Passport Voice
21st Century Telephony

NORTEL
NORTHERN TELECOM

Passport Voice: Transport, Networking and Beyond

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This workshop provides on overview of Passport's industry-leading voice services, winner of Data Communications' 1996 "Hot Product" award, and "Best of Show" at InterOp last year. Many customers are already using Passport voice for economical voice transport. We will discuss how Passport's new voice networking capabilities enhance the economics through operational simplification, and enable the use of higher compression technologies. Future evolution of Passport voice services will also be discussed.

About the presenter:

David Sargent started his career with Nortel Technolgy (formerly Bell-Northern Research) as a system verification engineer with the SL-10 product line in the mid '80s. Since then, he has held various positions in system engineering, global support and product management within Nortel Technology and Nortel.

David has a broad engineering and networking system level background. After extensive experience in the deployment of Passports into the Nortel GES enterprise network, Dave brought these "real network" views into his role as product manager. He was initially in the ATM area and is now product manager for the Voice and Transparent Data Service (VTDS) and Path Oriented Routing System (PORS) programs.

DataComm MAGAZINE
HOT PRODUCTS
JANUARY 1996

WINNER
Data Communication LAN Times
BEST
OF SHOW 1995
The McGraw Hill Companies
INTEROP '95
ATLANTA

Agenda

- **Voice on the passport network**
- Passport advanced network features
- Voice service overview
- Voice networking and futures
- Market experience with Passport voice

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This workshop will cover:

- the rationale for including voice in a network consolidation strategy;
- the advanced networking capabilities of Magellan that make network consolidation possible (from the voice perspective);
- an overview of today's voice service;
- adding more intelligence to the network through the addition of voice networking;
- highlights of market experience; and
- a summary and question period.

Why Nortel for Voice?

DMS-500

DMS-MTX DMS-300

Centrex   Meridian   SuperNode

DMS-250   Norstar   GSM

PCS

DMS-100

**Nortel - more than 100 years of voice experience**

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Nortel has an unmatched pedigree for delivering effective voice solutions to the market.

As a key driver in the digital telecommunications evolution, Nortel has developed a broad range of products servicing the public and private market.

Nortel is the leading manufacturer of with Meridian 1—the world's best selling PBX.

Nortel offers world-class capabilities in voice networking capabilities. Magellan is leveraging this experience to bring an effective integrated voice service to the Passport platform.

The Passport voice service has been very well received in the market place. There are now plans to repackage and distribute Passport technology through Meridian channels as well as through Magellan.
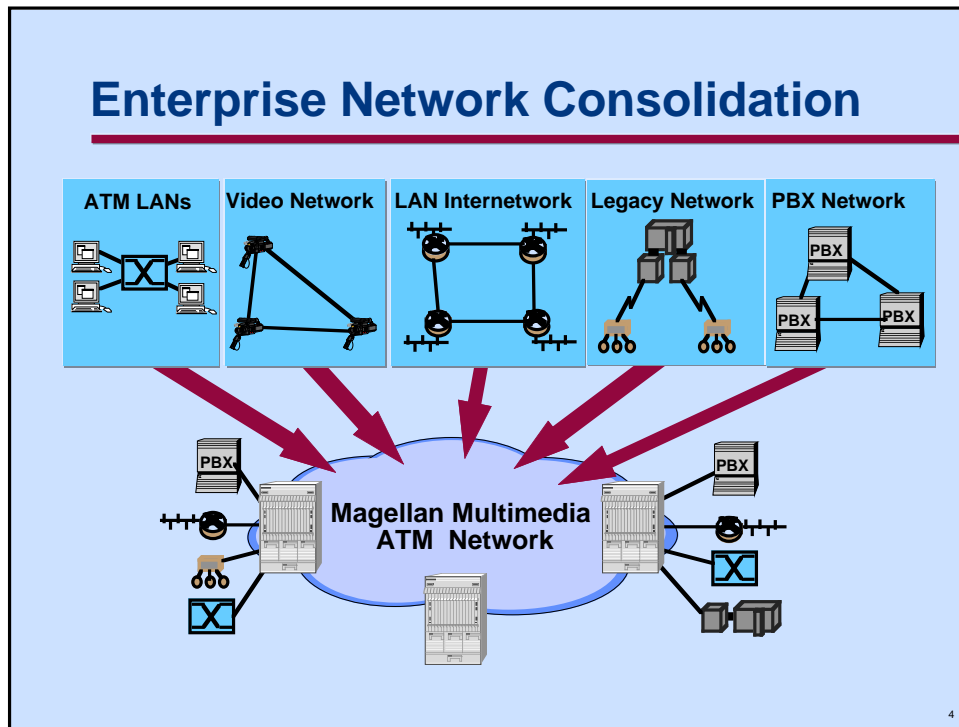
Network operators are faced with the challenge of providing users with more services while their budgets are frozen or shrinking. This requires operators to get more out of current bandwidth, through the use of advanced compression techniques and intelligent bandwidth management. Two major areas of opportunity are: to eliminate wasted bandwidth (reserved bandwidth that is not used all the time), and to reduce operational costs by reducing the number of boxes to maintain and manage.

Passport supports a full range of traffic types including voice, native ATM, LAN, frame relay, and transparent data (Bit and HDLC).

Voice is a significant piece of the network consolidation story. Voice traffic growth is still significant (20%/year in Nortel GES network) and voice is still a major revenue generator in most networks. Many areas of the world are experiencing deregulation of voice service, which creates cost savings opportunities.

Passport allows operators to take advantage of data traffic's generally bursty nature. The "quiet periods" provide an opportunity to add voice traffic and essentially combine voice into the enterprise network for "free".

ATM is the ideal media for providing transport of multiple traffic types due to its inherent design to support multiple classes of traffic.

Passport supports existing traffic and performs efficient adaptation to ATM. This positions operators to take advantage of reduced ATM tariff's, compared to leased lines.
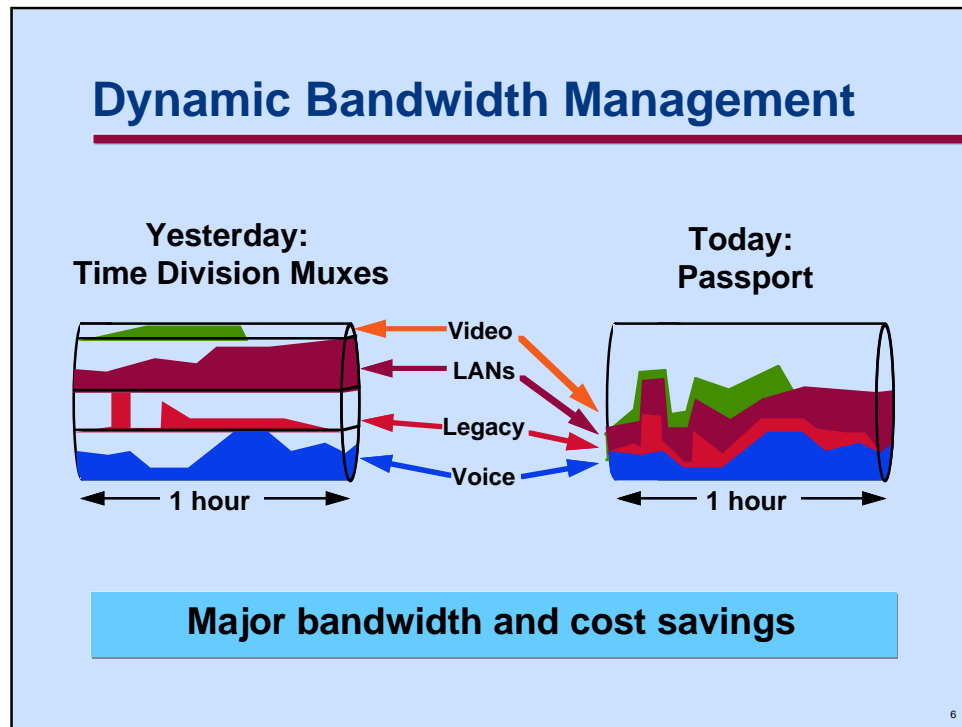
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The key to Passport's abilities to provide economic solutions to the enterprise network is the advanced networking capabilities.

The following pages will focus on Passport's advanced networking features—from the voice perspective.

Dynamic Bandwidth Management

Yesterday: Time Division Muxes — Today: Passport

Video, LANs, Legacy, Voice — 1 hour

**Major bandwidth and cost savings**

Magellan's Multiple Priority System (MPS) enables Passport to manage bandwidth intelligently.

MPS has no physical bandwidth partitioning (boundaries) like TDM. This provides the opportunity for major cost reduction through efficient use of bandwidth.

The MPS system takes advantage of statistically sharing bandwidth. The applications also pre-process the information to aid in the statistical bandwidth sharing:

- constant bit rate (CBR) voice -> variable bit rate (VBR) voice

- video CBR while active (idle suppression)

- bursty data has access to full link speed and any unused bandwidth

MPS uses three emission priorities and four discard priorities to ensure different traffic types get the appropriate class of service treatment.
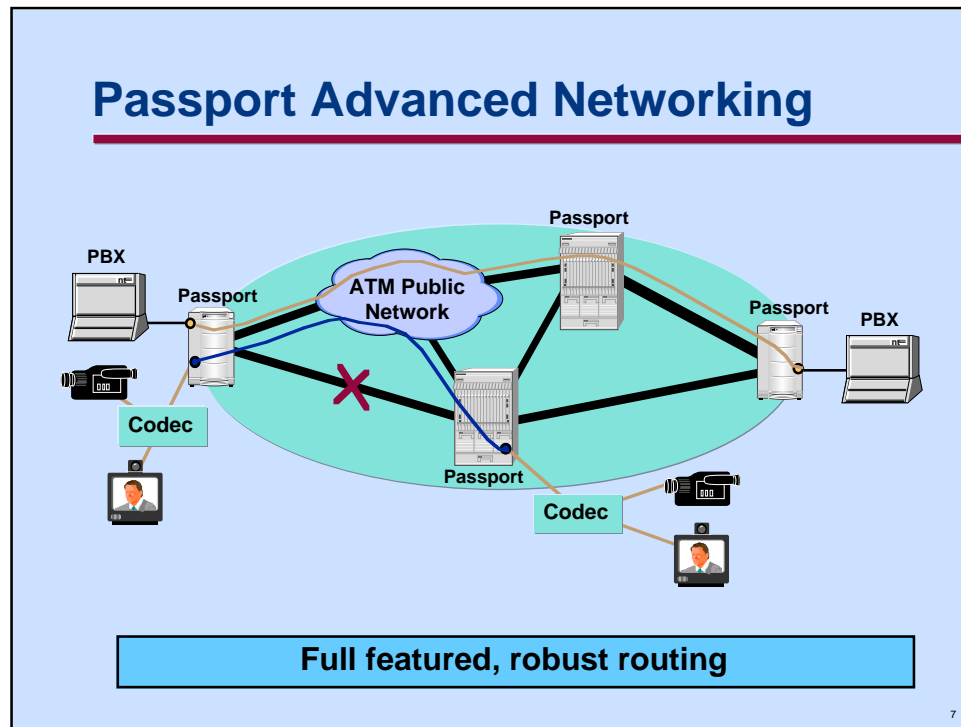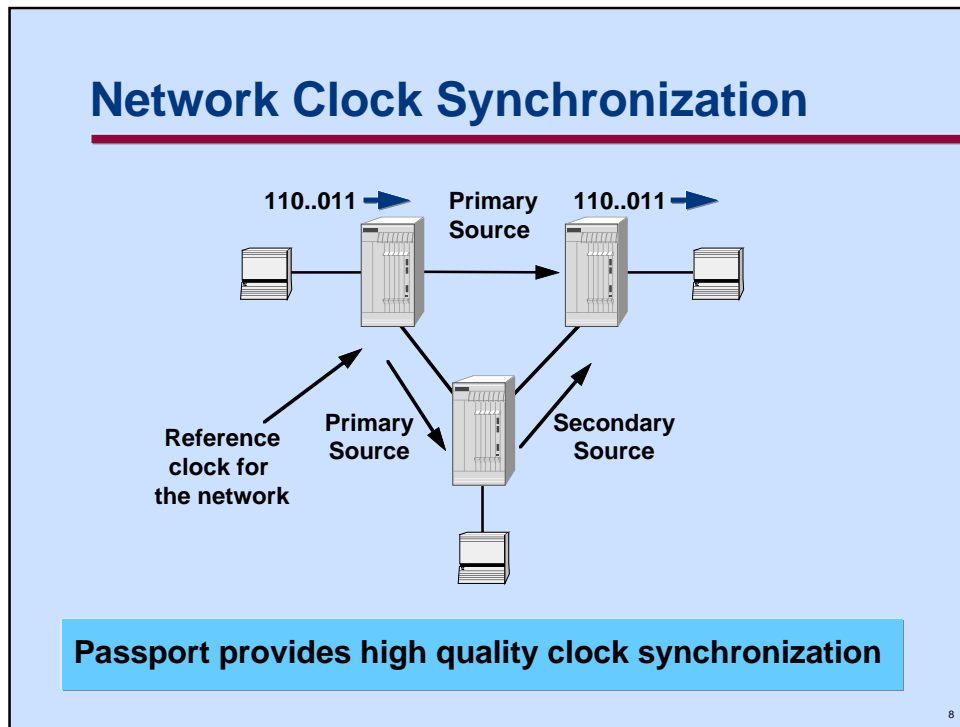
Path oriented routing system (PORS) is a fully feature network routing system.

PORS capabilities include:

- manual or automatic route selection based on predefined criteria

    – criteria includes: minimization criteria (cost/delay), trunk type (terrestrial/satellite), security levels, and maximum delay

- automatically re-route around failures (eg: reroute through public ATM on failure)

- ordered delivery to reduce delay and delay variations

Passport enables the coexistence of multiple routing systems (such as PORS, CNLS and native DPN-100 routing) on top of a single topological view.

Network Clock Synchronization

110..011 ➤   **Primary Source**   110..011 ➤

Reference clock for the network   **Primary Source**   **Secondary Source**

**Passport provides high quality clock synchronization**

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A key feature of any enterprise network switch is the support of a high quality clock sync mechanism. It is essential that the ingress and egress clock to the Passport network are consistent—to facilitate the support of isochronous traffic such as voice and video. Bit slips will cause cell/information loss and would result in a click or pop sound in a voice conversation.

Every Passport control processor has a Stratum 3 clock and is a potential clock source to sync from the network. Passport's Stratum 3 clocks can receive sync from any incoming line and, via a PLL circuit, can synchronize to external clocks of equal or better quality (eg. Stratum 1 from a service provider network). A highly reliable clock distribution mechanism is used to sync the entire Passport network.

A benefit of a cell-based network, that contains egress buffers and uses silence suppression, is that there is an inherent ability to absorb bit slips due to clock inaccuracies.

- Example: If the Passport network is synced to an external Stratum 1 source, and we loose all reference sources, our master clock begins in a holdover mode and starts to drift at Stratum 3 rate. At Stratum 3 accuracy (255 bit slips per day) we would loose approximately 1 cell per day.

| Stratum Clocks		
Level	**Accuracy**	**Typical Application**
1	1.0×10^{-11}	Atomic clock used to synchronize public networks
2	1.6×10^{-8}	Internal clock on some transmission systems
3	4.6×10^{-6}	Internal clock on some transmission systems
4	3.2×10^{-5}	Internal clock on most PBXs and CPE
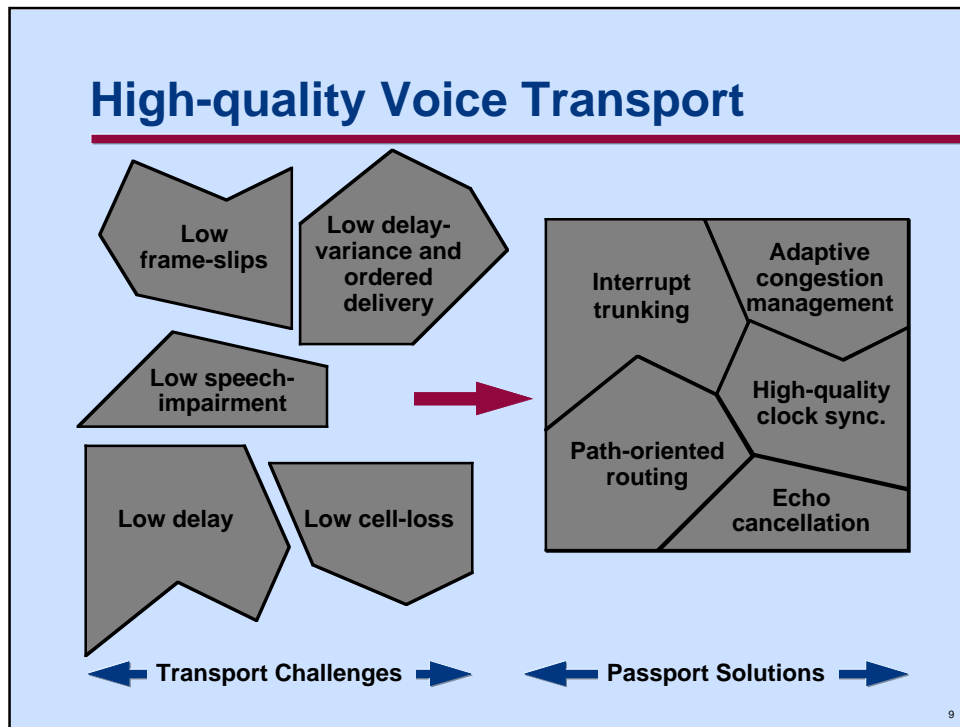
To summarize Passport's advanced networking capabilities from the voice transport perspective, there are several voice transport characteristics that need to be met in order to deliver high quality voice:

1) Low frame slips -> to avoid speech disruption

- Passport employs a very high quality clock sync mechanism

2) Low delay variance and ordered delivery ->impacts effective communication

- Passport's path oriented routing system (PORS) is a connection-oriented routing system that ensures ordered delivery, as cells follow the same path

3) Low speech impairment -> impacts speech quality

- Passport uses integrated echo cancellation and industry-standard compression algorithms

4) Low delay -> impacts ability to communicate effectively

- Passport uses priority queuing mechanisms to ensure high priority cells are serviced first and frame/cell trunks have an interrupting mechanism to inject voice cells into large frames in mid-transmission

5) Low cell loss -> avoid disruptive clicks and pops on call

- Congestion reactance through dynamic down-speeding

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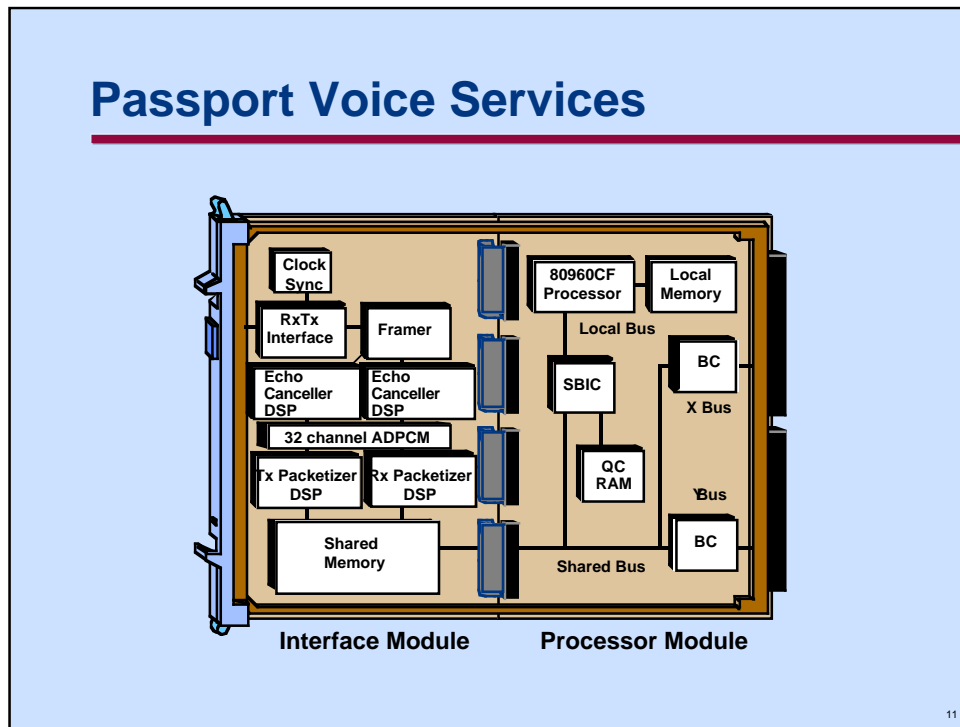
The Passport voice card:

- comes in three 1-port variations that support the international standards for DS1, E1 or TTC-2M.

- on-card (integrated) echo cancellation, dynamic ADPCM compression from 32-16 kbit/s, silence suppression, fax/modem detection, A-Law/μ-Law conversion and signalling support
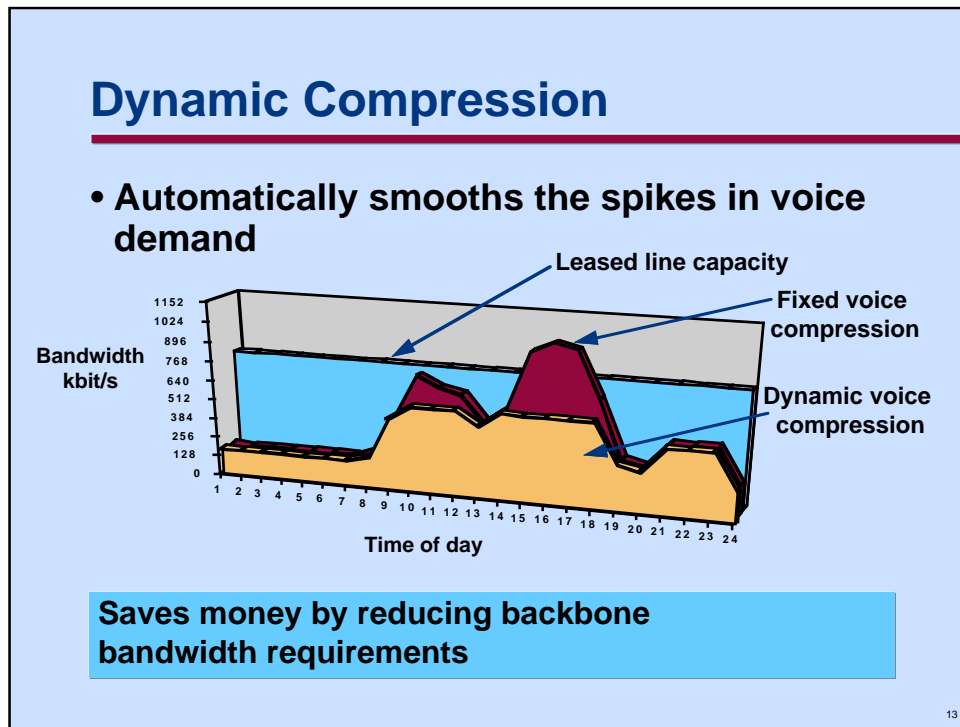
The signalling support includes:

- interpreted CAS signalling (idle/seize codes)—no bandwidth is used in wide area when idle

- currently transparent CCS signalling, with the exception of the call discriminator feature which can support variable class-of-service parameters for voice or digital data calls, supports MCDN and DPNSS protocols

Passport Voice Savings
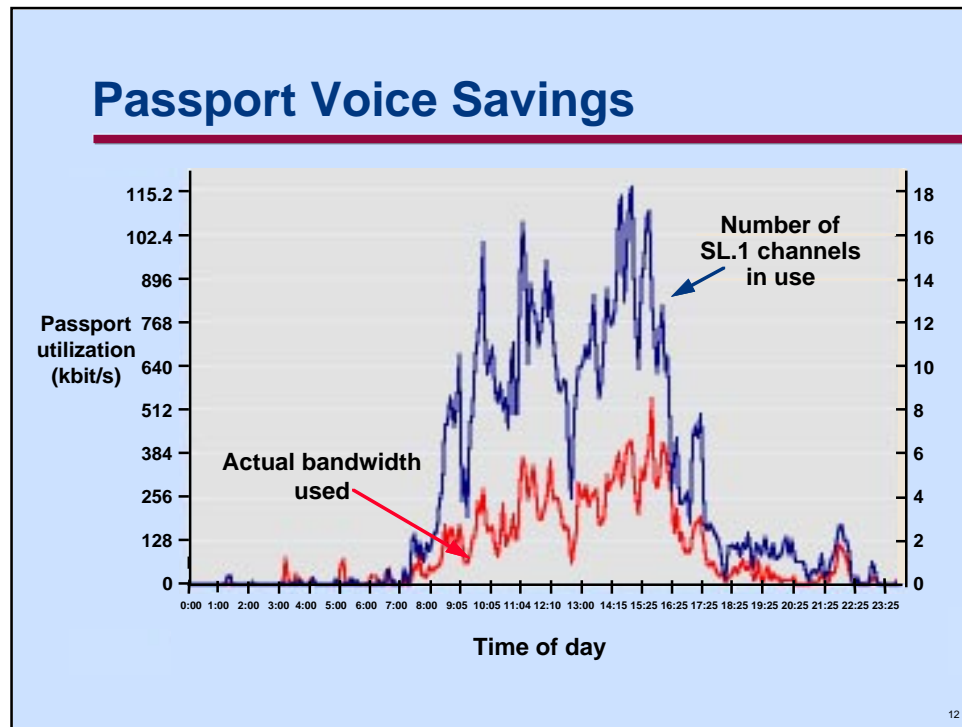
The economics of Passport voice have been demonstrated in many networks to date. This is a graph from a live customer network. It represents a statistical savings ranging from 2.5:1 to 4:1 during the busy hours and up to 100% in non-busy hours.
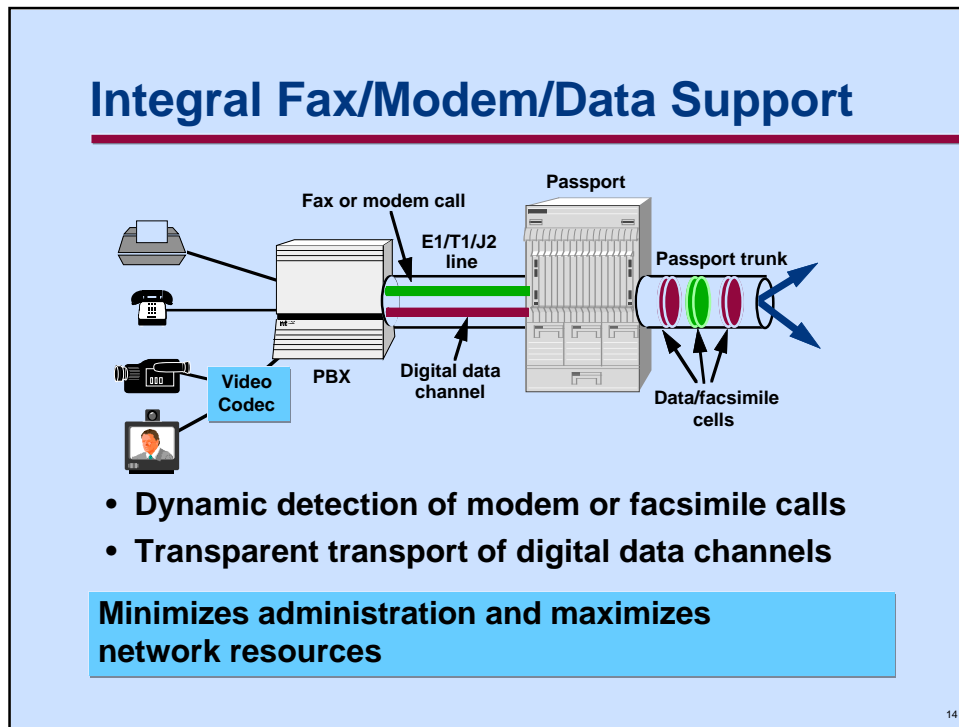
This illustrates the opportunity to combine voice traffic statistically with data traffic for efficient transport over the wide area.

The reference setup was a DS1 with 2:1 ADPCM, silence suppression and a low level of fax/modem traffic.

Dynamic Compression

- **Automatically smooths the spikes in voice demand**

Leased line capacity

Fixed voice compression

Dynamic voice compression

Bandwidth kbit/s

1152
1024
896
768
640
512
384
256
128
0

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Time of day

Saves money by reducing backbone bandwidth requirements

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The dynamic compression feature allows for more aggressive engineering (and more cost savings) compared to fixed compression schemes.
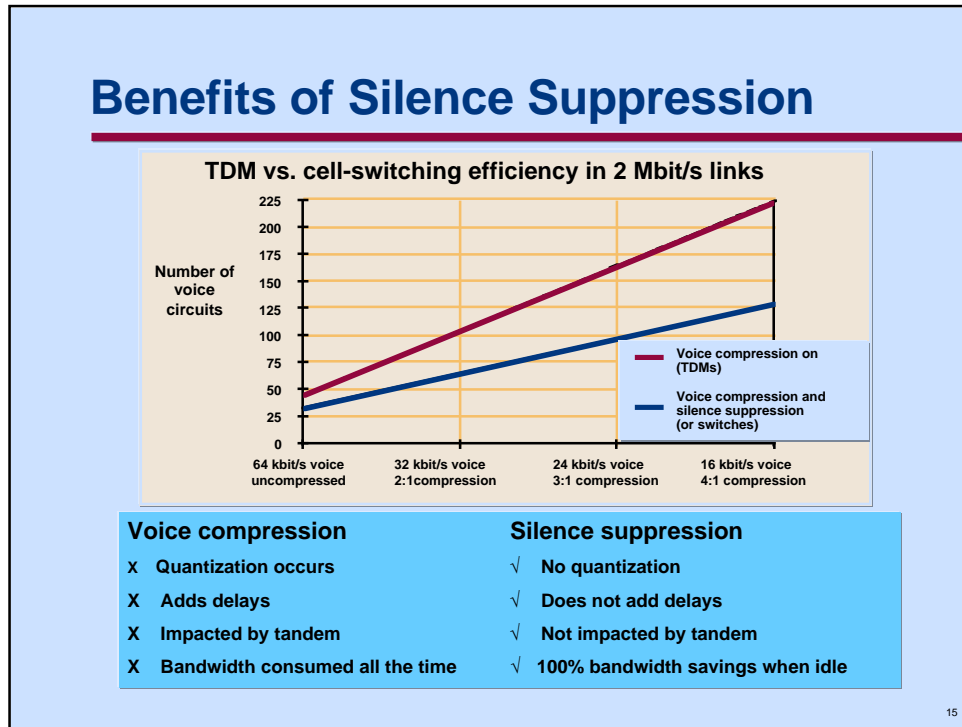
Operators configure the maximum and minimum compression levels desired. Calls start off at the maximum compression level defined (i.e. 32K ADPCM), and if the voice traffic encounters congestion, the compression can be increased to the minimum compression level (i.e. 16K ADPCM). The silence suppression technique can also be off in non-congested situations and enabled if congestion is encountered.

Integral Fax/Modem/Data Support

- Fax or modem call
- Passport
- E1/T1/J2 line
- Passport trunk
- PBX
- Video Codec
- Digital data channel
- Data/facsimile cells

- **Dynamic detection of modem or facsimile calls**
- **Transparent transport of digital data channels**

Minimizes administration and maximizes network resources

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The Passport voice service supports integrated handling of fax, modem and digital data calls. There is no need to segregate traffic types, hence administration is reduced and the need for reserving channels for data support is eliminated.

For fax and modem, Passport will detect the 2100HZ tone and adjust the features such as compression and disable silence suppression and echo cancellation.

For digital data calls, Passport has the ability to monitor the CCS channel (DPNSS and MCDN protocol) and, upon detection of a digital data call, will provide the call with a clear channel.

Benefits of Silence Suppression

TDM vs. cell-switching efficiency in 2 Mbit/s links

Number of voice circuits

- Voice compression on (TDMs)
- Voice compression and silence suppression (or switches)

| 64 kbit/s voice uncompressed | 32 kbit/s voice 2:1 compression | 24 kbit/s voice 3:1 compression | 16 kbit/s voice 4:1 compression |

Voice compression	Silence suppression
X Quantization occurs	√ No quantization
X Adds delays	√ Does not add delays
X Impacted by tandem	√ Not impacted by tandem
X Bandwidth consumed all the time	√ 100% bandwidth savings when idle

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Passport uses an advanced silence suppression scheme to eliminate the wide area transport of silence in typical voice calls.

This statistical savings technique can save up to 50% of bandwidth in typical voice conversations as the typical speaker talks for less than 50% of the time and listens the rest of the time.
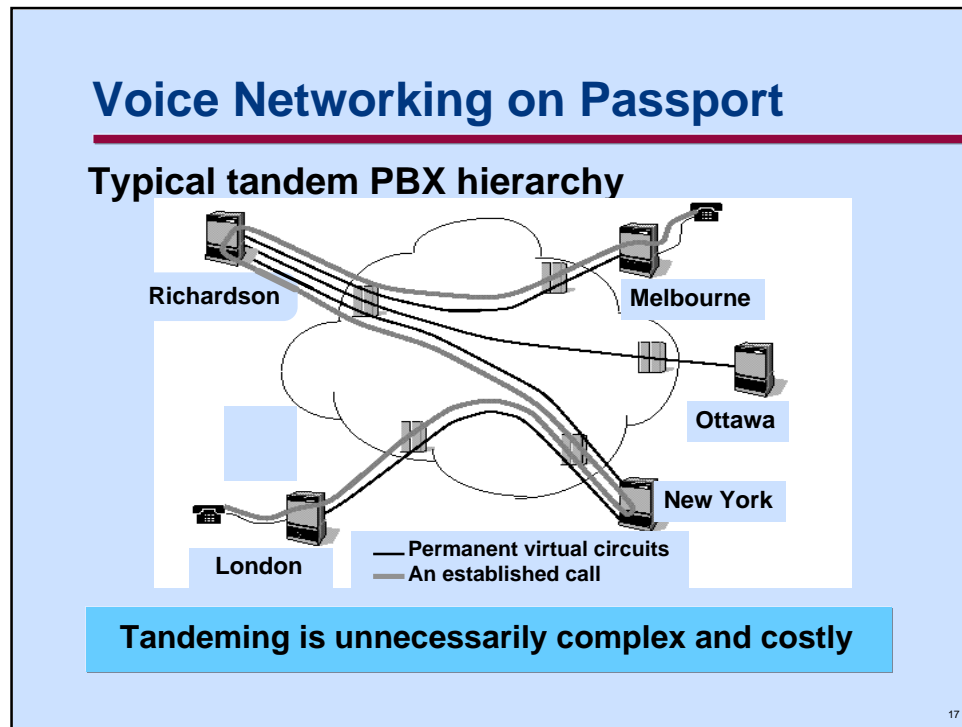
Key characteristics of Passport's silence suppression are:

- No impact on the voice quality

    There is no appreciable added quantization distortion or delay.

- Dynamic noise matching

    Passport dynamically tracks the noise level of the speaker and inserts comfort noise at the egress that matches the speakers environment.

- Dynamic threshold

    The threshold between background noise and speech varies depending on the level of background noise. This makes Passport's implementation effective in high noise environments.

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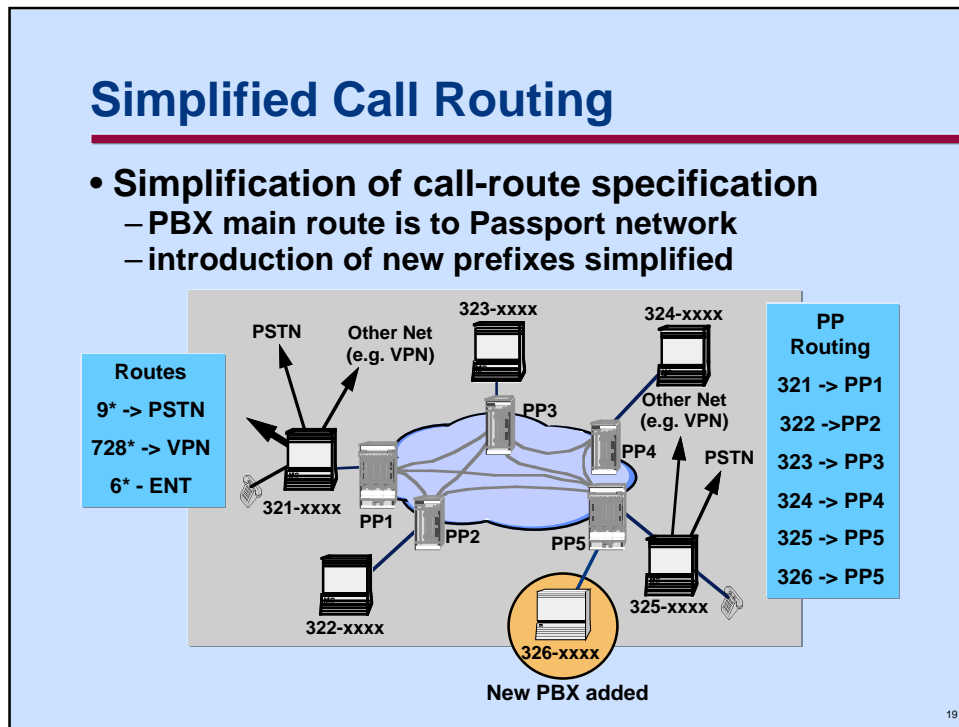
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Voice Networking on Passport

Typical tandem PBX hierarchy

Richardson

Melbourne

Ottawa

New York

London

—— Permanent virtual circuits
—— An established call

Tandeming is unnecessarily complex and costly

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Passport is looking to solve some of the traditional problems in typical tandem PBX hierarchies today.

Without voice networking (or routing by the cloud), a typical call has to transit tandem switches in order to find its way from point A to point B. This necessitates that the Passport network provides the information in PCM format to the transit switch.
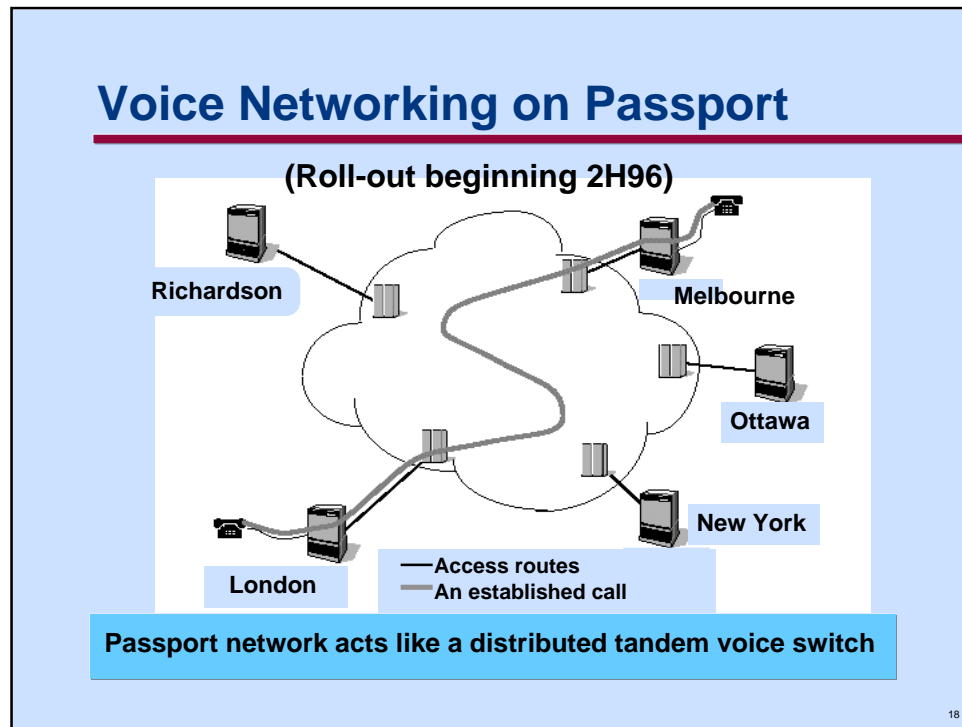
If the Passport network can appear as a single, distributed tandem switch to external PBXs, it would be possible to interpret the dialed digits and route directly to the destination.

This voice networking capability is redefining the playing field by adding intelligence to the wide area bandwidth manager.
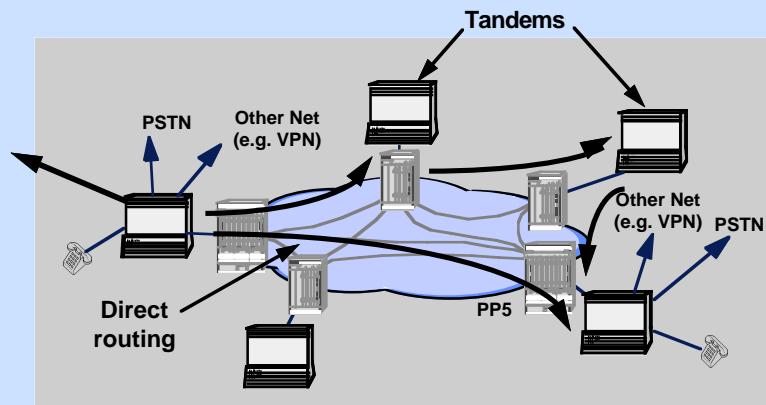
Simplified Call Routing

- **Simplification of call-route specification**
  - **PBX main route is to Passport network**
  - **introduction of new prefixes simplified**

Routes

9* -> PSTN

728* -> VPN

6* - ENT

PP Routing

321 -> PP1

322 ->PP2

323 -> PP3

324 -> PP4

325 -> PP5

326 -> PP5

323-xxxx

324-xxxx

PSTN **Other Net (e.g. VPN)**

Other Net (e.g. VPN)

PP3

PP4 **PSTN**

321-xxxx

PP1

PP2 **PP5**

322-xxxx

326-xxxx

325-xxxx

New PBX added

This example illustrates how Passport's voice networking can simplify administration of the PBX routing tables.

Passport routes all the enterprise network traffic, and provides central administration of the network routing table. Adding a new prefix, for example, would mean that a quick update to the Passport routing table is sufficient. There is no need to update the routing tables on the PBXs.
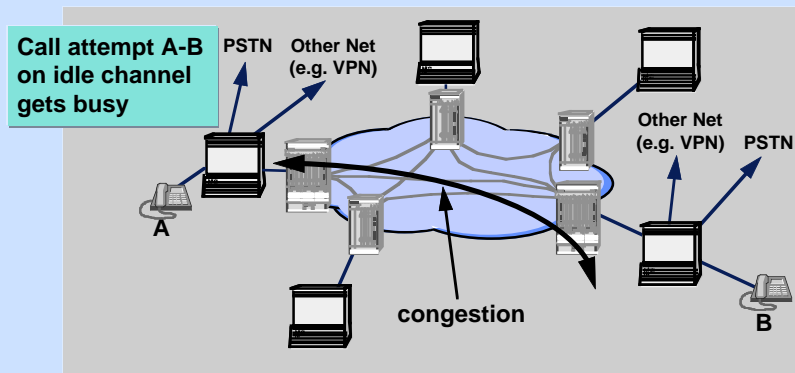
Without Passport voice networking, bandwidth would be consumed on a number of routes to provide the traffic to the tandem PBXs. Passport's dynamic route computation ensures that every call will take the most optimal path to the destination.

Wide area network topology changes are totally transparent to the PBXs.

Intelligent feedback is provided to the PBXs if the call cannot be completed in the Passport network. This facilitates the decision of the PBXs to provide an alternate path or overflow route.

Benefits of Voice Networking

- **Reduced hardware and maintenance costs**
  - **up to 50% less digital interfaces**
- **Improved bandwidth efficiency**
  - **every call routed directly over optimum path**
- **Higher end-to-end voice quality**
  - **only one compression/decompression per call**
- **Improved quality of service**
  - **Passport can reject calls during congestion**

Nortel is #1 for voice!

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In summary, the benefits of voice networking include:

1) a reduction in hardware and maintenance costs

- the number of interfaces required will be based on traffic volumes and will not be a reflection of the hierarchical structure

- tandem sites can have interfaces, that were used to handle the tandem function, re-deployed for providing revenue generating connections

- routing table maintenance is simplified with Passport's central management

2) improved bandwidth efficiency

- optimal routing directly to the destination

3) higher end-to-end voice quality

- achieved by avoiding multiple compressions and decompressions (which distort voice signals)

- facilitates the use of higher compression algorithms (LD-CELP, ITU-8, ...)

4) improved quality of service

- intelligent interaction with the PBXs allows connection admission control

Voice Networking Roll-out

- **Field trials beginning 3Q96**

- **First protocol: ECMA QSIG**

- **Other protocols to follow, including:**
  - **MCDN**
  - **CAS (DTMF, DS1, TTC-2M and E1)**
  - **North American ISDN**
  - **ISO QSIG**
  - **DPNSS**
  - **country-specific ISDNs**

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The initial focus on the voice networking roll-out is on the private networking protocols.

Lead customer field trials will begin in the third quarter of this year. The feature set will include support for the ECMA QSIG protocol, basic diagnostic and network management capabilities.

Trial capability of the features CAS support, North American ISDN and simplified accounting is targeted for the end of 1996 with general availability for 1Q97.

Development of the MCDN and DPNSS protocols (not part of our protocol stack) is being performed in parallel to the main development and will be available in 1997.

Passport will be the only intelligent bandwidth manager to support the MCDN (Meridian's Q.931 +value added extensions) protocol. The combination of Meridian and Passport using MCDN will provide users with the most advanced feature set in the industry today.

Future Strategic Offerings

- **Fax idle suppression**
- **Advanced compression algorithms (LD-CELP, G.729 ...)**
- **Fax demodulation**
- **Tandem pass-thru**
- **Enhanced echo canceller**
- **Multi-port card**

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Other initiatives being undertaken to enhance the voice service offering include:

Fax idle suppression (3Q96)

- improves the efficiency of fax transport by deleting idle periods
- preliminary lab tests show savings of 20% forward direction and 80% reverse direction

Voice card evolution (1997)

- advanced compression algorithms (LD-CELP, ITU-8, ...)
- fax demodulation up to 14.4 kbit/s
- the ability to "pass-thru" tandem switches compressed and still provide signalling to tandem switches (does not have the benefits of voice networking, such as congestion control, simplified call routing and efficient bandwidth usage)
- enhance the echo canceller to out perform external echo cancellers in the market today
- design a multi-port card

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Who's Using Passport Voice?

- **Leading service providers world-wide**
  - international and domestic carriers

- **Corporate**
  - banking, software manufacturers, oil, electronics, health care

- **Defence**

- **Campus environments**
  - universities

Customers from around the world are realizing the economic benefits of Passport voice service

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As of March 1996, more than 20 customer networks were running Passport voice service live and recognizing savings.

The customers span the globe and represent a wide spectrum of businesses.

The existing customer base is split evenly between providers offering an end service and private or enterprise networks.

The Nortel corporate network run by Nortel GES, runs Passport voice-over-ATM. This offering currently covers the North American continent and handles in excess of 80K calls per day.

MFS and Magellan Passport

- **First public voice-over-ATM VBR service**

- **WAVE (wide area voice exchange)**

- **Allows end-user to reclaim unused bandwidth for data**

- **Up to 50% savings using silence suppression**

WINNER

Data
Communication
LAN Times

BEST

OF SHOW
1995

The
McGraw Hill
Companies

INTEROP '95

ATLANTA

By now you have no doubt heard about the advanced voice-over-ATM offering by MFS Datanet, based on Magellan Passport voice and ATM service.

This is an example of a customer and vendor partnering to provide an industry first—resulting in the success and industry recognition of both customer and vendor.

Passport Voice Service

$ **Bandwidth efficiency**

✓ **High quality voice service**

✓ **Resilient networking**

✓ **Flexibility for the future**

✓ **Leading the way in voice-over-ATM**

Tomorrow's voice transport today!

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Passport's dynamic voice compression, silence suppression and integrated fax/modem support provide bandwidth efficiency and facilitate savings in network bandwidth charges.

Passport offers high quality voice service through the use of industry standard compression, integrated echo cancellation and employment of a high quality clock sync mechanism. Further, it provides resilient networking features which ensure the call stays up even under link failure scenarios.

Passport offers a flexibile solution for the future with a clear migration to voice features that will be required to provide the most cost effective solutions.

Clearly, Passport is leading the way in voice-over-ATM.

For more information on Passport voice at Inform '96 see:

- Related workshops and plenaries

    – Real-World Experience with Passport Network Consolidation

    – Voice: A customer Case Study, Australian Department of Defence

    – Building the Enterprise Solution

    – Nortel's Internal ATM Network: A Customer Perspective

- Whiteboard sessions on network consolidation

- Demonstration Center