to the enterprise is VIPR's ability to use private (unregistered) IP addresses, which are the norm in large organizations and create independent virtual routing environments. Within each routing environment, QoS capability up to Absolute QoS may be applied. This enables enterprises to operate their enterprise VPN on a unified service.

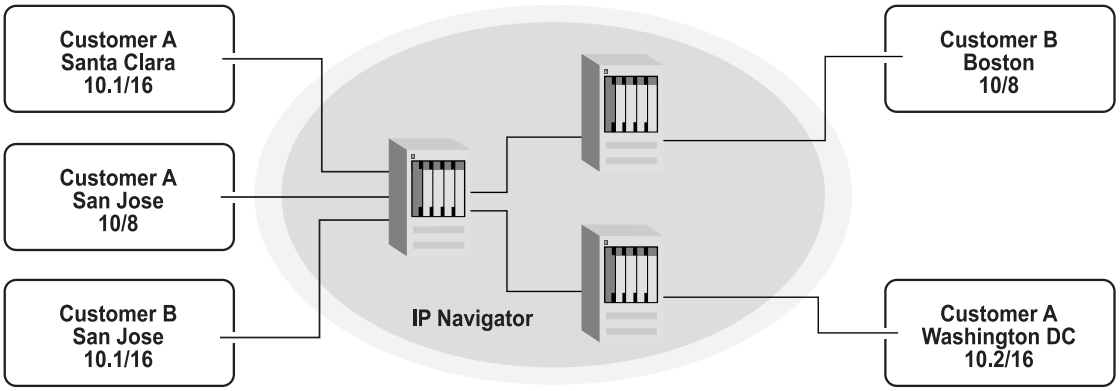

Figure 5 – Virtual IP Routing makes configuring and managing a VPN as straightforward as configuring and managing a router-based private network.

3. MultiVPN for the Enterprise

Organizations, large and small and in both the public and private sectors, are intrigued by VPNs. They realize VPNs are the future of enterprise networking as private networks get too complex – and expensive – for most organizations to justify. A VPN can integrate private enterprise, semi-private extranet and public Internet access, all over a single connection for each site or user, with less cost, greater capability and flexibility, and just as much, if not more control than a private network ever could.

But despite the many advantages, organizations continue to have fundamental concerns about utilizing VPNs in most enterprise applications: compatibility/security, availability and manageability. Ascend's MultiVPN strategy is the first to attack these concerns head on, giving enterprises all the benefits of VPNs without sacrificing or even jeopardizing any of the control organizations have grown to expect with a private network.

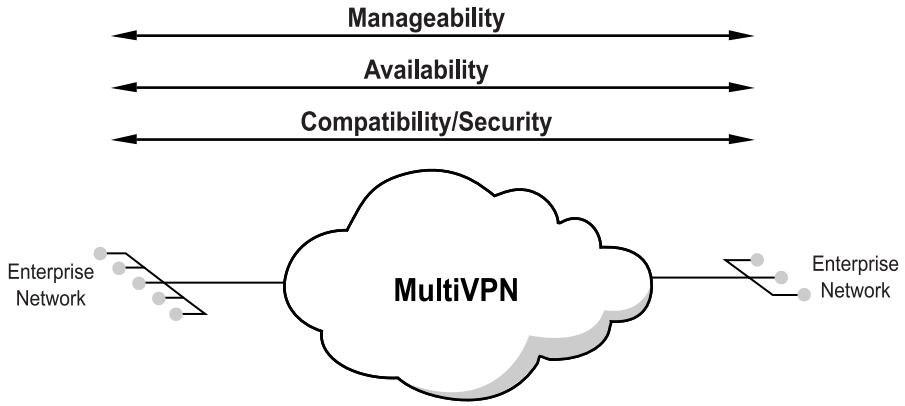

Figure 7 – Ascend's MultiVPN strategy overcomes all the fundamental user concerns that typically prevent enterprise-wide adoption of virtual private networks.

MultiVPN Benefits for the Enterprise

- *Lower costs – from 30 to 80%, according to industry analysts – for data networking and voice/video/fax telecommunications*
- *Extend reach and gain ubiquitous access to enterprise sites, other organizations and information worldwide*
- *Build new, secure communication relationships with buyers and suppliers*
- *Leverage enhanced and expanded services that are unavailable in the PSTN, such as multicast and ubiquitous interoperability*
- *Increase flexibility and simplify operations with a single per-site connection to the enterprise network, an extranet and the Internet*
- *Achieve high reliability through the carrier-class redundancy and resiliency of the public network infrastructure*
- *Gain greater control end-to-end with genuine Customer Network Management*

Compatibility/Security

Compatibility and security are tightly coupled, because making enterprise applications compatible with the "open" public network also makes them vulnerable. The MultiVPN architectures put the "private" in a virtual private network. The combination delivers the following capabilities:

- **Virtual Private Remote Networking** delivers Internet-based VPN capabilities. These solutions offer multiprotocol access and routing via the True Access Operating System (TAOS), which is embedded into all MAX and MAX TNT products. Ascend's remote access products support ATMP, L2TP and PPTP tunneling protocols and handle security through Secure Access™ Firewall, IPSec encryption and Ascend Access Control™ (extended RADIUS).
- **Virtual Private Trunking** segments one's enterprise traffic from all other traffic to deliver high value network services even during periods of extreme congestion.
- **Virtual IP Routing** securely extends the enterprise Local Area Network (LAN) over the Wide Area Network (WAN) and enables "Absolute" QoS.

Availability

For the enterprise to depend on the VPN, the public network must deliver the same dependability and performance as a private network. Ascend's MultiVPN access, routing and switching products have features that make the public network perform as well as the Public Switched Telephone Network (PSTN) with guarantees for all three dimension of availability: throughput, latency and latency variations, and uptime. ATM's ability to deliver circuit-like Constant Bit Rate (CBR) is well known. But Ascend extends this concept of Quality of Service (QoS) capabilities from ATM to both Frame Relay and IP. Ascend also adds the ability to deliver and confirm Service Level Agreements (SLAs). Together, QoS and SLAs offer the full range of availability to fit any need and budget.

Manageability

The tremendous flexibility afforded by VPNs, ironically, makes them appear too nebulous to be managed effectively. Organizations have always wanted to manage their enterprise networks end-to-end, including their private portion of the public network. Surprisingly, this seamless provider/subscriber capability has remained elusive, until Ascend extended its Navis™ network management architecture to include network-wide support for the MultiVPN environment.

With Navis, enterprise network managers have a unified view of their access and third-party router network. This capability may be combined with the Navis-based Customer Network Management (CNM) services that are delivered from within the service provider infrastructure. The service provider can offer the enterprise this control because they have integrated CNM capabilities from Ascend into their network. As a result, the enterprise subscriber has a window into the infrastructure to view, monitor, reconfigure, troubleshoot and otherwise manage its entire VPN – their private portion of the public network.

4. MultiVPN for Service Providers

MultiVPN enables the delivery of these capabilities in part or in total while addressing the issues of high availability service delivery, cost-effective service management and the effective delivery of CNM services. VPNs present service providers with unprecedented opportunities to create highly differentiated and profitable value-added services. Many are also interested in becoming "full-service" by adding voice communications (over IP, Frame Relay and ATM), developing channel expansion partnerships with resellers and integrators, and even offering turn-key outsourcing of the VPN. And many want to provide or obtain network resources wholesale from one another in the form of virtual points of presence or V-POPs. With MutliVPN, service providers can implement VPN services and build other value-added services as their infrastructure expertise and business plans evolve. At the same time, MultiVPN allows them to overcome these three primary obstacles: high availability, service management and customer network management.

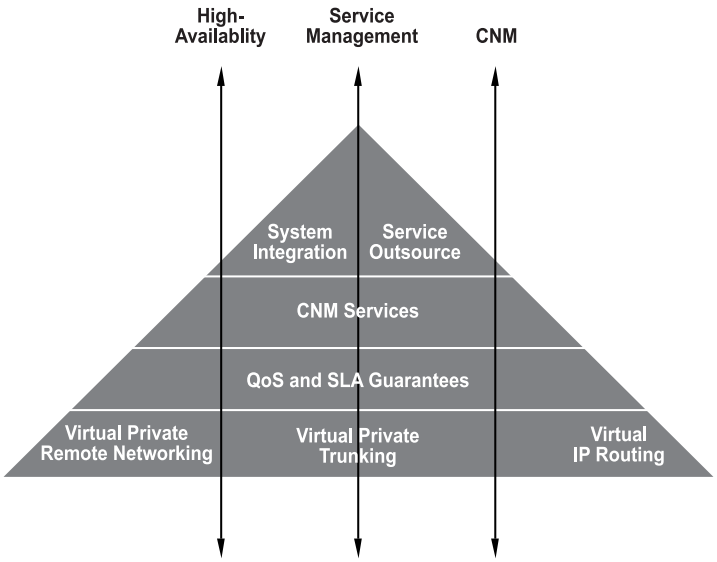

Figure 8 – Ascend's MultiVPN strategy satisfies the three demanding needs of the service provider.

MultiVPN Services

Ascend lets service providers offer highly differentiated – and profitable – value-added services. Specific capabilities include:

- *Choice of MultiVPN architectures: Virtual Private Remote Networking, Virtual Private Trunking or Virtual IP Routing*
- *Comprehensive security provisions, including integrated firewalls, IPSec, secure routing domains and logical segmentation of physical resources*
- *Service Level Agreement (SLA) delivery and confirmation reporting*
- *Tiered Quality of Service (QoS) options ranging from "best effort" to an absolute guarantee of throughput and latency*
- *End-to-end management with full Customer Network Management*
- *Value-added features, such as Voice over IP (VoIP) and IP multicast*
- *Value-added services, including systems integration and on-going support*

MultiVPN Benefits for Service Providers

- *A huge business opportunity with substantial revenue potential*
- *Delivery of highly differentiated – and profitable – value-added services*
- *Ability to leverage Ascend's experience and installed base in IP, ATM and Frame Relay networks as a foundation for future infrastructure deployment*
- *Offer QoS and SLA assurances – with confidence – for mission-critical applications*
- *Reduce operating costs through tiered wholesale arrangements with other providers for access ports (virtual points of presence or V-POPs) and/or backbone bandwidth*
- *Become more of a full-service provider through managed network services, and even complete "turn-key" partnerships with resellers and integrators*

High Availability

Enterprise subscribers demand Service Level Agreements (SLAs) that offer money-back guarantees whenever network quality or availability falls below some predefined level. Such stringent service deliverables goes well beyond the traditional measure of availability – whether the leased line is up or down – to require automated recovery and resiliency in the public network infrastructure. Ascend's MultiVPN products have a common carrier-class architecture that has the redundancy and rerouting capabilities service providers need to deliver SLAs and QoS guarantees to enterprise customers who require continuous uptime. Because MultiVPN products and services can be completely managed by Ascend's Navis network management, service providers can comfortably offer a secure network infrastructure that enterprise customers can easily depend on.

Service Management

With Ascend's Navis network management products, service providers get comprehensive control of four distinct elements – service creation, provisioning, operations and billing. In addition, they have the ability to leverage the existing infrastructure for the profitable deployment of new services on a "pay as you grow" basis. Navis begins by giving service providers the ability to create a powerful and dependable network infrastructure – capable of delivering multiple services, quickly and easily. Navis then offers unparalleled flexibility for provisioning a wide range of services that appeal to diverse subscriber needs, while simultaneously optimizing utilization of network infrastructure resources for maximum profit.

On a 24x7 basis, Navis continues managing the entire infrastructure providing details ranging from the "big picture" view of the enterprise to details about the performance on a single port. In addition, Navis helps reduce overall operating costs through advanced features like real-time network monitoring, automated provisioning and streamlined fault management. Navis also gathers detailed accounting information on network utilization by all subscribers and for all infrastructure resources. In this way, service providers are able to set competitive rates that preserve profitability. In short, Navis allows network managers view all of the MultiVPN services and devices on their network as a single, comprehensive entity.

Customer Network Management

Ascend's Navis Customer Network Management (CNM) extends the service management capabilities by sharing network infrastructure information – securely – thereby empowering the enterprise to manage its VPN. CNM grants real-time, 24-hour access to complete configuration, performance and fault information – all through the familiar Web browser interface for maximum productivity. The service provider has total control over read (view only) and write (manage) capabilities, which affords the flexibility to define a range of CNM services to meet different customer needs. Additional security provisions include network partitioning, a Secure Sockets Layer (SSL) interface and IPSec encryption of transported information.

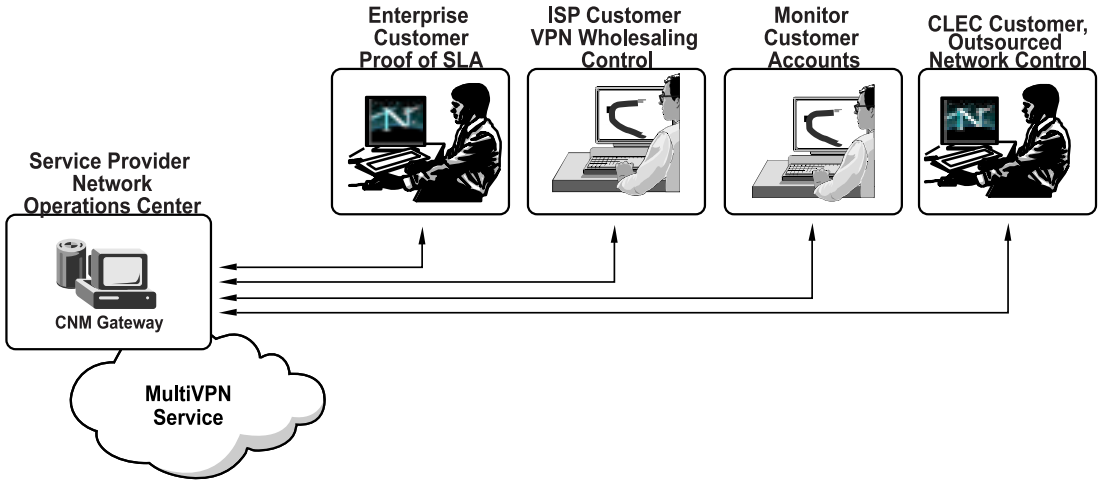

Figure 9 – Ascend's Navis CNM gateway combines unprecedented VPN management capabilities with the simplicity of browser-based access.

5. Ascend's MultiVPN Product Line

Ascend's MultiVPN products work in tandem to create the most comprehensive VPN solutions available on the market today. Because they address the needs of both the service provider and the enterprise, MultiVPNs make world-wide deployment a reality across multiple infrastructures and multiprotocol environments MultiVPN solutions are transforming the public network into a cost-saving resource for enterprises and a revenue-generating opportunity for service providers.

Ascend's MultiVPN strategy takes a practical approach with incremental and enabling enhancements to the public network infrastructure that build on the existing foundation, much of which already employs Ascend's access, routing and core switching products. These enhancements also satisfy the special needs of enterprises, enabling them to tap the full potential of the public network's power and presence.

Ascend's fully integrated MultiVPN offering includes common provider/subscriber elements (Navis CNM, Ascend Access Control and Secure Access), along with products specially designed for service providers and enterprise subscribers. And rather than offer just a few VPN-ready products. Ascend has incorporated robust VPN capabilities into its entire provider/subscriber product line. This section provides a list of the provider and subscriber offerings with no discussion of specific features. Details on these and other products are available at Ascend's Web site (www.ascend.com).

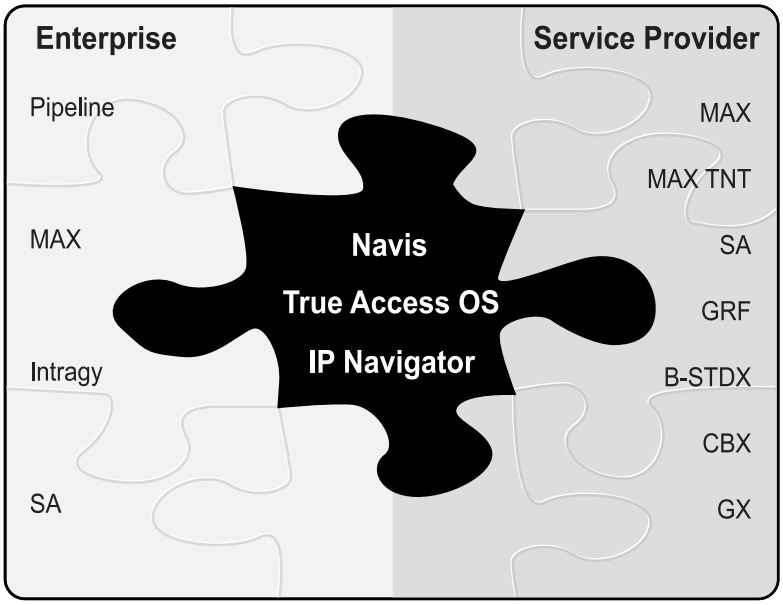

Figure 10 – Ascend's VPN product line is a fully integrated solution with customer premises equipment, infrastructure access, IP routing/switching, core switching, security and management, that together constitute the industry's most comprehensive VPN offering.

Service Provider Offering

Ascend's comprehensive service provider offering encompasses three related areas: core switching, IP routing/switching and network access.

- Core Switching products include B-STDX Frame Relay switches, the CBX 500 Multiservice ATM switch and the GX 550 Core ATM switch.
- IP Routing/Switching products include IP Navigator solutions integrated directly into multiservice switches as well as the GRF MultiGigabit router.
- Network access products include MAX WAN Access Switches and SA Broadband Service Units.

Enterprise Subscriber Offering

Ascend's award-winning Pipeline family provides the industry's widest assortment of VPN-capable routers for branch offices, small office/home office (SOHO) environments and telecommuters. VPNs benefit substantially from the superb price/performance and low cost of ownership of the Pipeline. Some sites may select an SA Broadband Service solution for offering advanced, ATM-based data, video and voice services. For larger sites in a hybrid private/virtual private network, Ascend's MAX WAN Access Switch offers a total solution. The MAX offers the capability, scalability and flexibility enterprises need in the migration from private to virtual private networks.

6. MultiVPN: Fulfilling the Promise

Ascend's MultiVPN strategy fulfills the promise of VPNs by making "the network of the future" a reality today for the full range of enterprise-wide networking needs. Ascend is the first vendor to adopt a provider/subscriber approach to VPNs and to deliver a solution that offers a comprehensive choice of VPN architectures. MultiVPN makes virtual private networking a commercial reality by overcoming the obstacles to pervasive deployment by providers, as well as widespread adoption by subscribers. And Ascend is the only vendor offering the full spectrum of products and features necessary to meet the demanding needs of providers and subscribers alike. MultiVPN from Ascend. It's more than a strategy. It's a whole new way of doing business.

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