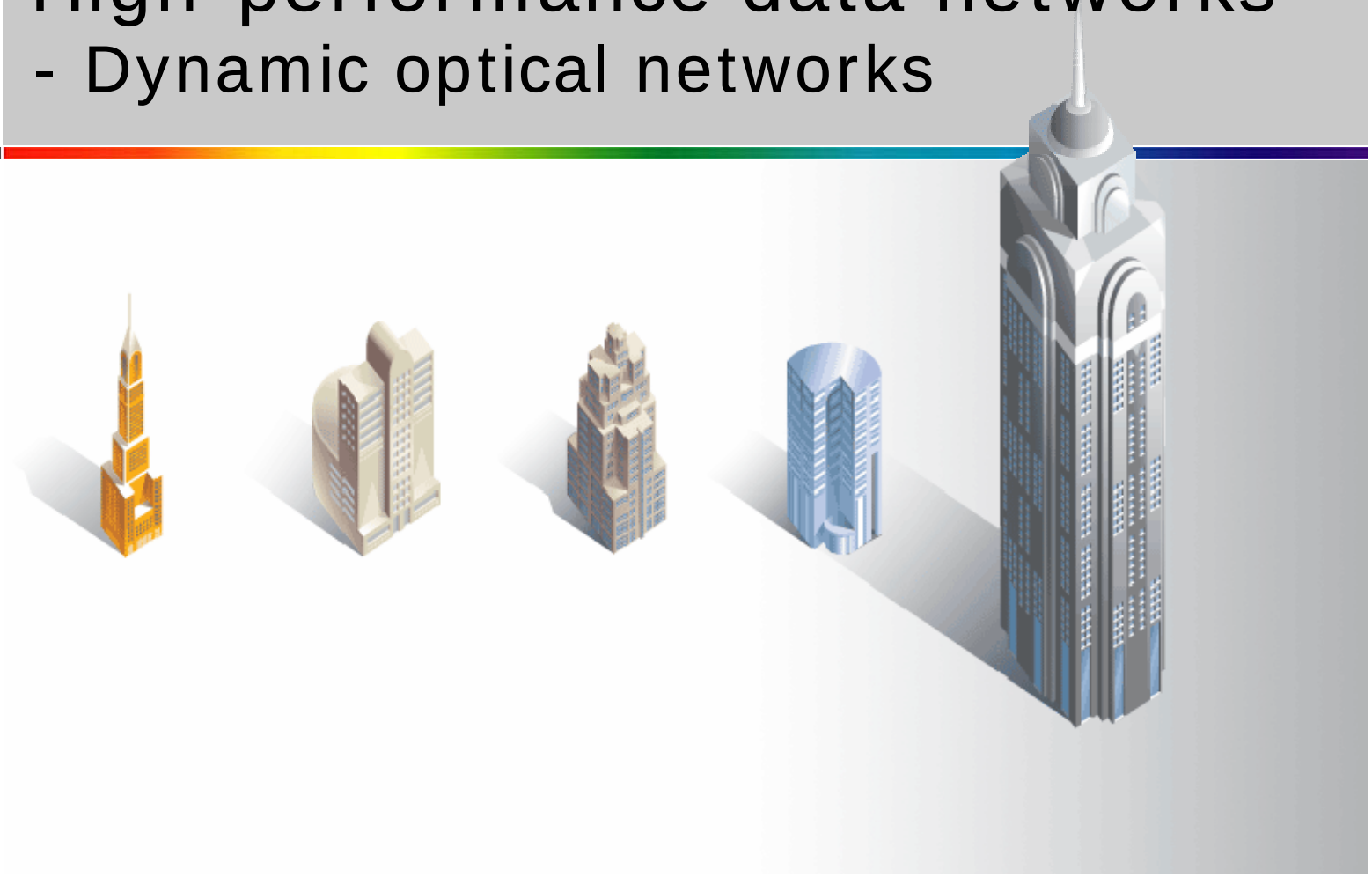
Turning
metro visions
into value

Per B. Hansen
ADVA Optical Networking
iGrid 2005 (San Diego, CA)

High-performance data networks
- Dynamic optical networks



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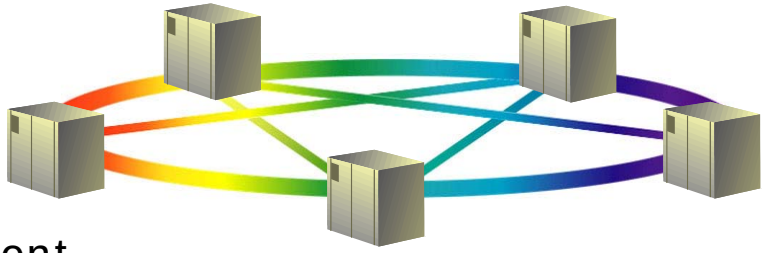
Outline

- High-performance optical networks
  - Distributed data management
  - Distributed data processing
- Economics of dynamic optical networks
  - Strength and weaknesses
  - Advantages of static/dynamic hybrid architectures
- Dynamic optical network applications
  - Dynamic re-routing with varying traffic patterns
    - *Dynamic optical pass-through*
  - Dynamic service provisioning
    - *How dynamic should be edge of the network be?*
- Summary

High-perf. data networks

- Distributed data processing/computing



- Distributed data management

- Drivers:
  - Allow time-sharing (access to larger resources)
  - Facilitate granular non-service affecting capacity growth
  - Ensure availability (from failure resilience to BC/DR)

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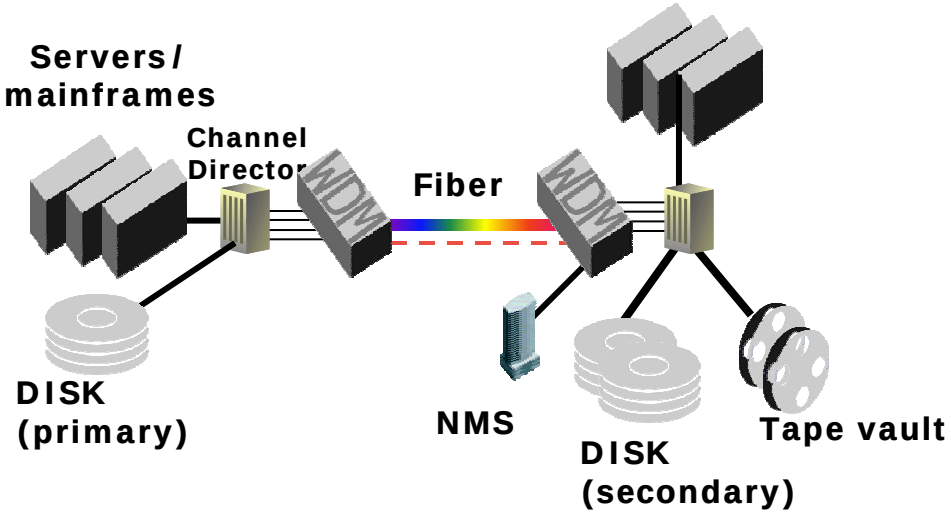
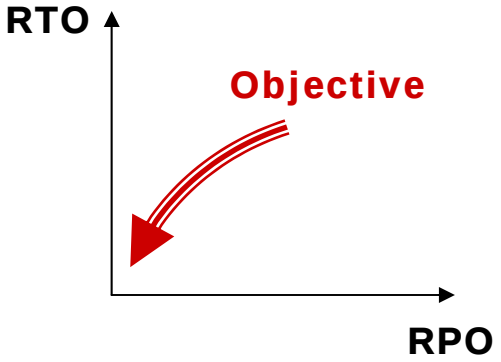
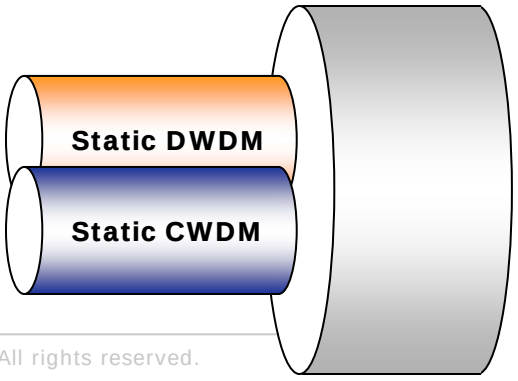
Data management networks

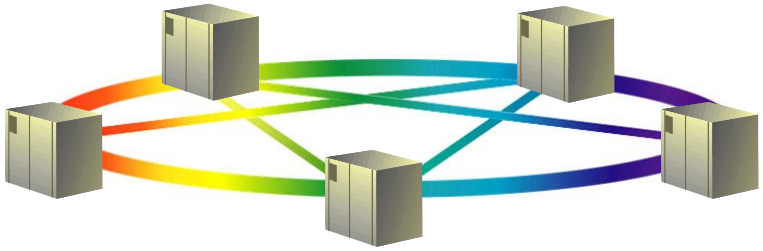




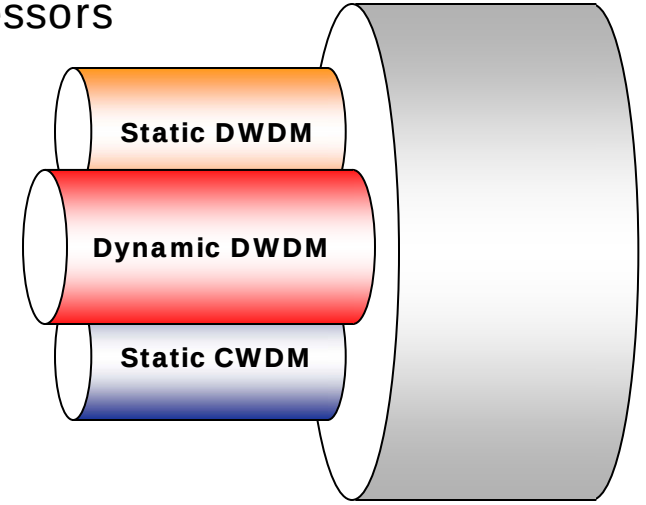
- Mirrored facilities
  - Recovery Time Objective (RTO) → Large bandwidth need
  - Recovery Point Objective (RPO) → Continuous, low-latency connection
- Characteristics
  - Very predictable
  - Point-to-point systems
  - Ultra-high availability needs



Data processing networks



- Mesh of interconnected processors
  - Large networks of 10s to 100s of processors
  - Distribution of large blocks of data
  - Latency sensitive
- Characteristics
  - Mesh topology
  - Variable and bursty traffic demands
  - Some resource redundancy



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Static & dynamic

Static WDM advantages

- Lower 1st installed costs (savings > 50%)
- Lower equipment cost/service (savings > 50%)
- Simpler installation & maintenance
- CWDM & DWDM flexibility

Dynamic WDM advantages

- Increased planning flexibility
- Faster incremental service turn-up
- Simpler service upgrades
- Shared protection and mesh topologies

Lowest service costs
CAPEX

Highest provisioning flexibility
OPEX

CAPEX: Capital Expenditure

OPEX: Operating Expenditure

Hybrid

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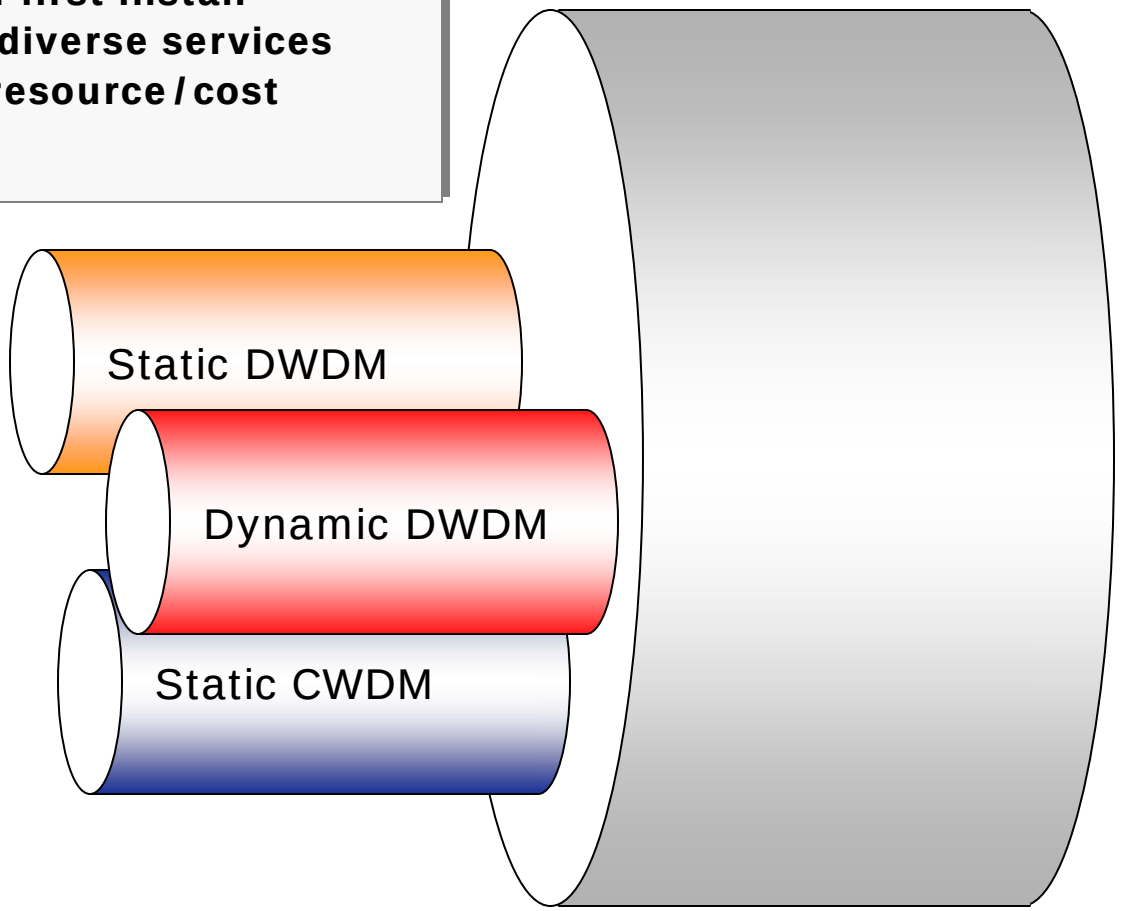
Hybrid network platform

- **Lowers cost of first install**
- **Co-hosting of diverse services**
- **Allows wider resource/cost sharing**



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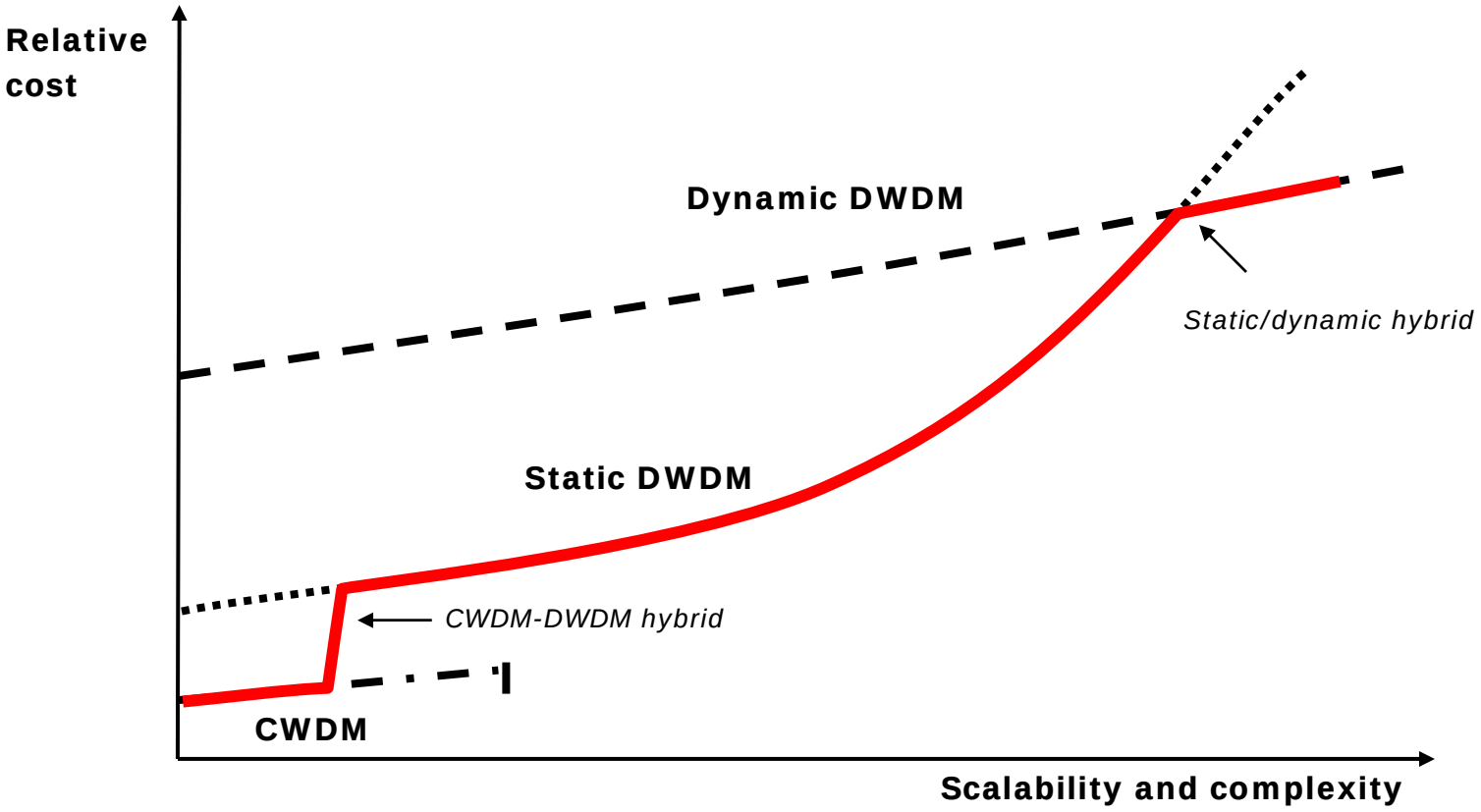
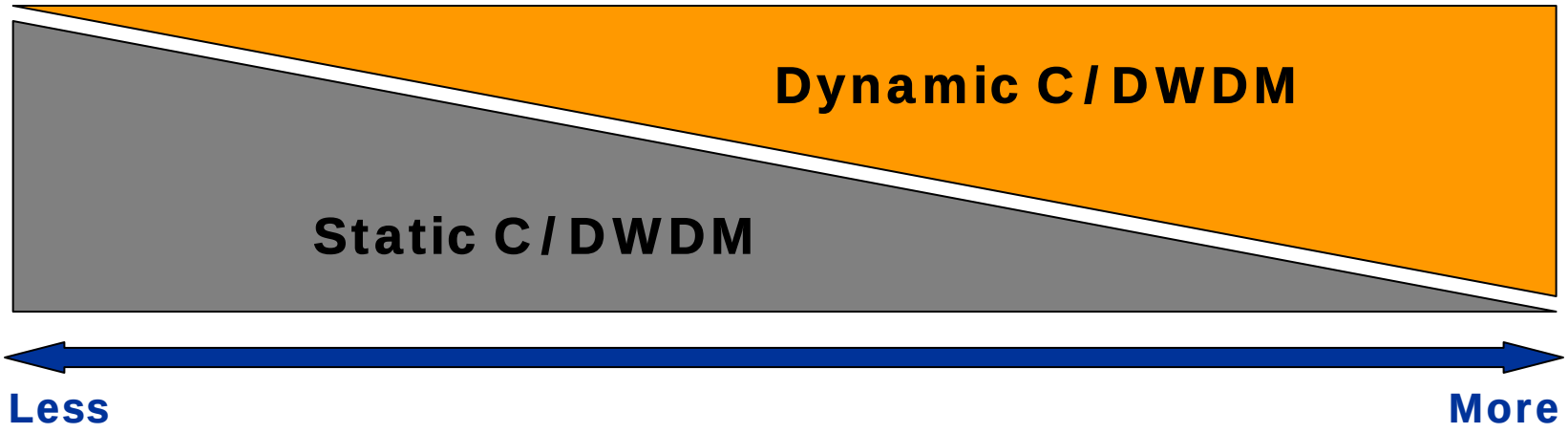
The real scalable platform



Leveraging the right technologies with hybrid migration and / or universal platform

Optical network technology



Variable traffic with granularity of wavelength and above

Unpredictable traffic pattern

Meshed network topologies

Scale of networks

Network fill rate

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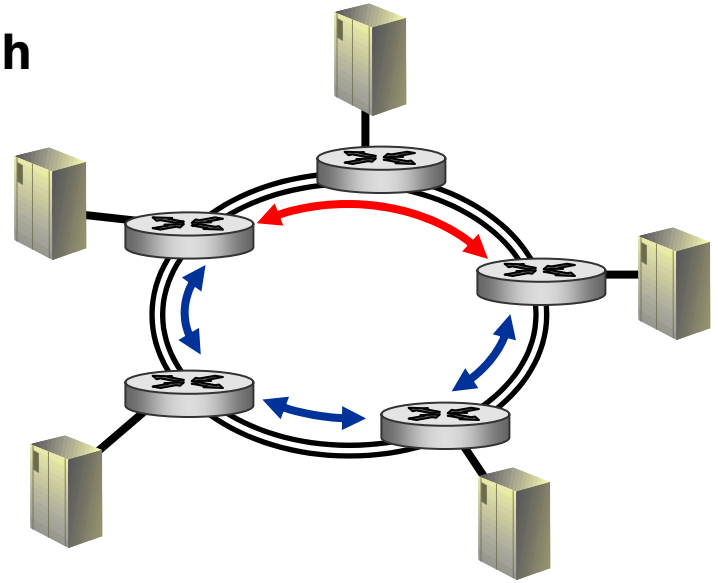
Dynamic service re-routing

- **CWDM + Optical pass-through**
  - Cost-effective routing
  - Off-loads expensive router/switches
- **DWDM + Pass-through**
  - High and scalable transmission capacity
  - Logical mesh on a physical ring
- **Dynamic reconfiguration**
  - Responds to varying traffic demands (Minutes into month)



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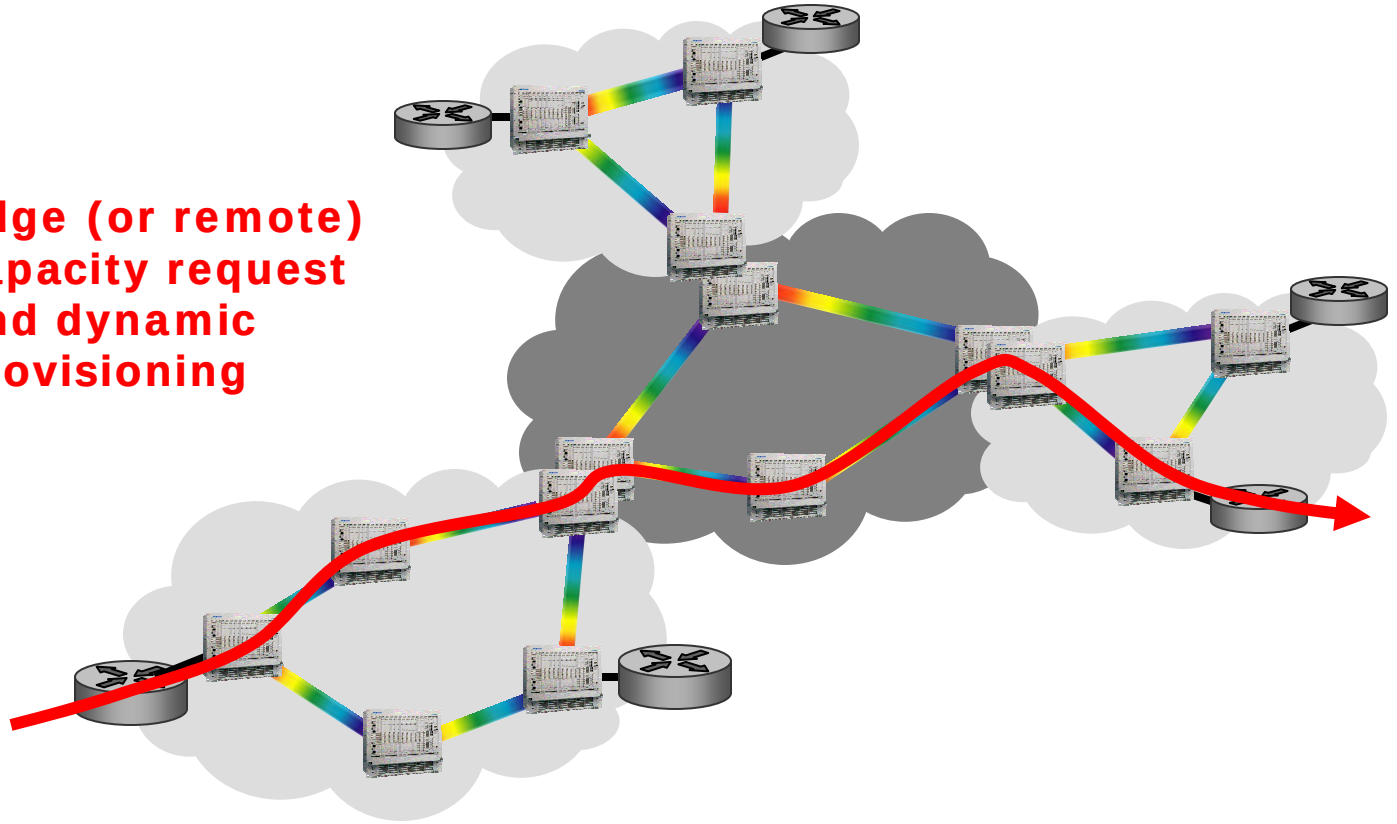
Dynamic service provisioning

Edge (or remote) capacity request and dynamic provisioning



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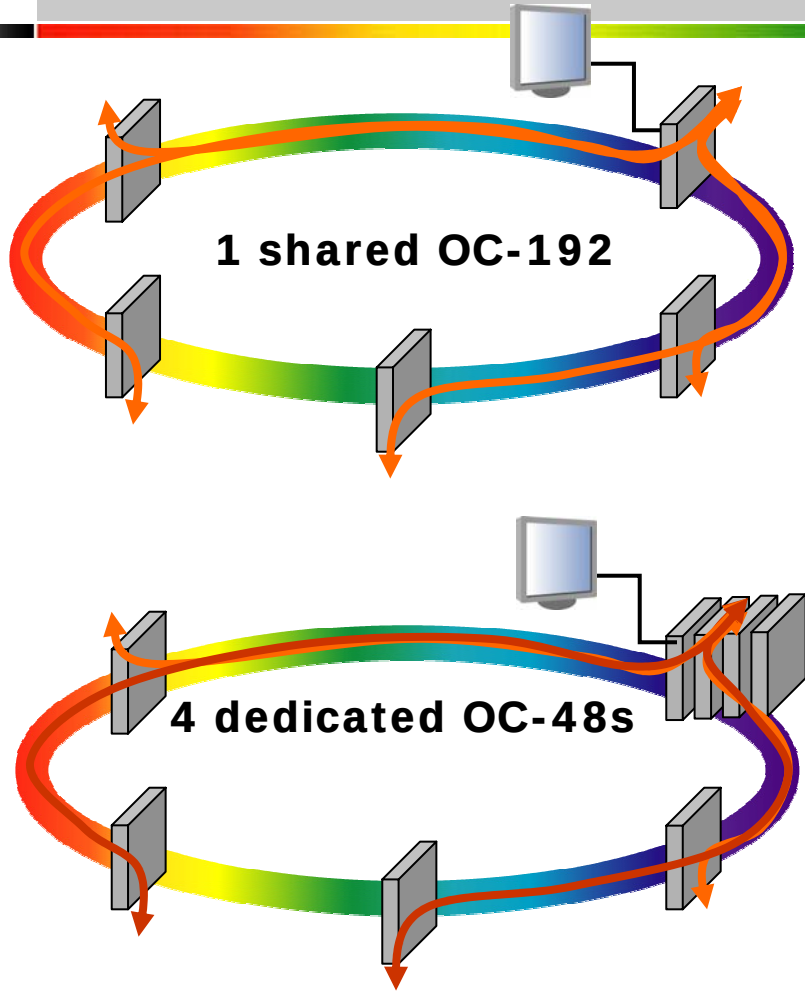
Cost of idle time



Example:

- Hub connecting to 4 satellite sites
- 6h of 10 Gb/s to each of 4 sites
- $P_{OC\text{-}192}/P_{OC\text{-}48} = 3$

Time-share single-λ:

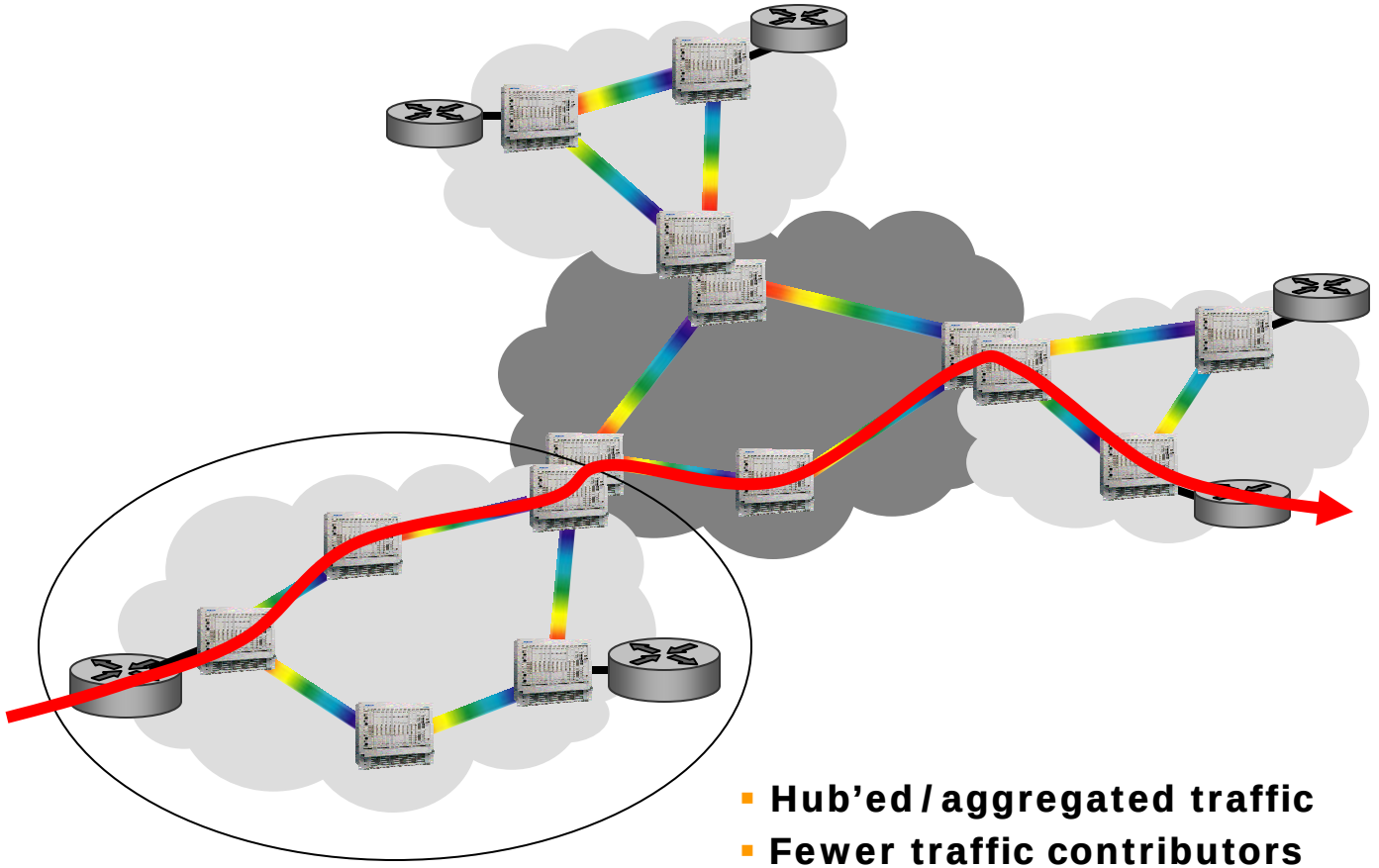
- $P = 5x3xP_{OC\text{-}48} = 15xP_{OC\text{-}48}$
- Wavelength usage: 1

Dedicated lower-speed λs:

- $P = 8xP_{OC\text{-}48}$
- Wavelength usage: 2

Dynamic vs static includes a cost / wavelength tradeoff

Dynamic service provisioning



- **Hub'ed / aggregated traffic**
- **Fewer traffic contributors**
- **Hardware idle time vs job urgency?**

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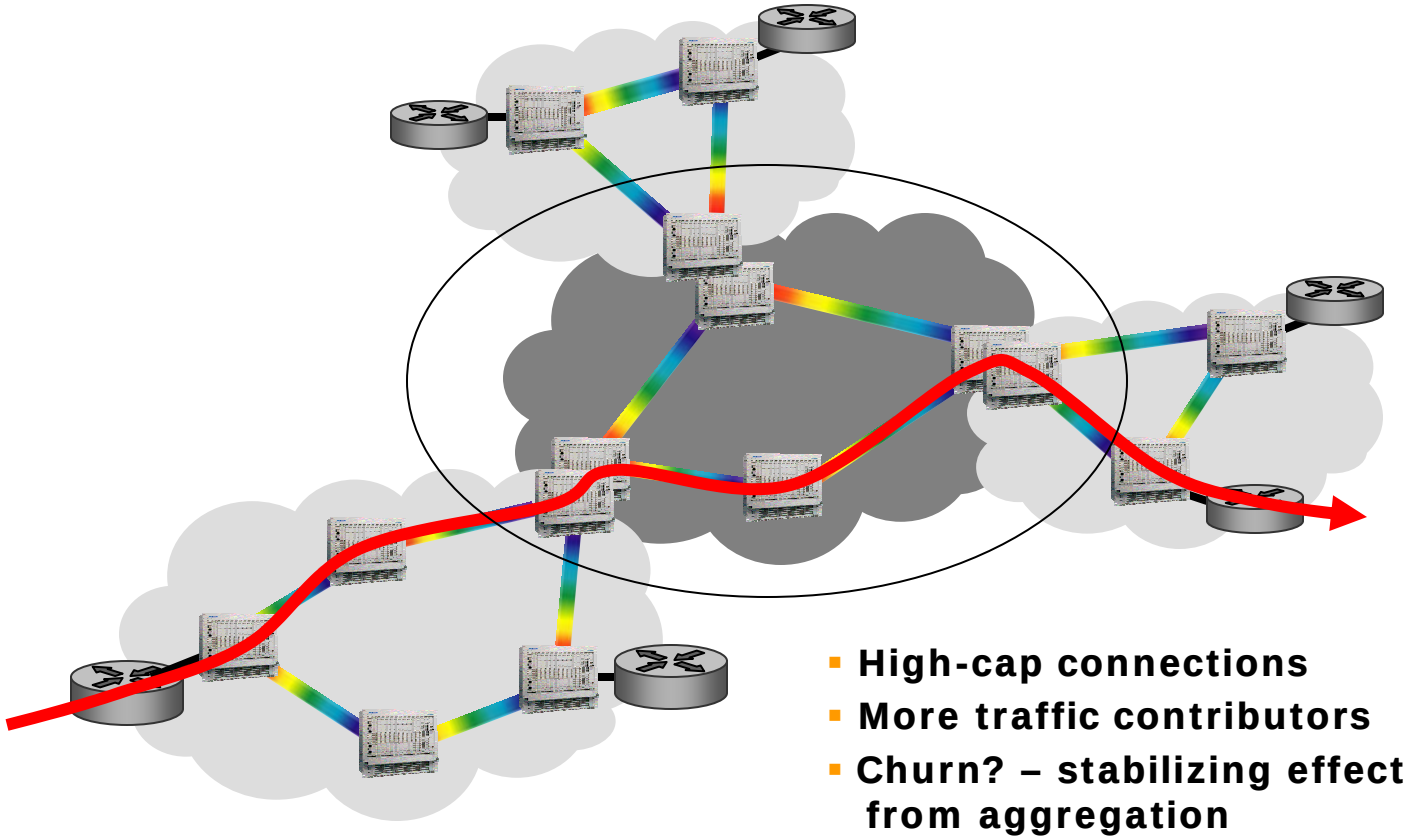
Dynamic service provisioning



- **High-cap connections**
- **More traffic contributors**
- **Churn? – stabilizing effect from aggregation**

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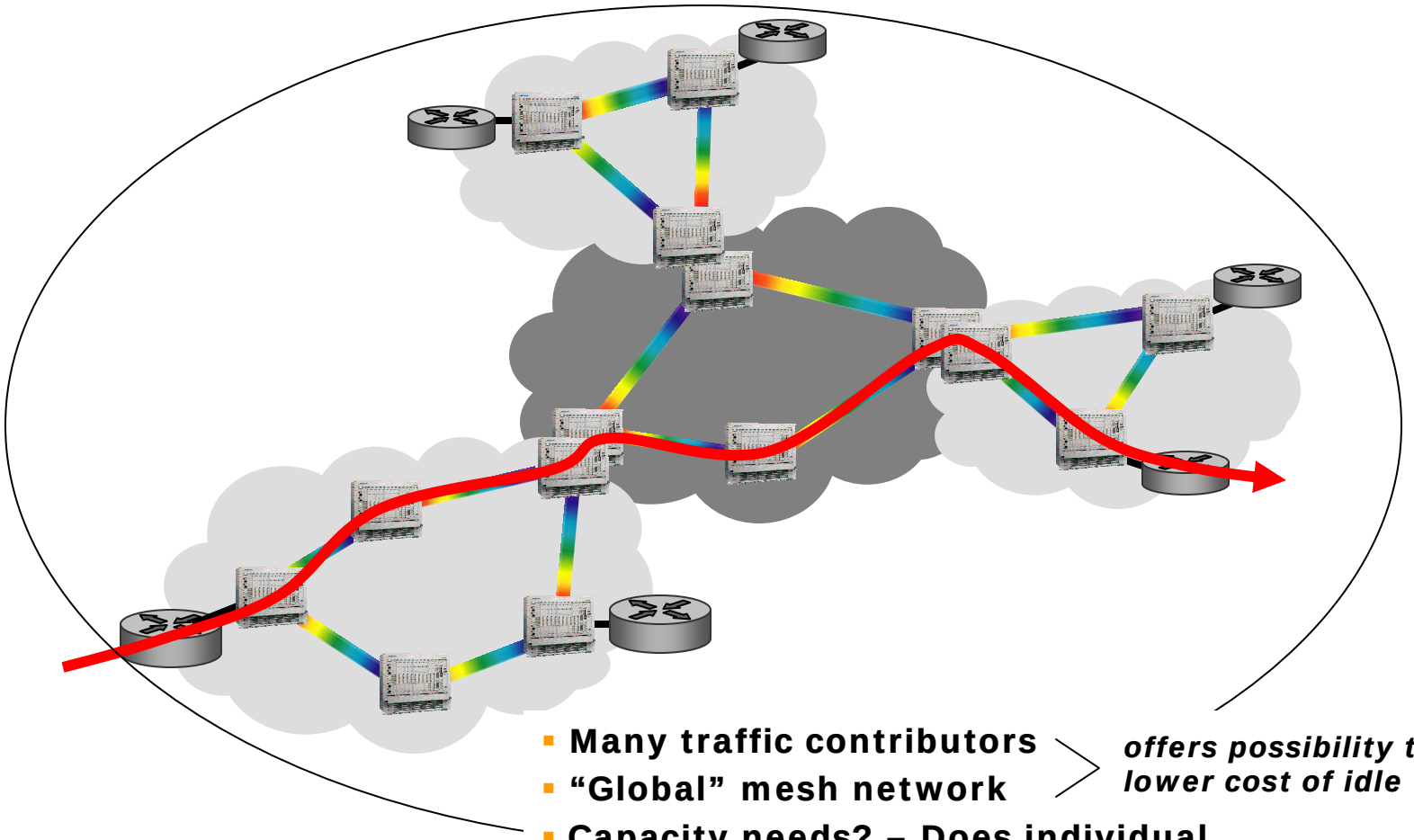
Dynamic service provisioning



- **Many traffic contributors**
- **"Global" mesh network**

offers possibility to lower cost of idle time

- **Capacity needs? – Does individual contributors deliver λ+ capacities**

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Summary

- Networks experience a range of opposing demands
  - Lowest cost of first install – lowest threshold to getting a service
  - Maximizing utility – providing a service to all users within budget
  - Maximum bandwidth – the biggest pipe for the money
  - Option for advanced features – the problem of saying “no” and “never”
  - Service availability – from best effort to ultra-available
  - Network scale – sharing of geographically disperse resources
  - Time sharing high-perf. resources – Demand adaptation across networks
  - …
- Opportunities for optimizing a network design by
  - Recognizing network topology
  - Recognizing traffic demands with degrees of predictability
  - Architecting a network solution that leverage that knowledge
- Optimum solution: a hybrid network platform that supports a wide range of technologies from static CWDM to dynamic DWDM.

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Thank you

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