Introduction Optical technology

Cisco IP+Optical The Foundation for Profitable Services

Cisco Systems

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Agenda

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

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Why IP+Optical

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

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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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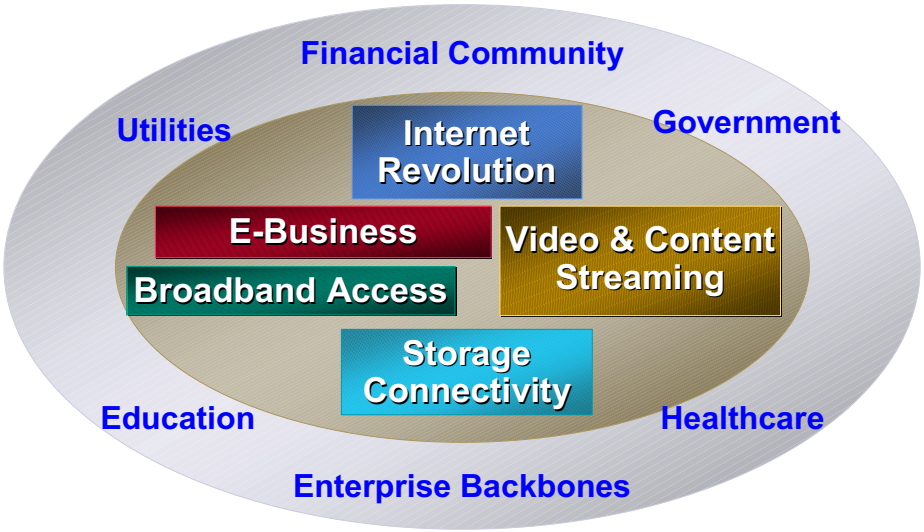
Markets and Drivers



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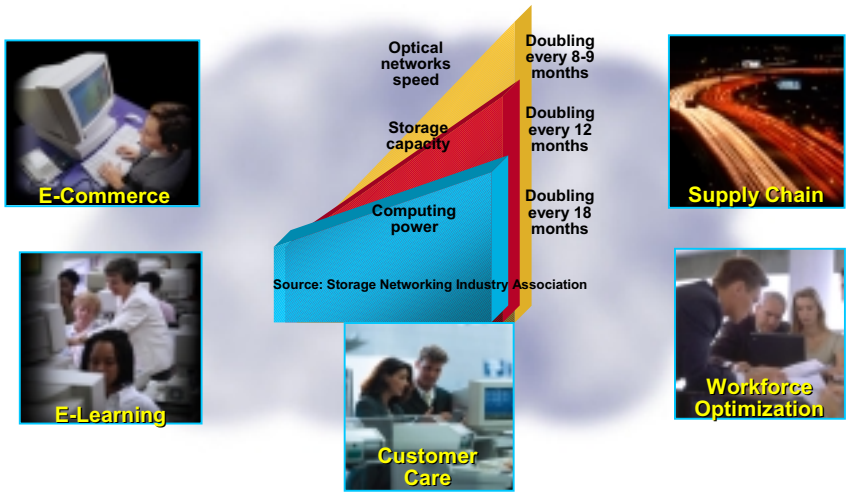
Customer Perspective

Rapid Technology Innovation



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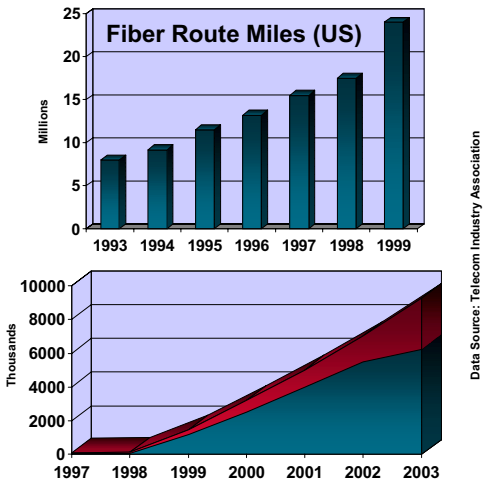
What's Driving Demand for IP+Optical?

- 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



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Enterprise Customers Need…

- Service density and velocity to:
  - Drive profitability with the highest revenue per wavelength
  - Secure the lowest cost per incremental service
- Efficient service delivery to:
  - Respond to new company requirements wavelength by wavelength
  - Rapidly scale to meet varying bandwidth demands
- Flexibility of transport protocol to:
  - Aggregate a variety of low bit rate services on any wavelength
  - Transport any data service on any wavelength
- Externalization of storage on the network to:
  - Share and protect information and storage resources
  - Provide accessibility to mission-critical stored data

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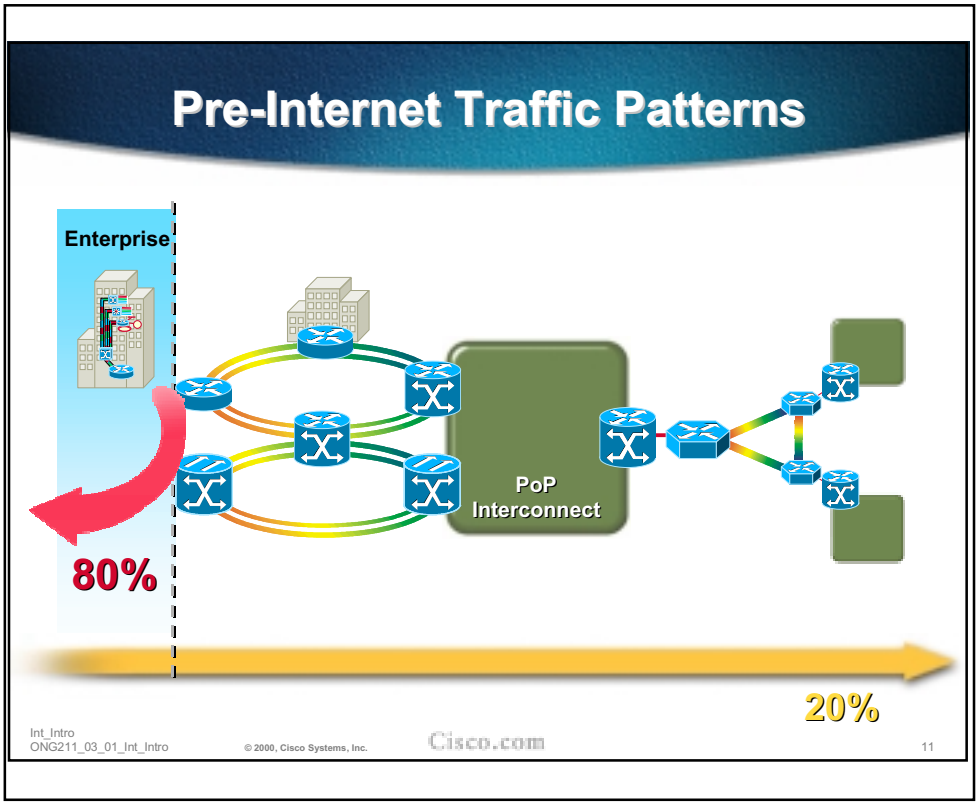

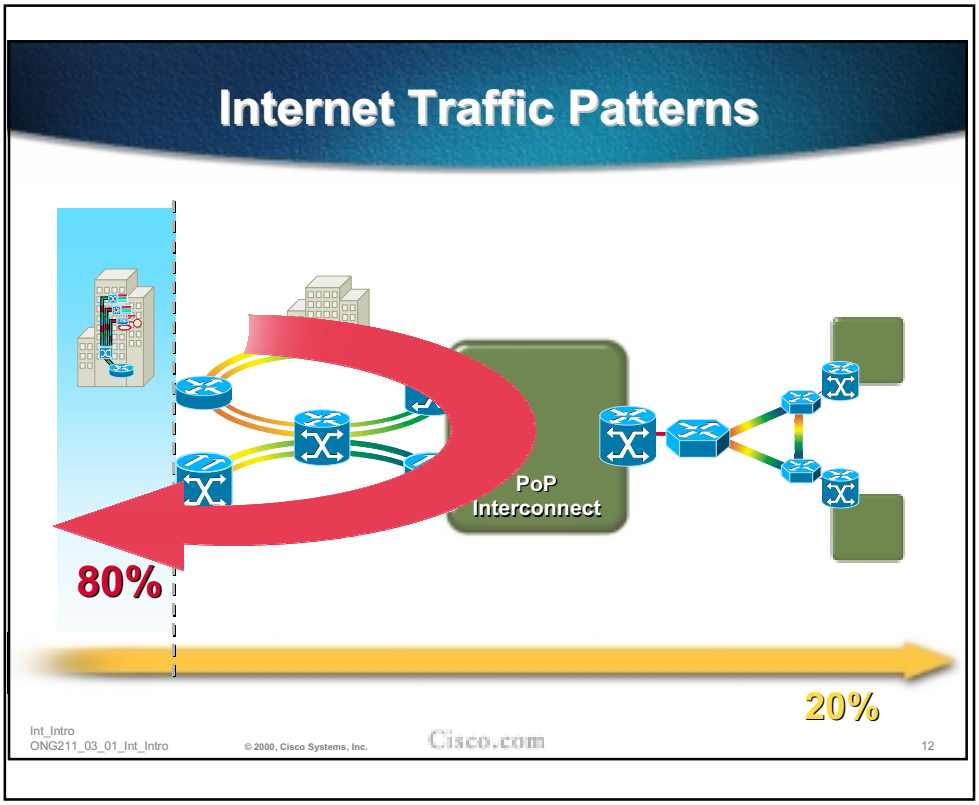

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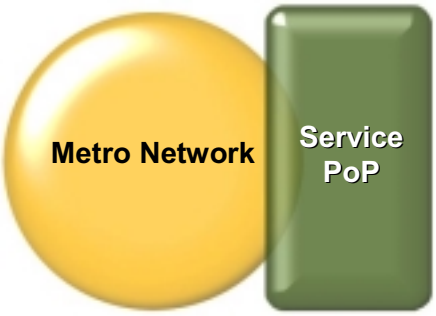
Roles of the Metro Network and Service PoP



- 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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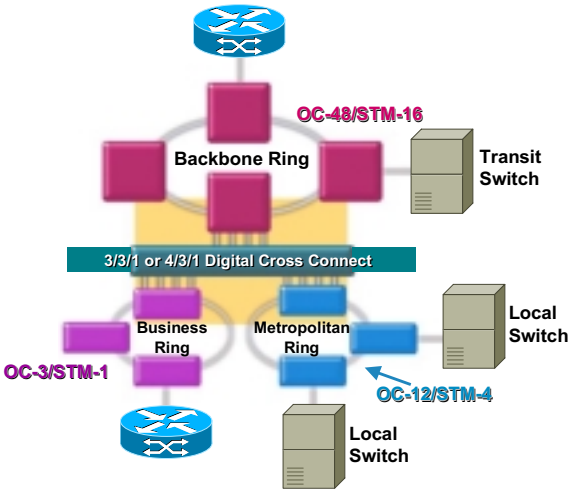
Traditional Metro Infrastructure
Pre-Internet



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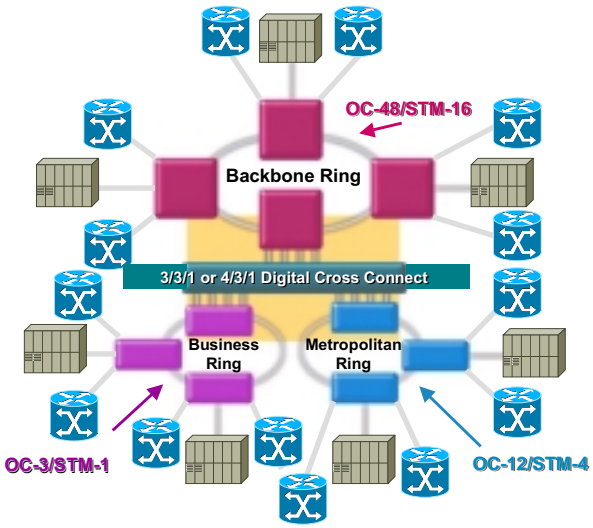
Traditional Metro TDM Infrastructure
Internet Era



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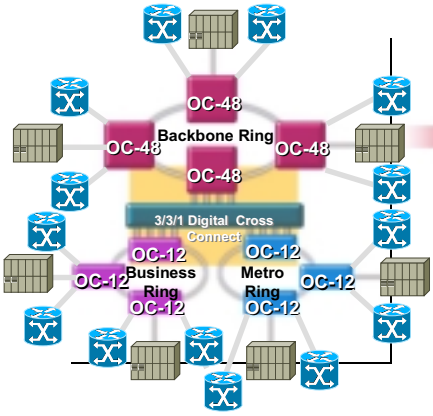
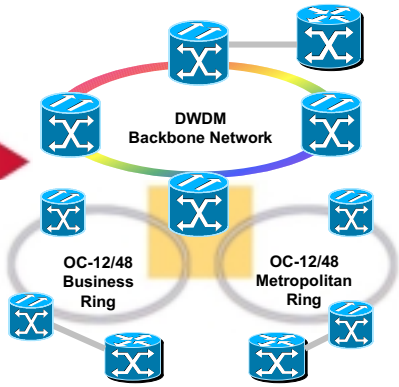
Radical Economics Enable New Services





- Slashes transport costs by 50% or more
- Superior ROI: fewer, more compact nodes; multi-service flexibility and scalability; 4x-16x traditional bandwidth for more services.
- Extends evolutionary transport to metro edge, enabling new services and revenues
- Provides lowest initial and lifecycle cost
- Easy to engineer, install and manage

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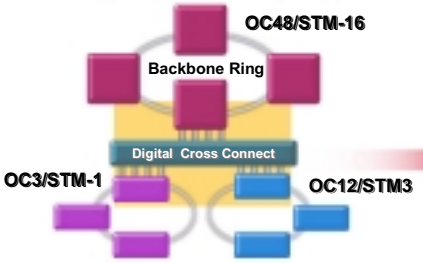
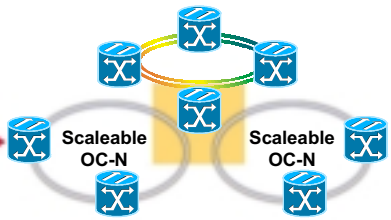
Next Generation Economics…Today!

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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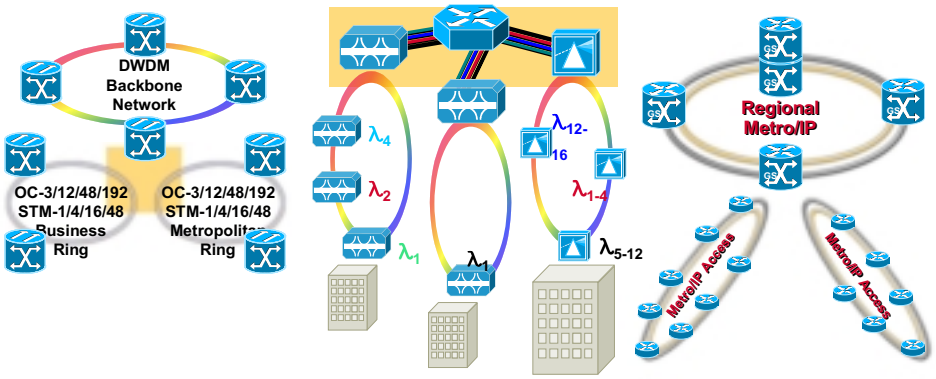
New Metro Infrastructure Options



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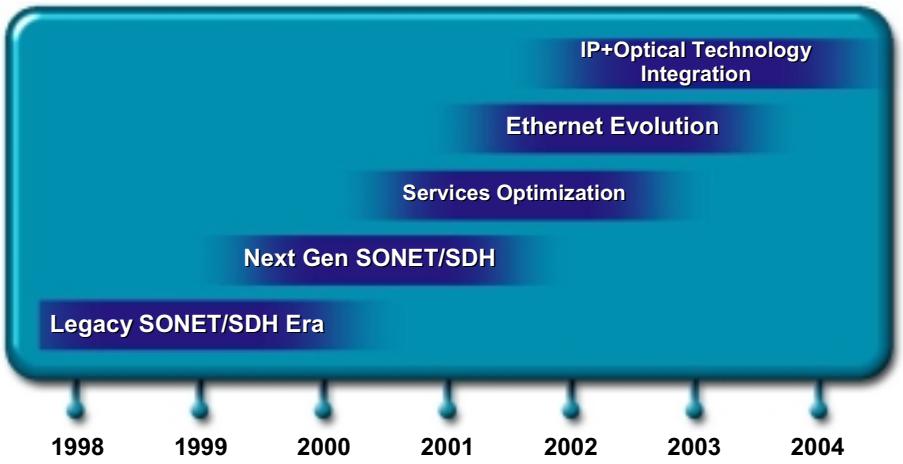
IP+Optical Metro Evolution



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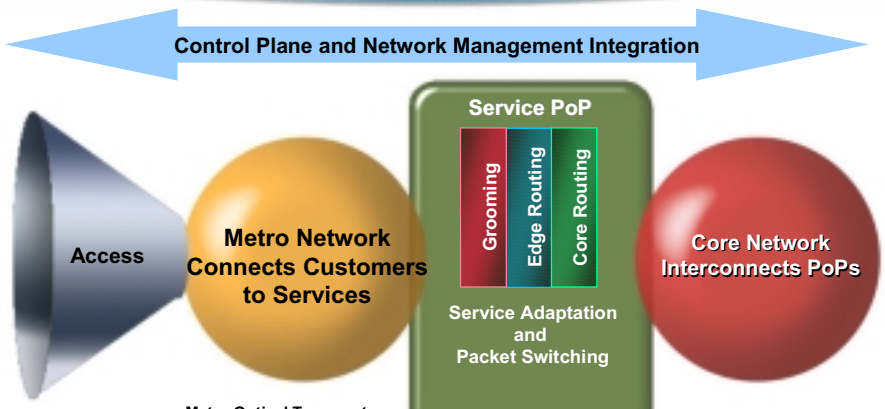
Network Architecture
Cisco Delivers All The Elements



- DSL
- Fixed Wireless
- Frame Relay
- ATM
- Leased Lines
- Cable
- Ethernet

- Metro Optical Transport
  - SONET/SDH
  - Ethernet/IP/Switches
  - DPT
  - DWDM

Packet Services:

- VPNs
- QoS
- App Hosting
- Content Hosting

- Web Hosting
- Voice over Packet
- Packet Transport

- SONET/SDH
- Long Haul DWDM

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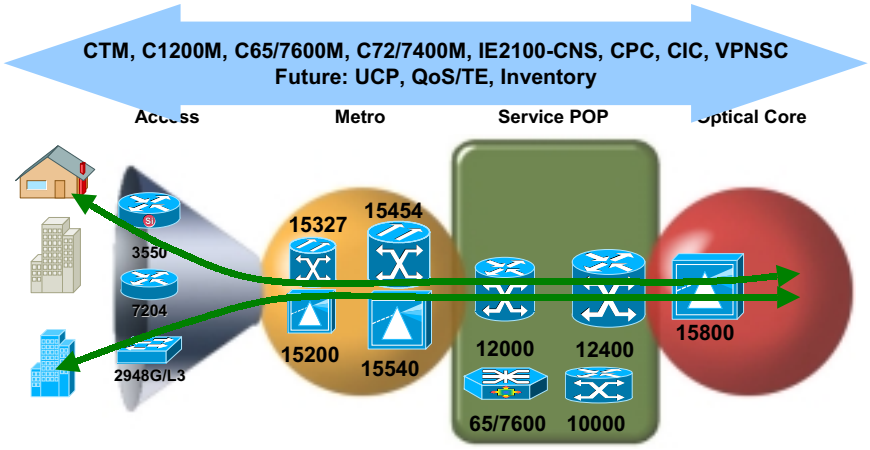
IP+Optical Portfolio



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Metro Network Design
Three Key Missions

λ To The Building

λ on demand
- Low cost
- OC48 POS, GigE
- High-bandwidth services

Next-Generation Optical Transport
- Service density + DWDM
- Plug and play multiservice
- Low-bandwidth services

Extended Services Platform
- Storage networking
- Multiple GE delivery
- Data center interconnect/enterprise

Supercharged SONET

High-Density Extended Services

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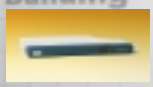
Cisco Product Mapping

λ To The Building

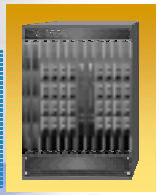
ONS 15201 + 15252
- lowest first cost λ to building solution
- OC-N, GE, bit-rate independent



ONS 15216 + 15454/15327

- 500+ customers
- #1 Ethernet over SONET (CIR)
- #1 OC48 (RHK)

ONS 15540 ESP
- Dense ESCON, FC, GE
- EMC, IBM certified
- Transparent, bit-rate independent interfaces



Supercharged SONET

High-Density Extended Services

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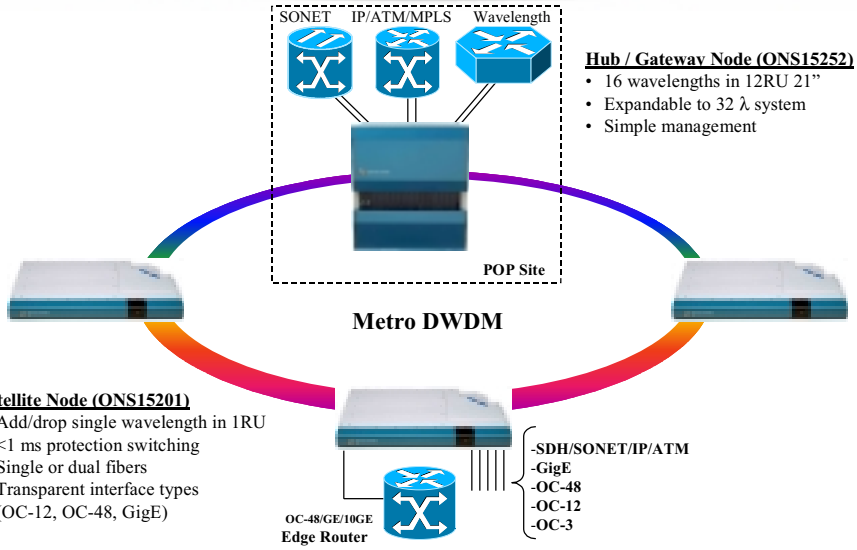
Metro Network for Wavelength Services



Hub / Gateway Node (ONS15252)
- 16 wavelengths in 12RU 21"
- Expandable to 32 λ system
- Simple management

Satellite Node (ONS15201)
- Add/drop single wavelength in 1RU
- <1 ms protection switching
- Single or dual fibers
- Transparent interface types
- (OC-12, OC-48, GigE)

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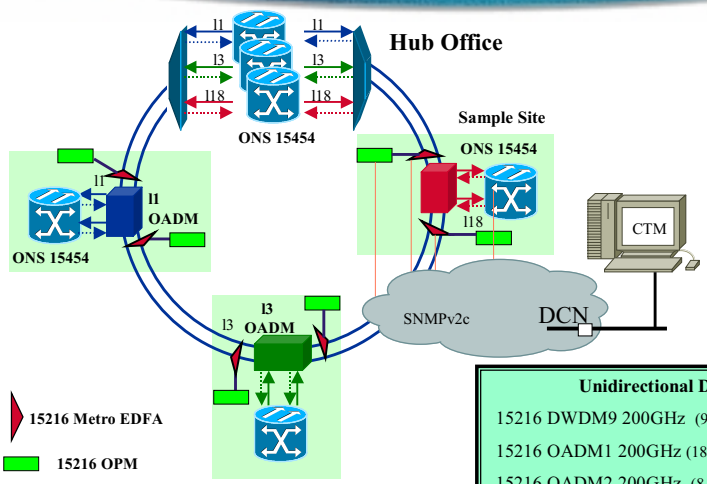
15454 & 15216 Metro Network



Unidirectional DWDM solutions

15216 DWDM9 200GHz (9x9λ Uni Red, Blue)

15216 OADM1 200GHz (18 versions, 1λ add/drop, 2paths)

15216 OADM2 200GHz (8 versions, 2λ add/drop, 2paths)

15216 C-band Metro EDFA (high power)

15216 Optical Performance Manager

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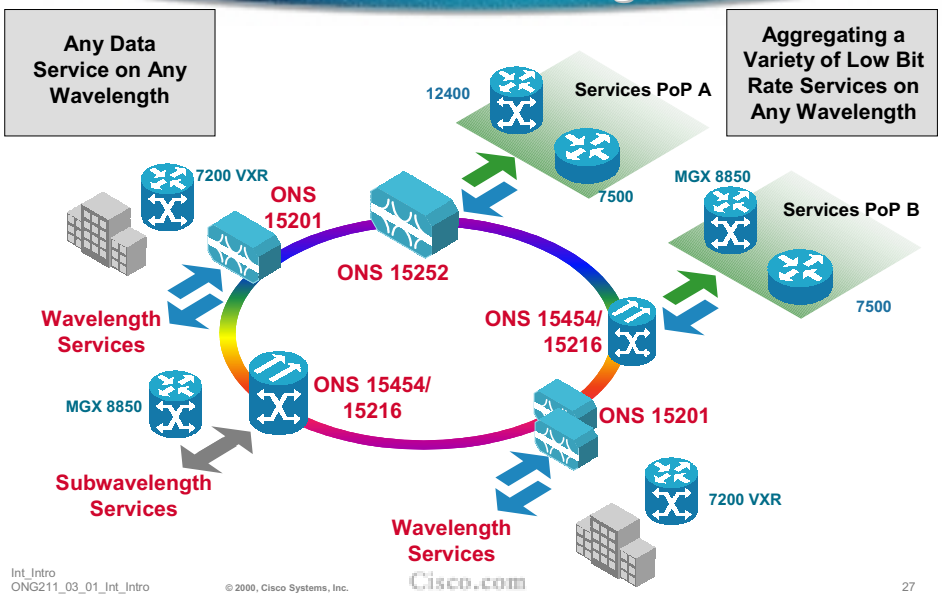
Metro Network—Wavelengths to the Building



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Cisco Evolves Today's Optical Networks By…

- Supercharging SONET/SDH Transport
  - OC3 - OC192 Transport and Bandwidth Management
- Integrating Optical Networking
  - OADM, DWDM, Wavelength Services
- Delivering Multi-Service Capability on Demand
  - TDM, SONET/SDH & Ethernet/Data
- Access-Metro-Core Transport
- Carrier class redundancy
- Providing Next Generation Network Economics…Today!
  - Lowest Lifecycle Cost

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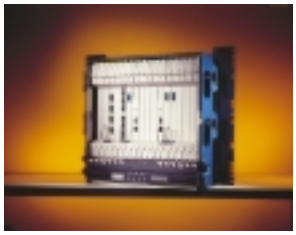
Cisco Differentiators



- Field proven embedded base
  - 500+ Customers across all segments
  - Over 25k Systems in-service
  - 15000+ DWDM Channels deployed
- DS1 to OC192 with VT1.5 grooming on a single shelf
- Efficient transport of TDM, packets, cells, and frames
  - 3000 Gig-E cards shipped
  - 30,000 10/100 Ethernet cards shipped
- Increase infrastructure efficiency with 32 ITU OC-192 optics
- 1 RU for single wavelength add/drop
- Integration with OSS infrastructure

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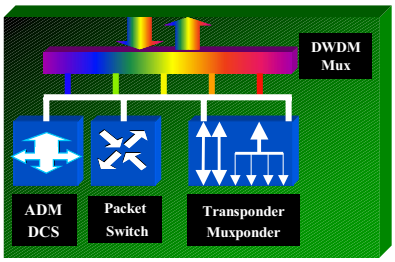
DS1-OC192 + Ethernet

ONS 15454



- Supercharged SONET/SDH Transport
- Integrated Optical Networking
- Unprecedented Multiservices On Demand
- Radical Economics
  - Low first and lowest lifecycle cost

SONET TDM Capability

- DS1, DS3, STS-1E
- OC-3 / 12 / 48 / 192 / 768
- UPSR & 2/4F BLSR Transport

Ethernet / Data Capability

- Ethernet / FE / GigE / 10GE
- POS
- RPR (IEEE 802.17/DPT)

DWDM Capability

- 2.5/10G ITU-T grid optics
- 2R/3R trans/muxponder
- Wavelength add/drop mux
- Amplification & compensation

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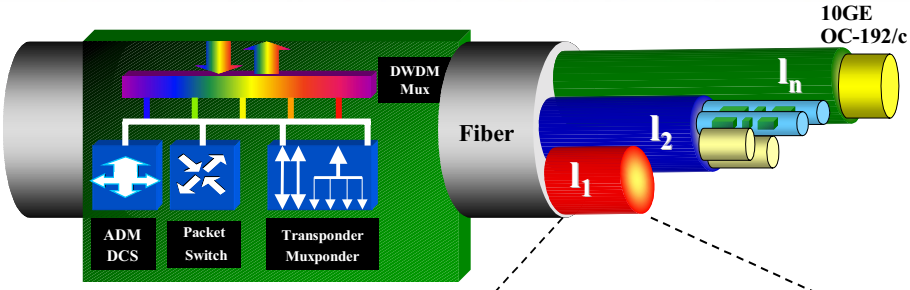
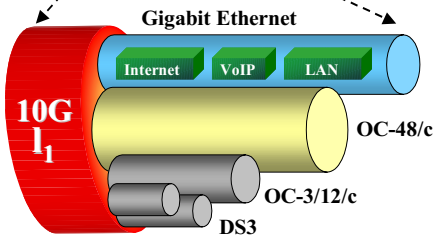
Infrastructure Efficiency



ONS 15454

- Efficient aggregation of services into wavelengths
  - VT & STS multiplexing
  - Packet switching
  - Wavelength multiplexing
- Generate superior ROI



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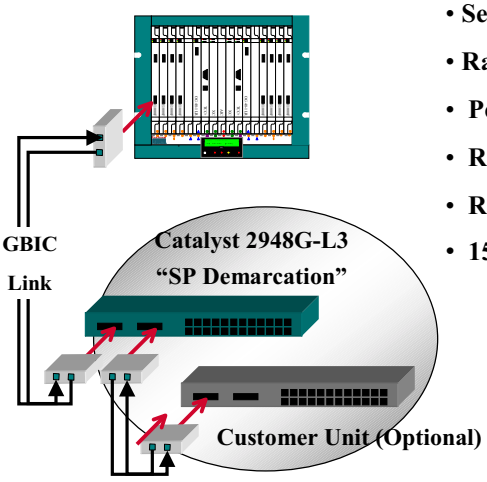
L3/L2 Ethernet Private Line CPE



- Service Demarc at GbE or 10/100 Ports
- Rate Limit 2-1000 Mbps
- Port Based Security
- Remote Verification of SLA
- Remote Provisioning & Upgrades
- 15000+ Installed Since Jan'00 FCS

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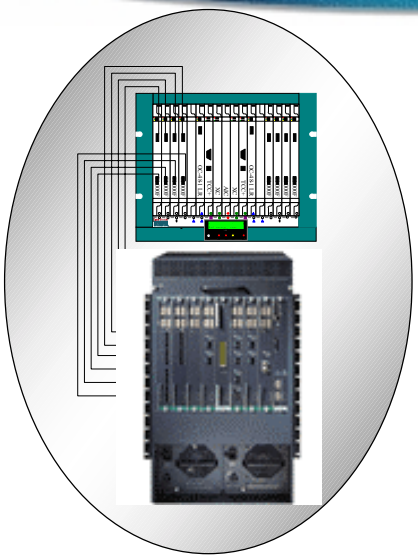
Cisco 7600 for Aggregation



Cisco 7600

Efficient Aggregation - 1 Card terminates all ONS 15454 GbE interfaces with SX or LX GBICs

Rate Limiting

SLA Management via Netflow

VPN Services

9 Slot Chassis

5 Line Cards with Full Logic Redundancy, Cross Bar Fabric

4, 8, 16 GBIC Port Options / LC

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Meeting Needs with IP+Optical

Enable and sustain service long-term profitability

- Increase service velocity
- Efficient wavelength usage
- Enable IP value-added services
  - Ethernet is an emerging subscriber interface
- Scale Network Appropriately
  - Flexible to traffic type, pattern & topology
  - Footprint & power cannot increase with bandwidth

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15216-DWDM8-RED/BLUE
15216-OADM1/2

15216-DWDM8-RED shown

- 200 GHz Spacing, 18 Wavelengths
- Ultra Compact 1 RU
- Variable Optical Attenuation (OADM)
- Monitor Ports at Outputs

Channel	ITU#	*Wavelength(nm)*
1	21	1560.61
2	23	1558.98
3	25	1557.36
4	27	1555.75
5	29	1554.13
6	31	1552.52
7	33	1550.92
8	35	1549.32
9	37	1547.72
10	43	1542.94
11	45	1541.35
12	47	1539.77
13	49	1538.19
14	51	1536.61
15	53	1535.04
16	55	1533.47
17	57	1531.9
18	59	1530.33

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15216-EDFA

15216 Metro C-band EDFA

- C-Band EDFA for Metro / Regional DWDM
- Total Output Power 17 dBm
- Automatic Gain Control Loop
- Integrated GFF w/ Constant 23 dB gain per Channel
- Low Noise Figure < 6.0 dB
- Ultra Compact 1 RU
- Monitor Port at Output

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Optical Performance Monitor

- Designed to monitor up to 40 DWDM channels simultaneously at 100 ghz
- Rapid and precise measurements of:

  Power, Wavelength & OSNR
- 60 dB Dynamic range
- Monitors any DWDM fiber
- Uses as low as .5% tap
- Small spectrometer built in
- Dual inputs for multi-source monitoring

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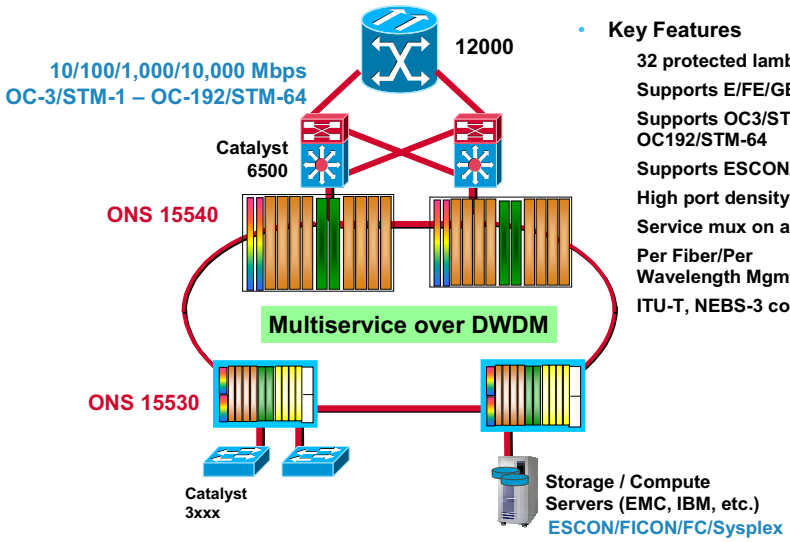
Metro Network—Storage Networking Solution



- Key Features
  - 32 protected lambdas
  - Supports E/FE/GE/10GE
  - Supports OC3/STM-1 - OC192/STM-64
  - Supports ESCON/FICON/FC
  - High port density
  - Service mux on a lambda
  - Per Fiber/Per Wavelength Mgmt
  - ITU-T, NEBS-3 compliant

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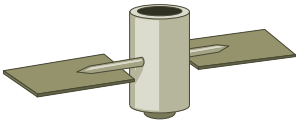
ONS 15530 and ONS 15540

- 32 lambdas/fiber; 64 /rack
- Transparent and switched modes
- WaveFill, WaveGuard and CDL
- 10GE, GE, ESCON, FICON, FC and SONET support
- 2.5 G and 10 G wavelength
- Pt-Pt, ring and mesh networks
- High Availability Options
- NEBS

Hub

Satellite



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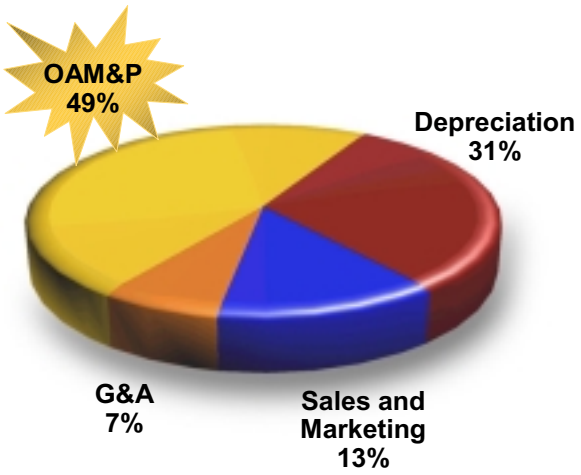
Network O&M Cost Allocation

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



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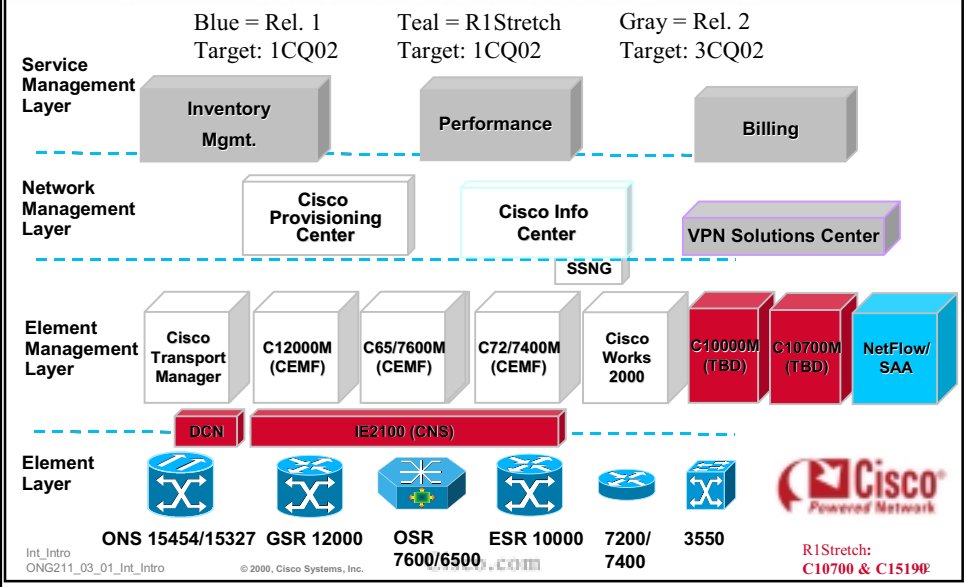
IP+Optical Management Draft Architecture



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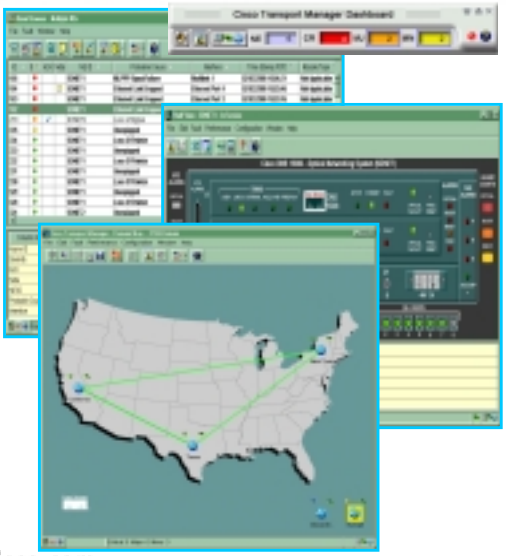
CTM - One System, Any Service

- Complete Optical Domain Management
  - 15201, 15252, 15216, 15327, 15454, 15530, 15540, 15800
  - Access/Metro/Core
- Java-based "Manage Anywhere" Architecture
- Robust OSS Integration
  - SNMP, CORBA & TL1



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Complex Network Management

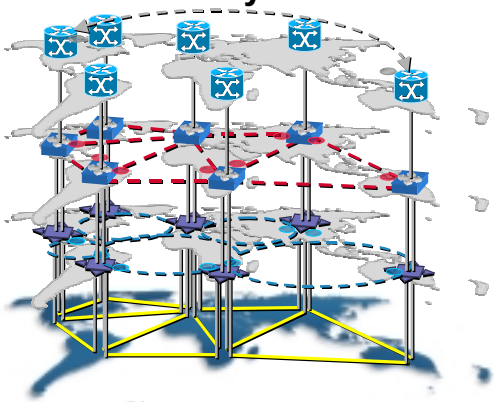
- To provision a circuit, operators must coordinate changes across a wide variety of system types and protocols
- Process can take 60-180 days

IP Router Mesh

ATM Mesh

SONET/SDH Rings: Add/Drop Multiplexers, Digital Cross Connects

Point-to-Point DWDM



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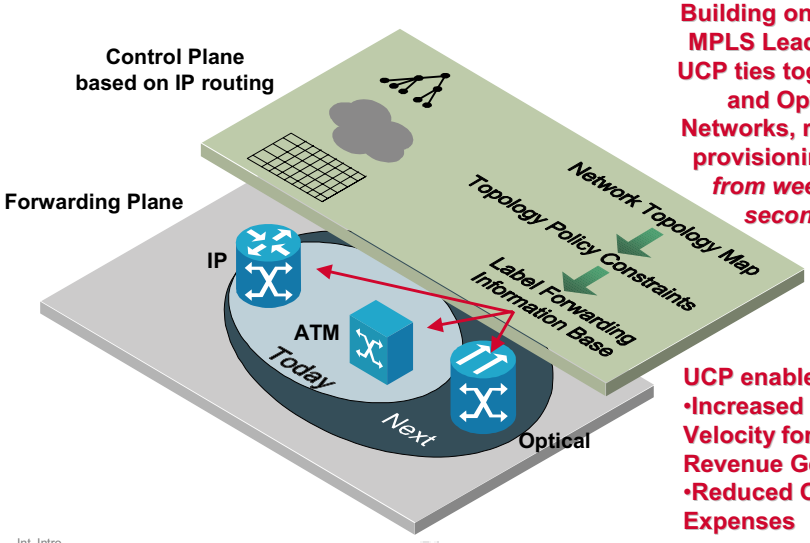
Cisco's Strategy for a Unified Control Plane



Building on Cisco's MPLS Leadership, UCP ties together IP and Optical Networks, reducing provisioning time *from weeks to seconds*

UCP enables:
- **Increased Service Velocity for Faster Revenue Generation**
- **Reduced Operations Expenses**

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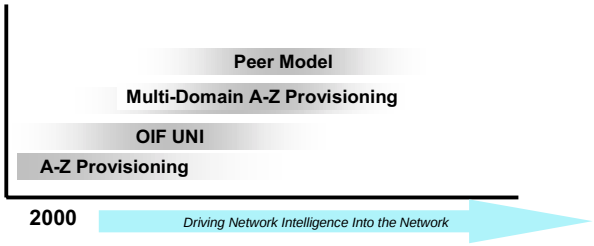
Unified Control Plane
Four Phase Plan



A-Z Provisioning	Point-and-click per-domain provisioning for optical transport networks.
OIF UNI	Provisioning across optical transport and IP network elements
Multi-Domain A-Z Provisioning	Combining phase I and II to provision IP and optical elements, across multiple domains
Peer Model	Building unified IP+Optical management domains using tools and technologies that share GMPLS abstraction.

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Agenda

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

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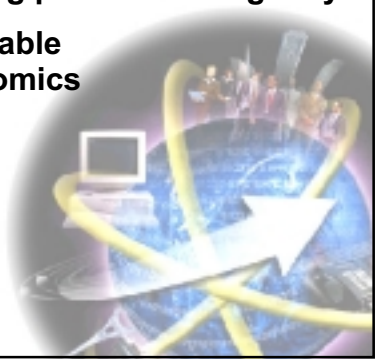
Service Provider Challenge

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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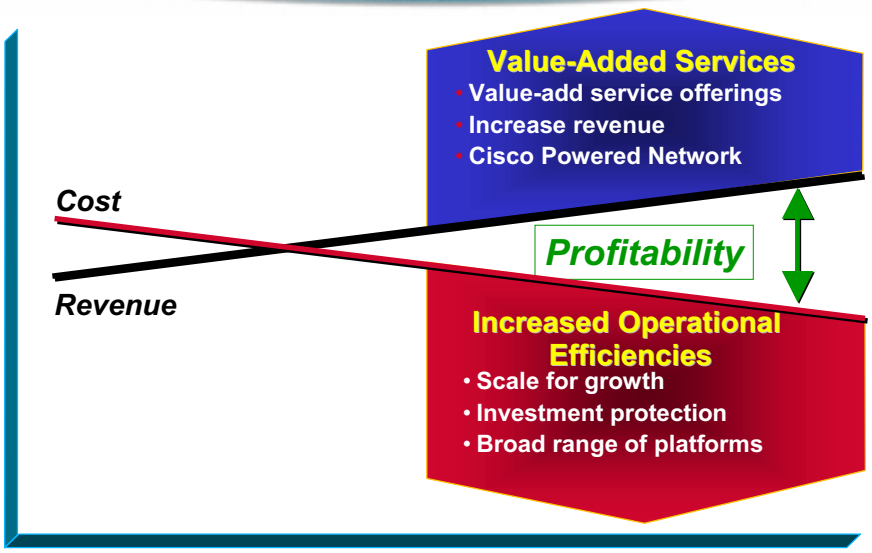
Service Provider Road to Profitability



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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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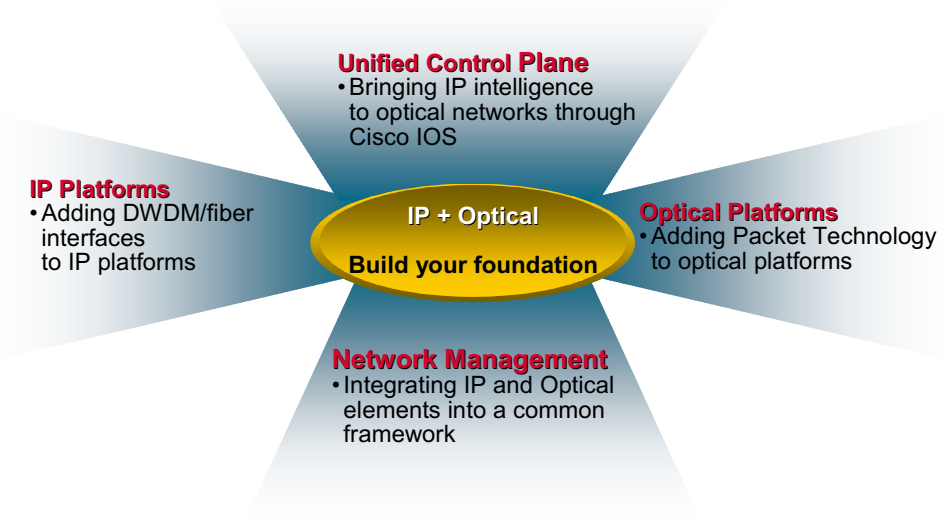
Cisco IP+Optical Combining All the Elements



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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

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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