NPI Subcommittee on Communications

Subcommittee Chair:
Steve Grubb
Infinera
Optical Communications Policy Working Group

- Steve Grubb, Infinera, Subcommittee Chair
- Tom Hausken, OSA-OIDA Liaison

- Companies represented on Committee:
  - AT&T, Corning, Finisar, IBM, Infinera, Google, Verizon, Alcatel-Lucent, Aurrion, BlueLine Global Partners, One Chip Photonics, Lightwave Advisors, OpSIS
- Universities: Univ. of Arizona, UCSB, USC
Economic Impact Examples

• Photonics technology is the cornerstone of the US Information based economy

• Nearly 500,000 jobs lost in Photonics since the collapse of the Telecom bubble (CATO Institute)

• **Photonics Jobs are highly leveraged**
  – Only 2% of all public companies are photonics companies
    • But contribute >10% of all US public company revenues
    • And 6% of all public company jobs
Role(s) of Photonics in Enabling Competitiveness

- Optical Communications technology has enabled the 100X increase in capacity over the past decade
- Continued innovations are needed to maintain exponential growth and drive the information based US economy
- US based Trusted sources desired to counter Cybersecurity threats
Performance and Technology Barriers

- Simultaneous advances needed in data rate, cost, power
- Needed to drive the next 100X in capacity
- Opportunities in Photonic Integration, Advanced Optical Manufacturing and Packaging, Nanophotonics
Other Barriers to Competitiveness

- Unfair trade practices
- Violation of Intellectual Property
- Disintegration of supply infrastructure
- Lack of new supply of qualified optical graduates, academic brain drain
Key Recommendations

1. Increased U.S. government agency investment in R&D is needed to enable and accelerate commercialization of solutions, for use in the U.S. infrastructure and abroad, and to pre-empt other countries from dominating the technology to the exclusion of the U.S.

2. U.S. government agencies should ensure that fair trade practices are upheld and intellectual property is protected in the telecommunications equipment market.

3. U.S. government agencies should invest in companies and facilities to assure trusted sources ("safe provenance") of specific equipment and components for their own future equipment needs.

4. The U.S. government and state governments should increase funding for trade school education in optics, and U.S. immigration policy and R&D investment should be oriented to attract and retain leading researchers in the U.S.
NPI Subcommittee on Communications

Industry Representative:
Joe Berthold
Ciena
Optical Communications

The continuing need - low cost at great scale

Joseph Berthold
Vice President, Network Architecture
Office of the CTO

February 28, 2013
## Key Takeaways

1. Internet Growth – driven by network economics
2. Optical communications technology generations – how did we get here?
3. Challenges ahead – approaching limits of current technologies
4. Terabits ahead – the long and short stories
5. Direction forward
Industry Achievement
Greater than 1000X cost reduction over the last 20 years

Backbone DWDM per-bit, per-km cost improvements over time

Source: Ovum
Technology Evolution - Major Leaps Forward
Exploiting new technologies as we approached practical limitations
Coherent Optics By Analogy
The latest generation of optical transmission technology

Non-Coherent Optics

Morse Code:
- Power (on/off) carries info.
- Dumb receiver.

Coherent Optics

Digital Radio:
- Amplitude & phase carry info.
- Tunable receiver. Digital enhancements.
How many more can we fit in the window?
The optical amplifier window is getting pretty full!
Scaling Optical Channel Capacity Beyond 100G
Three dimensional optimization for cost and spectral efficiency

- Increasing symbol rate
- Increasing bits per symbol
- Increasing the number of carriers
Terabits – Short and Long Distance Implications

We met the 100 Gbps challenge – 10X fiber capacity increase over 10 Gbps!

100 Gbps DWDM channels are entering large scale deployment

Our next factor of 10 of network capacity scaling is ready to be shipped

How about the next step, to 400 Gbps or 1 Tbps optical channels?

→ Short distances – data center interconnect, fiber access networks
  → If there is no need to share the fiber – life is good!
  → Significant investments will be needed to achieve attractive costs

→ Long distances - scaling continental scale fiber link capacity by 4X or 10X?
  → We don’t know how to achieve this in an economic way
  → What happens if cost/unit bandwidth improvements slow?
Technology for a Parallel World
Focus on low cost photonic integration technology

Silicon Photonics
Ride the silicon investment coat-tails

Integration of silicon with optical sources

- Field ripe for innovation
- Integration technology
- Packaging technology
- Manufacturing technology

300 mm (12 inch) silicon wafer

It’s not only about processors and memory!
- Optical communications
  - Birthday cards
Thank you