The Evolution of a Transport Network

Presented by:

Comcast

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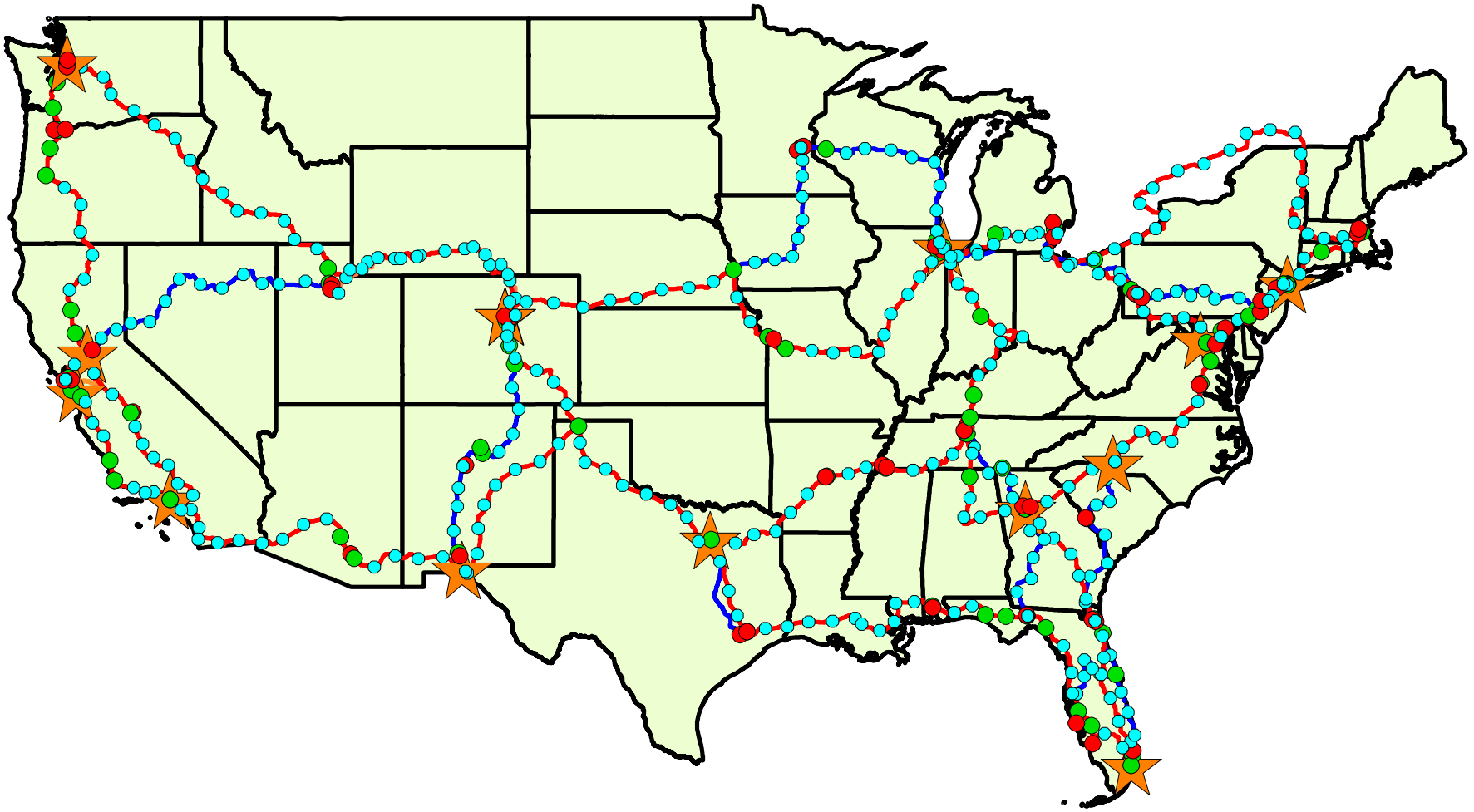
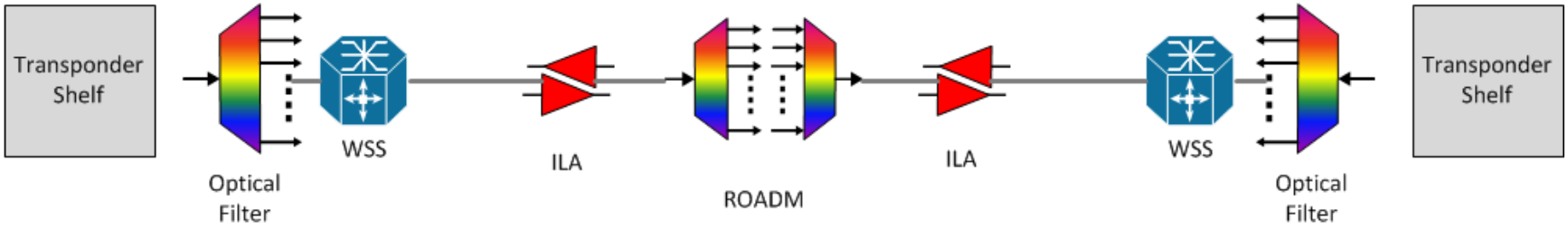
Today's national backbone network – 2013

- Over 58,000 km of fiber
- Colocation
  - Over 450 physical sites
- Equipment
  - Over 1200 transponder and photonic shelves
- Wavelengths breakout
  - Core is Nx100G
  - Minimal 40G on Edge for Metro & Access
  - Small amount of Intra-RAN links still Nx10G

How did we get here?



Quick DWDM Overview



- WSS – Wavelength Selectable Switch
- ILA – In-Line Amplifier Site
- ROADM – Reconfigurable Optical Add-Drop Mux

Background

- Goal: National network to support Comcast traffic
  - Data
  - Video
  - Voice

- Reach: Traffic sources and destinations
  - Regional networks spread across the continental US
  - Internal and external partners

The Start of an Idea: 2003-2004

- Vendor Selection Process
  - Fiber
    - E-LEAF/NDSF/TrueWave Classic/SMF-28
  - Equipment
    - Nortel (now Ciena)
      - CPL (Common Photonic Layer)
        - » In-line Amplifier, ROADM
      - OME6500 (Optical Multiservice Edge)
        - » Transponder
    - Dispersion compensating transponders vs. non-compensating transponders

Time to deploy: 2004-2005

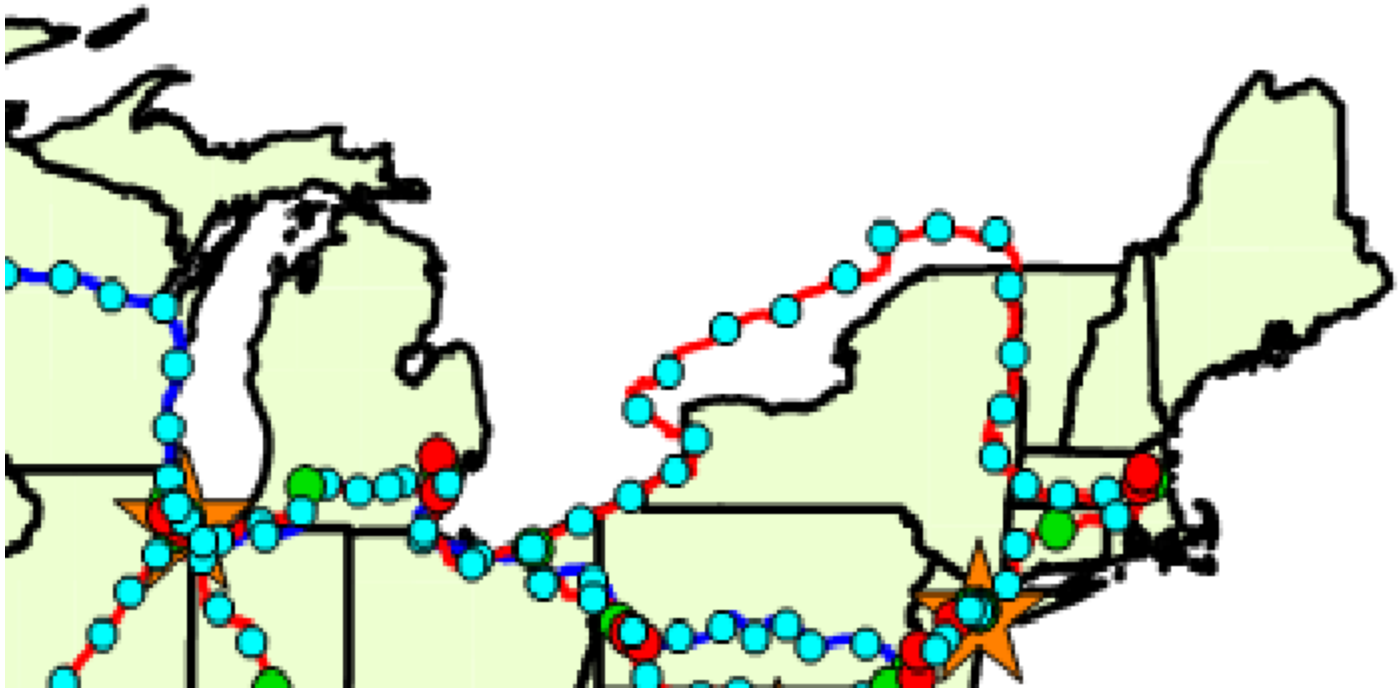
- Over 30,000 km of fiber to start
  - Multiple Long Haul fiber providers as well as internal fiber
- Colocation
  - Over 450 physical sites
    - 3rd Party: Gateways, Amp sites, ROADM
    - Comcast: Regional Touch Points
    - Carrier Neutral: Edge Touch Points
- Equipment
  - 400+ Photonic Shelves and 100+ Transponder Shelves

Fire it up: 2005-2006

- Initial deployment
  - 2x10G Core to Core links
  - 1x10G Core to RAN Links

- Growth
  - 2x10G grows to 4x10G with 8x10G projected

Growth and the need for 40G



Design Considerations: 2005-2006

- Built with DSCM's and dispersion compensating electronics
  - DSCM's didn't allow max potential reach of the transponders
- Built with C/L Band splitters to "future proof"
  - L Band never materialized
- Additional future-proofing plans were made
  - Raman amplified spans were selected

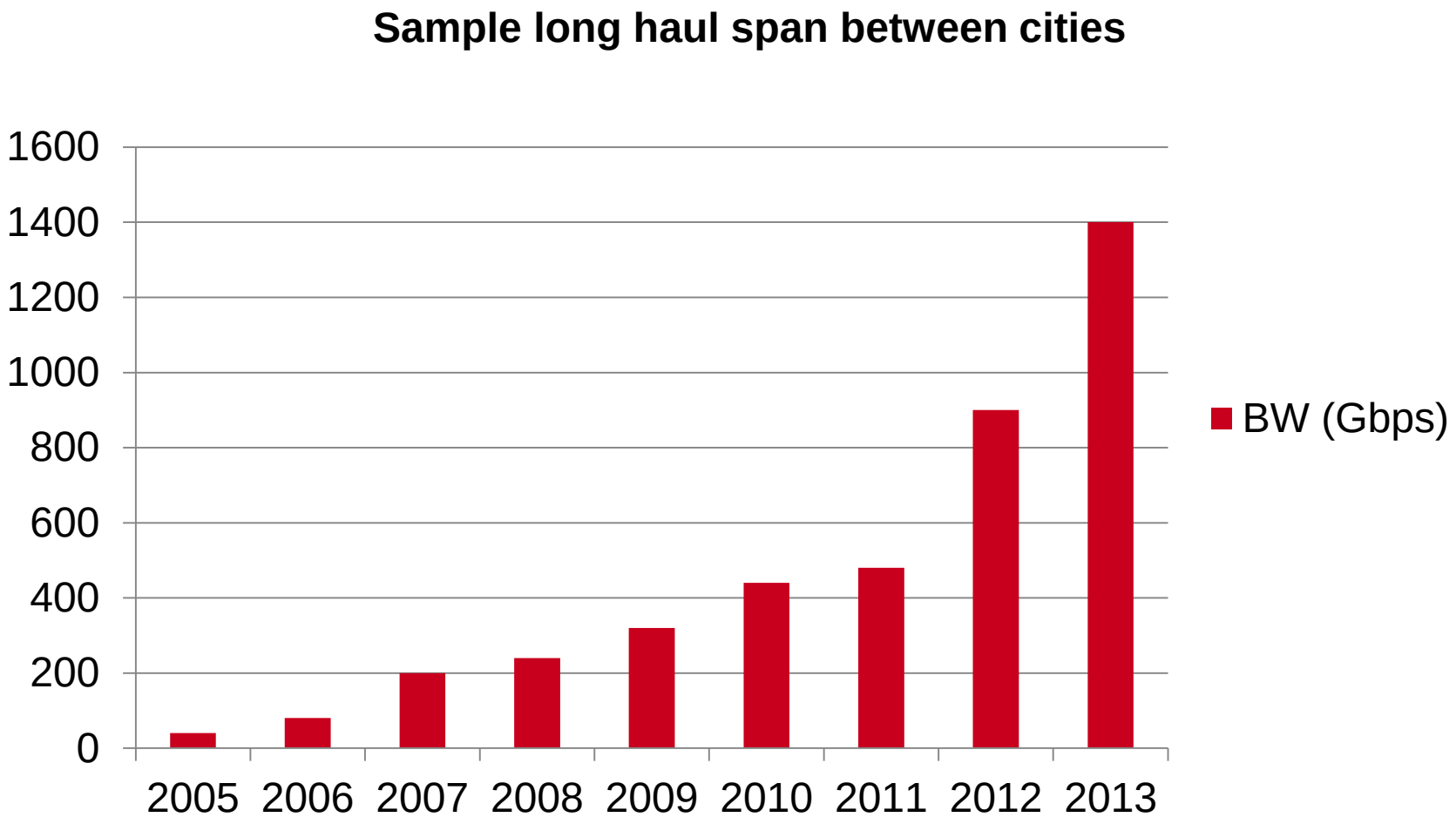
Never stop moving: 2006-2009

- 2006 sees the start of the evolution
  - Core to Core goes Nx40G (OC768)
  - Core to RAN stays Nx10G
- Raman is introduced into the network on select spans
- Introduced “Integrated DWDM Optics” (on the router card) into the network
- 100G trial on production network – March 2008

Design Considerations: 2006-2009

- Integrated Optics
  - Reach
  - Dependency on Dispersion Compensation
- Deploying 40G on a network optimized for 10G
  - 40G Transponder solution arrives 2008
  - Improved reach, fewer regens
  - Differential provisioning
- YoY BW growth
  - Pushing to the edge of technological capabilities
  - 100G is a must for our future
  - Network preparation needed to allow for 100G

The Need for 100G



Clean-up: 2010-2012

- Remove DSCM's (Dispersion Compensation Modules)
  - 2 Year Project

- More Migration
  - Core to Core goes to 100G (2012)
  - Core to RAN goes to 40G

- Thin OADM (TOADM) to ROADM
  - 2 Year Project

Design Considerations: 2010-2012

- Database Replication Service (DBRS)
  - OSPF used for inter-shelf topology awareness, but Network is growing too large for a single OSPF area
- 100G improves reach with the help of RAMAN
- Network gets optimized for 40G and 100G
  - Some 10G still present in network
- Preparation for 100G required on going maintenance on the production network

Present Day: 2013

- TOADM to ROADM at the edge

- Migration continues
  - Continued upgrades of Nx100G Core to Core
  - Core to RAN goes to Nx100G

- Network expansion
  - New routes, new vendors, new builds, new partnerships

The Future: 2014 and beyond

- All RANs go Nx100G
- 400G/1T
  - Looking for it now
- Colorless/Directionless
- Expanded reach
  - New fiber allowing fewer amp sites
  - Submarine type abilities for a terrestrial application?

Thank You