Technology Directions

Madrid Global IPv6 Summit
Jan 2001

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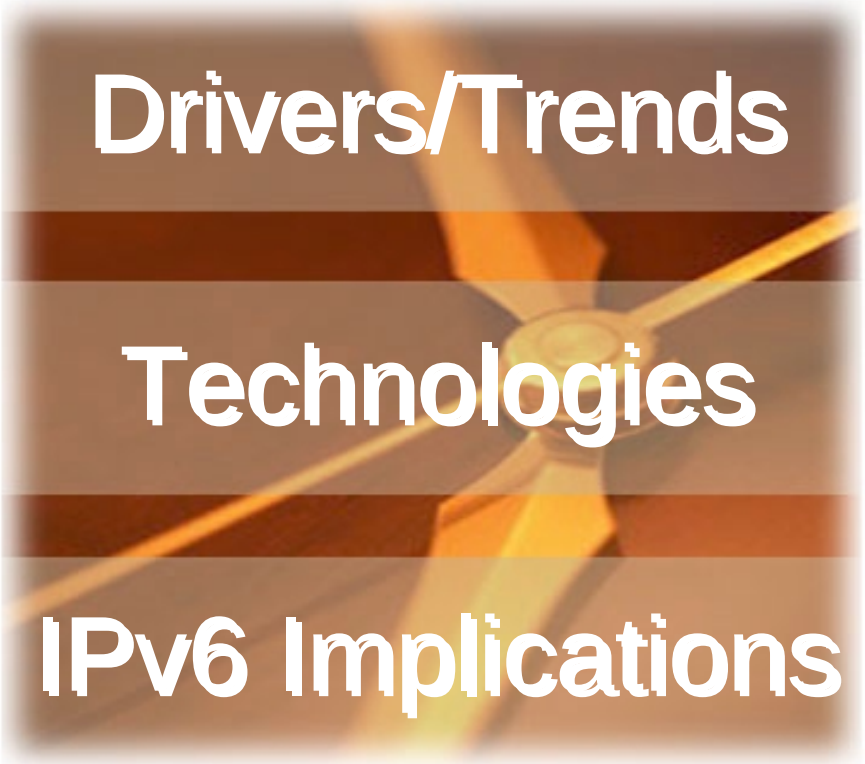
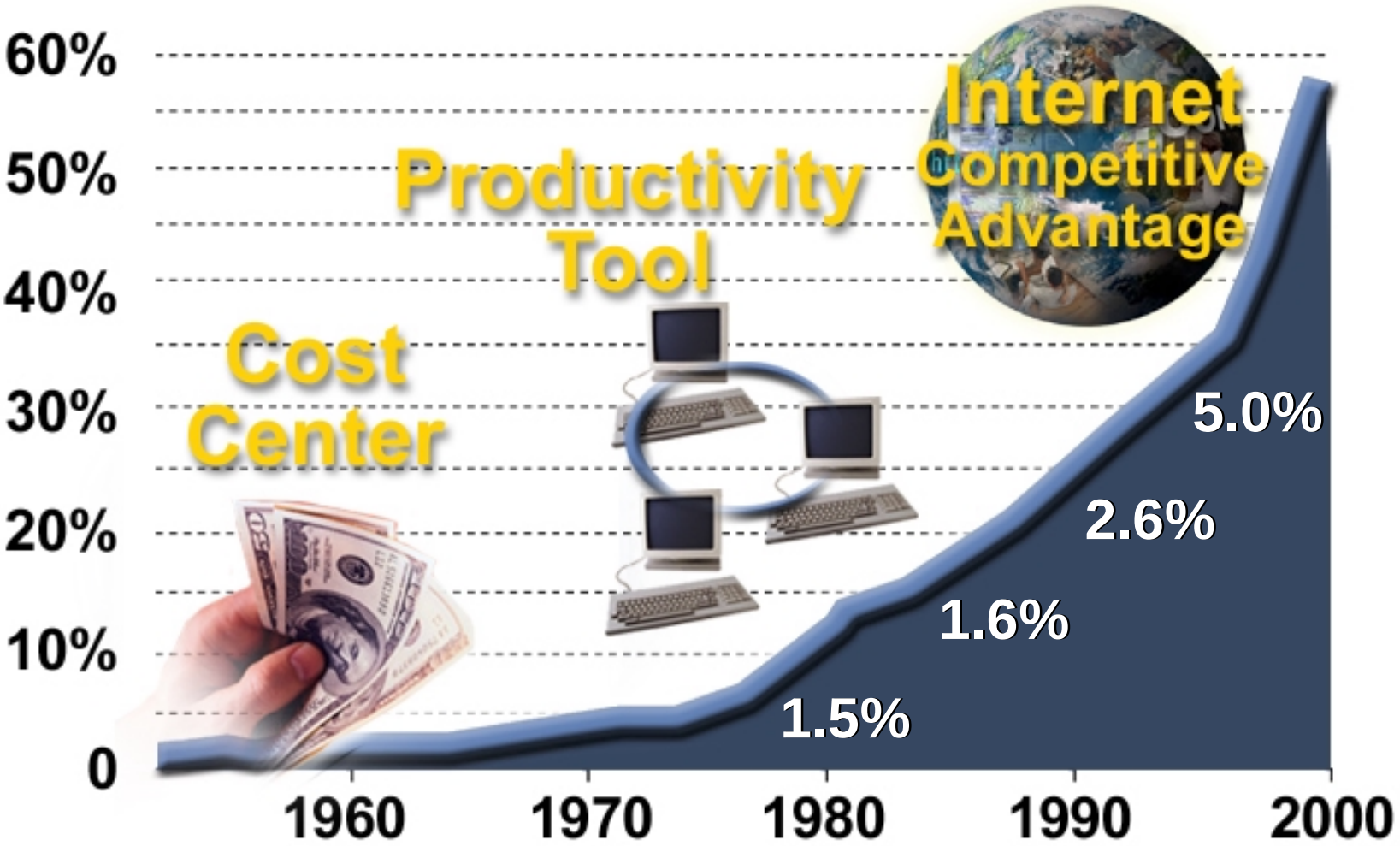
Cisco Systems

Agenda



The Internet Effect

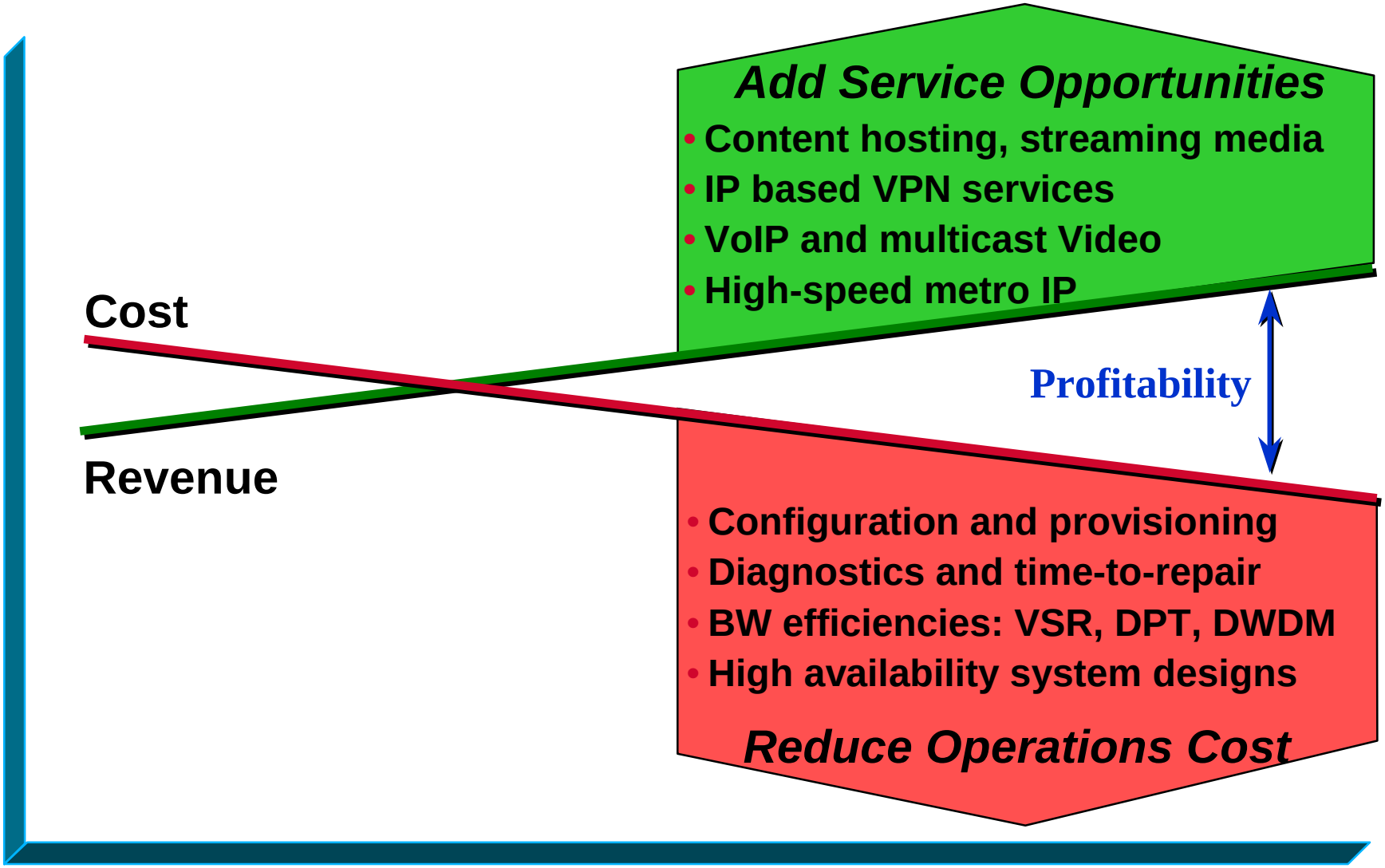


Source: U.S. Govt. Bureau of Economic Analysis

Service Provider Drivers

- New Revenue Opportunities
- Accelerated Service Deployment
- Deregulation
- Operational Efficiency

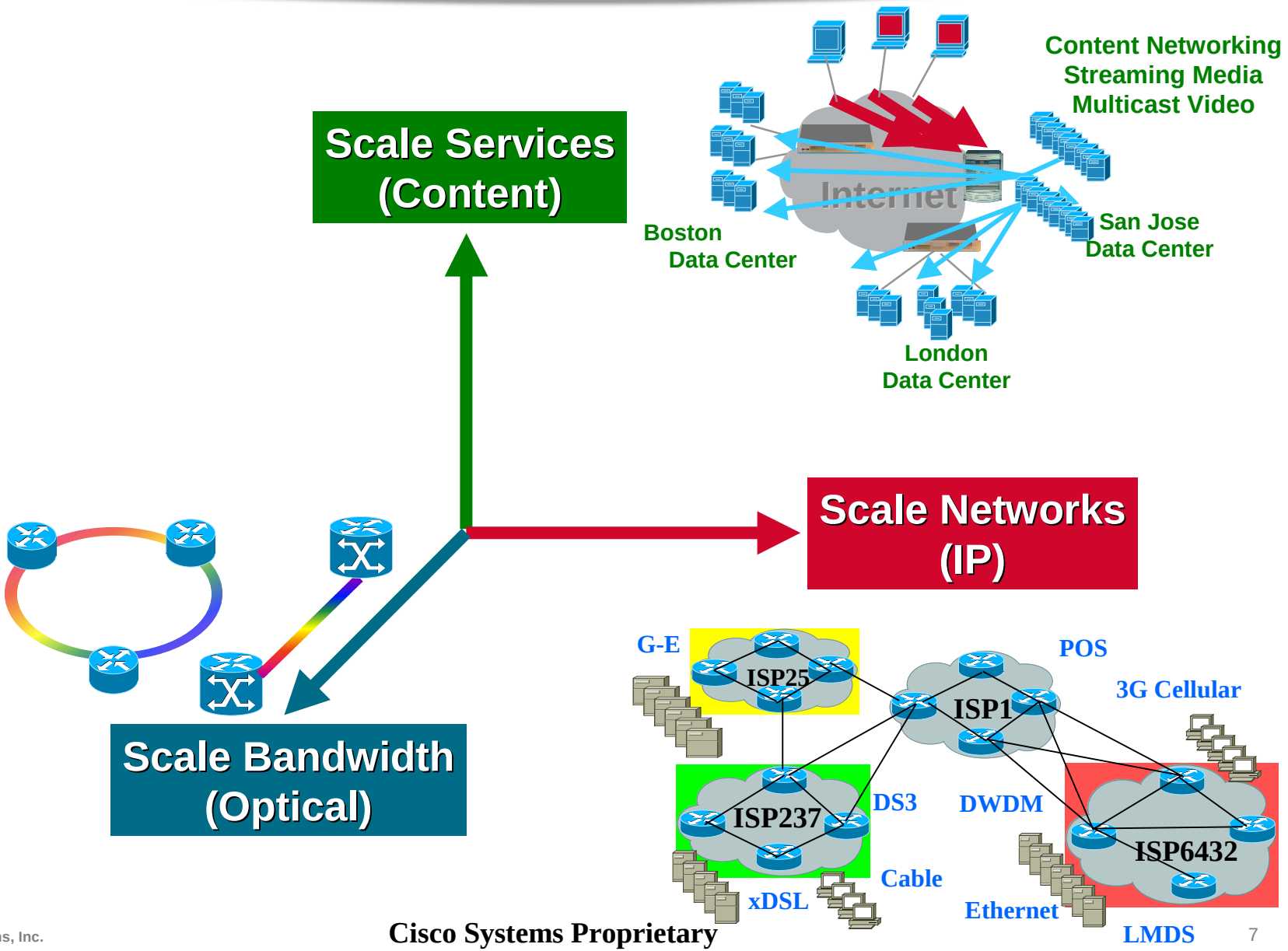
Value Proposition



State of the Internet

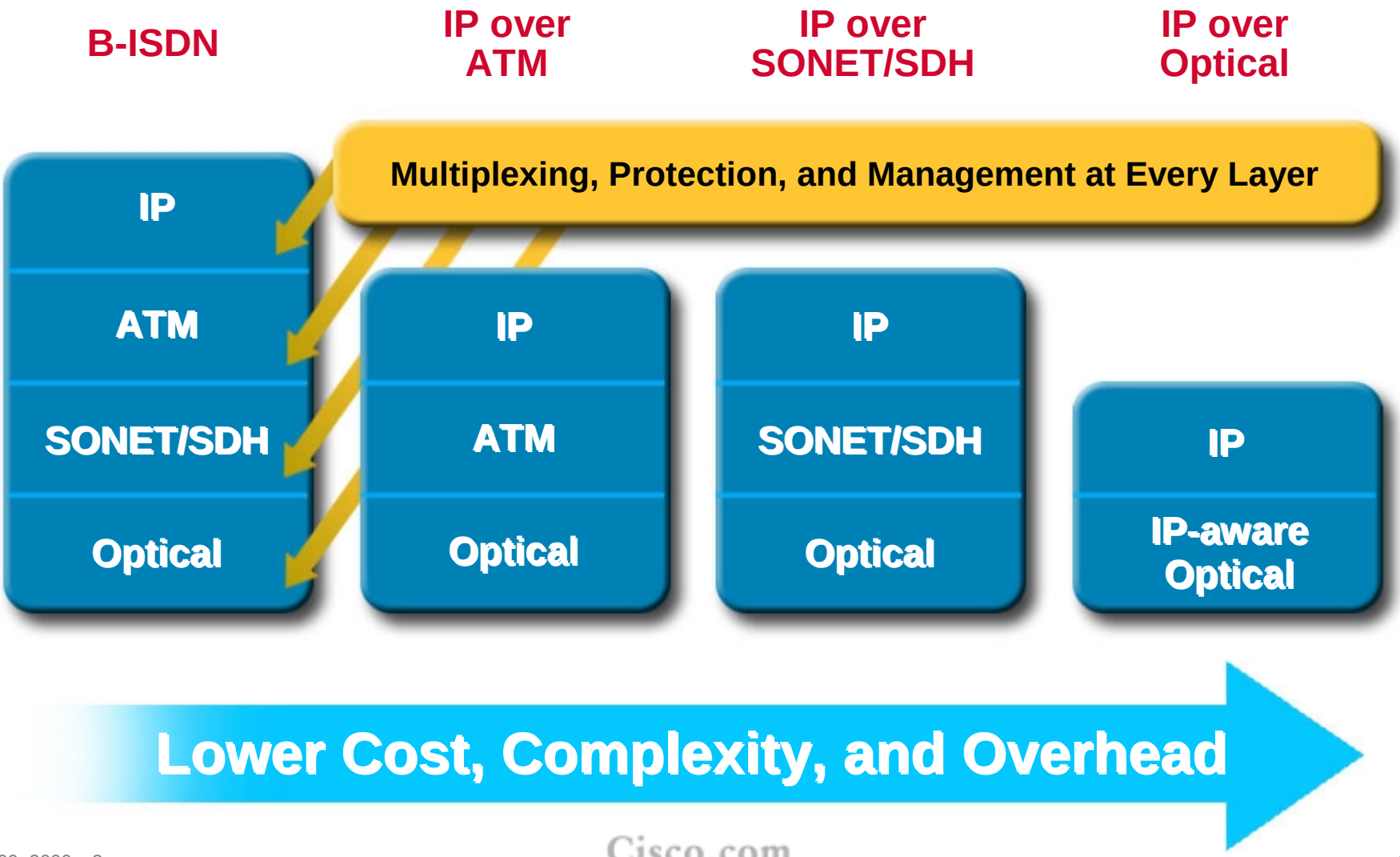
Parameter	Today	Next 24 months
Backbone Bandwidth	Multiple 2.5 Gbps	N x 10 Gbps
Key Access Rates	E1, DS3, STM-1	GE, STM-4, STM-16
Infrastructure	Packet over SONET/SDH	POP Consolidation Integrated IP+Optical
Management	Component Level, CLI	IP Services Management
Traffic Management	Tunnels/VCs & MPLS TE	Optical + MPLS + IP Options
Services	Premium Internet	Real time Content Voice, Video, VPN

Dimensions of Scalable Infrastructure

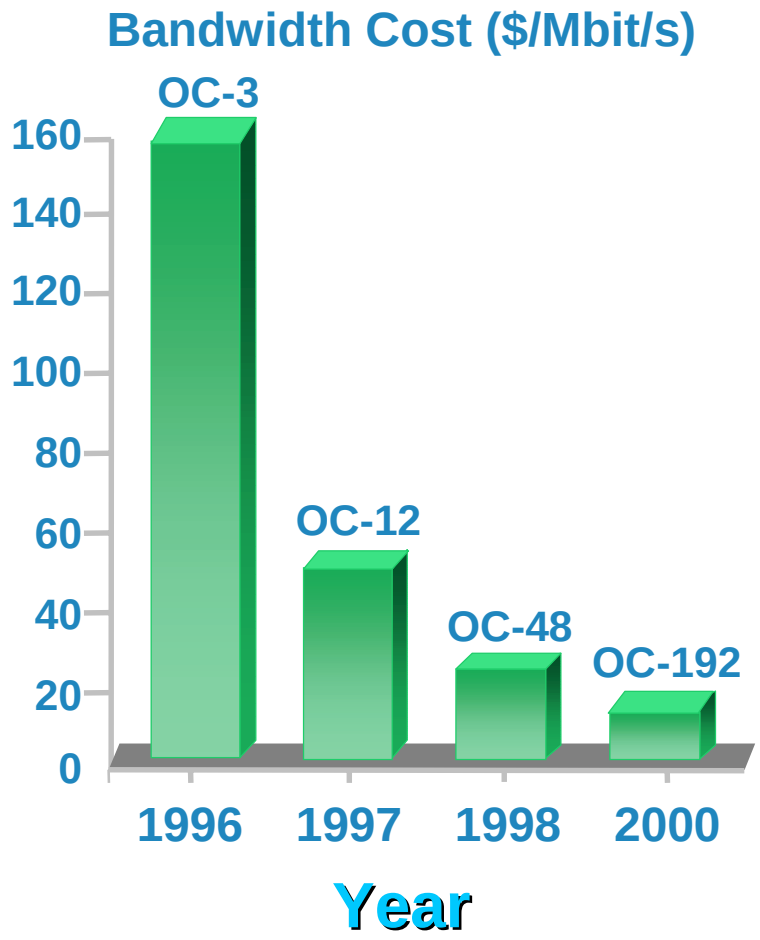


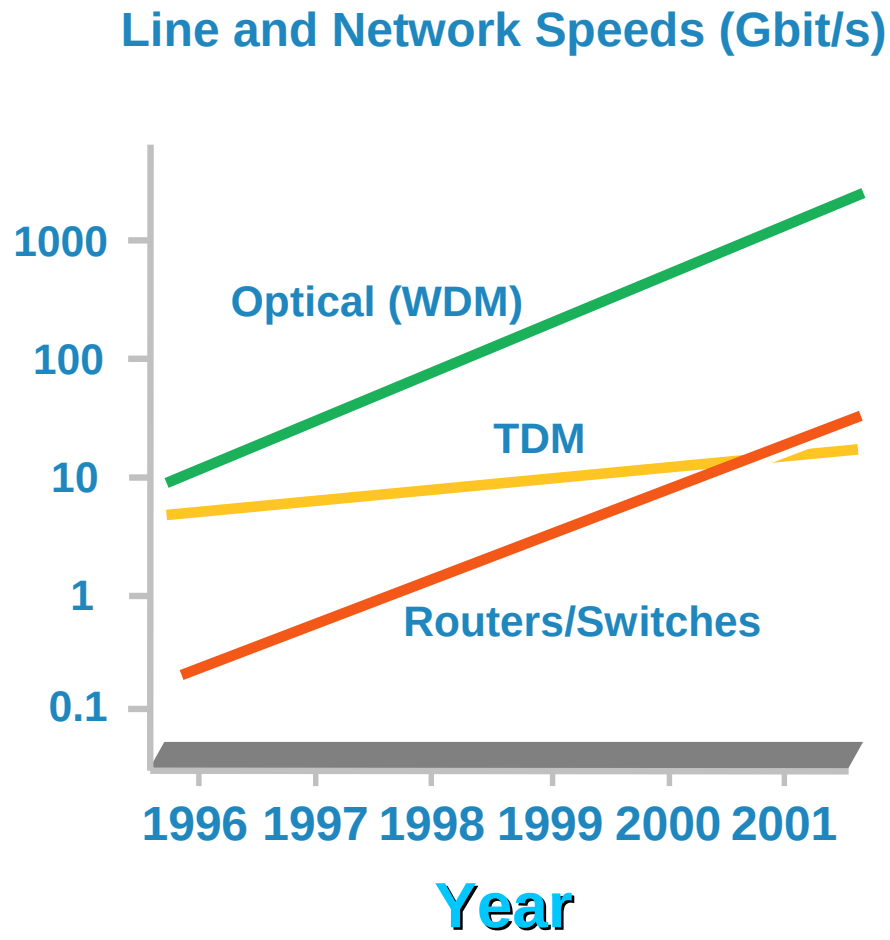
New World Internet

Simplified Network Operations



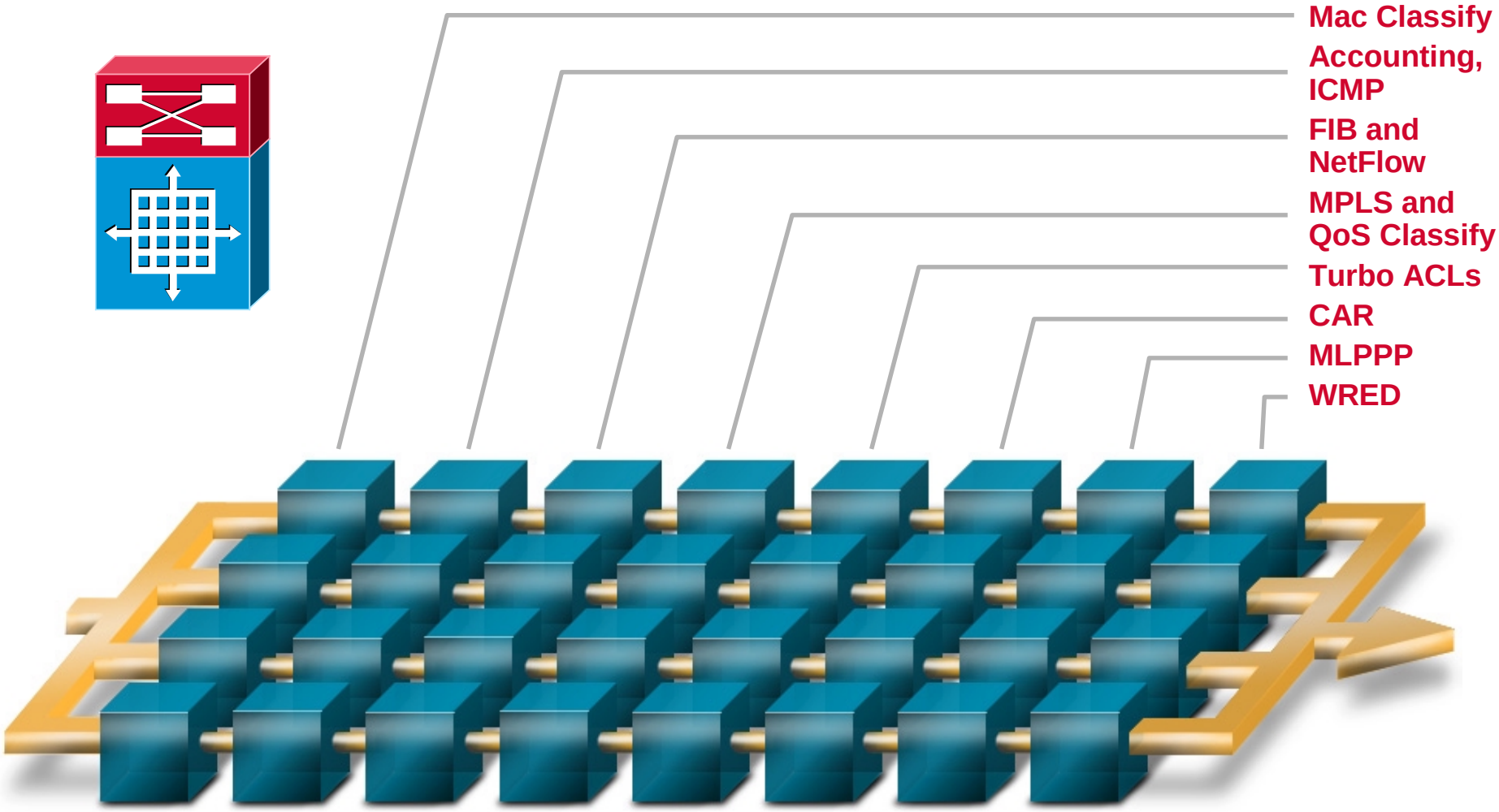
The Cost of Bandwidth





Source: Ryan, Hankin and Kent and Internal Data

Cisco Parallel Express Forwarding



Radical Economics Example—Ethernet Service

- IP over Ethernet = plug and play
- Today—Cogent: 100 Mbps for $1000/month

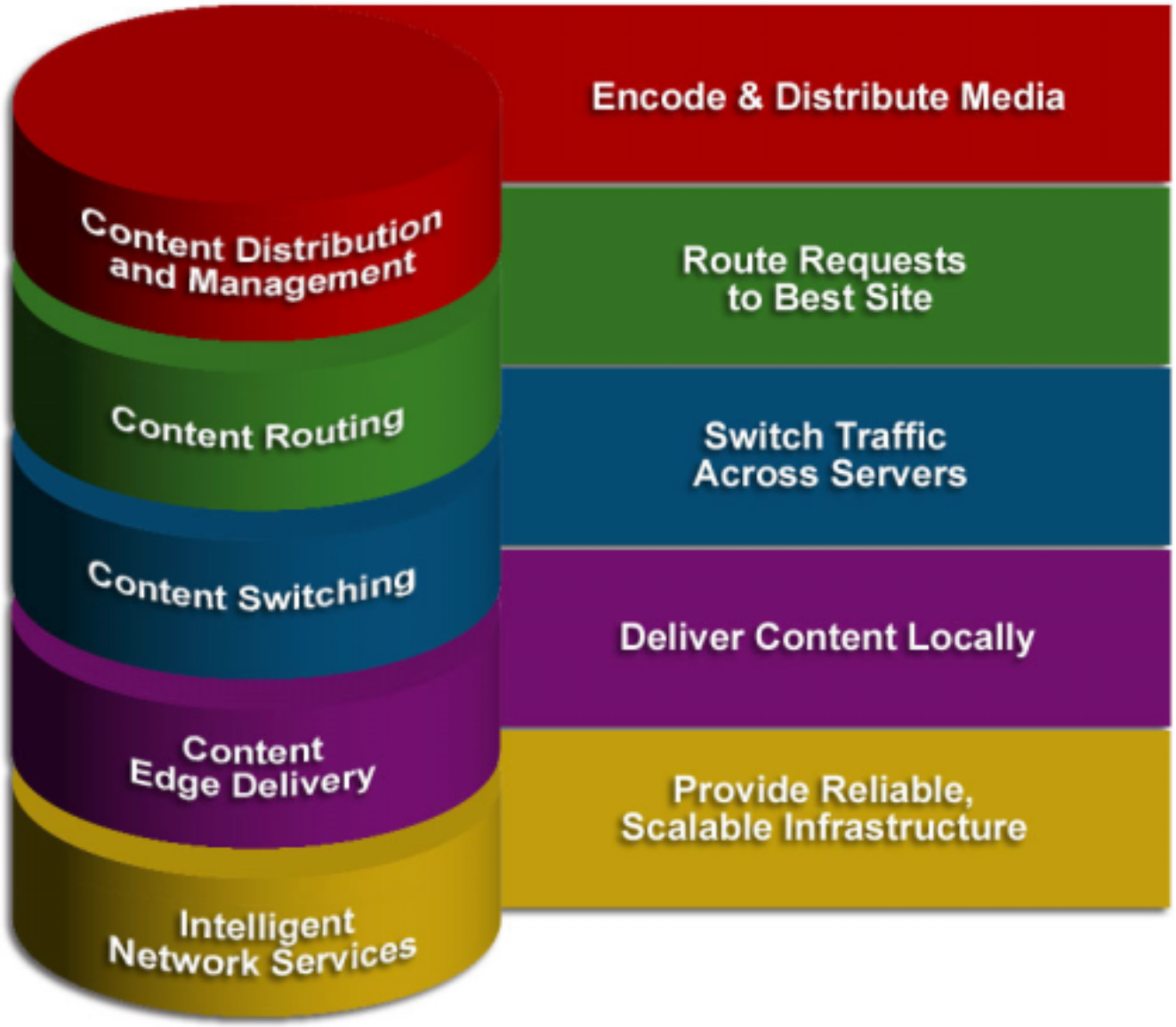
  (1/100 price/bit of DS1)
- 1GE WAN access for $1000 by 2002
- Ethernet as the new subscriber interface—building LECs, Metro Ethernet SPs, offer 10M-1G on demand

Enterprise Economics Meet the WAN

Content Delivery Networks

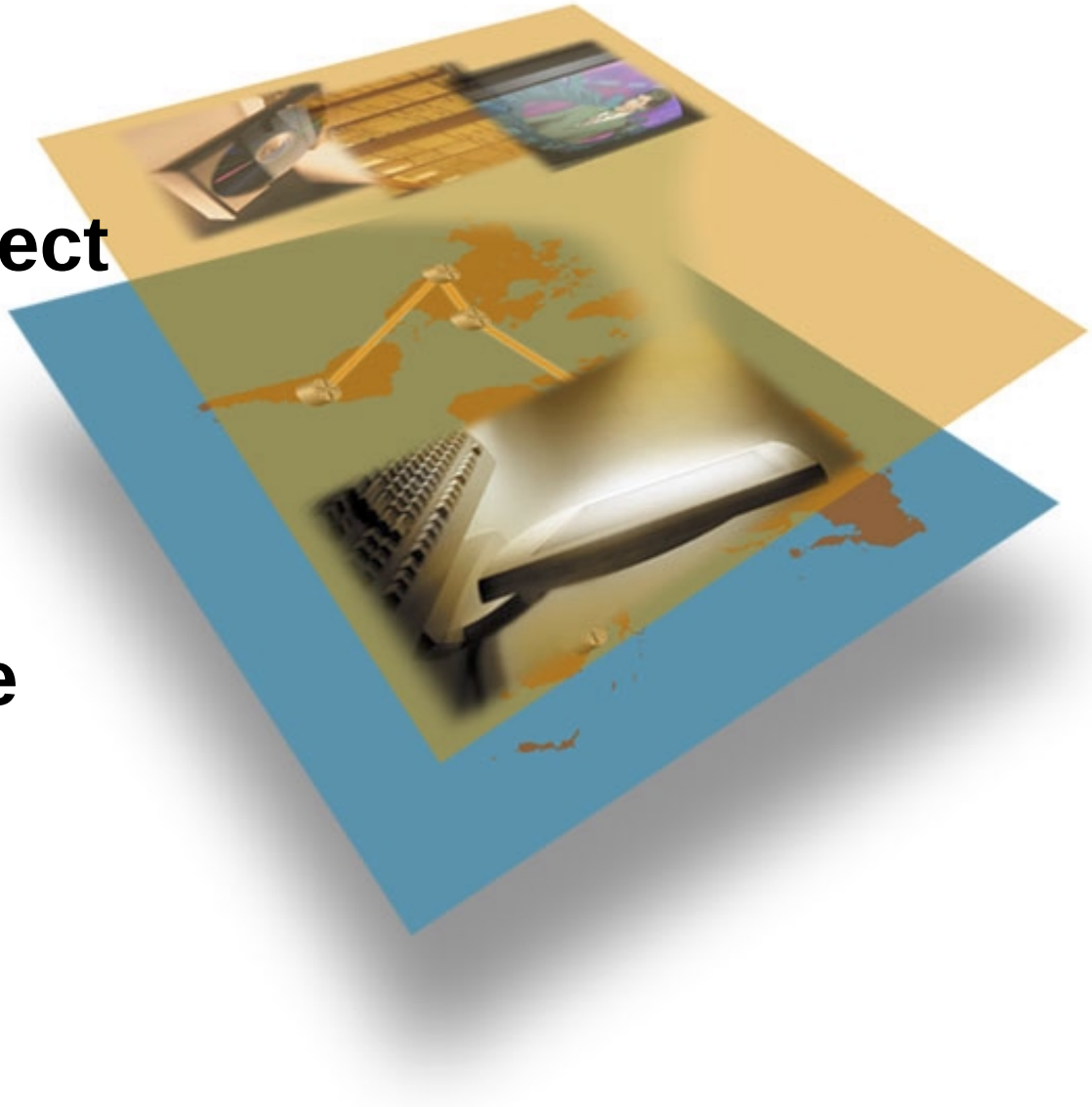
Five key Elements

Bypass Bottlenecks



Content Layer

- **Content Delivery Networks automatically direct users to content that is closest**
- **IP networks provide a reliable platform for content delivery**



The Mobile User
Removing Location Dependency

Anytime/ Anywhere Internet Access

Internet-Enabled Devices

Networking within the Home

On Campus Mobility

Network Appliances

Dedicated computer appliances bring the necessary ease of use

- **Set top boxes**
- **Downloadable Audio (MP3)**
- **Electronic Books**
- **Intelligent phones**
- **Browser appliance**
- **“5 IP devices per body”**

Connected to the Internet and to each other!

Entering The Home

Pervasive Computing

Smart Devices

Multi Client Architecture

Ubiquitous Communications

Globally Accessible Internet

Availability vs. Security

Content

Services

Personalization

Mobile Internet SP Business Model

Increasing Value Add.

Convergence at Application Layer

ASP Hosting & HVAS

Transaction Services:
eCommerce & Location Based
Push Advertising
Control & Monitor

Premium/Unified Messaging

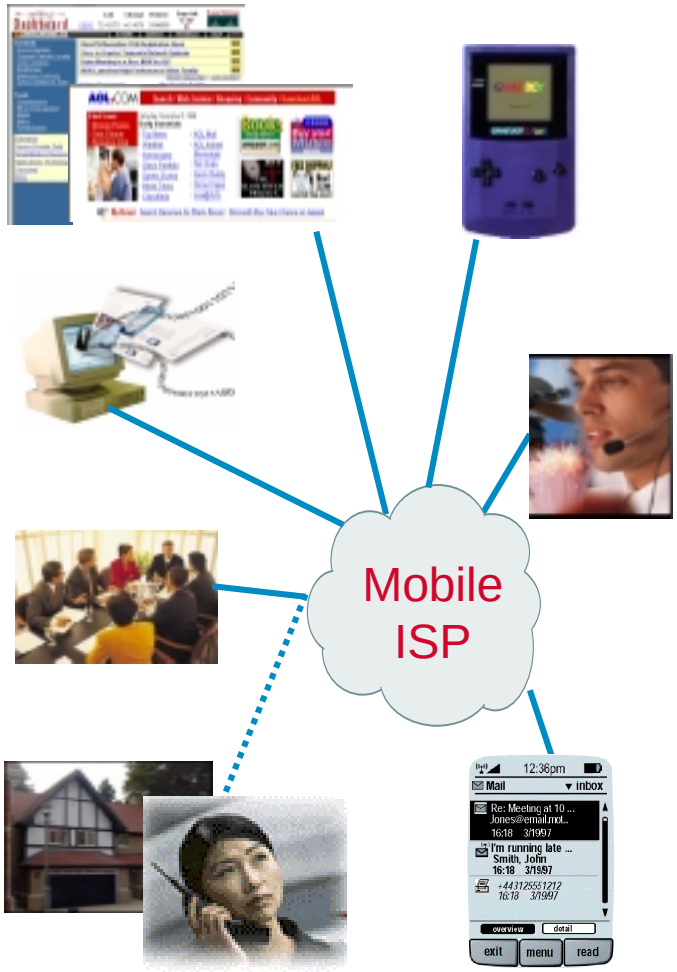
Intranet Access (VPN

Information Services

Internet Access

Basic Voice Usage & Messaging

Mobile IP Infrastructure



IPv6 Implications

Why IPv6

- IETF IPv6 WG began in early 90s, to solve addressing growth issues, In the interim:
  - CIDR, NAT,… were developed
- IPv4 32 bits address = 4 billion hosts
  - ~40% of the IPv4 address space is still unallocated

  BUT
- IP is Pervasive, Exponential Deployment
  - Data, Voice, Audio and Video integration is a Reality
  - Regional Registries apply a strict allocation control
  - Current Addressing scheme is not optimum (as for any)

IP Version Comparison

IP Service	IPv4 Solution	IPv6 Solution
Quality-of-Service	*Differentiated Service (DiffServ)*	*Differentiated Service (DiffServ)*
Security	*IPSec*	*IPSec*
Autoconfiguration	*DHCP, ZeroConf*	*Serverless, ZeroConf Renumbering, DHCP*
Mobility	*Mobile IP*	*Mobile IP*
IP Multicast	*PIM/Multicast BGP*	*PIM/Multicast BGP, Scope Identifier*
Addressing Range	*32-bit, Network Address Translation*	*128-bit, Network Address Translation*

Why a larger address space is needed

- Overall Internet is still growing at 400%/year worldwide
  - ~320 million users in 2000, ~550 million by 2005
- Emerging population/geopolitical & Address space
  - Standford University has more address space than China
  - How to move to e-Economy without Global Internet access?
- 400 million mobile phone users in 2000, over 1 billion by 2005
  - UMTS Release 5 is Internet Mobility, 1/3 of 1B connected
- ~1 Billion cars in 2010, 15% should get GPS and Yellow Page services
- Billion of new Internet appliances for Home users
  - Always-On

IPv6 Deployment Requirements Customer Perspective

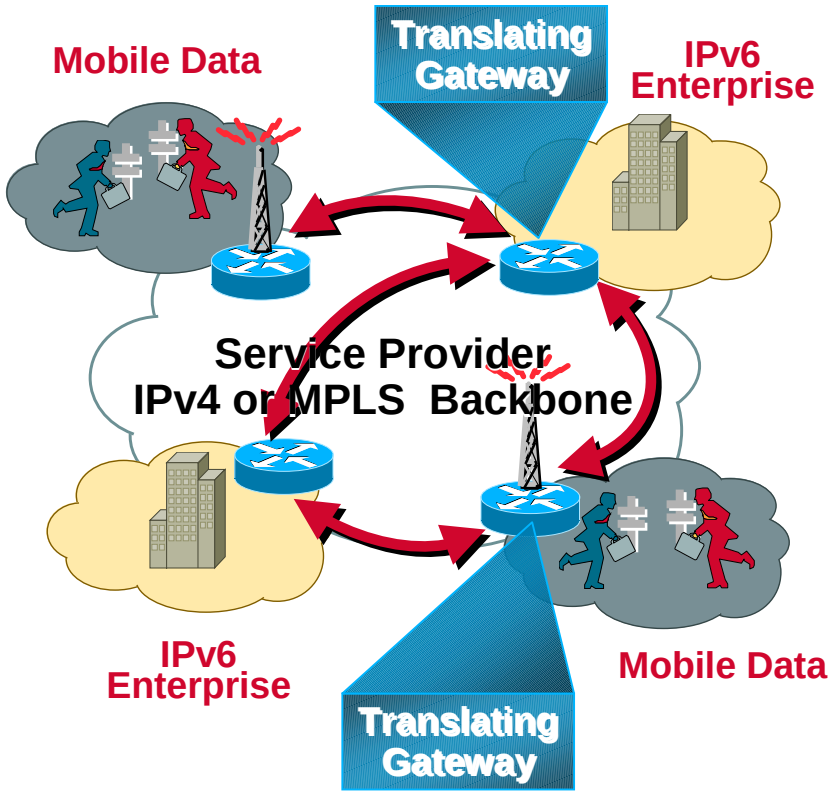
- Availability of IPv6 When/Where Needed
- No Disruption of IPv4 services
- Incremental Upgrade, No 'Flag Day'
- Minimize Operational Cost, Learning Curve & Support Requirements

IPv6 Tunnels over IPv4 or MPLS Infrastructure

- **IPv6 over IPv4 Internet**
  - **ala 6Bone**
- **Any Cisco IOS 12.2(1)T routers can be used as IPv6 Edge**
  - **6to4 Tunnel**
- **Leveraging defined Tunneling Technology**
- **No impact on existing IPv4 or MPLS backbones**
  - **using high-speed POS interfaces**

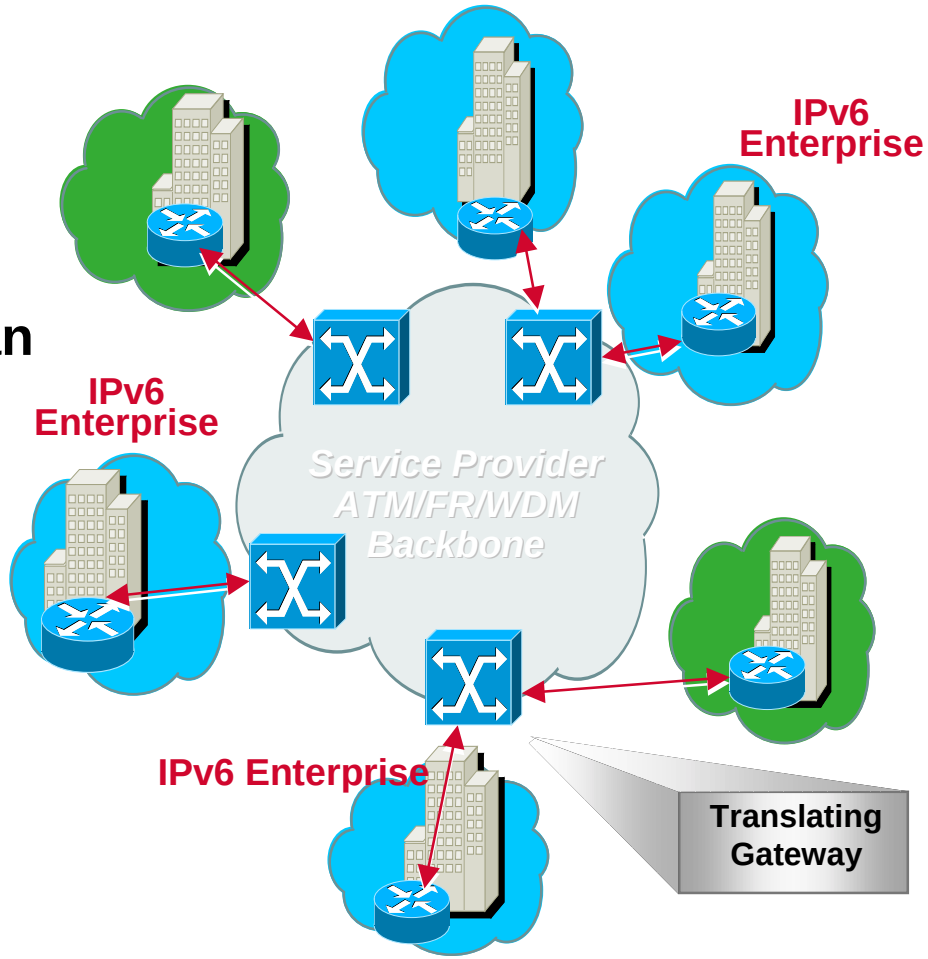
Edge IPv6 Infrastructure:

IPv6 over IPv4 Internet:

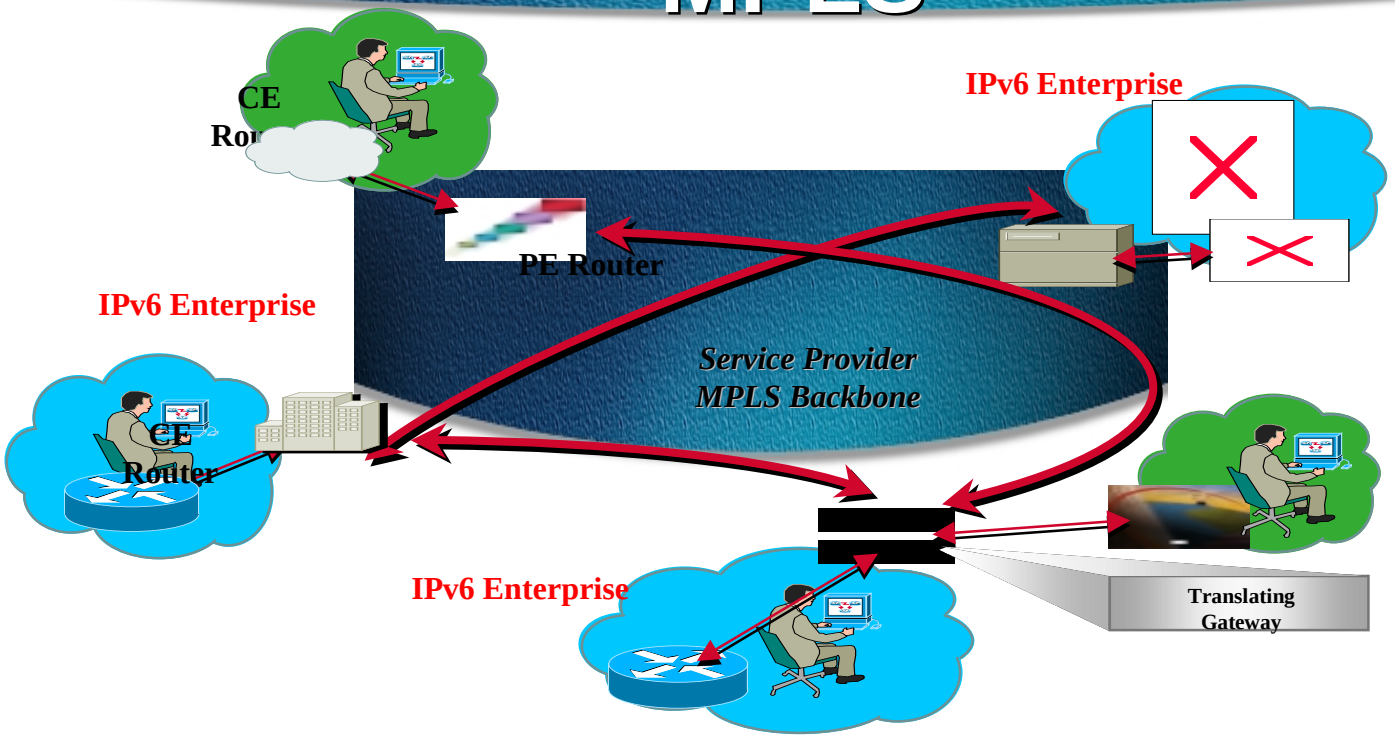


Native IPv6 over Dedicated Links

- Native IPv6 over dedicated infrastructures
  - No impact on IPv4 traffic and revenues
- Any Cisco IOS 12.2(1)T routers can be configured
  - ATM & Frame Relay PVC's
  - Serial Lines, SONET/SDH, FE/GE
- IPv6 over FE/GE, ATM or SONET/SDH can run over an Optical Infrastructure (dedicated lamda)



IPv6 Edge Router (6PE) over MPLS



- Many Carriers, large ISP and Mobile SP have invested in MPLS solutions
  - Core devices may be ATM switches or Core Routers
  - Leverages MPLS features, eg. MPLS/VPN, TE, CoS,...
  - IPv6 Edge router (6PE), 6PE allows the SP to offer IPv6 at lower cost and risk

IPv6 @Cisco Systems

- Co-chair of IETF IPv6 WG
- Well Known Cisco 6Bone router
  - ~ 50 tunnels with other companies
  - acts as 6to4 Relay
- ‘Founding Member’ of the IPv6 Forum
- Official CCO IPv6 page is www.cisco.com/ipv6
  - Cisco IPv6 Statement of Direction published last June
  - Cisco IOS IPv6 EFT available for free since 3 years
  - ~around 500 sites running Worldwide

IPv6 Forum

- 98 companies
  - Cisco is a founding member
  - Regularly speaking at every summit
- www.ipv6forum.com
- Mission is to promote IPv6 not to specify it (IETF)
- Global and Regional summit
  - U.S.,Japan, Spain, Middle-East, Canada, Korea,...

Summary

- New services in consumer and mobile will drive the industry toward implementation of IPv6
- Current IPv4 infrastructure is stretched well beyond intended capabilities
- Larger address space offers advantages and efficiencies in the network
- Implementation methods will insure smooth integration of v4 and v6.

Empowering the Internet Generation℠