



## **Driving VoIP Solutions**

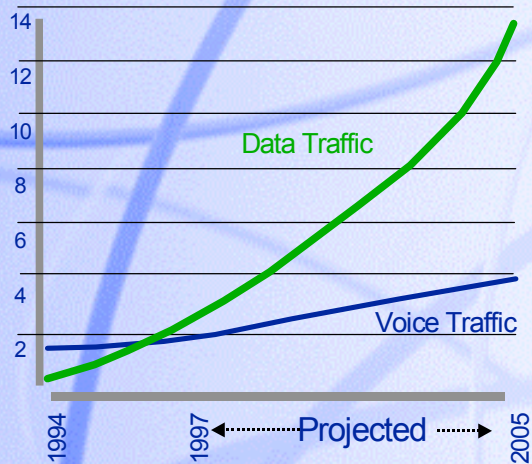
# **The Reality of the Technology and the Market**

**Phil Edholm, CTO and VP, Network Architecture**

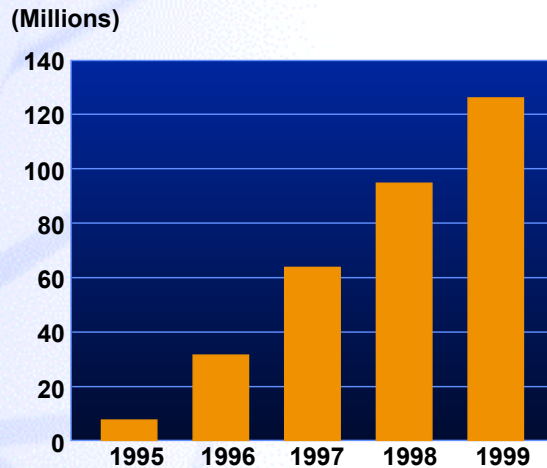
**Enterprise Product Portfolio**

# Drivers of Change

## Wide Area Traffic Growth



## Worldwide Internet Users

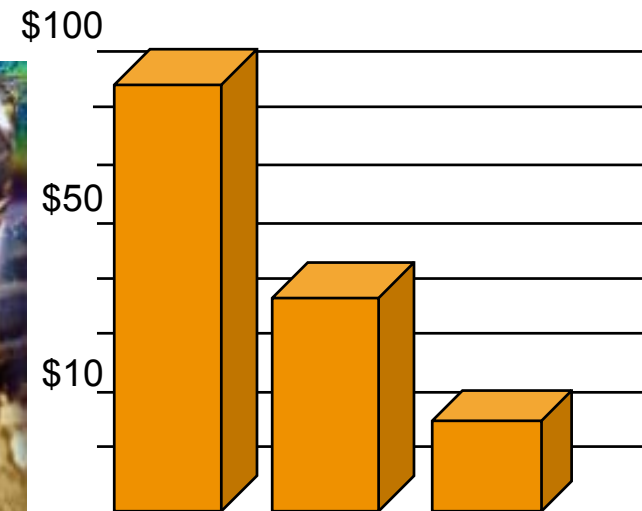


Source: International Data Corporation

## Switched L2/L3



## Business Costs



## Web/IP Technologies



Mobility



## Deregulation

# What's IP got to do with it?

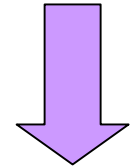
- It's open and ubiquitous
- It's connectionless
- It's not sensitive to distance, time or usage
- It rides Moore's & Metcalf's laws
- It's transport independent
- It's application independent
- It's potential is unlimited
- It's getting better at QoS



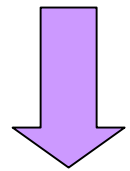
# Why IP Telephony is good for customers?

- **Hard Dollar cost reduction**
  - WAN Cost Reduction
  - Improved WAN Price/performance
  - Consolidation of multiple networks in one
- **Operational Improvement**
  - LAN/Campus Integration
  - Simplified moves, adds and changes via IP/DHCP
  - Policy and Directory Consolidation
- **Enhanced Applications**
  - Unified Messaging = improved productivity
  - Web enabled Call Centers = improved customer care
  - Collaborative/ Mobility/Open Applications
  - The WWWs 350M users by 2003

**Save Money**

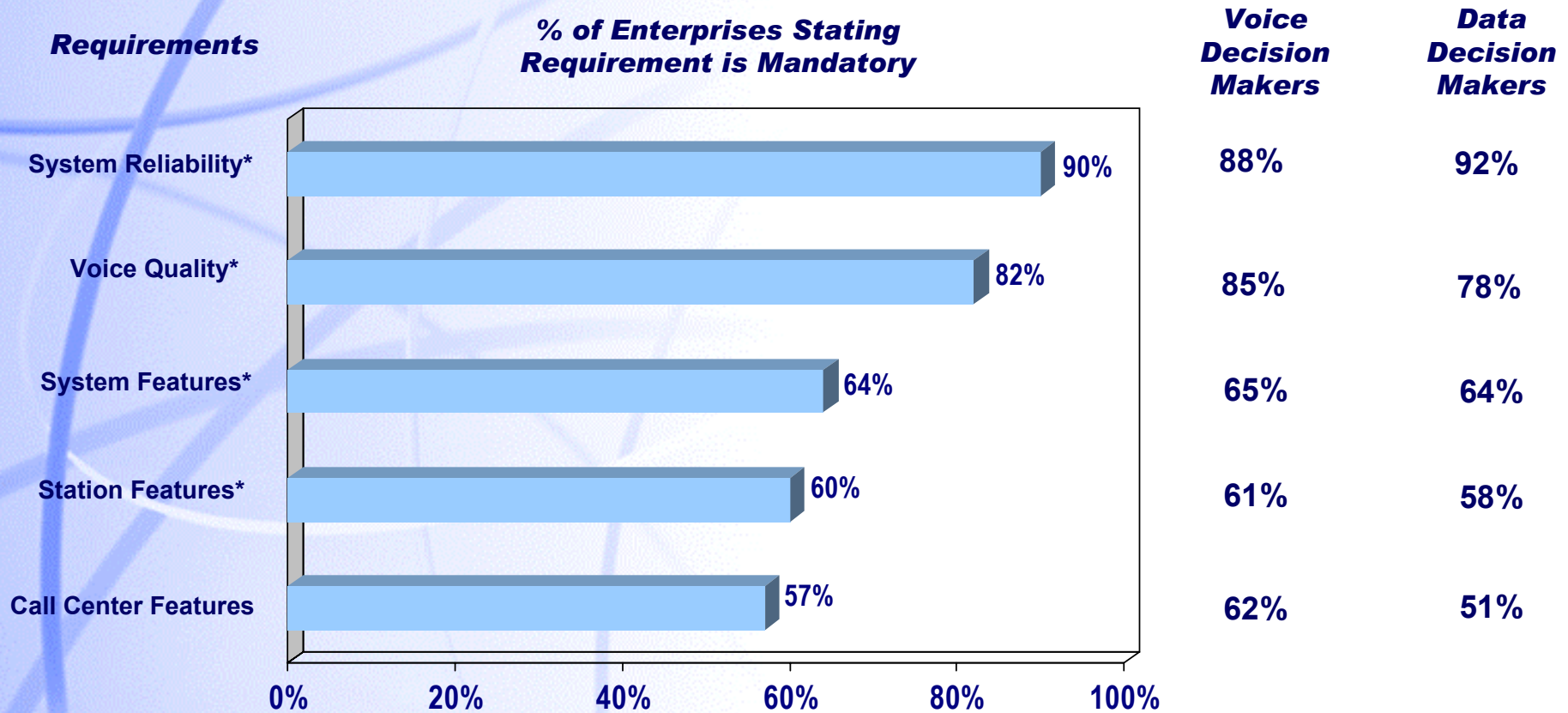


**Simplify**



**Add Value**

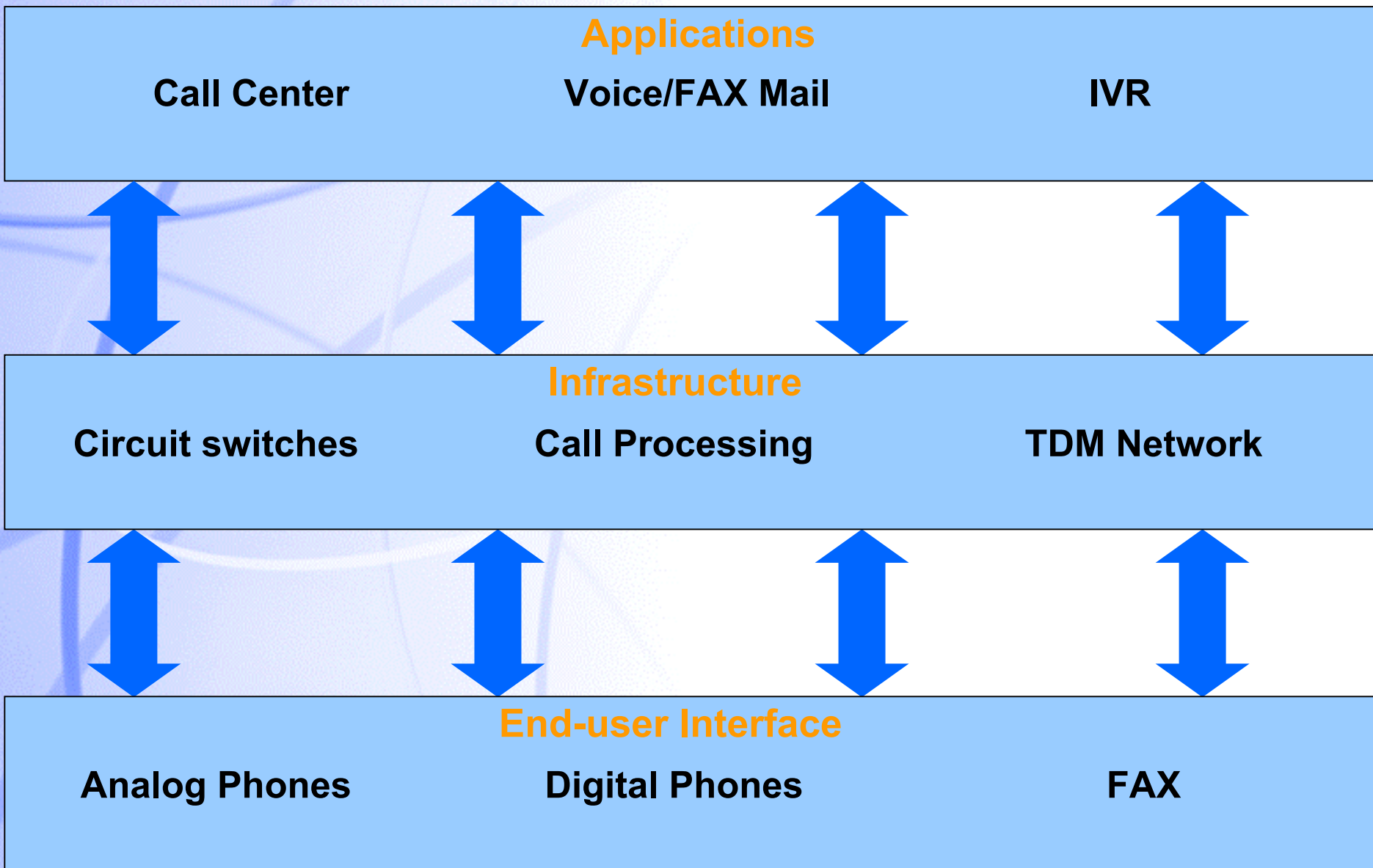
# Customer Internet Telephony Requirements



\* Equivalent to PBX

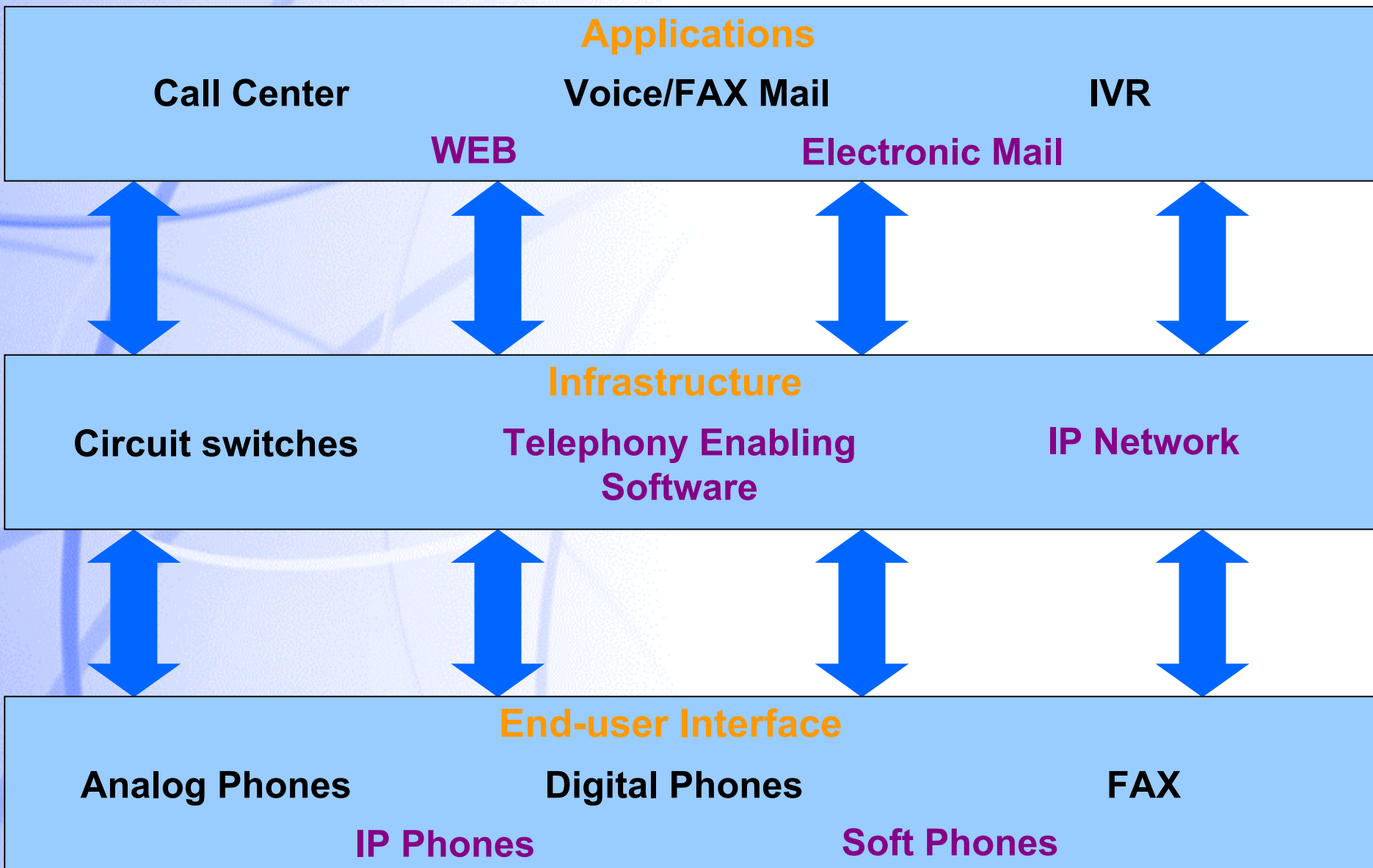
Source: Phillips InfoTech

# Telephony





# Internet Telephony



# What to look for in Internet Telephony?

- **Quality Telephony**
- **Extensive feature sets & applications**
- **Global capability**
- **Bullet-proof reliability**
- **Low Total Cost of Ownership**
- **Scalability**
- **Skills & support availability**



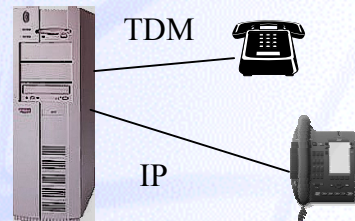
# Enterprise Communications

## 1. Various Roles and Services:

- Executives
- Secretarial
- Customer Engagements
- Consulting
- Sales
- IT
- Customer Service
- Customer Care

## 2. Various Voice Communication Product Solutions:

–Hosted / Centrex



–PBX and IP PBX



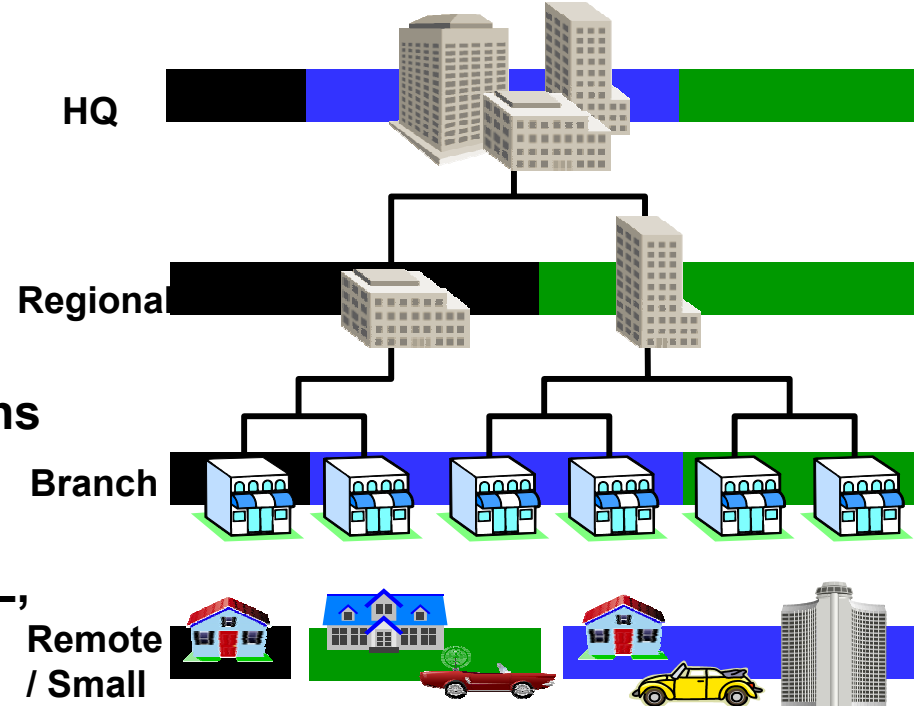
–Key System and Small Office solutions



–Dial Access, VoDSL, Mobility



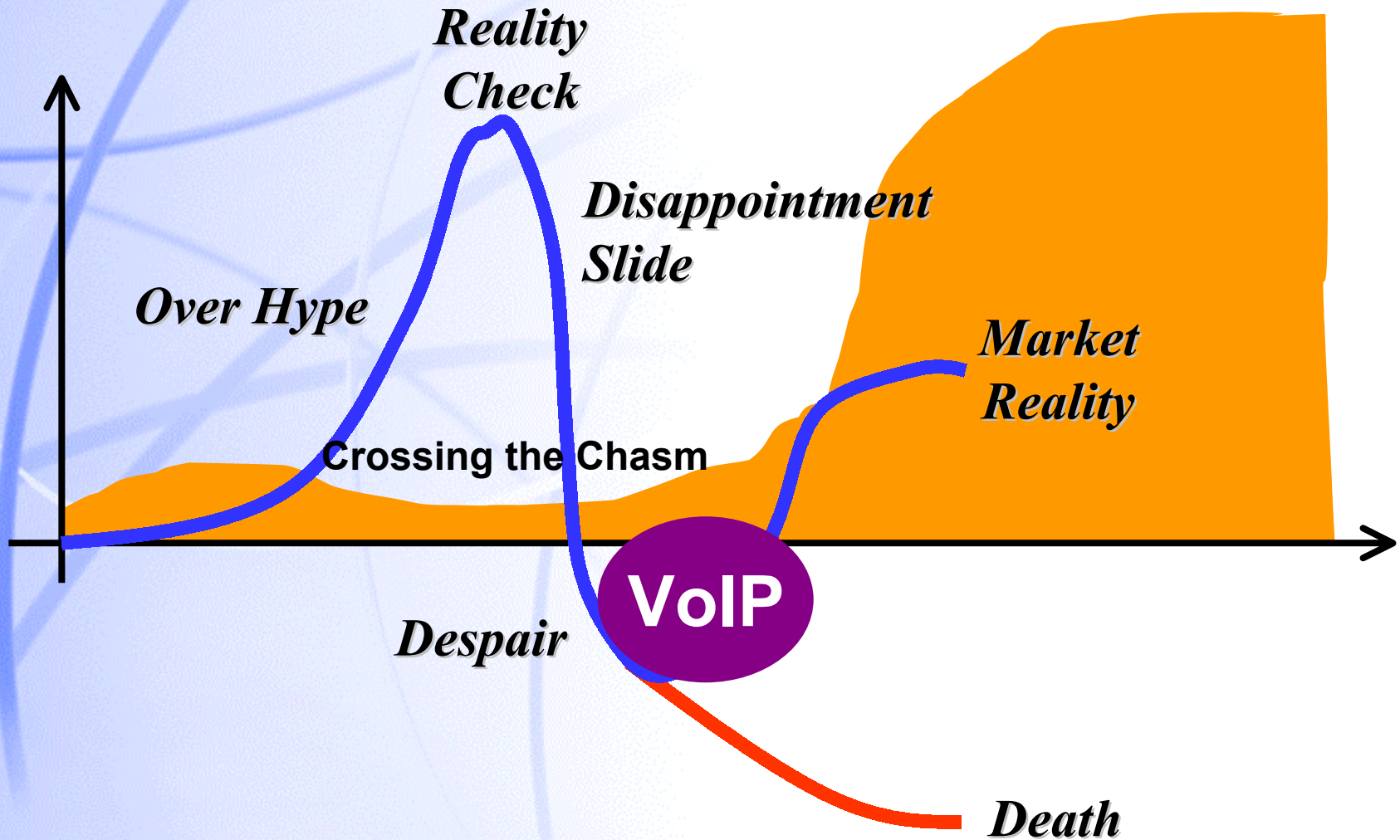
## 3. Various Locations

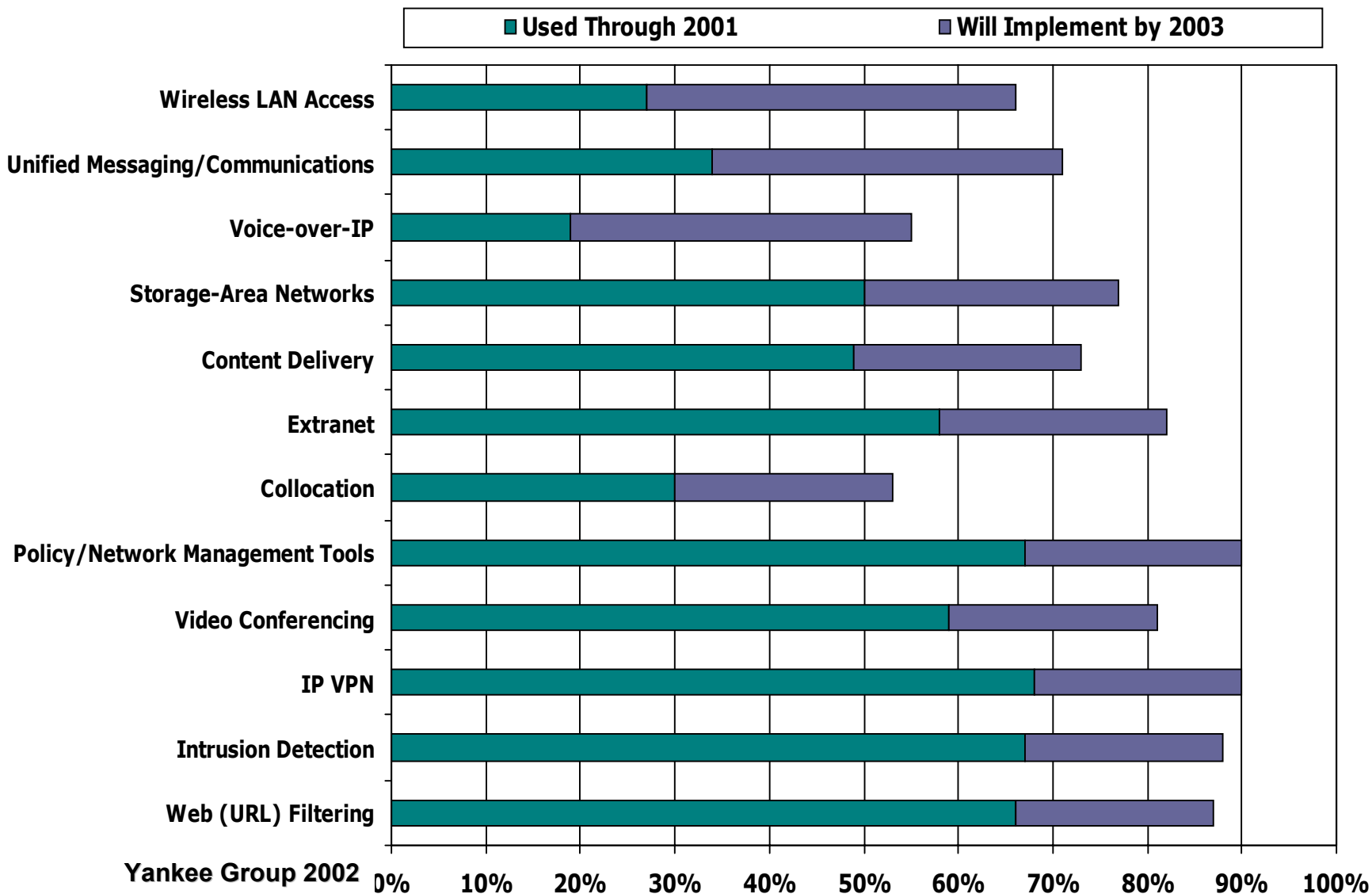


## 4. Various Business Delivery Models:

- Hosted
- Managed
- CPE

# New Technology Introduction Curve...

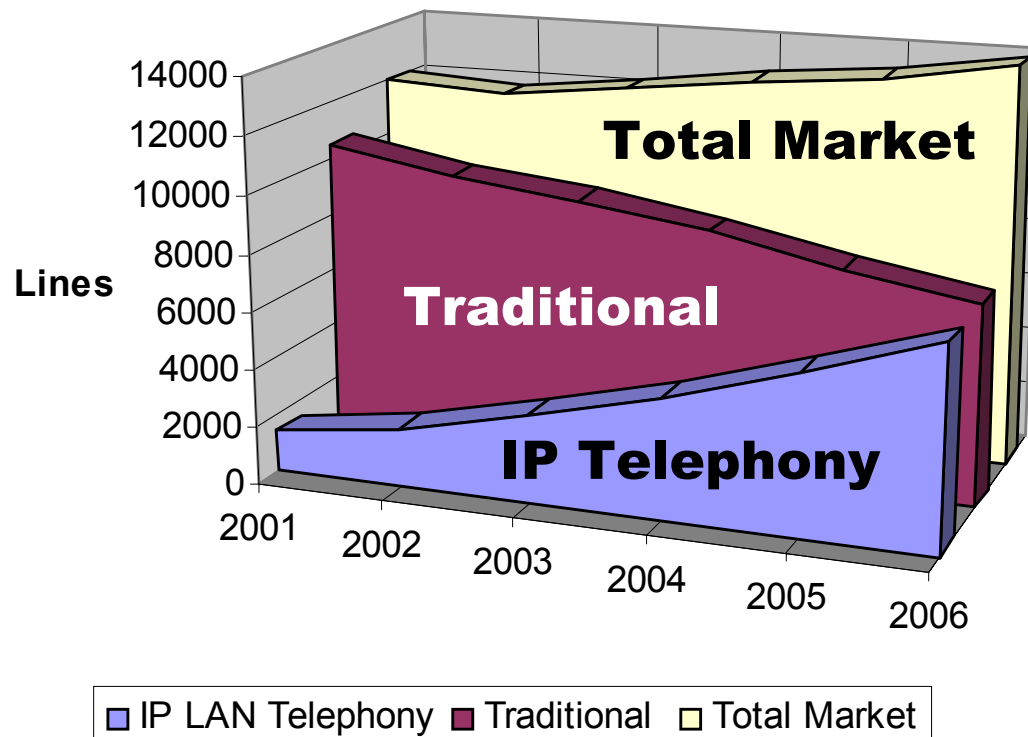






# Migration Rate to IP PBXs

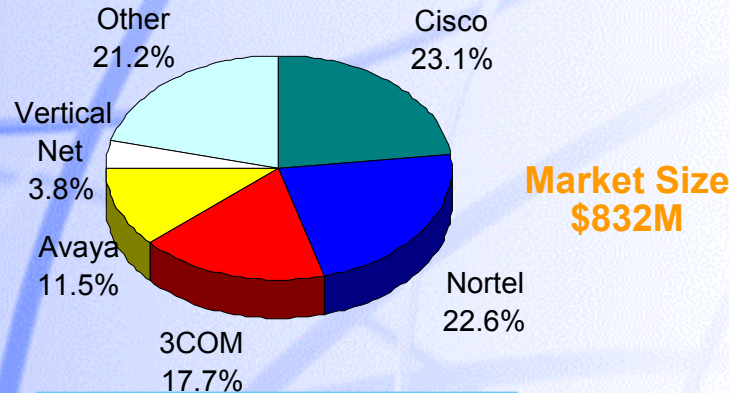
- IP Telephony CAGR at 36%, crossover point for IP and traditional lines in 2006
- The Migration will be Business Case driven – not hype drive



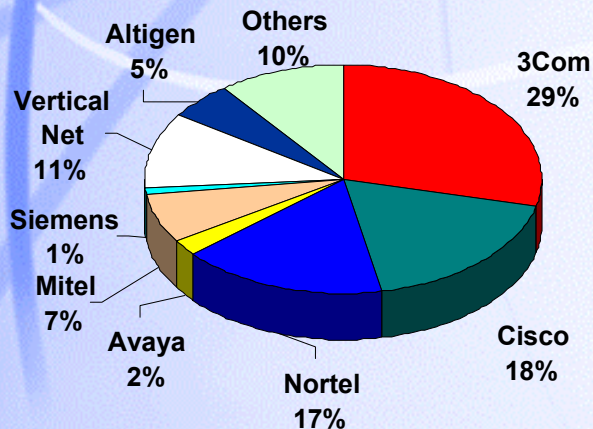
Source: Phillips InfoTech

# 2001 US VoIP Market Share

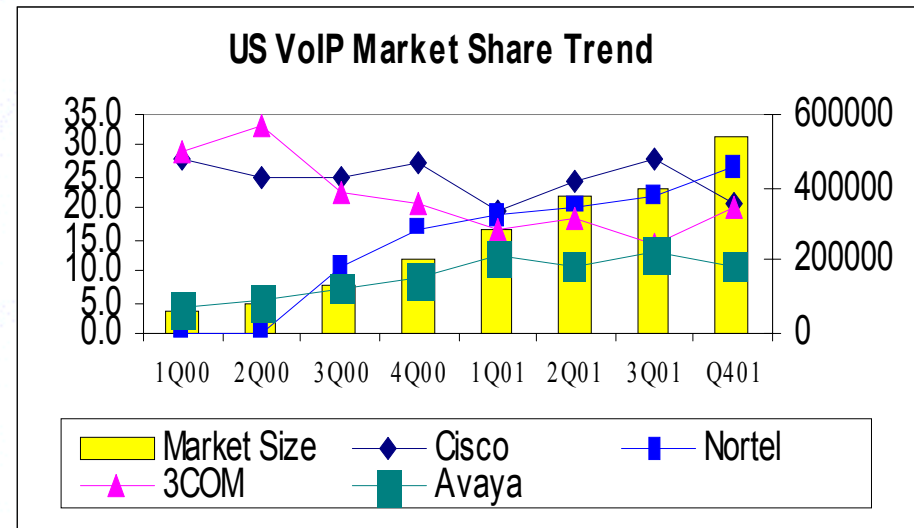
**2001 US Market Share  
(Total Lines Shipped)**



**2001 US Market Share  
(Total Systems Shipped)**



**1Q00-4Q01 Market Share Trend  
(Lines Shipped)**

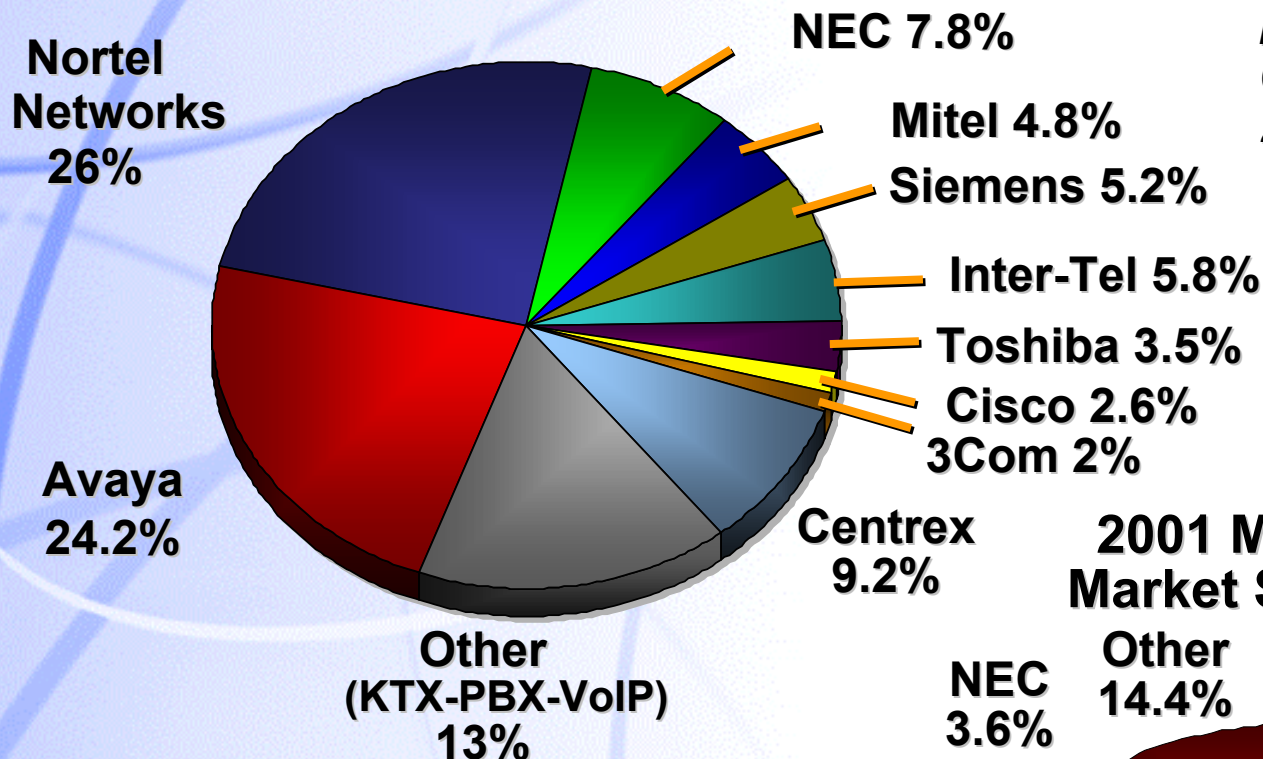


- ▶ The Enterprise VoIP market grew another 34.4% Q4'01 over Q3'01, and over 229% year over year.
- ▶ Nortel .5% behind Cisco for 2001 total lines shipped (all categories combined)
- ▶ Nortel #1 in IP-Enabled segment of VoIP for 2001
- ▶ Nortel #1 in Converged segment of VoIP for 2001

## Nortel #2 in US Enterprise VoIP 2001

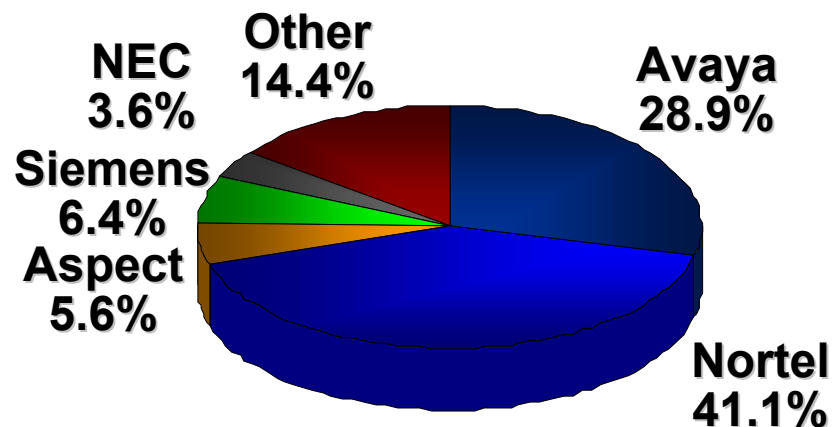
# North American Voice Market Share

*Phillips InfoTech,  
Enterprise  
Communications  
2002 report*



**NA CPE Total Line  
KTS-PBX-VoIP  
Aggregate Share 2001**

**2001 Market Share  
Market Size: \$2,096B**



**Contact Centers**



# Interoperability and Standards

- **Control Standards**
  - H323
  - Megaco
  - SIP
- **Codec**
  - Seems to be converging on:
    - G729
    - G711 – PCM

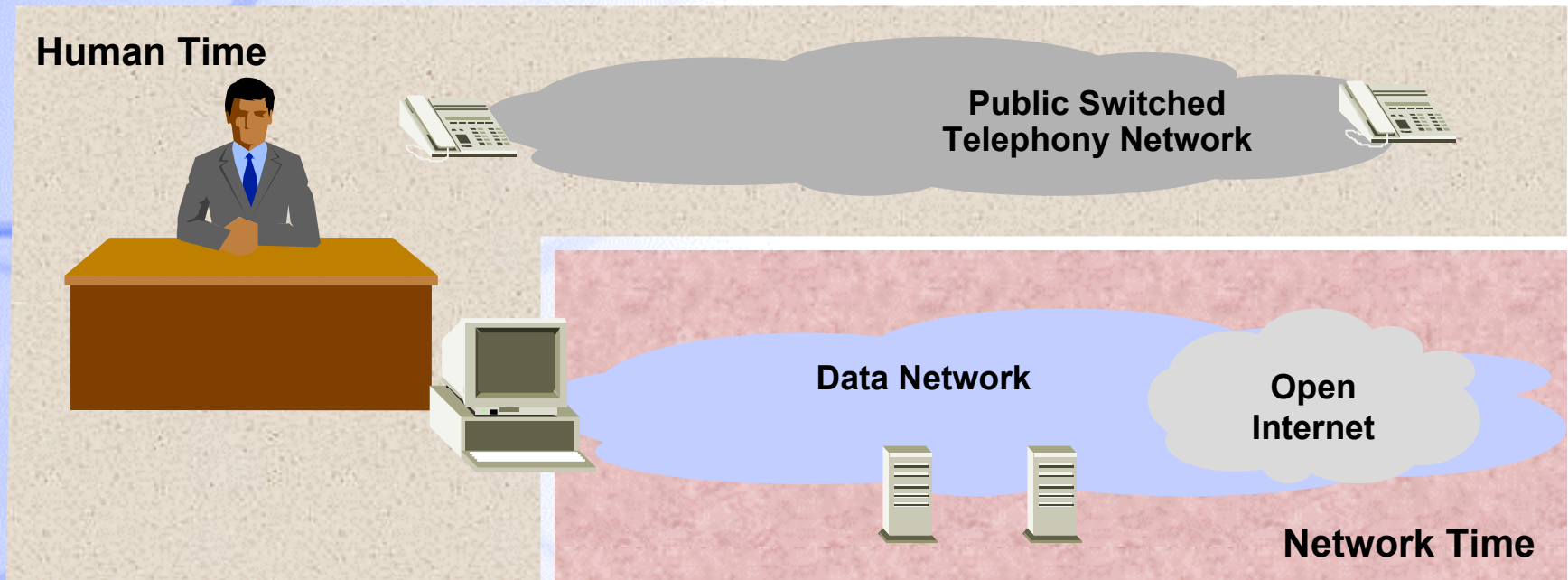
# Summary of Market Data

- **Internet Telephony is a reality - it will happen**
- **Knowing how and when is the challenge**
- **Customers will NOT adopt incomplete solutions**
- **Installed based TDM transition is a key requirement**
- **Inter-working is critical**
- **Common components should be offered**
- **Standards are needed for openness**

# **Delivering Voice Services over IP Networks**

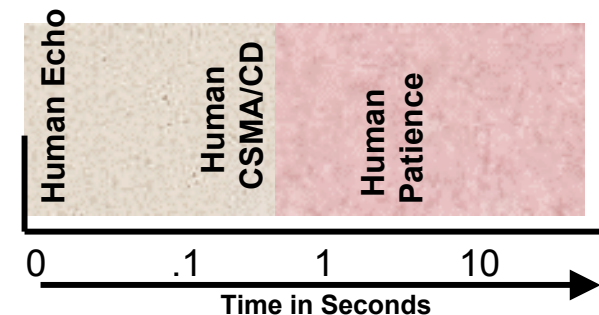


# Human Time Versus Network Time

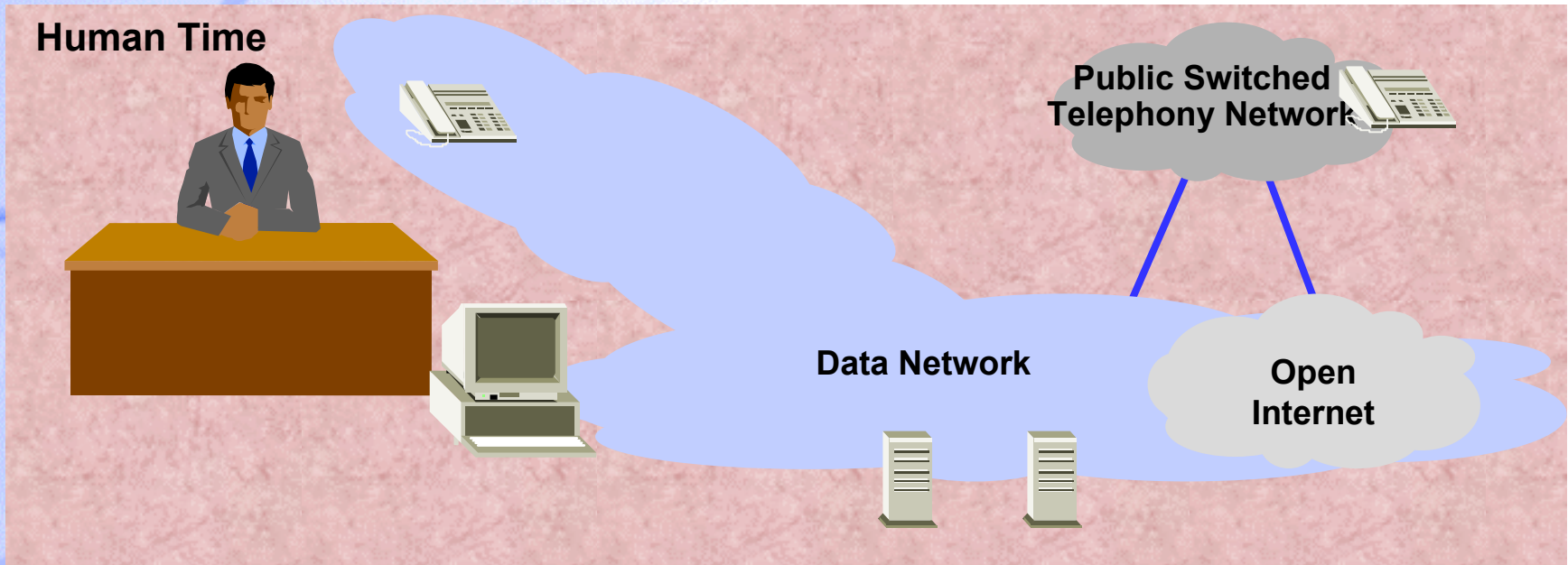


- Human time is based on interpersonal communications and human tolerance for delay
- Human time dominates voice and video communication
- The PC operates in human time to the user and isolates him from network time
- Data network time is for batch functions (file transfer, printing, Web pages, etc.) and is based on patience
- Human interaction “CSMA/CD” defines the edge of human time at about 250-300 msecs

## Human Tolerance of Delay

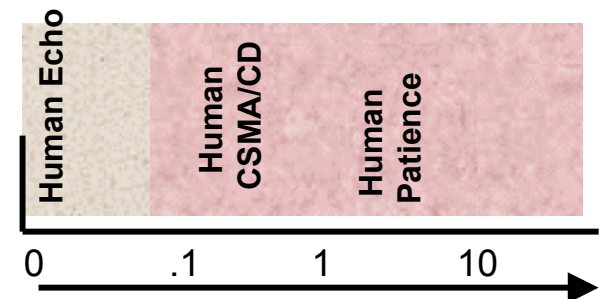


# Data networks must operate in human time



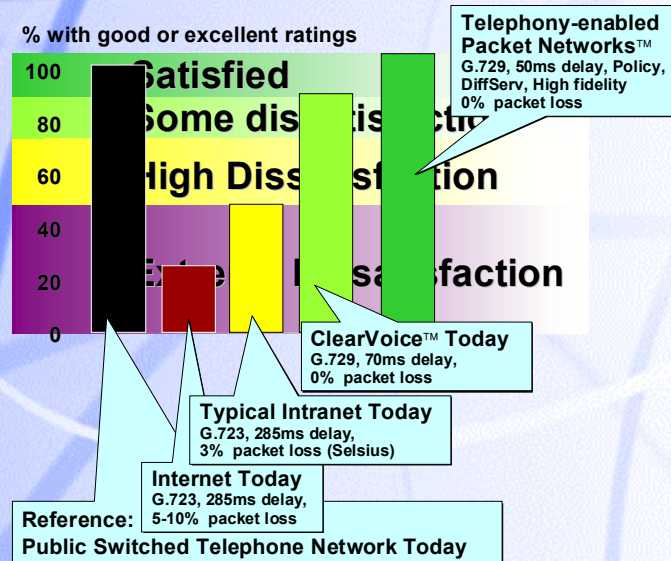
- Data networks must support human time in the future
- VoIP and VideoIP require human time
- Collaboration and community applications on the data network have strong interaction component and must operate in human time to succeed
- Network computing and thin clients require human time services
- Policy and QoS are the only way to meld human time onto the data network and maintain the overall capabilities of the system

Human Tolerance of Delay



# Telephony Session Quality

Nortel Networks test of consumer expectations for voice quality, 1998



## Delay Impact on Perceived Voice Quality

Round Trip Delay      %Poor or Worse

150 msec	3
175 msec	4
200 msec	5.5
225 msec	6.5
250 msec	8
300 msec	10.5

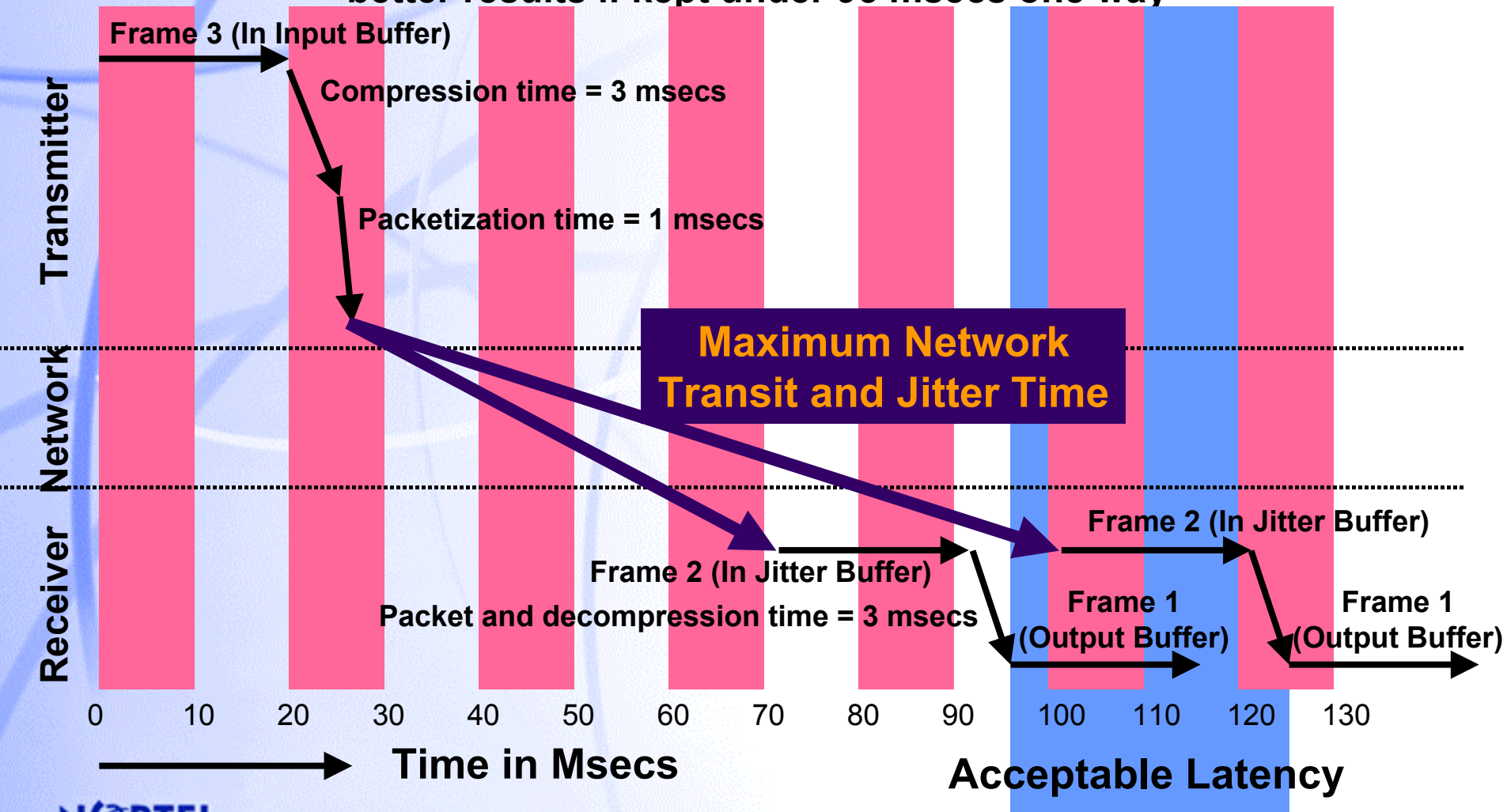


# Latency is a sum of the parts

- **Quantitization time (10-30 msec)** - the sample time to generate a discretely sampled element
- **Compression time (2-10 msec)** - the time it takes to compress the voice into packet form
- **Packetization time (1msec)** - processing time to assemble and transmit the packet
- **Network transit time (variable)** - the time to transition the network
- **Reverse packet and decompression (2-3 msec)** - the time it takes on the receiving end to output the samples
- **Latency is for a round trip**

# Time model of network

Round trip time must be less than 250 msecs or 125 msecs one way (voice input to output) to meet criteria for telephony quality interactive voice - better results if kept under 95 msecs one way



# Network transit time

- Additional Jitter Packets = 20 msec each
- Packet Transmission time =  $\frac{\text{Distance}}{.8 \times \text{SoL}} + \frac{\text{Packet Length}}{\text{Tx speed}}$
- For 5000 miles = 38 msec
- Switch or Router hops
  - Switch hops with cut-through < 1 msec
  - Routers can add time - 1-3 msec
- Total must be less than 75 msec at all times
  - For a ten router hop net with two extra jitter packets and a 5000 mile trip, the total is: 98 msec

**Keys to successful voice is minimizing jitter packets through QoS/CoS, and grooming the network for router hops**



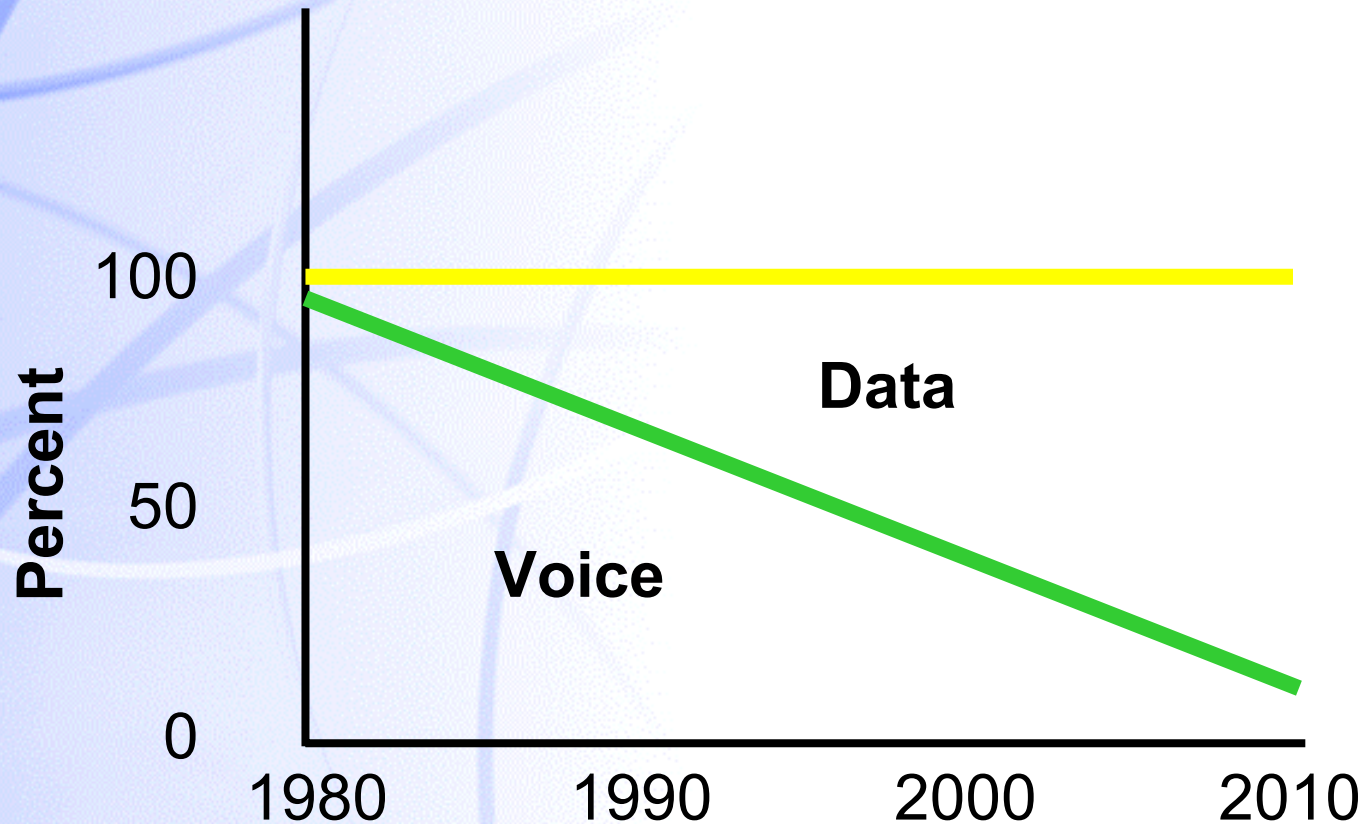
# Lost Packets

- **Each packet represents about 20 msecs of voice**
  - A single lost packet is noticeable (there is no time for error correction)
  - Multiple packets lost (or underruns) is interpreted as bad quality
  - Packets are lost due to errors or congestion
- **Typical Bit Error Rates of current networks generate acceptable performance**
  - BER =  $10^{-8}$  (100,000,000 bits transmitted without an error)
  - Assume total of transited hops is 10

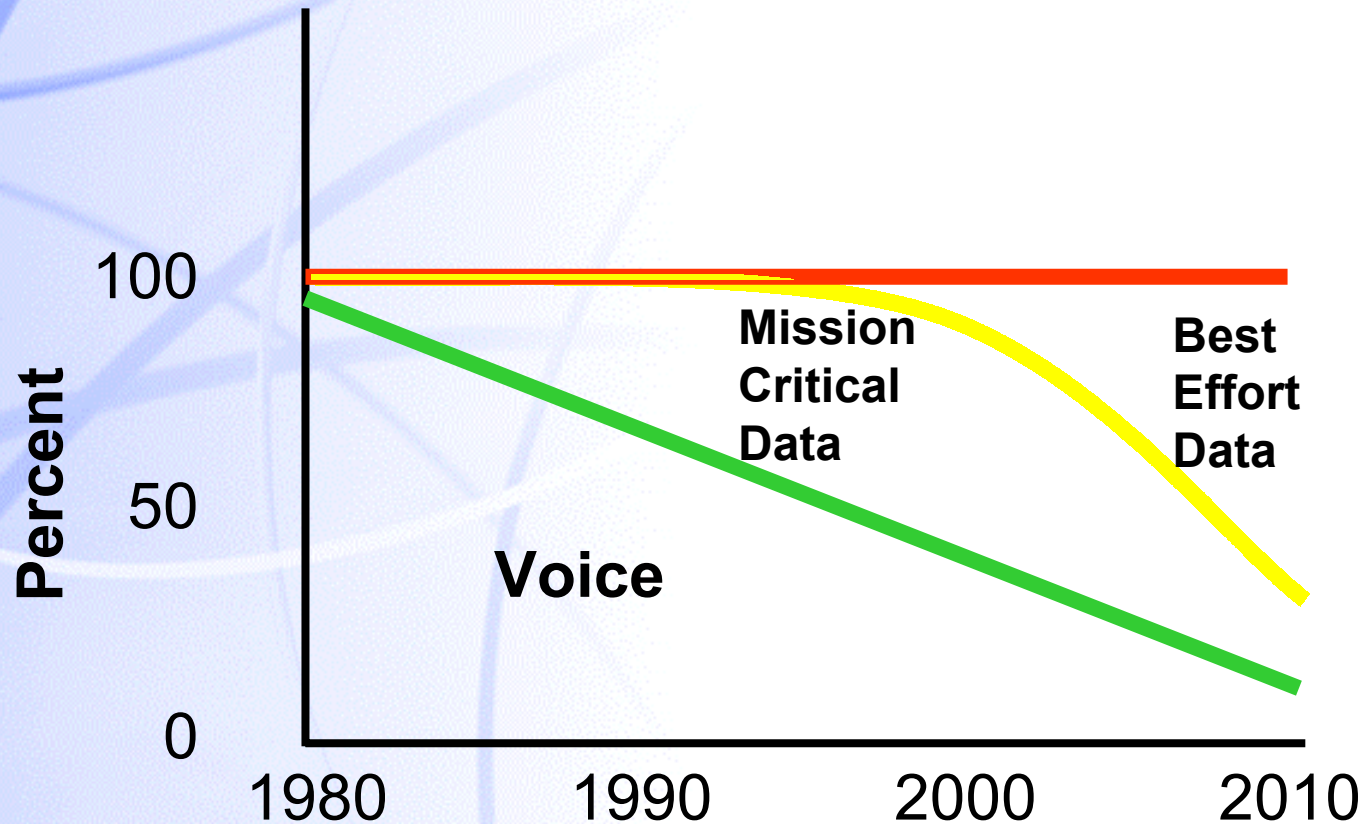
$$\frac{10^8 \text{ bits}}{(10 \text{ hops})(15000 \text{ bps} * 60\text{s/m})} = 11 \text{ minutes between occurrences}$$

**Reliable BER generates acceptable voice, lost packets due to congestion (no QoS queuing) will dramatically degrade quality as will high BER networks paths or circuits**

# Driving Class Based QoS

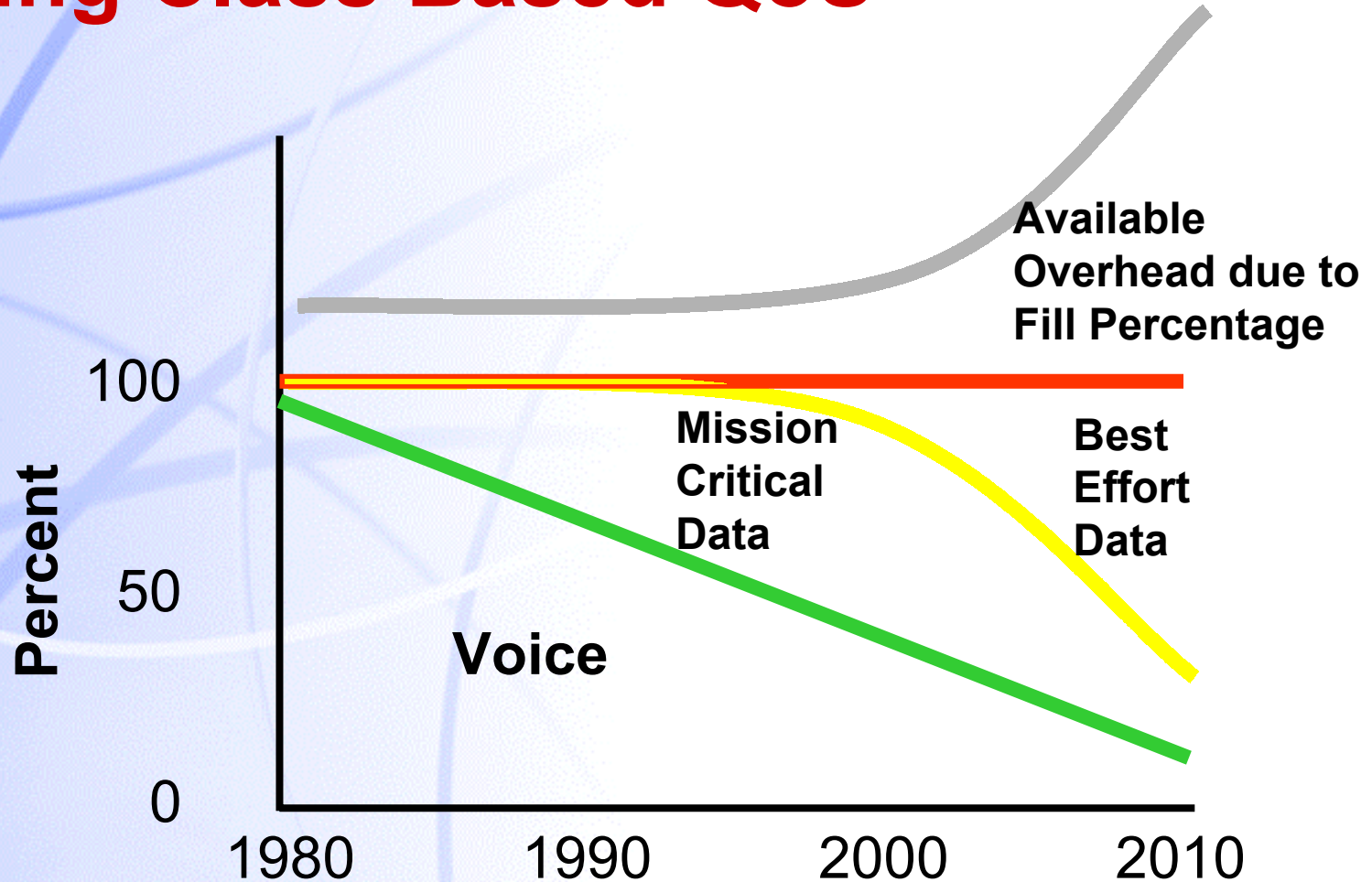


# Driving Class Based QoS

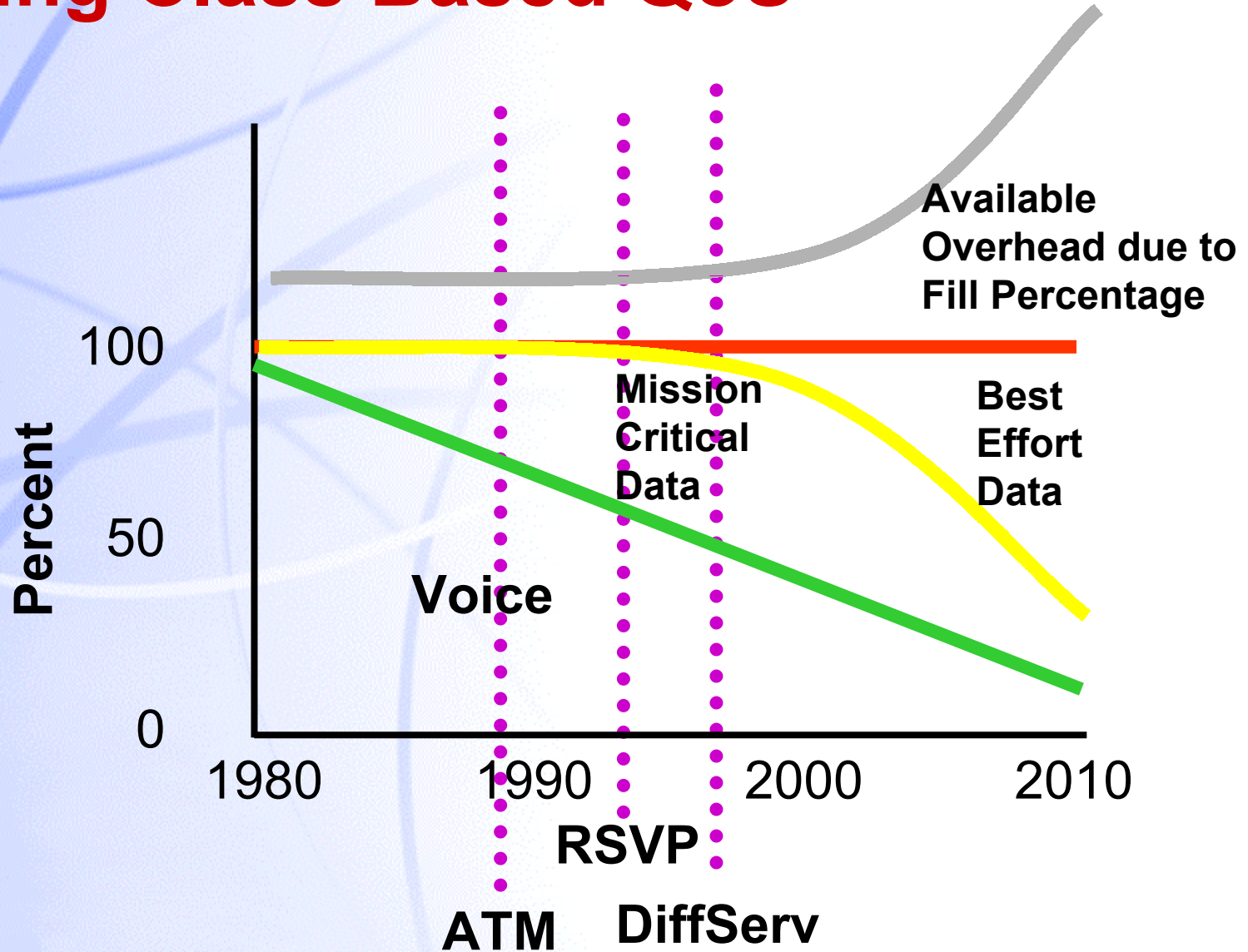




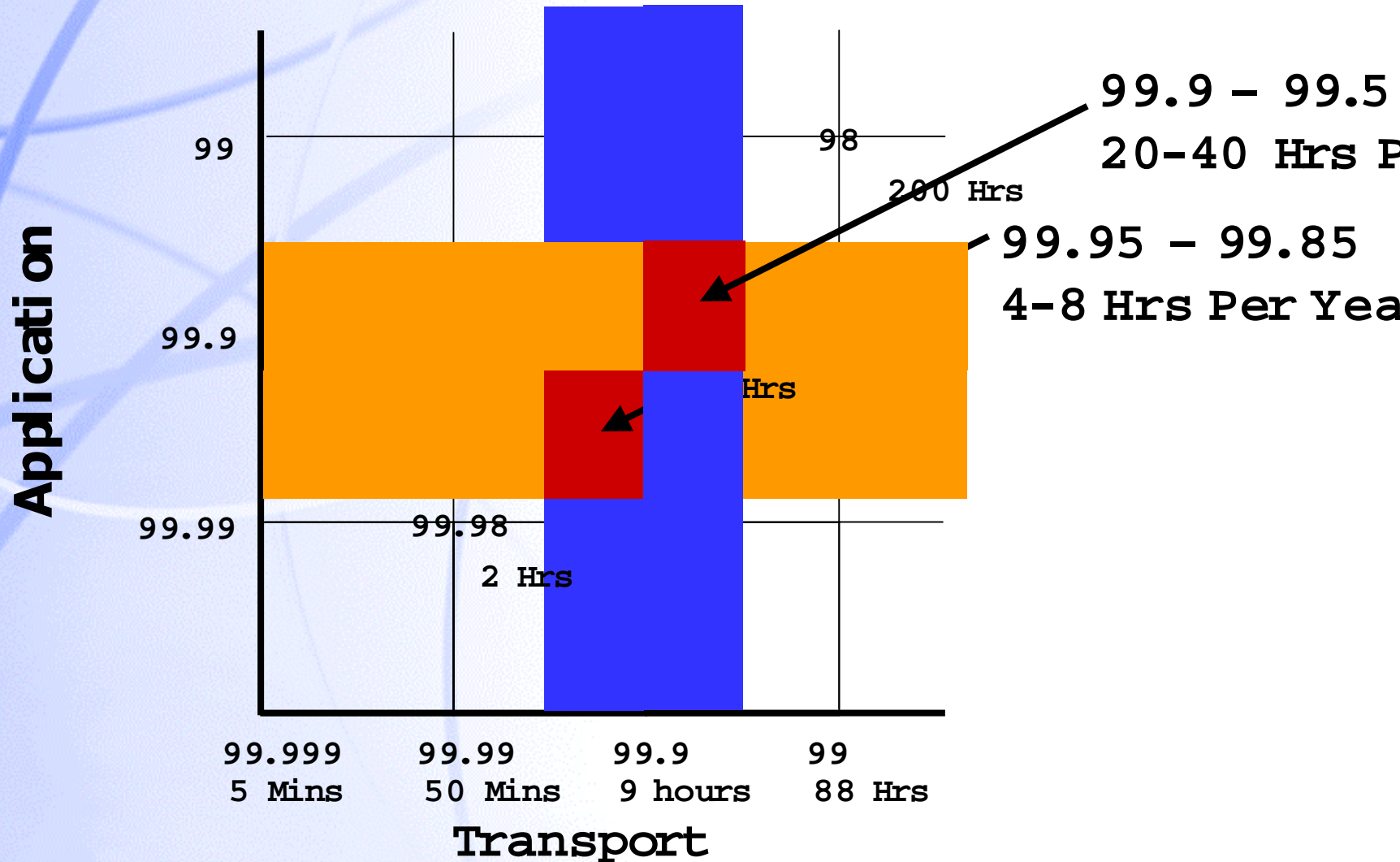
# Driving Class Based QoS



# Driving Class Based QoS



# Reliability Transformation





# Decision Values of VoIP

- **Control Integration**
- **Media Integration**
- **Cost**

# VoIP Control Integration

- **Will be the ultimate driver**
- **Application Integration**
- **Currently based on TAPI**
  - Just like a PBX
- **Future is web paradigm**

# SIP Integration Multimedia Collaboration

- **Multimedia Services**

- Videoconferencing
- Instant Messaging
- Audio & video streaming

- **Telephony Services**

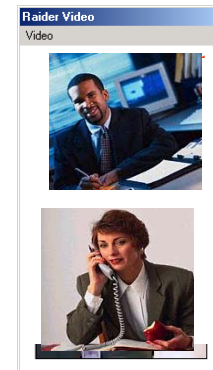
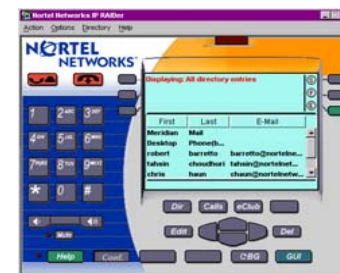
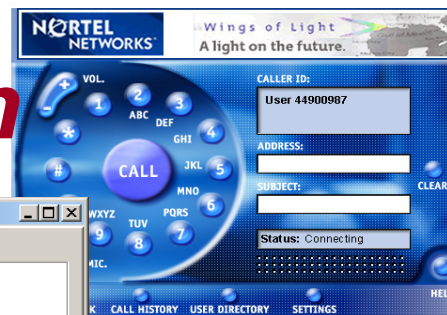
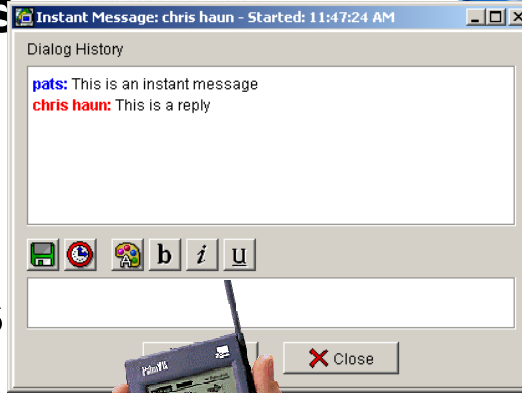
- Call redirect
- Multiple server registration
- Real time call management

- **Mobility**

- Dynamic registration, Find-me/Follow-me
- Hoteling

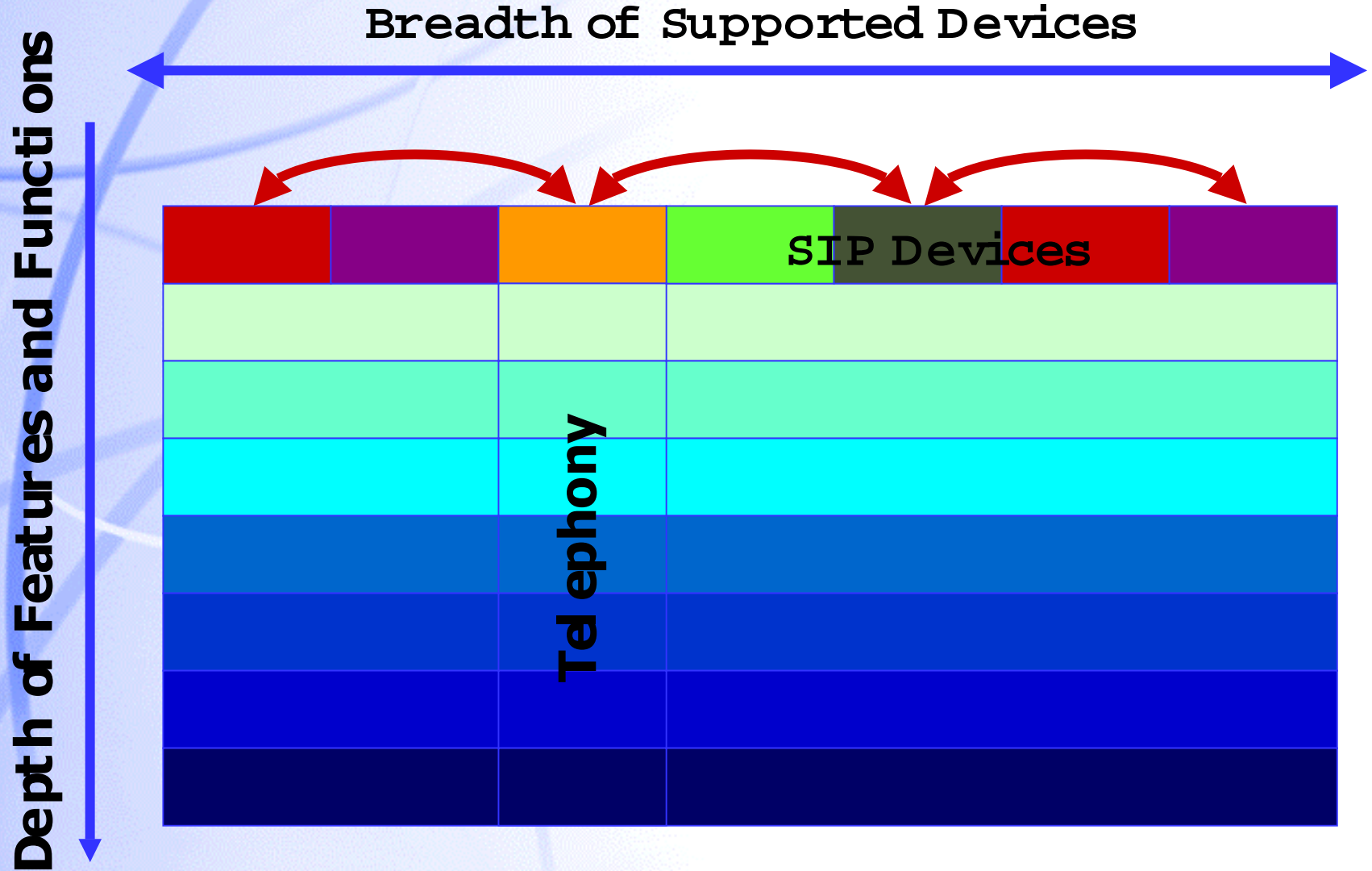
- **Personalization**

- Personal Call Agent
- Dynamic Call Handling






# SIP and Telephony



# VoIP Media Integration

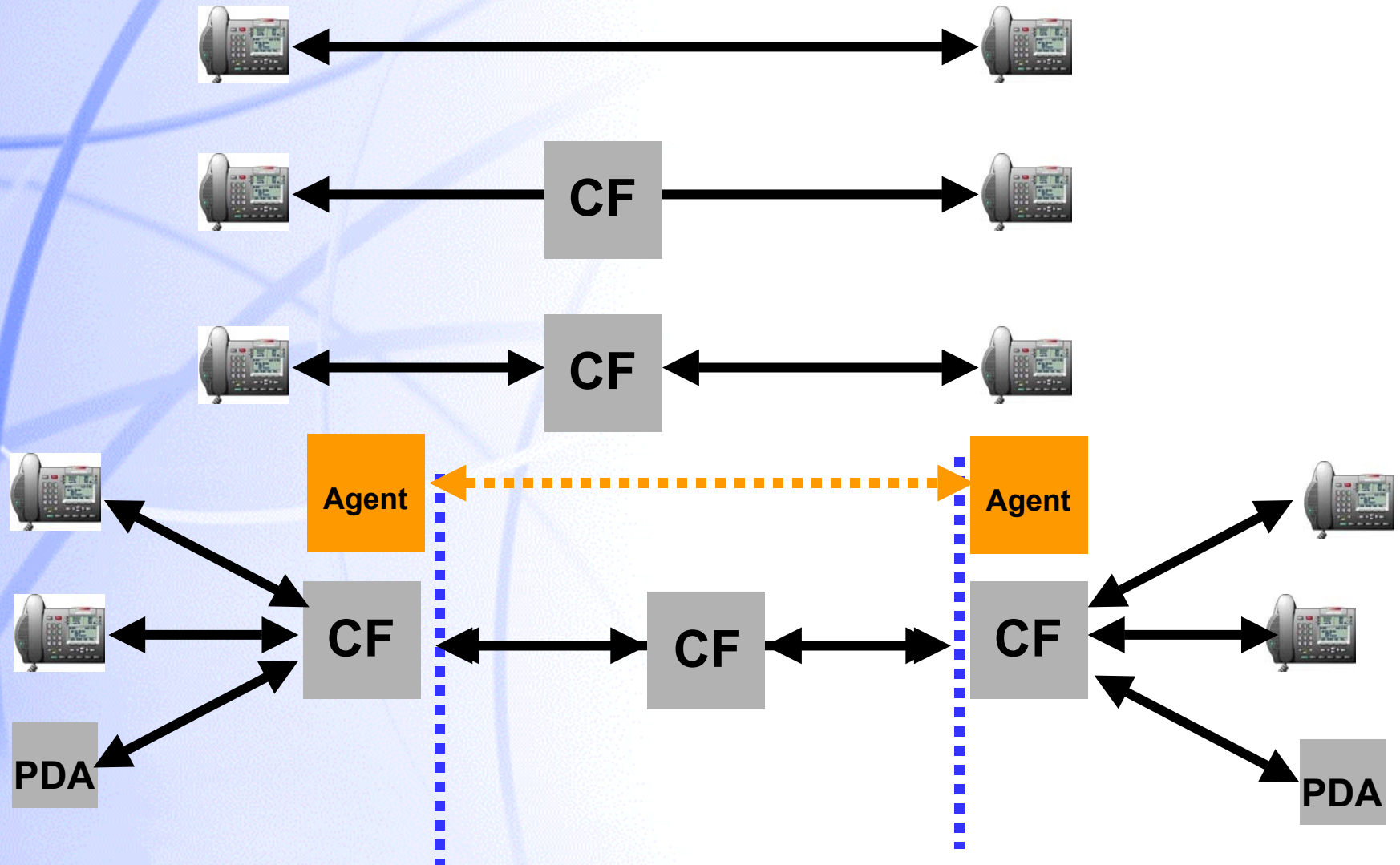
- **Single wire value**
- **Not typical - VoIP is emerging as a separate device from the PC**
- **Media integration values**
  - 
    - Recording
    - Synthesizing
    - Transforming**Better as Server Functions**
- **As voice is person to person, media alterations reduce value**
  - Potential for handicapped access and dating
- **Future values of packetized voice will emerge**

# New Media Capabilities

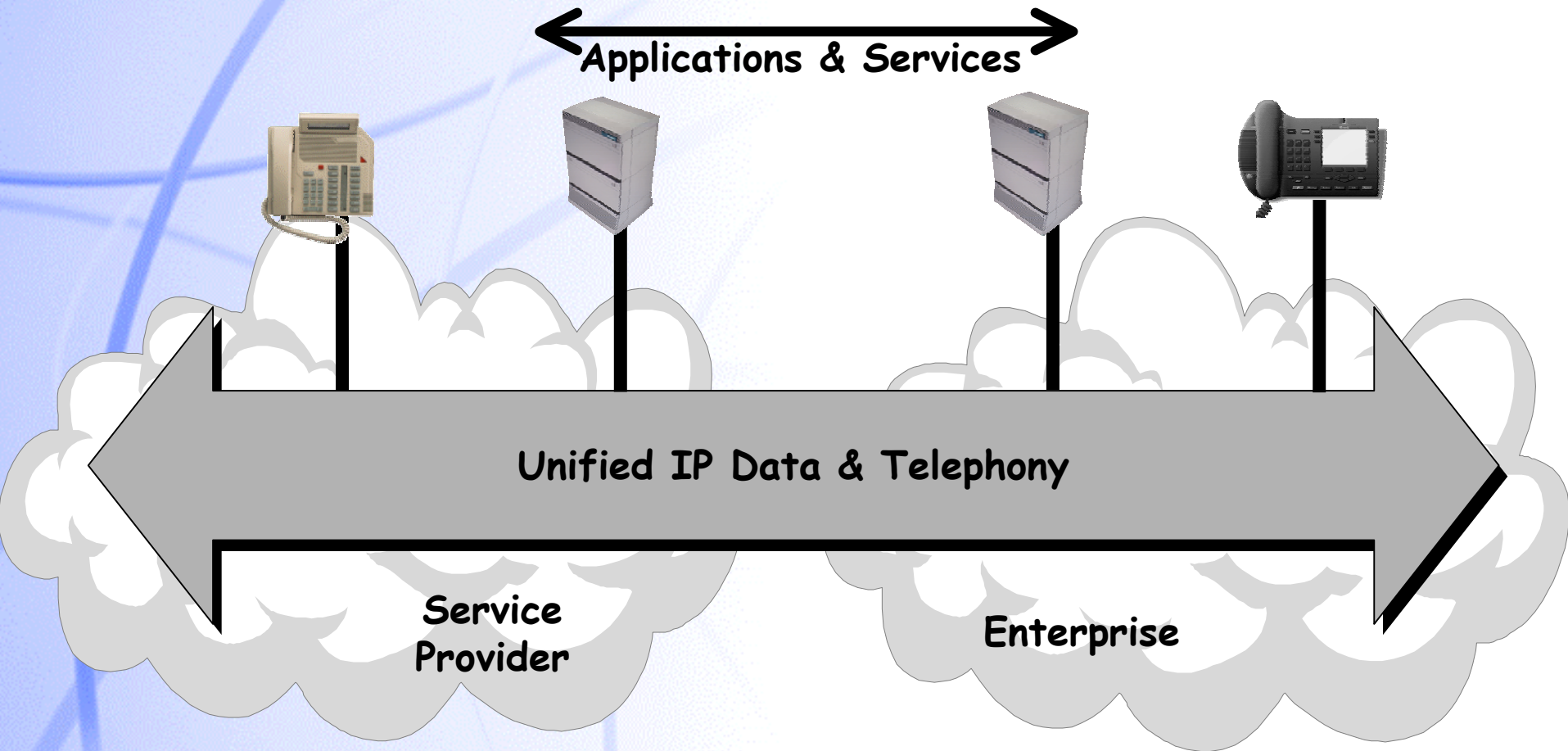
- **New Conferencing Paradigm**
  - 500 microsec added latency
  - 10-100K conference ports on a PC
  - Fungible in growth
- **New Capabilities**
  - Constant Conferencing
  - Every Call includes a conference call
  - Audio “Virtual Space”
  - Integrated Personal Agent technology



# Redefining Inter-human Communications



# Think of telephony like we think of the Web



# What is it like?

- **“Phone calls can be URLs”**
- **A conference call is an object... you can “E-mail me a conference call”**
- **Telephony apps are buttons on Web pages**
- **Voice control panel is Web browser**
- **Like the Web, telephony value & content can be anywhere**
- **Streaming Web audio/video is now part of telephony**
- **Service creation is rapid**
- **This vision drives IP Enabled and Succession**



# VoIP Cost Impact

- **Acquisition cost**
  - VoIP equipment
  - IP capable network
- **Ownership cost**
  - MAC (Moves, Adds, and Changes)
  - Support
  - Other functions
    - 911 tracking

**Note: all costs are in US Dollars**

# Desktop Cost Comparison



**\$1 per day**

Nortel/Customer Analysis



**\$35 per day**

Gartner Group Data (\$68 total Computing)

**Typical IT Dept spends less than 3% of budget on voice**

## Now VoIP?

- Intelligent Edge
- Distributed Intelligence
- Increased Support

## Computing Trends

- Network Computing
- Network Displays
- Centralized models

**Gut Feel - is this really going to be less?**

# Long Distance - the real value?

- Assume 1 hour per day per employee
- Assume 50% is intra-business (within the company)
- Current long distance at under \$.05 going to 2 cents
- Cost of long distance at 2 cents is \$288 per employee per year, \$144 for intra-business
- Assume one pair of VoIP ports for every 3-5 employees
  - Trunk and line or trunk
- At \$600 per port, and all intra-business long distance on IP and no charge for bandwidth:
- Payback is about 2-3 years

**International Traffic is the Real Value**



# Is it really free?



**Voice will  
be free in a  
few years**

**A few decades hence, energy may  
be free - just like unmetered air.**

**John von Neumann, 1956**

# What if it is really free?

- **Assume that the VoIP equipment is free**
  - All telephones, gateways, gatekeepers, call processors, etc.
  - All maintenance and support
- **But .... You have to live with.....**

**Data reliability of 99%**

**versus**

**Voice Reliability of 99.999%**

**In other words, telephones go from 5 minutes to 88 hours per year of unavailability to your customers**

# The real cost of reliability loss

- **Assume that of the 88 hours, 30 occur during business time**
  - Average business is open  $6 \times 9 = 2815$  hours per year
  - Total hours = 8760
  - Average open is 32%
  - 32% of 88 is 28 hours - round up because of Murphy's Law
- **Assume \$300,000 revenue per employee with 50% gross margin**
- **Lost revenue =  $30\text{hrs}/2815\text{hrs} * \$300\text{K} = \$3197$  per year**
- **Assume 50% margin - margin/earning loss is = \$1598 per year**



# What a savings!!!!

## To Save.....



**\$1 per day  
about \$250 per year**

**....the business lost over**

**\$1598 per year!**

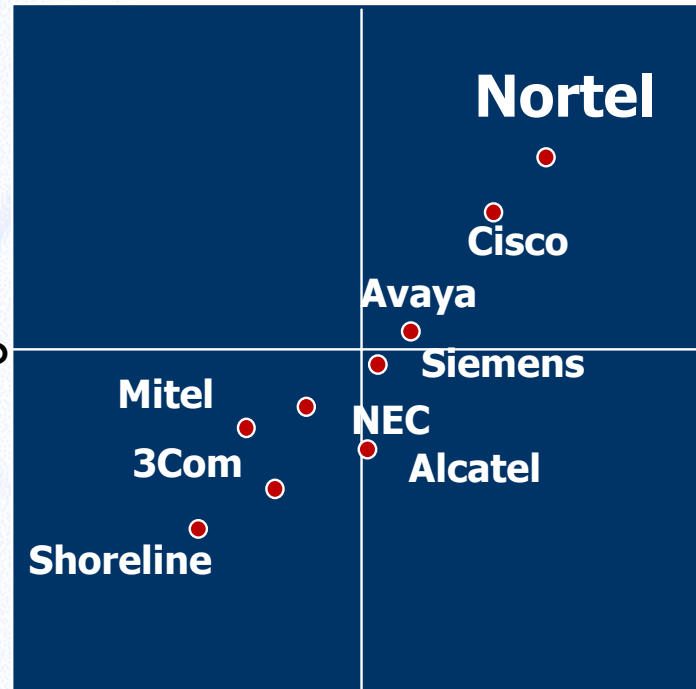
**And the CIO lost his job....**

# Defining the Future

Greater Than 100 Line Solutions

“Nortel leads in both Vision & Ability to Execute.”

Ability to Execute



Completeness of Vision

SOURCE: Gartner Research, February 2002.

# Nortel Networks Leadership

**#1 CPE North America (Total Lines Shipped) - InfoTech**

**#1 VoIP US Q4 '01 (Total Lines Shipped) - InfoTech, The Eastern Management Group**

**#1 VoIP US Q4 '01 (Total Systems Shipped) - InfoTech**

**#1 VoIP IP-Enabled US (Total Lines Shipped) - InfoTech**

**#1 VoIP Converged US (Total Lines Shipped) - InfoTech**

**#1 KTS North America (Total Stations Shipped) - InfoTech**

**#1 KTS Canada (Total Stations Shipped) - InfoTech**

**#1 PBX Canada (Total Lines Shipped) - InfoTech**

**#1 in IP phone systems Q4 '01 - (The Eastern Management**

**#1 Multiservice WAN Switch Q4 '01 - SRG, Dell'Oro, In-Stat**

**#1 Enterprise WAN Switch Q4 '01 - SRG, Dell'Oro, In-Stat**

**#1 ATM Core Switch Q4 '01 - Infonetics**

**#1 IP Service Switch Q4 '01 - SRG, Infonetics**





# *Enterprise Solutions*

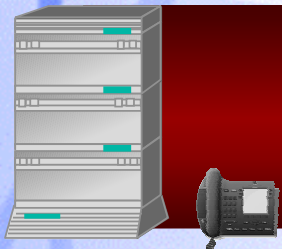
## Nortel Networks Succession Strategy



**Managed Services**



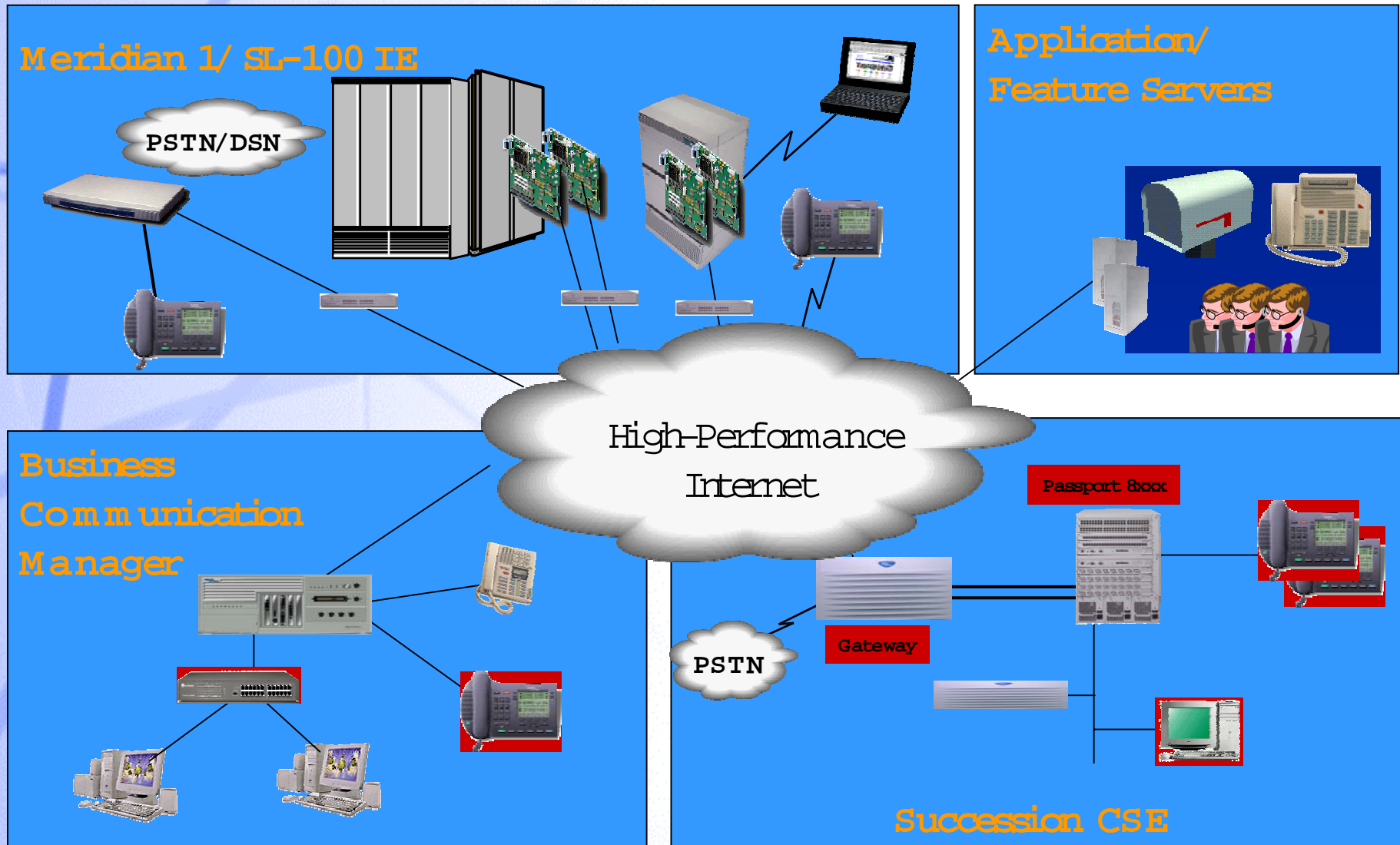
**Succession Communications Server  
for Enterprise 1000**



**Internet Enabled  
Traditional Voice Portfolio**

*Build Out Voice Values to Enterprise Network  
& Managed Services Emerging Market*

# Nortel Networks IP Telephony Portfolio





# Succession Enterprise

## Clients



39xx



802.11



PC



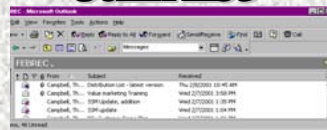
i2004



SIP  
Enabled

## Multimedia Applications

### CallPilot



Unified Messaging



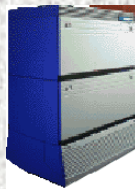
Symposium  
Contact Center  
Peripherals Self-Service

### Multi-Media



Collaboration

## Call Servers



M1



SL-100



BCM



Norstar



CSE 2000



CSE 1000



CSE MX

## Networks Access



TDM

### Passport

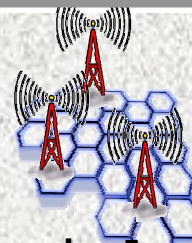


IP, Frame AT M

### Optical



OpTera



Wireless



PRI-SIP

CSE M X brings it all together and completes our strategy



# Introducing *CSE MX*

- *CSE Multimedia Xchange* is a new VoIP Telephony Applications Platform

## *Multimedia applications*

- *Collaborative, mobility, presence, Video services, personal call Management*

## *Xchange*

- *VPN services, number plan consolidation, H.323, MGCP, SIP*



- Built in the Java programming environment

- Hardware independent

- SIP Applications development engine

- CSE MX has evolved from IMS & CS 3000

- Service provider heritage brings ultimate reliability

# Conclusions - as if you weren't there already

- **Nortel is the leader in Voice and Voice over Data, including IP**
- **We are firmly committed to IP based solutions**
- **VoIP needs to be implemented for the right reasons**
- **Convergence and applications values will drive the implementations**
- **Be careful of flimsy, poorly thought savings schemes that do not reflect reality**
- **VoIP will be driven, as the web was, not by IP, but by transformational communications value**