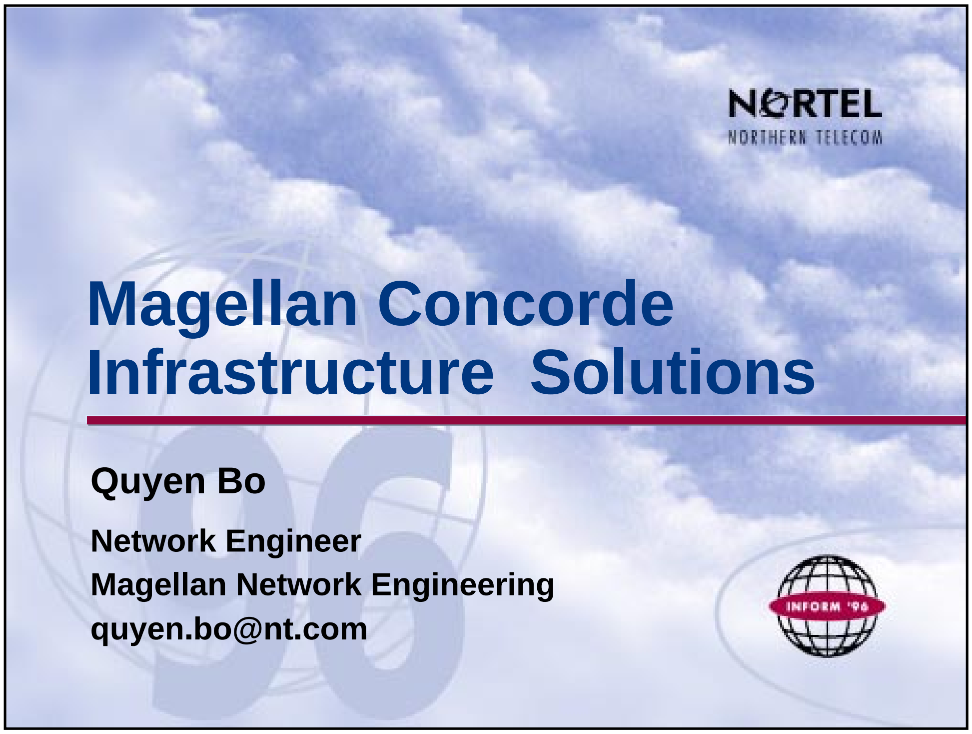

This workshop examines the ATM backbone product requirements triggered by emerging services and applications--focusing on emerging business, and residential broadband applications.

An overview of Concorde, Nortel's ATM backbone switch, is presented to demonstrate how it meets the requirements of today's service providers. This presentation is of interest to both service providers and enterprises since it provides an understanding of the directions service providers are taking with their backbone networks and the resulting impacts on enterprises.

About the presenter:

Quyen Bo is a network engineer, and has been with Nortel's Magellan Multimedia Network Engineering group since 1995.

He started his career in the telecommunications industry with Manitoba Telephone Systems (MTS) in 1990 in the Network Services division. While at MTS he was part of a team that planned and evaluated common channel signaling 7 (CCS7) for Manitoba's telephone network resulting in the deployment of CCS7 network in 1991.

Quyen joined Nortel Technology (formerly Bell Northern Research) in 1993 as a member of scientific staff. He worked on software development projects involving the multi-application platform of Nortel's flag ship DMS central office switch. The multi-application platform supported frame relay, X.25, CCS7 signaling, cellular packet data, and the Meridian packet handler for speech recognition applications.

Quyen holds a B.Sc. (EE) degree from the University of Manitoba, and an M.Eng. degree in Computer Engineering from Carleton University.

Agenda

- The role of ATM in public networks
- ATM network architecture
- Role of Magellan Concorde in backbone infrastructure solutions

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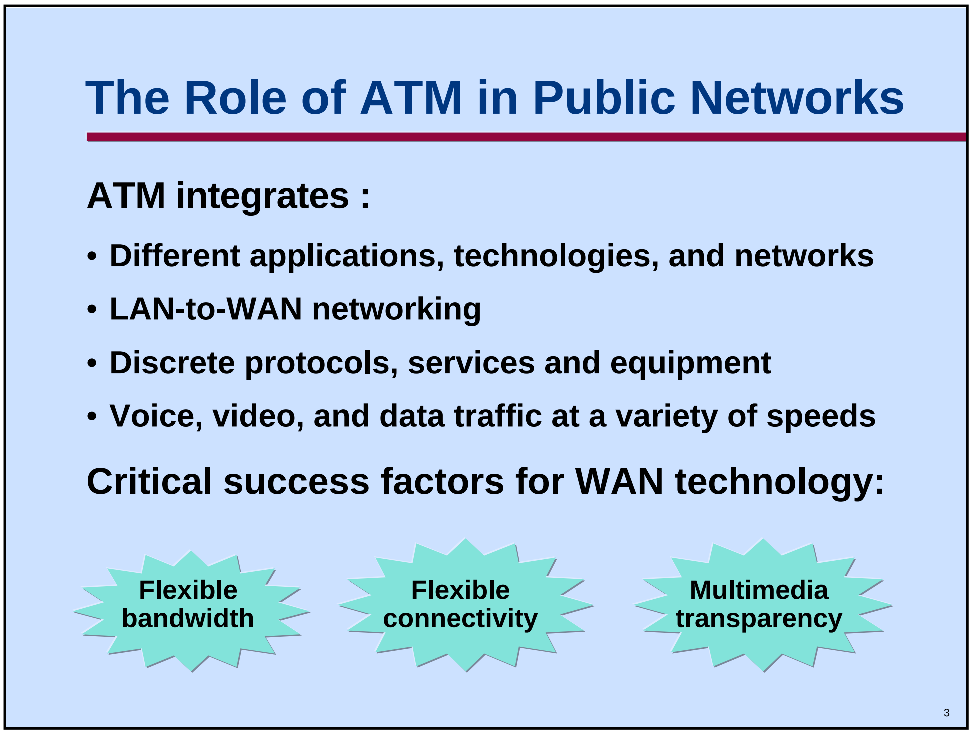


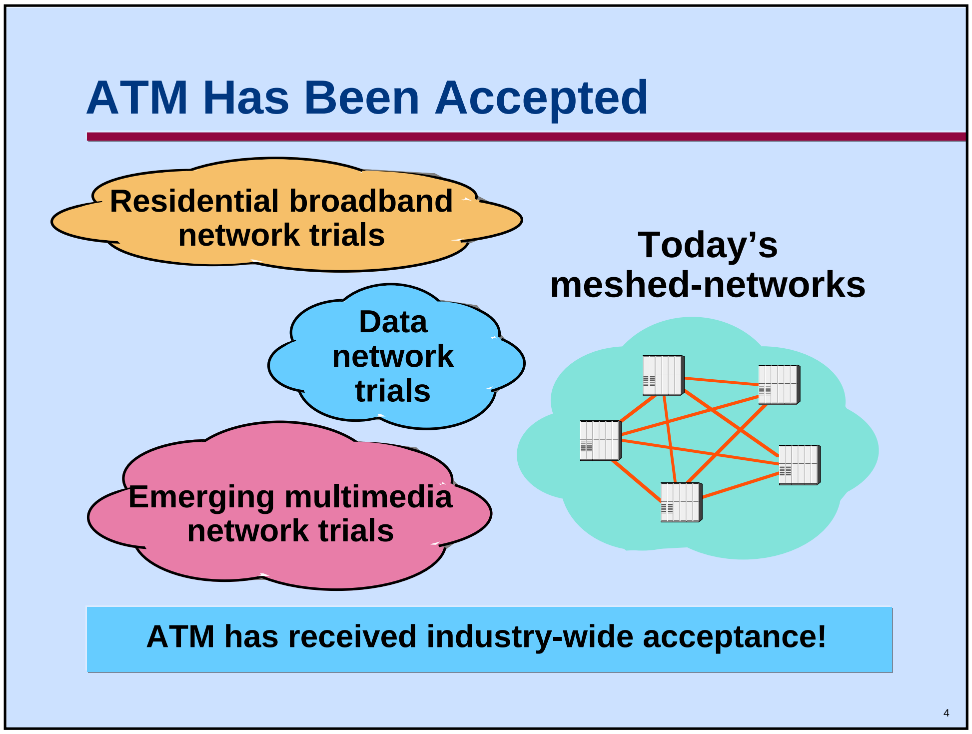
A recent study conducted by Nortel revealed that a typical enterprise maintains six or seven separate overlay networks, each based on a complex mix of equipment and communications protocols. For example, a corporation might have separate networks for voice, video, multimedia traffic, high and low-speed data, and legacy data such as System network architecture (SNA).

Maintaining and managing these separate networks is time-consuming, costly, and complex. Furthermore, spare capacity in one network is not available to another network that is approaching traffic overload.

Let us ask the following questions:

“Is ATM the right technology for WAN networking?” If so, “What are the critical success factors for a technology to support communication network infrastructures?”

The critical success factors for WAN technology include flexible bandwidth, flexible connectivity and the ability to support multimedia traffic transparently.



Acceptance of ATM technology for WAN networking is evident based on a large number of ATM network trials that have been deployed in the last few years.

Application specific ATM network trials have been launched for:

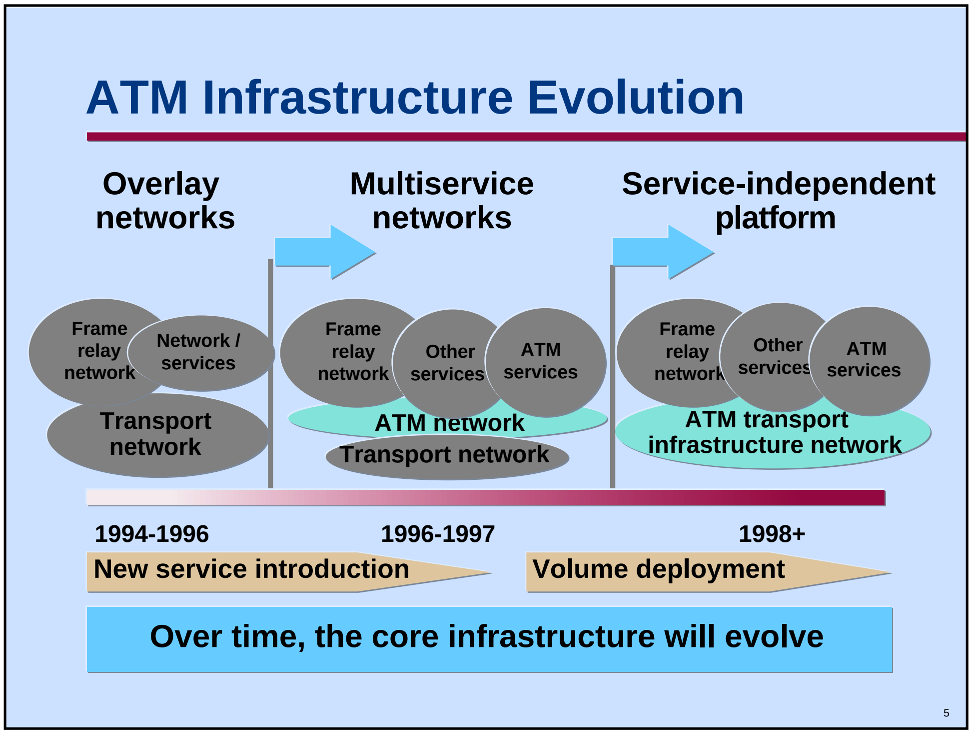
- educational institutions to share resources, and to offer new services, such as distance learning;
- health care industry (for services such as medical image sharing);
- high-tech laboratories linked together around the world; and
- residential broadband network trials for home entertainment (such as video on demand),

In addition, numerous other application-specific ATM trials are happening around the globe.

Today's ATM public networks are generally <u>application specific</u>!

- Multiple overlay networks focused on immediate revenue generation
- Networks are derived from interconnected (meshed) ATM access switches

Service providers will begin to consolidate these multiple overlay networks into a common infrastructure in order to reduce costs - it is a matter of economics! A consolidated network solution provides the opportunities for cost savings and the ability to bring services to market faster.

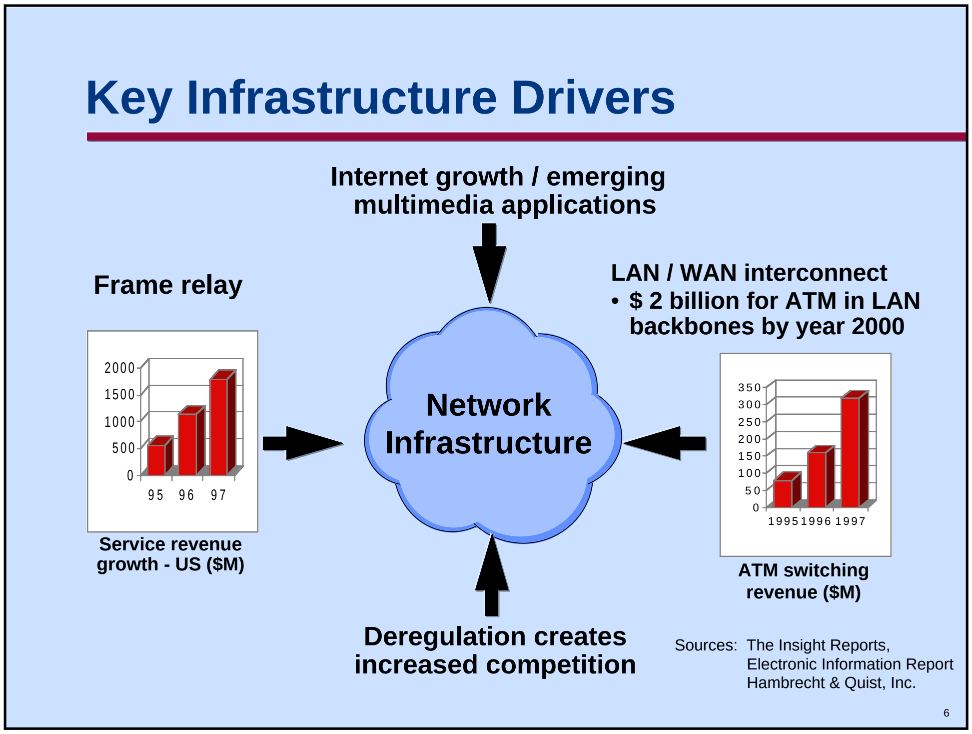


Let us look at the market forecast for ATM deployment in the public network.

In the past few years, all major service providers have deployed application-specific ATM network trials to support business communications needs. In particular, the focus has been to serve the rapid growth in the business data market in the near-term, with the expectation to be able to support emerging multimedia traffic sources in the next few years.

Over time, ATM technology will evolve in the core infrastructure of a service provider's network. Such core infrastructure will evolve to become service independent and be able to support improved time-to-market response for emerging service opportunities.

In addition, as the core network evolves, the underlying transport infrastructure will evolve to integrate ATM and SONET/SDH interworking optimizing network resource utilization, and increasing network performance and overall system reliability.



Key business applications that are driving the growth for public ATM networks include:

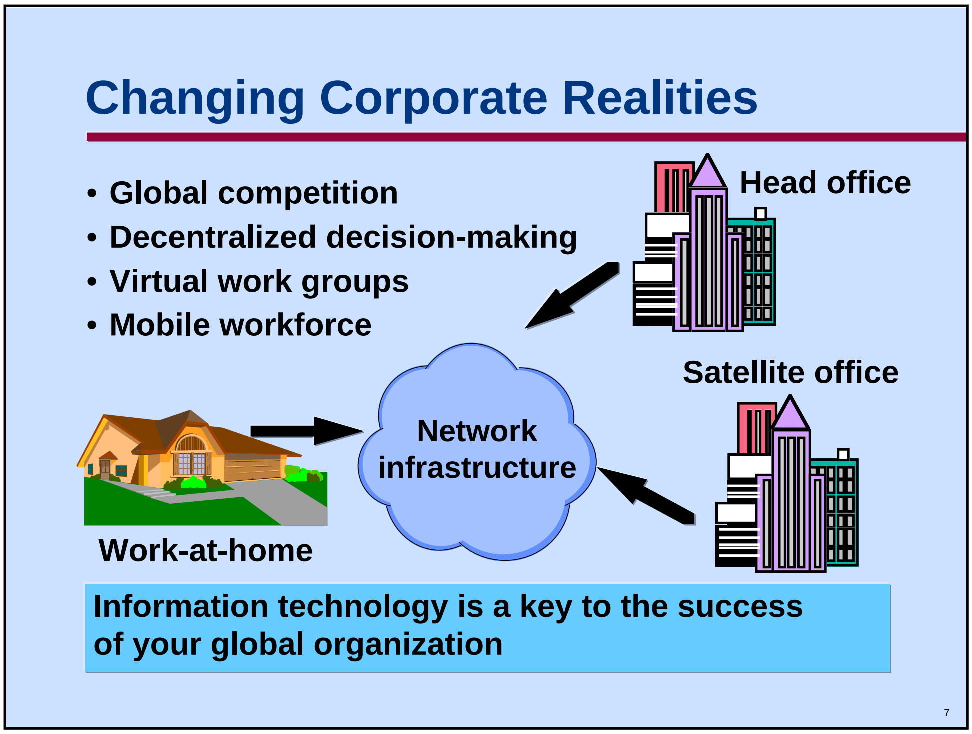
- business/work-at-home (LAN segment, and internet access); and
- growth in multimedia applications.

Although the ATM market is an emerging market, with equipment sales of less than $100M in 1995, there are strong indications that it has enormous potential to grow over the next four years and into the next century.

Today, there are more than 30 million users of the world-wide web, with more than 130,000 web sites around the world. In the business sector, frame relay and emerging interactive multimedia applications are driving the need for higher network performance. Some examples of emerging applications include:

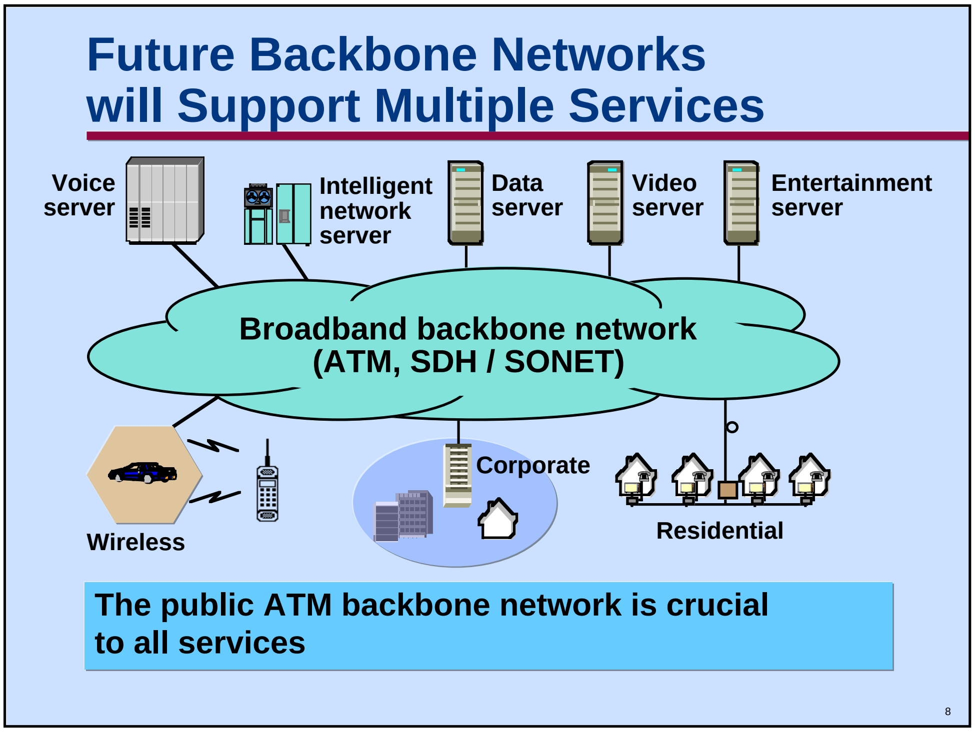
- MPEG video (includes applications such as video conferencing, desktop video, shared whiteboard discussion, TV broadcast, etc);
- imaging (used in engineering design applications, medical, etc.)

In addition, the industry trend toward deregulated markets is attracting new entrants to provide network services. Service providers are making aggressive plans to accelerate the deployment of competitive networks and services, utilizing the latest technologies available - including ATM and SONET. Each of the individual forces just described has an impact on the construction of the core network infrastructure.



Today's enterprises require flexible, reliable, and high-performance telecommunications network solutions to support decentralized decision-making, virtual work groups, and enhanced peer-to-peer communications—not to mention a growing number of mission-critical transactions. At the same time, these solutions must serve the needs of an increasingly mobile workforce—employees away from the their desk, on the road, at home, or at a remote site—while providing the platform to support emerging broadband multimedia applications.

To help enterprises meet the challenges posed by these new business realities, Nortel is working with key customers and strategic industry partners to deliver global, end-to-end solutions that will drive the cost-effective and rapid evolution of data, voice, and video networks into a common backbone infrastructure.



By the year 2000, it is predicted that the amount of traffic on many of today's public and private networks will have increased tenfold - and most of that traffic will be associated with high-speed data, video, and interactive multimedia broadband services, including internet applications, video-on-demand, and desktop video conferences. To support higher speeds, traffic volumes, and the service variety that broadband applications will bring, Nortel is working with customers to evolve their networks to a broadband infrastructure, to be consistent with their installed base of equipment, service demands, and business directions. This evolution to a broadband infrastructure promises to deliver a much wider and richer set of information, communications, and entertainment services.

How can we build an effective network that will support a customer's evolving business needs, while at the same time meeting the immediate business networking requirements?

The critical success factors for future backbone network infrastructures include: flexibility, scalability, reliability, and high performance.

The service provider is interested in running a profitable business, while the business end-user is interested in knowing how well the network infrastructure will support their business communication needs.

Agenda

- The role of ATM in public networks
- **ATM network architecture**
- Role of Magellan Concorde in backbone infrastructure solutions

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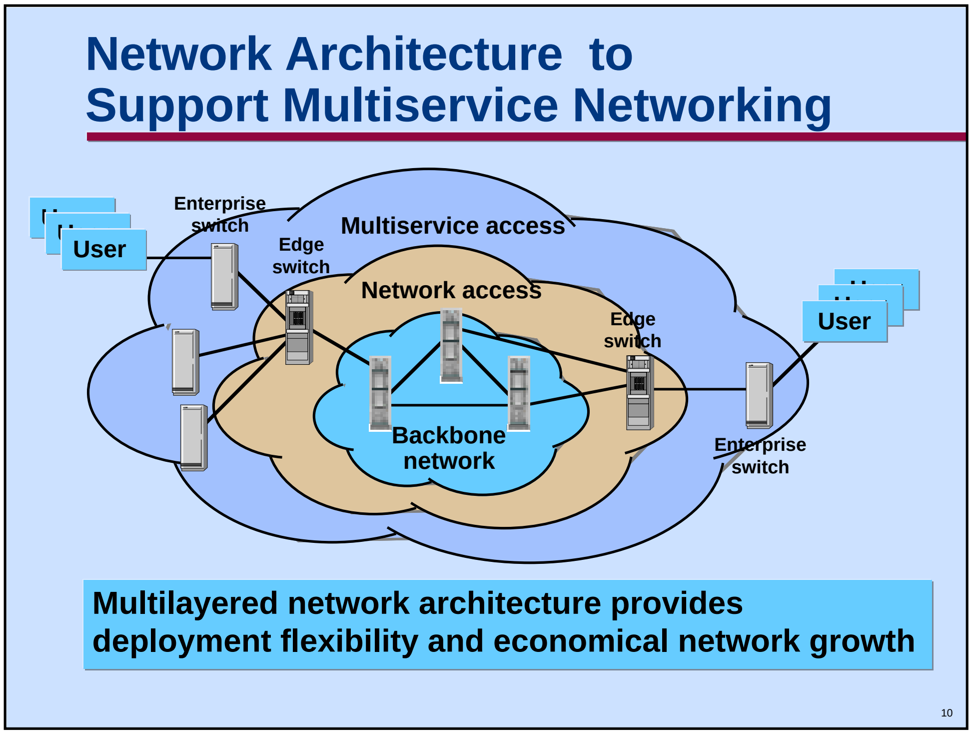
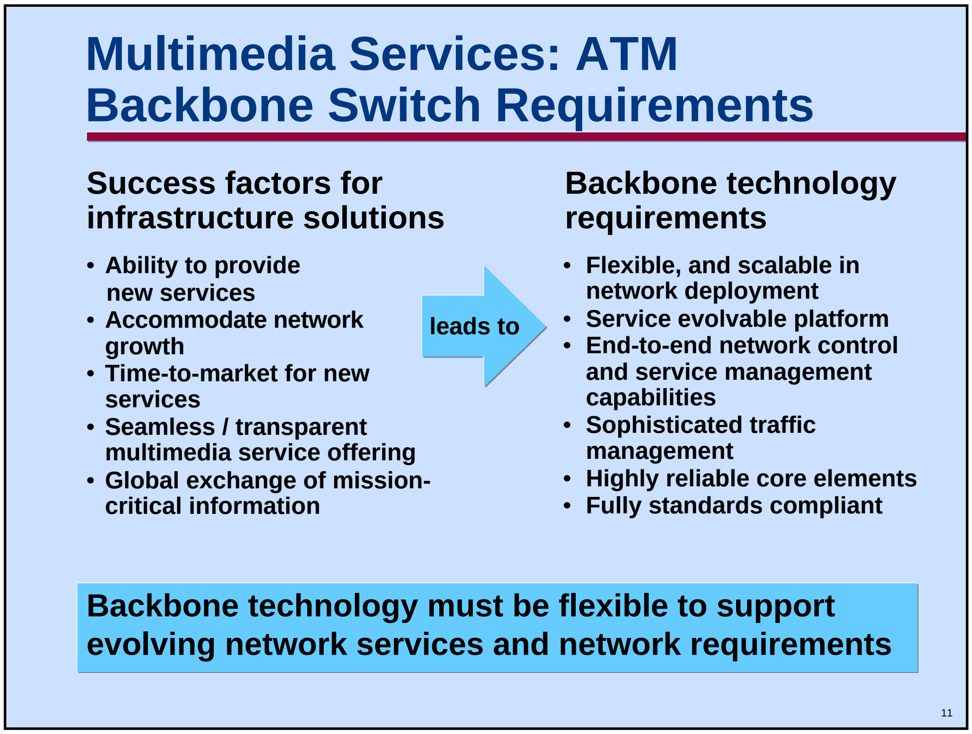


Building on our past experience in delivering end-to-end global telecommunication infrastructures, our knowledge of the emerging multimedia application drivers, and the feedback from discussions with Champions of Innovators (lead-users), we believe that a layered network infrastructure would best meet the future network evolution needs.

The ATM network architecture comprises of several layers: backbone network layer, access network layer, and multi-service access layer.

- **Core Backbone Layer**: a high-performance, high-capacity and service-independent ATM network that provides ATM and SONET/SDH integration for high-speed transport with statistical multiplexing and bandwidth management
- **Network Access Layer**: ATM network access and concentration that will extend the reach and value of the core ATM network cost-effectively
- **Multi-service Access Layer**: provides adaptation for different traffic types, providing the access and the interworking capabilities that extend the public ATM network to include end-to-end customer solutions

This multi-layered network architecture suggests the need for a common, end-to-end routing and signalling mechanism; consistent ATM traffic management and congestion control schemes; and an integrated network and service management capability. As we will see in the following slides, the Magellan Concorde is well suited to meet these requirements.



The product requirements highlighted in the preceding sections are summarized below, as are the benefits to the network service providers and to end-users.

Features:	**User benefits:**
Highly reliable network elements	Maximize network availability
Flexibility in deployment	Economical choices
Sophisticated traffic management	Ensures throughput of critical information
End-to-end networking and management	Increases revenue opportunities by providing end-user services
	Platform for narrowband services
SONET capabilities	Network failure transparent to end-users
Rigorous standards compliance	Service interoperability in a multi-vendor environment providing end-user services

Agenda

- The role of ATM in public networks
- ATM network architecture
- **Role of Magellan Concorde in backbone infrastructure solutions**

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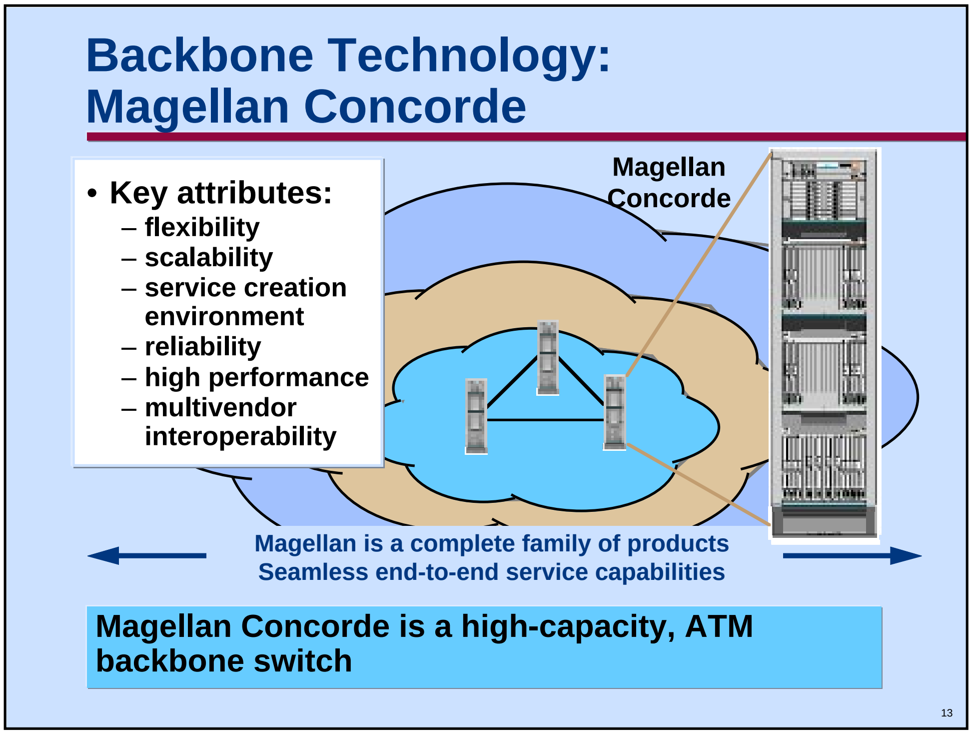
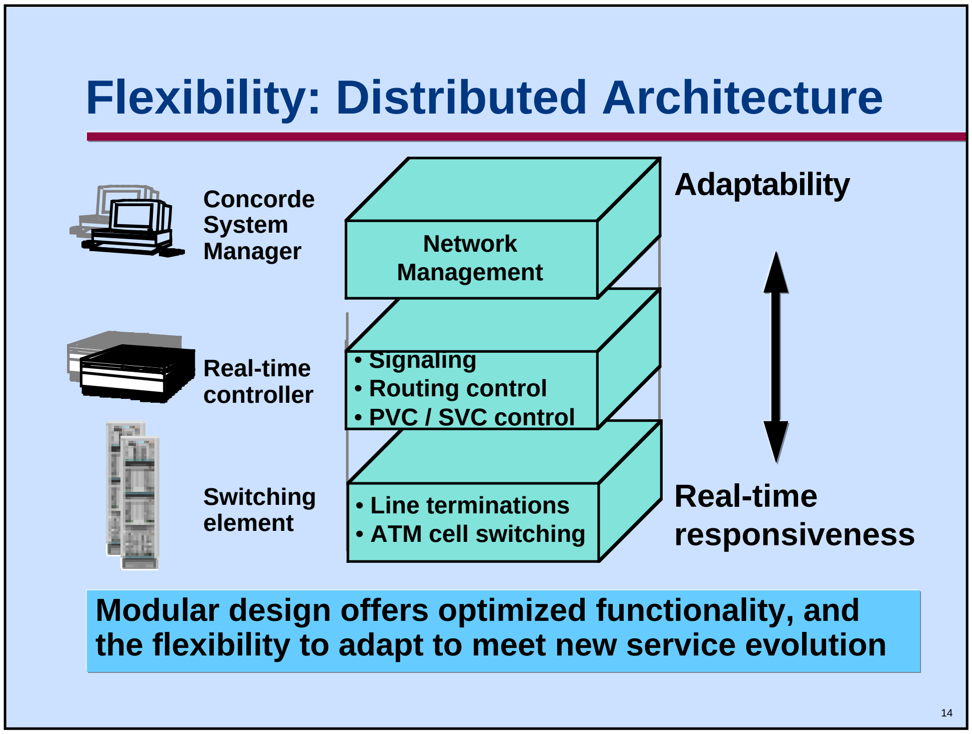


The Magellan product family offers the service provider a complete range of end-to-end networking capabilities. Magellan delivers common routing and signalling functionality, consistent ATM traffic management, and enhanced network and service management capabilities across all its platforms (Magellan Passport, Vector, and Concorde).

Magellan Concorde, Nortel's high-capacity ATM backbone switch, enables service providers to efficiently deploy and manage large ATM backbone networks. The Magellan Concorde base capacity is 10 Gbit/s, and is scalable to 80 Gbit/s. Other key features of the Magellan Concorde switch include: SONET / SDH interfaces, SVC capability, and a compact physical design.

By concentrating traffic from ATM devices at end-user sites, the Magellan Concorde switch reduces costs of facilities and transport equipment, and simplifies network infrastructure for easier management.

The following slides will explore Magellan Concorde's key attributes in more detail.

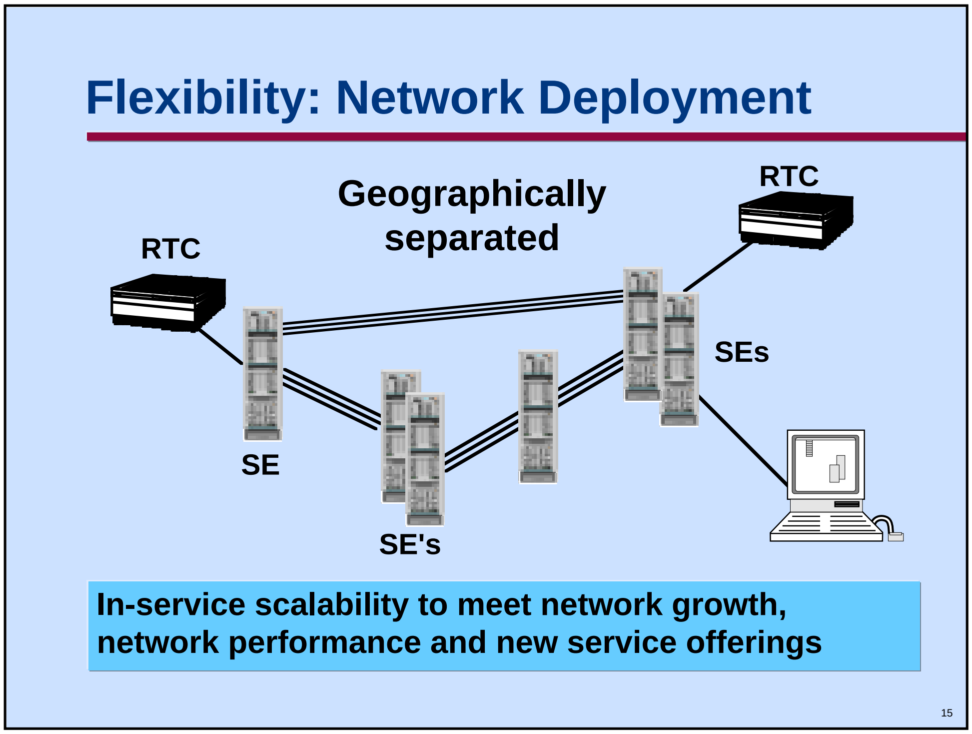


The Magellan Concorde architecture lets service providers take advantage of the latest computing technologies, offering a cost-effective pathway to greater capacity and improved network functionality.

By separating switch functions into discrete layers, Magellan Concorde's distributed architecture offers significant advantages to the service provider.

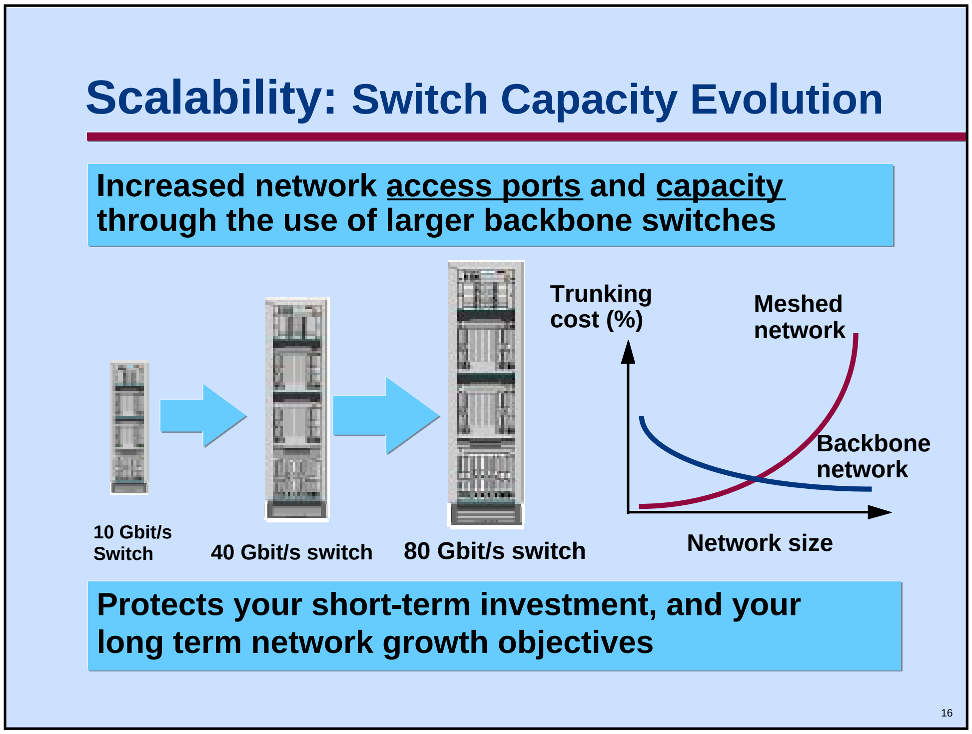
The division of switch functions into three distinct layers (switching element, real-time controller, and Concorde system manager) enables service providers to modify one layer without affecting functions in another layer. This functional independence allows more efficient management of diverse tasks, such as the development of custom applications, the addition of switching elements to meet increased service demands, and performance adjustment for diverse traffic requirements.

The Magellan Concorde switch provides ATM switching of both permanent virtual circuits (PVCs) and switched virtual circuits (SVCs). The switch is optimized for full integration in a SONET/SDH network with the capability to support local access services and inter-carrier networking services.



Concorde's distributed architecture delivers flexible network deployment options, and allows for network growth. A sub-network can be managed by the Concorde system manager (CSM) at a central location. Central offices with switching elements deployed can be unmanned, providing a maintenance-free deployment office.

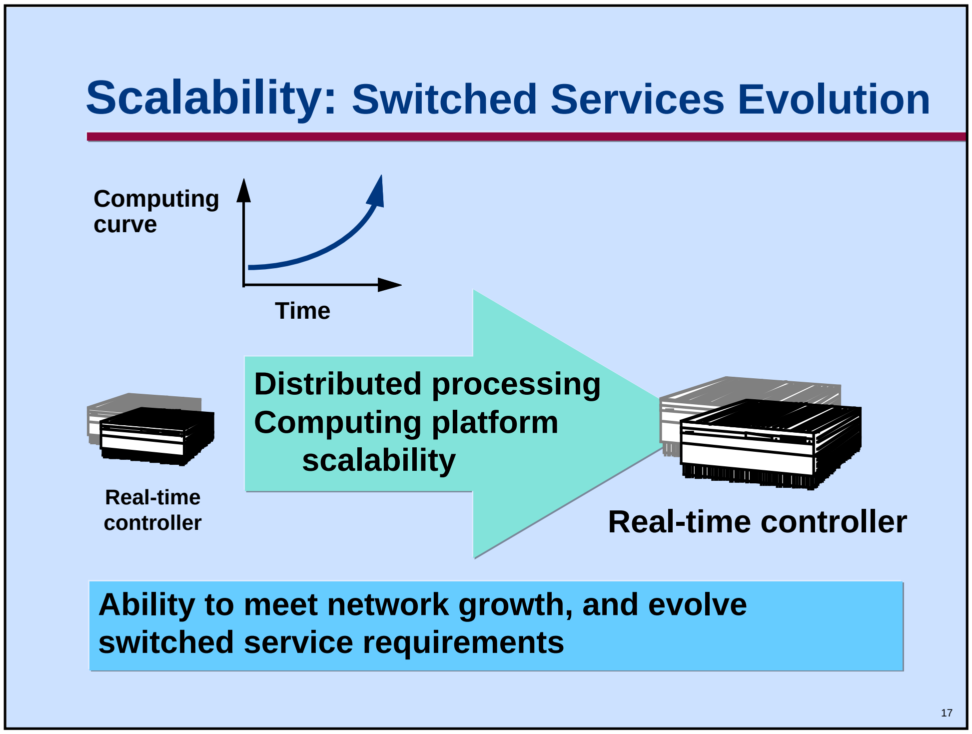
The deployment flexibility supported by both the real-time controller (RTC) and the Concorde system manager (CSM) allows them to be deployed anywhere in a Concorde network where operator resources are available. Remote connection to the RTC and CSM is supported—allowing operators to manage their network from any convenient central office (CO) location.



The Magellan Concorde switch is scalable from 10 Gbit/s to 80 Gbit/s. Network interfaces supported in the initial deployment include OC-3, and OC-12. Higher speed interfaces such as OC-48, and OC-192 are being planned.

As the network grows, more switching capacity is required. Network capacity increases can be accommodated either by deploying additional switches configured in a meshed topology, or by replacing existing network elements with higher capacity switches (40 Gbit/s, or 80 Gbit/s). As shown in the above cost curve, a fully meshed network imposes a large cost element to support access terminations—the N(N-1) problem!

Concorde's scalable architecture allows service providers to protect their short term investment by providing a network evolution path.



The need for distribution of processing resources:

As ATM switched services (SVCs) evolve, so will the need to develop new services that are not constrained by distance. Advances in computing technology, particularly in the client/server environment are enabling the distribution of intelligence across the WAN. The ability to harness the power of multiple processing engines that are geographically dispersed will be a key infrastructure requirement.

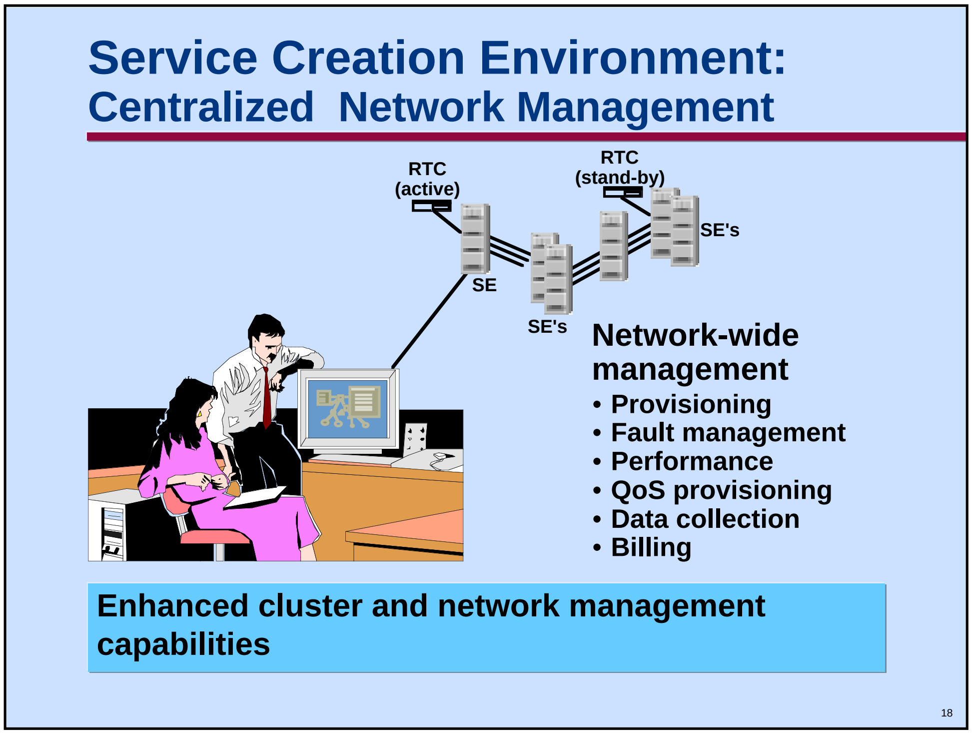
The need for scalability of processing resources:

The processing power of computing platforms has increased tremendously over the last few years, and will continue to increase over time. Since most call/connection processing is performed in real-time, infrastructure networks which provide switched services(SVCs) must be capable of utilizing the latest and greatest processing technology available to remain competitive and efficient.

Concorde delivers:

The Magellan Concorde's real time controller (RTC) was designed with the evolution of processing distribution and scalability in mind. The RTC is the core real-time call/connection engine within the Concorde architecture. Concorde's RTC software operates on a commercially available HP 9000 series UNIX workstation today.

Over time, as faster and more powerful computing technology becomes available, the RTC can be easily migrated over to newer computing platforms. This allows service providers to maintain their investment in Concorde and ensure that the RTC keeps pace with tomorrow's new service demands.



Infrastructure management systems and applications must provide reliable and accurate data management, and support real-time control interactions for service level management.

The Concorde system manager (CSM) provides a centralized database which ensures consistency of service attributes across a Concorde backbone network. The CSM is physically connected to a single switching element (SE), but logically interfaces with each SE via the real time controller (RTC). The CSM is the central repository of all management information within a Concorde network.

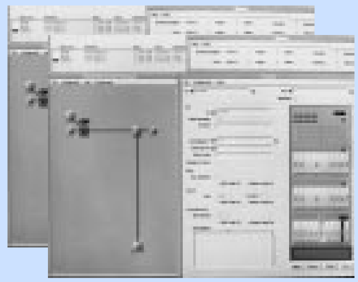
The CSM delivers reliable data storage of configuration, performance and billing data within its centralized object-oriented management information base (MIB). The CSM's user-friendly GUI provides service level visibility across multiple network-level objects, enabling centralized surveillance of the network, and end-point PVC provisioning.

External management access into the Concorde system is provided via the CSM open interface, which is initially based on complex management information protocol (CMIP).

The CSM supports a client/server architecture and can support multiple client stations connected to a server to allow for real-time remote access and management. Furthermore, the CSM architecture is based on principles of Bellcore's (and now TINA-C's) information network architecture (INA) to enable evolution for future services

Service Creation Environment: Rapid Service Creation

- Nodal level auto discovery
- Simplified service engineering with pre-engineered service descriptors



Service Creation Environment

Ability to quickly create new service sets

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Service Creation Environment: Rapid Service Creation

The timely response to market needs a primary objective for most services providers, and one that usually characterizes a successful service offering. The Concorde system manager (CSM) was designed to reduce the service definition, engineering and provisioning processes.

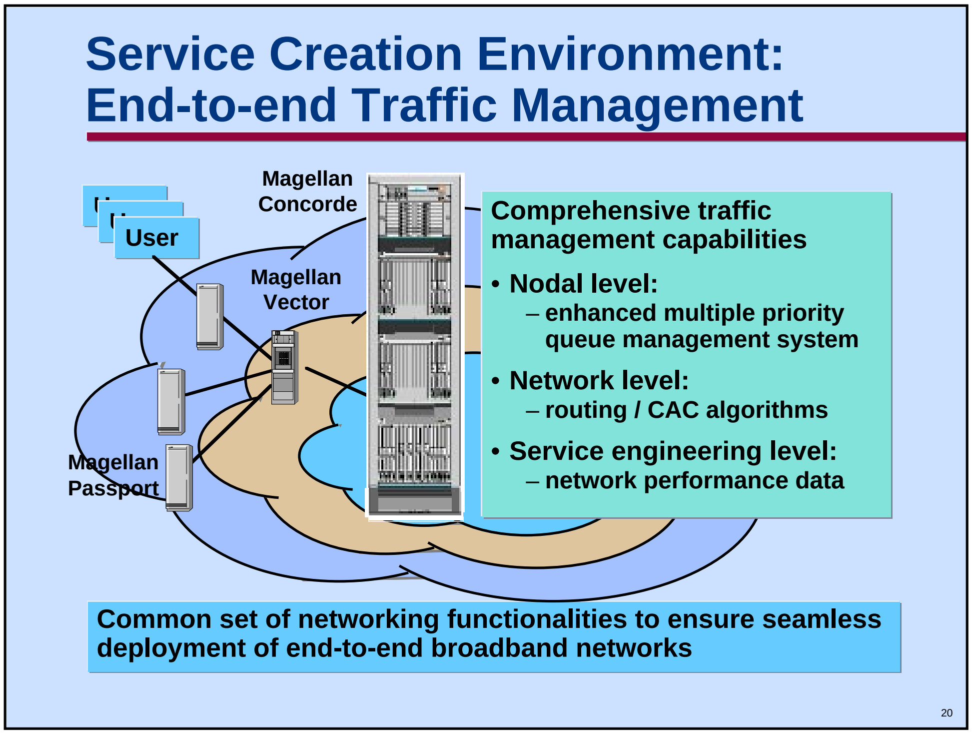
The CSM is equipped with a unique suite of configuration applications that enable rapid service creation. The CSM automatically discovers a Concorde network and populates its database with the appropriate attributes which correspond to individual line cards.

The CSM’s service provisioning applications allow the operator to simply specify the end points of a PVC to be established across a Magellan Concorde network, and the required service characteristics.

The CSM will simplify the task of service engineering through the use of pre-engineered service descriptors, which represent the actual service being subscribed to by the end-user. For example, you can include a T1 frame relay, 10 Mbit/s ethernet or 25 Mbit/s video service, rather than an abstract ATM technology specific definition. Service descriptors can be created in advance to map the required traffic characteristics of a particular class of service to the necessary ATM network resources. Attributes of a service descriptor include the assignment of an ATM quality of services (QOS) which includes required cell loss rate, cell delay variation, etc. Traffic requirements in terms of sustained cell rate (SCR), peak cell rate (PCR) and burst tolerance (BT) can also be preconfigured, along with a traffic priority classification based on the setting of usage parameter control (UPC) discard eligibility criteria.

With pre-engineered service descriptors, the provisioning of PVCs is greatly simplified. Upon customer request, an operator simply has to input a customer’s end point addresses into a single GUI form, select the desired service descriptor(s), and press ‘Return', completely eliminating the need for any detailed technical knowledge of the underlying network equipment.

Furthermore, for switched virtual circuits (SVC) this service creation process is completely automatic.



Nortel's Magellan products - Passport, Vector, and Concorde are evolving towards implementing a common set of networking functions to ensure seamless deployment of end-to-end broadband networks. A key feature supported across Magellan product platforms is a comprehensive traffic management capability called the Magellan Multiple Priority System™ (MPS), operating at the nodal level, the network level, and at the network engineering level.

At the nodal level, Concorde provides a sophisticated set of real-time traffic management capabilities including multiple traffic priority queues for efficient handling of ATM services such as CBR, VBR, and UBR etc. Also, several UPC/NPC (usage parameter control/network parameter control) traffic policing mechanisms can be programmed to ignore, monitor, mark or discard violating cells based on a pre-configured services descriptor.

At the sub-network-level, routing and connection admission control (CAC) algorithms are employed to control multiple network elements as required to meet your end-to-end service needs. Tuning parameters are also provided to allow over and under-booking, when needed, to optimize network resources.

To support on-going network engineering, the CSM provides traffic and performance data collection and reporting tools for post-processing and analysis.

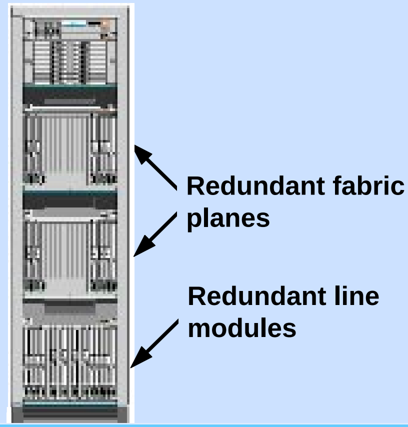
Magellan MPS allows network operators to meet class of service guarantees to end-users, while optimizing network resource utilization, to achieve controlled degradation under extreme traffic conditions. MPS supports multi-vendor networking based on international standards.

Furthermore, MPS traffic management capabilities are also extended to switched virtual circuits (SVCs) to ensure the same consistent service implementation when SVCs are requested by an end-user.

Reliability:
Fully Redundant Architecture

Concorde delivers 1+1 sparing on all real-time components:

- **Switching fabric**
- **Line modules**
- **Intra-switch connections**
- **Connection/call and control processing**



Highly reliable backbone switch - overall 99.98% switch availability

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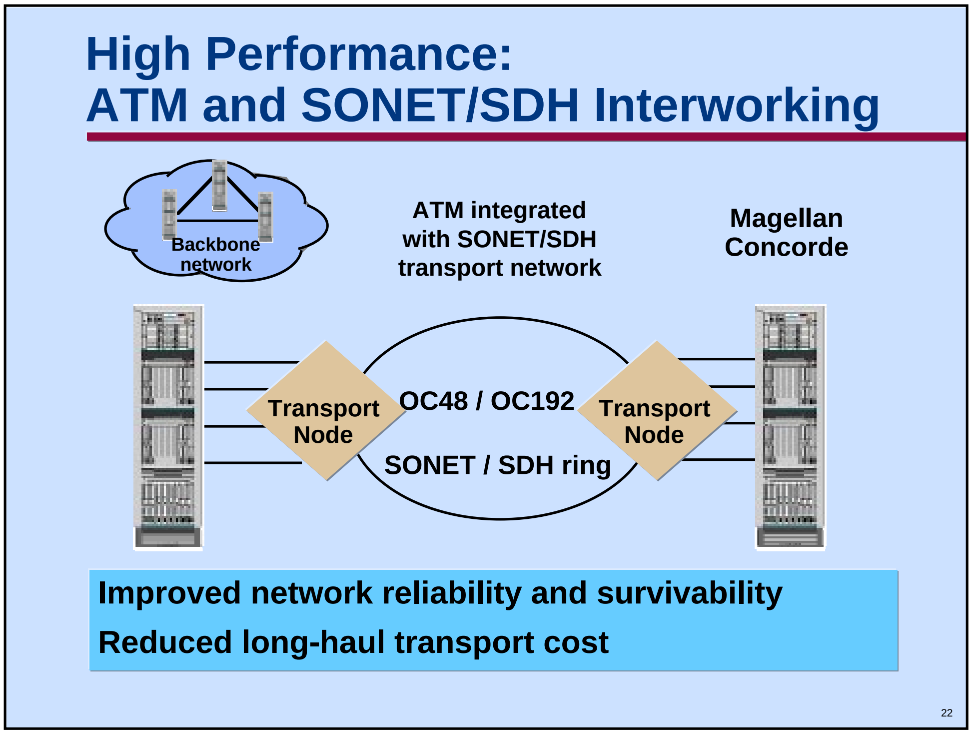
The need for a highly reliable infrastructure

It is mandatory for an ATM backbone network to be highly reliable, given that it supports large amounts of traffic, interworks with multiple access switches, and supports multiple ATM and non-ATM based services simultaneously.

Failure of any real-time components in an ATM backbone switch can have disastrous results if 1+1 sparing is not provided.

Concorde delivers 1+1 sparing on all real-time components:

- Fabric
- Line Modules (DS-3, OC-3, OC-12)
- Intra-switch connections (AX modules, QPC modules)
- Connection/call and control processing subsystems (RTC)



By supporting ATM and SONET/SDH interworking, the Magellan Concorde establishes synergy with transport products for support of the evolving backbone infrastructure. The Magellan Concorde supports:

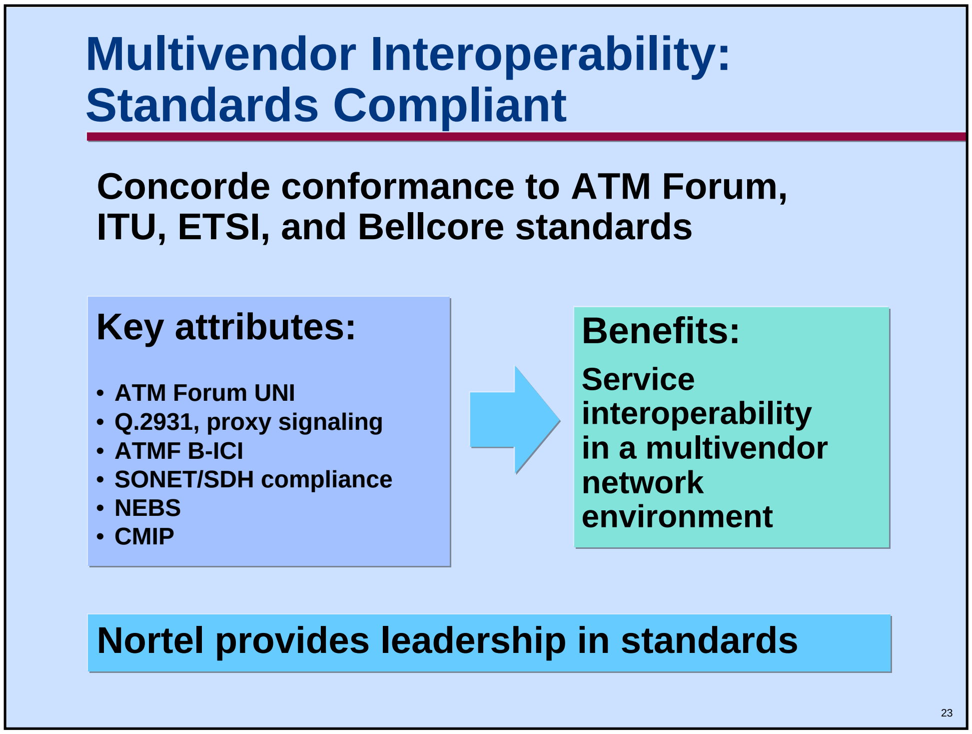
- SONET/SDH compliant optical protection
- SONET/SDH integrated operations & network management

Using ATM as an intelligent user of SONET/SDH transport networks improves transport equipment bandwidth utilization. This is accomplished through the use of ATM as a vehicle for dynamic real-time management of variable bandwidth. Also, integrating ATM with SONET/SDH transport networks improves the ATM backbone network's reliability and survivability.

Benefits of integrating ATM with SONET/SDH networks include:

- End-to-end survivability
- Multi-vendor network interoperability
- Evolution to multi-service transport
- Common performance measurements

Magellan Concorde is compliant with SONET/SDH standards and supports 4xSTS-3c mapping to STS-12 interfaces, enabling a wide range of options for SONET/SDH network design. Connections to SONET/SDH transport systems, like Nortel's S/DMS TransportNode, are handled using intra-office optical facilities that support performance monitoring features. The optical link between the Magellan Concorde switch and S/DMS TransportNode may be configured in a redundant configuration to provide superior system reliability.



The Magellan Concorde complies with ATM Forum, ITU, ETSI, and Bellcore standards.

Nortel has representation in all international and open systems interconnection (OSI) standards bodies. In addition, Nortel has demonstrated leadership positions in all associated industry forums, such as the ATM Forum, ITU, ETSI, ANSI, and Bellcore standard bodies.

ATM Infrastructure Checklist

Infrastructure attributes	Concorde features
• Network deployment options: Flexible, scalable, and evolvable	√
• Sophisticated traffic management	√
• End-to-end network control and service management	√
• Highly reliable network elements	√
• SONET / SDH capabilities	√
• Fully standards compliant	√

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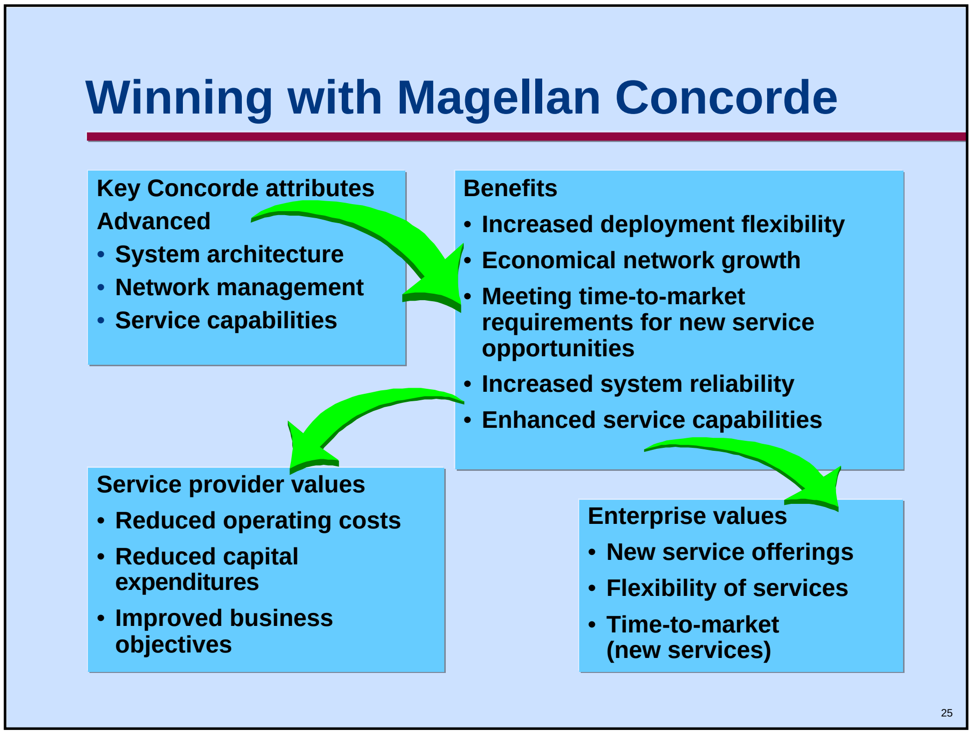

In conclusion, Magellan Concorde provides the ideal solution to service providers for their ATM backbone infrastructure.