



NAOPpag Monthly Meeting Agenda & Notes

BlueJeans Meeting ID: 720160650

Attendees: Marc Wallman, Wm Deigaard, Harvey Newman, Jim Stewart

Staff Attendees: Linda Roos, Chris Wilkinson, Kathleen Kay, Rob Vietzke, George Loftus, John Moore

Unable to Attend: Michele Norin, James Deaton, Celeste Anderson, Roy Campbell, Dee Childs, Wendy Huntoon, Rod Wilson

3/14/18

Due to light attendance, postponing discussion until April Meeting.

Request for update on Cloud Connect

Wm- How are people architecting campus border walls? Haven't heard much talk about this. Would be interesting session in prep for the shift.

Harvey- very interested in this. Would like to know how all fits together-feels campus people have little knowledge of what's really going on.

Good discussion for GS18- Rob interested in sharing Wm's Rice story.

1. Welcome (Marc Wallman)
2. Strategic topics:
 - Internet2 optical network planning (Chris Wilkinson, Internet2 Director of Network Engineering and Planning)
 - Chris will provide background on the current optical platform and plans for the future. There will be ample time for discussion. His slides begin on page 2.
3. Internet2 update
4. NAOPpag standing agenda items
5. Next meeting: April 11
 - planning for open and closed NAOPpag meetings at the Global Summit
 - Closed Meeting at GS: Monday, May 7, 7:30am
 - Open Meeting at GS: Monday, May 7, 8:45am

INFRASTRUCTURE UPGRADE PLANNING

INTRODUCTION OF OPTICAL UPGRADE SUBPROJECT DISCUSSION

DRAFT FOR NAOP DISCUSSION
March 14, 2018



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Infrastructure Upgrade Program Background

- When Internet2 accepted BTOP funds in 2010, we set in place a infrastructure replacement cycle that would look at routers/switches in 2018/19 and optical gear in 2020/21
- Since that time, two factors have changed our thinking about that timing:
 - Community input and ecosystem-wide planning effort recommending a longer term and more comprehensive view of our services driven by the router/switch layer. (Selecting and designing that layer requires more time.)
 - Changes in technology of optical and router/switch platforms that are likely to require an “open optical” line system –before- the most efficient service & router/switch platform can be tested, selected & deployed.
- With NAOP input, we are now contemplating beginning the optical platform review and upgrade first, with the router/switch and services layer to follow.



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Why moving the optical upgrade to the front of the larger program now makes sense

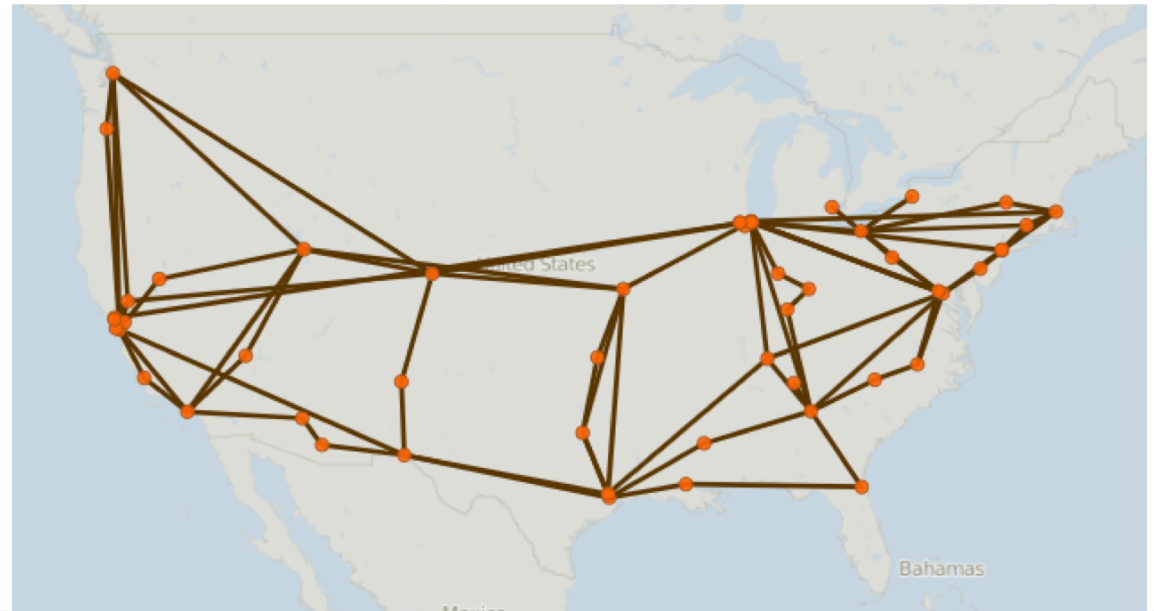
- Optical layer is the building block for Internet2/ESnet/CENIC and other partner efforts
- Introduction of open line system support, colorless (100g+) wavelengths are important for community infrastructure sharing and new technology implementation
- There are over 85 optical add-drop sites, so this is potentially the largest number of sites requiring work, potentially requiring more time for upgrades. Getting it complete enables other timelines.



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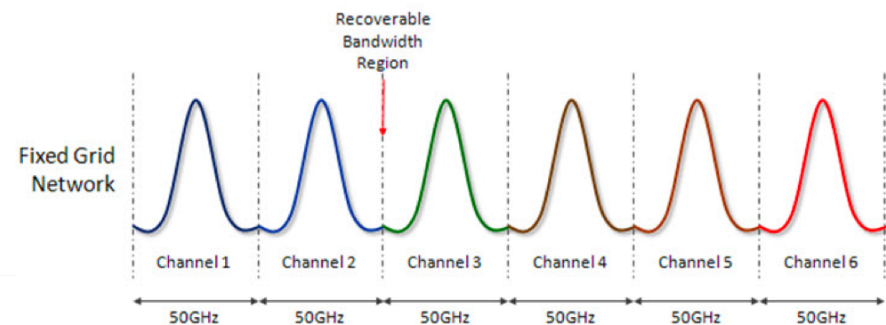
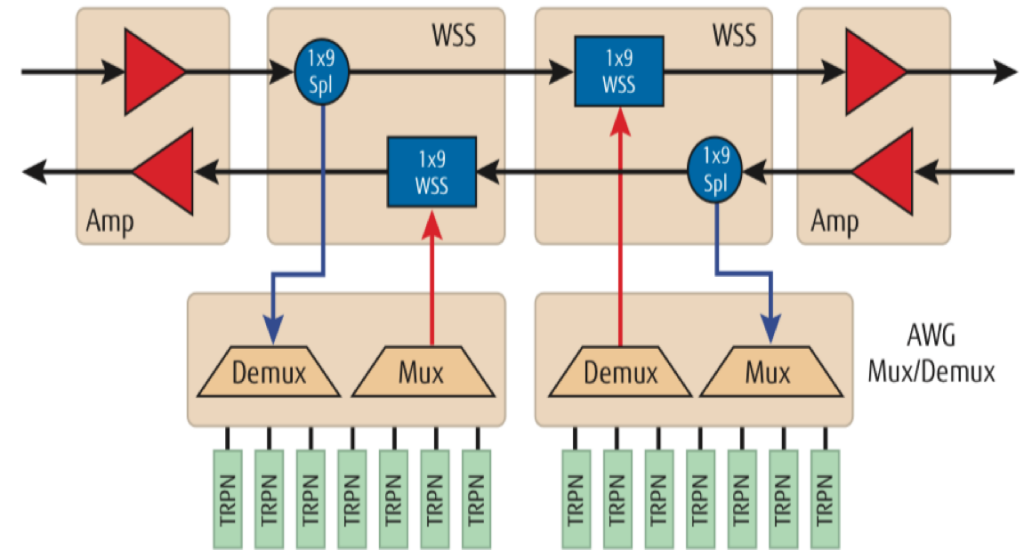
Internet2 Optical Transport (AL1S) Services:

- Shared Infrastructure Platform
 - ESnet
 - CENIC/PWNGP
- Internet2 Backbone
 - Backbone Circuits
 - Backhaul
 - Other Member
 - NOAA / PAC-12 / ETC.
- Currently:
 - 85 add-drop
 - 320 amp sites



Internet2 Optical Transport (AL1S), Key Facts:

- Fully operational in Late 2012
- Traditional Fixed Grid 50 GHz System
 - Directional ROADMs
 - Passive Filters
 - Active configurable MUX/DeMUX (WSS)
- “Fixed Grid” means each optical channel is 50 GHz wide, whereas new 200G, 400G technologies will require 75 GHz or 100 GHz

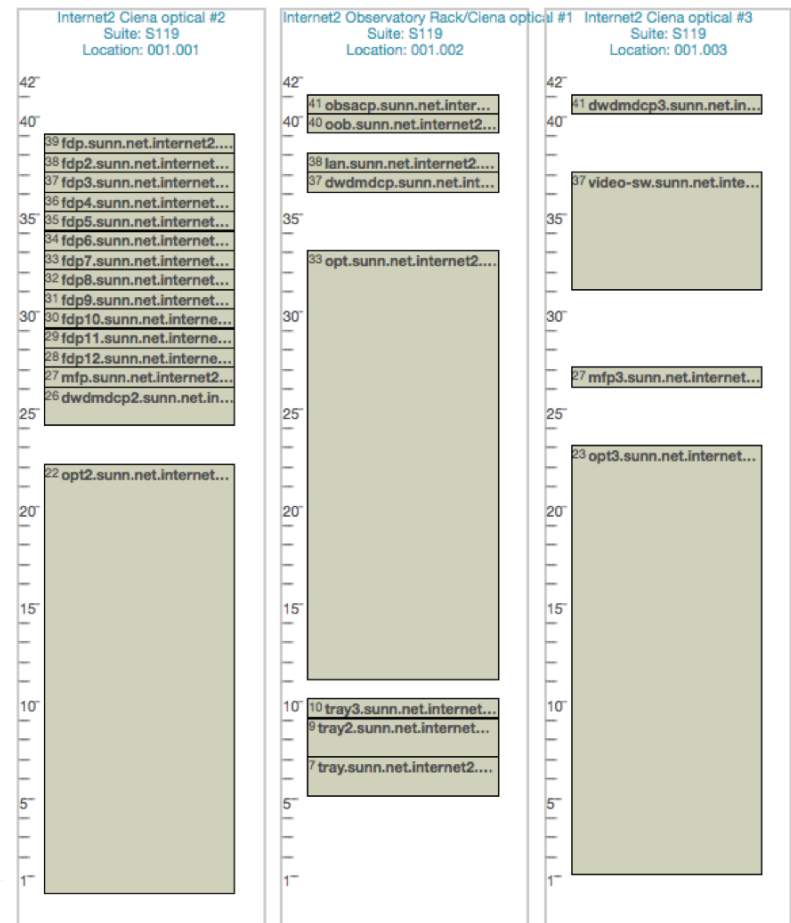


Internet2 Optical Transport (AL1S), Emerging Requirements:

- Community and Partners:
 - Infrastructure Sharing / Foreign Wave Support
 - 100 G / 200 G / 400 G / + Support
 - Automation
- Internet2:
 - Disaggregation of WSS and Amplification Platform from Transmission Elements
 - Colorless – Support for 100 G / 200 G / 400 G wavelength types
 - Contentionless
 - Possibly Directionless where it makes sense
 - Automation

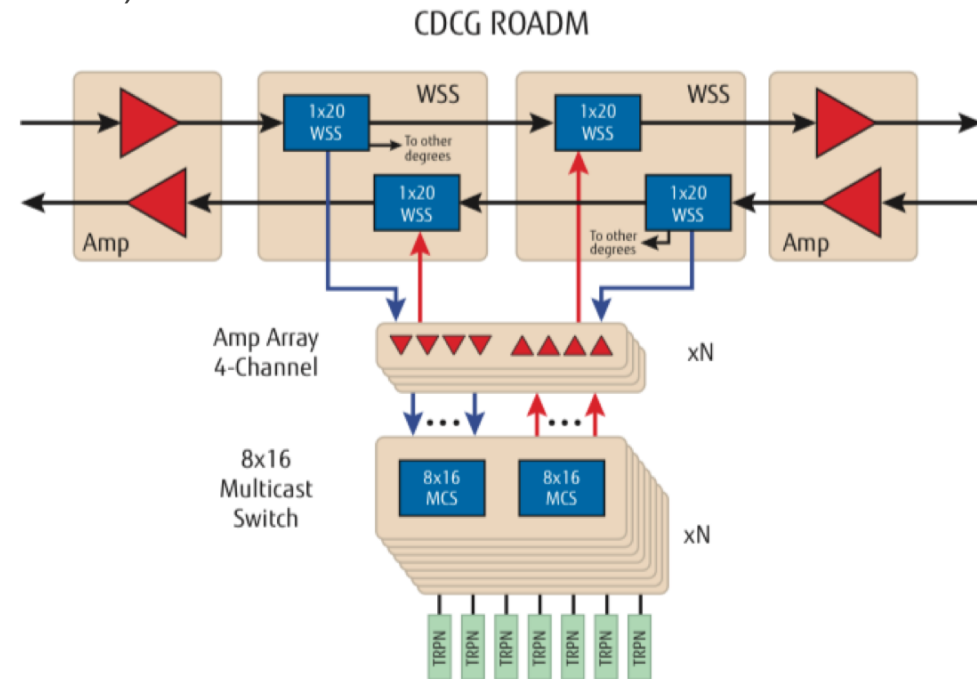
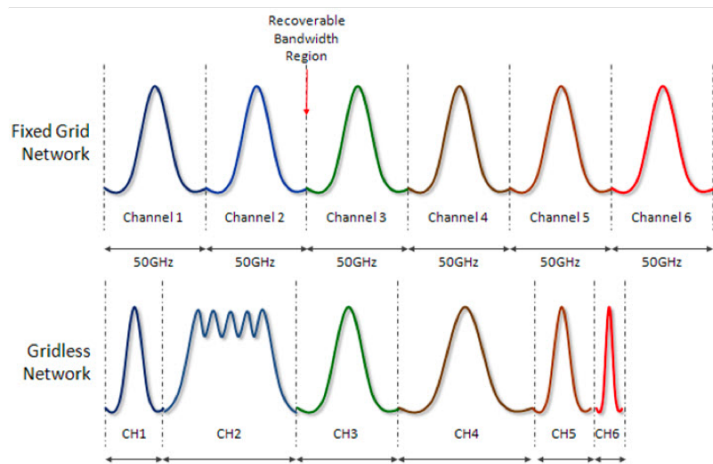
Internet2 Optical Transport (AL1S), Known Challenges:

- Lack of support for 400G and above
- Proprietary Software Stack
- Manual Provisioning
- **Large Footprint / Power Utilization**
- **Maintenance costs on older gear**
- Wavelength Contention in Dense Metro



Internet2 Optical Transport (AL1S), One Possible Future Evolution:

- FSS (Flexible Spectrum Switch, FlexGrid WSS)
 - variable channel spacing
 - maximum spectral efficiency



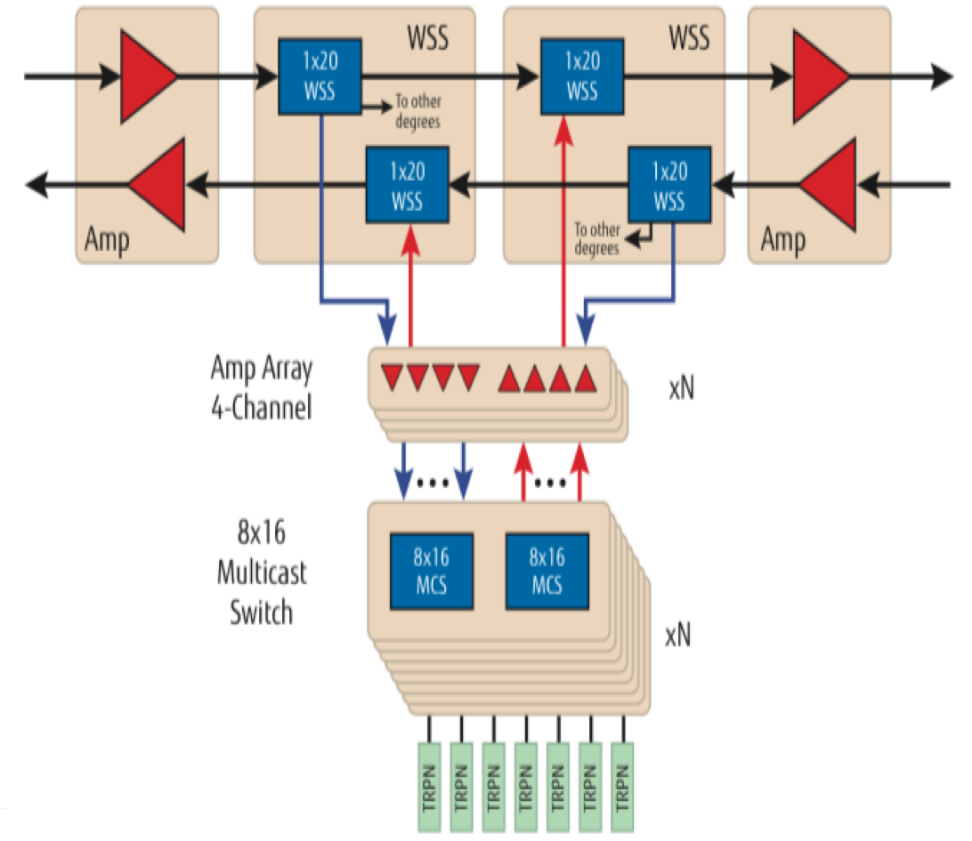
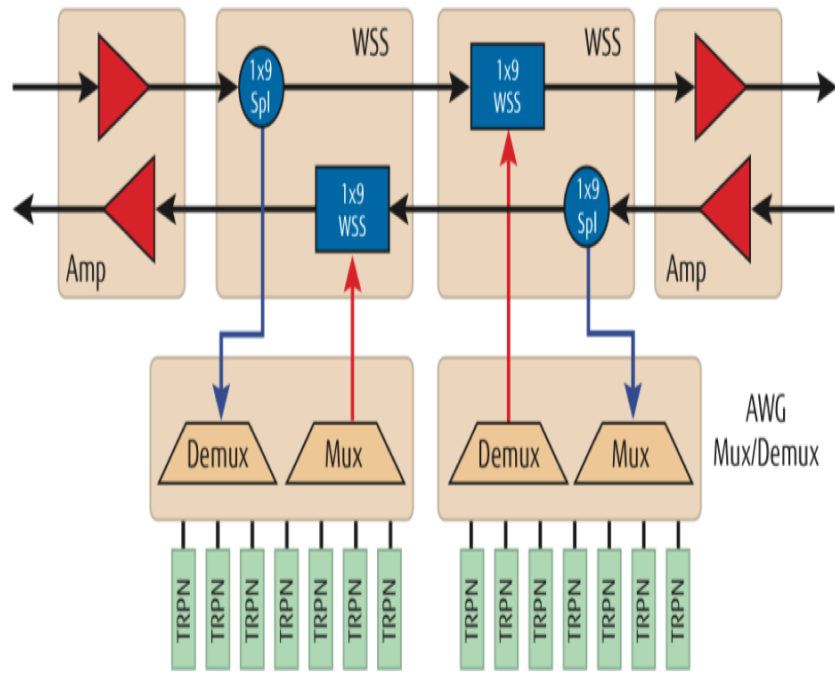
Internet2 Optical Transport (AL1S), Near Term Roadmap

- Proactive software update cycle to preposition for new hardware families/functionalities
- Increase modeling and planning to better understand the network
- Initial implementation of "FlexGrid" technology due to benefits in space and energy efficiency
 - Apply to new add-drops, metro expansions (Sunnyvale, possibly New York & Los Angeles)
 - Gain valuable experience!

Internet2 Optical Transport (AL1S), Planning for 2019

- Market Survey / RFP
 - Ciena should be best positioned to maintain their role, but it is possible that a competitor could dislodge them
 - Full Footprint
 - Vendor Neutral Technology review
 - Open ROADM Software Stack
 - Foreign Wave / Infrastructure Sharing
 - Gridless / Colorless Technology (400G and beyond)
 - Contentionless and Directionless where appropriate
 - Total cost of operations, including space, power consumption, maintenance costs

What this looks like in the hardware (software is another story):



Other Activities to be addressed

- Northern Tier Path
 - Can we find an affordable opportunity to finally bring the Northern Tier path into the national architecture?
- Metro and Cloud Connect Augmentations
 - Sunnyvale is underway as a 2018 project
 - New York, Los Angeles, Dallas to be studied as well

Potential Next Steps:

- NAOP Feedback
- NTAC Feedback
- ESnet and CENIC Feedback

- Development of the Market Survey
- Board budget submission for placeholder for 2019 capex submitted in July

- Issuing and management of the Market Survey, With Community Participants

- If all this goes well
- Implementation Planning