



Why IP+Optical

- Service Providers' # 1 challenge is finding new ways to deliver profitable services
- Service Providers need simultaneous reduction of costs and acceleration of profitable new service revenues
- Optical Networking economics alone create commoditization; no benefit to Service Providers
- Optical alone isn't the answer; it's **IP+Optical**:
IP enables value-added services
Optical radically lowers costs

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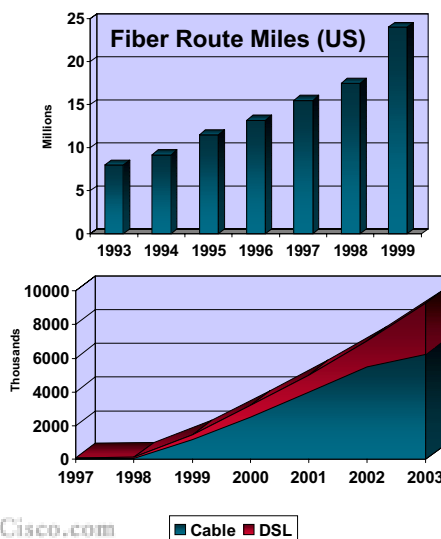
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What's Driving Demand for IP+Optical?

- Tremendous growth in raw transport bandwidth demand
- Demand for Public IP Carrier services is growing
- Today, transport bandwidth is available in the Core but a "services bandwidth barrier" exists in the Metro and Services POP



Data Source: Telecom Industry Association

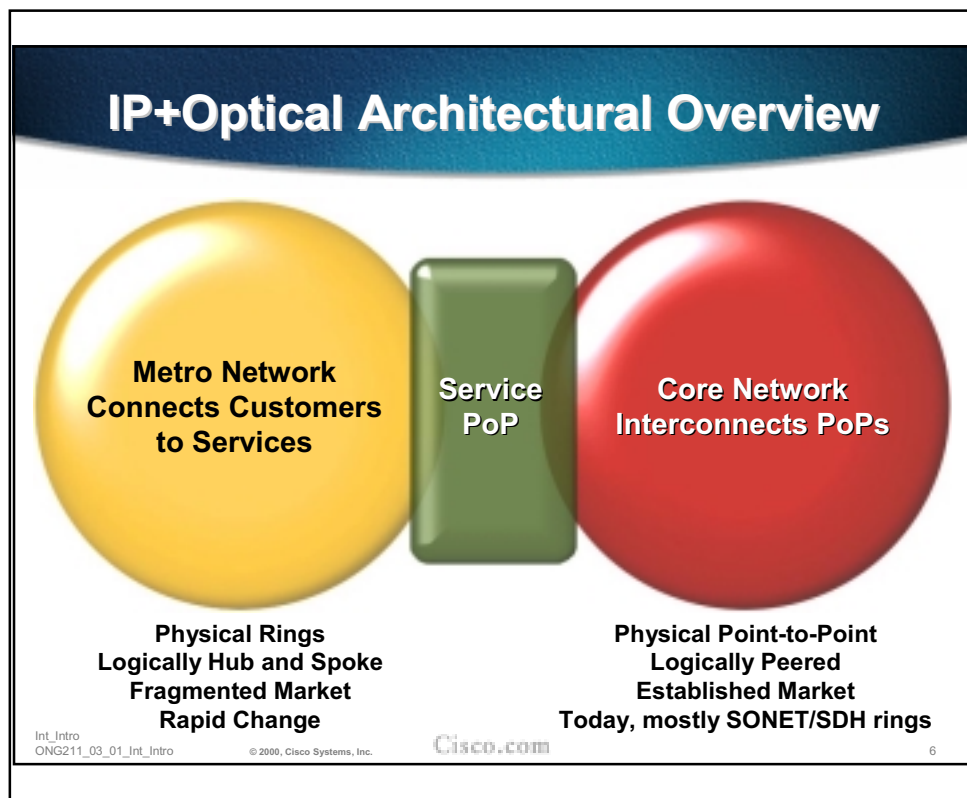
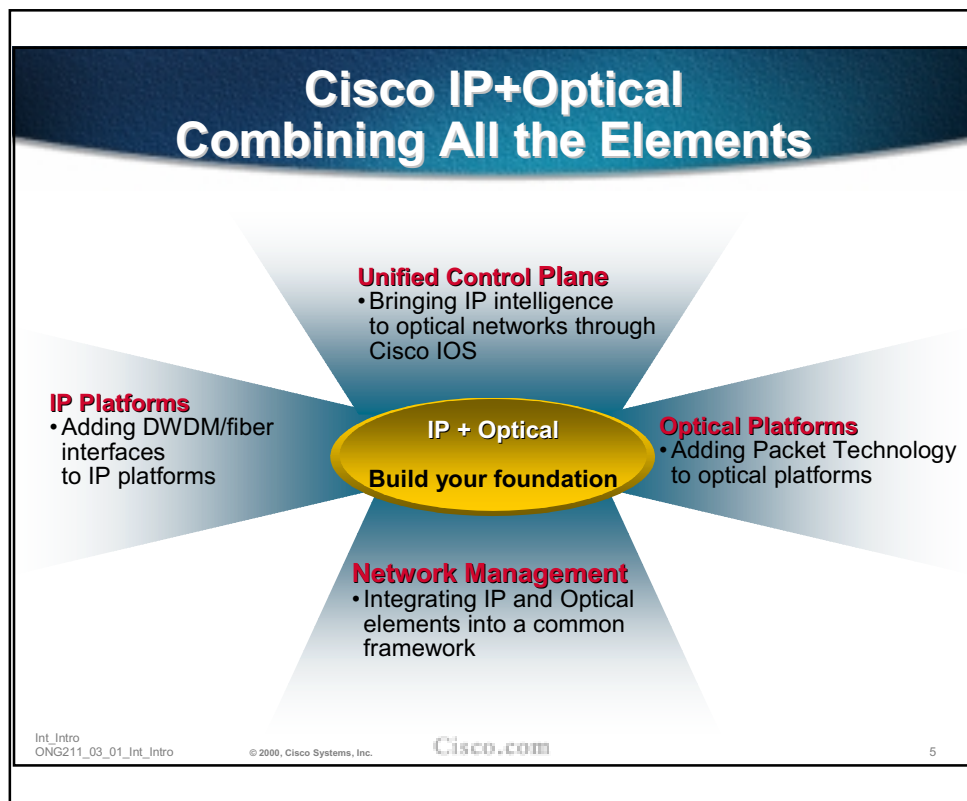
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■ Cable ■ DSL

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Agenda

- Introduction
- **Internet Traffic Evolution**
- Metro Solutions
- Core Solutions
- Management
- Summary



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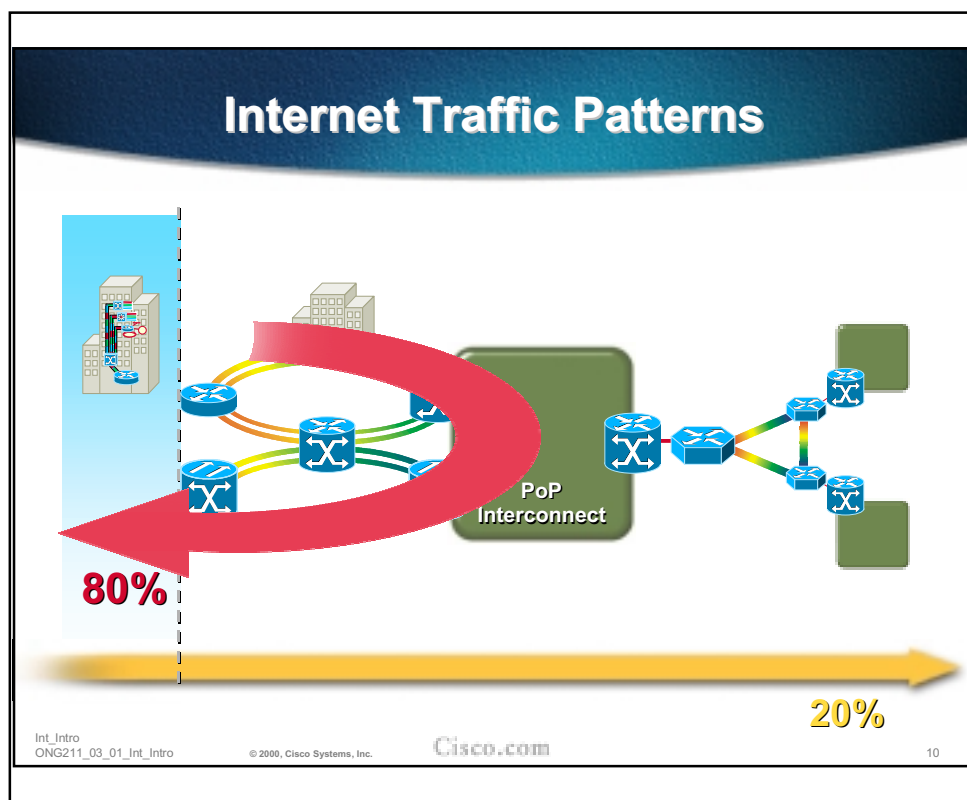
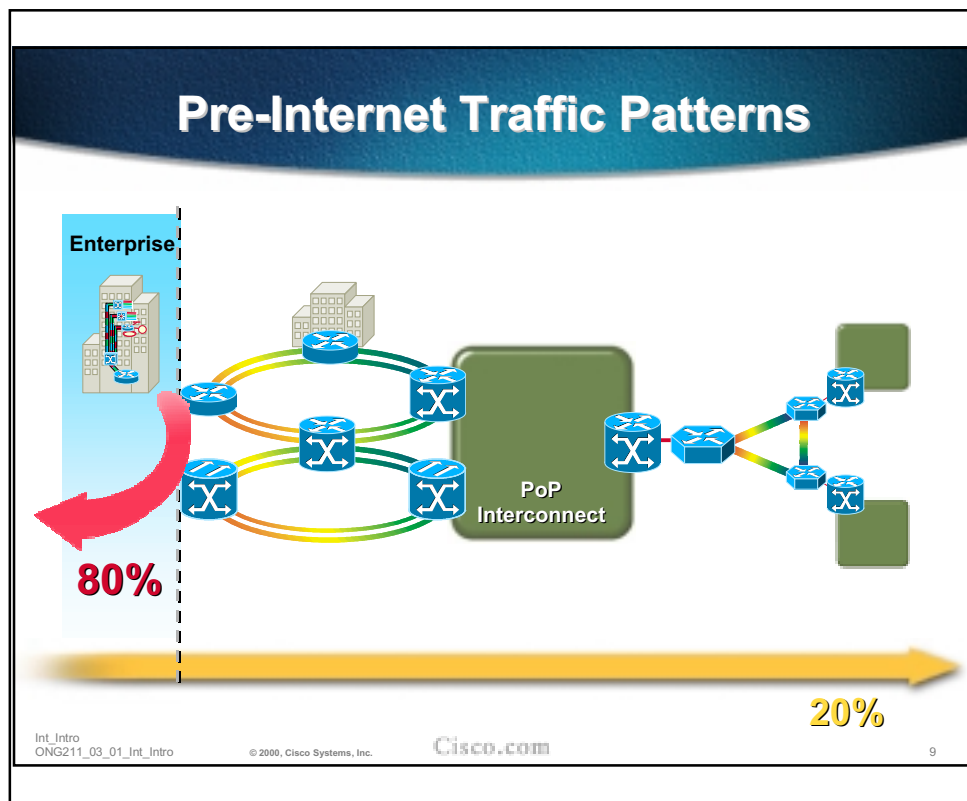
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The Internet Economy

- Internet changing every business relationship
- Requires seamless extension of internet applications throughout and beyond the enterprise
- Reduces costs to enable next generation economics



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Internet Video

- Have you ever used Internet Video?
- How about this?



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Internet Video Services

- Where does the content come from?



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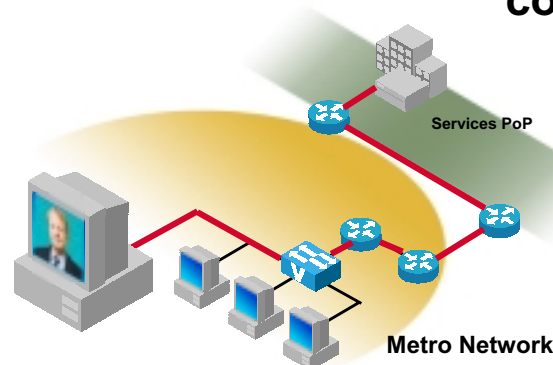
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Internet Video Services

- Local delivery via a metro network
- Where does the content come from?



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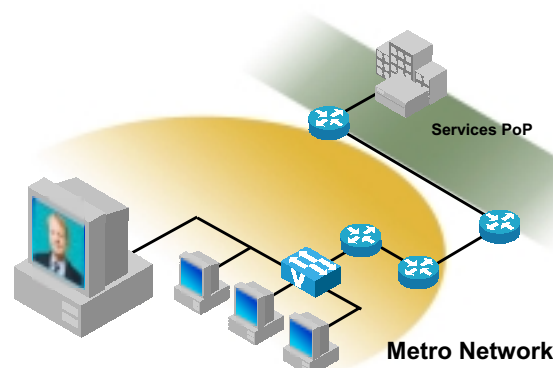
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Internet Video Services

- How does content get to the Services PoP?



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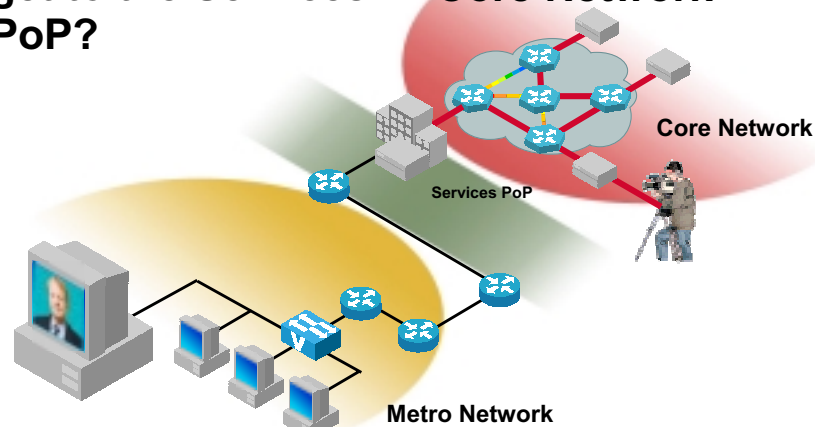
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Internet Video Services

- How does content get to the Services PoP?
- Distribution over a Core Network



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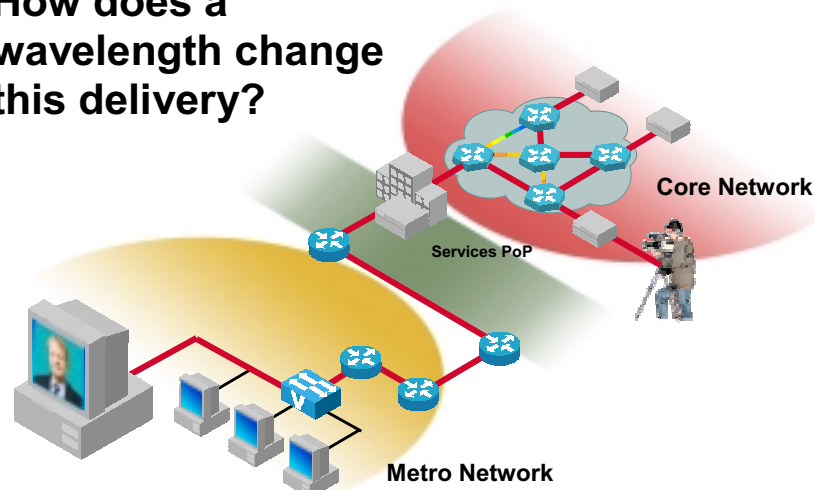
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Question of the Day

- How does a wavelength change this delivery?



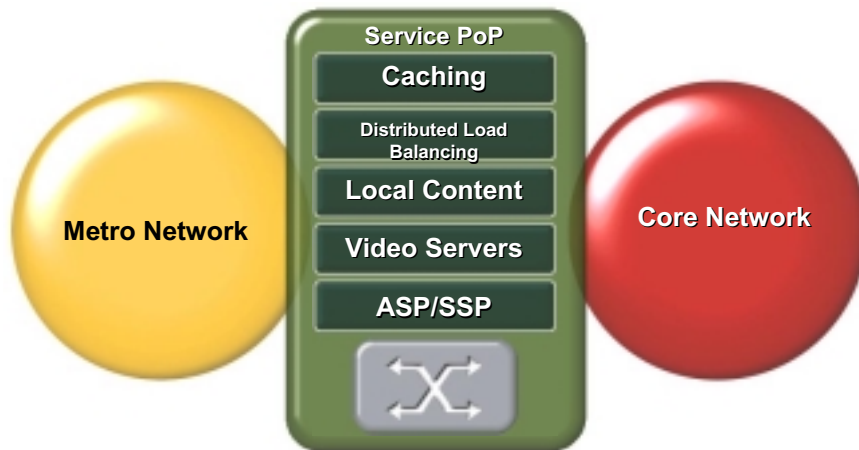
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Evolution of Interconnect



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- Internet Traffic Pattern Evolution
- **Metro Solutions**
- Core Solutions
- Summary



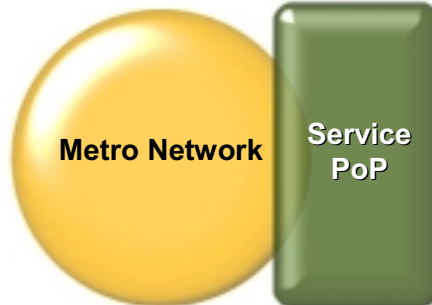
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Roles of the Metro Network and Service PoP



- User to service delivery
- Packets dominate
- Many technologies and topologies
- Upstream aggregation
- IP and application aware
- Increasing intelligence and applications
- Content rich service delivery
- Forward traffic where appropriate

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Issues in the Metro Network

- Connecting users to IP-based services
- Reducing cost of per-user provisioning
- Service velocity (turning up connections quickly)
- Addressing last mile limitations
- Ensuring standards

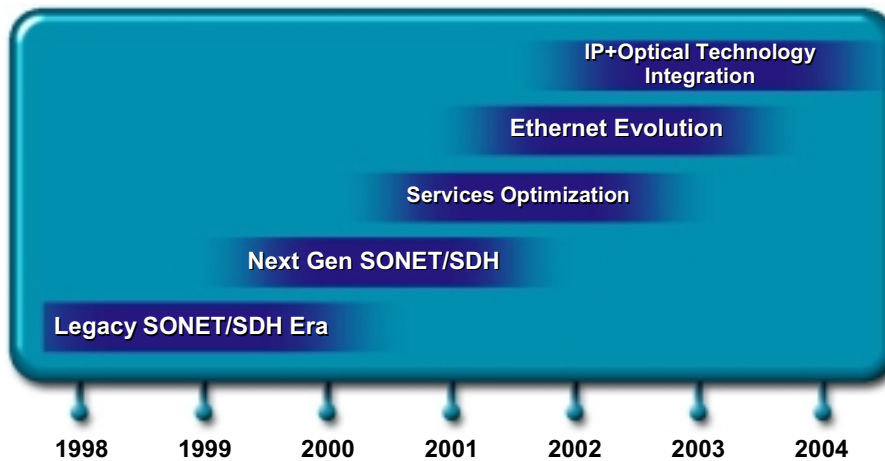


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IP+Optical Metro Evolution



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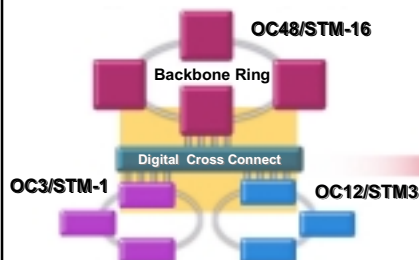
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Next Generation Economics...Today!

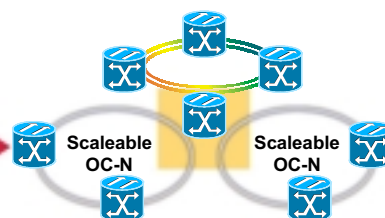
Traditional Implementation

\$\$\$\$\$



New Paradigm

\$



- Slashes transport costs by at least 50% (\$470,000 to \$1.1 Million)
- Superior return on investment with efficient bandwidth management
- Fewer network elements
- Lowest initial and lifecycle cost
- Easy to engineer, install and manage

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- **Core Solutions**
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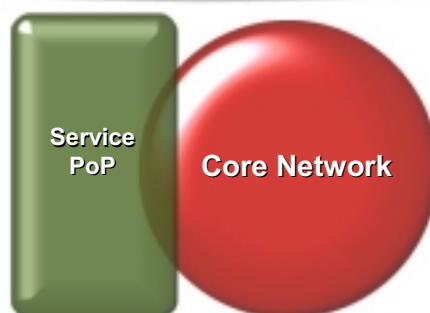
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Roles of the Service PoP and Core Network



- | | |
|----------------------------------|------------------------|
| • Muxes packets onto λ s | • Switches λ s |
| • IP and application aware | • Packet dumb |
| • Software and electronics | • Minimizes \$/bit |
| • Service delivery | • Physics intensive |

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Issues in the Core Network

- Meeting Internet demand for high-capacity circuits (especially 2.5 and 10Gbps)
- Service velocity (turning up b/w quickly)
- How to switch DWDM-scale traffic volumes
- Cost of switching
- Ensuring standards



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DWDM Economics



- Wavelengths as virtual fiber
- Increase capacity of existing plant
- Reduce regeneration expense
- Based primarily on physics, not networking

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Important Future Core Developments

- Extra long-haul DWDM
- Tunable lasers/filters
- Optical switching
- Low-cost optics

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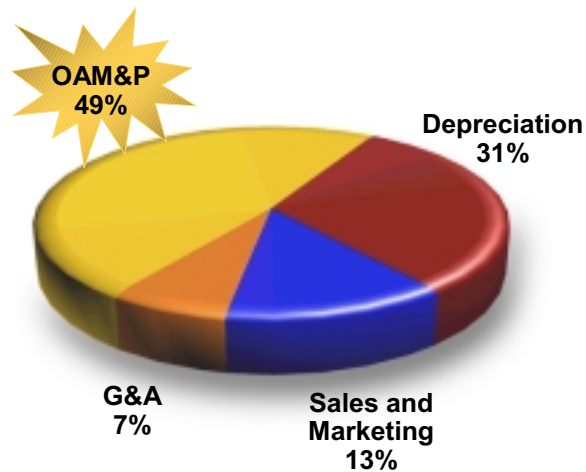
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Service Provider Cost Allocation

- OAM&P cost dominates most service provider's budgets



Source: ARMIS 43-01 Reports
and Probe Research, Inc.

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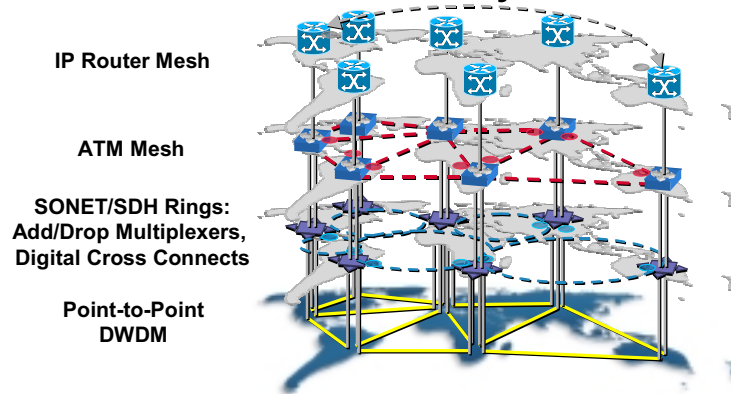
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Complex Network Management

- To provision a circuit, operators must coordinate changes across a wide variety of system types and protocols
- Process can take 60-180 days

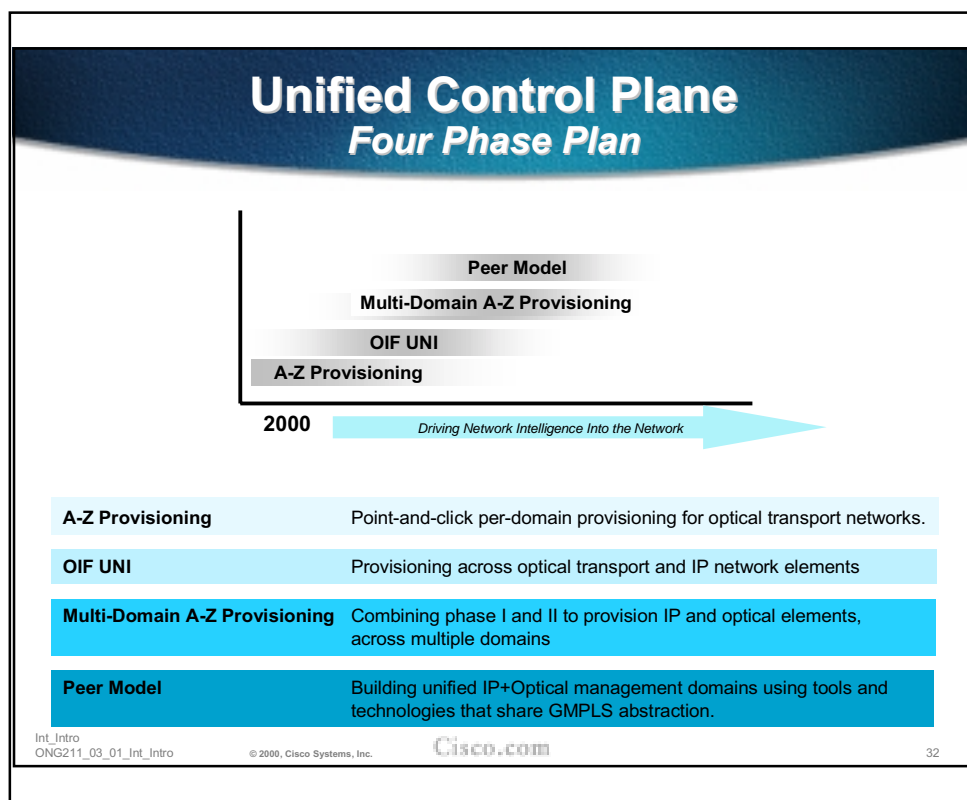
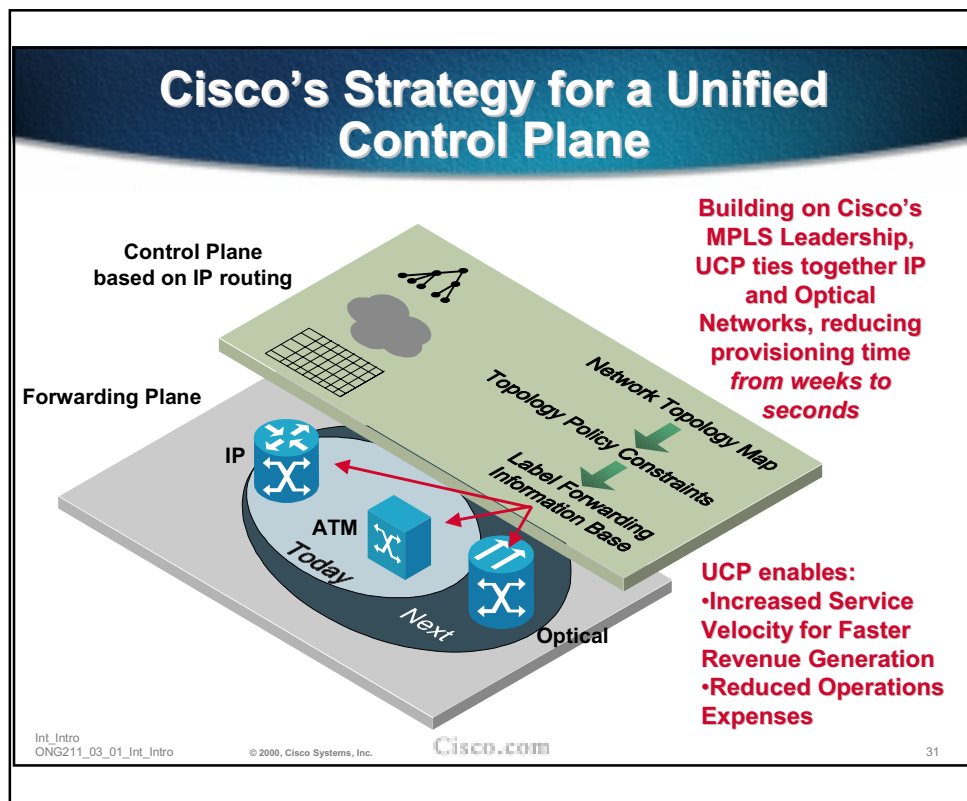


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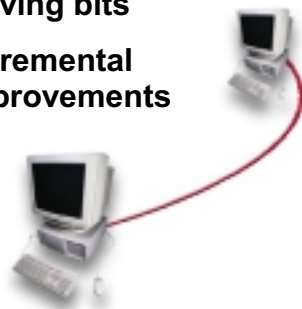
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Service Provider Challenge

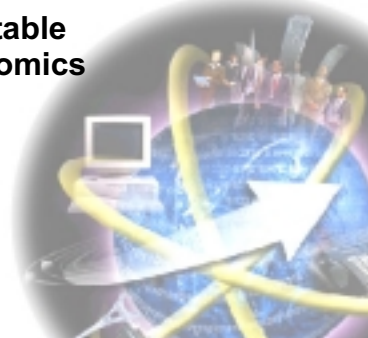
Isn't Just About...

- Scaling the Internet
- Lowering costs
- Moving bits
- Incremental improvements



It's About...

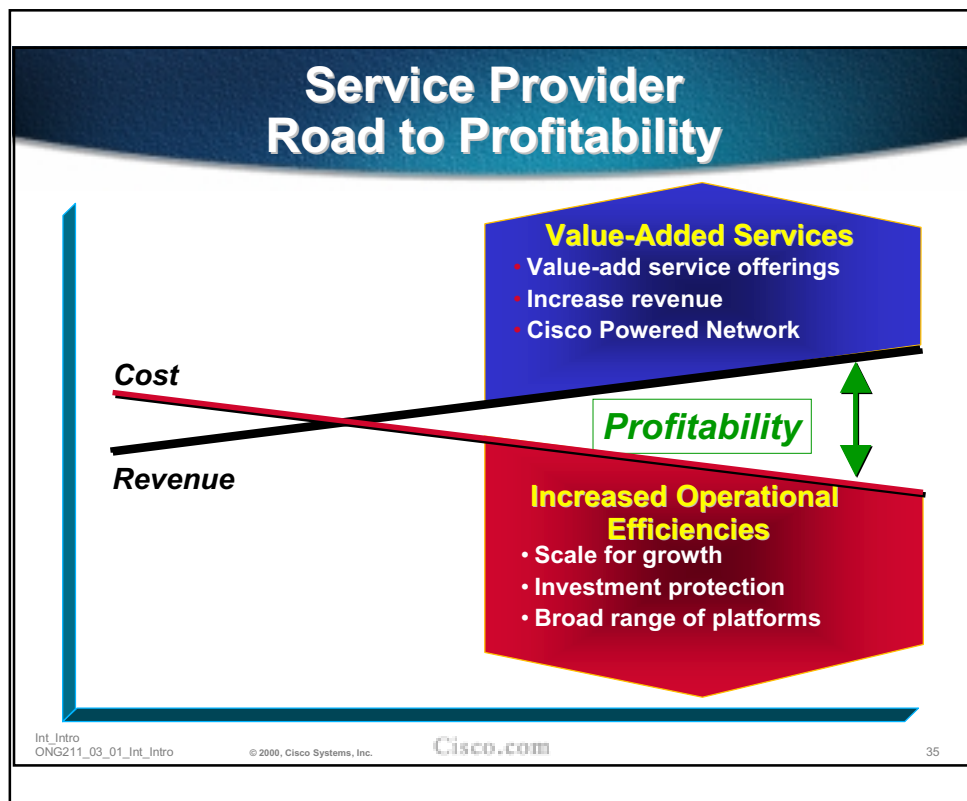
- Raising service velocity
- Differentiated services
- Moving packets intelligently
- Profitable economics



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Profitable 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

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The Promise of the Internet



The integration of IP and optical technology will be the standard for tomorrow's networks. It is the combination of the intelligence of IP networks with the near unlimited bandwidth of optical technology that will deliver on the promise of the Internet.



Chris Nicoll, Vice President
Current Analysis, Inc.

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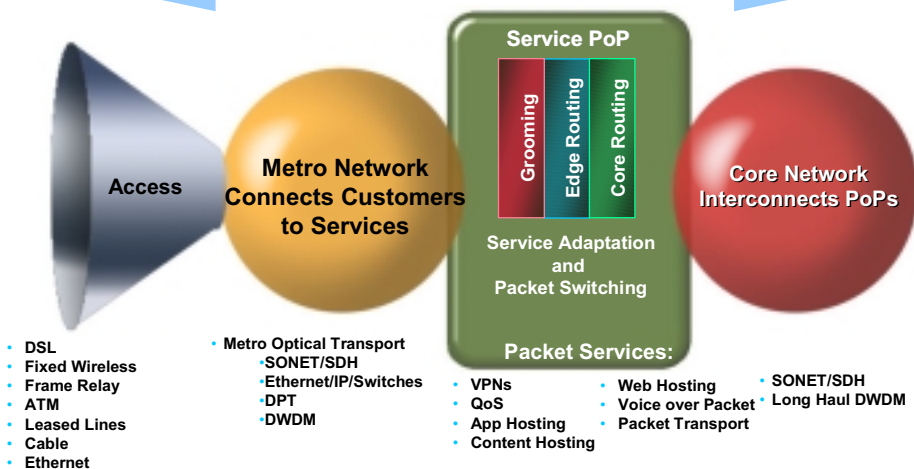
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Service Provider Network Architecture

Cisco Delivers All The Elements

Control Plane and Network Management Integration



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IP+Optical Strategy Summary

- **The Internet has changed forever the way traffic flows; old traffic patterns are no longer dominant: point-to-point connections typical of the old TDM voice world are not typical in the new data world**

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IP+Optical Strategy Summary

- **The all-optical network is a fallacy; light has no intelligence for service delivery**



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IP+Optical Strategy Summary

- You need to choose a supplier who is an expert at enabling IP services as well as optical and is focused on creating profitable economics for its customers

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