



Telco-media convergence

Network Implications

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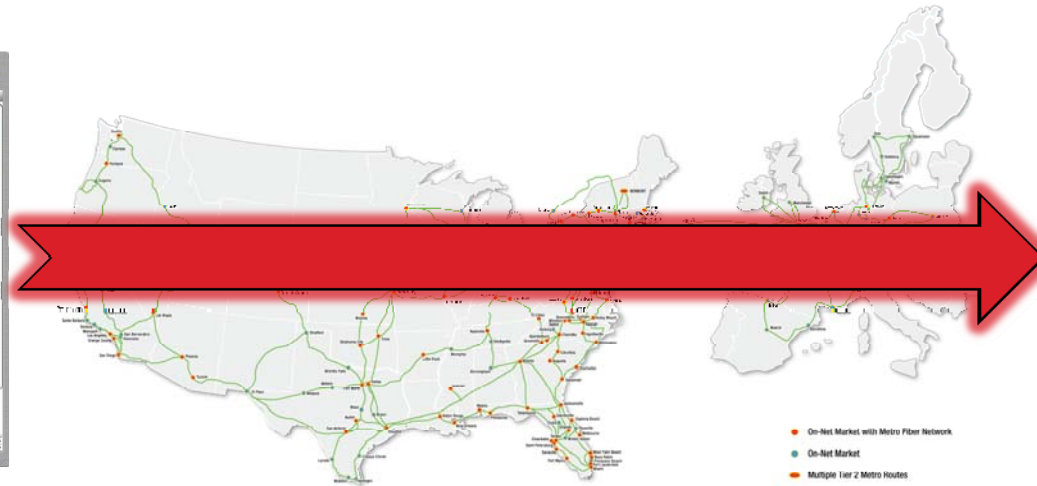
A large, abstract graphic on the right side of the slide. It consists of various shades of blue, including a dark blue background with lighter blue horizontal bands and a large, light blue circular shape. The words "responsive", "reliable", "service", "performance", and "trusted" are overlaid on this graphic in a light blue, sans-serif font. "responsive" is at the top, "reliable" is in the middle, "service" is on the left, "performance" is at the bottom, and "trusted" is on the right, oriented vertically.



iTunes Store Top Music Retailer in the US

CUPERTINO, California, April 3, 2008

Apple® today announced that the iTunes® Store surpassed Wal-Mart to become the number one music retailer in the US, based on the latest data from the NPD Group*. With over 50 million customers, iTunes has sold over four billion songs and features the world's largest music catalog of over six million songs.

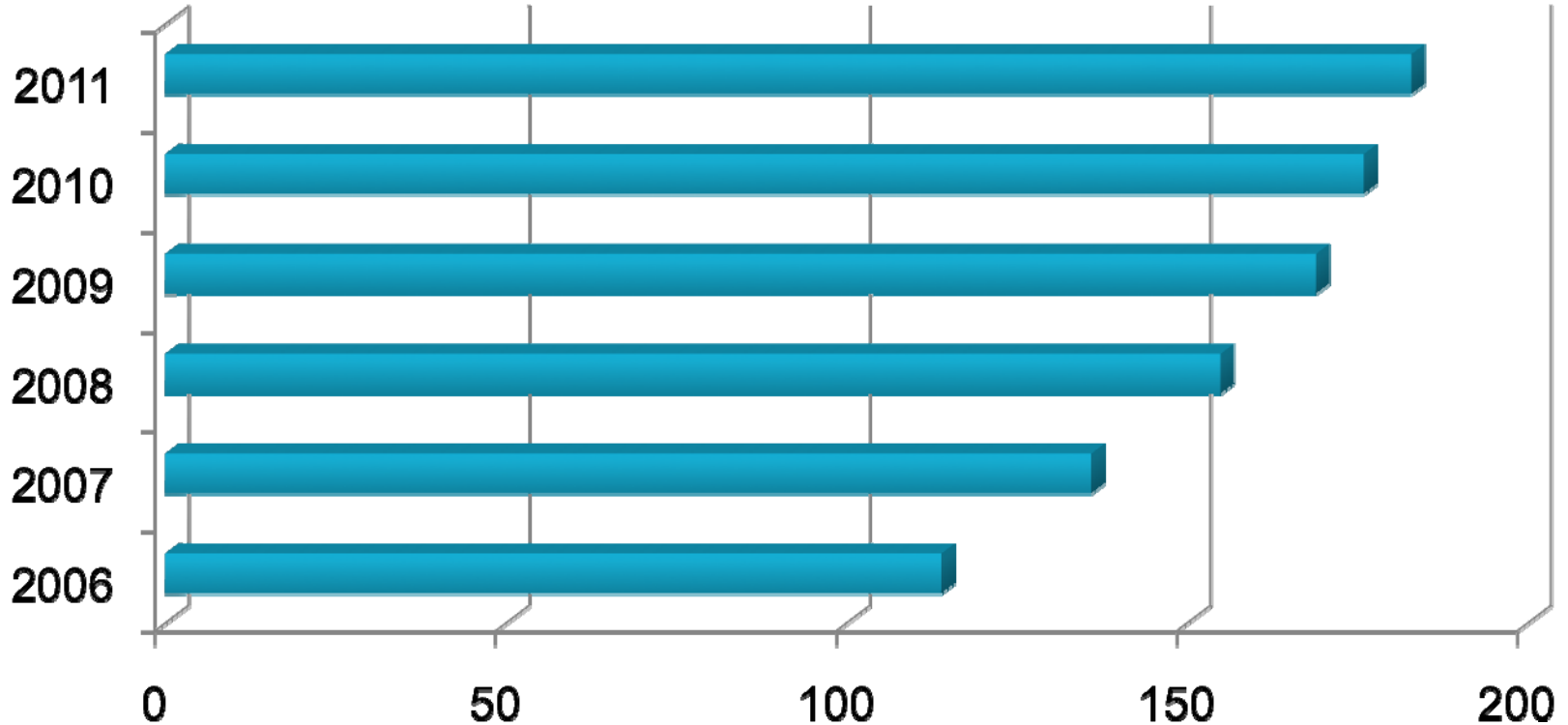


- On-Net Market with Metro Fiber Network
 - On-Net Market
 - Multiple 1 or 2 Metro Routes
 - Longhaul Network
- European network includes wavelength capacity.

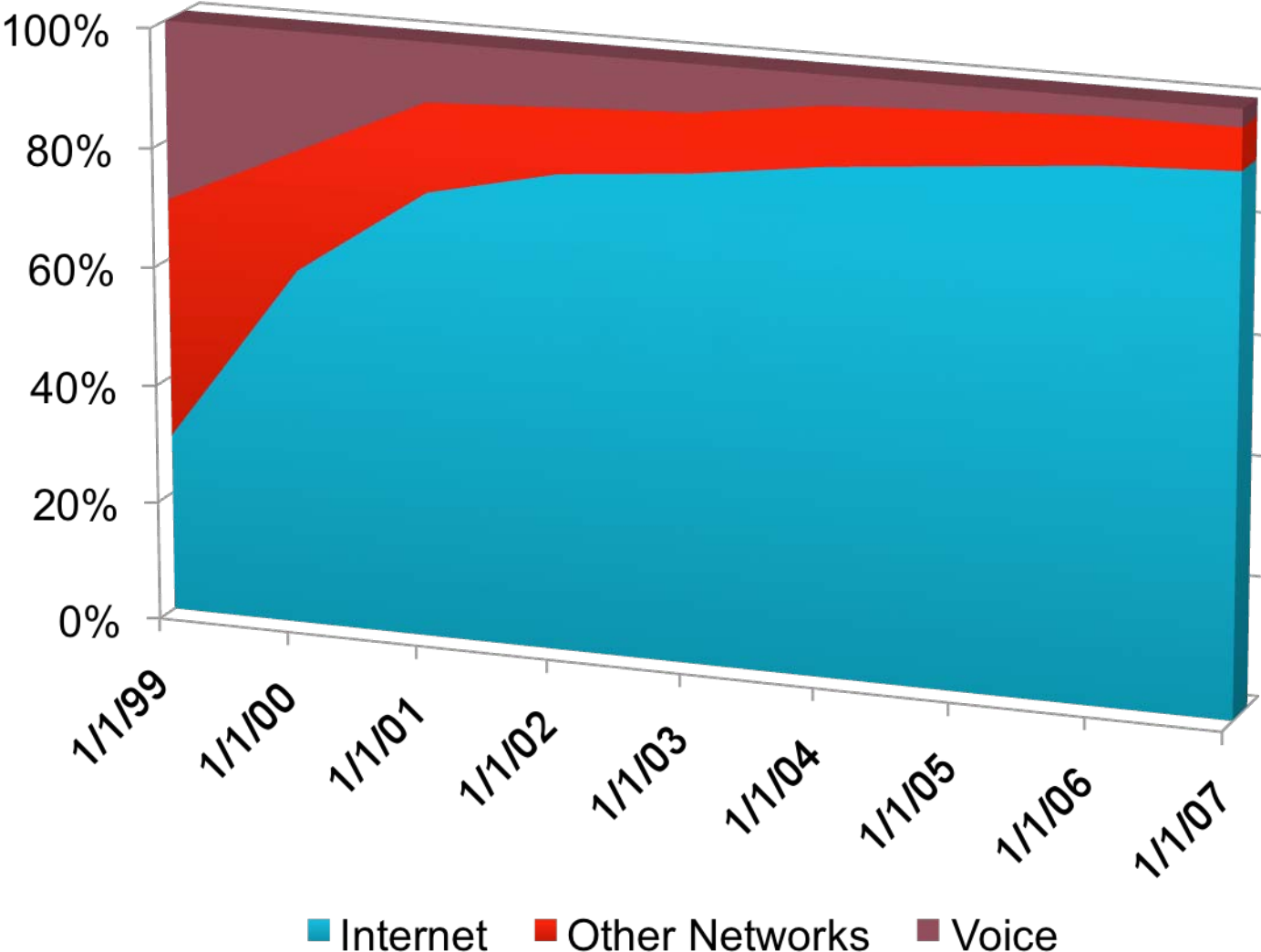
But video drives the traffic

- Video files 1,000s of times larger
- Despite recent growth penetration is still small compared to TV

US Online video viewers

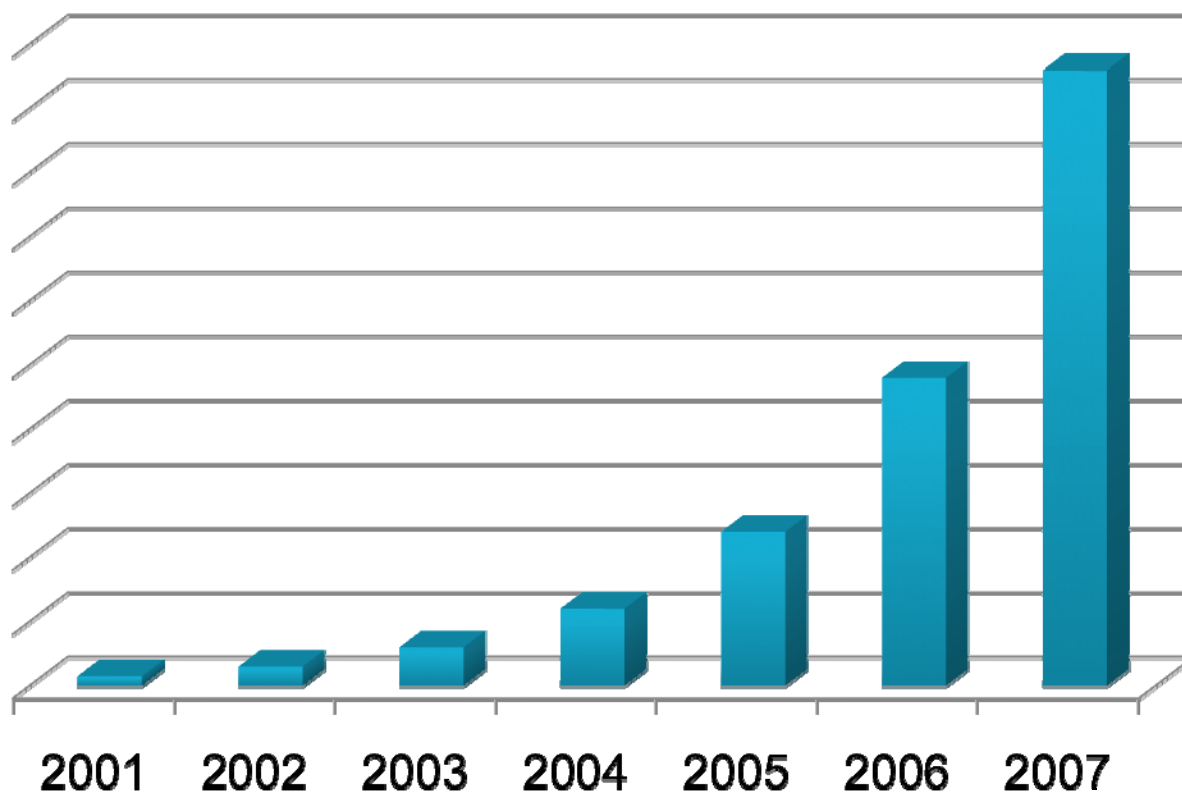


Internet is network of choice



Level 3 IP network growth

■ ~ 100% per annum, NOT ~70% per annum



- ⌘ The Internet, and IP network, grows massively
- ⌘ Video is the payload that drives most of that demand
- ⌘ What are the key elements for distributing video over the Internet?

Key elements that drive cost and must scale

Operations (OPEX)

- Optimal deployment of operational resources.

CPU

- CPU resources drive the speed at which content can be distributed.

Storage

- Storage allows providers to carry the widest breadth of digital content.

Space/Power

- Access to a nationally distributed set of space and power resources ensures that distribution can scale to meet demand.

Bandwidth

- A nationwide network of significant reach allow content to reach the widest possible audience

Implications for network planning

Parts of the network scale differently

Scenario	Low	Medium	High
IP Core Scale	4.5x	14.2x	80x
DWDM scale	2.7x	6.7x	30x
Power scale	1.8x	5x	26x

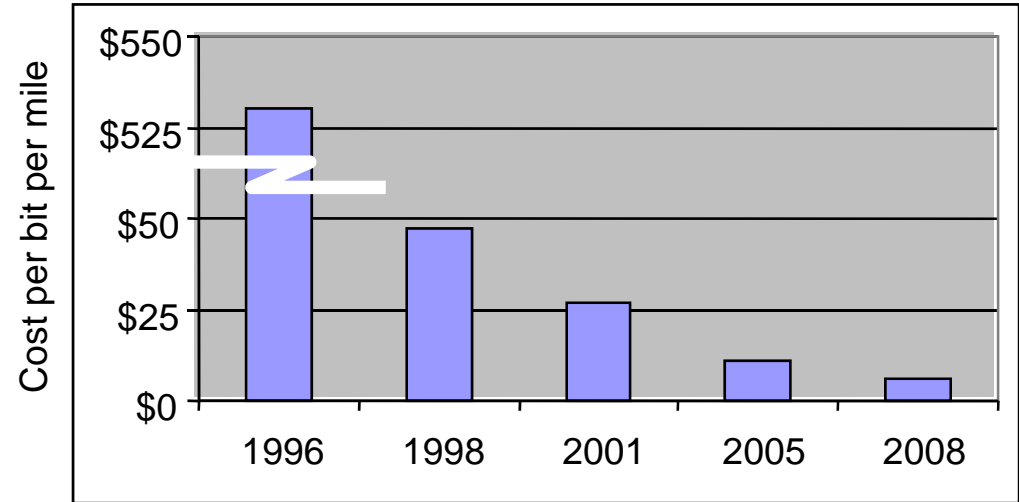
5 year scaling requirements

- ❖ Key impacts
 - ❖ Scale
 - ❖ Economics
 - ❖ Infrastructure
 - ❖ Power

- ❖ Medium and high growth lead to problems due to scale
 - ❖ For example under high growth our busiest route will need > 800 10Gbps segments
 - ❖ Load balancing IP across that many interfaces becomes impossible
 - ❖ Physical space for cross connects
 - ❖ Opex required for implementation and churn
 - ❖ Our largest customers already connect to us through multiple 10GE ports – they want a simpler architecture
 - ❖ 40GE and 100GE ports are necessary
 - ❖ Bigger OSXs are needed

- ❖ New technologies continuously lower the cost of transporting bits but when can you justify the change?
- ❖ Need the volume to justify a change
- ❖ Or you stay on the older technology for longer

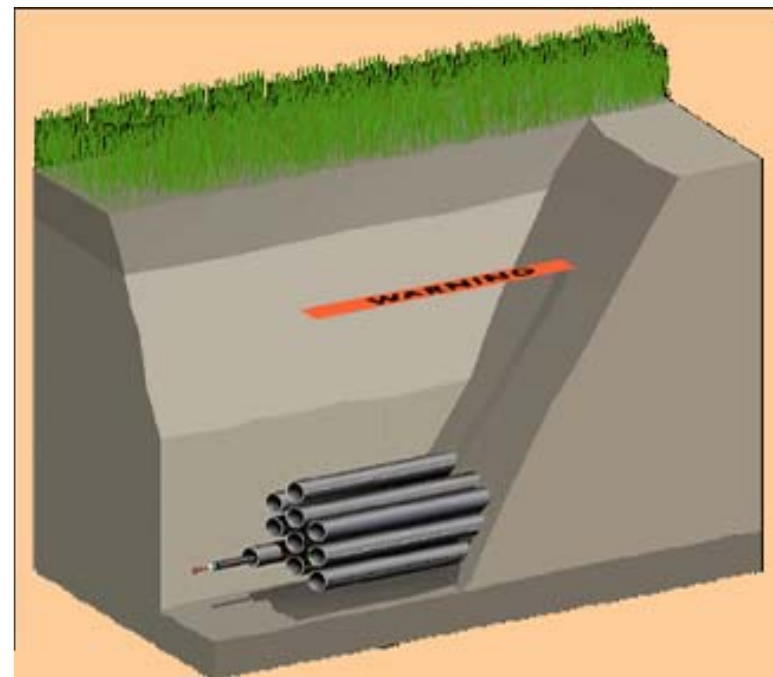
Optical Network Cost Trends



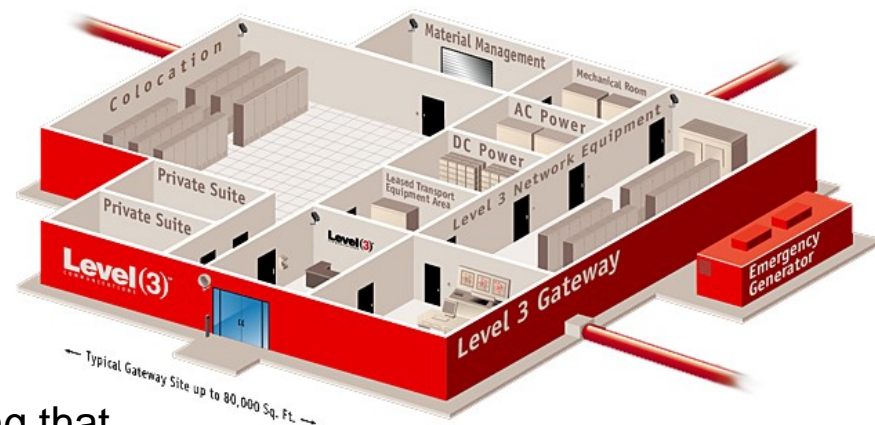
Digital Optical Networking

A simpler, more flexible approach for optical networks, whereby Photonic Integrated Circuit technology makes pervasive digital functionality economical, and reverses the industry's recent "analog optical" trend.

- ❖ As the network grows so does consumption of fibre and duct
- ❖ In our high growth scenario the optical network needs to be 30x bigger than today
 - ❖ Do you have the fibre,
 - ❖ colocation or
 - ❖ running line space?
- ❖ You can trade off fibre consumption with higher speed DWDM systems, but ...
 - ❖ They cost more per carried bit,
 - ❖ they consume more power

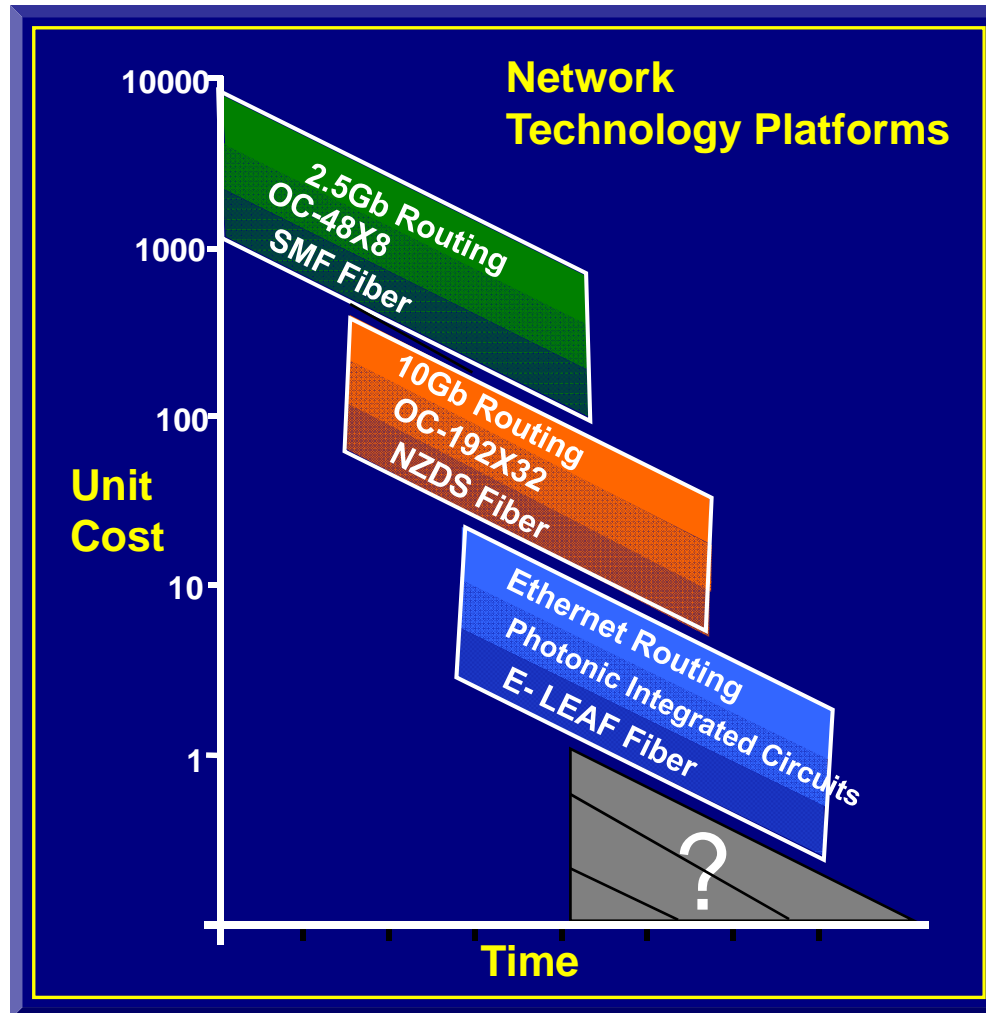


- ❑ Power & cooling may be biggest obstacle for growth
- ❑ Newer generation cost efficiencies derived partly from
 - Faster CPUs
 - Higher density circuitry
- ❑ But that means
 - Higher power consumption
 - Greater cooling infrastructure
- ❑ Is your power plant capable of supplying that
 - Is your utility supplier capable of bringing it in from the street
- ❑ Can your chiller plant deal with the extra load?
- ❑ You could mitigate chiller upgrades by increasing equipment spacing
 - If you have the space

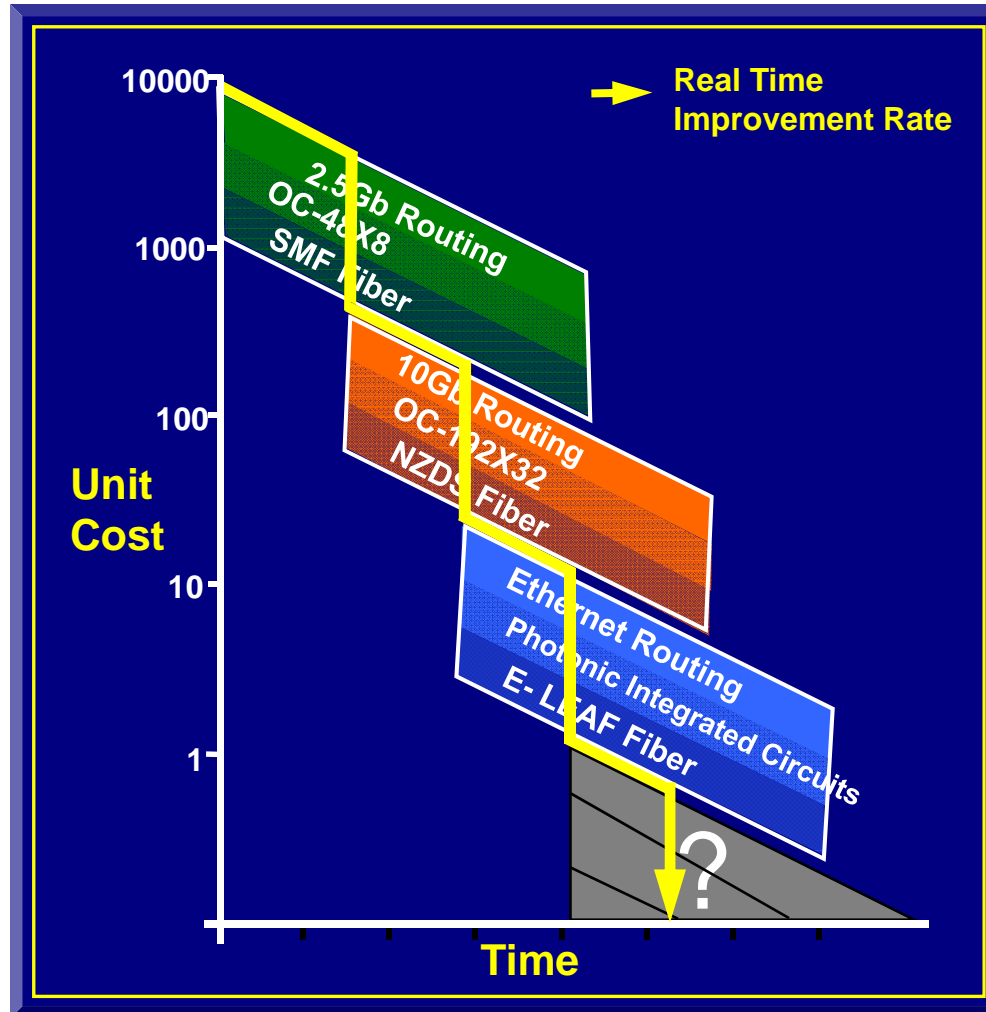


Level 3's experience to date

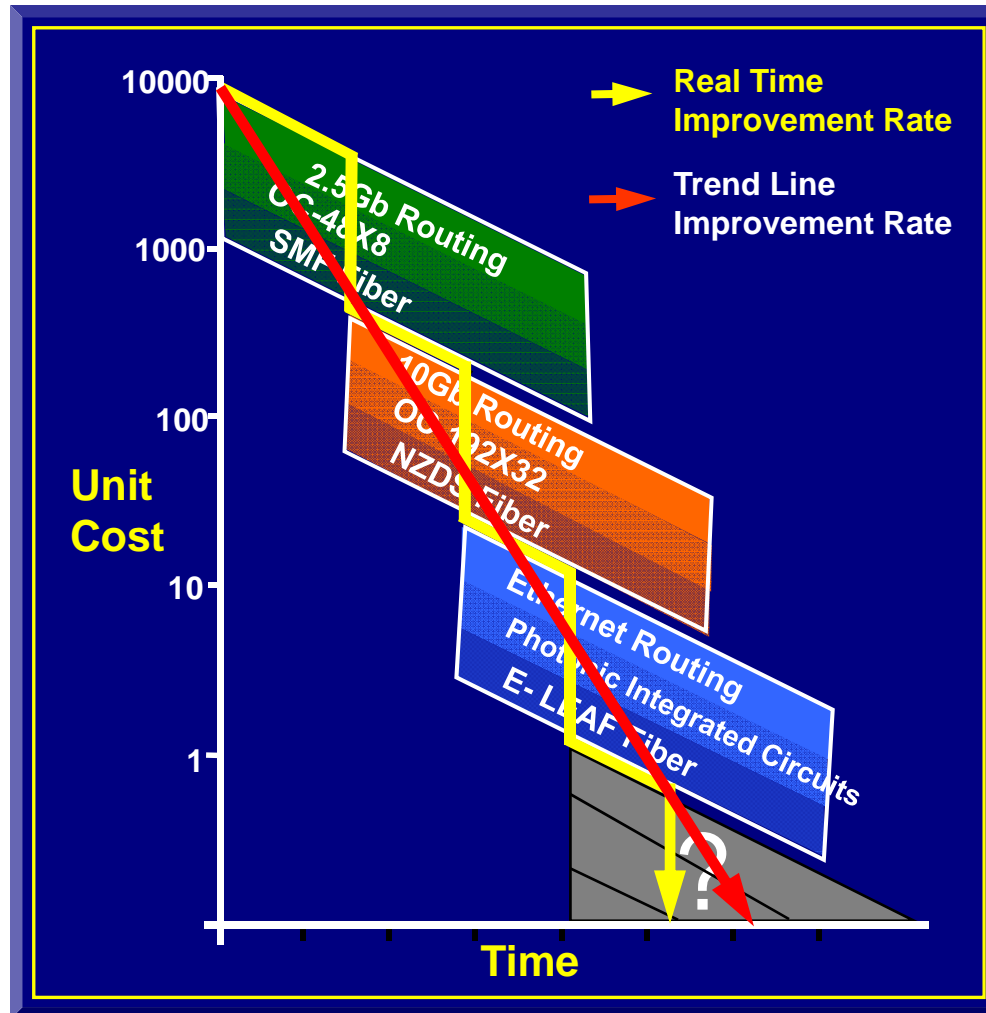
Price Performance Improvements Are Not Smooth And Predictable



Price Performance Improvements Are Not Smooth And Predictable

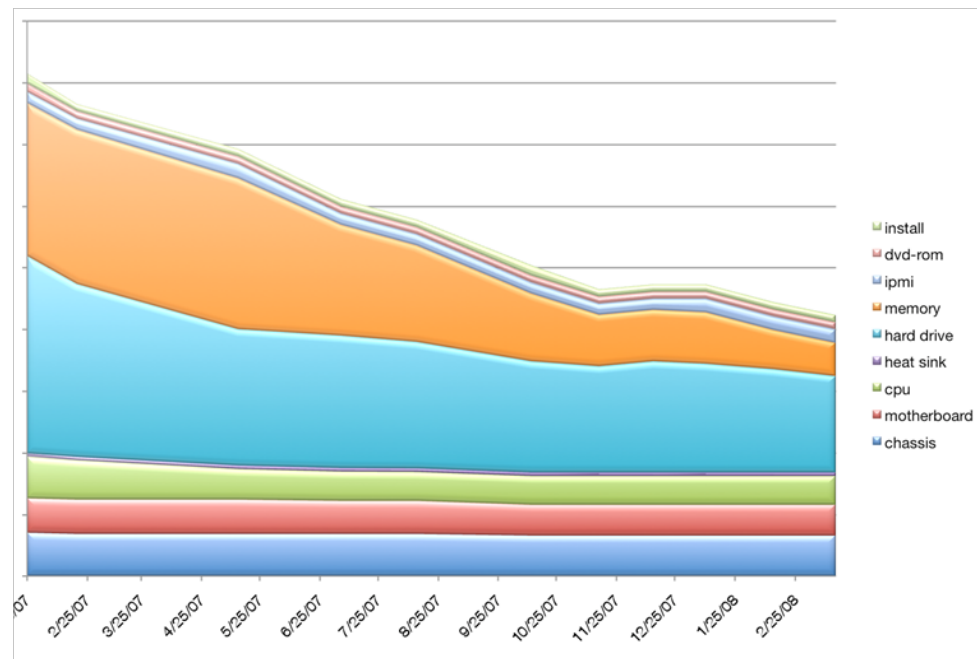


Price Performance Improvements Are Not Smooth And Predictable



- ❑ Commodity elements
- ❑ Don't buy too much ...
- ❑ Utilization has massive impact
- ❑ Power
- ❑ Opensource file management

14 month reduction in server cost



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 **hadoop**

Summary

- ⌘ Media is converging with networks ... fast
- ⌘ Being able to scale with ever lower unit costs is difficult ... but necessary
- ⌘ Why should telco's care?

“What is the advantage for Content Distributor Networks like Level 3? As broadband ... achieves critical mass, its value as a distribution technology is starting to rival ... that of the traditional [television] network ... The value-add is two-way interactivity and ... consumer relationship marketing opportunities ... When you add video capability to this high-speed, two-way network, you start to see the foundation for a new generation of networked television technologies.”

Shelly Palmer, author Television Disrupted.