Challenges of the Terabit Wave

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Ethernet Alliance Panel – OFC 2012

Challenges

- The challenge of the network
- The challenge for the systems
- The challenge for the optical component technology

The challenge of the network

Three topics:
Traffic growth driving bandwidth
Economics driving cost pressure
Architecture shifts affecting system/component need

Global IP Traffic Drivers, 2010–2015

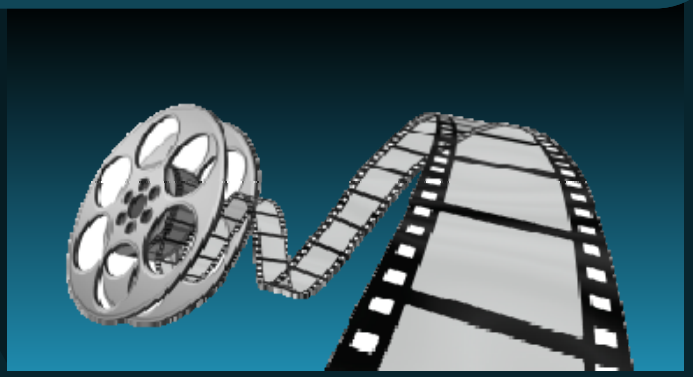
More Devices
Nearly 15B Connections

Faster Broadband Speeds
4-Fold Speed Increase

Key Growth Factors

More Internet Users
3 Billion Internet Users

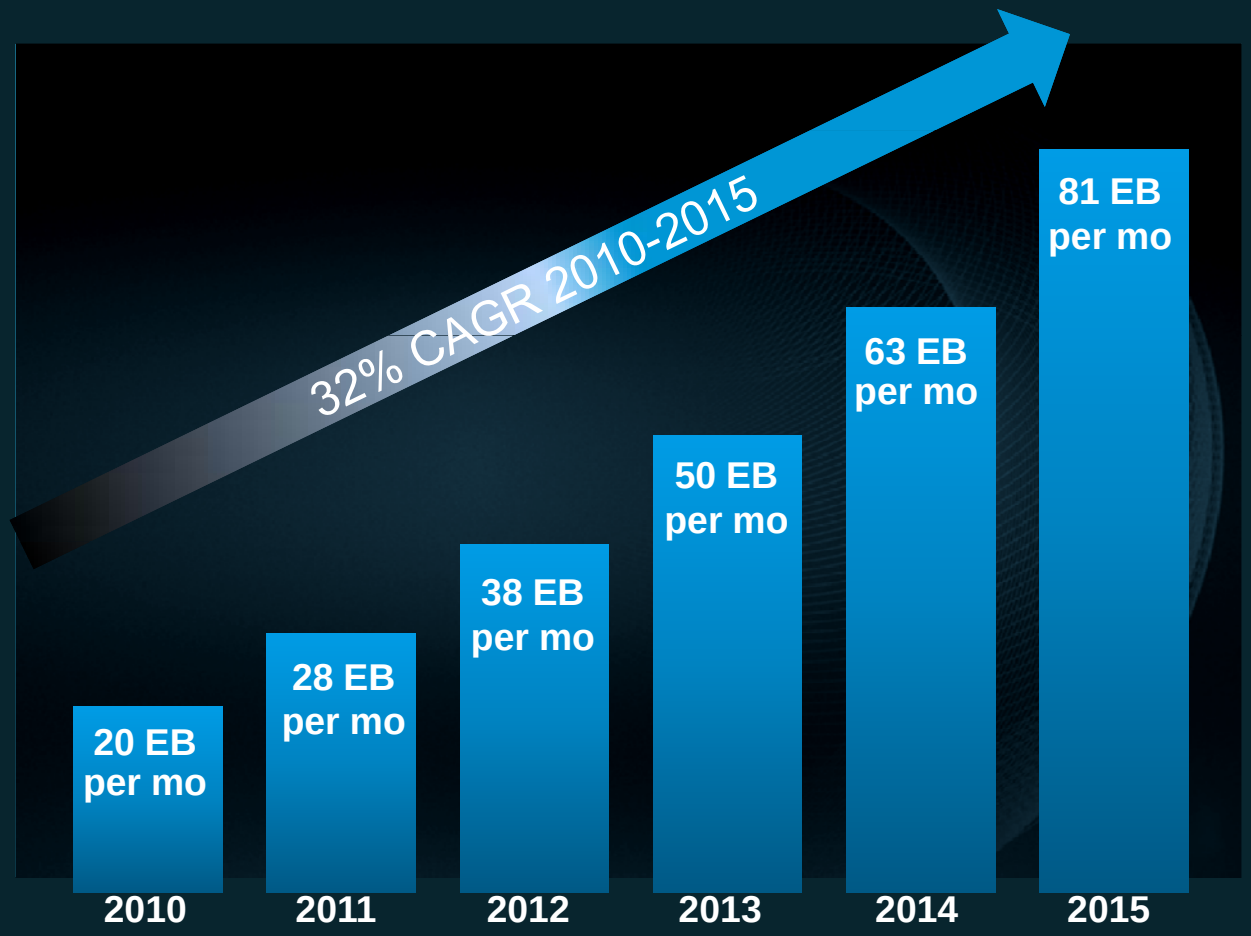
More Rich Media Content
1M Video Minutes per Second



Source: Cisco Visual Networking Index (VNI) Global IP Traffic Forecast, 2010–2015

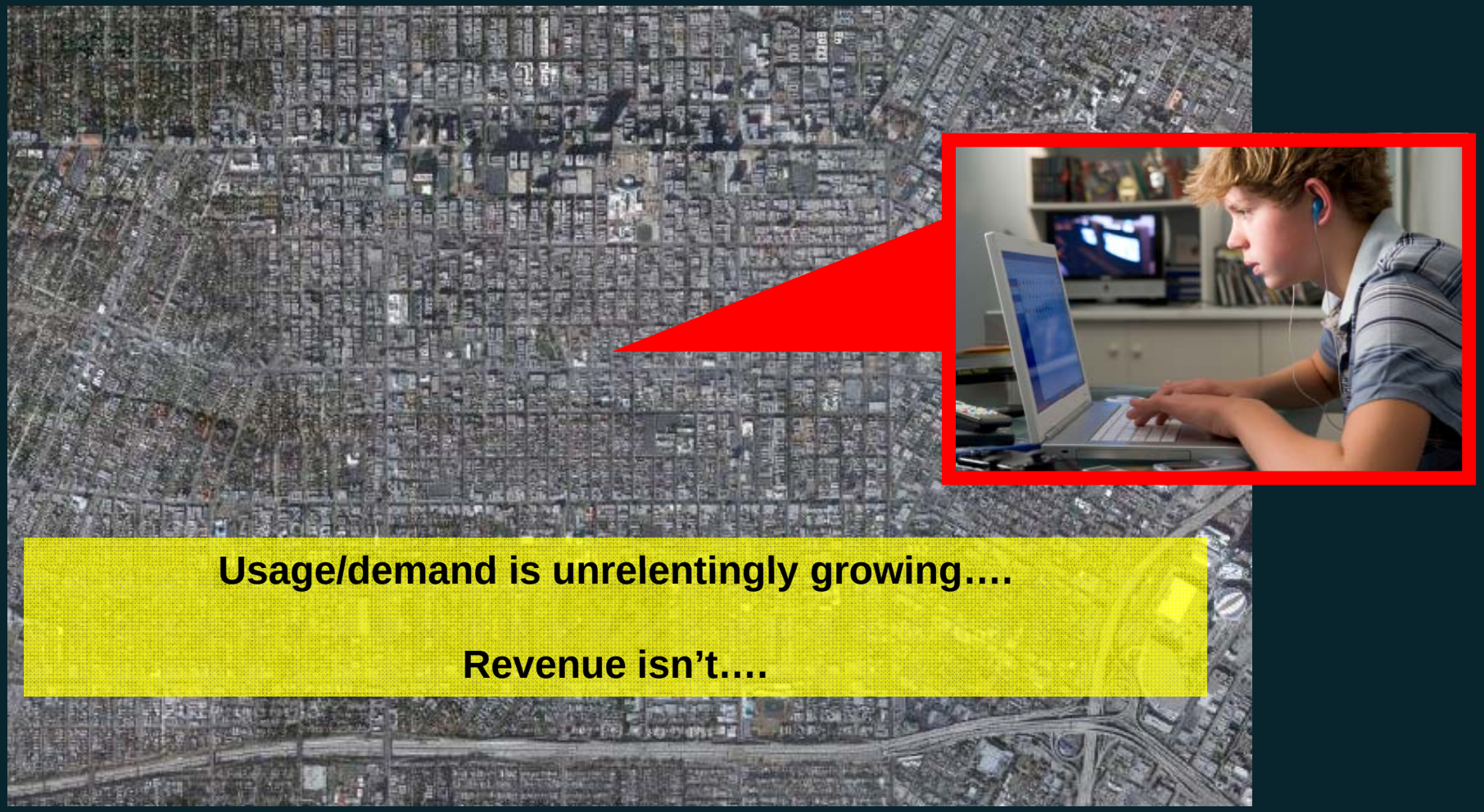
Entering the Zettabyte Era

Global IP traffic will increase 4-fold from 2010 to 2015



Source: Cisco Visual Networking Index (VNI) Global IP Traffic Forecast, 2010–2015

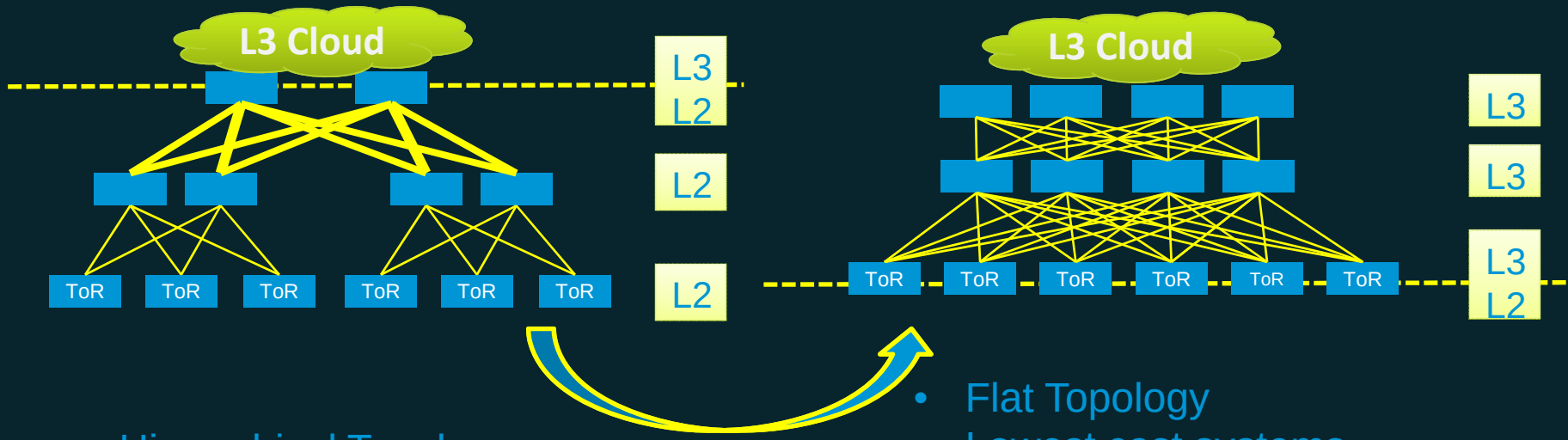
The economic challenge of this terabit wave



Usage/demand is unrelentingly growing….

Revenue isn't….

DC Architecture trending



- Hierarchical Topology
- High-end & low end system and i/o mix
- Oversubscription

- Next gen interfaces insert at core & migrate deeper

- Flat Topology
- Lowest cost systems
- Highly meshed – no oversubscription
- Significant machine to machine traffic – low latency

- Significant port count and link increase
- Requires high-density low-cost optical interfaces

The challenge for the systems

Two key challenges:
System Cost
Density

Systems for the Terabit wave

Many platforms across the networking space

Data Center Access

Data Center Aggregation

Edge/Aggregation Routing

Core Routing

The terabit wave isn't something that is coming… it is already here.

Systems today already supporting > 100G per slot, nx100GE under development. Systems already scaling up to 322Tb/s

Optical Challenges Systems

Many platforms across the networking space

Data Center Access

Data Center Aggregation

Edge/Aggregation Routing

Core Routing

Optical Challenges

Port Density
Port Cost
Power
Thermal

System Cost can be dominated by these issues

The challenge for the optical technology

Optical technology…

…Is the key enabler for systems to maintain pace with the requirements of the Terabit wave

Challenge		Goal
Size reduction	→	Port Density increase
Power reduction	→	Port Density increase
Reach	→	System/network scaling
Packaging simplification	→	Increased Yield, lowers cost
The next speed (400G/1T)	→	System Scale, lower costs

Promising trends

Optical integration:

- Photonic integrated Circuits
- Laser arrays
- Silicon Photonics

Advanced Modulation:

- Silicon capability (Moore's Law) enables electronic complexity to reduce optical complexity.
  - Long haul coherent transmission
  - FEC/equalization to reduce cost on short reach interfaces
  - Optical PAM-n – proposal at IEEE for next-gen 100GE using a single laser

Low-cost manufacturing

- High volume 10G shipments
- Optimized packaging

Summary

Relentless traffic demand is putting pressure on all aspects of the network:

- Architectures
- System Designs
- Component technology

Innovation is required at all levels to meet the demand

Thank you.