**Frame Relay
Service Strategies**

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Frame relay continues to generate interest from end users and service providers who are taking advantage of the cost savings and revenue that service provides.

Most consultants would agree frame relay's success is a result of the technology's simplicity, a focused marketing campaign and the ability to reduce networking costs from anywhere between 30% and 50% compared to leased lines. In 1996, cost savings in the area of $300 million (globally) will be realized in networking expenses as a result of frame relay.

Statistically, frame relay is the most successful data service introduced in the public market to date. No other technology has experienced the tremendous growth and attracted so many users in as short a time.

The purpose of this presentation is to highlight the technical benefits and illustrate the opportunities of entering into the frame relay service providing market. The discussion is presented from a marketing view and highlights various strategies for positioning oneself competitively.

About the presenter:

John Casadonte is a North American network consultant for Nortel's Magellan portfolio and has more than 10 years of experience in the data communications industry. John's primary responsibility is the communicate the value of the Nortel frame relay products and services. John is Nortel's primary representative in the frame relay Forum and has chaired the North American Market Development and Education Committee for the frame relay Forum since January 1995.

Agenda

- **Technology and market**
- **Positioning technical differentiators**
- **Positioning strategic differentiators**
- **Evolution and conclusions**

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What is Frame Relay?

- **A version of packet switching that takes advantage of:**
  - greater DTE intelligence
    - (PCs on LANs rather than simple terminals)
  - improved line quality
    - (digital lines and fiber optics)
- **Transmit frames at Level 2**
  - no error correction
  - limited congestion control
    - end-user systems can perform recovery at higher OSI levels
  - reduced overhead processing
  - increased throughput

Management of Network Layer RNR
Management of Network Layer RR
Detection of Out-Of-Sequence Packets
Management of P(R) (Packets Recieved)
Management of P(S) (Packets Sent)
Management of W Bit
Management of D Bit
Respond to RR (Receiver Ready)
Respond to RNR (Receiver Not Ready)
Act Upon Reception of REJ
Track numbers of Retransmissions
Respond to P/F (Poll/Final) Bit
Generation of REJ (Rejection Message)
Check Received N(S) Against V(R)
Acknowledge Recieved I-Frames
Manage timer T1
Buffer Packets Awaiting Act
Manage V(S) State Variable
Manage V(R) State Variable

Frame relay functions

Multiplexing of Logical Channels
Fill Inert-Frame Time
Address Translation
Discard Incorrect Frames
Recognise Invalid Frames
FCS Checking/Generation
Transparency
Flag Recognition/Generation

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The requirements for data networking are constantly changing, as is the environment in which the data network is expected to operate. The following factors have contributed to frame relay's acceptance as a sound technology.

- The increasing need for better performance due to the wide spread use of graphical applications and client/server technology

- Today's applications require large amounts of bandwidth for a short period of time (i.e. FTP, e-mail)

- The improved quality of transmission facilities. Most data circuitry is digitally based

- End-points (PCs) have a higher degree of intelligence, allowing common network- based functionality (error checking/recovery) to be handled

For the past decade, the data communication protocols have been engineered with a different set of principles. These principles have changed and newer technology can provide a better solution in many circumstances.
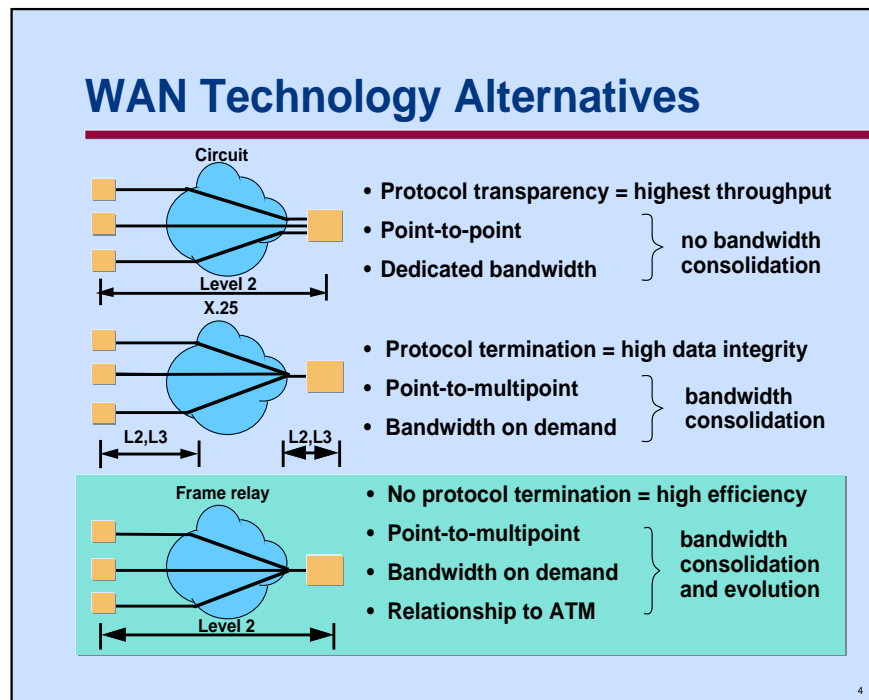
Each WAN technology has its advantages and disadvantages.

Leased Line

The core value of frame relay relative to leased lines is its ability to do bandwidth consolidation. Frame relay does not necessarily replace leased lines, as a leased facility is still required for the interconnection of devices to the network component. Frame relay greatly reduces the number of leased lines in a network and thus provides a huge cost savings. However, frame relay will not always be the best choice, especially if the applications demonstrate high utilization and demand dedicated connections.

X.25

The core value of frame relay relative to X.25 is it can deliver higher throughput. This is primarily due to the network and CPE not requiring to terminate and manipulate any protocol procedure and therefore the network uses its processing capacity to deliver throughput. On the other hand, the X.25 service involves rigorous error checking and correction at both levels 2 and 3, and therefore guarantees higher integrity of the data being transferred, still a requirement in some market segments. Most applications today (ie., LAN-LAN) are bursty in nature and provide a perfect match for the characteristics of frame relay.

An evolution path

An evolution path to ATM is critical for many end users, however, wide scale ATM deployment lags initial predictions. Frame relay offers a solution today. Frame relay is currently the only technology with a defined procedure to interwork with ATM. This advantage strengthens the argument to deploy frame relay today.
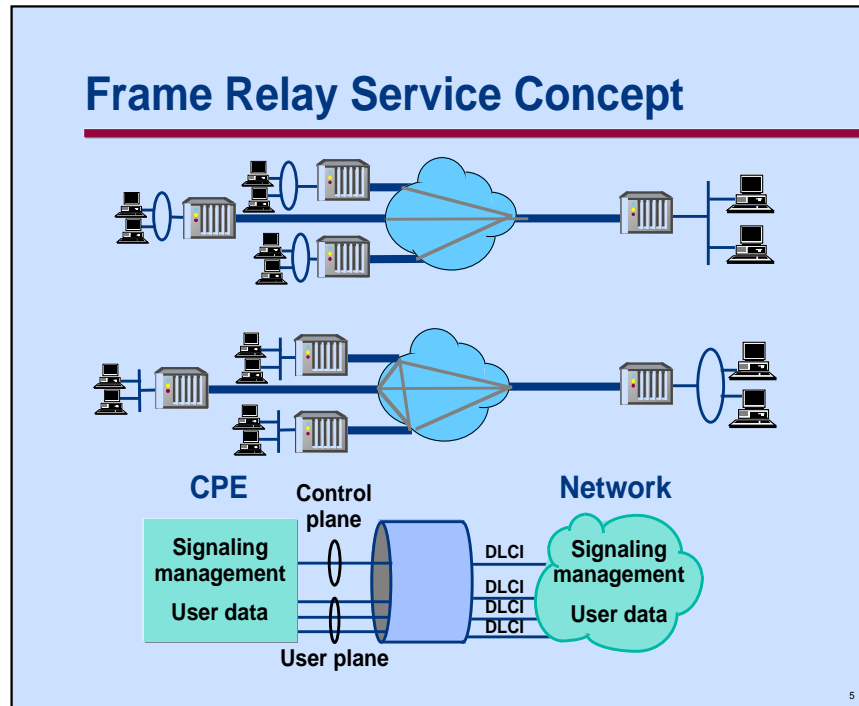
Frame relay is built around the principle of multiplexing logical connections over a single physical facility. The connection is controlled by several components which also double as the basis for the tariff definition offered by the provider.

- **Port connection** - speed at which the physical facility connects the end user to the network.

- **DLCI (data link control identifier)** - a number representing the logical connection from the end user to the network.

- **CIR (committed information rate)** - average bandwidth allocated under normal conditions to a specific DLCI represented in bits/s. Typically defined below port speed.

- **EIR (excess information rate)** - extra bandwidth assigned to a DLCI (if available) represented in bits/s. Typically configured as the difference between CIR and port speed.

- **PVC/SVC(permanent/switched virtual circuit)** - the logical connection between two frame relay ports either pre-defined or established on demand.

For example, a customer may be configured to use a 64 kbit/s port connection with one DLCI. The CIR is typically less than the port speed, for example 32kbits/s and the EIR would also be 32 kbit/s. Some configurations do not include the EIR definition. A PVC or SVC is then established to a similarly configured frame relay port. The DLCI numbers have local significance only.

As in most data communication protocols, frame relay has a function dedicated to the operation and management of the interface which is monitored at all times. This information is exchanged over the control/management plane. The control/management plane is responsible for establishing connections if an SVC is used, or maintaining and verifying the connection between the end user and the network. An example of a management plane function is the keep alive message which verifies the network is operational.
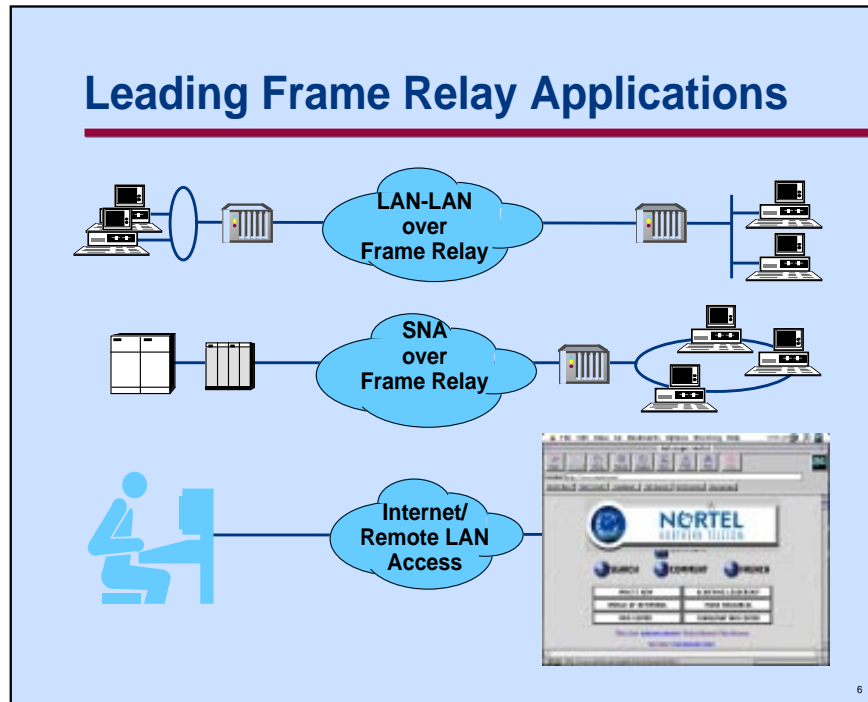
When frame relay was initially introduced, the service was targeted as a leased line replacement technology. The data service most widely used for data applications was LAN-to-LAN connectivity. End users quickly saw value in frame relay and netted savings between 30-50% of their leased line charges. At one point in time, LAN-to-LAN represented nearly the sole application in the frame relay marketplace.

After end users became comfortable with the technology, SNA users began, in 1994, to sample the service to replace 9.6 analog multi-drop facilities. The strategy became so successful that nearly 50% of the frame relay market today is transporting SNA traffic.

Today, frame relay is being used to connect business and residential users to the Internet. Frame relay is the predominant connection method for accessing WWW or Internet resources. Nearly all of the Internet service providers use frame relay as the core networking technology.

Other non-conventional frame relay services, such as voice and video, have entered the mainstream and have started to make an impact. The ability to handle CBR traffic over a frame based technology will provide additional options to ATM for some end users as the incremental expense is minimal compared to a technology upgrade.

Drivers of Frame Relay

- **Savings over private line networking**
  - savings on access, CPE and network costs
    - one WAN port, one facility
- **Greater flexibility in network expansion**
  - simplified architecture
  - easier adds, changes and deletions
- **Higher survivability due to shared resources**
  - improved application performance and network utilization
- **Lower cost of ownership**
  - reduced management and administrative costs
- **Multiprotocol bandwidth consolidation**
  - enterprise user maximizes link utilization

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As in most technological decisions, end users are largely driven to new technology because they see the benefits that will improve the current situation. Others are lured by the 'bleeding edge' mentality, wanting to be the first with a new technology. Frame relay offers benefits that do not require a *bits and bytes* understanding of the technology. It attract all types of users. In other words, it has become an easy sale for both the seller and buyer.

The single most important benefit that attracts users to frame relay above any other is the potential cost savings. Typically, to realize cost savings above the existing private line environment, the end user should be connecting a minimum of three locations.

Frame relay offers more than cost savings, it is a vehicle to expand the end user business and improve productivity with minimal expense.

Frame relay is also capable of squeezing additional bandwidth out of a highly utilized private networking facility.

Market Growth

Worldwide frame relay services market

(in US $Ms)	1993	1994	1995	1996	1997	1998
Total	80.2	267	799.2	1634	2584.1	3572.3

Source: 1995 Vertical Systems Group

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Continued high growth in LAN interconnection, conversion of SNA networks to distributed client/server architectures, increased use of groupware applications and higher bandwidth applications like multimedia are fueling the demand for frame relay services worldwide.

Worldwide frame relay service revenue is projected to climb from US $267 million in 1994 to more than US $3.5 billion in 1998. This represents a compounded average growth rate (CAGR) of 91%.

For 1995, U.S. revenue will top $500 million, with non-U.S. revenue reaching this level in 1996.

Examples of Service Definitions

Provider	Port Speeds	CIR	Port over-subscription	Tariff Structure	Analog dial access	ISDN access	SVCs	ATM Inter-operability	Managed Offering	Managed Service
(A)	56/64 kbit/s - T1/E1	4-64kbit/s	200%	flat rate	yes	yes	yes	no	yes	Near real-time SNMP monitoring and reports
(B)	from 56 to 512kbit/s	19.2-768 kbit/s	200%	flat rate	yes	yes	no	no	yes	Monthly reports
(C)	56/64 kbit/s - T1/E1	4-512 kbit/s	200%	flat rate	yes	yes	no	yes	no	
(D)	56/64 kbit/s - T1/E1	0; increments of 8 kbit/s	200%	flat rate	no	yes	no	no	Yes	Configuration management, near real-time SNMP monitoring and reports
(E)	56/64 kbit/s - T1/E1	0; increments of 8 kbit/s	Unlimited	usage and flat rate	yes	yes	yes	no	yes	SNMP monitoring/reports
(F)	from 56 kbit/s to 6 Mbit/s	0,56,128,256 and 512 Mbit/s	Unlimited	flat rate	yes	yes	yes	yes	no	
(G)	56/64 kbit/s - T1/E1	0,19.2,38.4 kbit/s	None	flat rate	yes	yes	no	no	yes	Near real-time SNMP monitoring and reports
(H)	from 56 kbit/s to 1.024Mbit/s	1 kbit/s increments	400%	flat rate	yes	no	no	yes	yes	Near real-time monitoring
(I)	56/64 kbit/s - T1/E1	16,32,48 and 64 kbit/s	None	flat rate	yes	yes	yes	no	yes	Configuration management; real-time SNMP monitoring and reports

Since the first public service offering, frame relay has attracted all levels of service providers. The number of new providers continue to grow, which is making selling 'commodity' frame relay mainly a price competition. Most service providers have introduced frame relay with similar strategies, making it very difficult to differentiate solely on feature functionality. Some service providers understood this dilemma and focused their differentiators on non-technical areas. These providers have established differentiation strategies—a necessity for continued success.

There is plenty of room in this market, especially as acceptance expands internationally. Service providers must grasp frame relay as it will impact revenue in two separate fashions: increase revenue as the service is rolled out or decrease revenue as the customer base with existing technology (leased line, SDLC, X.25) gravitates to providers who offer a frame relay service.

Service-specific Differentiators

- **Traffic prioritization**
  - Legacy/LAN/voice coexistence
- **Resiliency**
  - UNI/NNI back-up
  - disaster recovery
- **Switched access/Remote LAN access**
  - digital: ISDN BRI/PRI; SW56
  - analog V.34
- **High-speed access**
  - host-link consolidation (up to 50 Mbit/s)
  - native LAN mode services (4, 10, 16 Mbit/s)
- **Switched virtual circuits**
  - meshed interconnectivity
  - reduced costs
  - voice/video application support

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A service provider must be responsive to issues in the market place.

When end users realize the benefits of placing one application on frame relay, they begin to consolidate more of their applications. The same scenario applies to network expansion, and as the end-user locations increase, a frame relay service with disaster recovery features become more desirable as a catastrophic failure impacts a greater number of end users and inevitably the business.

For businesses justifying expansion, even the cost of frame relay may discourage an installation of a dedicated facility. For those situations, and for new working arrangements (i.e. working at home), the most cost-effective method of extending the network may be to implement switched services.

As networks grow, the demand on performance for the central locations may result in costly equipment purchases. High speed services provide the ability to leverage the capabilities of the existing equipment and provide a scalable solution without a technology upgrade.

Finally, frame relay networks continue to grow and the increasing number of users have made the scalability of the network an issue in servicing the end user. The service providers are looking for relief to offset the linear progression of cost and revenue. SVCs will deliver this solution for the service provider and will provide an incentive to the end user to begin creating meshed environments.

Traffic Prioritization

**Networks must leverage or supply the prioritization
for each traffic class to maintain an application-specific
quality of service**

SNA

Frame Relay
Network

FTP

SNA

FTP

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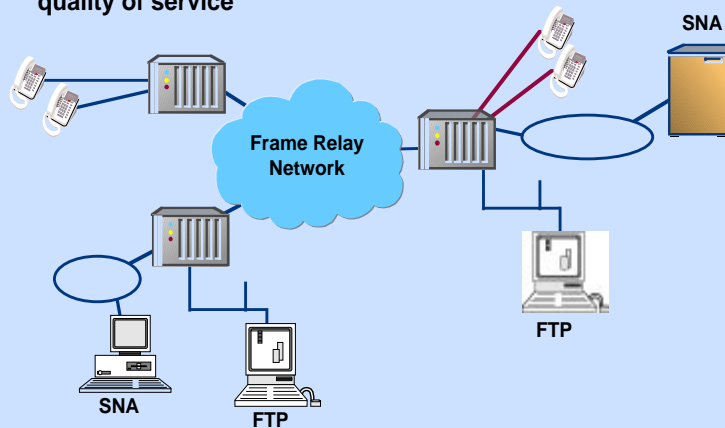
Today a frame relay network should be equipped with traffic management functionality that allows the prioritization of traffic within the network topology to effectively support the diverse set of applications in use.

Traffic management capabilities should extend to the edges of the network to effectively deliver the quality of service required. Once the traffic reaches the destination port, the network's ability to prioritize based on application is important to end users.
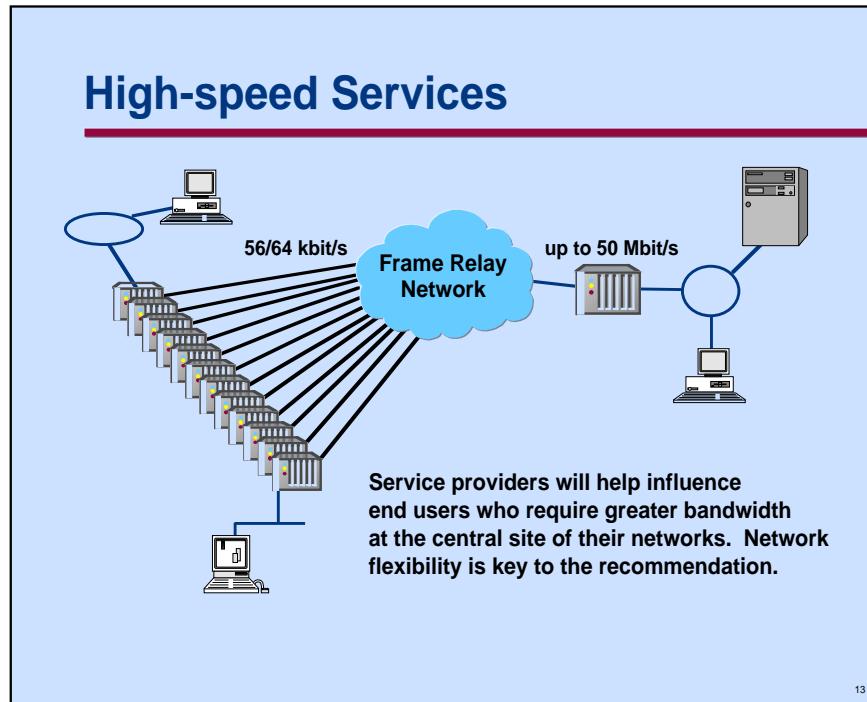
This technique effectively allows the sharing of a network between delay-sensitive traffic (SNA) with high throughput applications (FTP).
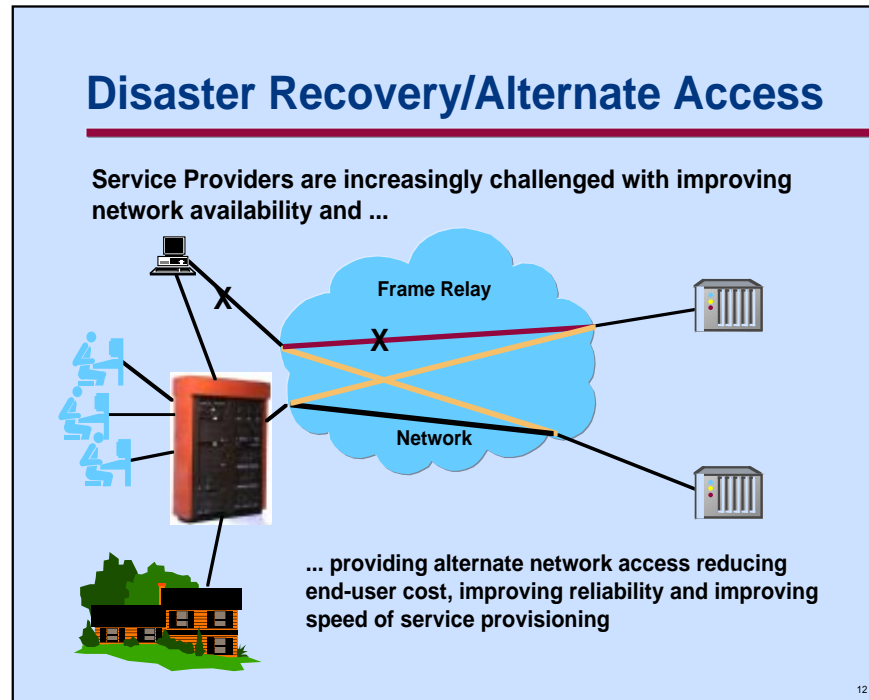
Failures are common to all technologies and the ability to be responsive from both a network and customer service perspective is critical in maintaining the end users confidence. Also, end users search for cost reduction to justify further expansion of their network or allow for alternative work programs.

Disaster recovery is becoming a common term in the industry. A strategy on disaster recovery has become increasingly important as specific segments of the market requiring nearly 100% availability have pressed the service provider into offering back-up functionality to both their physical connection to the network and the logical connections within the network. CPE equipment is typically equipped with dial functionality and is used when the primary leased connection fails (or if no leased connection exists). The service provider should be prepared to offer this functionality as a component of the service definition. Failures within the network which make reaching the primary destination impossible have proven to be critical issues in the market. Some service providers have contracted disaster recovery companies to assist them in delivering this functionality but these approaches are typically too expensive and not responsive. Today's service providers continue to search for solutions to this problem.

Products that deliver automatic and/or dynamic capabilities to offer a seamless disaster recovery solution are most desirable and will attract markets with mission critical requirements.

High-speed Services

56/64 kbit/s   Frame Relay Network   up to 50 Mbit/s

Service providers will help influence end users who require greater bandwidth at the central site of their networks. Network flexibility is key to the recommendation.

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Most customers have deployed frame relay in a star topology, similar to their previous leased line network. In this configuration, one location functions as the central point of traffic for one to many remote locations. The central point of the star typically requires the most bandwidth because more traffic passes through it than any one of the remote locations.

Initially, customers ordered 64 kbit/s access (DS0) for remote locations and DS1/E1 for the headquarters site. When traffic or number of locations increased and signs of congestion became apparent at the headquarters site, the customer was forced to order another DS1/E1 facility from their service providers which doubled access costs and required additional hardware or customer premises equipment (CPE). With the advent of higher speed frame relay, customers can now gain higher speed access from the service provider without having to spend additional capital on equipment or facilities.

High-speed frame relay provides a viable alternative to end users who are not ready to commit to ATM services. With the ability to reach to speeds at or above DS3/E3, the investment in frame relay equipment and services can be maximized.

Differentiating Tactics - Strategic

- **Innovative tariffs**
  - using port speed, # of PVCs, CIR, distance
- **Provide a 'guaranteed' service**
  - proper engineering of backbone
    - over engineer backbone
  - provide reports validating usage
- **Offer component management of CPE equipment**
  - and/or consulting services
- **Virtual private networking/customer network management**
  - private NNIs
- **Customer service and marketing**
  - responsive and educated support staff
  - lead the introduction of new products, services and technology

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There are many ways to attract attention to a service from a non-product-oriented view. Strategic positioning is an area where service providers can illustrate their value added philosophy through creative measures including special packaging or administrative support.

The majority of end users are attracted to service oriented organizations who can make up for the void in technical expertise required to manage a data network. By off-loading management to a provider a customer can focus his efforts on the revenue generating side of the business. For those end users who want to take advantage of the tariffs but still want control of the management of their networking components, the service provider should be prepared to offer a hybrid solution, delivering the best of both worlds.

An investment in a solid support organization will play a huge role in the successful introduction of any technology-based service. The support organization is by far the most interactive point to a customer and is representative of your organizations concern for customer satisfaction.

Service providers should also be up front with their end users in providing information as soon as possible. The continuing dialogue will maintain a link, and develop trust between the service provider and his customers.

Innovative Pricing

Customer premise   Central Office

PVC   Flat CIR / Zero CIR / Usage

Access Line   PORT   SVC

Tariff Example

Speed	Port Mthly	One-time	Access Mthly	One-time
56 kbit/s w/DSO	75.00	375.00	50.00	630.00
128 kbit/s w/DS1	150.00	375.00	175.00	634.00
384 kbit/s w/DS1	400.00	375.00	175.00	634.00
1.536 Mbit/s w/DS1	500.00	375.00	175.00	634.00

Other Features	Monthly Charge	One-time Charge
First DLCI per port	None	None
Next 2-6 DLCI per port	15.00 each	None
Next 7-11 DLCI per port	10.00 each	None
12th an above DLCI per port	5.00 each	None
Change charge per port	None	30.00
Traffic detail per customer	15.00	50.00

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Pricing can act very effectively as a positioning statement. Generally, the market has witnessed two strategies relative to positioning; offensive and proactive defense.

Offensive Positioning

Offensive positioning basically means that you define and price the service to sell, and you "lead" with the frame relay sale when appropriate. Many smaller service providers have catapulted themselves into the public eye and into mainstream network sales opportunities by launching a frame relay service before the dominant provider(s) have become serious about the opportunity.

For offensive positioning to be most effective, you should be able to offer customers substantial benefits in network price/performance over the "next best" alternative.

Most service providers launching a frame relay offering will fall into the offensive positioning category.

Proactive Defense

Proactive defensive positioning means that your company is probably one of the market's largest service providers. You may decide to enter the frame relay market early to prevent other carriers from targeting your installed customer base by using frame relay as the leverage to get in the door. Your early pricing may not be as aggressive as it would be in an offensive position. However, for the target market the pricing is still aggressive enough so that a would-be competitor could not gain a substantial edge over your service because your own pricing is too high and above market value.

In proactive defensive positioning you take an aggressive market stance. Your objective is to protect your customer base and market position by being the leading provider of frame relay so that another service provider cannot do so instead.
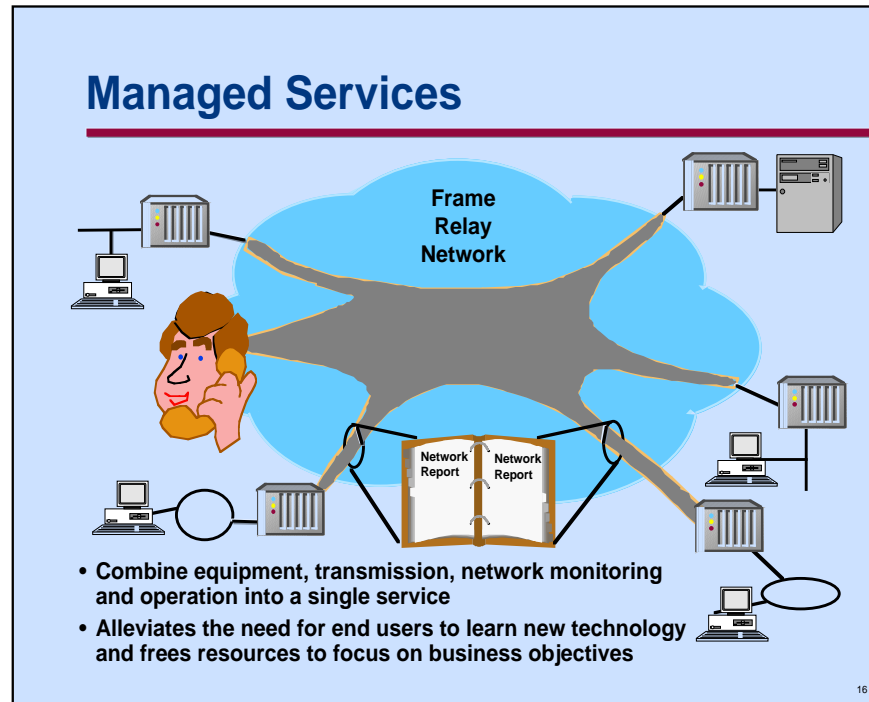
The demographics of the frame relay industry have surprised many consultants and analysts. The market is comprised of many companies with an average of 6-10 ports each. Typically these organizations are looking for a service provider who can provide service as well as management of all networking components (including CPE). This is an important feature for this size company due to their inability to finance a complete MIS organization and to continually stay on top of technology trends.

The next level of customer typically has a network which he wishes to fully or partially offload to the provider but requires a level of visibility to his networking components. This scenario is packaged by service providers as customer network management. For this level of end user, this feature is very important as it provides the end user with the means to maintain his network and take on the responsibility of maintaining its availability.

In both cases each customer will require proof that his service is operating within the parameters defined by the service contract. This information should be made available in either hard copy, in the form of a report, or on demand via a network management connection to the network.

The networks ability to offer managed service functionality enhances the service definition and is a prerequisite to the service providers ability to package this feature as part of his customer support. Responsiveness to requests for various levels of service will increasingly be viewed as differentiators in the market.
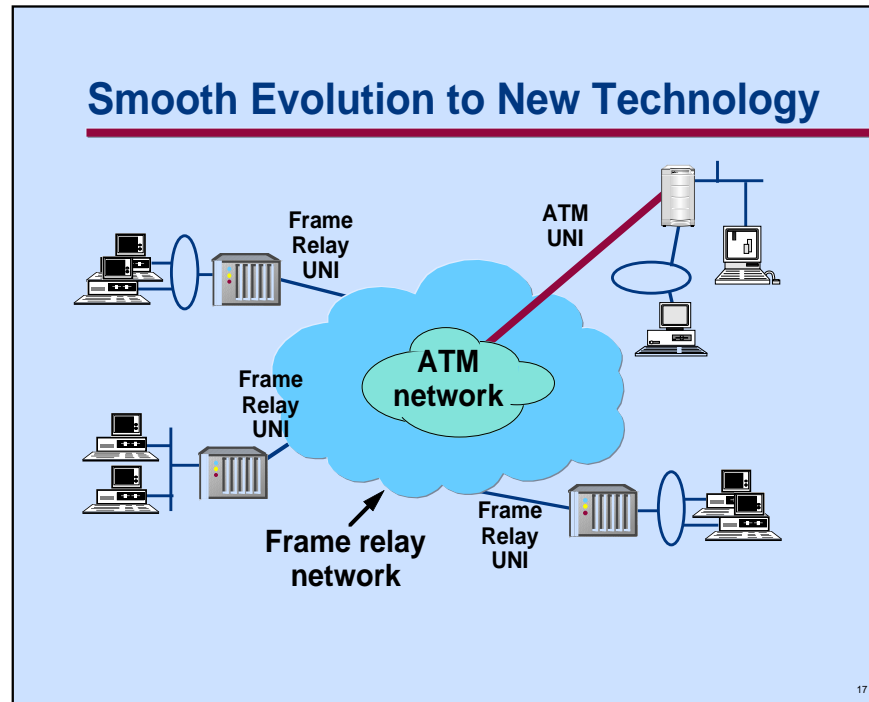
With each media announcement, the end user is faced with new promises about technology which will improve the business environment. The challenge for the service provider is to play a role in the decision making process, convincing the end user of its commitment to protect investment in the end user's current technology. The service provider must be able to discuss its own evolutionary steps in order to convince the prospect that their network is future proof.

The industry (trade press/consultants) have conditioned the prospect to believe frame relay is only a stepping stone to ATM. This is grossly mis-represented as many service providers have agreed that a very small number of users will use ATM in the next few years.

Nevertheless, it will continue to remain on the checklist for all customers.

The service industry determined that ATM will be a player in their network—initially as core switching technology—to consolidate networking infrastructures (transparent to the end user).

Early adopters of ATM will most likely have frame relay remote locations, therefore, a solid strategy to integrate the technologies must be in place and articulated concisely to the prospect.

Conclusions

- **Strong growth through the end of the century with excellent revenue opportunities**

- **Established frame relay service providers will be positioned to offer follow-on services**

- **A platform with many value-added frame relay features is a key differentiator for next generation service offerings**

- **Administrative responsiveness, technical support and flexibility are values of high interest to the end user**

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All consultants and analysts agree that frame relay is a strong technology with a following which will drive the market well into the next century.

Companies who enter this market are not only taking advantage of a revenue generating opportunity but also establishing credibility in the data services market and setting themselves up for follow-on business, as technology evolves.

Consider how Nortel can be a key partner in establishing a solid frame relay services strategy. The options of differentiating oneself in both product and service discussed in this presentation are a means to attract the market to your service. Addressing only one of these areas will make the service vulnerable to competition who will play it to their advantage. Stress the importance of administrative and customer support and rely on Nortel to support these objectives.

End users you attract will provide many years of revenue for both existing and future technologies. A successful strategy will also be based on the organization's ability to address the prospect's expectations and dispel the misleading market hype.