

**Key Note, ISCC 2000,  
Antibes-Juan les Pins, France, July 5, 2000**

# **The Next Generation Networks/Services and IP**

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# What I learned from Euro 2000

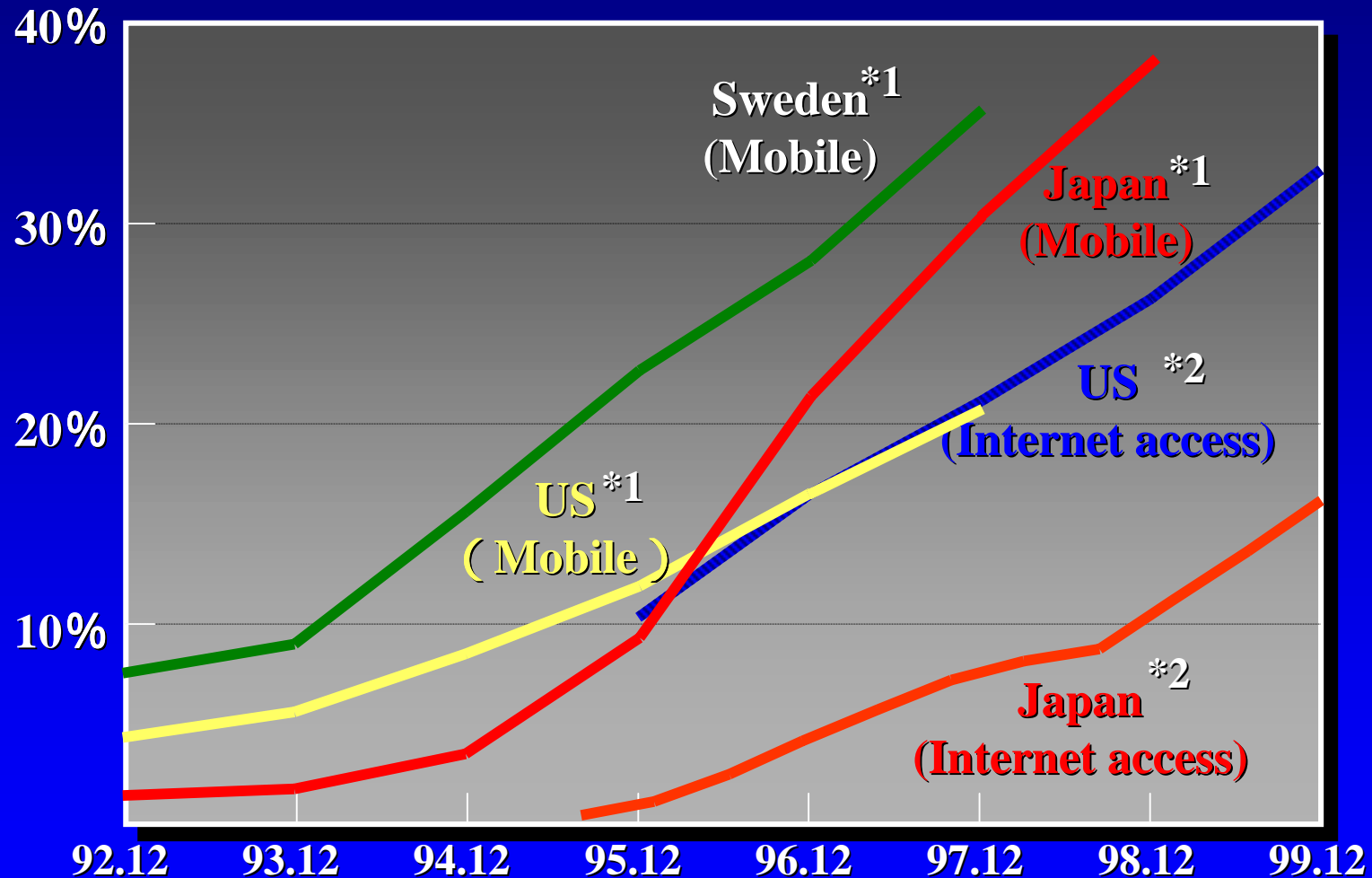


# Outline

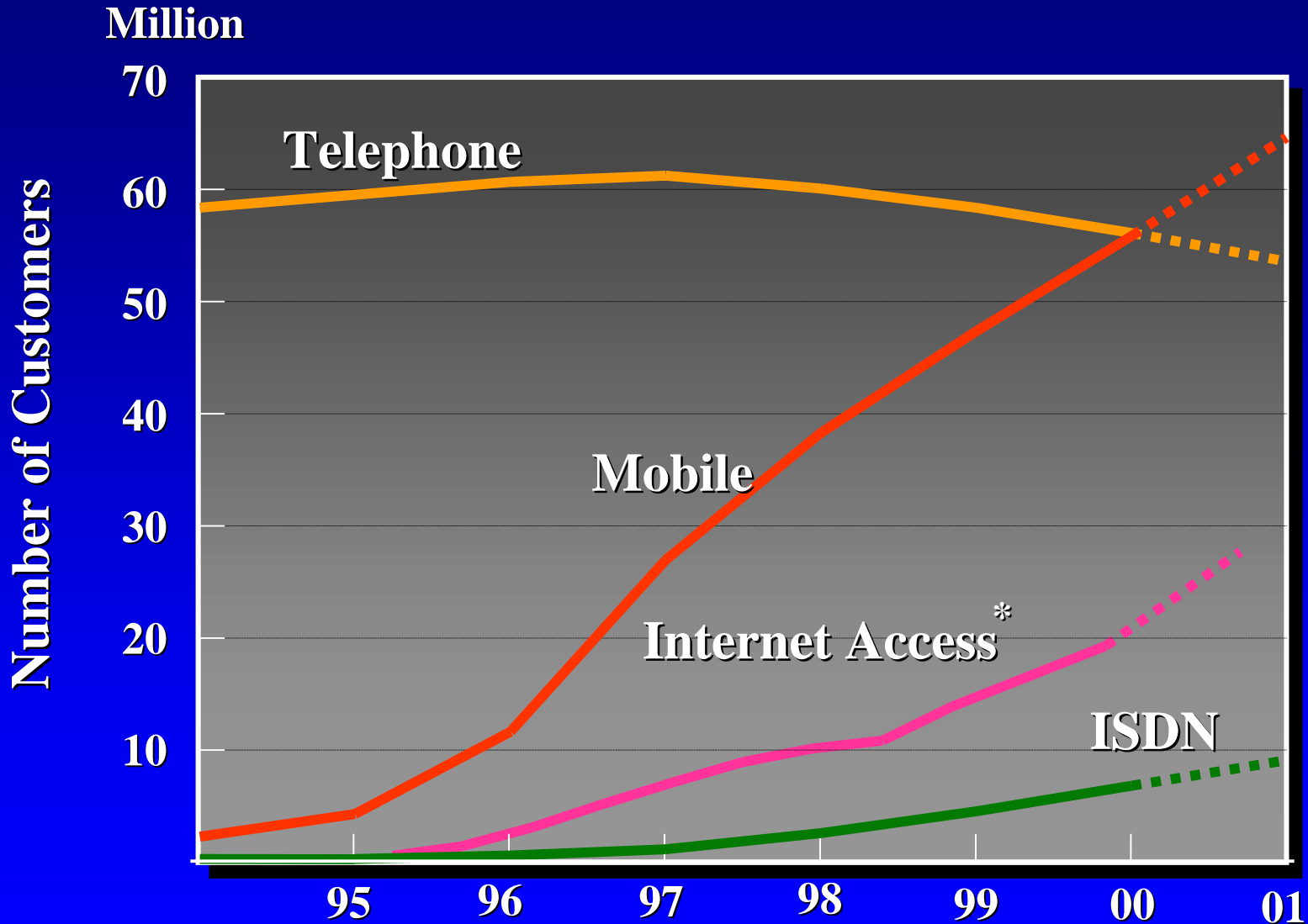
- **Trends in Services**
- **Trends in Technologies**
- **Telecom Networks & Internet**
- **Requirements to NGN**
- **Network Strategies for NGN**
- **QoS Strategies for NGN**
- **Issues & Challenges**

# Trends in New Telecommunication Services

Penetration



# Number of Telecom Customers in Japan

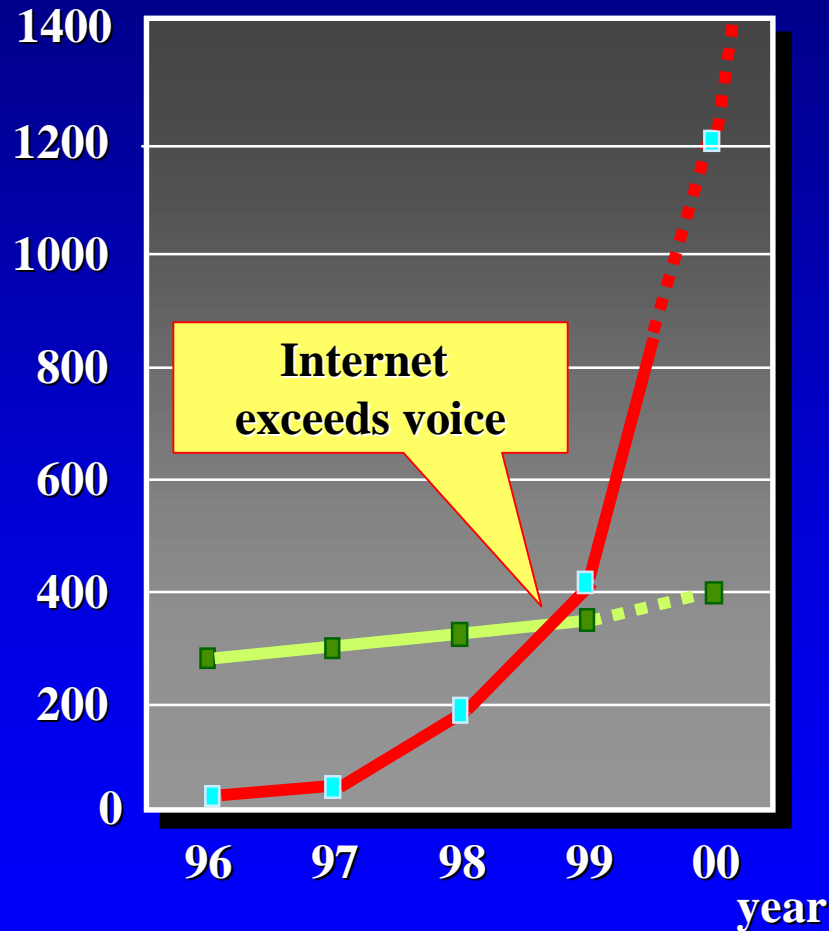


\* : Estimation by IDC (International Data Corporation)

# Growth of Internet Traffic

(Gbit/s)

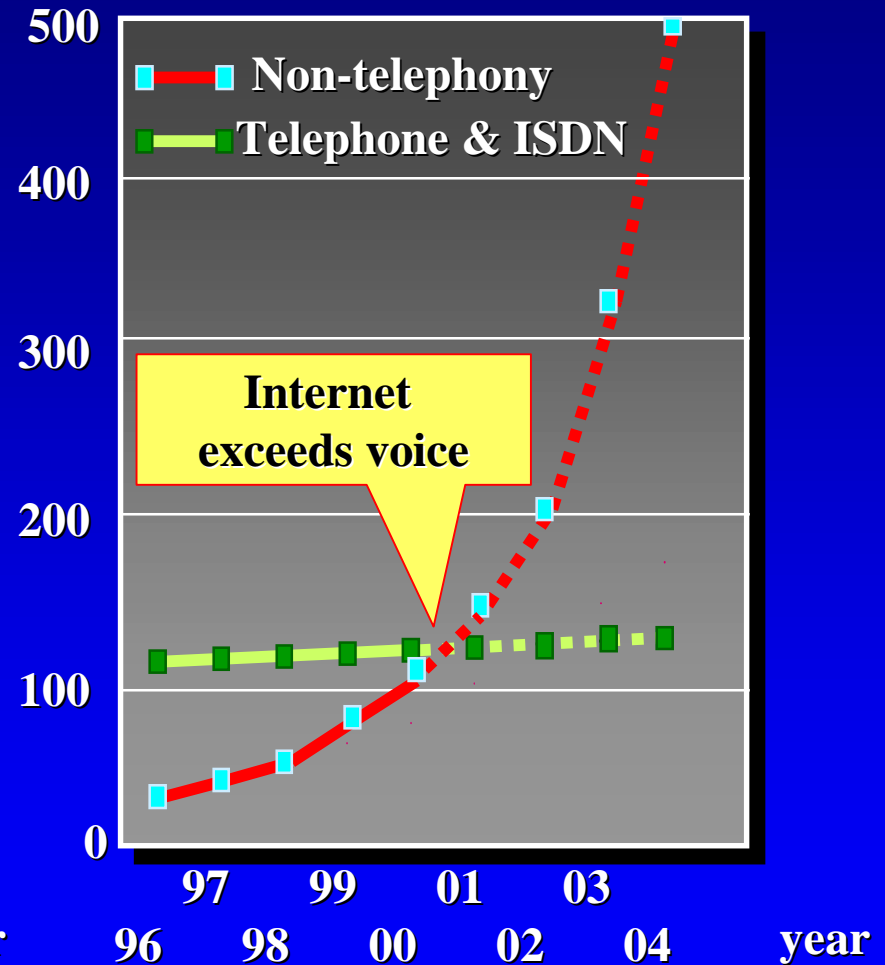
## U.S.A.



Source : IGI Consultation

(Gbit/s)

## Japan



Source: Modified NTT data

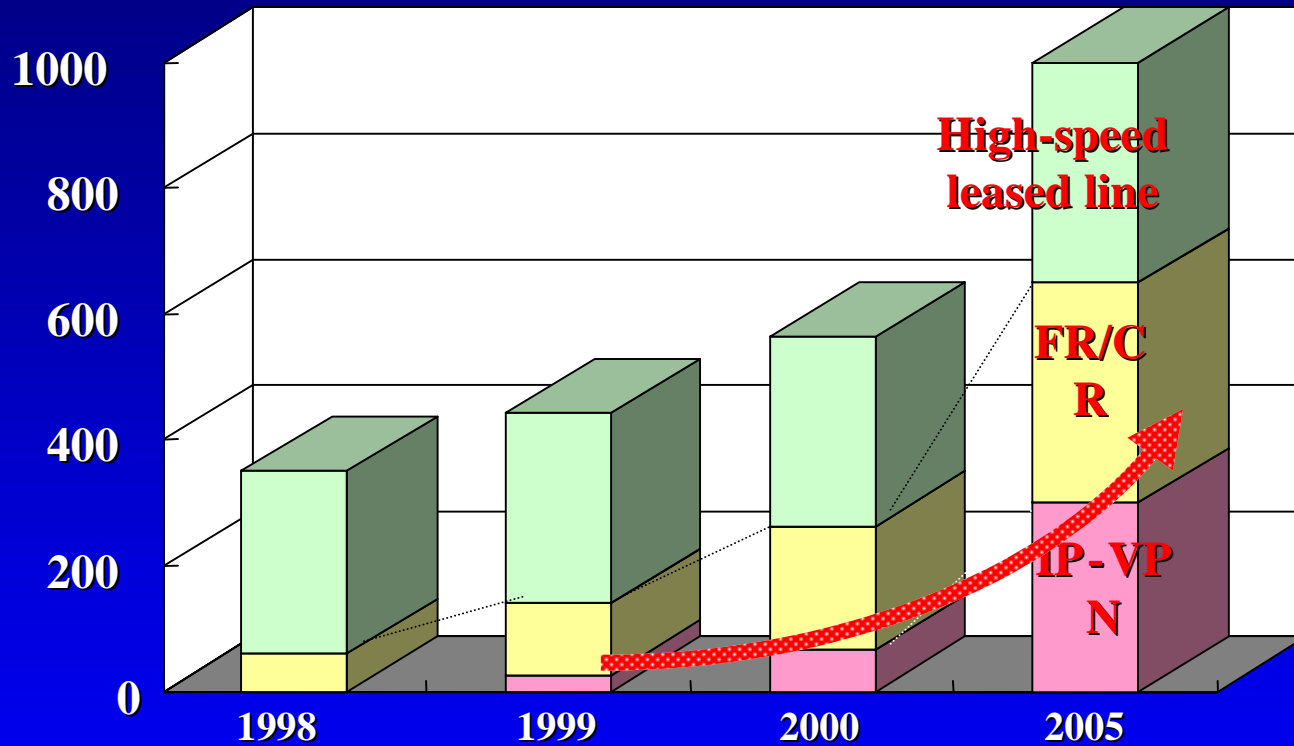
# Key Events

- **1960's Nationwide Network**
- **1970's Dial Connection**
- **1980's Global Dial Connection, Digital Integration**
- **1990's Internet Explosion**  
(1998 Internet traffic exceeds telephone traffic.)
- **2000 Mobile phones exceeded fixed telephones**  
**Mobile Internet (i-Mode) : 8M users in 1.5 yrs**
- **-2010 IT & Home Electronics, Digital Migration ? ?**



# Estimated VPN Market in Japan

(billion yen)



FR: Frame Relay  
CR: Cell Relay

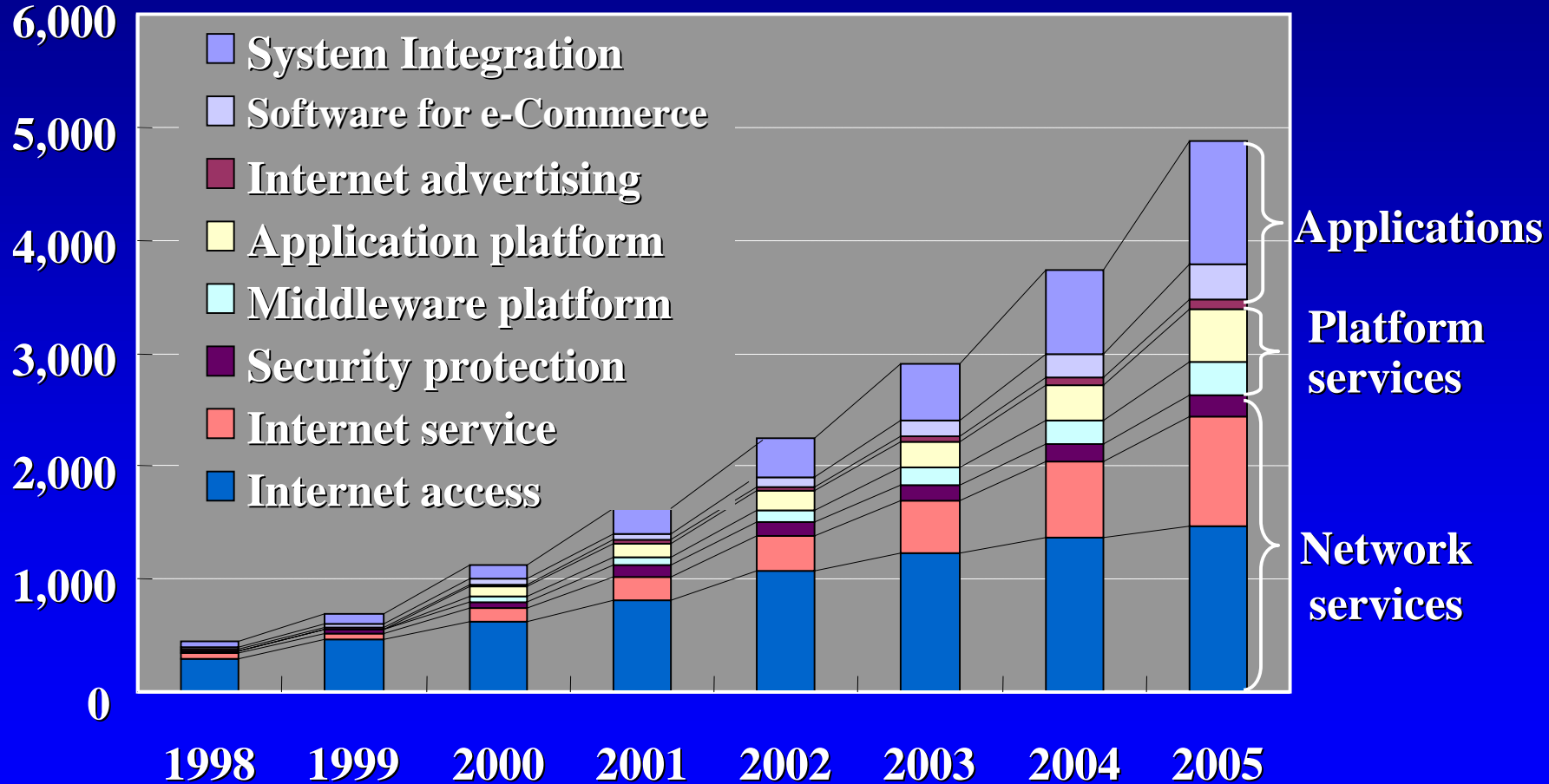
## IP VPN Market

Year	1998	1999	2000	2005
Yen	-	26 billion	68 billion	300 billion

- 90% of FR/CR uses TCP/IP.  
- Assumption: 30% of high-speed leased line and FR/CR customers will use IP-VPN in 2005.

# Market for Multimedia IT Services in Japan

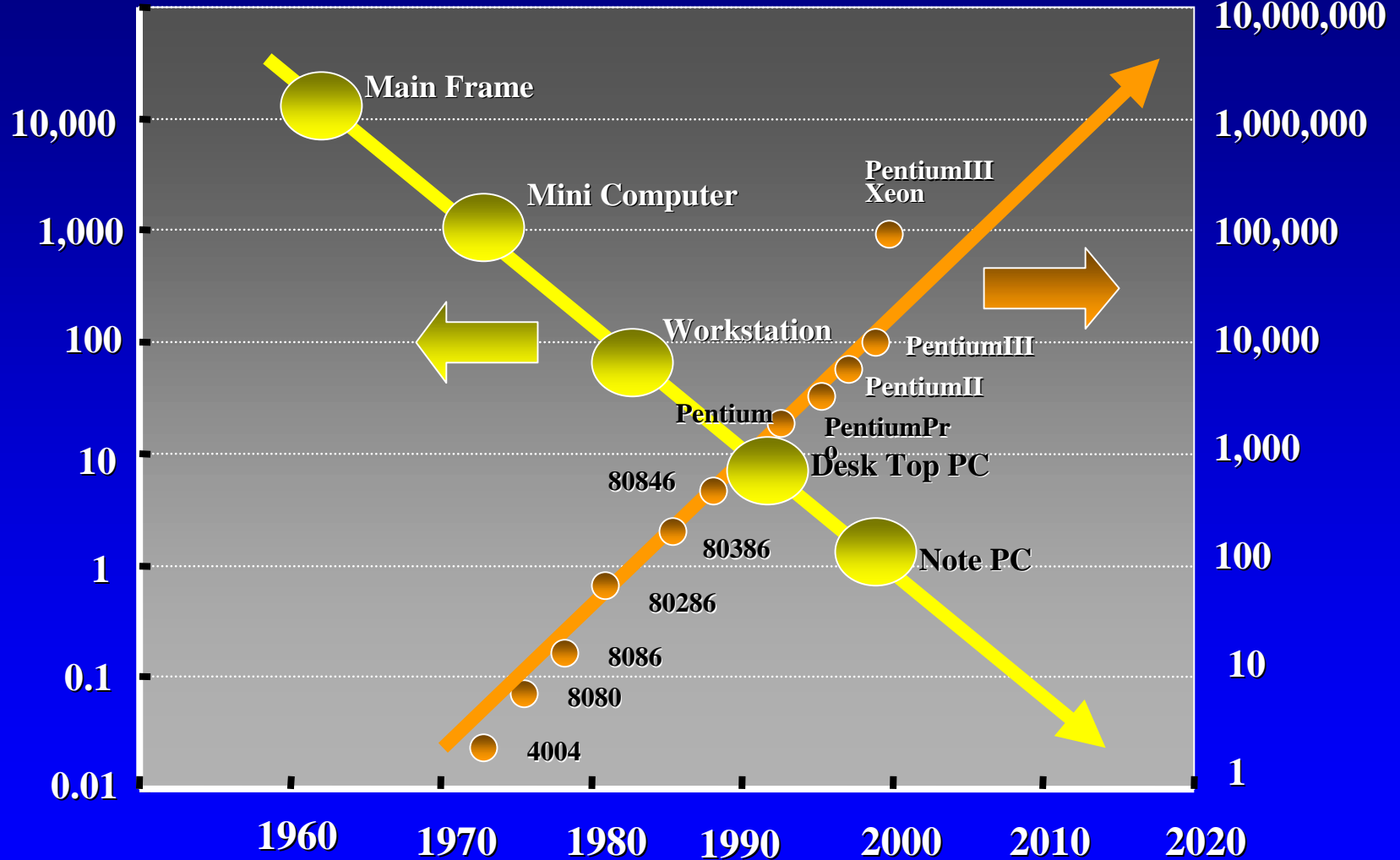
(billion yen)



# Technology Trends

Weight (kg)

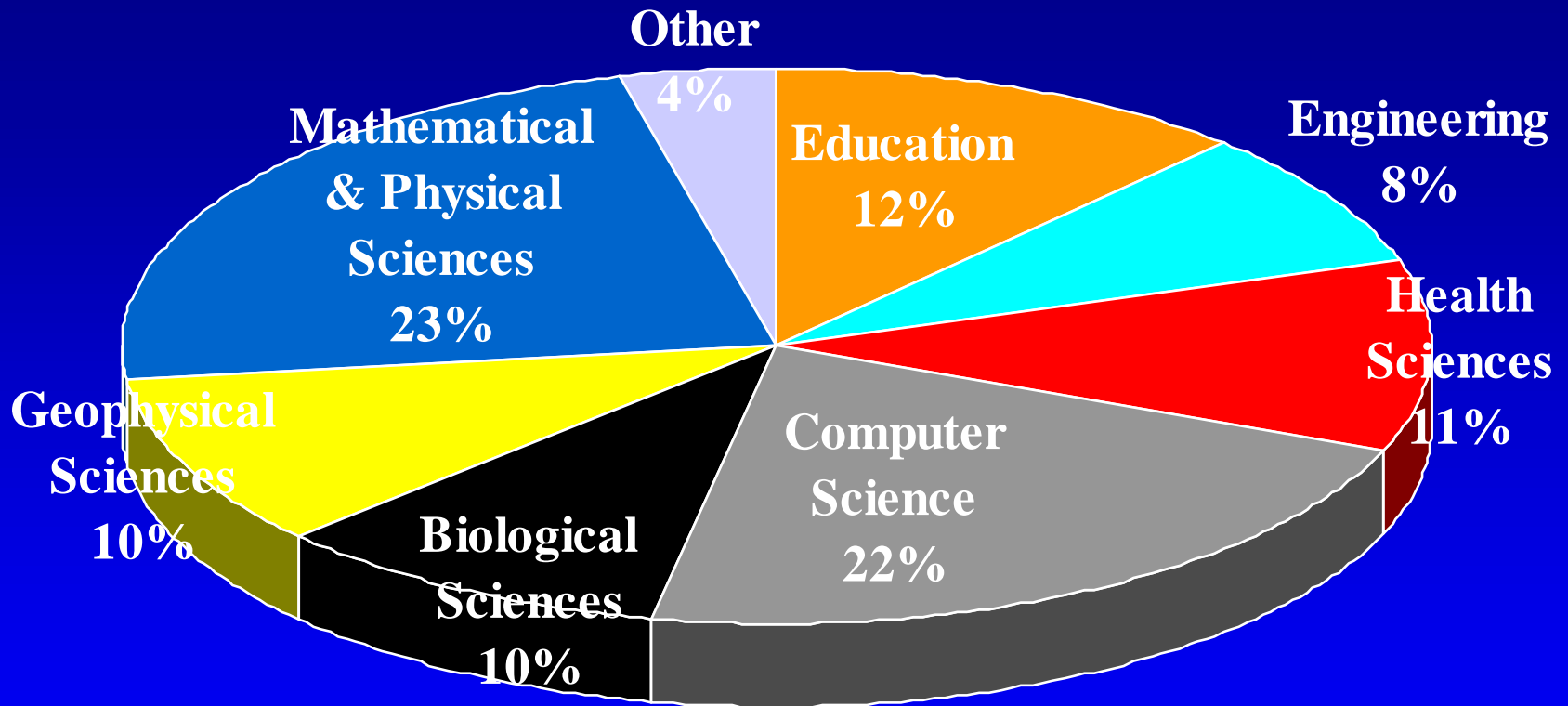
Number of transistors on a chip



Source: TIME, July 3, 2000

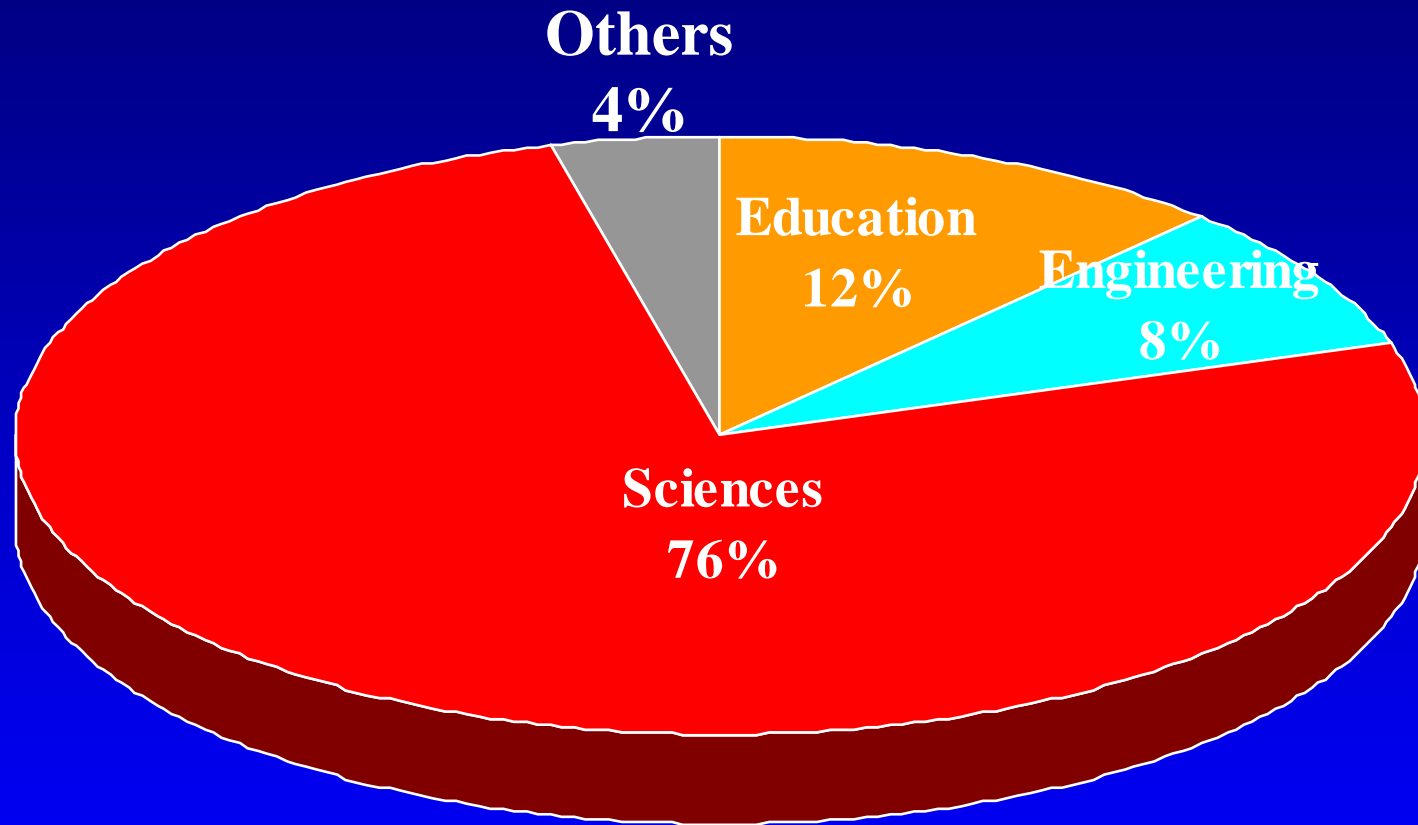
K. Asatani, ISCC 2000

# Distribution of Internet2 Projects



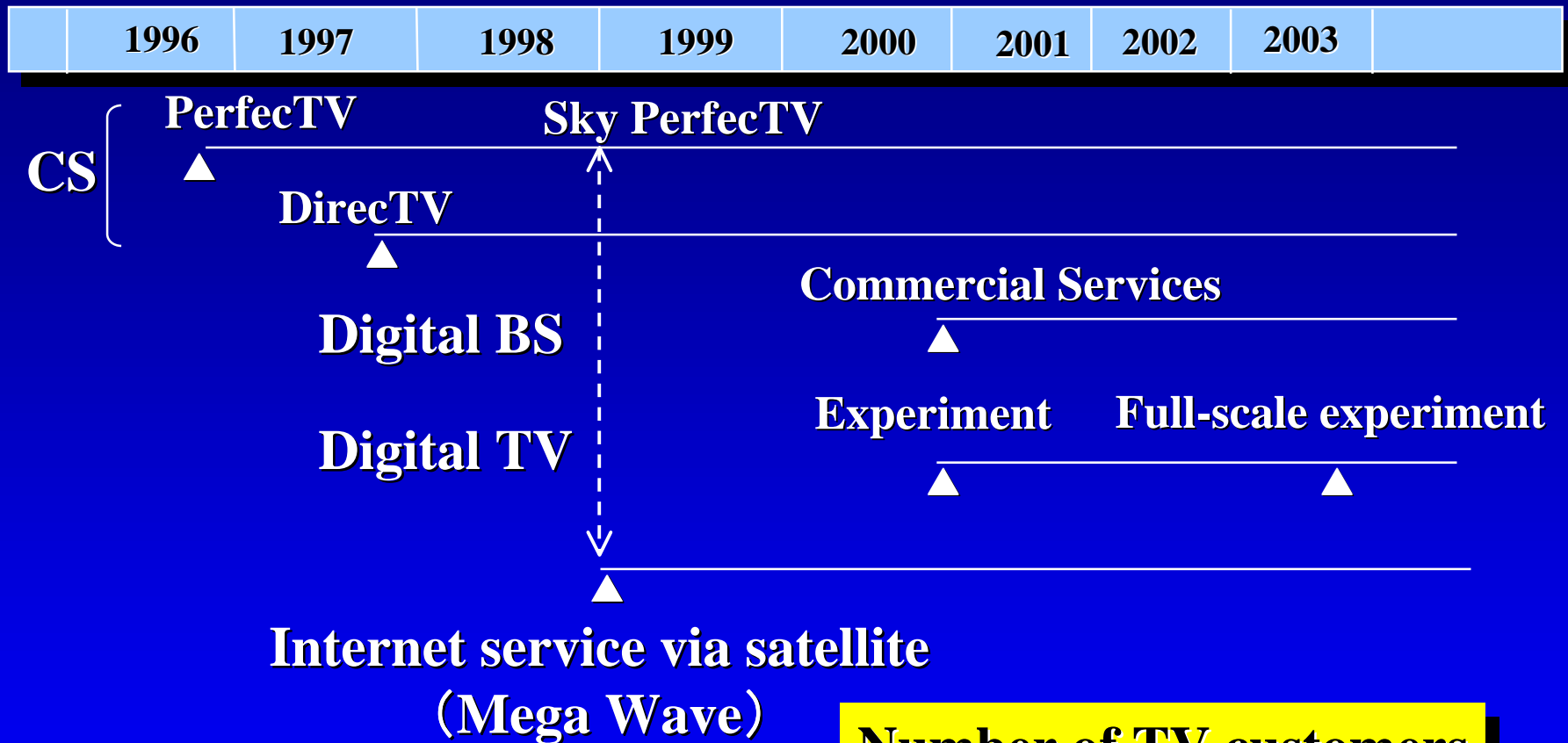
Source :  
<http://www.ncsa.uiuc.edu/SCD/DAST?clearing/graphics/disc.htm>

# Distribution of Internet2 Projects



Source :  
<http://www.ncsa.uiuc.edu/SCD/DAST?clearing/graphics/disc.htm>

# Digital TV Broadcasting in Japan



**Number of TV customers**

- TV: 27 million
- BS: 13 million
- CS: 1 million

# Telecom at a glance

- **Global telephone services with guaranteed quality (233 countries/regions)**
- **High scalability**
- **Advanced capability (e.g. IP over ATM)**
- **Matured traffic engineering**  
**Predictable/measurable traffic**
- **Quick recovery from network failure**
- **Easy E-E network operation**
- **Stable growth (e.g., 8%/year in USA traffic, 4B subscribers in Y2K)**

# Internet at a glance

- **Non-guaranteed QoS :Best Effort**
- **Global connectivity:**
  - IP: 96countries, UUCP:144 countries,**
  - e-mail:173 countries**
- **Low scalability**
- **Enhancing new services: CO emulation**
- **Premature traffic engineering**
  - Hard to predict/measure traffic**
- **Hard to recover from network failures**
- **Complicated E-E network operation**
- **High growth (e.g. 100%/year in USA traffic)**



# Characterizations of Internet & Telecom

	Internet	Telecom
QoS	non-guaranteed best effort	<b>guaranteed</b>
Primary Objective	<b>reachability</b>	<b>real time</b>
Connection	connectionless	connection
Security	low	<b>high</b>
Dependability	?/low	<b>high</b>
E-to-E operability	low	<b>high</b>
Cost/bit	<b>low</b>	high
Charging	<b>flat/on usage</b>	on usage

# Network Management for NGN

- **Connectionless type network**
  - controls at transport layer (TCP)
  - controls by host servers (end systems)
    - limited capability by end system control
    - user demands for cheap but unreliable services
- **Connection-type**
  - controls at network layer
  - controls by network nodes
    - real time voice, moving picture(streaming signals)
    - user demands for reliable services
- **Likely Solution**
  - connectionless + connection emulation
  - end system control + network node control

# Some requirements to NGI

- **Reliable**
  - proven technology
  - self healing
- **Bandwidth Management**
  - limited bandwidth need management
- **Quality of Service**
  - some flows need timeliness or constant bit rate

Source: Based on R. Goode, Global IPv6 Summit, Paris, 1999.10

# Some Requirements to NGI

- **Priority Levels**
  - some messages outrank other ones
- **Simple to Manage**
  - infrastructure must not be too complex to manage
- **Low Protocol Overhead**
  - limited bandwidth must be used efficiently (header compression, multicasting)

Source: Based on R. Goode, Global IPv6 Summit, Paris, 1999.10

# IPv6の技術的特徴

- 1 . 拡張されたIPアドレス空間 128ビット (32ビット : IPv4)
- 2 . 自立的な構成技術 低管理コスト
- 3 . モバイルIP
- 4 . マルチキャスト、エニ-キャストのサポート
- 5 . セキュリティの組み込みによるセキュリティ向上
- 6 . フローラベルによるQoS制御
- 7 . 既存のインターネットアプリケーションへの後方一貫性
- 8 . IPv4よりも優れたパフォーマンス
- 9 . コンパクトで単純なヘッダ構成
- 10 . 将来への拡張性 ( 拡張ヘッダ )

# IPv6 Features

- 1 Extended IP Address Space 128bit (32bit : IPv4 )
- 2 Auto-configuration
- 3 Mobility
- 4 Multicast, Anycast
- 5 IPSec
- 6 Flow label
- 7 Backward compatibility
- 8 Better performance
- 9 Compact & simple header
- 10 Future extension (extended header)

# Requirements for NGN

attribute	values
QoS	non-guaranteed QoS with less price & <b>guaranteed QoS</b>
Primary Objective	<b>reachability &amp; real time</b>
Connection	do not care
Security	low with less price & <b>high</b>
Dependability	low with less price & <b>high</b>
E-to-E operability	<b>high</b>
Cost/bit	<b>low</b>
Charging	<b>flat/on usage</b>

# Network Resource Management Overview

QoS Non-Guaranteed

QoS Guaranteed

Connectionless

*No Network Resource Management*  
**IP**

*Statistic Network Resource Management*  
**DiffServe**

Connection

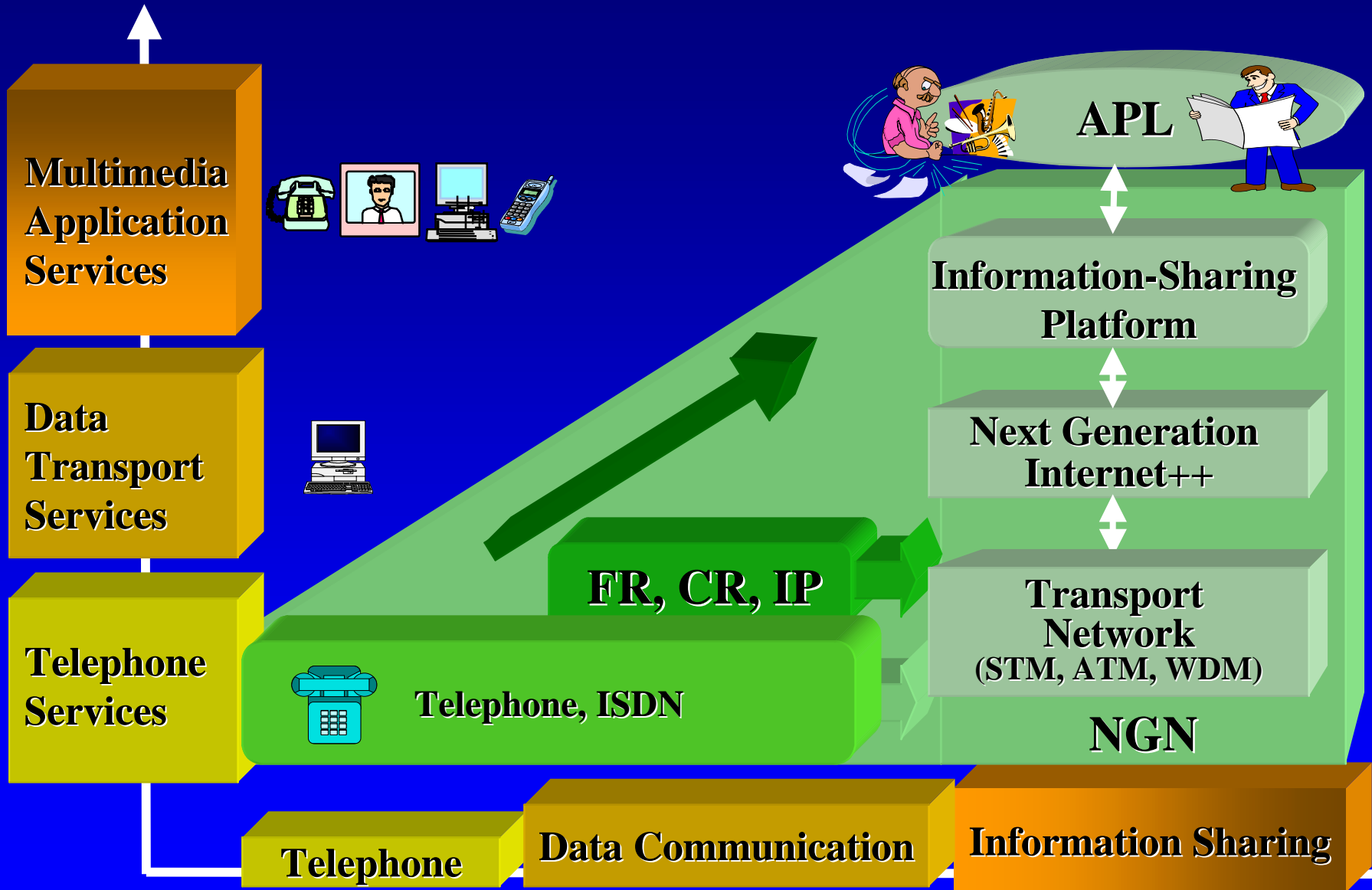
*Statistic Network Resource Management*  
**ATM UBR**  
**ATM ABR**

*Statistic Network Resource Management*  
**ATM VBR**

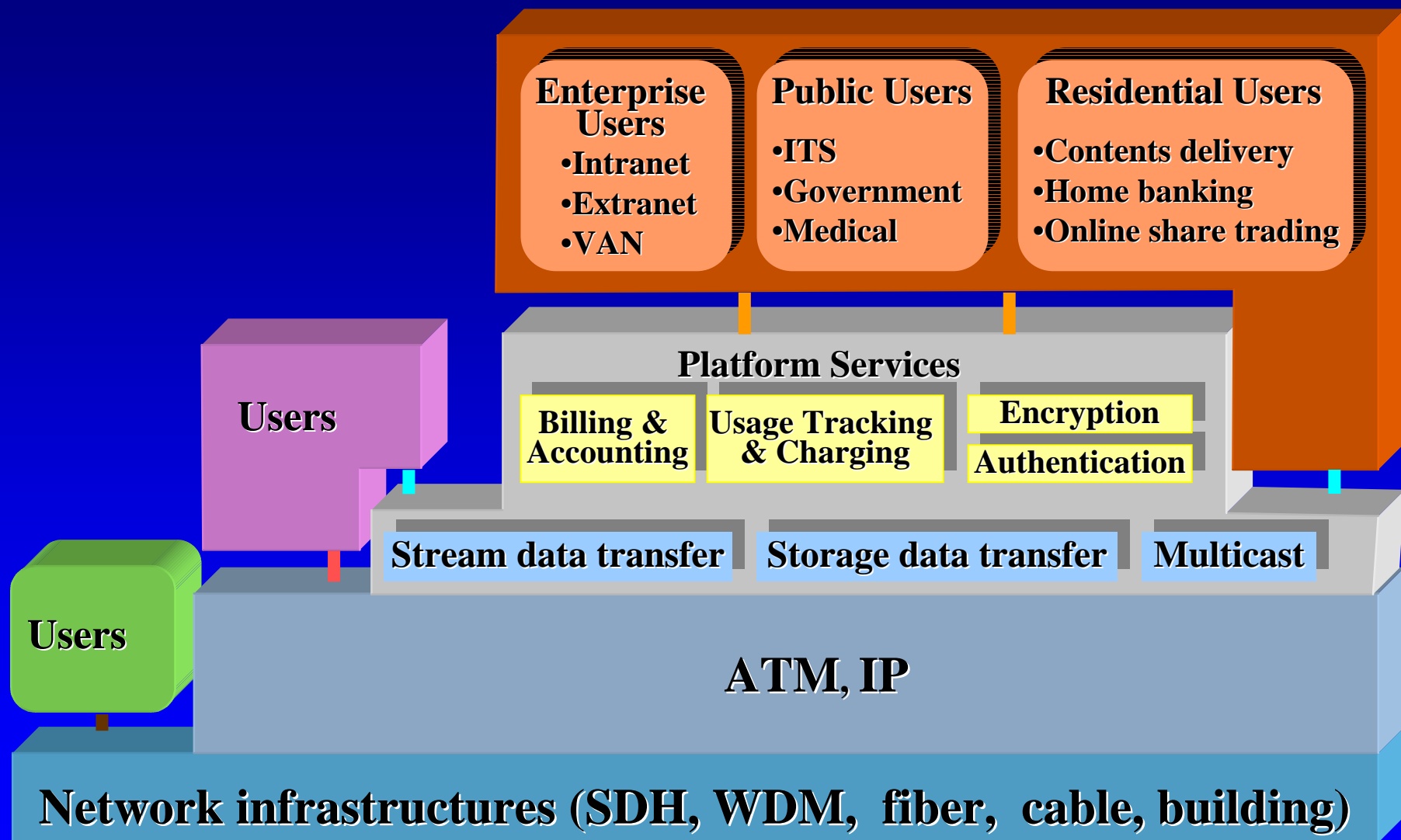
*Deterministic Network Resource Management*  
**ATM CBR**  
**Internet RSVP**



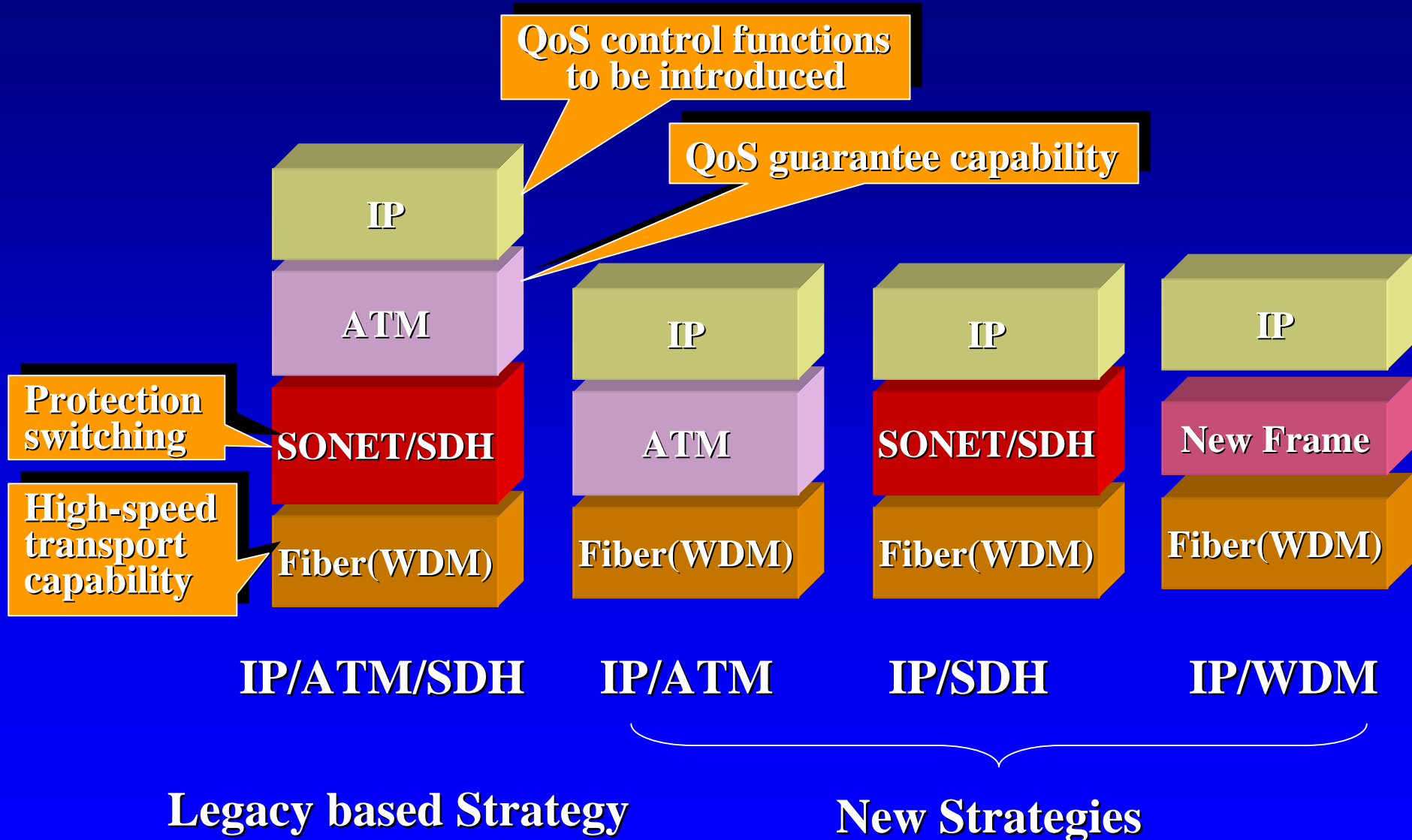
# New Paradigms in Communication Networks



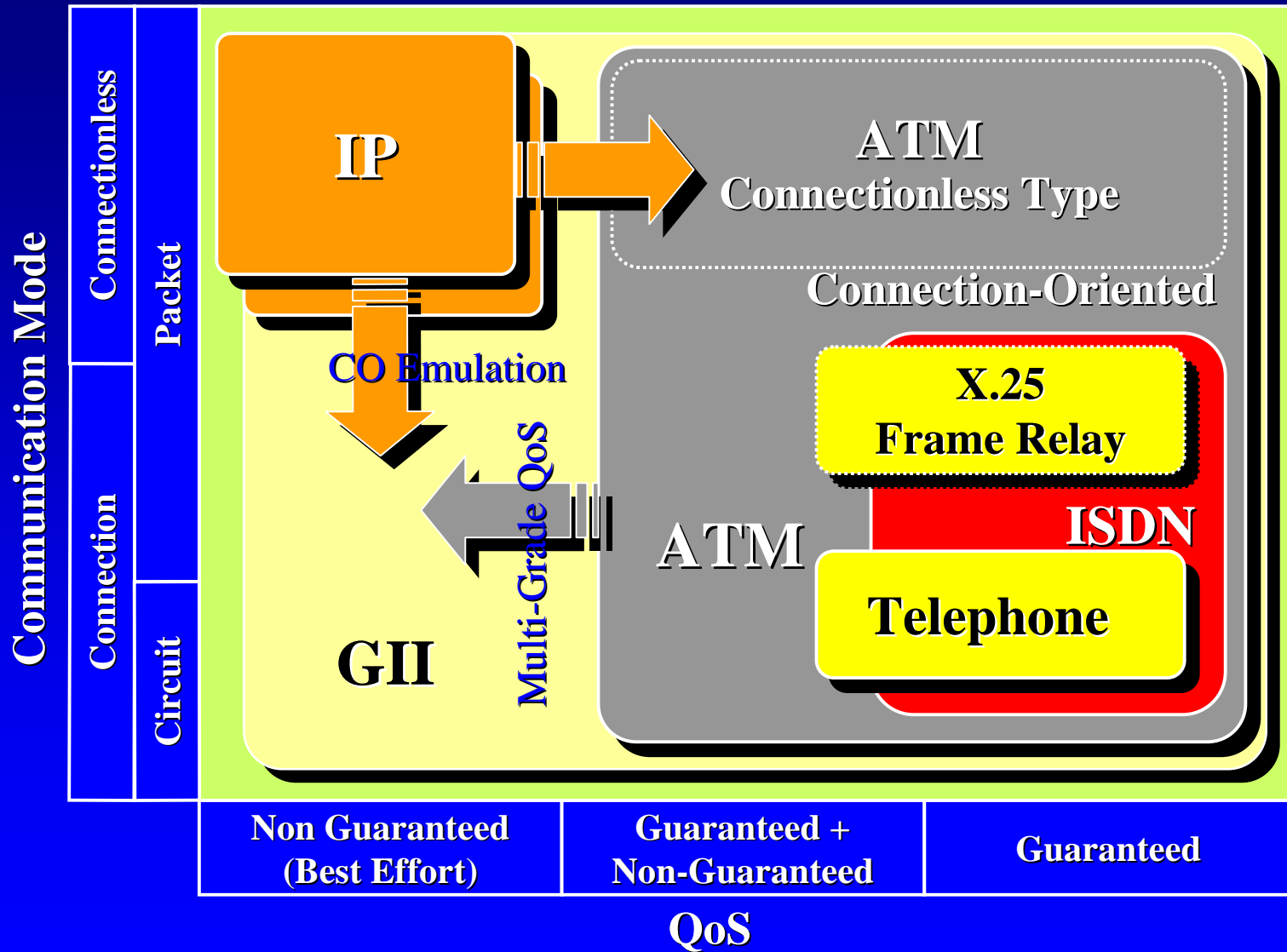
# Platform Services for Information Sharing



# Backbone Transport Network Strategies



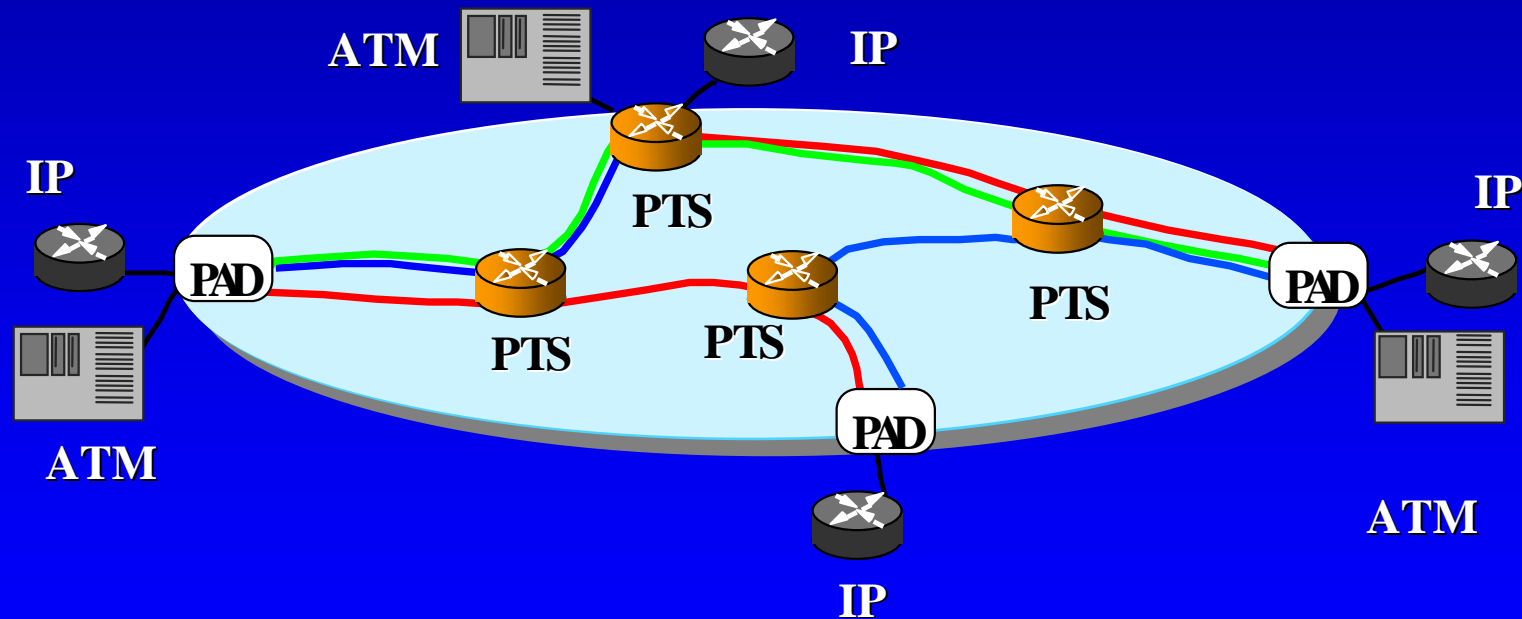
# Multimedia Communications and QoS



# Simple and High-Speed Photonic Networks

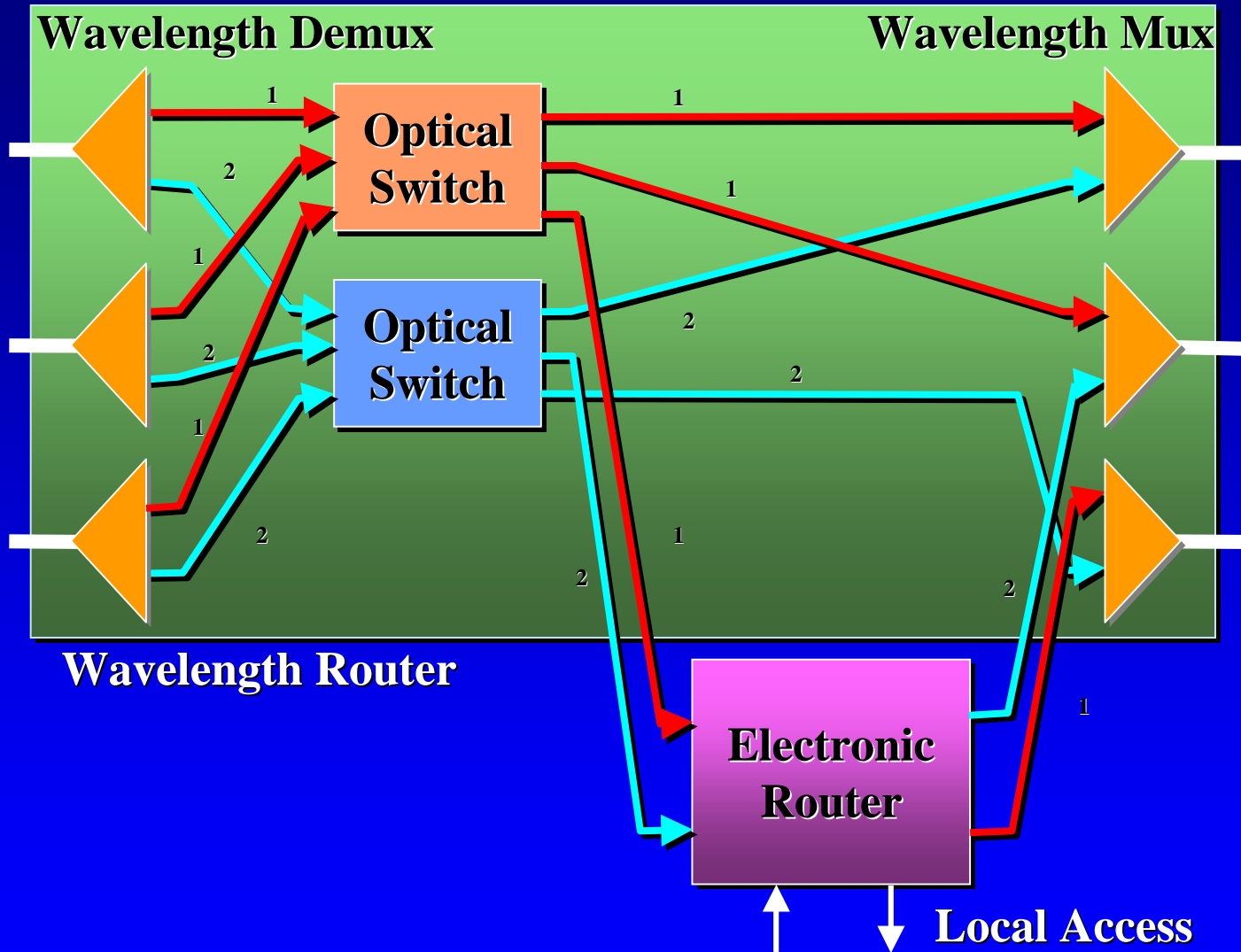
## Wavelength Path

- Tera bit/s Network
- Small Delay Backbone
- Cost-Effective Network



PTS: Photonic Transport System  
PAD: Payload Assembler-Disassembler

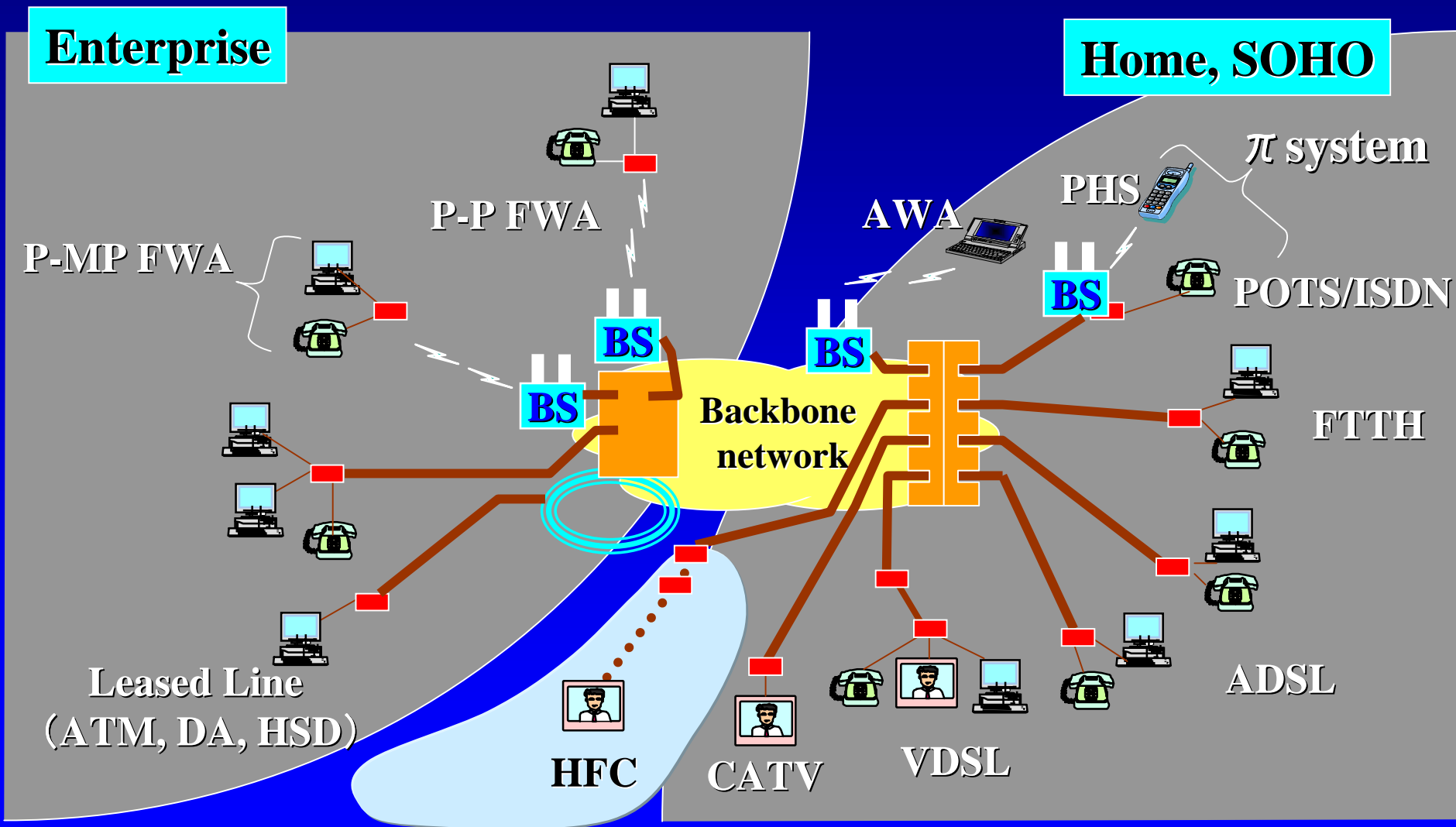
# Wavelength Router



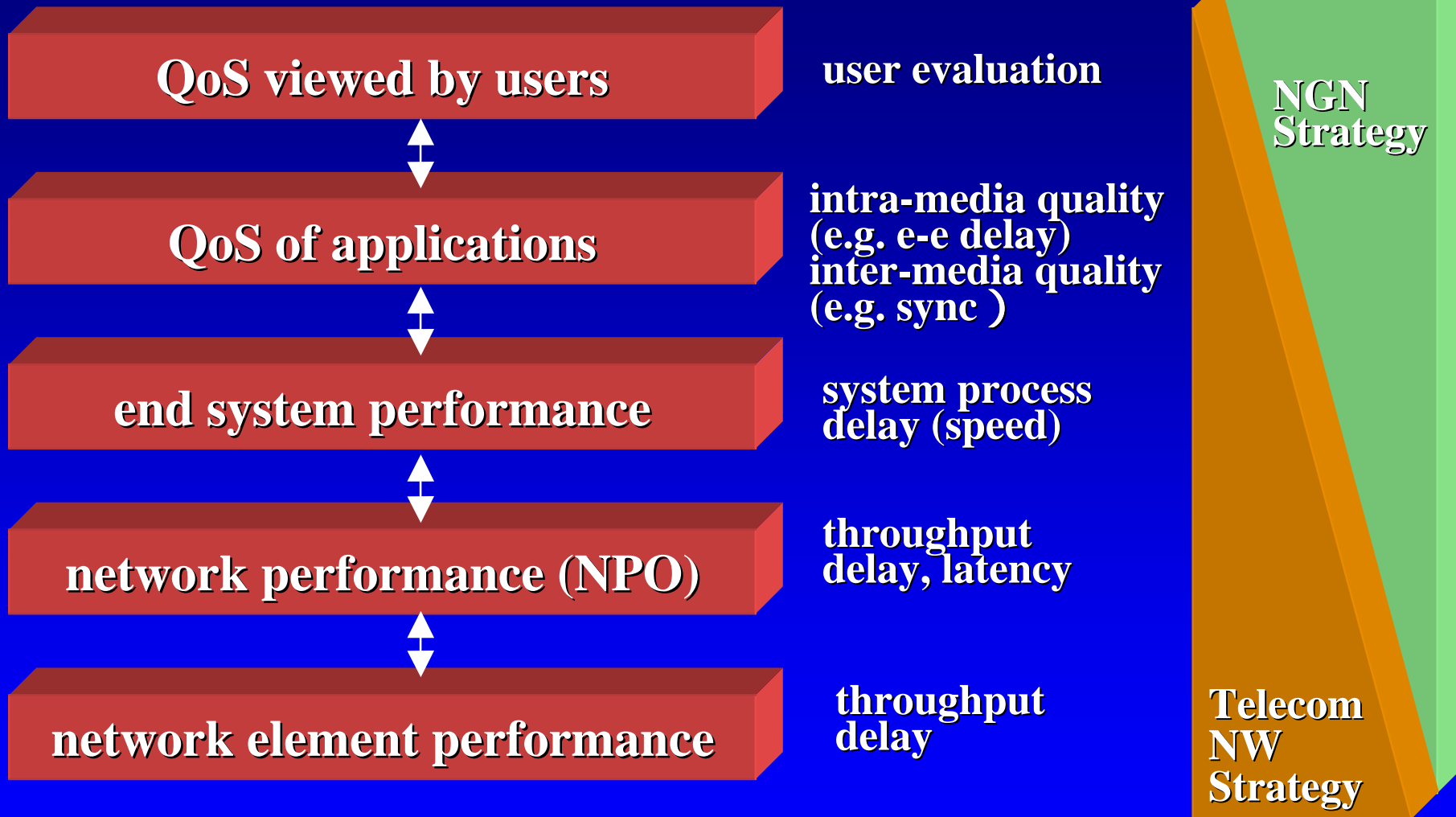
Source: M. Murata, K. Kitayama & H. Miyahara

K. Asatani, ISCC 2000

# Access Service Lineup



# QoS Architecture

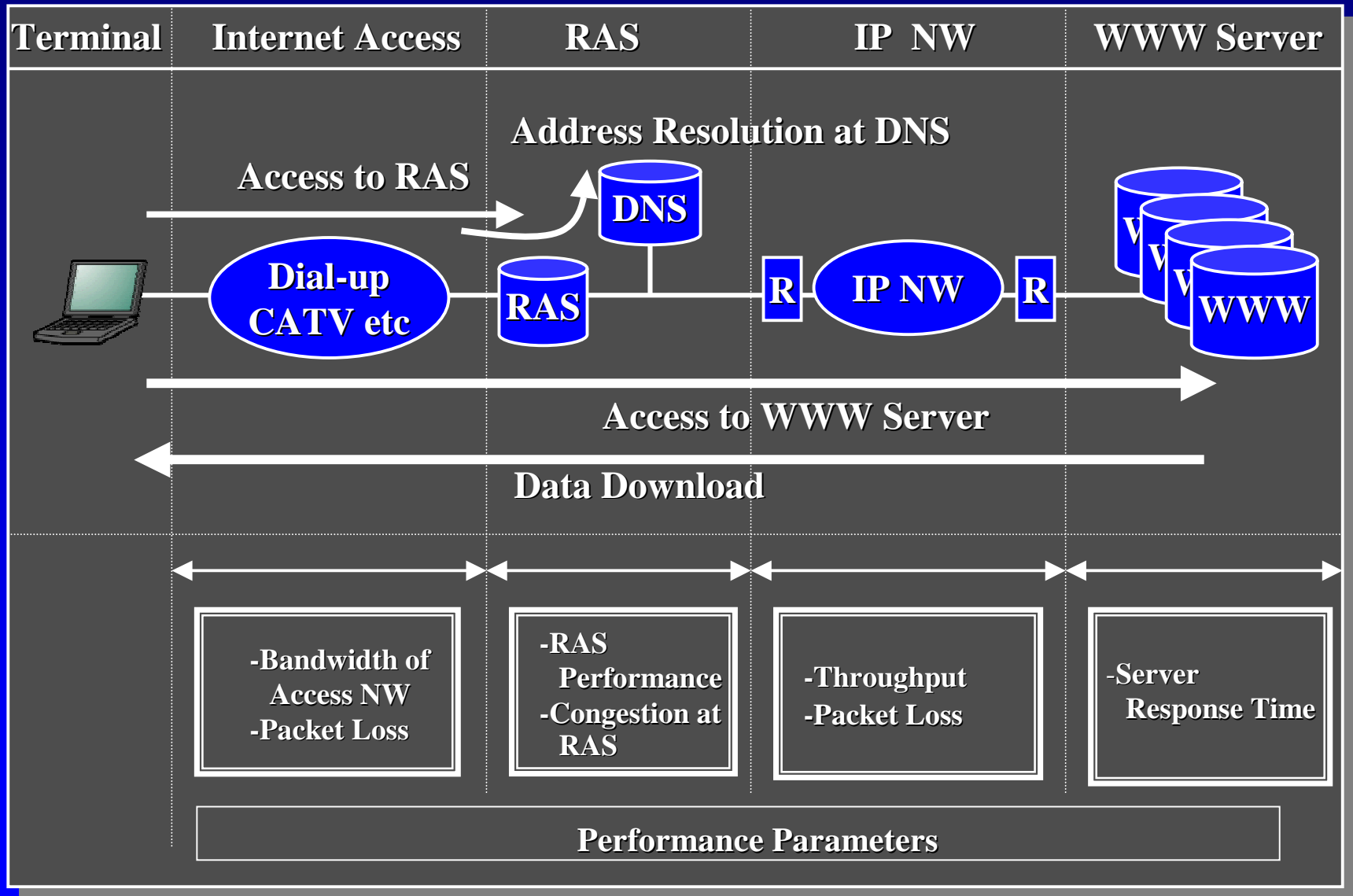


**NPO : Network Performance Objectives**

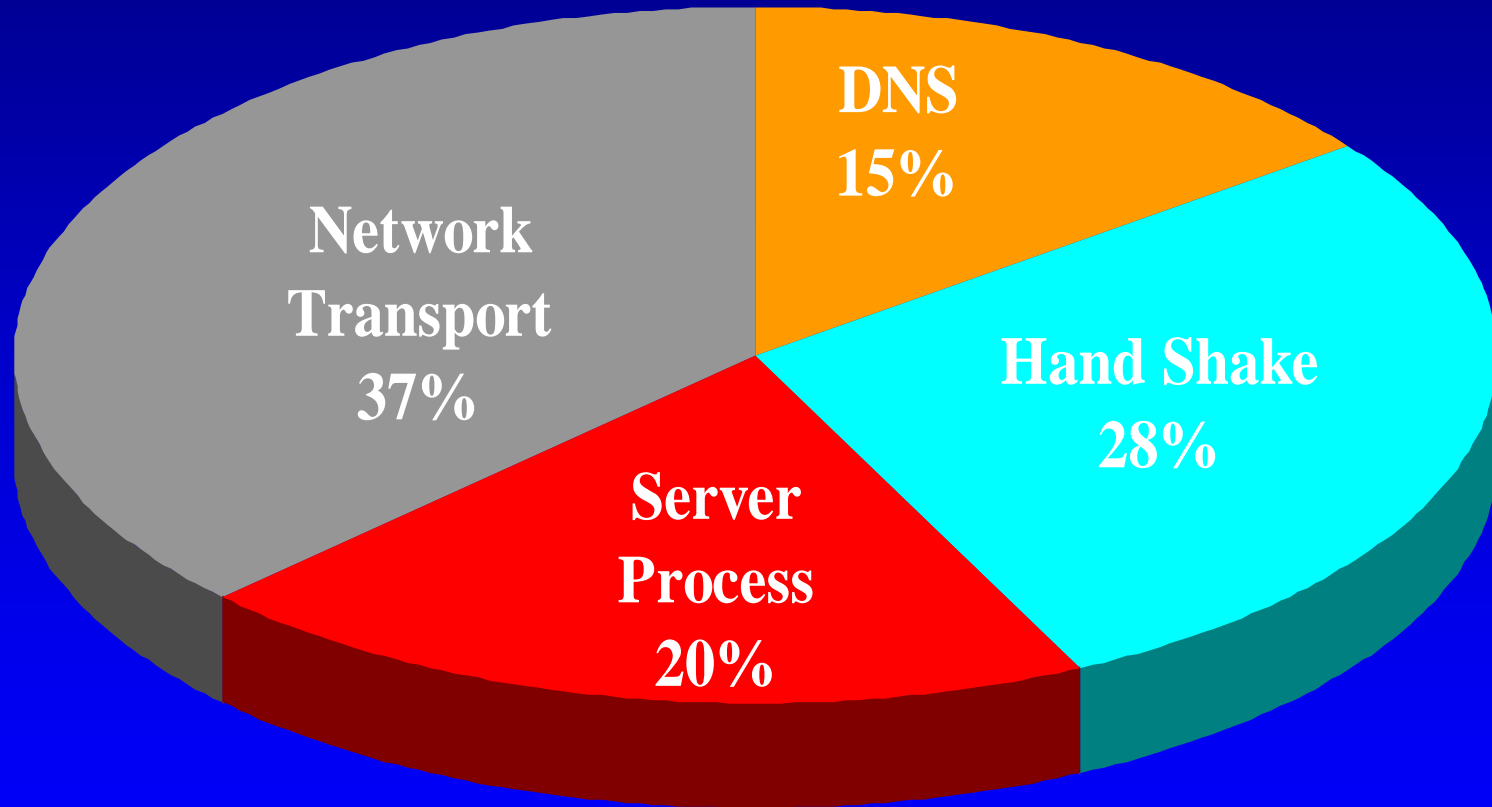
**EDO : Equipment Design Objectives**



# QoS for WWW Server Access



# Delay Distribution in Web Downloading

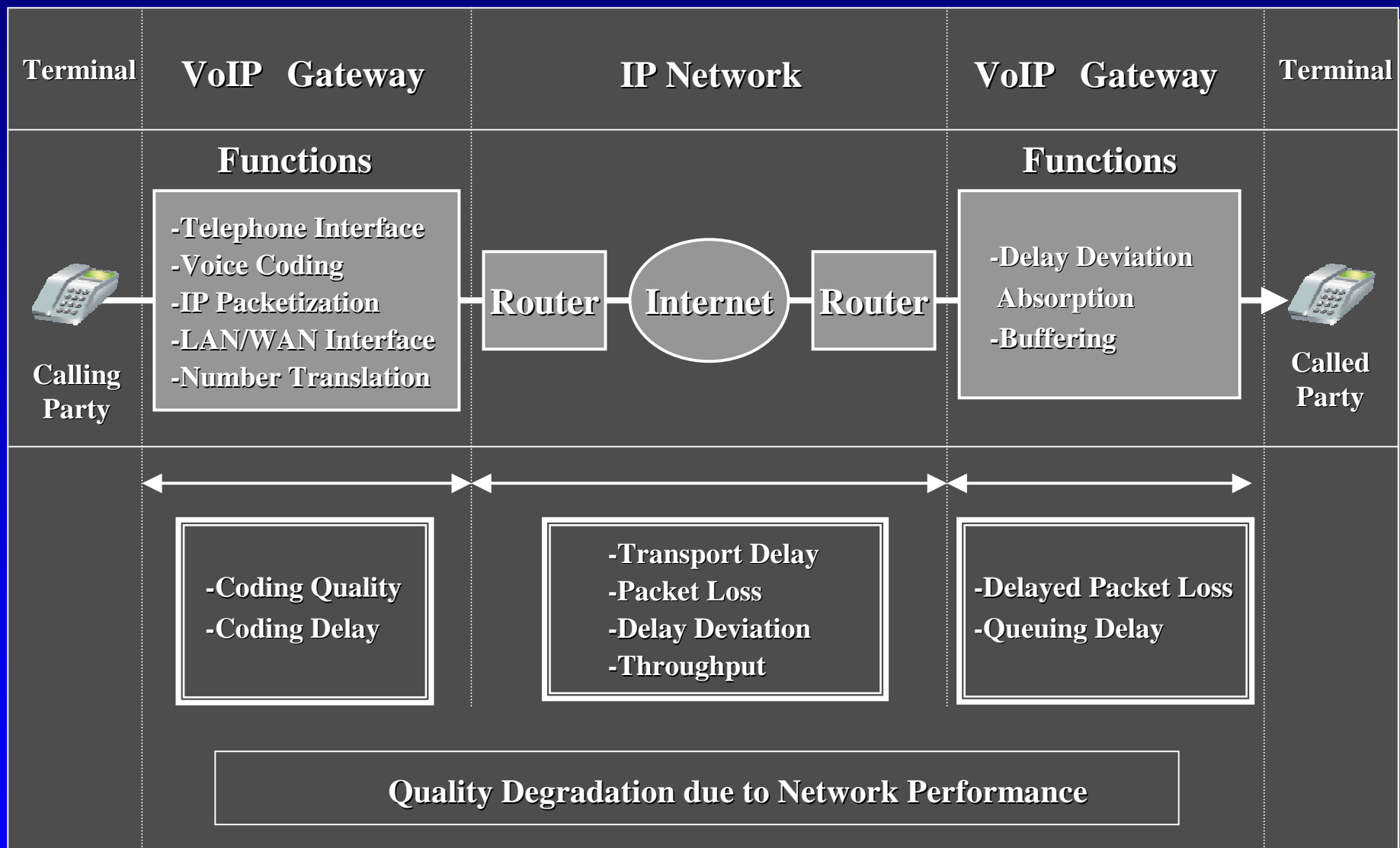


Source: Y.Fujita, M. Murata & H.Miyahara, Trans.IEICE, 1998.  
Based on the data at <ftp://www.telcordia.com/pub/huitema/stats>

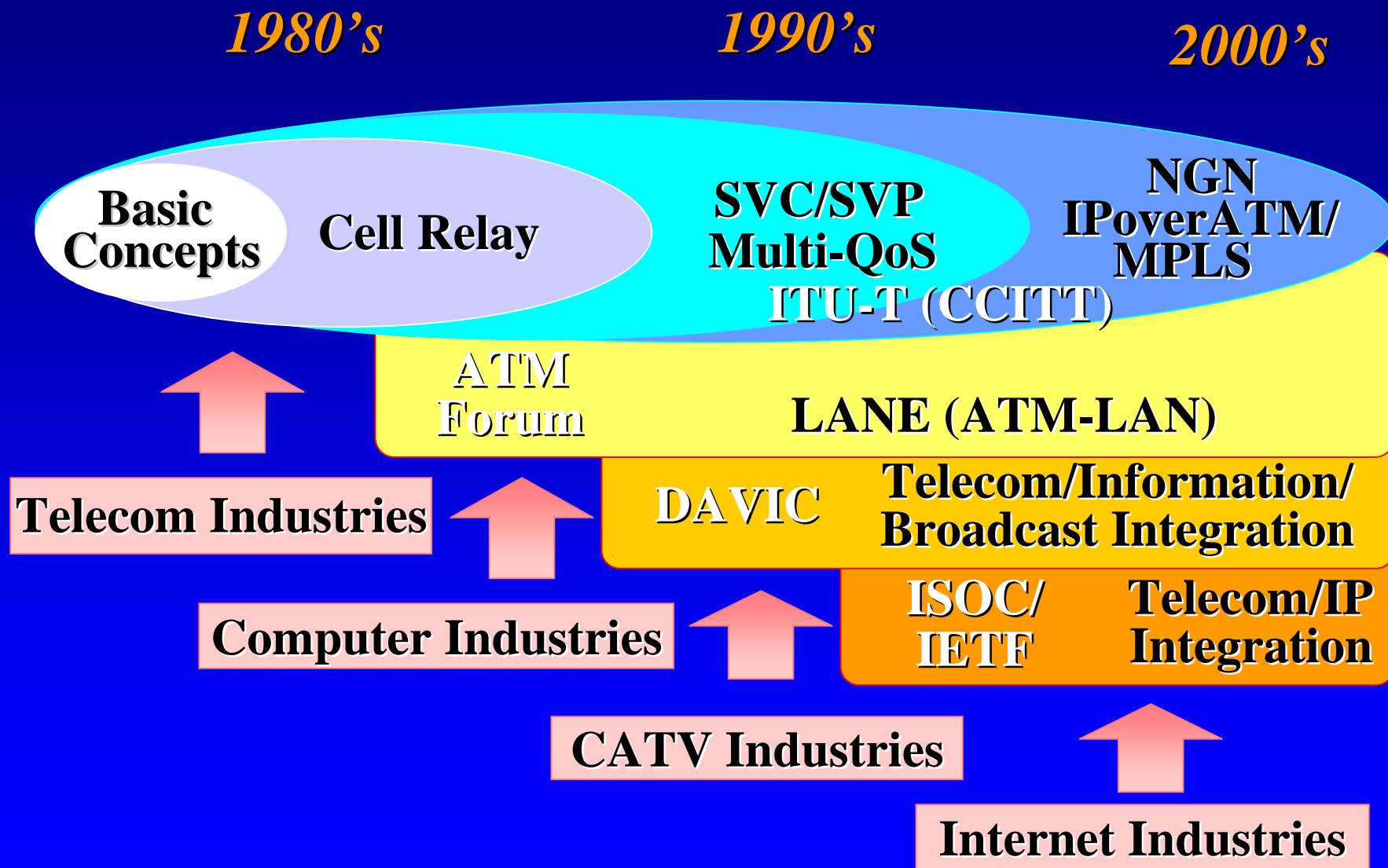
# QoS Role is Growing



# VoIP QoS & Performances



# Scope & Involvement of ATM Standards



# Scope & Involvement of IP Standards

*-1980's*

*1990's*

*2000's-*

**TCP/IPv4  
ftp,smtp**

**WWW**

**RTP  
VoIP**

**QoS  
Multicast  
IPv6**

**IETF/ISOC**

**ATM  
Forum**

**MPOA LAN/WAN**

**Internet Industries**

**ITU-T**

**Telecom/IP  
Integration (GII)**

**Computer Industries**

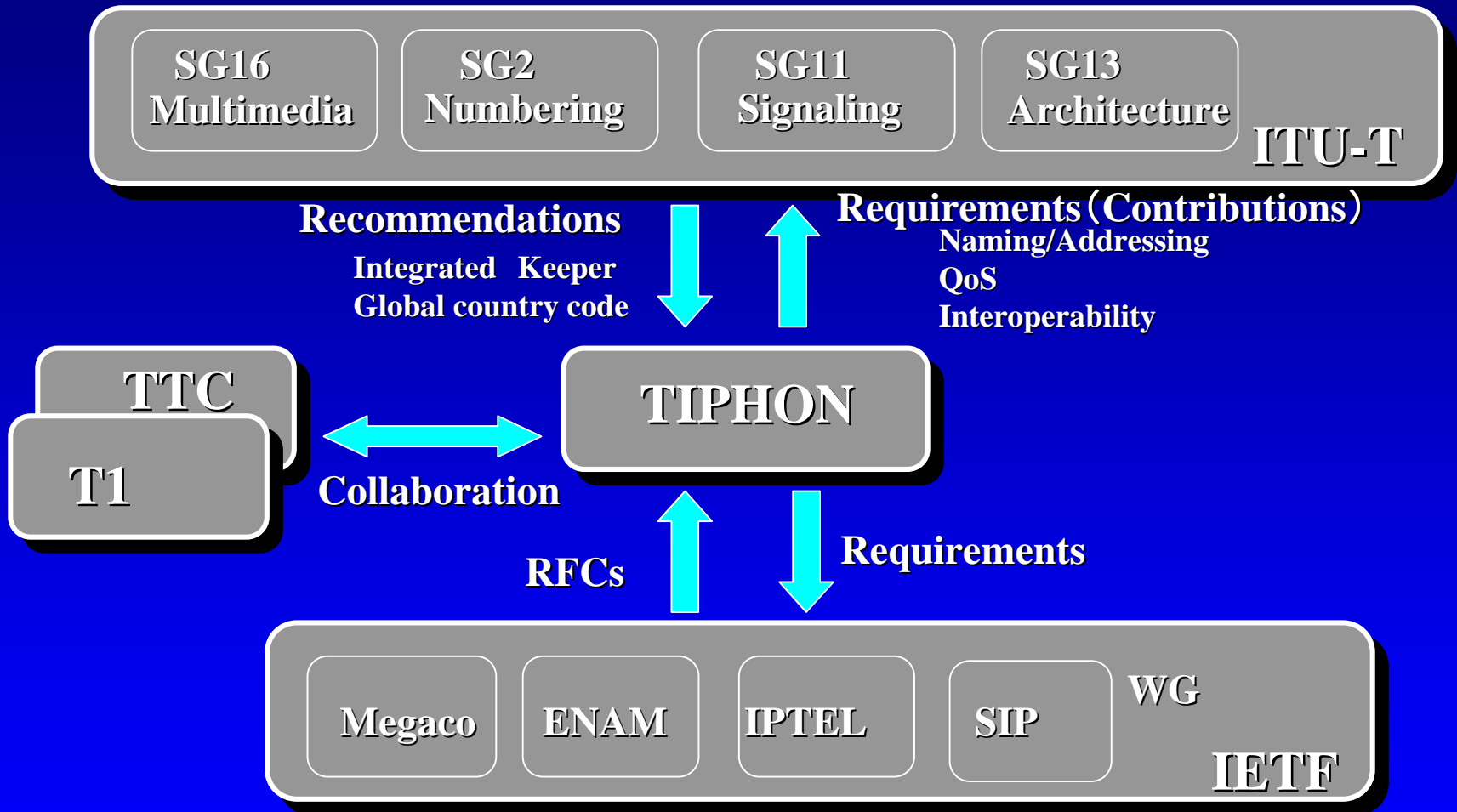
**ITU**

**Telecom/Information/  
Broadcasts Integration**

**Telecom Industries**

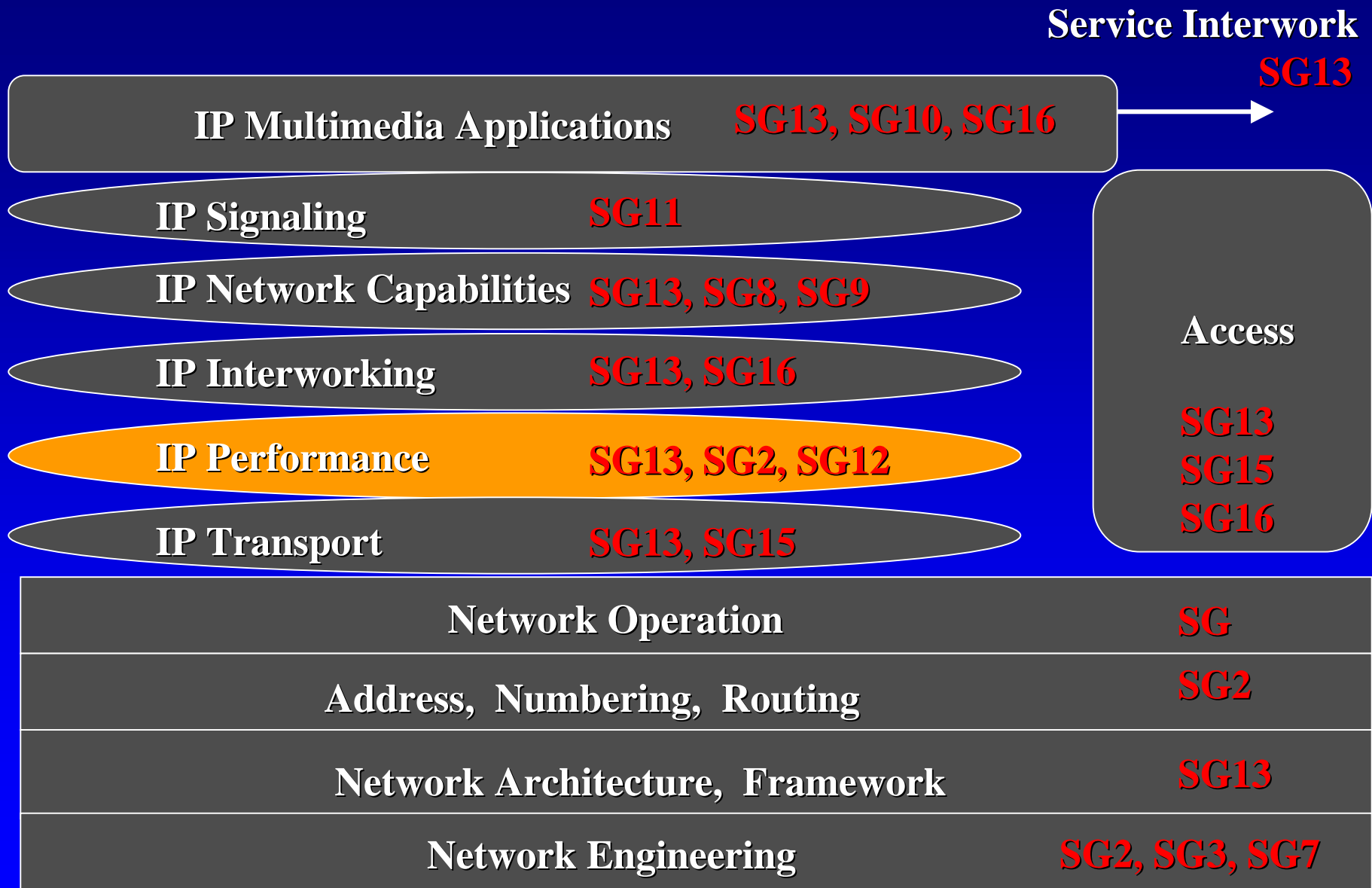
**Broadcast Industries**

# ITU-T, TIPHON & IETF



enam: new numbering  
iptel: IP Telephony  
sip: Session Initiation Protocol

# ITU-T IP-Project & Study Items





# IP Network Performance Framework

Phase		Performance Criteria	Speed	Accuracy	Dependability
Connection Setup		IP Telephony Connection Setup			
User Information Transfer	Higher Layer	IP Telephony Application			
	IP	IP Packet Transfer			
	Lower Layer	IP Network Lower Layer			
Connection Release		IP Telephony Connection Release			
<b>Availability (Reliability)</b>					
IP Network Availability					
<b>Network Synchronization &amp; Time Distribution Performance</b>					
IP Network Synchronization & Time Distribution Performance					

# Availability Parameters



**Unavailability: IP Packet Loss Ratio(IPLR) > C1**

**C1 = 0.75 (Other candidates: 0.9 and 0.99)**

**Measurement duration: 5 minutes**

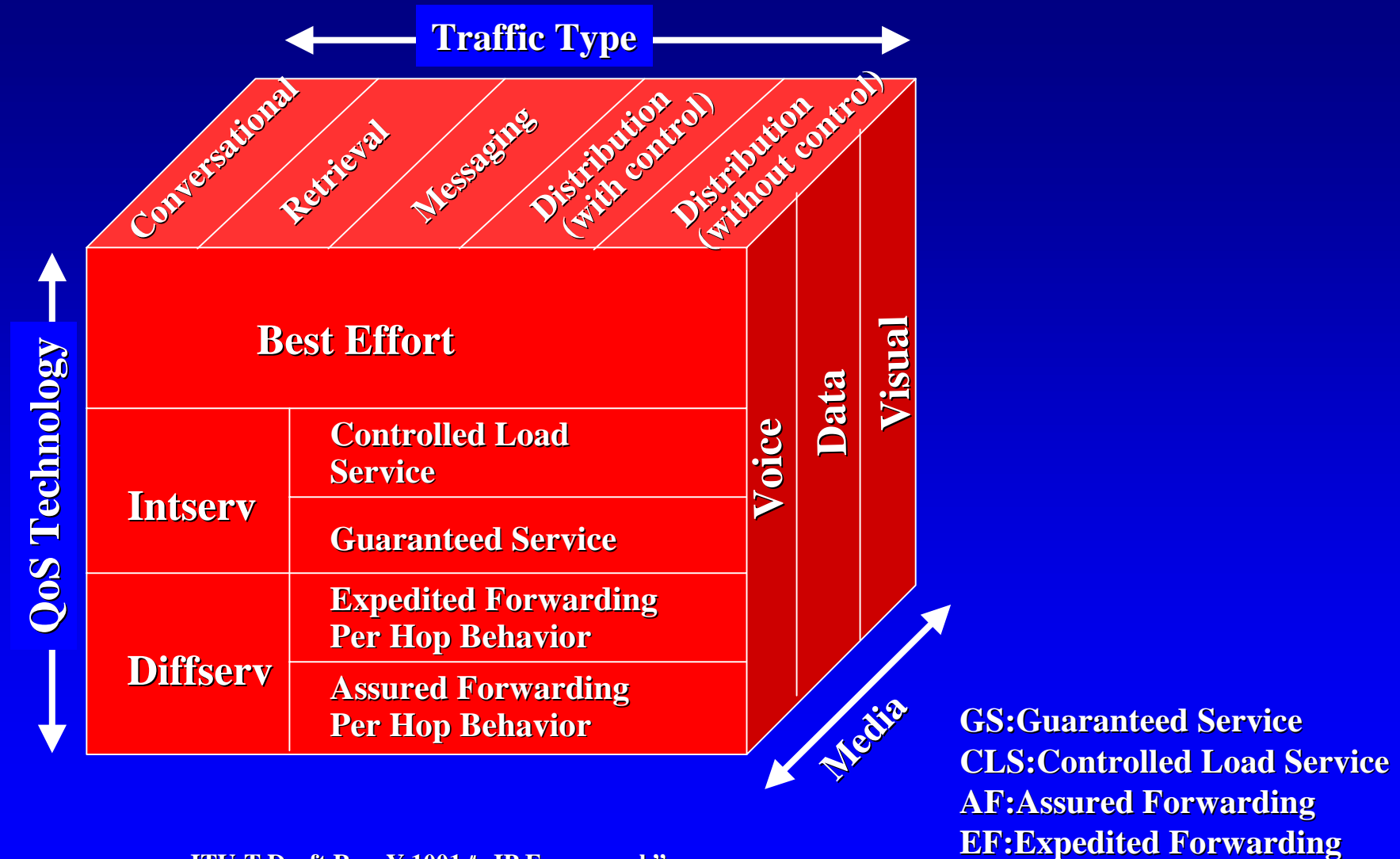
**Metrics:**

**Percent IP service unavailability (PIU)**

**Percent IP service availability (PIA)**

**Unit = % Time Ratio**

# QoS Technology in IP Networks



ITU-T Draft Rec. Y.1001 " IP Framework"

# TIPHON QoS Class

QoS Class	BEST	HIGH	MEDIUM	Best Effort
Total QoS	> PSTN/ISDN	PSTN/ISDN	Cellular(GSM)	Usable
Voice Transmission Quality(G.109)	Under study	> 85	> 70	> 50
Voice Quality	>G.711	>G.726(32kbps)	>GSM-Full Rate	Not Specified
E-E Delay				
TIPHON-05001	< 150ms	< 250ms	< 450ms	<Not Specified
TIPHON-05006	< 150ms	< 250ms	< 350ms	< 450ms
TIPHON-05009	< 100ms	< 100ms	< 150ms	< 250ms

**TIPHON :Telecommunications and Internet Protocol  
Harmonization Over Networks  
95 % Values**

# IP QoS & Performance Studies in IETF

Subject	IETF WGs
<b>Measurement</b> IP Packet Transfer Performance AP Flow Performance NW Elements Benchmarking	IP Performance Metrics WG(ippm) Real-time Traffic Flow Measurement WG (rtfm) Benchmarking Methodology WG (bmwg)
<b>Operation &amp; Management</b> Monitoring Management QoS Control	SNMP Version 3 WG (snmpv3) xxx MIB WG xxx = Ethernet, Physical Topology,rmon Distributed Management WG (disman) Policy Framework WG (policy) Internet Traffic Engineering WG (tewg) Integrated Services WG (intserv) Differentiated Services WG (diffserv) Multiprotocol Label Switching WG (mpls)

# Other Organizations (1)

## The ATM Forum

### IP over ATM & Traffic Management

- FAST (Framed ATM over SONET/SDH transport)
- Mapping Diffserv into ATM Service Class
- GFR(Guaranteed frame rate)

## T1 Committee

- T1A1.2 Network Survivability performance
- T1A1.3 Performance of Digital Networks and Services
  - T1A1-14 Active Specification and Allocation of Internet Service Performance
- T1A1.5 Multimedia Communications Coding and Performance
- T1A1.7 Signal Processing and Network Performance for Voiceband Services

# Other Organizations (2)

**IOPS.ORG (INTERNET OPERATORS GROUP)**

**Objective: IP Operations & Performances  
fire drills and smurf**

**NIMI (National Internet Measurement Infrastructure)**

**Project in NSF (National Science Foundation)**

**Objective: IP Quality Metrics and Measurement**

**VoIP-QoS-Forum**

**Objective: VoIP QoS Management**

**QoS Forum**

**Objective: QoS Control**

# Issues in Next Generation Networks/Services

- **Maintaining or even Improving Telecom QoS levels**
- **More QoS Guarantee other than the Best Effort**
- **More Secure**
- **More Reliable:**
  - Servers/Routers' recoveries take longer time.**
- **More Mobile**
- **Charging/Accounting Capabilities**
- **Next Generation Networks penetration?**
  - Applications Driven or Network Driven?**
  - What is(are) the killer application(s)?**
  - Interoperability with legacy telecom applications**



# Challenges

- **Killer Technology**
- **Killer Applications:**  
**Telephone & Internet, what else?**
- **Standards**
- **Implementation**
- **Collaborations among Service Venders, Equipment Venders & Users**
- **Users' Demands & Support**
- **Quality and Reliability is “MUST” even for Best Effort Services.**

