



Delivering Carrier Class Ethernet Transport Infrastructures

Future Networks, Stockholm 2007

Marko Ivanov
October, 2007

Who is Ciena?

→ Fast facts about Ciena:

- 15 yr old supplier of optical and data networks
- Strong customer base with 2/3 of the worlds largest service providers
- Leading innovator in carrier class Metro and LH WDM, Optical switching, reliable data switching
- Our philosophy: Enable customer success with 100% reconfigurable, software-defined, service-selectable networks that offer flexibility, adaptability, manageability and network assurance

Serving the world's largest and most advanced service provider, government, and enterprise networks

- Founded 1992
- HQ in Maryland USA
- Cumulative global market leader in long haul DWDM and Intelligent Optical Switching
- ~1,700 employees worldwide
- Over 250 Patents held with 100 pending.
- Numerous R&D centers worldwide.
- Service and support across the Americas, EMEA and Asia
- **46% y/y growth over last 3 years**

Leadership in key network areas

Access

Ethernet over any medium; any service over Ethernet

Transport & Switching

Software-programmable networking for ultimate flexibility

Packet Interworking

Getting the most of your IP/MPLS investment

Network & Service Management

Consistent, granular metrics and unified control for all services

Services

Product-lifecycle services and professional services tailored to your specific goals

- First commercialized DWDM technology
- First intelligent optical switch
- World's leading optical control plane
- Data compression for storage applications
- First and only programmable optical line cards
- Leaders in packet + optical networks
- Driving 40G and 100G

The services that are driving networks' growth

Heavily reliant upon the advancement of Ethernet

→ Consumer

→ Broadband

→ Wireless



→ Enterprise

→ IP, storage, Disaster Recovery

→ Private line & Private Networks

→ Wholesale

→ Ethernet for Infrastructure

→ Wireless Backhaul

→ Broadband Aggregation



Ethernet: Designed for open standards & services



Ethernet: Global, Open, Cost Effective

Most heavily implemented and interoperable standard in data networking history.



The issues that the network must address

Flexible

Flexibility to support any service – on-demand

Adaptable

Must be adaptable to varying service environment

Manageable

Designed to manage services and service level agreements

Assured

Reliable design, implementation and management

Goal: A Service optimized optical networks

What the end customer wants

→ End Customer Perspective

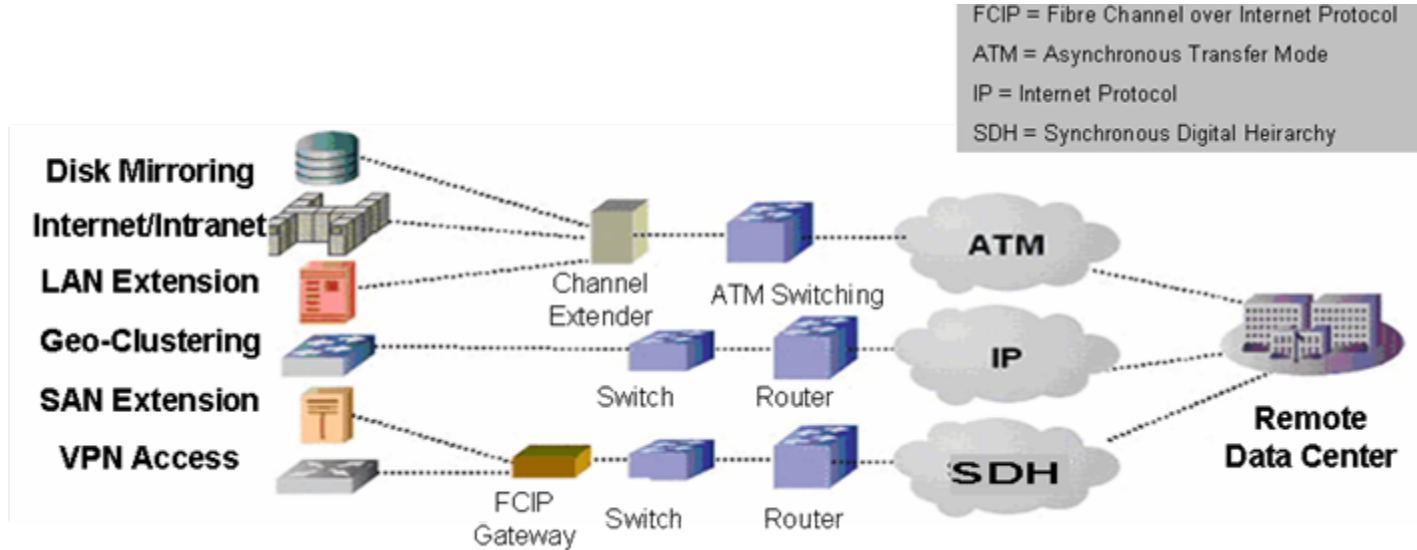
- **Uniformity:** Intuitively, “it works”. LANs are simple to construct and operate
- **Improved Performance:** Perception that WAN Ethernet is “newer/faster” vs. ATM/FR, Private Line, SDH, etc
- **Improved Economics:** People empirically observe that Ethernet is “cheaper”, and want to take advantage of that

→ Carrier Perspective

- **Must give the customers what they want:**
 - Flexible connectivity: point to point, point to multi-point, any to any
 - Better performance (bandwidth) for money spent
- **Need to move to common platforms**
 - From traditional/“legacy” to strategic/new for a variety of reasons: New services, converged services, etc.
 - And find a way to migrate legacy services to newer infrastructures

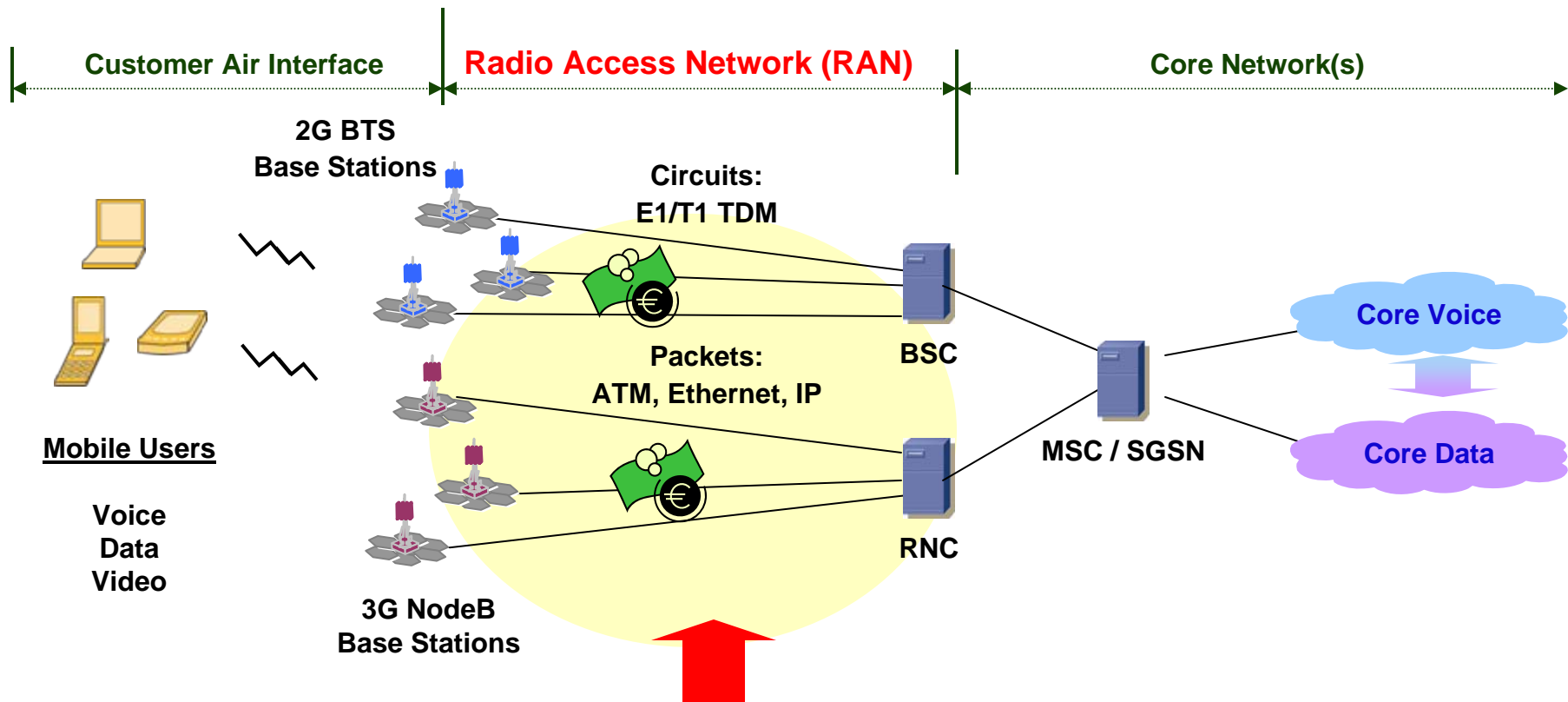
What enterprise want from their operators

- Enterprise customers want simpler, higher speed solutions including
 - Storage Area Network (SAN)
 - Wide Area Network (WAN)



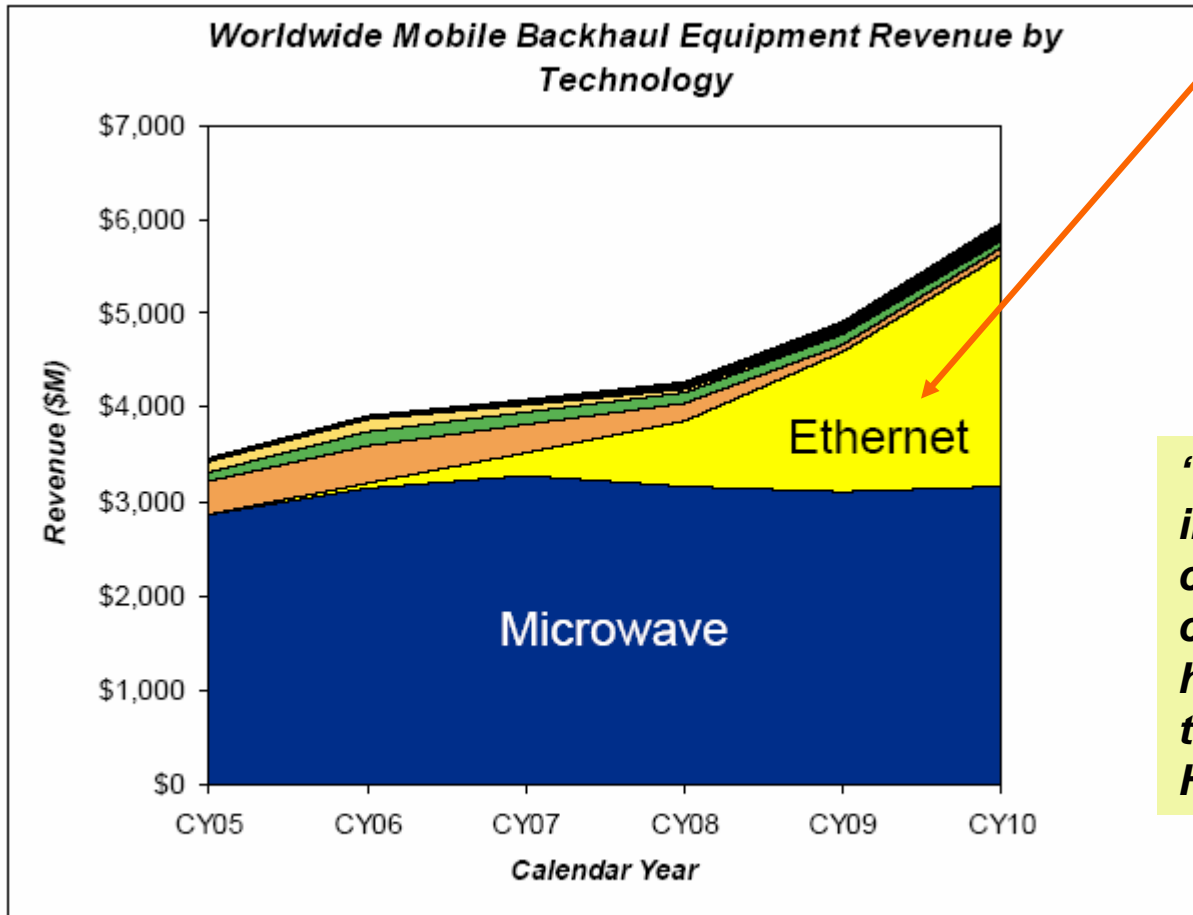
Enterprise are looking for ways to reduce complexity & cost

Challenges for the Wireless operators = OPEX



OPEX crunch is forcing mobile backhaul changes to Ethernet

Ethernet will play a major role in Mobile Backhaul



Clearly Ethernet's high bandwidth, lower cost appeal is growth driver

"There is now near unanimity in the global operator community that Ethernet or carrier Ethernet technology holds the answer to reducing the cost of mobile backhaul.", Heavy Reading, May 2007

Source: Infonetics Research Mobile Backhaul Equipment, Installed Base & Services, March 2007



What Technology & Standards can help

Technology & standards changing the landscape

Flexible service enabling technology

→ OTN (ITU G.709)

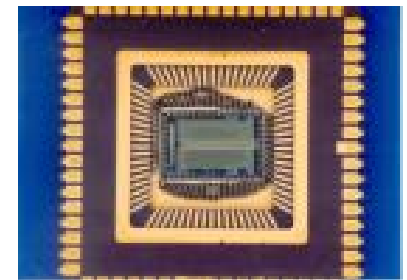
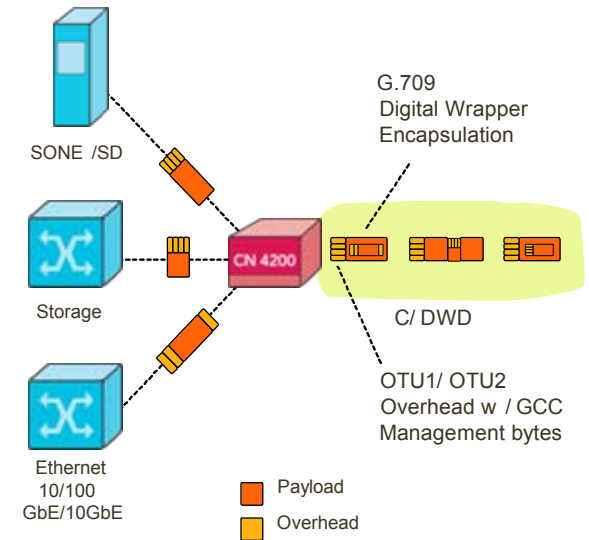
→ Any service, Ethernet, Storage, Video & more (10Mb to 100Gb) – will displace SONET/SDH

→ Programmable Hardware

→ Optics delivering any service - on demand

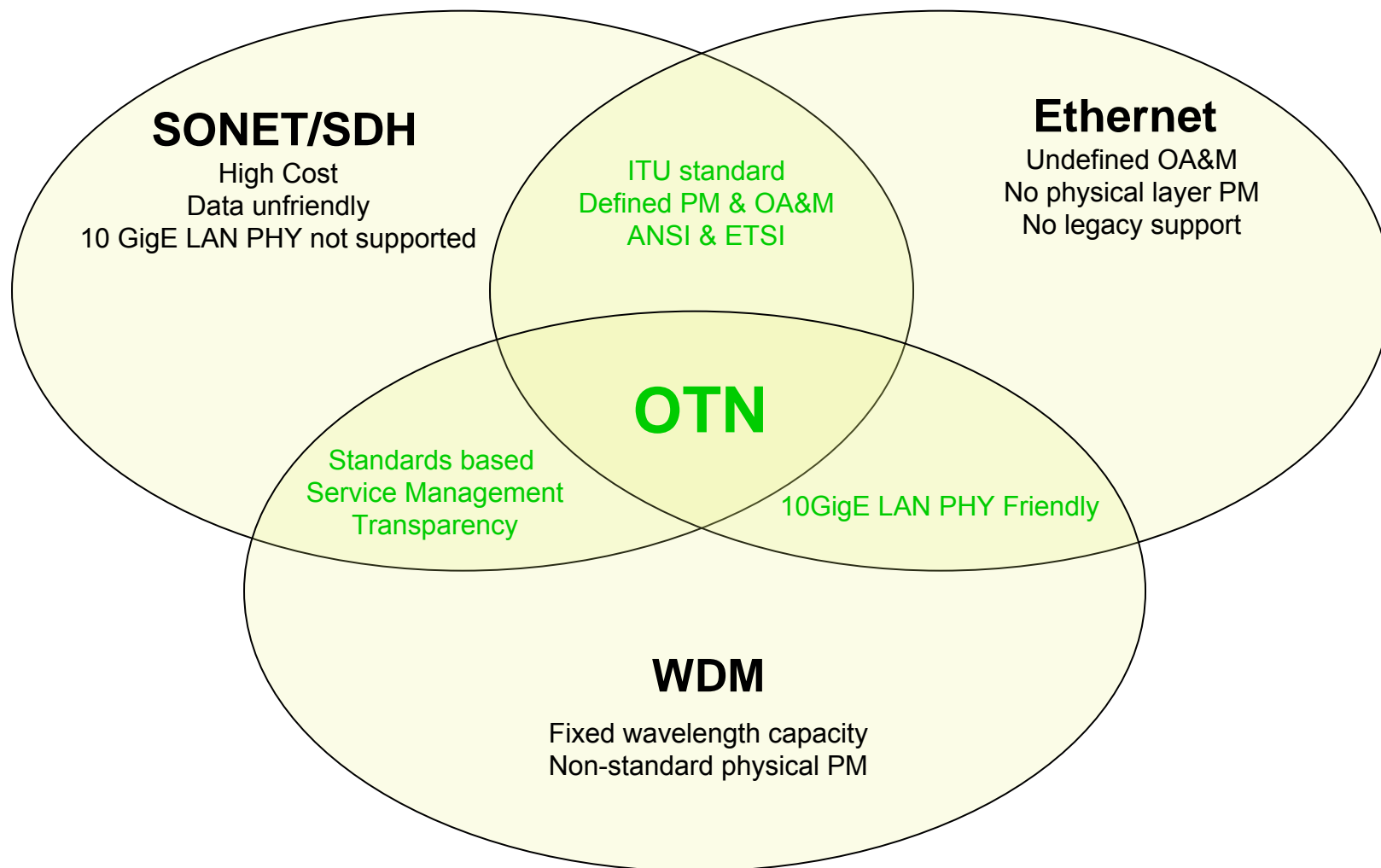
→ Network and Service Automation

→ Control plane automation integrated with Service Level Management reduces CAPEX & OPEX



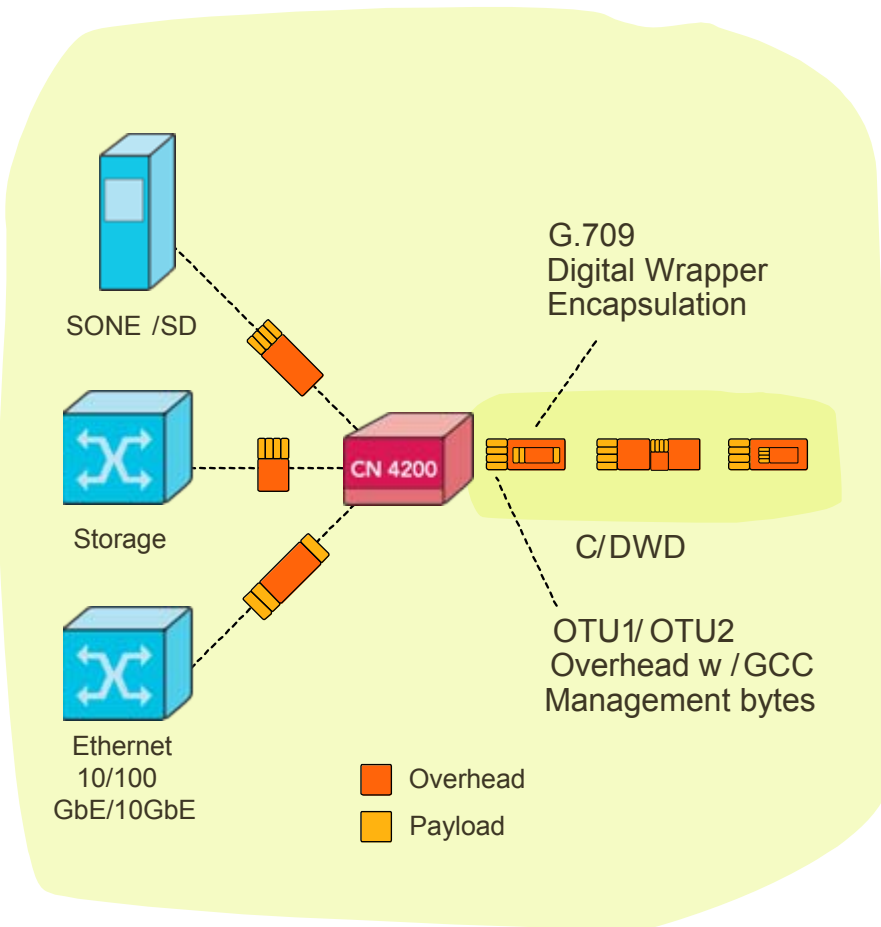
Understanding the significance of OTN

Open, Transparent & Managed



OTN is a cornerstone for future Optical networks

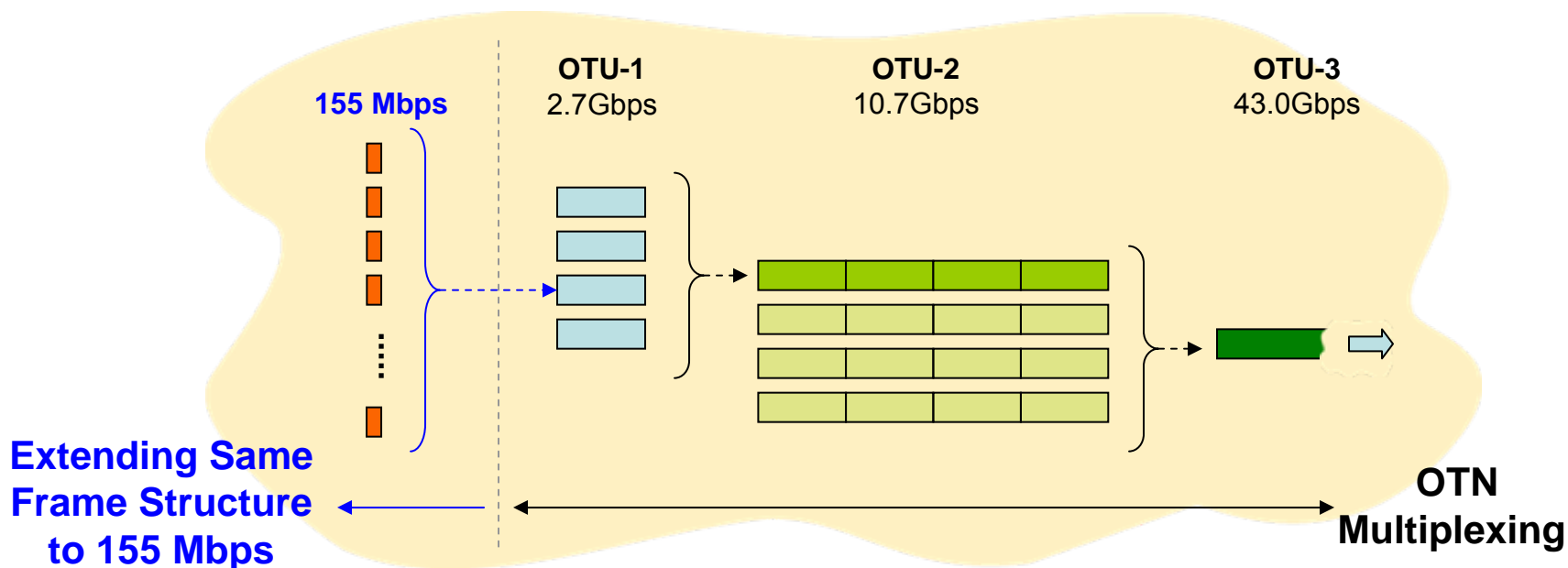
Grooms any service onto optical networks



- Any service from 10Mb to 100Gb
- Forward looking (transparent)
 - Ethernet, Storage & beyond
- Backwards compatible
 - SONET/SDH
- Well defined OA&M
 - Identical to SONET/SDH
 - Services & optics management
- A global standard
 - ITU G.709/Digital wrapper
 - ANSI and ETSI accepted

How OTN grooming improves OPEX

- Extend truly transparent multiplexing down to 155 Mbps rate
- Enable more transparent services per wavelength, up to 64 per 10G
- Add/drop and re-groom any wavelength at any node
- Reduces wavelengths required by 78%

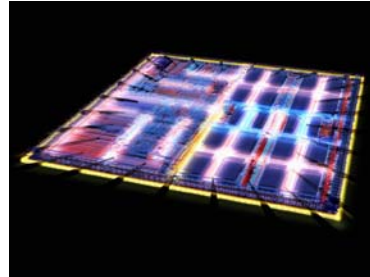
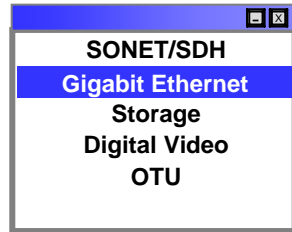


How OTN complements SONET/SDH

| Features | SONET/ SDH | OTN |
|--|---------------|-----|
| Multi-Service technology | ✓ | ✓ + |
| Resiliency/PM/OA&M for Ethernet | ✓ | ✓ |
| Transparent support for SONET/SDH | | ✓ |
| Defines WDM (optical) management | | ✓ |
| Ethernet Friendly (10GbE, 100GbE) | | ✓ |
| Cross-network transparency | ✓ | ✓ + |

Building in flexibility with Programmable Hardware

Change with your end user requirements – on demand



→ Programmability using FPGA technology

→ Software defined functionality

- Each port is individually remotely programmable
- Offer new services – on demand!
- Future proof! Downloadable/Upgradeable/

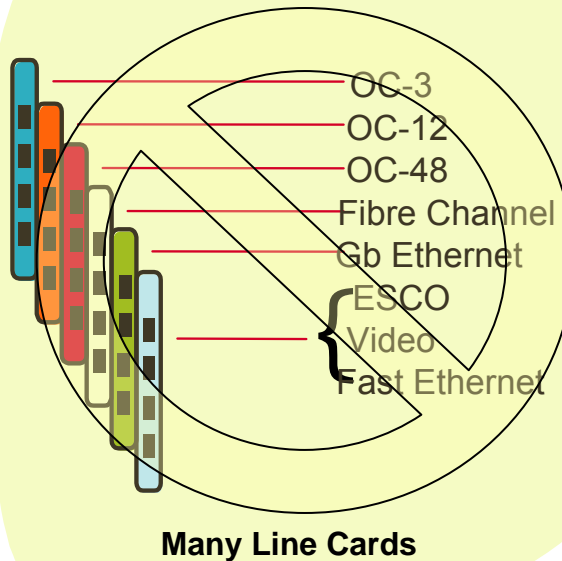
→ Pluggable, tunable and reconfigurable optics

“traditional approach”



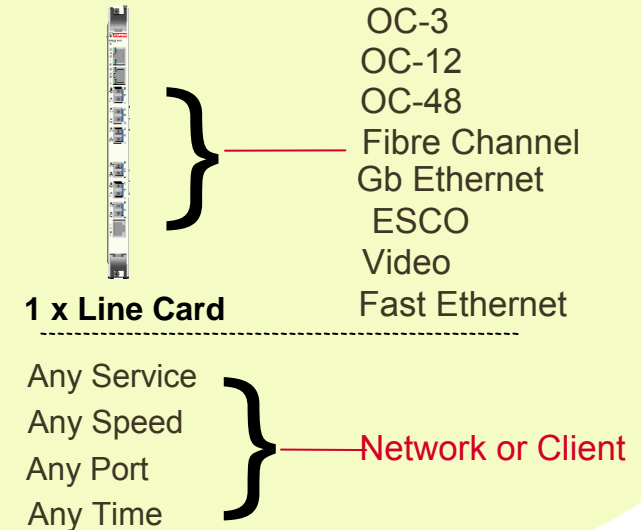
How that translates into Optical equipment

Traditional approach



66% fewer spares
95% faster provisioning

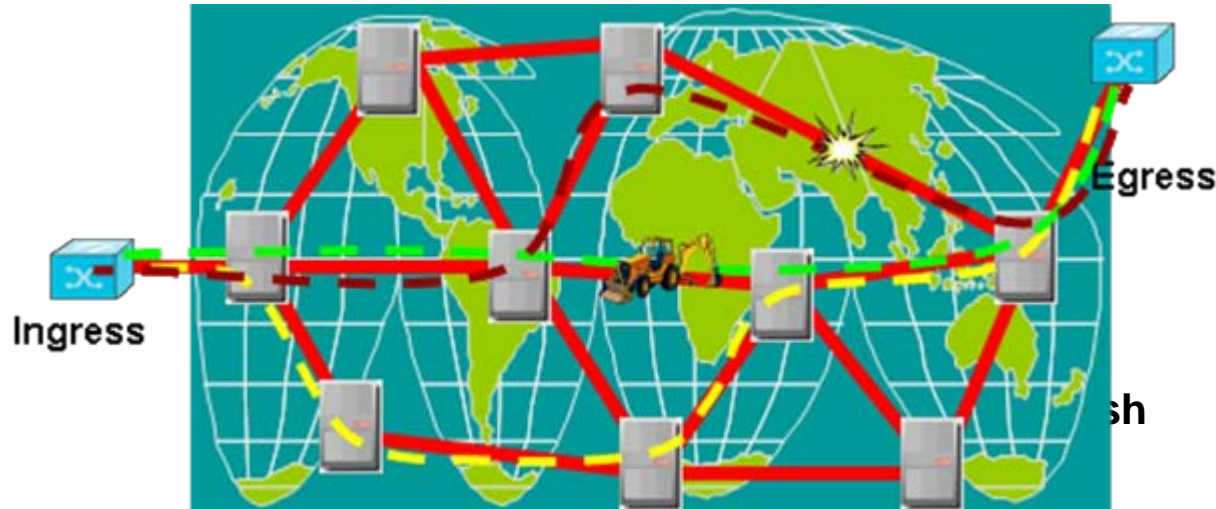
Programmable approach



Benefits

- One card, one spare
- Faster service delivery
- Packet friendly
- Lower costs, higher profitability

Importance of automated optical networks



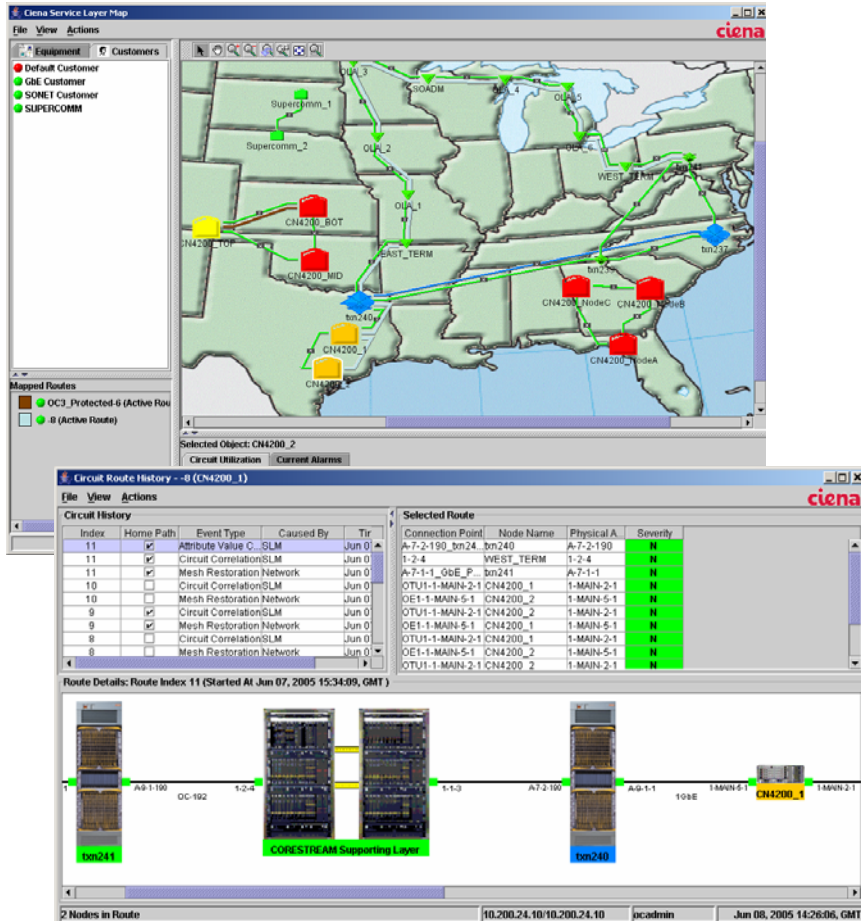
1. Click Ingress point
2. Click Egress point
3. Choose Bandwidth
4. Choose Service Level
5. Finished!



Benefits of Automation

- Point n click service delivery
- Improved network resiliency
- Networks re-route around multiple failures in under 50ms
- Lowers CAPEX & OPEX

Integrated Network & Services Management is essential *increases end-user satisfaction*



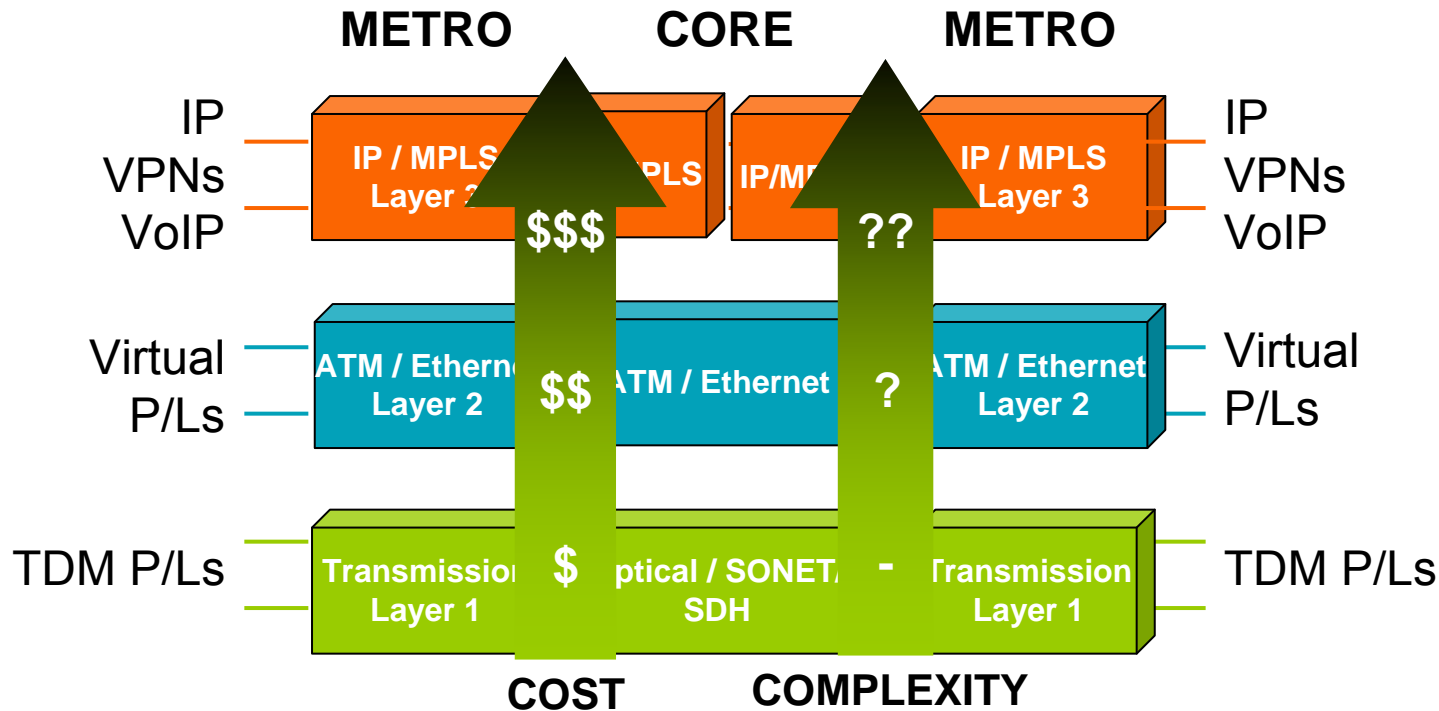
- Network & Service management are critical to scalability and manageability
- Must offer point and click OA&M tools
- Faster fault correlation & service restoration
- Proactive network planning and customer SLA management

Critical to customer satisfaction and OPEX containment



What is the best network architecture?

Customer pain points comes from an expensive architecture



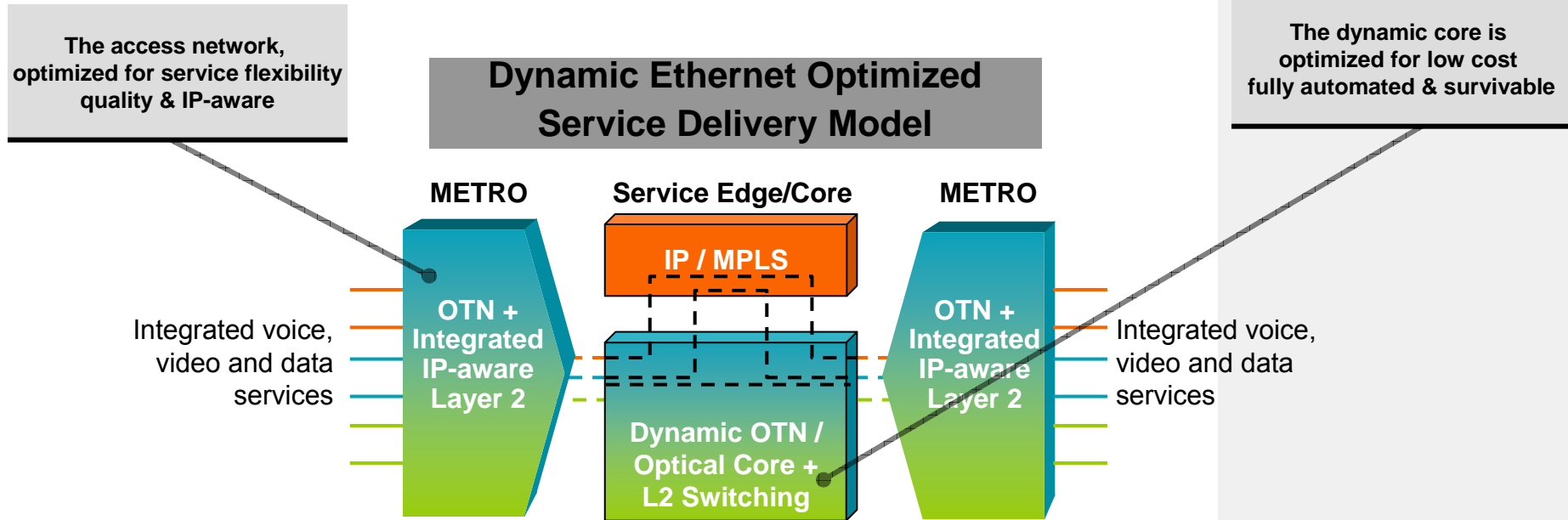
Problems

- Multiple high-cost network elements to purchase and administer
- Management + services interworking difficult

Multiple layers dedicated to different services raises CAPEX & OPEX

Ciena approach simplifies this architecture

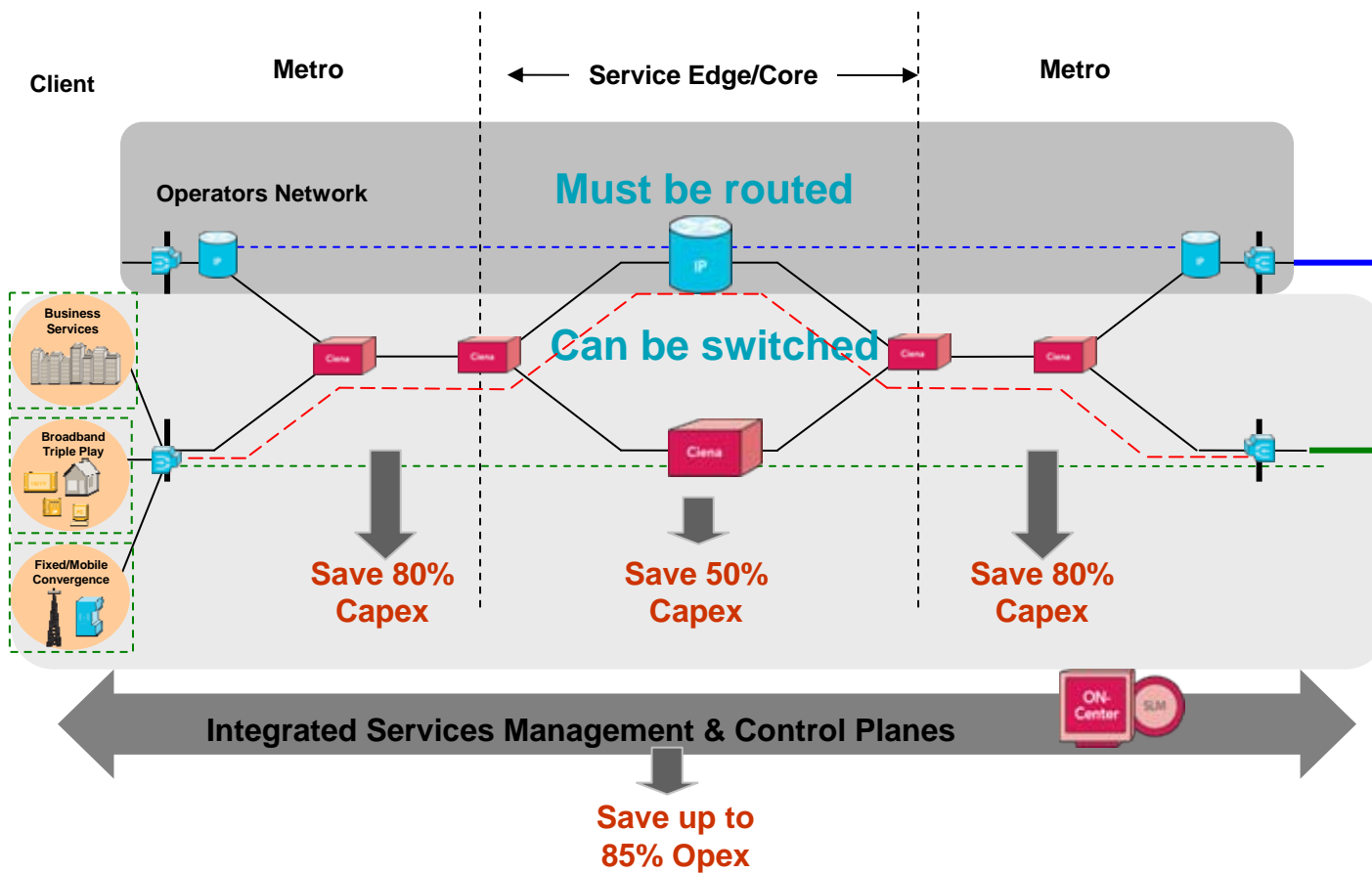
Optimized for services, at a much lower cost



→ What this offers network operators

- Supports any kind of traffic (Voice, Data & Video)
- Increases efficiency/flexibility & performance of network
- Lower Total Cost of Ownership

Why all IP traffic is not the same



Only few IP applications require routers everywhere

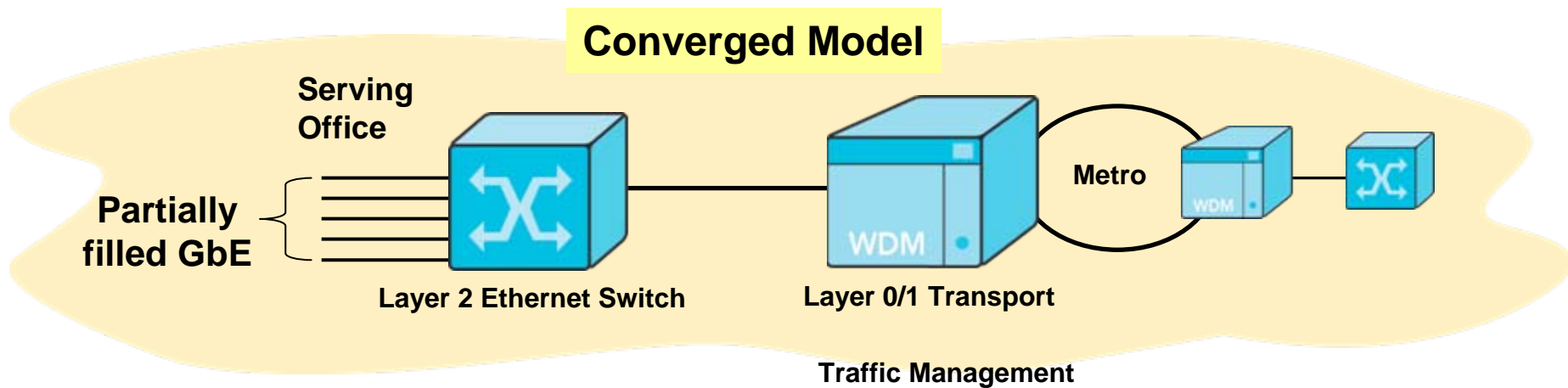
IP routed traffic
Private & Wholesale IP, VPN tables

IP Service Centric traffic
Business Svcs, Triple Play access, Video, Voice, VPN On-ramp, IPoTDM, Ethernet, VPLS

Most IP services can be switched over Ethernet networks

Switched networks can support many IP services at lower costs

One example of how to implement Carrier Ethernet



Eliminate the stand alone Ethernet switch

Integrate Ethernet traffic management

Reduce Cost & Complexity

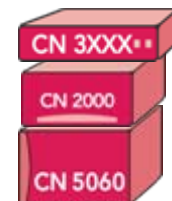
Summary benefits of the architecture

FSA provides

Resulting benefits

Ethernet over any access,
any service over Ethernet

- Economically reach more customer sites
- Amortize investment over more revenues



Integrated WDM/OTN/Ethernet
backhaul to Service Edge

- Lower complexity and Capex/Opex
- Optimize utilization of fiber/bandwidth and expensive service elements



Deterministic Ethernet transport

- Manage Ethernet like circuits
- High performance and high availability
- Robust OTN OAM, FEC, protection



Integrated multi-layer service
management & control plane

- Increase accuracy and provisioning speed
- Mesh-enhanced utilization and resiliency
- Guaranteed, measurable customer SLAs



Practical integration and
migration of legacy investments

- Retain customers and revenues
- Sweat existing assets
- Utilize proven OSSs and procedures

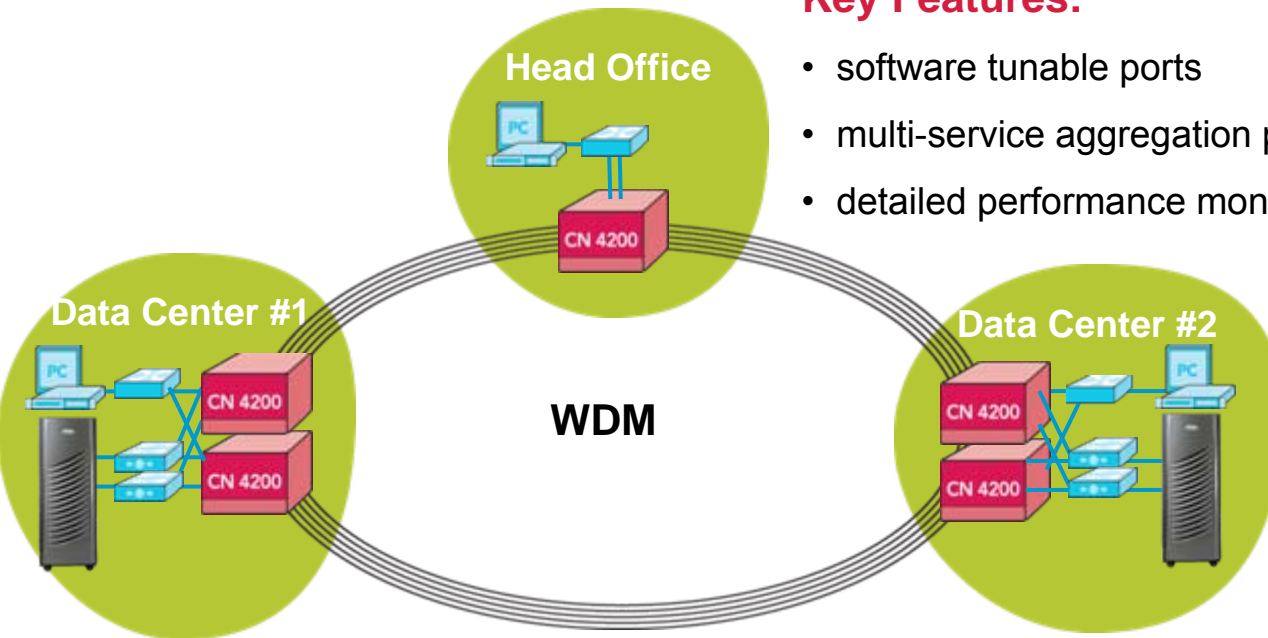




The Business Case for service optimized architectures

Is Flexibility more expensive?

Financial Services Firm Case Study



Key Features:

- software tunable ports
- multi-service aggregation per λ
- detailed performance monitoring

Challenge:

- New project to connect data centers and head office for Disk Mirroring and LAN traffic
- Carrier leased service = €1.3M for 3 yr

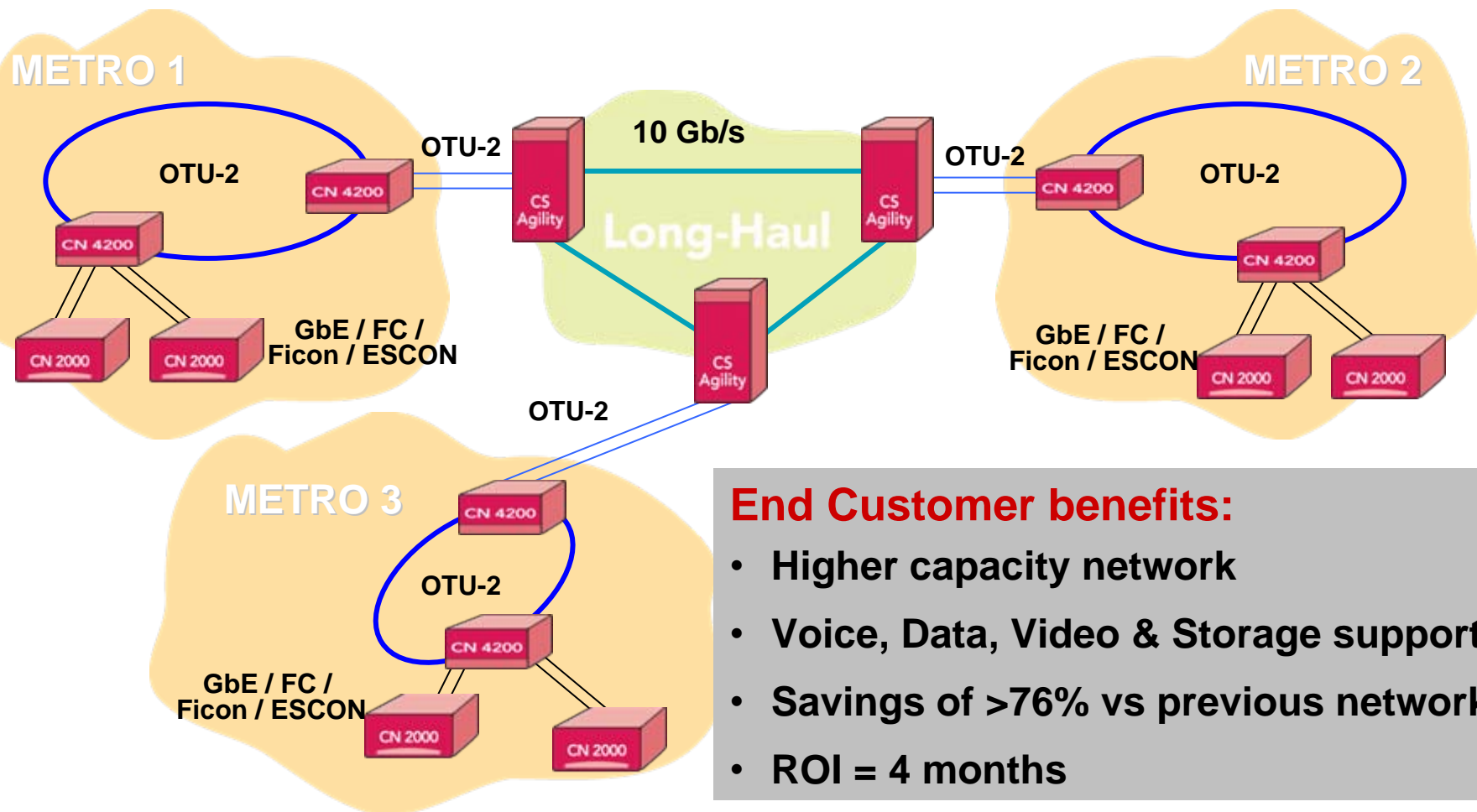
Solution:

- Offered an alternative using WDM and dark fiber
- Cost of Ciena Solution + WAN Services + Dark Fiber = €450k for 3 yr
- Savings of €850k

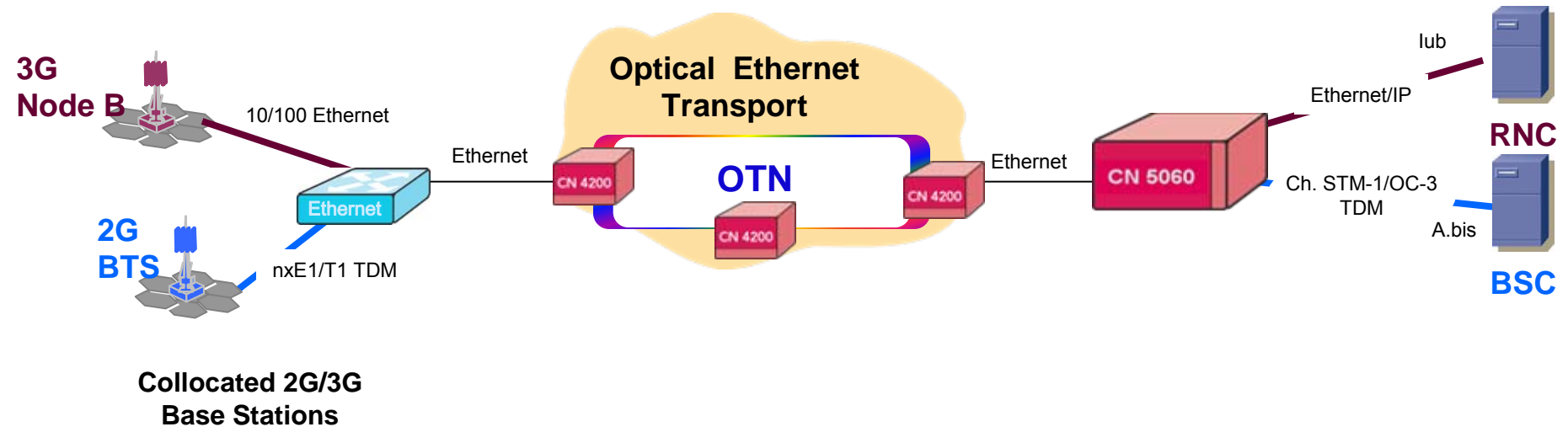
Applications: Storage, Disk Mirroring & Data Center connectivity

Private Optical 10 Gb/s Network with Carrier Partner

Financial Investments Firm Case Study



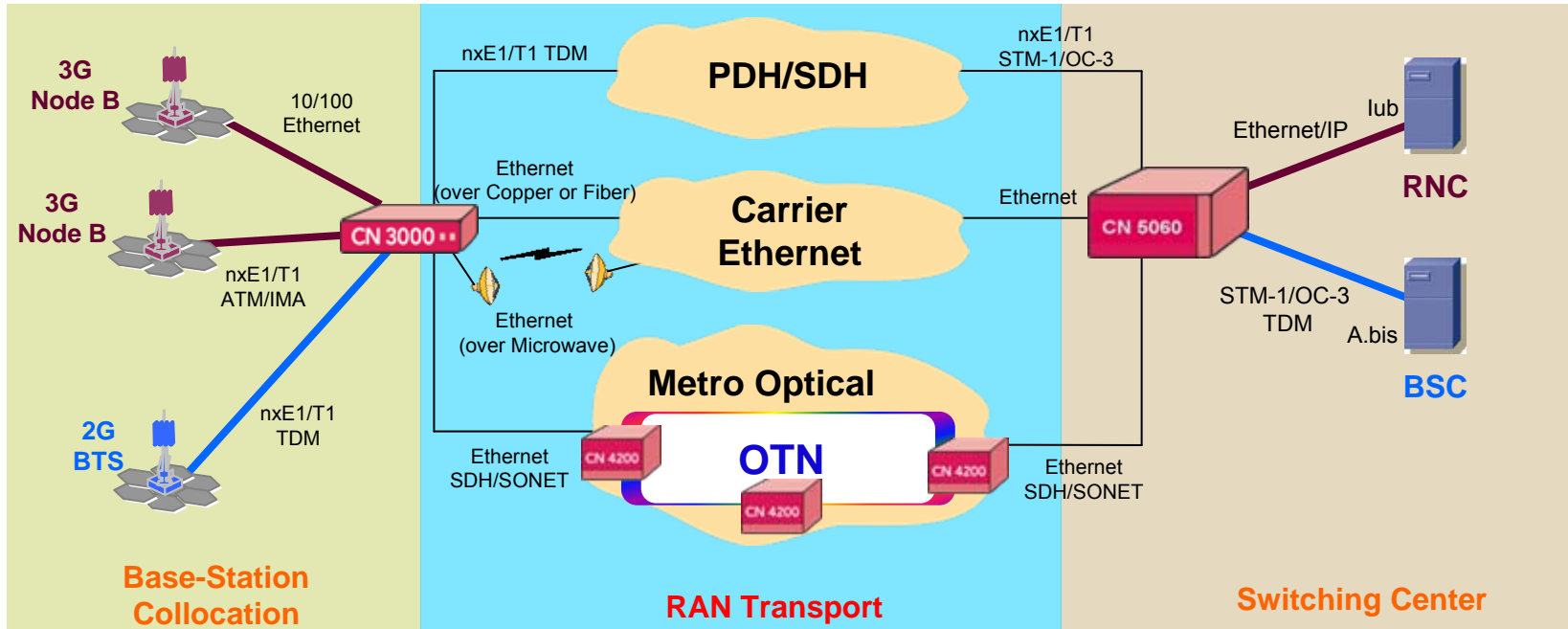
Requirements for Mobile Backhaul



→ What Mobile Operators want

- Ability to converge 2G & 3G RAN networks with scalability
- Ability to support packet and timing sensitive TDM traffic simultaneously
- On-demand migration (TDM today, Ethernet tomorrow)

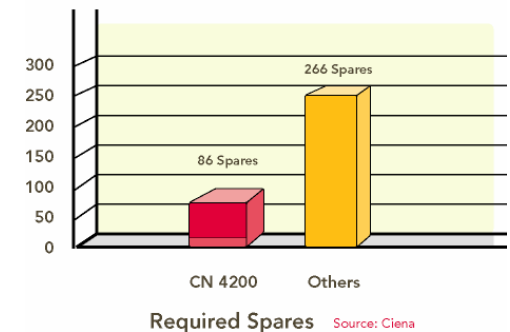
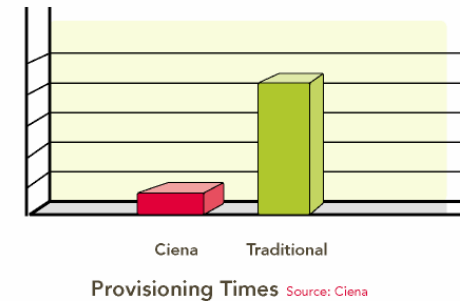
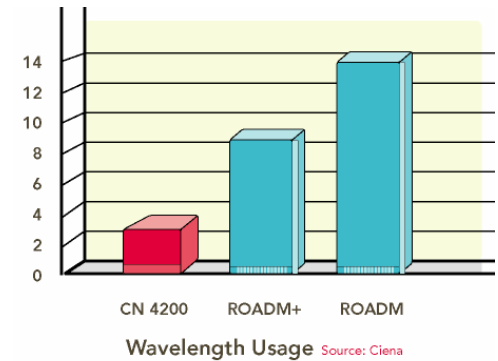
The Ciena approach to 2G/3G Backhaul



**Reduce OpEx of Radio Access Network up to 60%.
Flexibility to protect investment through 2G to 3G migration.**

Benefits of on-demand flexible solutions

- 95% reduction in provisioning time
- Eliminates man hours & truck rolls for add/change/move
- Reduce equipment planning
- 66% reduction in spares by
- 78% reduction in wavelength usage
- On-demand sub-wavelength routing
- Deliver new optical services



Final thoughts: Methods for transition and optimal convergence

- **Use OTN to optimize existing services together with Ethernet services**
 - Any service from 10Mb to 100Gb with well defines OAM
- **On-Demand Services with programmable optics**
 - Optics delivering any service, any port on demand
- **Distribute packet awareness to metro transport layer (L0/2 convergence)**
 - Features richness to support L2 / L3 systems/application demand
- **Integrate automated control and management planes to provision / signal a single unified service**
 - Leverage automation to provision, scale & restore all layers



Thank You