Reality and an Ambitious Future
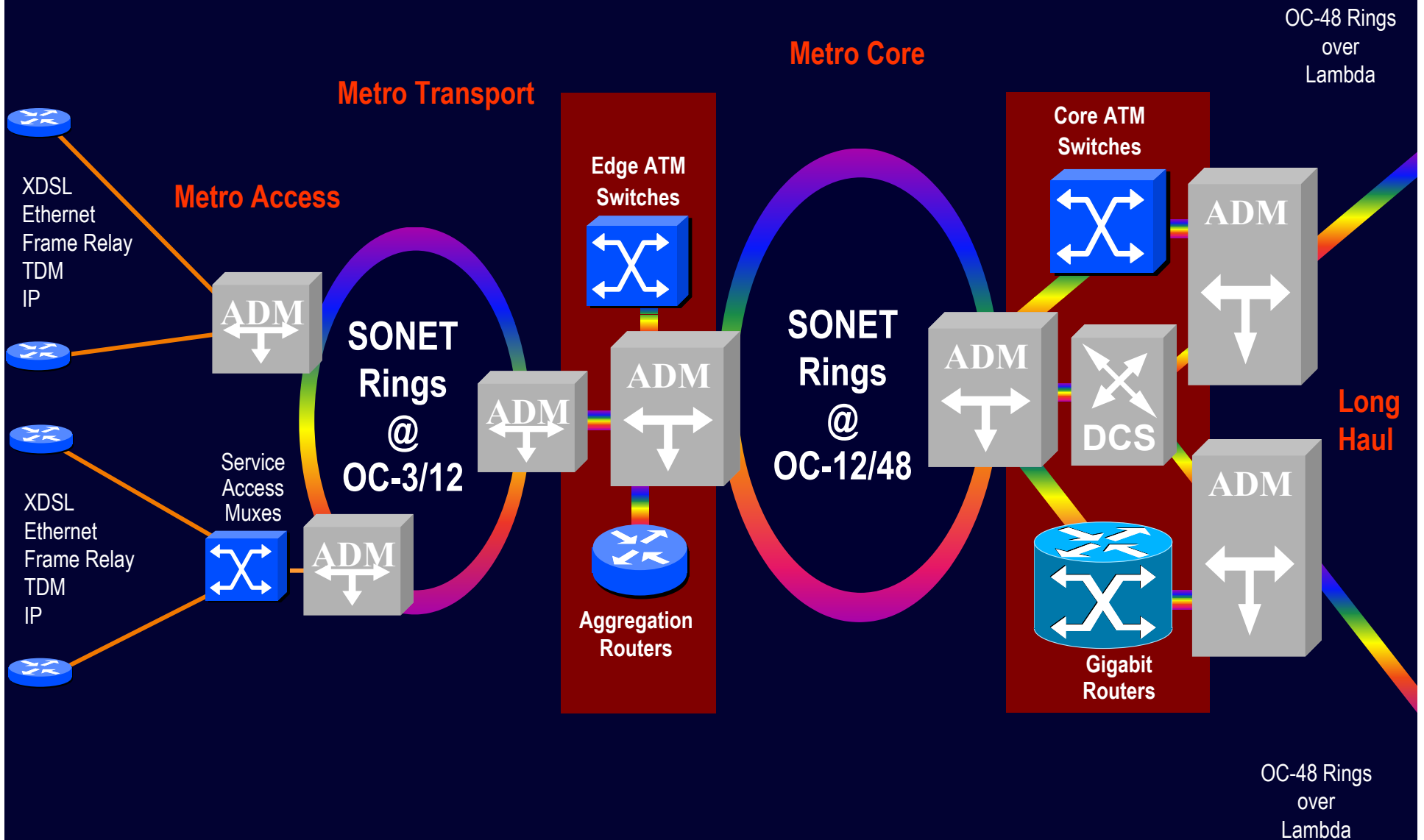
Sunil Tomar

President & CEO
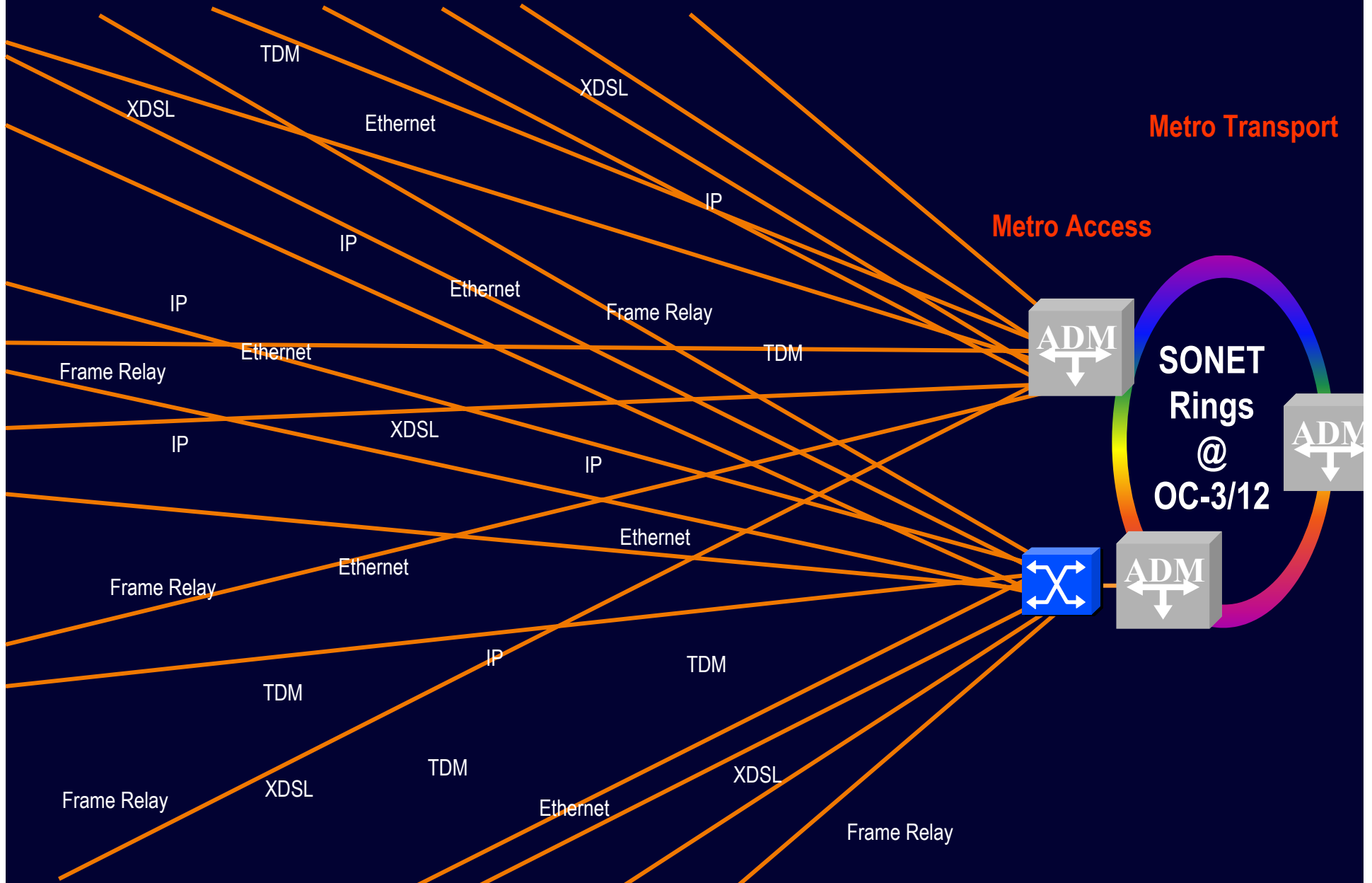
Brillus, Inc.

Agenda

- **A realistic view of today's access network**

- **Accommodating carrier and end-user demand**

- **Evolution to an all-optical network**

Today's Network Architecture

OC-48 Rings over Lambda

Metro Core

Metro Transport

Metro Access

Edge ATM Switches

Core ATM Switches

XDSL
Ethernet
Frame Relay
TDM
IP

ADM

SONET Rings @ OC-3/12

ADM

ADM

SONET Rings @ OC-12/48

ADM

DCS

ADM

Long Haul

Service Access Muxes

XDSL
Ethernet
Frame Relay
TDM
IP

ADM

ADM

Aggregation Routers

Gigabit Routers

ADM

OC-48 Rings over Lambda

Today's Network Architecture

Metro Transport

Metro Access

TDM

XDSL

Ethernet

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XDSL

IP

Frame Relay

Ethernet

IP

TDM

Frame Relay

TDM

XDSL

TDM

XDSL

Ethernet

Frame Relay

SONET Rings @ OC-3/12

CYRAS

- **Copper still dominates the access network**

- **New voice and data lines are being deployed daily**

- **Carriers face massive overlay networks which are only becoming more complex**

- **Intelligent aggregation is the immediate concern**

TDM
XDSL
Ethernet
Metro Transport
IP
Metro Access
IP
Ethernet
Frame Relay
Ethernet
TDM
ADM
Frame Relay
SONET Rings @ OC-3/12
IP
XDSL
ADM
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ADM
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TDM
Frame Relay
XDSL
Ethernet
Frame Relay
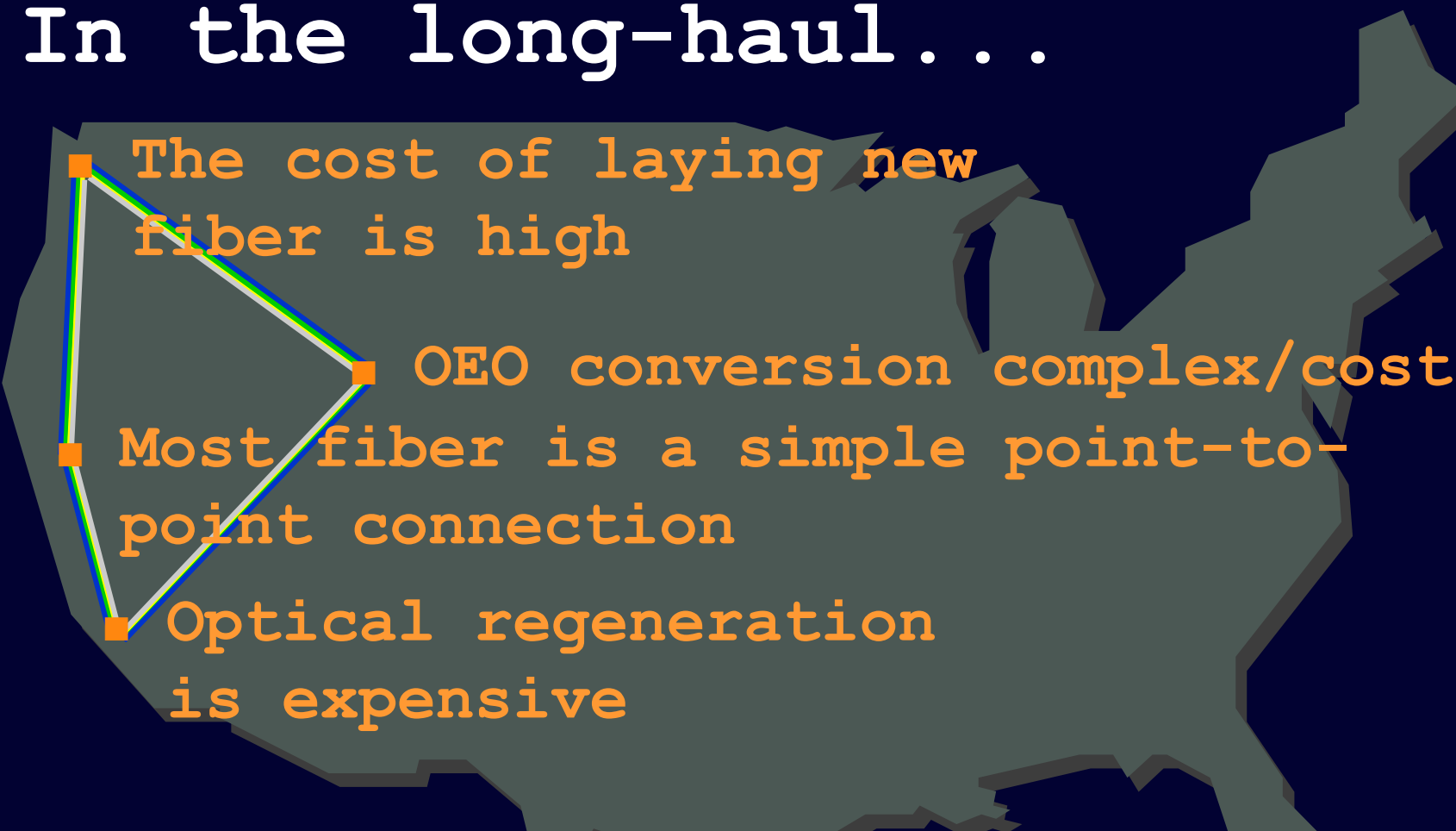
Understanding the Long-Haul

- Long-haul network has been built up with terabits of capacity

- Metro and access networks are slow to catch up

- Bottleneck is being pushed out to the access network

The long-haul pipes are not being filled
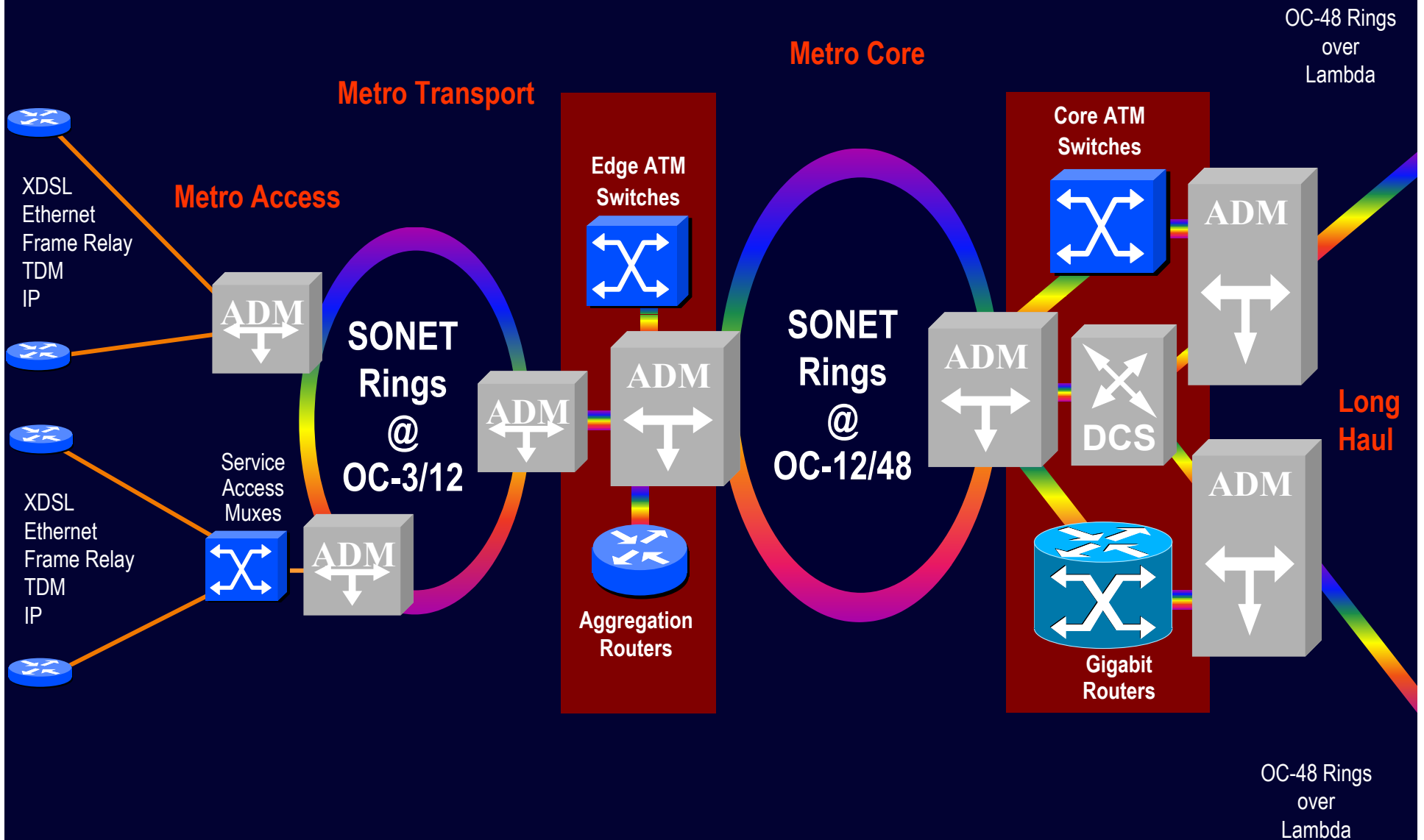
Trends in the Long-Haul

In the long-haul...

- The cost of laying new fiber is high
- OEO conversion complex/costly
- Most fiber is a simple point-to-point connection
- Optical regeneration is expensive

DWDM and all-optical solutions provide massive bandwidth

Trends in the Long-Haul

- **Terabits of traffic can now be transmitted through a single fiber**

- **Advanced optical technologies are easier to implement in the long-haul topology**

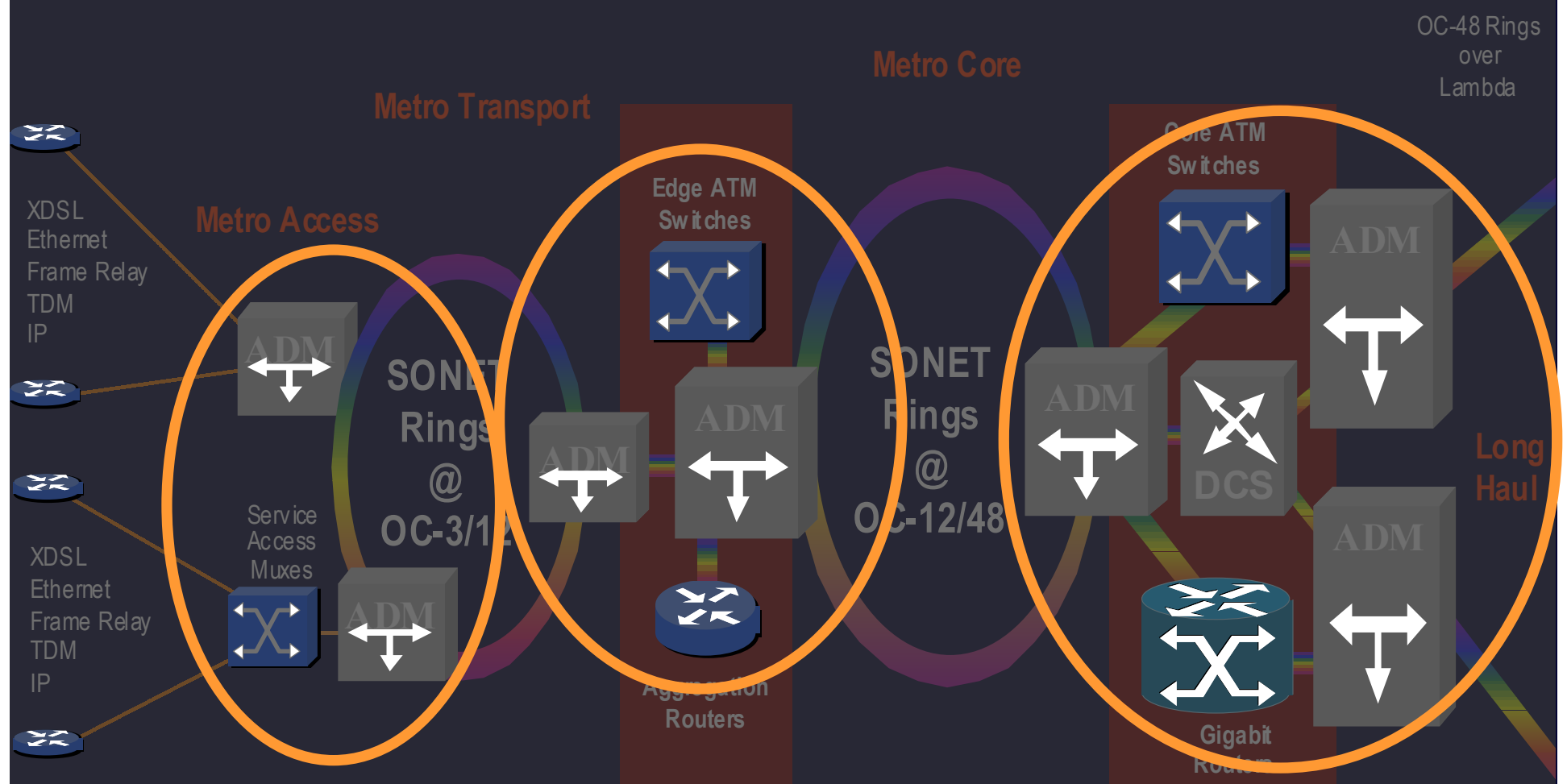- **To actually utilize the backbone bandwidth, half of the city would have to be a central office!**
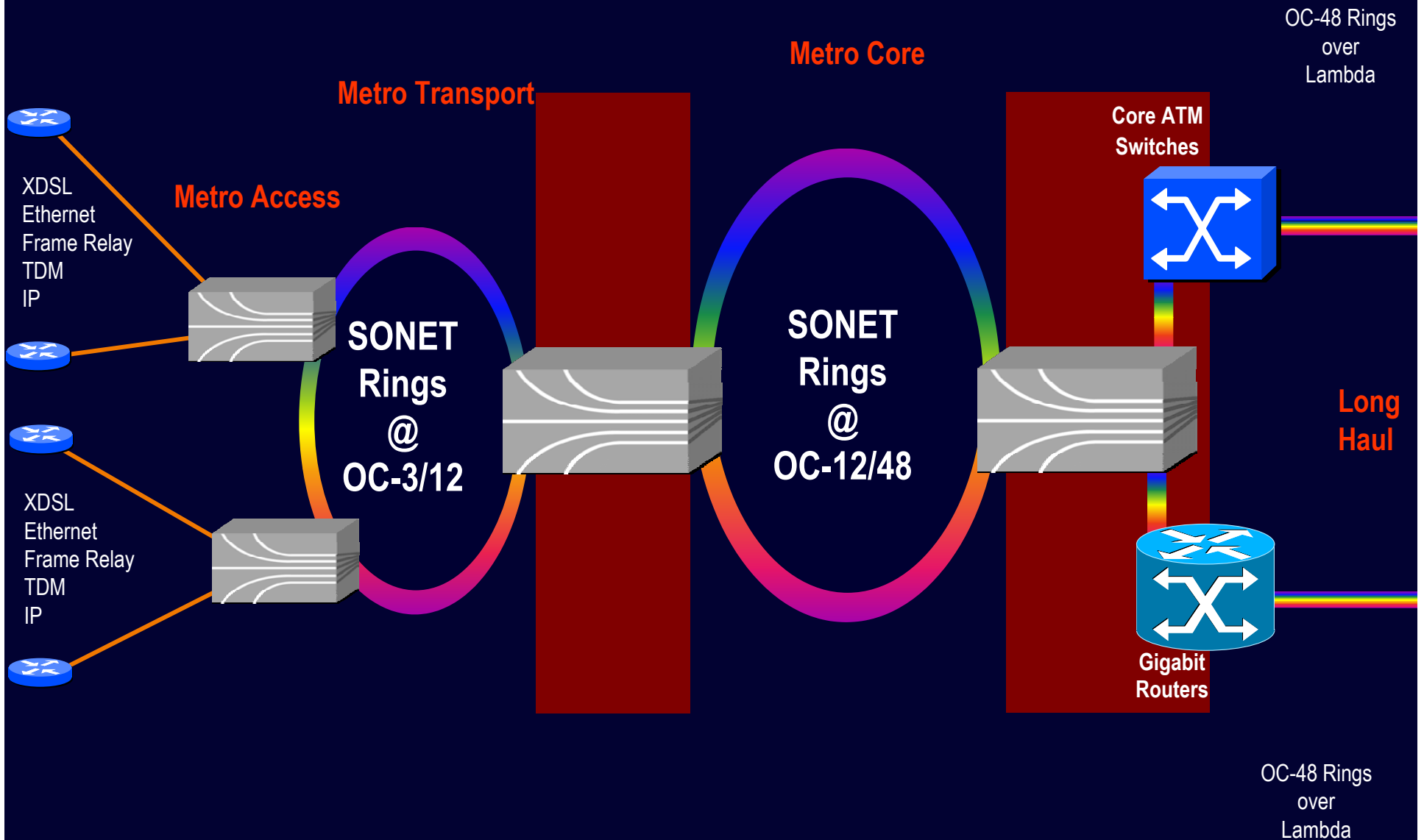
A Closer Look at the Metro Area
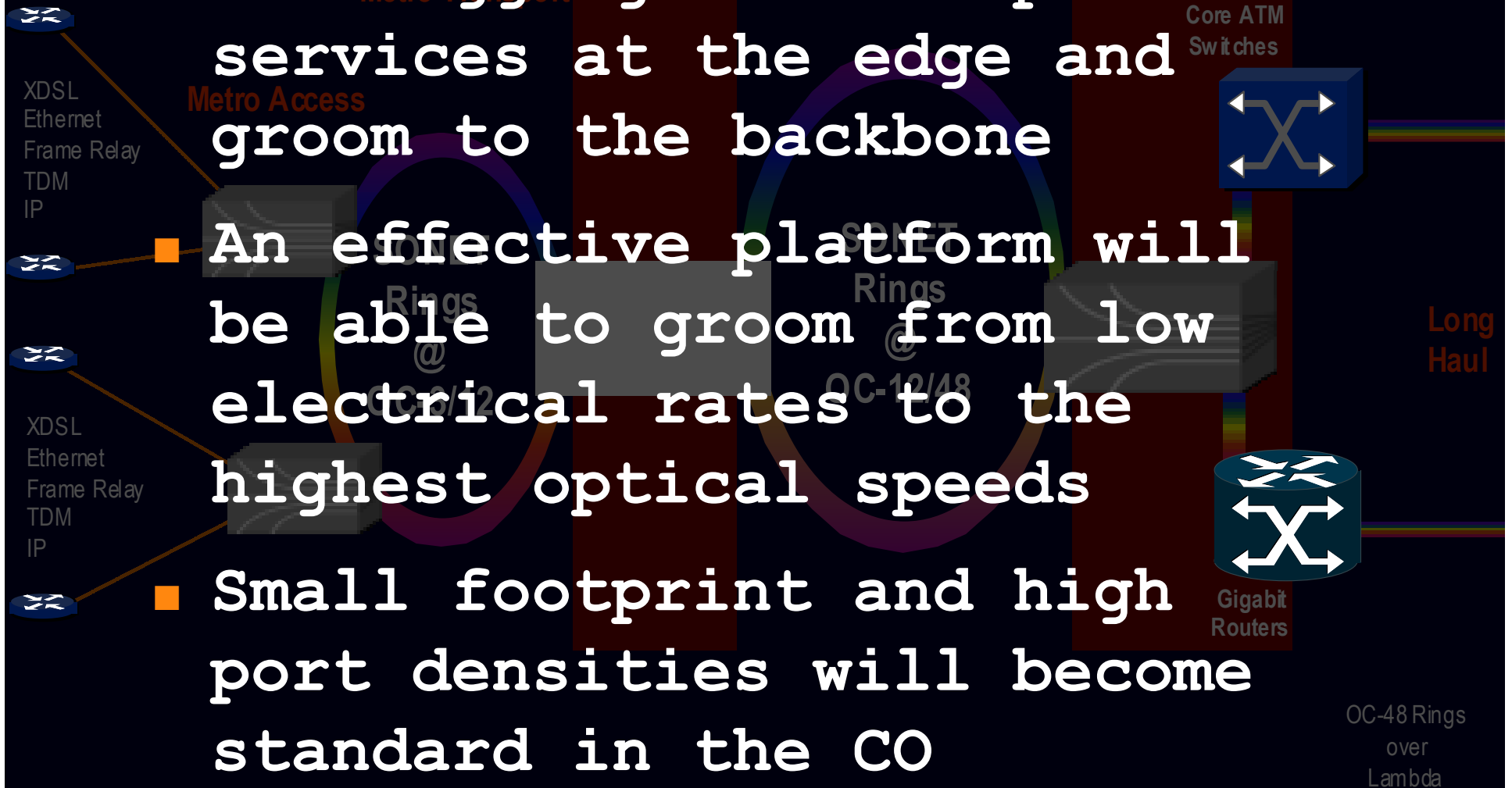
A Closer Look at the Metro Area

The Next-Gen Metro Area

Metro Core

OC-48 Rings
over
Lambda

Metro Transport

**Core ATM
Switches**

Metro Access

XDSL
Ethernet
Frame Relay
TDM
IP

**SONET
Rings
@
OC-3/12**

**SONET
Rings
@
OC-12/48**

**Long
Haul**

XDSL
Ethernet
Frame Relay
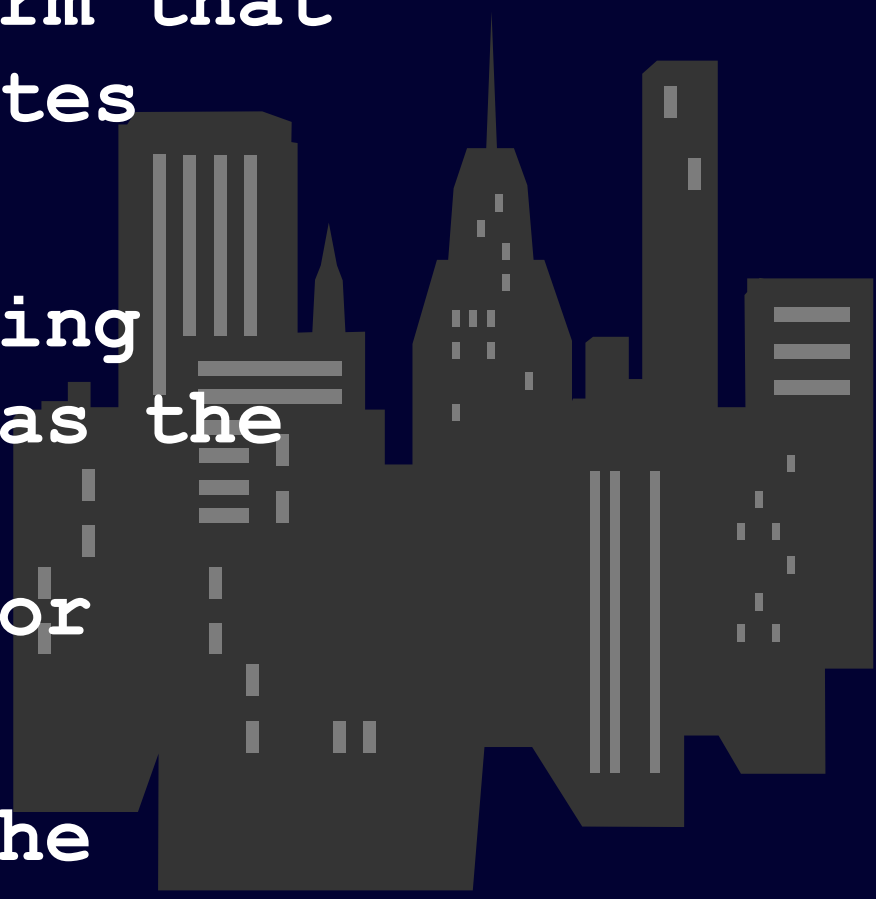TDM
IP

**Gigabit
Routers**

OC-48 Rings
over
Lambda

The Next-Gen Metro Area

CYRAS

- **Next-gen metro equipment must aggregate multiple services at the edge and groom to the backbone**

- **An effective platform will be able to groom from low electrical rates to the highest optical speeds**

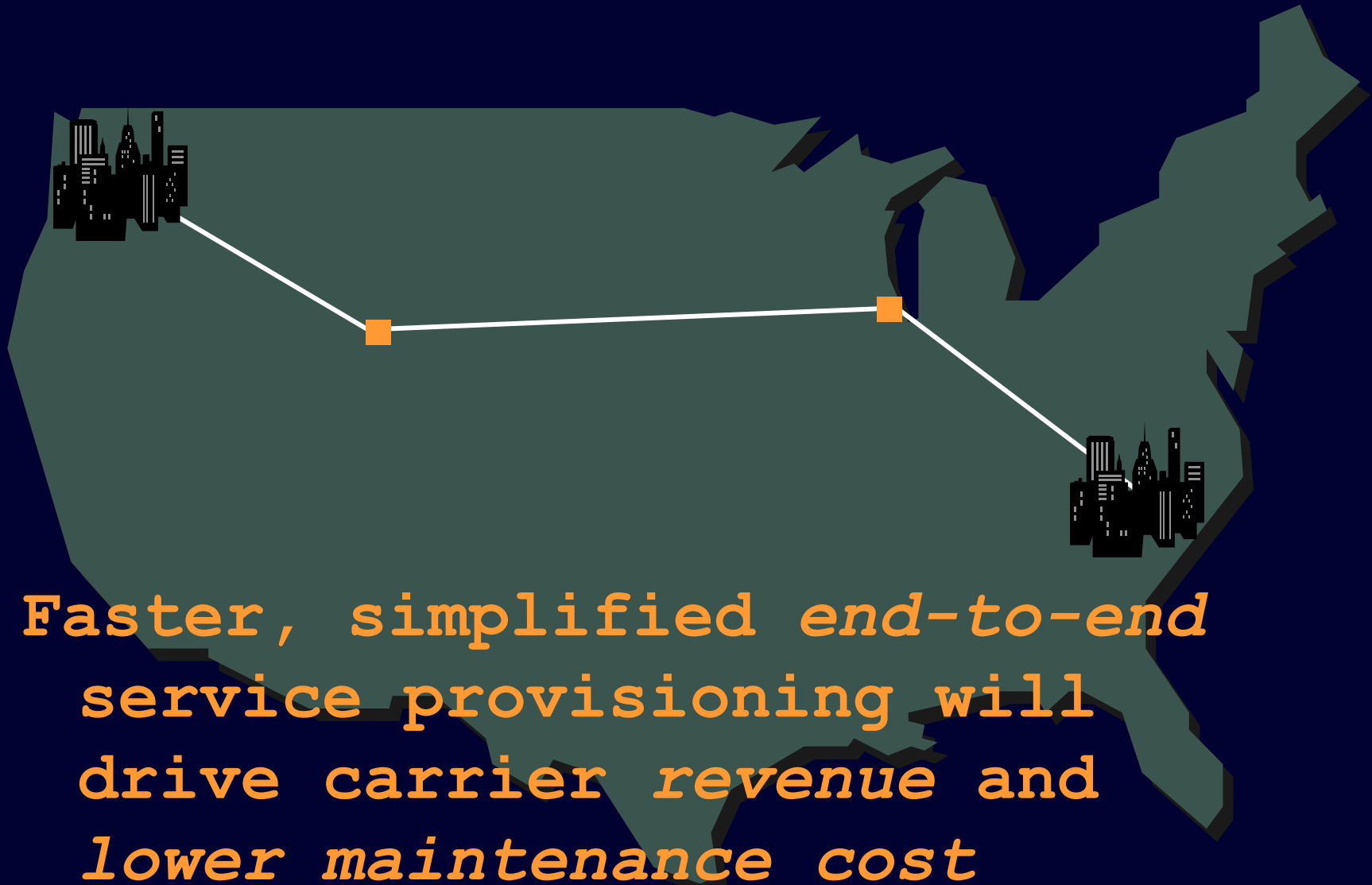- **Small footprint and high port densities will become standard in the CO**

OC-48 Rings over Lambda

Metro Core

Core ATM Switches

Metro Transport

Metro Access

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Ethernet
Frame Relay
TDM
IP

Rings
@
OC-3/12

SONET
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Long Haul

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IP

Gigabit Routers

OC-48 Rings over Lambda

The Next-Gen Metro Area

- **Carriers will need an evolutionary platform that effectively aggregates voice and data**

- **Leap-frogging existing technologies (such as the PONs strategy) is unattractive to major carriers**

- **Simplification of the system *and* network management is key**

The Next-Gen Provisioning

Faster, simplified *end-to-end* service provisioning will drive carrier *revenue* and *lower maintenance cost*

The Next-Gen Provisioning

- **Simplification begins with standards**

- **MPLS control plane will add edge-to-core-to-edge intelligence**

- **Adherence to these standards will provide an evolutionary path**
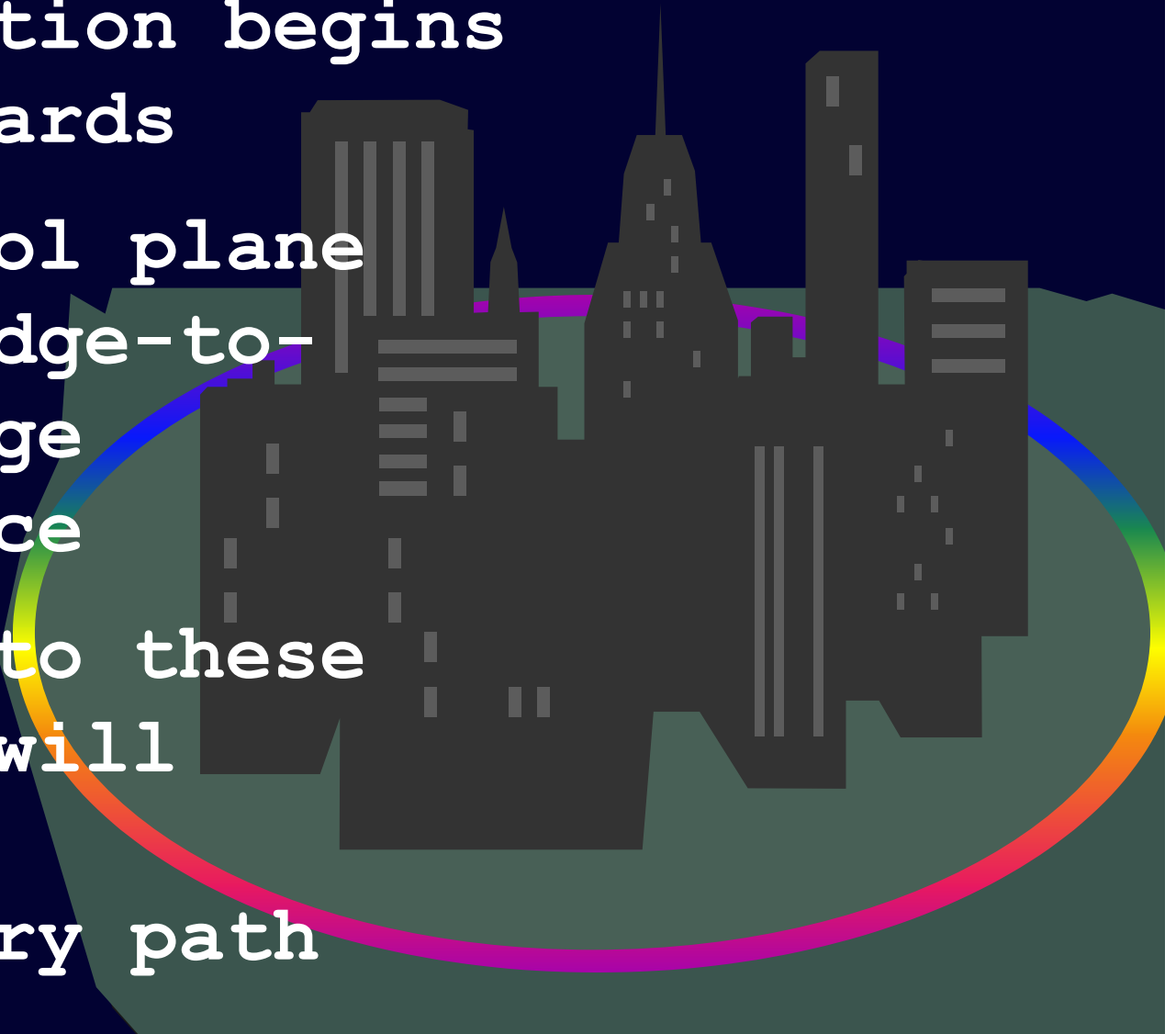
OEO vs OOO in the Metro Area

- For service aggregation, OEO conversion is necessary

- "Burning" wavelengths is spectrally inefficient

- Adding intelligence at the edge is key to filling wavelengths

WDM Alternatives in the MAN

Next-Gen SONET intelligence fills each wavelength

Lambda switching burns wavelengths without optimizing

Associated Metro WDM Costs

Throwing lambdas at the bandwidth crunch

- Is spectrally inefficient

- Quickly becomes more expensive than traditional solutions
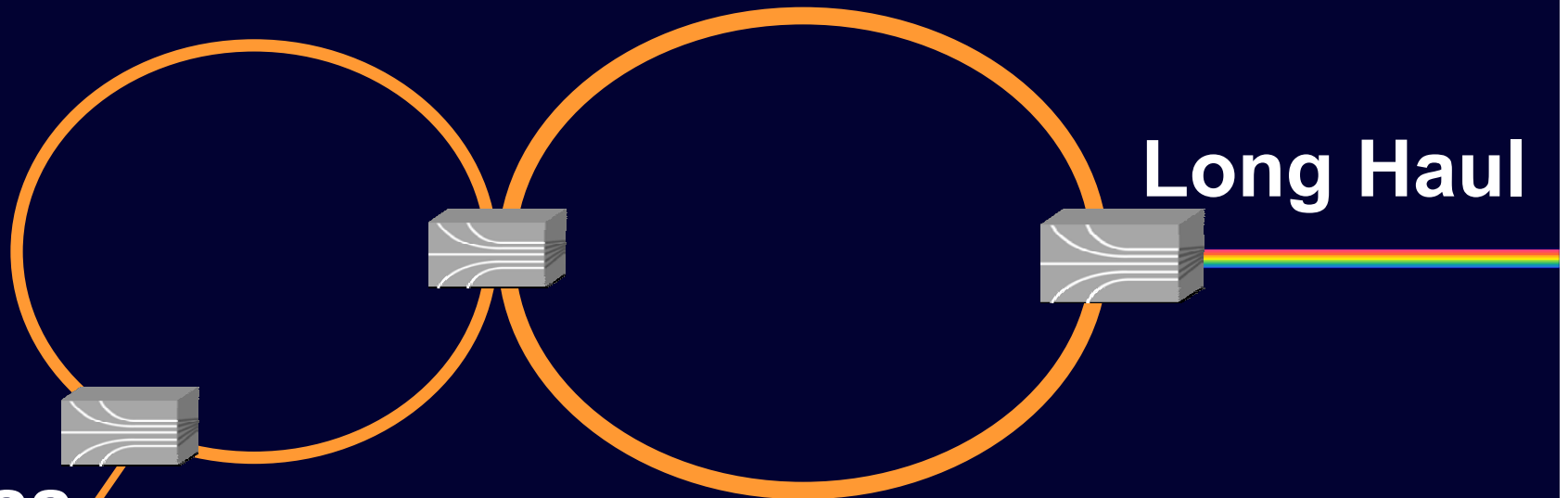
- Raises interoperability issues

Today's Network

Metro Transport

Metro Core

Long Haul

Access

- Single lambda aggregation; OC-48 OEO solution
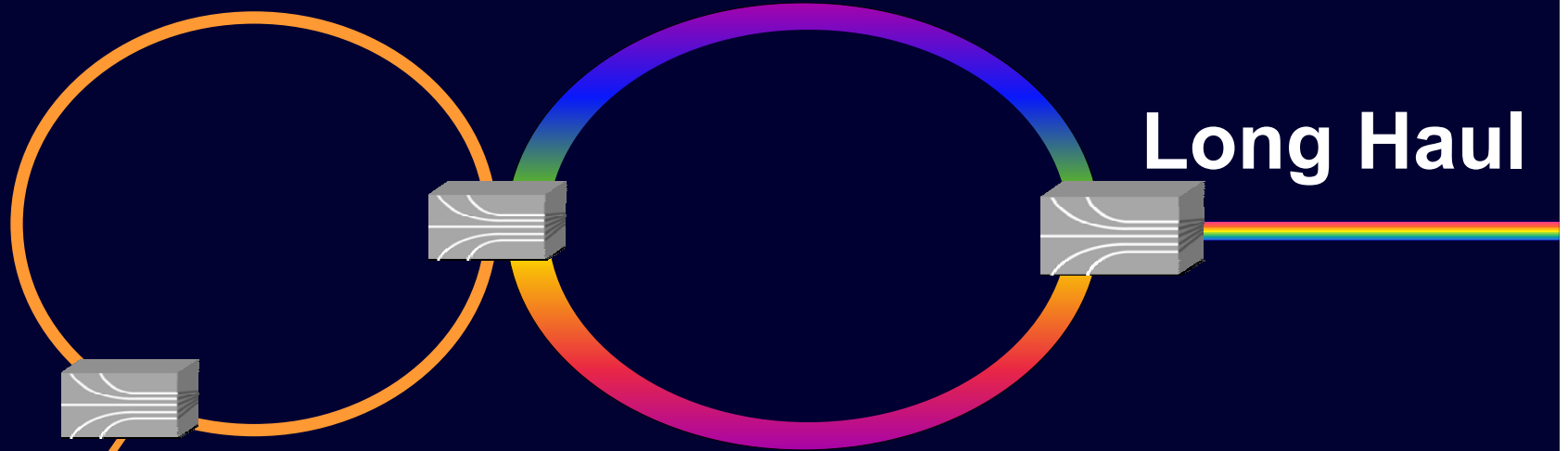- Metro Core, feeding long haul at 10 Gig (OC-192); OEO solution
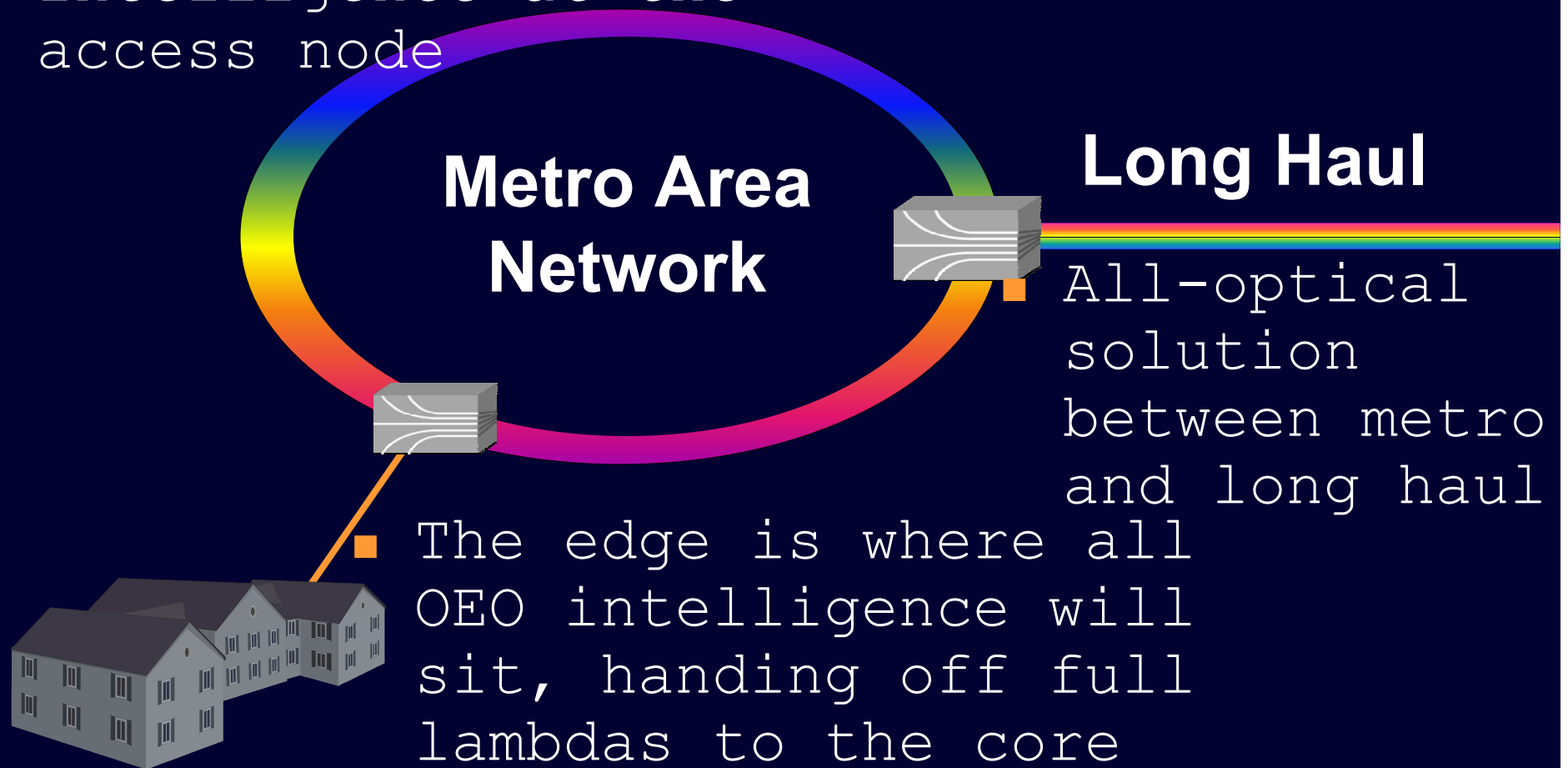
~10 Years (and beyond)

- Metro core and transport unify; multiple lambdas with intelligence at the access node

Metro Area Network

Long Haul

- All-optical solution between metro and long haul

- The edge is where all OEO intelligence will sit, handing off full lambdas to the core
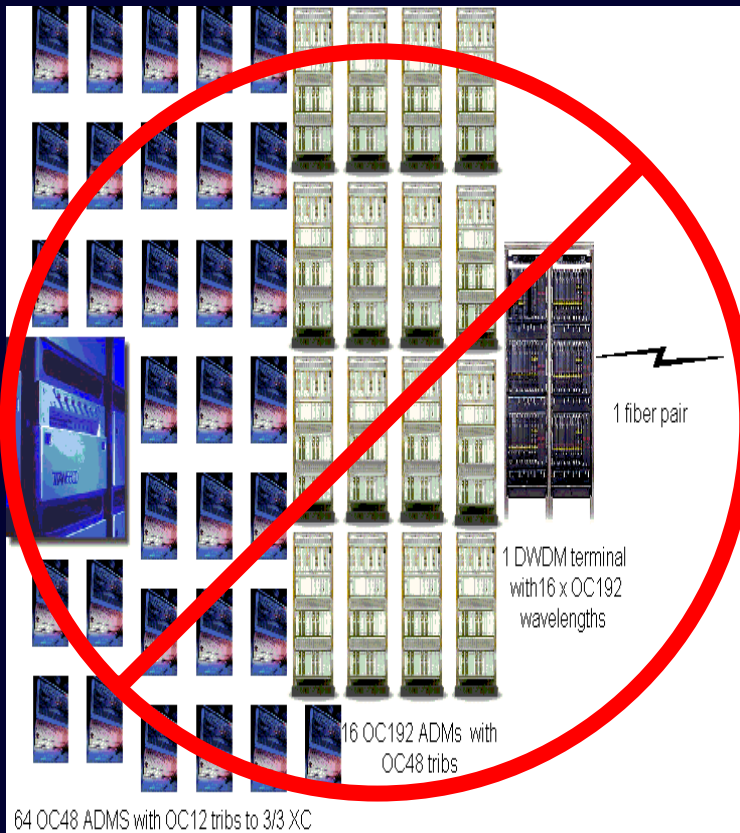
NG Metro Platform (NMP)

NMP Replaces

- Digital cross-connects
- SONET ADMs
- ATM service access mux/switches
- Frame Relay access switches
- DSLAMs
- Multiple lambdas
- MPLS switches
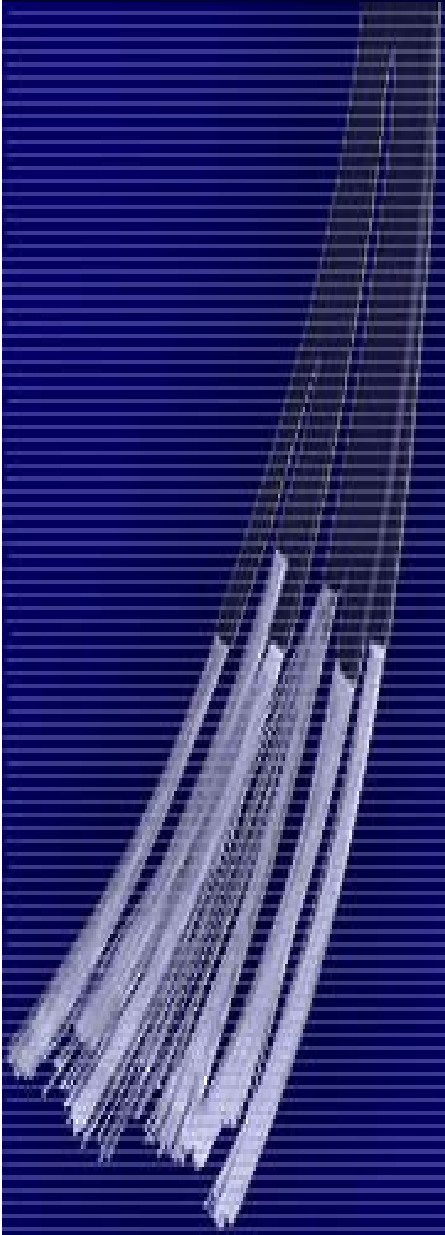
MNP - Scalability/Port Densities

40 Racks of Traditional Equipment

1 fiber pair

1 DWDM terminal with16 x OC192 wavelengths

16 OC192 ADMs with OC48 tribs

64 OC48 ADMS with OC12 tribs to 3/3 XC

5 racks of NMP
(3 shelves/rack)

- **Most Scalable Interfaces**
  - DS-1 to OC-192 for TDM
  - Fractional DS-1 FR to 4 x OC-12c ATM for data

- **3 Shelves per 7 ft. Rack**

- **Highest Port Densities (per shelf)**
  - 280 x DS-1 ; 240 x DS-3
  - 128 x OC-3 ; 48 x OC-12
  - 12 x OC-48 ; 2 x OC192

Conclusion

- The metro area is flooded with multiple services

- Next-gen equipment must look inside the lambdas

- Long-haul will evolve to OOO

- Service provisioning is the key to success