Ascend

WHITE PAPER

Scaling Frame with ATM

Frame Relay to ATM Interworking

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1. Introduction

The rapid adoption of, and dependence on, new data and multimedia communications have brought pivotal changes in the networking industry. The sheer breadth of the emerging Asynchronous Transfer Mode (ATM) technology has company executives and network managers struggling to reconcile their existing network infrastructures with the benefits of the next-generation of ATM-based networks.

The questions are threefold:

- What is the quickest and most cost-effective way to manage an expanding network when the demand for virtual circuits increases suddenly – first from 1,000 to 10,000 – and then rapidly to 100,000?
- How can our investment in existing equipment be protected?
- Can we derive immediate benefit from ATM today, while we move to the next-generation of full-scale ATM network infrastructure?

Vendors announce new products and promise network architecture solutions almost daily. Until now, however, the migration to ATM was frequently complex, costly, still experimental or not workable with existing equipment. However, one company is addressing the short-term issues right now with an effective alliance of both Frame Relay and ATM technologies.

The commitment of Ascend Communications to developing standards-based products has resulted in a family of multiservice WAN switches that support Frame Relay, ATM, IP, SDMS and ISDN. Based on a scalable hardware and software architecture, Ascend products are designed to keep pace with the rate of technological change. They provide the migration from today's Frame Relay network to tomorrow's ATM network. Ascend products offer high-performance and solutions that move beyond the problems and economic challenges associated with today's rapid network growth to address the significant challenge in deploying ATM technology.

Ascend offers the technology now. Ascend was the first switch vendor to offer Frame to ATM network and service interworking according to the Frame Relay standards. As the first to offer service interworking, Ascend provides products that allow endstations in a Frame Relay network to communicate with endstations in an ATM network. The rich Frame Relay to ATM Interworking functions of the Ascend multiservice switch product family ensure that a network planner can construct a clear migration path to, and take total advantage of, emerging ATM applications.

By implementing the Ascend family of products, a network planner can flexibly, easily and quickly provide interworking between existing – or new – Frame Relay networks and ATM networks. And, it can all be done without requiring any changes to the peripheral network devices themselves. Using the combination of standards-compliance and feature-innovation, Ascend gives its customers the only integrated multiservice Wide Area Network (WAN) switch.

2. The Technologies

Frame Relay

Frame Relay technology is a fast, economical, WAN transmission technology that is well-suited to data applications including Local Area Network (LAN) internetworking, SNA transport, Internet and intranet access. The use of Frame Relay technology has grown rapidly, and today many businesses depend heavily on Frame Relay for wide area transport of their day-to-day business applications.

ATM

ATM technology, utilizing a rapid cell-switching process, supports a host of additional applications, such as voice and video. As ATM technology and services become more widely deployed, full interoperability between Frame Relay and ATM devices and environments becomes increasingly important.

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3. The Frame Relay ATM Alliance

Achieving Frame Relay to ATM Interworking is simplified because of the numerous qualities and key features that the two technologies have in common. In most instances, a Frame Relay parameter has a directly corresponding ATM parameter. Their similarities facilitate effective interworking between them. (See Table 1.)

Feature	Frame Relay	ATM
Orientation	Connection-oriented	
Multiplexing	Statistical	
Relevant Standards	Frame Relay Forum ANSI, ITU-T, IEEE 802.2	ATM Forum ITU-T
Common Standards	Frame Relay and ATM Forum Joint implementation agreements for Frame Relay-ATM service and network interworking (FRF.5 and FRF.8)	
Speeds Defined	56 Kbps – 45 Mbps	T1 – OC.48/STM 16, and up (no theoretical limit)
PDU Size	Variable: 4,096 bytes packet maximum	Fixed: 53 bytes
Addressing	DLCI: 10 bit field	VPI/VCI: 24 bits total
PVC	Yes	Yes
SVC	Yes, but not prevalent	Yes
Flow Control	Per circuit	
Burst Capabilities	Yes, but defined by committed burst and excess burst	Yes: defined by maximum burst size
Ubiquity	Widely deployed: growing rapidly	Increasing deployment

Table 1 – Frame Relay and ATM Features

Frame Relay, with its variable frame size and low overhead, is optimized for data transmission and is especially attractive for LAN interworking across WANs. Proven, stable, and widely available from a number of service providers, recent Frame Relay innovations have now broadened its appeal even further. Today, even delay-sensitive data such as SNA and voice can be accommodated thanks to Quality Of Service (QoS) extensions such as Ascend's PriorityFrame technology. This significantly widens the addressable market for Frame Relay services, and is fueling a boom as end-user applications migrate from static leased line networks to public data services, taking advantage of the economies of scale that flow from a public shared facility.

ATM, with its fixed-length cells, provides a single unified transmission infrastructure that supports any form of digital transmission – data, voice, video or multimedia. On the surface, ATM provides raw bandwidth that can scale to continually higher speeds, but its more fundamental strength lies in its ability to support numerous qualities of service simultaneously. This allows for the consolidation of separate networks for voice and data onto a single unified architecture.

Both Frame Relay and ATM are *connection-oriented* technologies. They set up a Virtual Circuit (VC) from one point on the network to another. Connection-oriented methods reduce the processing requirements significantly by routing on a Virtual Channel Identifier (VCI) (Frame Relay DLCI or ATM VPI/VCI). Both Frame Relay and ATM accommodate bursty traffic. A traffic contract between the user and the network specifies what network service will be supported. A set of parameters is used for each Permanent Virtual Circuit (PVC) to characterize its speed and burstiness. Frame Relay uses parameters for Committed Information Rate (CIR), excess burst (Be), and committed burst (Bc). ATM traffic contracts are described by Sustained Cell Rate (SCR), Peak Cell Rate (PCR), and Maximum Burst Size (MBS). Because these parameters address the same problem, an effective translation of a Frame Relay contract to an effective ATM contract can be achieved. This translation is the heart of Frame Relay to ATM Interworking.

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4. The Frame Relay and ATM Interworking Industry Standards

The similarity between Frame Relay and ATM make Frame Relay a natural stepping stone to ATM. By combining both technologies, companies can protect their existing network infrastructure. The good news is that the solution combining the two technologies is proven and is rapidly being adopted and put to use now. The following two industry standards have been ratified by both the Frame Relay Forum and the ATM Forum:

- Frame Relay to ATM Network Interworking (FRF.5 Standard)
- Frame Relay to ATM Service Interworking (FRF.8 Standard)

These standards provide for seamless interoperability between Frame Relay and ATM, and they are implemented as software functions in Ascend multiservice WAN switches. The interworking functions give companies a migration path, allowing them to share data and resources throughout an enterprise by adopting high-capacity ATM in phases at corporate headquarters while deploying Frame Relay in regional and branch offices.

Frame Relay to ATM Network Interworking

The Frame Relay to ATM Network Interworking standard (FRF.5) enables two Frame Relay devices or networks to communicate across an ATM backbone. The Frame Relay to ATM Interworking technology responds to the need for more rapid communication by allowing enterprise Frame Relay networks to seamlessly scale up to high-speed ATM networks. The technology addresses the need to move the backbone beyond 45 Mbps trunks supported by Frame Relay today. Frame Relay to ATM Network Interworking allows ATM to be the high-speed backbone technology for Frame Relay users and lets the end-user or networking devices communicate with each other via the ATM network. (See Figure 1.)

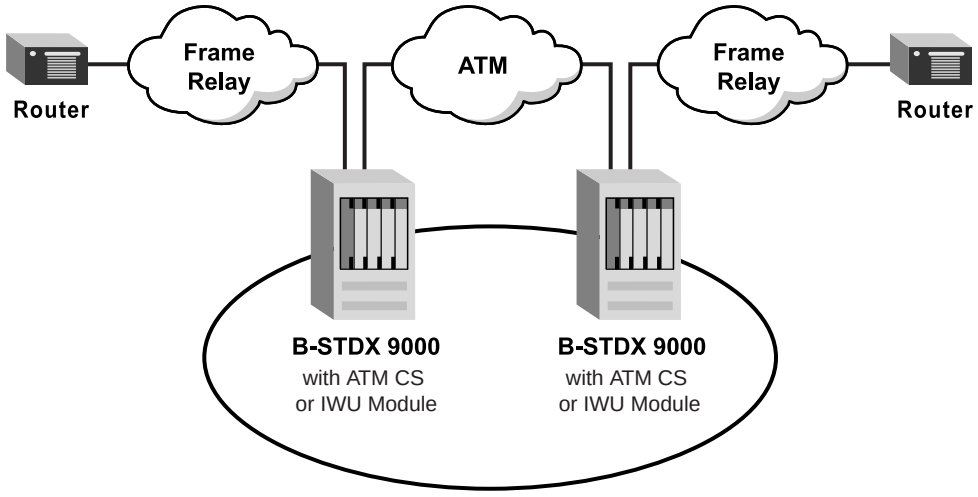


Figure 1 – Frame Relay to ATM Network Interworking

For example, SNA terminal users connected to Frame Relay access devices in branch offices can communicate with Frame Relay-attached IBM 3745 Communications Controllers in their corporate headquarters using the high-speed ATM network as the backbone. The Frame Relay devices communicate as they usually do, as if they are using Frame Relay for the entire session. They have no knowledge of the ATM network in the middle. An ATM backbone connecting multiple Frame Relay networks can provide scalablity and high-speed support for a large number of locations and end-user devices, without calling for alterations to the devices.

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Frame Relay to ATM Service Interworking

The Frame Relay to ATM Service Interworking standard (FRF.8) enables a Frame Relay user device to connect to an ATM user device over a common WAN backbone. Frame Relay to ATM Service Interworking enables seamless communication between ATM and Frame Relay networks or end-user devices. (See Figure 2.)

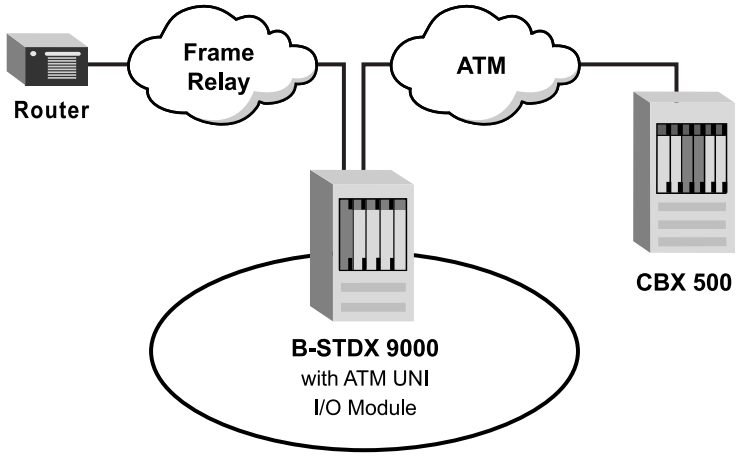


Figure 2 – Frame Relay to ATM Service Interworking

For example, in a network where ATM has been deployed at a corporate headquarters, the existing Frame Relay devices in remote offices can access the headquarters ATM-based applications using Service Interworking. Enabling existing devices to access new ATM-based applications allows low-cost access to high-speed networks, while protecting the investment in the existing equipment.

Frame Relay to ATM Interworking provides answers that support the communications between both the Frame Relay and the ATM devices without requiring modification to the devices themselves. However, successful support of these end-to-end communications requires technical compensation for the very different Frame Relay and ATM networking technologies. These compensating functions are performed by the Interworking function that is usually located on the switch platform at the boundaries of the Frame Relay and ATM services.

The primary task is to map various parameters or functions between Frame Relay and ATM networks. For example, frames or cells are formatted and delimited; discard eligibility and cell loss priority are mapped; congestion indications are sent or received appropriately. The Interworking function also supports traffic management by converting ATM and Frame Relay traffic parameters and providing translation for upper layer user protocol encapsulation.

The diagram in Figure 3 illustrates the interworking function in a Frame Relay to ATM Service Interworking environment. To enable communications between the Frame Relay device and the ATM application, the interworking function performs all tasks associated with mapping the Frame Relay-based message in the Frame Relay network to the ATM-based message in the ATM network.

FUNI

The Frame-based User-to-Network Interface (FUNI) was defined by the ATM Forum to provide frame-based access to ATM networks. It's most important feature is that it allows Switched Virtual Circuits (SVCs) to be mapped from Frame Relay to ATM. FUNI enables the efficient use of bandwidth by enabling users to transmit frames rather than cells to the ATM network. It represents a complementary alternative to Frame Relay to ATM Service Interworking and is most viable in cases where the wide area infrastructure is ATM-based. Generally put to use when the network is more than fifty per cent ATM-based, FUNI provides a means of enabling ATM QoS levels for network throughput and delay to be maintained from end-to-end, despite the fact that the access method is frame-based, rather than cell-based (ATM).FUNI requires software in the user equipment and an accompanying frame-based interface, as well as FUNI

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software in the switch to which the user equipment connects. Within the switch interface, the frames are segmented into cells and sent into the network. Cells coming from the network are reassembled into frames and sent to the user. Thus, the cost of the segmentation and reassembly hardware is moved from the user equipment to the switch. This means that the cost of the segmentation and reassembly function is shared by a large number of users.

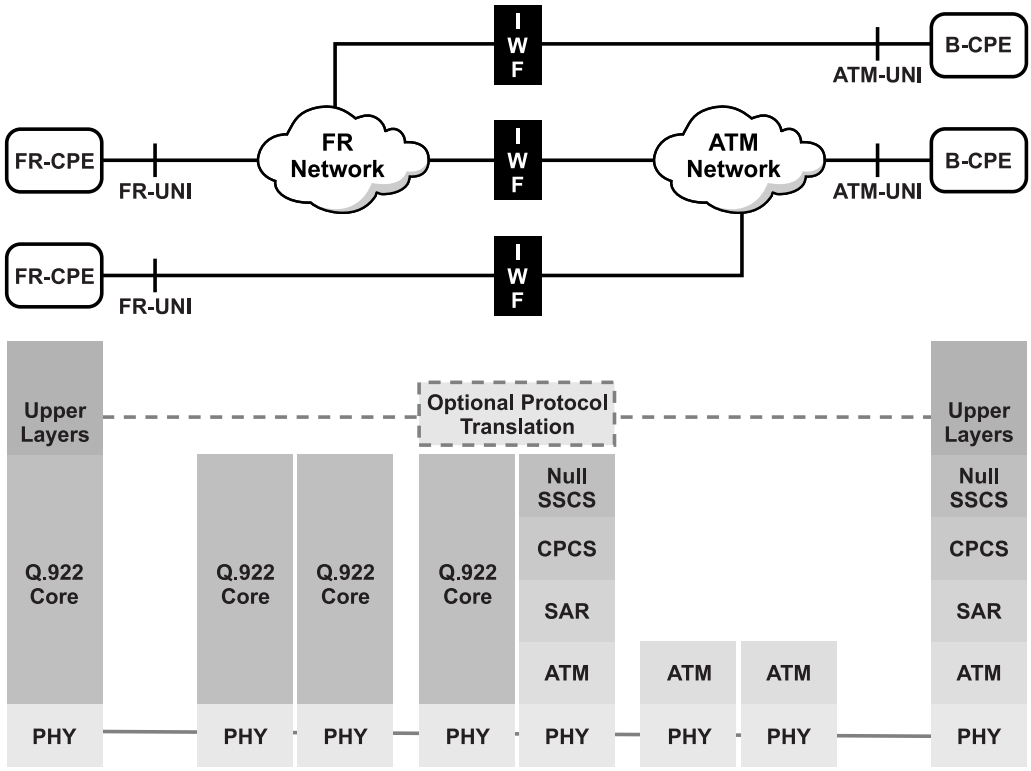


Figure 3 – ATM Interworking Functions

5. Understanding the Problem

The network planner understands the advantages and appreciates the benefits of the Frame Relay to ATM Interworking alternative as compared to other possible options. Driven by the need to protect the investment in existing networks while supporting the migration to ATM networks, the network planner today faces a separate series of questions related to managing the anticipated transition.

- Is Frame Relay to ATM Interworking available now?
- What products should I select today?
- Why should I choose one vendor's products over another's?
- What can be done to ensure the reliability and protection of the current network?
- How do I solve today's requirements in a way that ensures a seamless migration to the future network?

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6. Product Family Modules and Functionality

It is clear that network planners want and need a feasible solution to today's growth requirements and new technologies to position their networks for evolution to ATM. Interworking allows different technologies at either endpoint of a connection to communicate seamlessly with one another or make use of new network transport services. Interworking delivers a clear migration path to ATM, while taking advantage of today's Frame Relay services. The Interworking solutions from Ascend are designed to meet all of these user needs.

All Ascend products share a common software component, minimizing feature upgrades and allowing backward compatibility while providing consistent and timely support of new features. Ascend products provide the most proven, reliable and highly available networking solutions in the industry. The software component of the products provides for flexibility in network design and implementation, and reliability and ease in network management. The standards-based software delivers sophisticated capabilities for managing and controlling WANs, while integrating easily with existing management systems.

B-STDX Switches

The B-STDX 9000 is a 16-slot high capacity, modular multiservice platform for interworking among broadband packet networks, including Frame Relay, IP, ATM, SMDS and ISDN. The B-STDX 9000 accommodates large networks with high bandwidth requirements and provides the frame-based interface to an ATM network.

The B-STDX 8000 is an 8-slot modular multiservice platform providing the right balance of price and performance – including the reliability, management and multiservice capabilities of the B-STDX products. The B-STDX 8000 is designed to provide a cost-effective solution to meet the rapidly growing needs of low- to medium-density sites within public network carriers and enterprise end-user networks.

ATM CS Module

The ATM Cell Switching (CS) Module is a one-port DS3/E3 module supporting ATM services on the B-STDX platform. The CS module represents Ascend's second generation of B-STDX Frame-to-ATM Interworking technology. Building on Ascend's leadership in Frame Relay to ATM Interworking, the CS module supports both network and service Interworking, as well as the addition of native cell switching capability at 34/45 Mbps.

ATM IWU Module

The ATM Interworking Unit (IWU) Module is a one-port OC-3/STM1 module supporting ATM services on the B-STDX platform. The IWU represents a major extension in trunking and Frame Relay – ATM internetworking capacity for the B-STDX platform. The IWU provides support for both network and service Interworking at 155 Mbps.

CBX 500 Switch

The CBX500 multiservice switch offers solutions that transcend current problems and economic challenges to address the tasks and issues involved in deploying ATM technology. The CBX 500, in combination with the Ascend B-STDX family of products, allows networks to grow and respond to today's burgeoning demand for capacity, performance and port density.

Previous ATM WAN switches did not stand up to the challenge because they were primarily designed to demonstrate ATM ability in support of very high bandwidth and switching throughput. They did not have the scalability to move beyond the bandwidth issue and provide the real requirements necessary to deploy a production ATM network. In response to the multidimensional problem of planning network growth, the CBX 500 provides real solutions for real growth. The CBX 500 is service-ready and has the scalability to handle future network growth.

The CBX500 multi-service switch offers high-density solutions for ATM and Frame Relay. In addition to ATM services at DS1/E1 to OC12/STM-4, the DS3/E3 Frame processor card allows the CBX500 to support high speed Frame Relay services on a single platform.

Frame Relay and ATM both have roles to play as complementary technologies. The indications are that Frame Relay use will continue to grow. Figure 4 shows the implementation of ATM technology using the CBX 500 at the core of an ATM network with Ascend B-STDX switches providing Frame Relay traffic aggregation and ATM network interconnection.

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Ascend and FUNI

FUNI access to ATM is supported on all Ascend frame-based modules. The Release 4.1 for the B-STDX 9000 supports the FUNI specification providing FUNI-to-FUNI Switching, FUNI-to-Frame Relay Interworking, and FUNI-to-Cell switching (ATM Feeder Node).

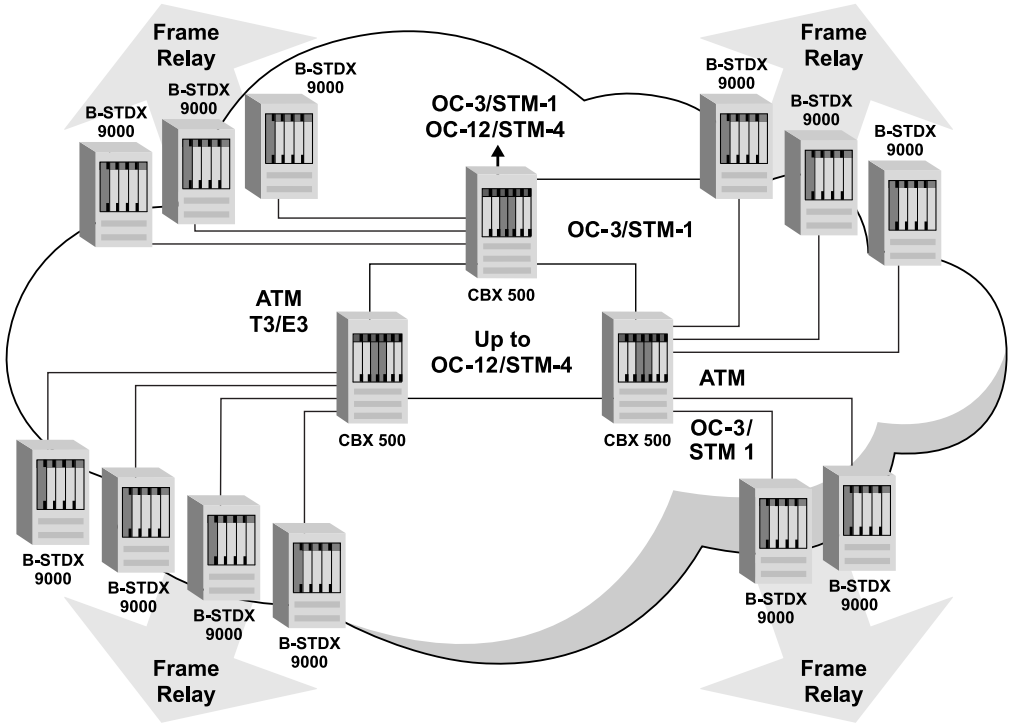


Figure 4 – The CBX 500 Switch as ATM Core

The B-STDX switches implement Frame Relay Interworking features and feed data service traffic in ATM-converted format to the core ATM network. The Interworking function ensures that the ATM migration is seamless and assures the coexistence of ATM technology with the existing packet-based customer equipment. ATM technology is the optimal mechanism for supporting the new high bandwidth applications. Once the traffic reaches the core, the CBX 500 provides:

- Quad-plane architecture providing simultaneous support for voice, video, SNA and TCP/IP
- High-speed network access
- Guaranteed QoS
- Sophisticated topology management through Ascend's Virtual Network Navigator (VNN)
- Support for 224,000 virtual circuits per port
- Circuit capacity that equals thousands of SVCs per second per switch
- Expansive cell buffers for bursty data traffic
- Port speeds up to OC-12 STM-4
- Usage-based billing

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Navis Network Management

Both NavisCore and NavisXtend applications can be used to manage the Ascend switch families.

- NavisCore operates in conjunction with HP OpenView to provide multi-service IP, Frame Relay, ATM and SMDS configuration and management of Ascend core switches from a single hardware platform.
- The NavisXtend family of applications extends the capabilities of NavisCore to align network management with the service providers' management of business infrastructure to reduce costs and enable new service offerings. Examples include automation of provisioning tasks, enhanced statistics gathering and SQL storage and intelligent fault handling.

7. Finding the Solution

New data and multimedia communications will continue to bring momentous change to the networking industry. Internet access, LAN interconnect and SNA transport will continue to drive market growth. Frame Relay technology and its network services are clearly the best means for delivering highly scalable and low-cost multiprotocol WANs.

The similarity between Frame Relay and ATM makes Frame Relay a natural progression to ATM. By combining both technologies, Ascend provides you with the ability to protect your existing network base while migrating to ATM. The solution combining the two technologies is proven, reliable and available to you today.

Ascend products, based on a scalable hardware and software architecture, allow you to migrate from today's Frame Relay network to tomorrow's ATM network. Both the B-STDX 9000 and the CBX 500 switches offer high performance and real answers that move beyond the present issues and the financial burdens that are associated with rapid network growth. In combination with other Ascend standards-based products, they allow you to direct network growth and take control of the issues involved in deploying ATM technology.

The solution is simple – Ascend. First to offer service and network interworking and continuing to innovate with higher performance solutions, Ascend ensures that a clear migration path exists and that you can use it to take advantage new ATM technology. Selecting Ascend standards-based products today will provide you with low-cost access to the high-speed ATM networks of the future.

8. Conclusion

The path is clear. Ascend has Frame Relay to ATM Interworking now. Ascend provides the solutions and the technology immediately by supplying Frame Relay and ATM on a single platform. Ascend gives you the only full Multiservice WAN Switch implementation available today. Ascend has immediate, sensible solutions *now.*

You can use the Ascend solution without costly reinvestment. Using the Ascend combination of standards-compliance and feature-innovation, you no longer need to contend with questions concerning how you can reconcile your existing network infrastructures or partial solutions to the problems. Now, you have the answers you need:

- Ascend provides the most cost-effective and rapid method to manage burgeoning network growth.
- Ascend does it without requiring you to make inappropriate, costly investments to protect the cost of your existing equipment.
- Yes, you can benefit from ATM today, while attending to the compelling responsibility of building for the future.

By purchasing Ascend products today, you can protect your current investments, while you easily and quickly provide interworking between the existing Frame Relay network and the ATM network of the future. Using the combination of Ascend standards-compliant and feature-innovative products, you can obtain the optimal Multiservice WAN Switch implementation available and you can obtain it today.

While other vendors promote sweeping, complete upgrades to ATM, Ascend suggests that a gradual, but progressive move to ATM, driven by real application and bandwidth demand, is the wise approach. For planners with vision, this sensible progression manages risk and leverages stable, standards-based technology. The Ascend interworking solution is commercially available now and is being used in production networks today. It can be in use in your company tomorrow.

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