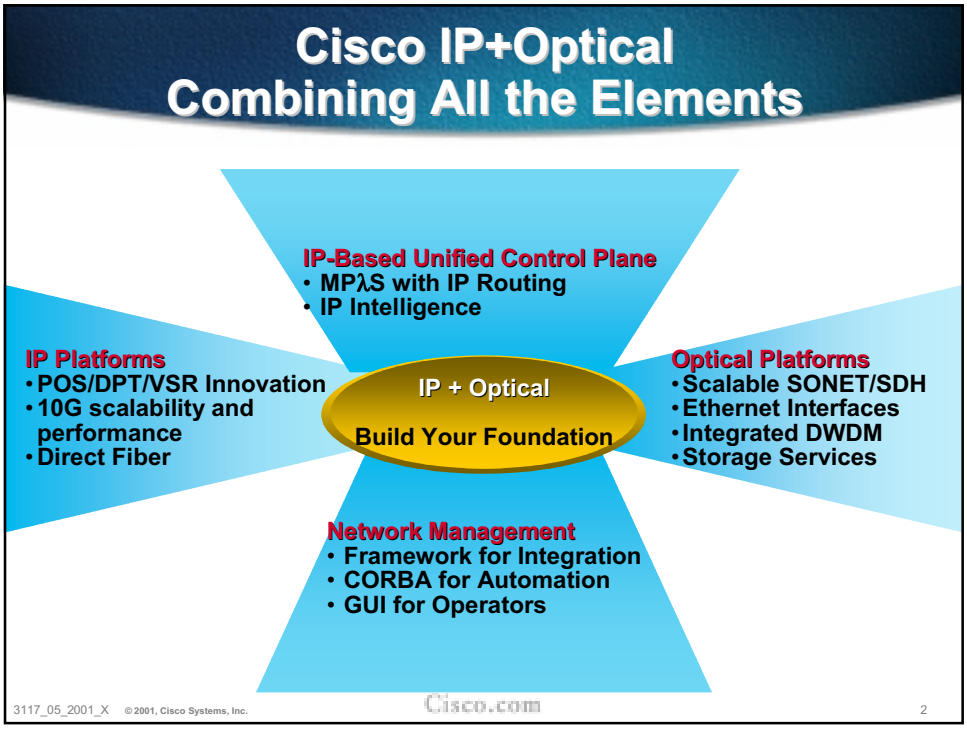

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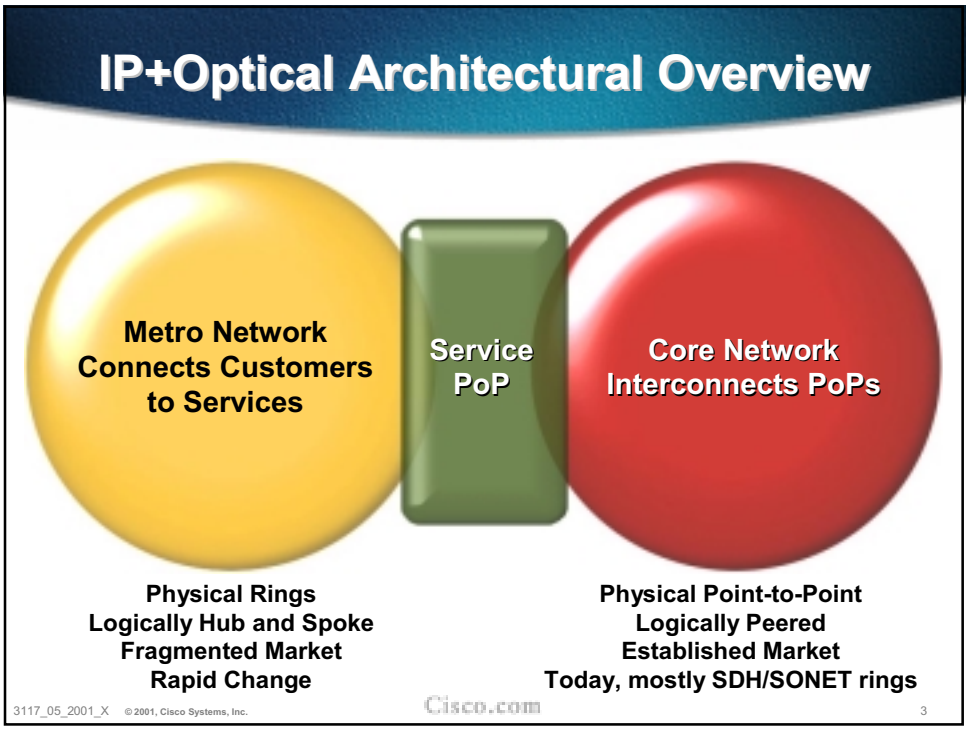

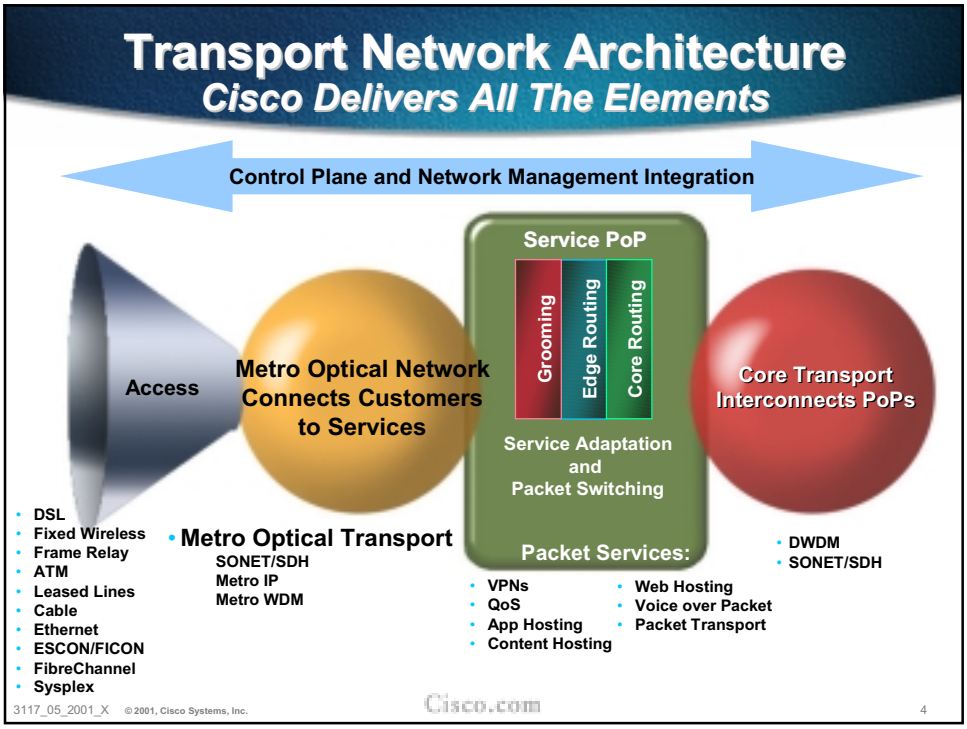

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Metro Network Solutions Agenda

- Metro Market Drivers
- Metro Optical Transport
- Metro DWDM
- Metro IP
- Total Network Solution

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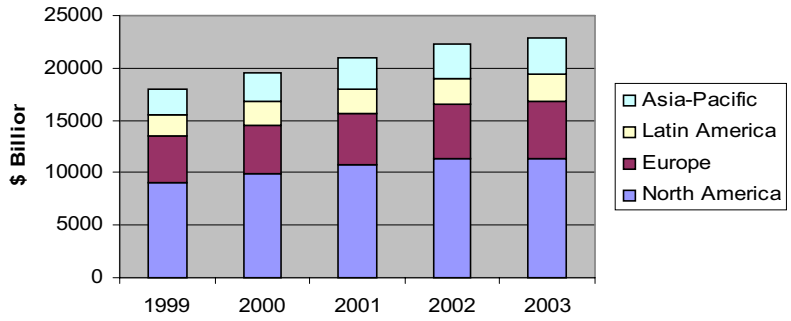
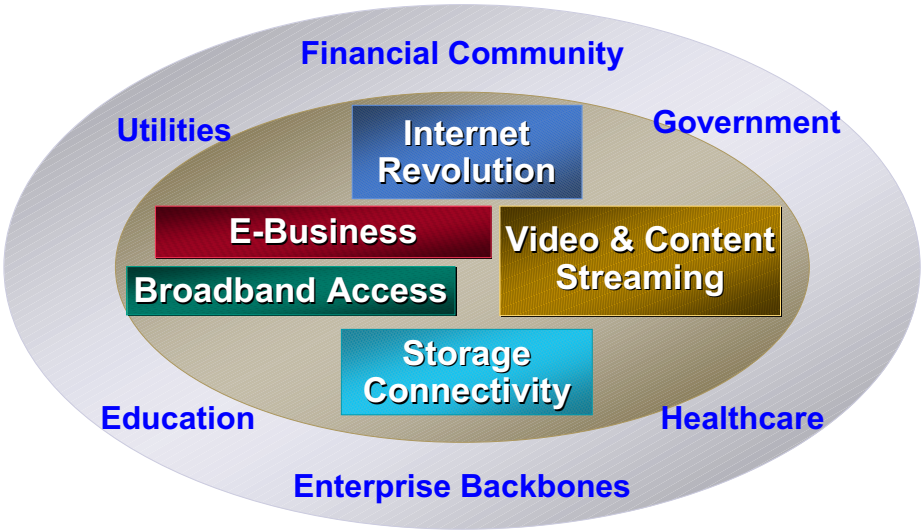
Global Optical Network Market

Worldwide Optical Transport Market, 1999-2003



Source: Gartner Group, April 2000

Markets and Drivers



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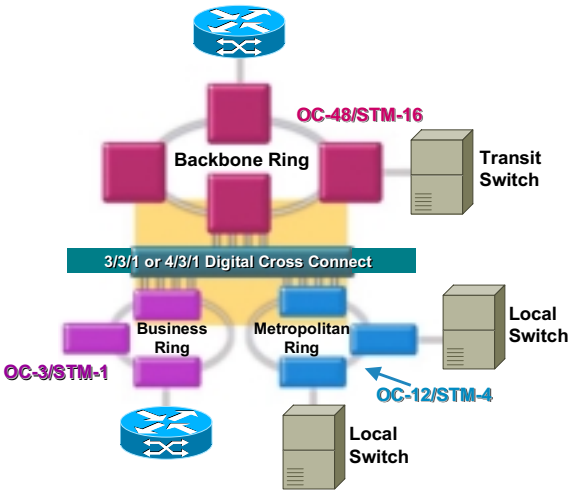
Service Providers Need…

- 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 customer 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

Traditional Metro Infrastructure
Pre-Internet



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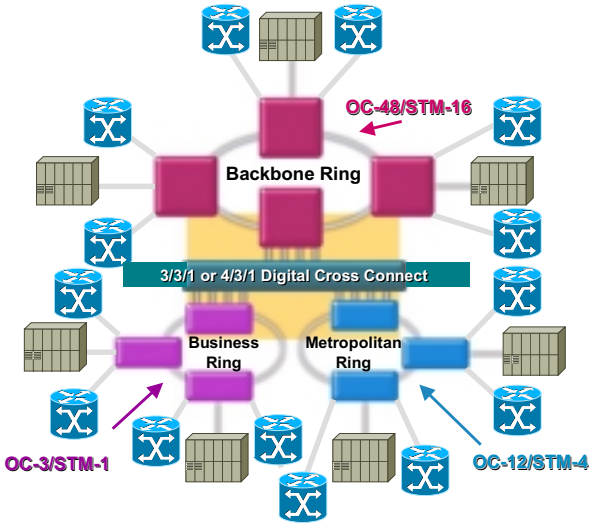
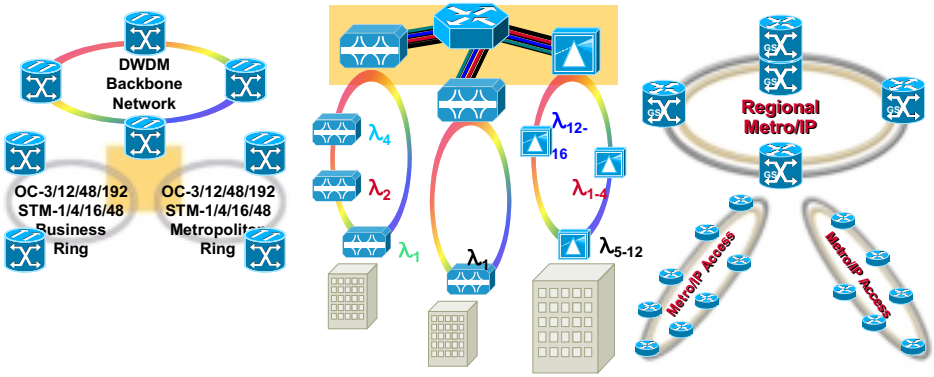
Traditional Metro TDM Infrastructure
Internet Era



New Metro Infrastructure Options



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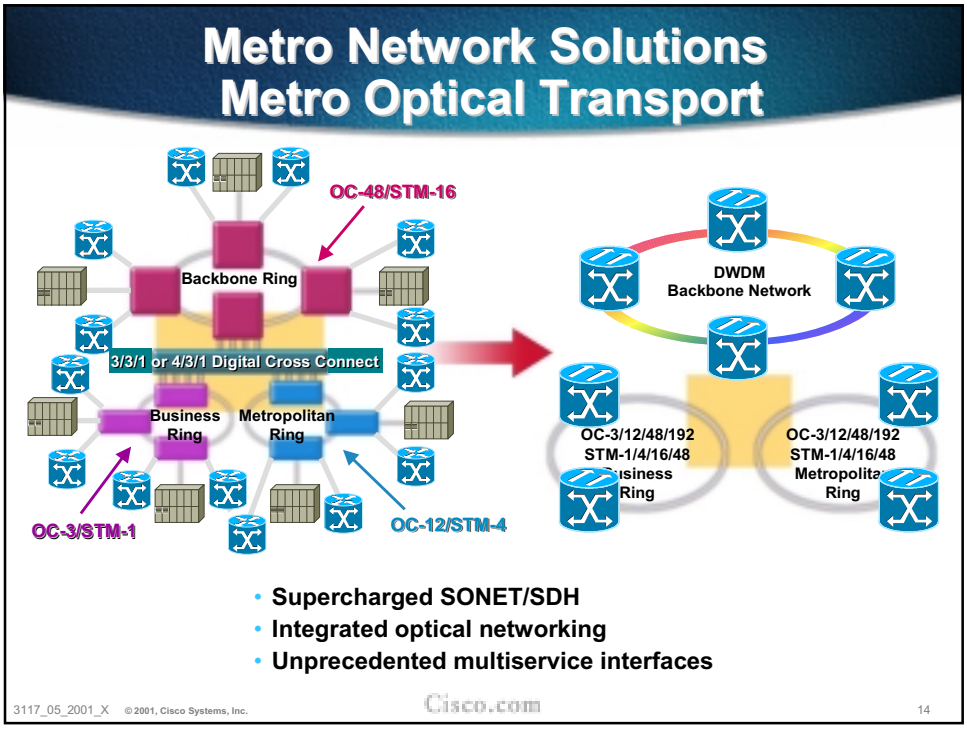

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Metro Optical Transport Benefits

- Supercharged SDH/SONET transport
  - Multi-bit rate OC-n/STMn transport
  - Integrated VT/VC and STS bandwidth management
- Unprecedented multiservice capability
  - TDM, Ethernet, ATM, video,wavelengths
  - Integrated data switching and concentration
- Integrated optical networking
  - Optical services
  - Massive capacity expansion
  - Wavelength/OADM management
- Radical economics… today!
  - Slashes first costs and operating expenses
  - Easy to engineer, install, and use

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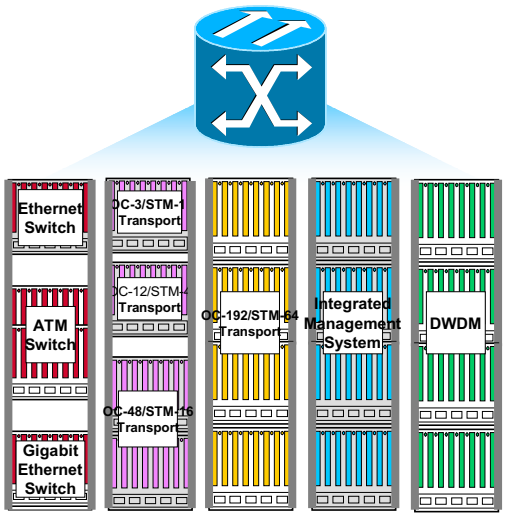
Supercharged SONET/SDH Transport

- Transport
  - OC-3/STM-1
  - OC-12/STM-4
  - OC-48/STM-16
  - OC-192/STM-64
  - DWDM
- Integrated VT/VC and STS bandwidth management
- Ethernet/TLS
- Integrated management system



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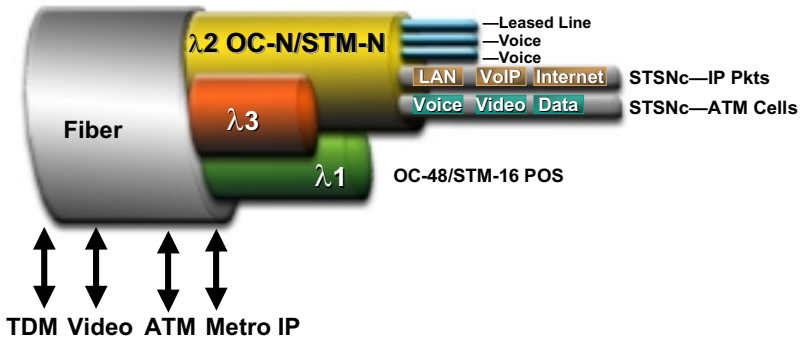
Unprecedented Multiservice Capability



- Integrated multiservice interfaces
- Services aggregated on wavelength(s)
- Services dedicated to wavelength(s)
- Statistical multiplexing of bursty data traffic
- Bandwidth oversubscription

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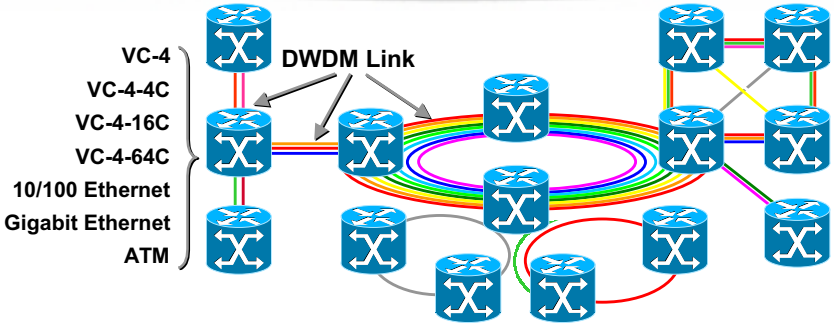
Integrated Optical Networking



- DWDM/SDH/SONET linear, meshed, and ring networking
- Optical services
- Massive network capacity expansion
- Wavelength management

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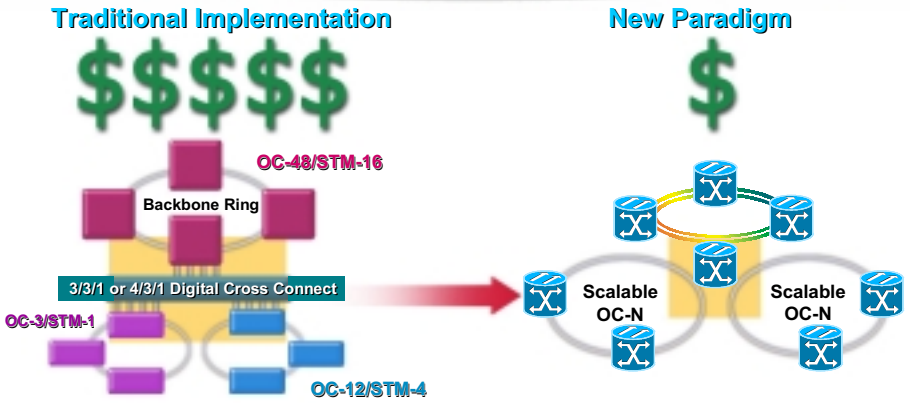
Radical Economics…Today!



- Slashes transport costs by up to or at least 50%
- 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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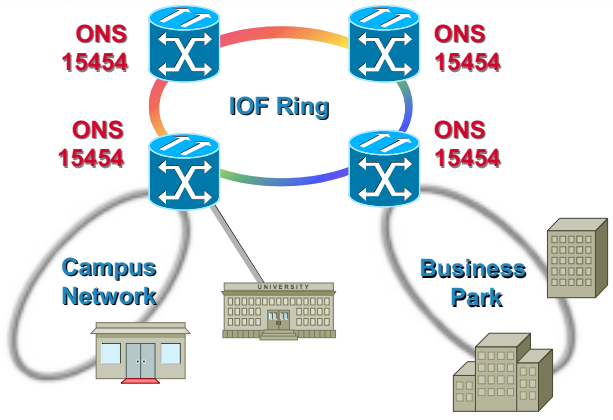
Interoffice (IOF) and Collocation Application



Multiservice Interfaces: Optical and LAN Access

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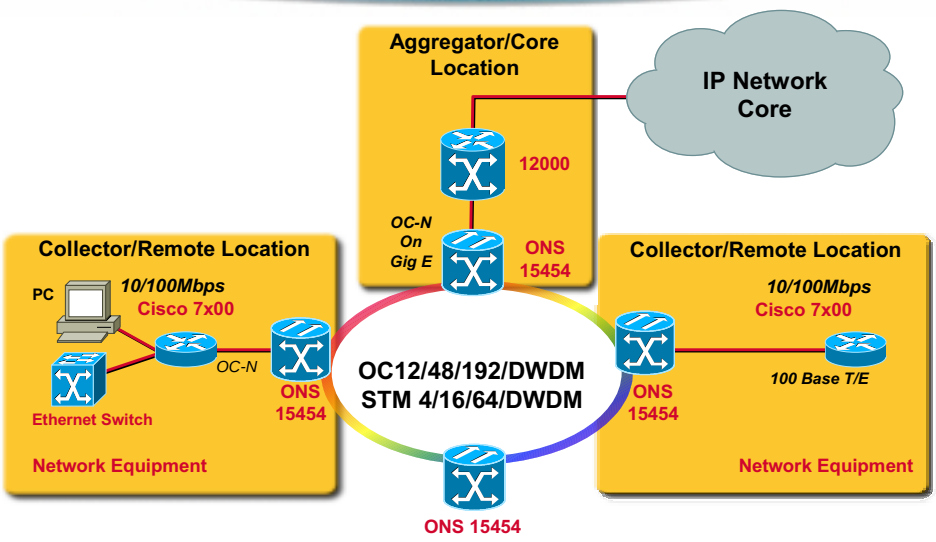
IP Transport Application



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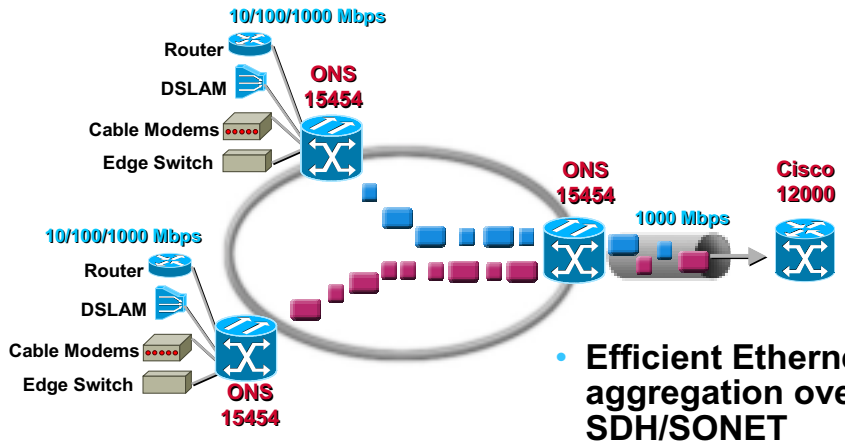
Flexible Ethernet Services Application



- Efficient Ethernet aggregation over SDH/SONET
- Shared bandwidth

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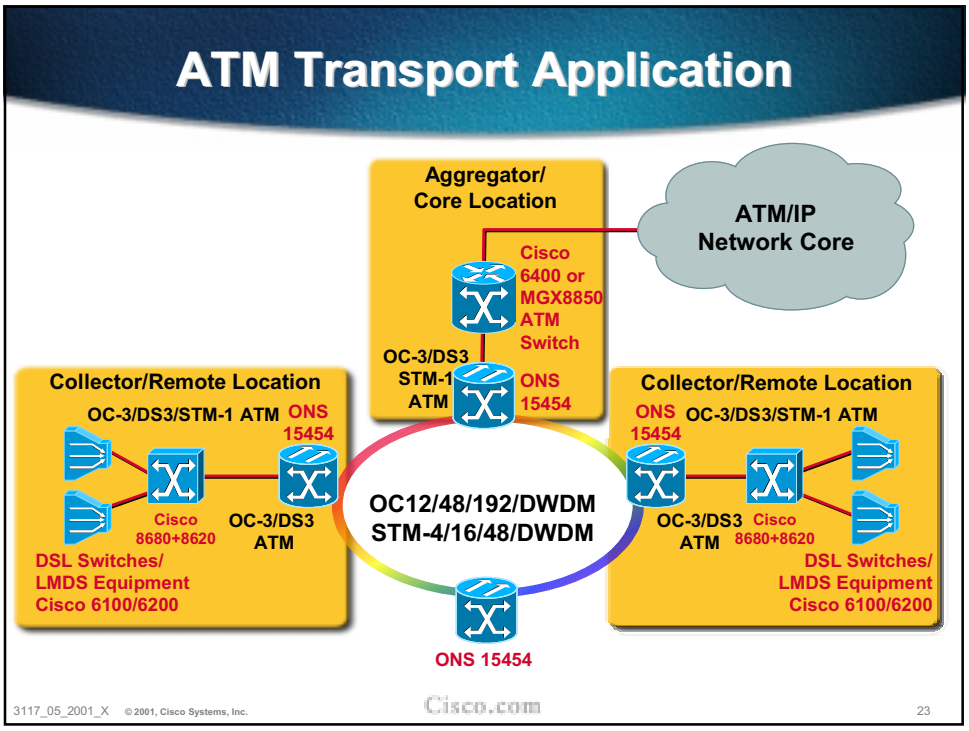

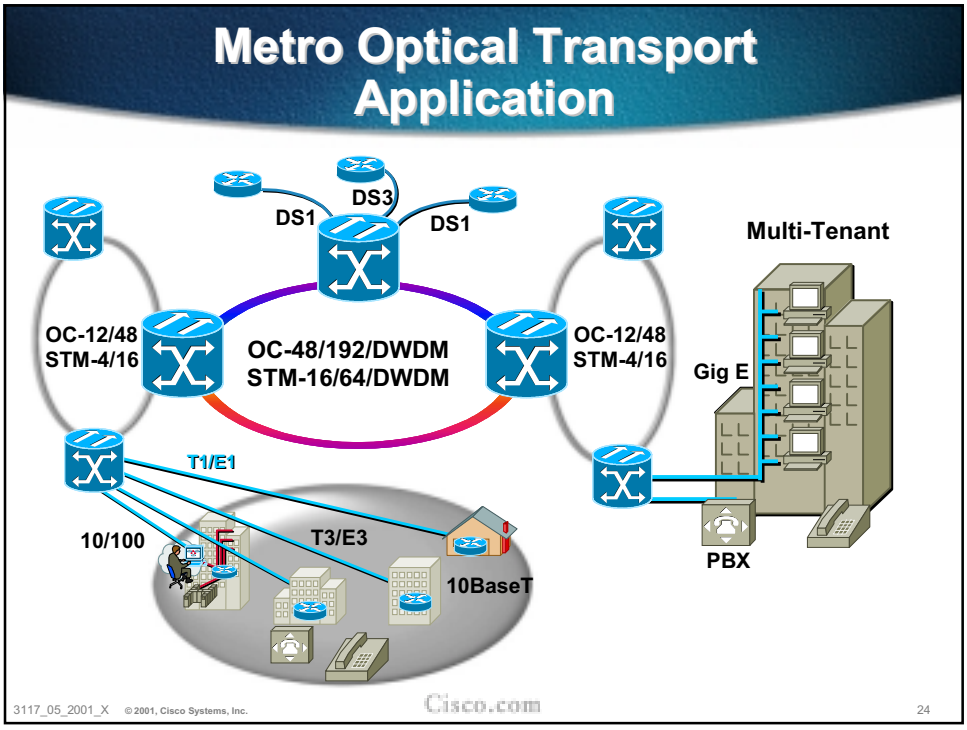

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Metro Edge Optical Transport

- ONS 15327: The first metro edge optical transport platform
  - Supercharged SONET/SDH (Ocn/STMn)
  - Integrated Optical Networking (DWDM, ITU wavelengths)
  - SONET/SDH and wavelength interchange with ONS 15200
  - Unprecedented multiservices on demand
  - TDM/Ethernet/ATM
  - Integrated data switching and cross-connect
  - Radical economics
  - Low first cost, lowest life cost
  - Smallest footprint
  - Fastest provisioning

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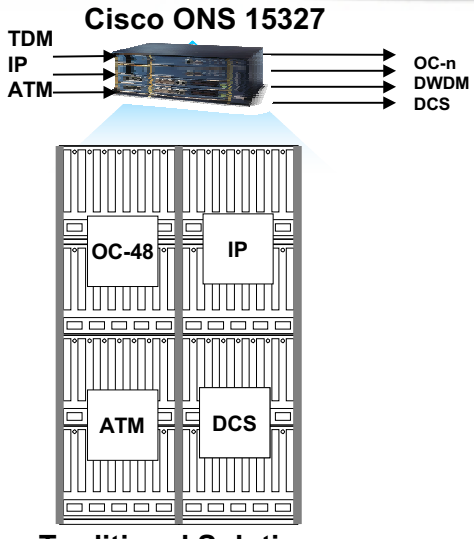
Supercharged Metro Edge



- Most flexible platform
  - OC-n/STMn SONET/SDH
  - DWDM
  - Integrated DCS
- Smallest footprint
  - 5 x 19 x 12 inches (14 per rack)
- Most service interfaces
  - OC-192/STM64/10 G
  - OC-48/STM16/2.5 G
  - OC-12/STM4/650 Mbps
  - OC-3/STM1/155 Mbps
  - 10/100/1000 Ethernet
  - DS1, DS3

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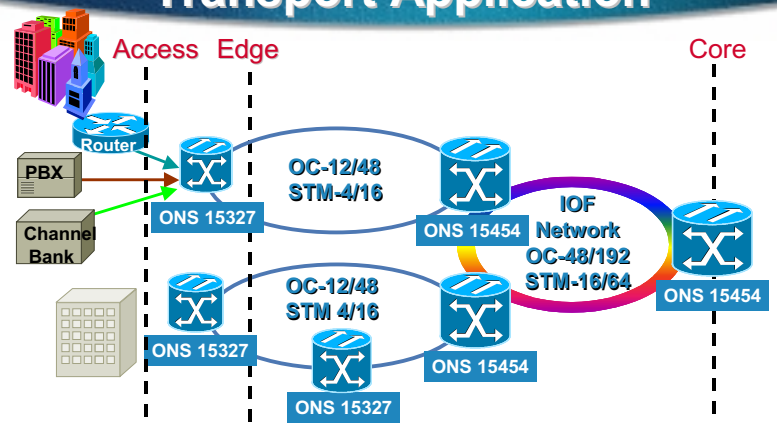
ONS 15327 Metro Edge Optical Transport Application



- Customer "Edge" rings
- Wireless PoP aggregation
- Customer premises multiplexer
- Small central offices

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Metro Optical Transport Platform Product Portfolio

Cisco ONS 15454

Cisco Transport Manager

Cisco ONS 15327

And Growing . . .

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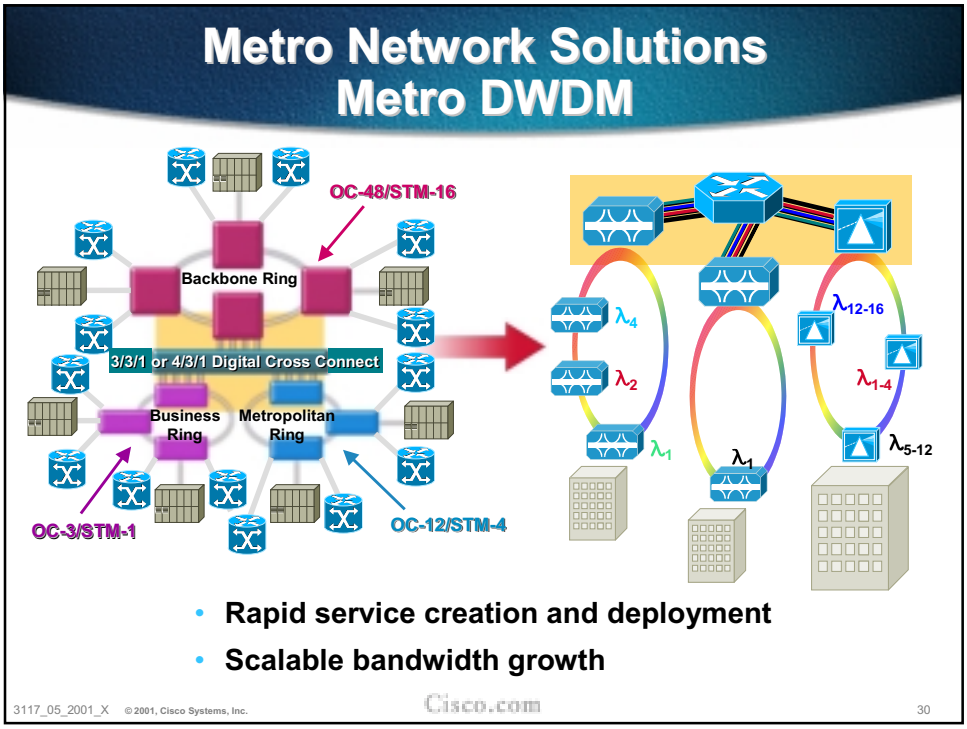

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Metro DWDM Benefits

- Includes first "Wavelength to the Building" Metro DWDM solution
  - Supercharged wavelength services
    - Instant wavelengths to the building, premise, or PoP
    - SONET/SDH or wavelength interoperability with ONS 15454 and 15327
  - Service density and end-to-end management
    - High-density storage and data services
    - Massive capacity expansion (32 lambdas @ 10 Gbps each)
    - Service multiplexing on a lambda
  - Unprecedented transport flexibility
    - Optical add/drop multiplexing (OADM)
    - Support for any service on any wavelength
    - Metro and regional applications
  - Radical economics
    - Lowest cost per service and highest service density
    - Quick deployment and turn up

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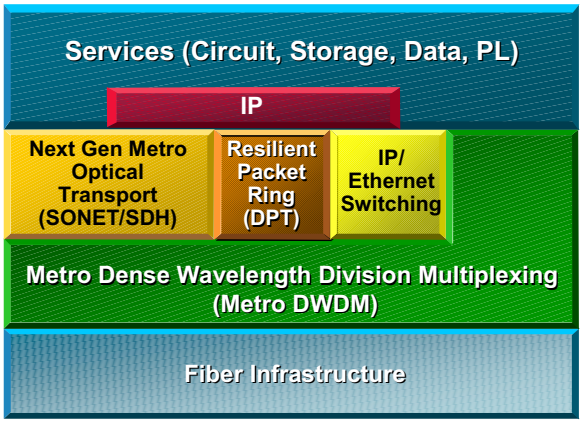
Metro DWDM as Enabler



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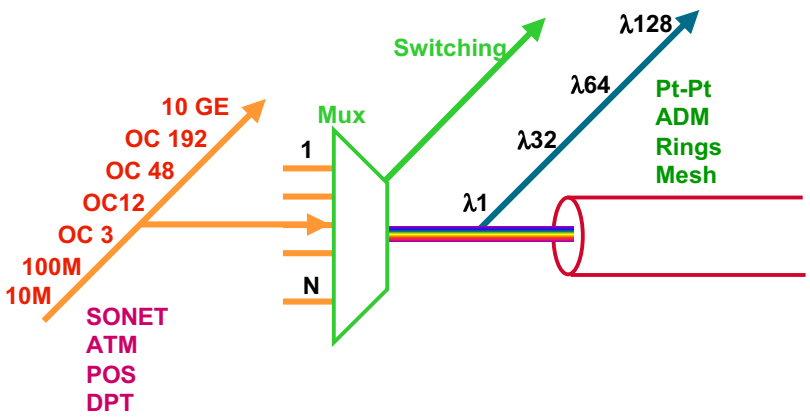
Metro DWDM Evolution



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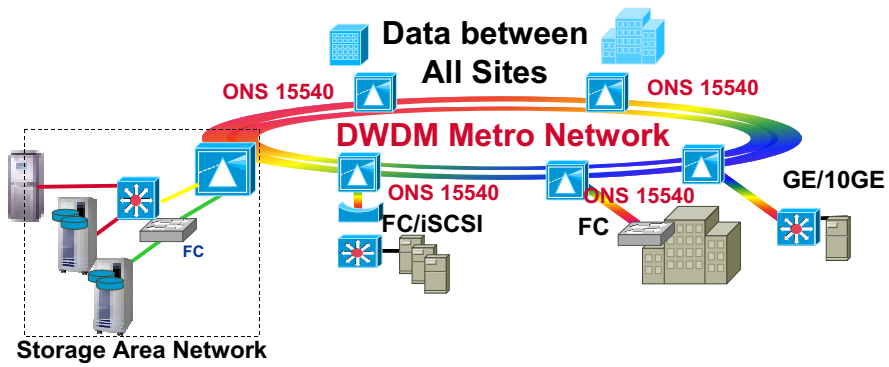
Integrated Networking over Metro DWDM

- Dark fibers or wavelengths from FSPs
- Offer managed storage services

  GE/10GE, SONET/SDH, ESCON, FICON, FC/iSCSI



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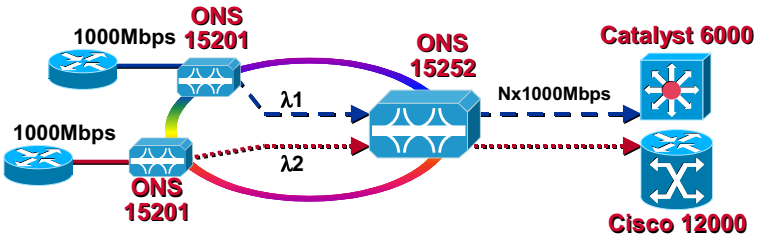
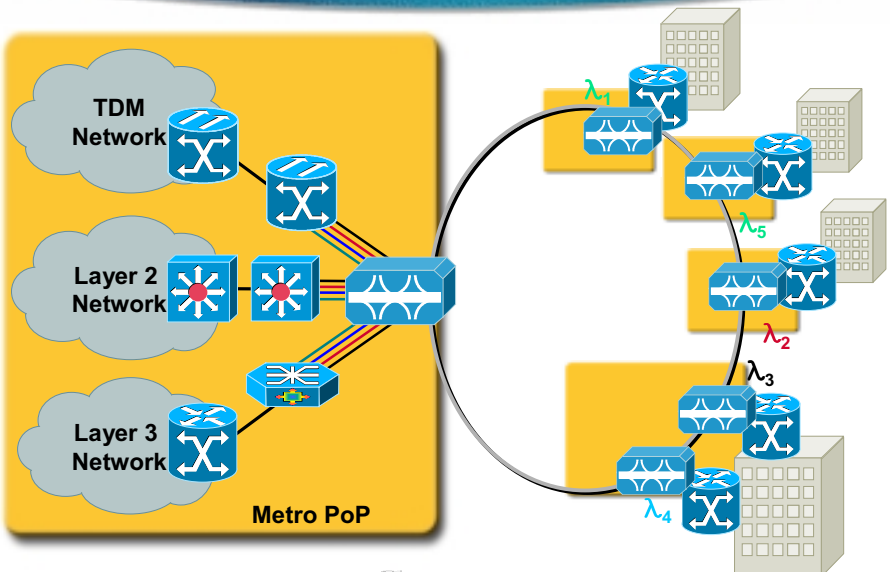
Ethernet over DWDM

- Line-speed Gigabit Ethernet transport over DWDM



- Dedicated wavelengths

Managed Wavelength Services



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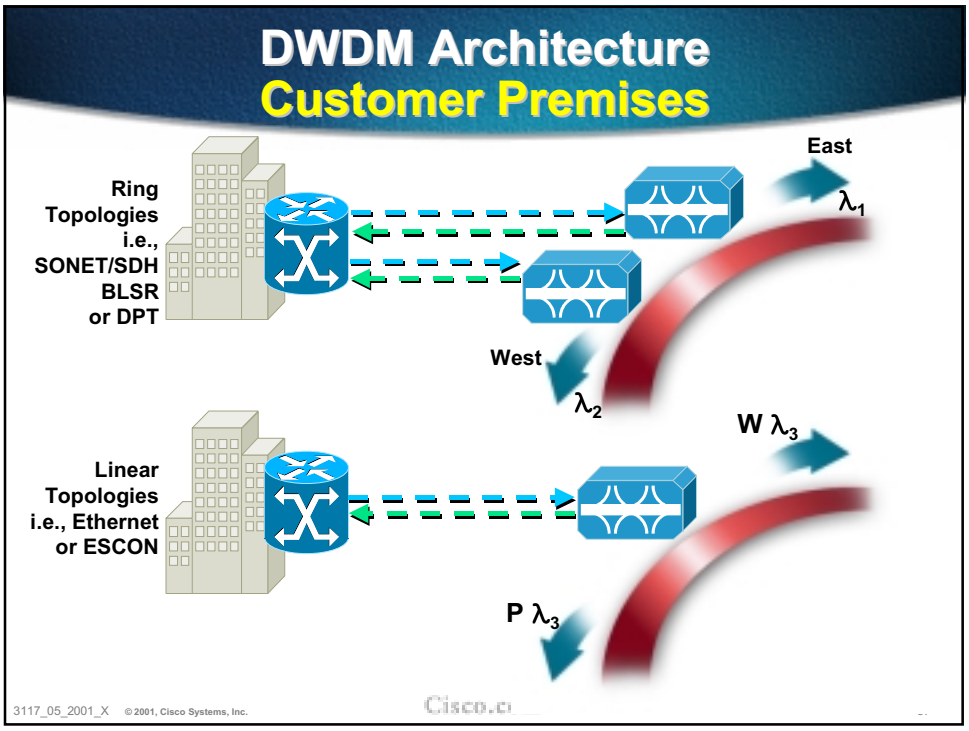

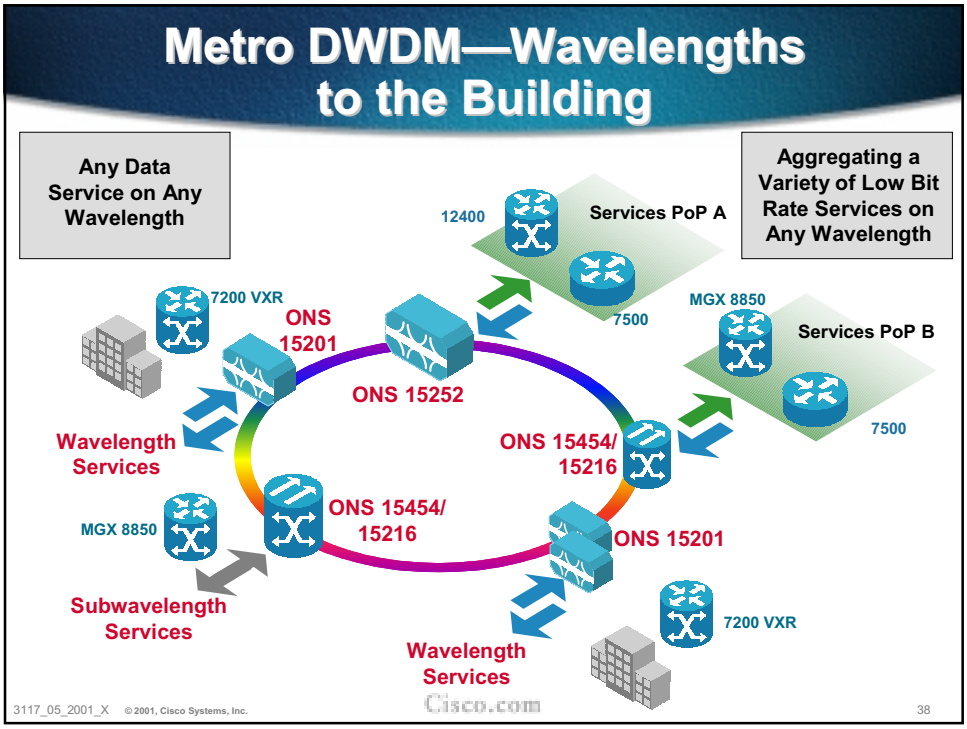

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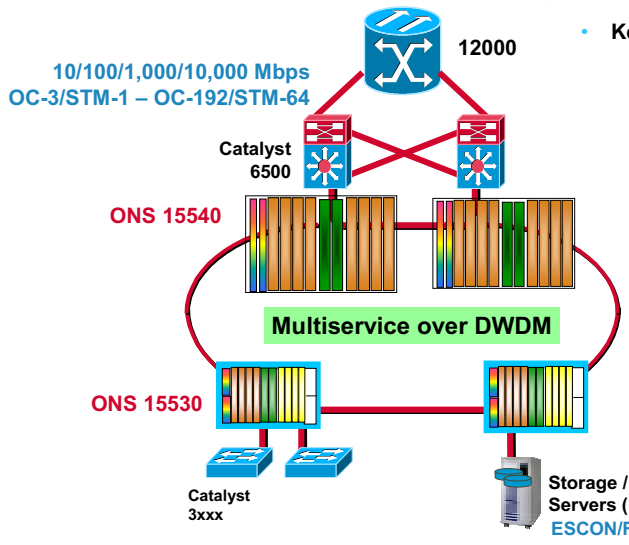
Metro DWDM—Storage Networking Solution



- 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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Cisco ONS 15540 Extended Services Platform (ESP)

- All new, all Cisco DWDM platform
- Integration of data, storage and legacy networking
- Built for both Enterprises and Service Providers
- Compact, service-dense, modular, scalable, flexible

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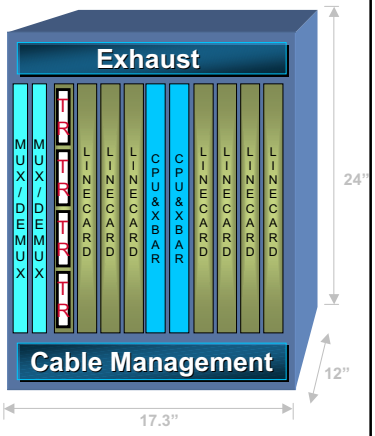
Cisco ONS 15540 ESP
Key Features and Benefits

- 32 lambdas/fiber (protected) @ 100 GHz (ITU Grid)
- Transparent and switched modes
- WaveFill, WaveGuard, OSC
- GE, ESCON, FICON, FC, SONET, SYSPLEX, 10GE ready
- 2.5 G and 10 G wavelength
- Point-to-point, ring and mesh networks
- High-availability options
- NEBS-3 compliant



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Purpose Built DWDM
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 Metro Optical Transport Product Portfolio

ONS 15201 + 15252

- Lowest first cost λ to building solution
- OC-N STM-N, GE, bit-rate independent

λ To The Building

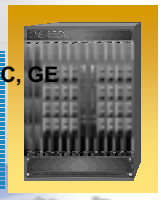
ONS 15216 + 15454/15327

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

Supercharged SONET

ONS 15540 ESP

- Dense FICON/ESCON, FC, GE
- EMC, IBM certified
- Transparent, bit-rate independent interfaces



High-Density Extended Services

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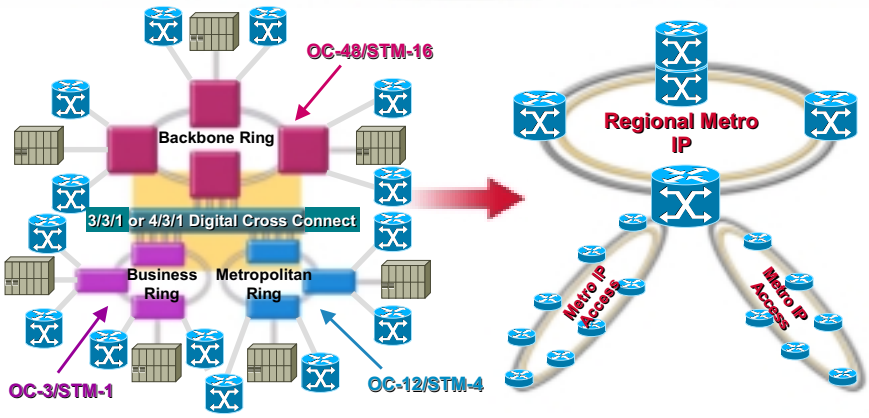
Metro Network Solutions: Metro IP



- Scalable Internet service
- Reliable IP-aware optical transport
- Simplified network operations

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Metro IP Benefits

Increased Service Revenue Opportunities
Decreased Operations Costs

- Scalable Internet service
- Reliable IP-aware optical transport
- Simplified network operations

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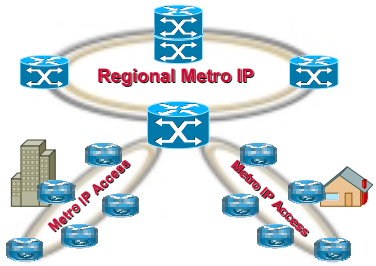
The Metro IP Solution
Powered by Dynamic Packet Transport



- Dynamic Packet Transport (DPT), the market-leading Resilient Packet Ring (RPR) solution
- Over 10,000 ports sold; over 150 customers worldwide
- Based on the Cisco-developed Spatial Reuse Protocol (SRP)–RFC 2892
- Submitted to IEEE 802.17 Working Group for consideration as the RPR industry standard

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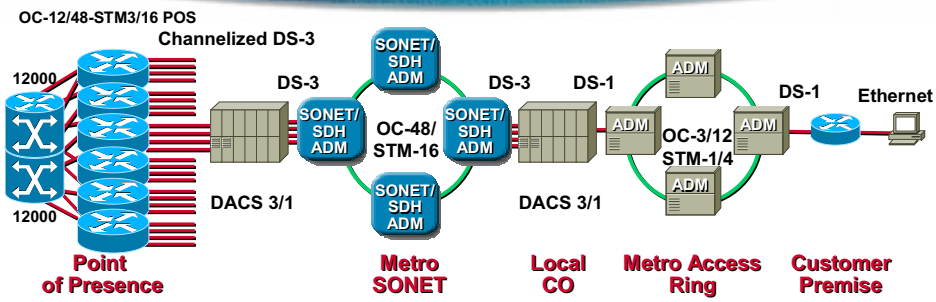
Today's Networks:
Backhaul over TDM Infrastructure



- Customer traffic is backhauled to the nearest PoP (sometimes 10s or 100s of miles away)
- Bandwidth is pre-allocated, no statistical multiplexing
- Transport "pipe" provides no added service value

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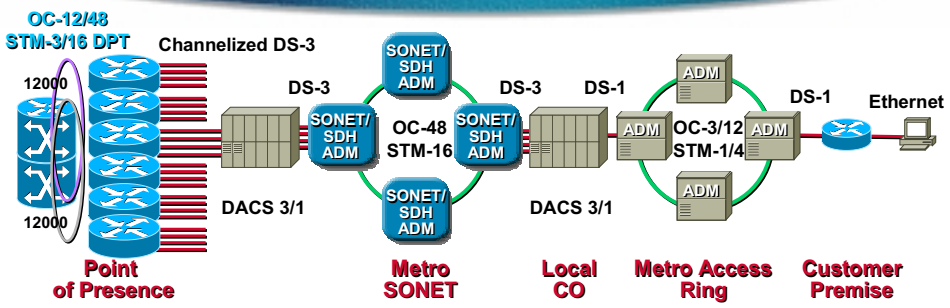
Metro IP
Phase 1: DPT in the PoP



- DPT-based PoPs are:
  - High performance (multi-gigabit IP)
  - Cost effective (fewer line cards/router slots)
  - Scalable (number of nodes, ring speed)
  - Easier to manage (simplified topology)

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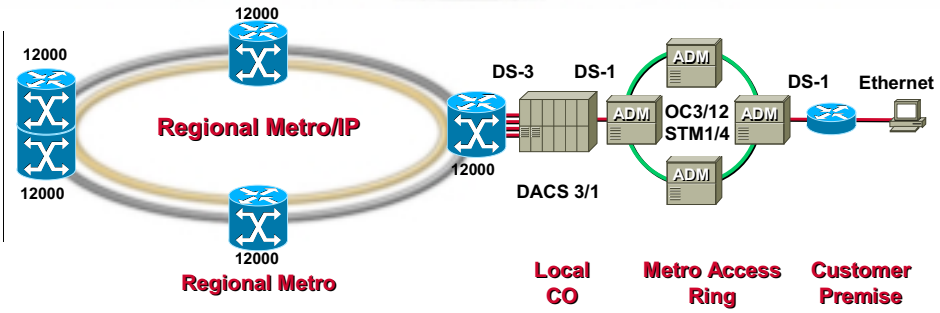
Metro IP:
Phase 2: DPT in the Regional Metro



- Regional Metro rings based on DPT:
  - Extend IP into the Metro area
  - Eliminate redundant network transport layers
  - Optimize bandwidth for IP
  - Simplify management

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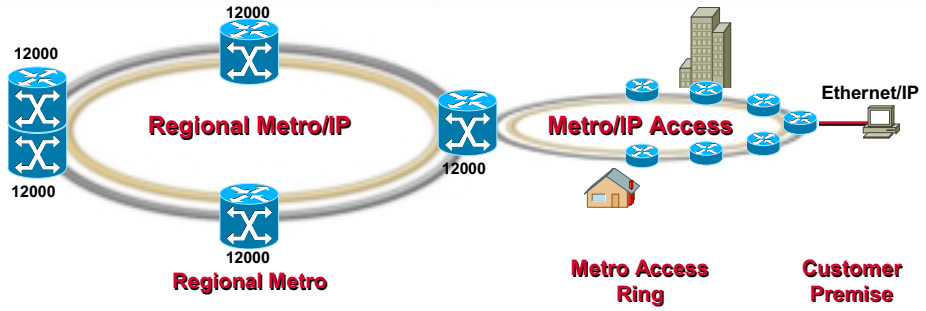
Metro IP: Phase 3: DPT in the Metro Access Rings



- Metro access rings based on DPT:
  - Provide PoP-to-customer solution optimized for IP
  - Distribute IP throughout the Metro area
  - Further reduces network cost and complexity

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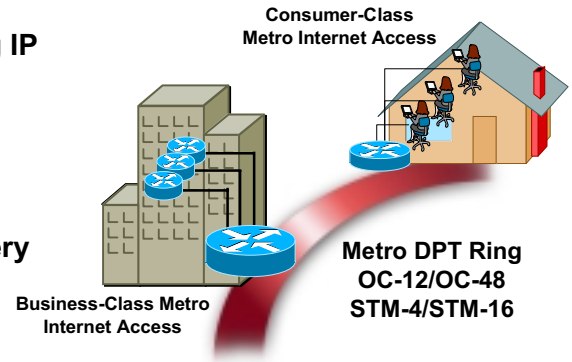
Metro IP Extending IP to Customer Edge

- Broadband IP/ Internet access
- Revenue-generating IP services (e.g., VoIP, VPN, multimedia)
- Ethernet customer subscriber interface
- Rapid service delivery



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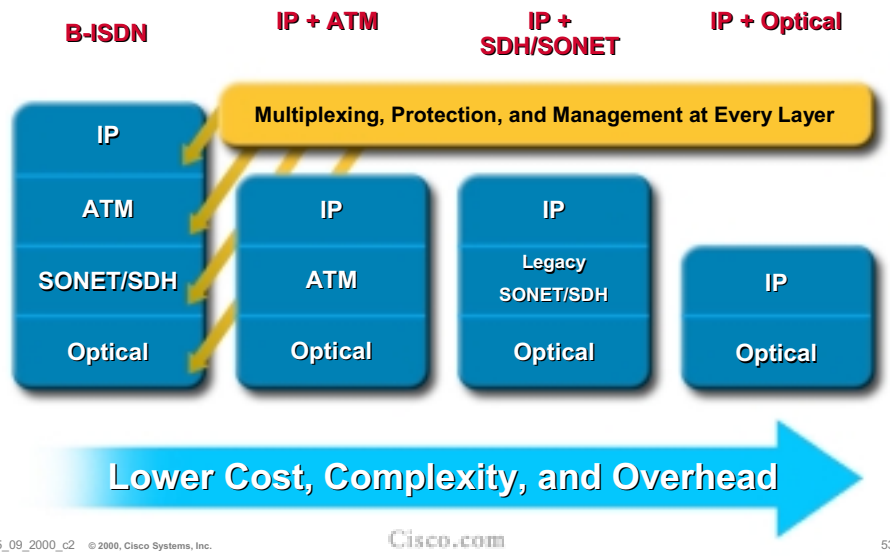
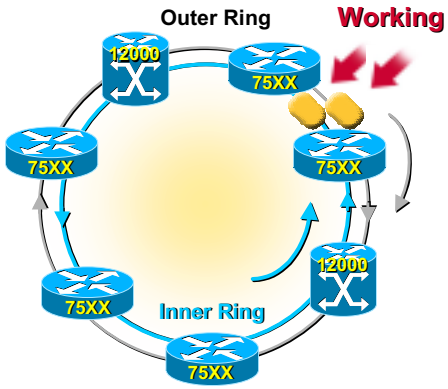
IP Transport Alternatives



Dynamic Packet Transport (DPT) New World IP+Optical Rings

Scalability and Service Optimization

- Dual counter rotating rings—data transport on both rings
- Maximize bandwidth efficiency for IP services
- Extend reach of distributed IP functionality over Metro area



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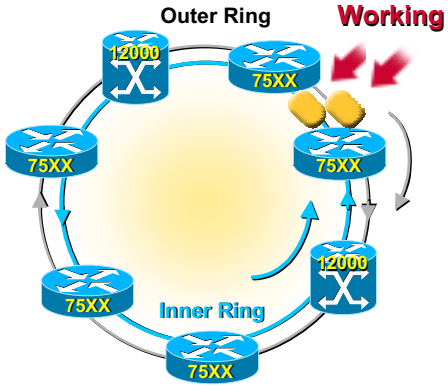
Dynamic Packet Transport (DPT) New World IP+Optical Rings

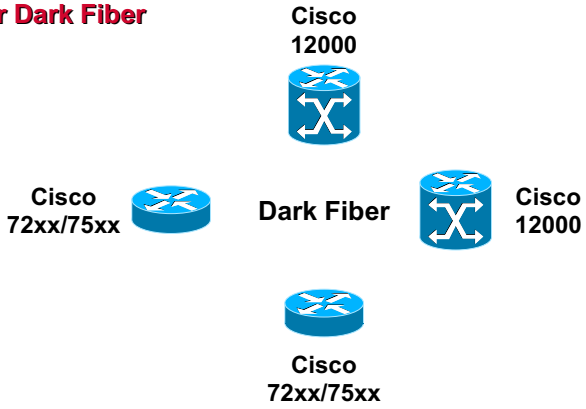
Reliability and Simplicity

- Intelligent Protection Switching (IPS) provide fast ring restoration (< 50ms)
- Eliminate SONET/SDH equipment while retaining resilience benefits
- Minimize provisioning configuration and maintenance requirements



DPT Transport Flexibility DPT over Dark Fiber

DPT Running Directly over Dark Fiber



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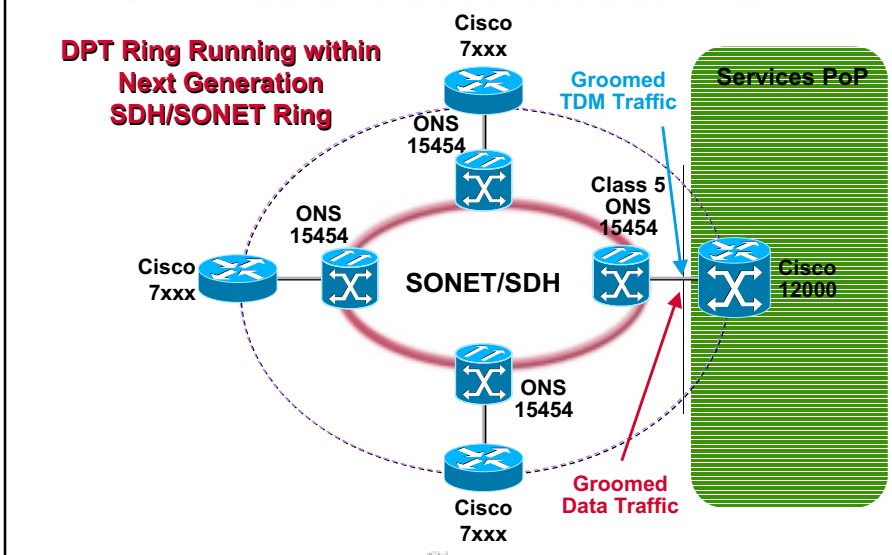
DPT: Optimal Network Flexibility
DPT over Multiservice Platform



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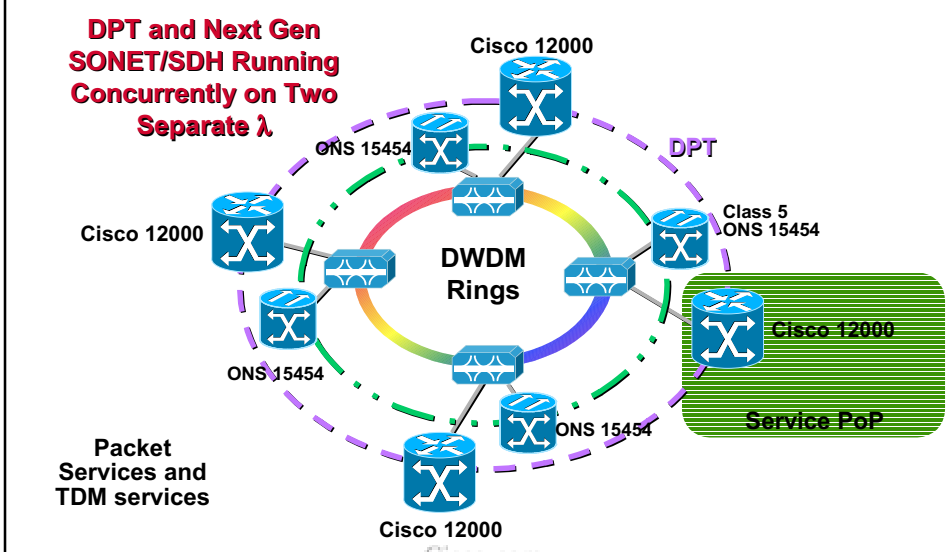
DPT: Optimal Network Flexibility
DPT and Multiservice Platform



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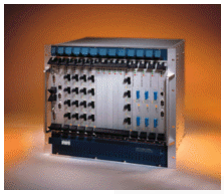
Metro IP Product Portfolio

Cisco 7500 Series



ONS 15190

ONS 15104

Cisco uBR 7200 Series

Cisco 7200 Series

And Growing... Cisco 12000 Series

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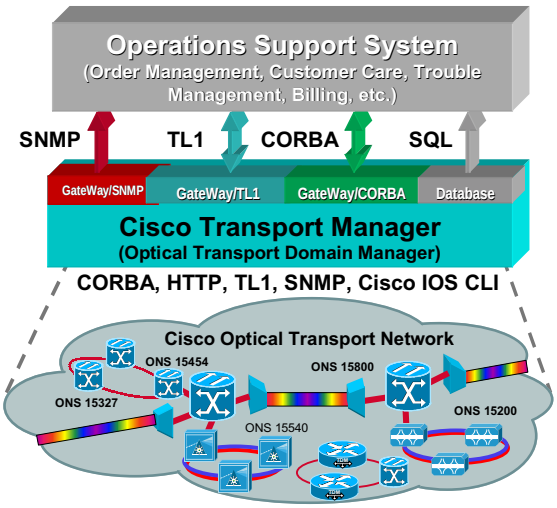
Management Layer Integration

- Single domain manager all optical transport technologies
  - SONET
  - SDH
  - Metro DWDM
  - Long-haul DWDM



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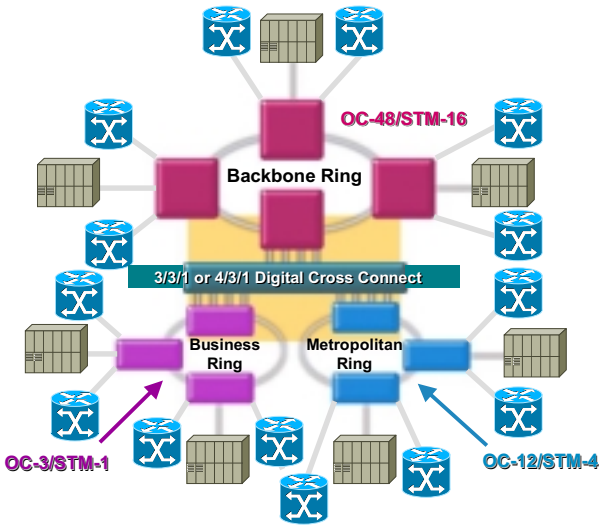
Migrating Your Metro Infrastructure



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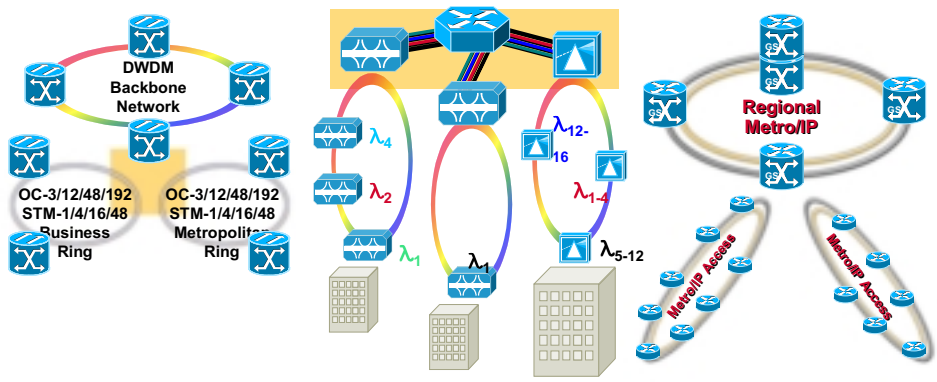
New Metro Infrastructure Options



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Cisco Metro IP+Optical Transport Market History...

- Introduced Metro Optical Transport Product Line at Optical Fiber Conference in March 2000, and since then…
  - 600+ Customers for both Metro Optical Transport and Metro DWDM
  - 25,000 ONS 15454 Systems Deployed
  - 30,000 Ethernet Ports and 3,000 GigE Ports
  - ONS 15327: introduced Jan. '00: Over 30 customers
  - ONS 152XX: introduced Mar. '00: Over 75 customers
  - - First wavelength to the building Metro DWDM solution
  - Resilient Packet Ring (RPR) market leader
  - - Over 10,000 DPT ports sold; Over 150 customers worldwide
  - #1 Supplier of Switched Ethernet
  - Fastest Growing Optical Supplier (Dell'Oro 2Q00)
  - #1 Market Share OC-48 (RHK, Jan. 2001)
  - #1 Market Share Optical Transport Ethernet Port (CIR, Jan. 2001)

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Metro Networks Summary

- No matter what your network's starting point, we have solutions to optimize your optical infrastructure
- Low initial and lifecycle cost made possible by fewer network elements, efficient bandwidth management and network provisioning
- Seamless integration with data and storage solutions to provide rapid, scalable service delivery

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