sanet.
Slovak academic network

100G NREN Backbone

Marian Ďurkovič
Network Architect

About SANET

- National research & education network in Slovakia
- Established as non-profit association in 1991
- Connecting universities, schools, research institutes, etc. to pan-European GÉANT network and global Internet
- Based on dark-fibre infrastructure since 2002
- 36 POPs in Slovakia
- Cross-border fibres to neighbour NRENs
  - ACONET, CESNET, PIONIER

sanet.
Slovak academic network

Project Objectives

- Researchers need 10 Gb/s for several applications
- Overprovisioned backbone is clearly the best solution
- Start with 2 x 100 Gb/s today
- Provide clear path towards terabit speeds in the future
- Use state-of-the-art technology
- Create robust and resilient network
- **K**eep **I**t **S**imple & **S**traightforward !

SANET - Slovak Academic Network

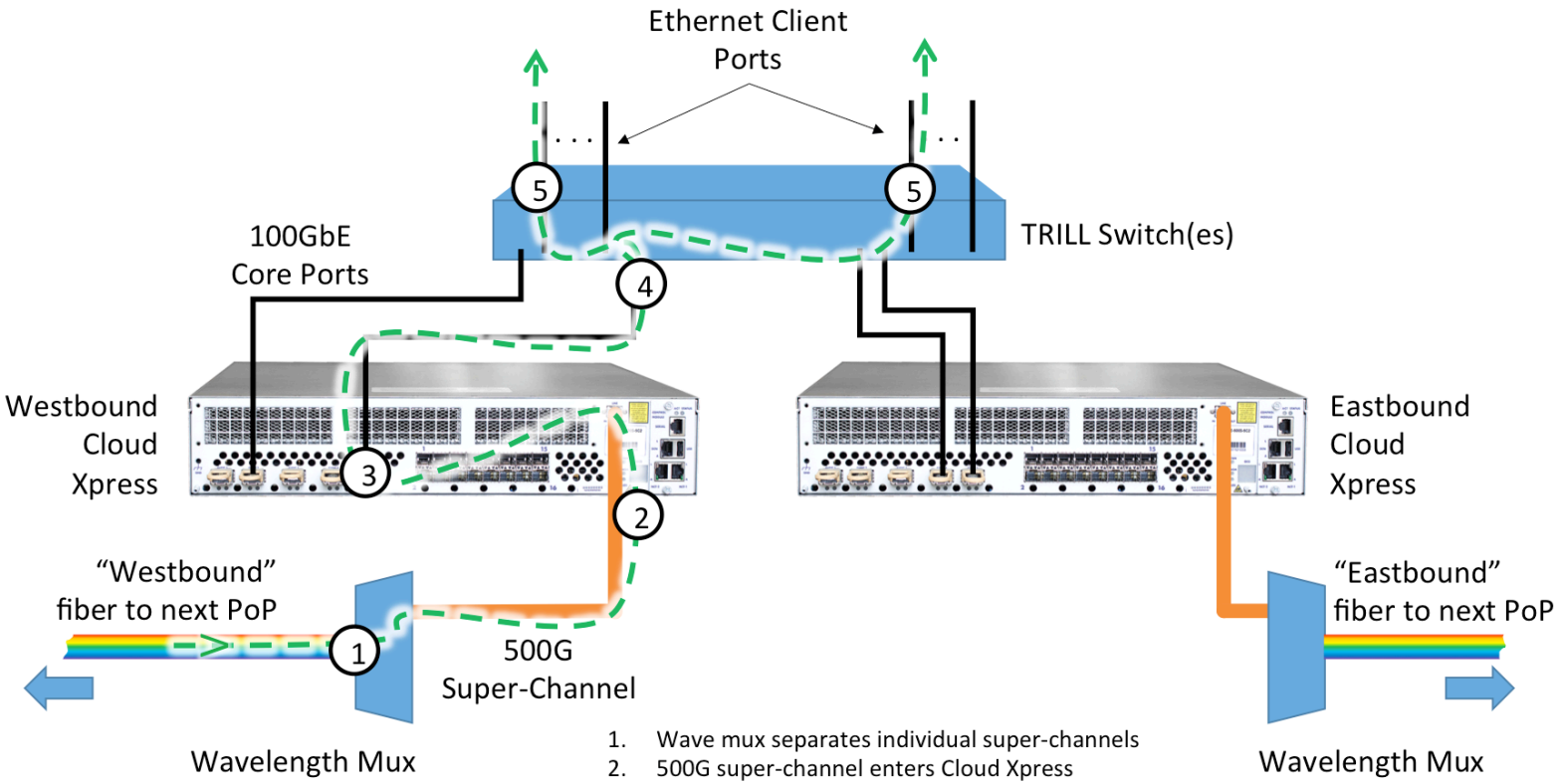
sanet.
Slovak academic network

Backbone Technology

- Based on cloud-scale equipment
- Specialized hardware with optimized functionality
  - Ethernet everywhere
  - No legacy interfaces or protocols
- Building blocks:
  - PtP DWDM system supporting 500 Gb/s superchannels
  - TRILL switches (3.2 Tb/s forwarding capacity)
- Compact size, green IT solution

sanet.
Slovak academic network

Network POP Design



1. Wave mux separates individual super-channels
2. 500G super-channel enters Cloud Xpress
3. Cloud Xpress extracts a specific 100GbE stream
4. 100GbE enters TRILL Switch
5. TRILL switch will forward packet data to client port(s)

sanet.
Slovak academic network

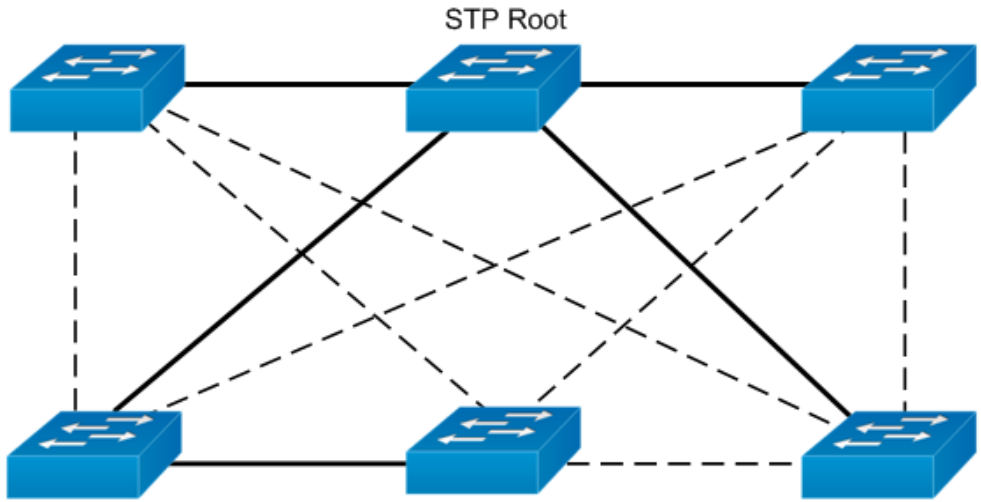
CloudXpress Advantage

- Extremely easy to setup & bring live
  - Much less optical patching needed
  - Link up in just a few minutes
- QSFP28 tributary ports
  - DAC cables could be used for 100GE connections
- Management via CLI, SSH, SNMP and NETCONF
  - The same UIs that routers & switches use
  - Easy integration into fully automated environment
- Instant bandwidth
  - HW ready for future demands

sanet.
Slovak academic network

Protocol Innovation

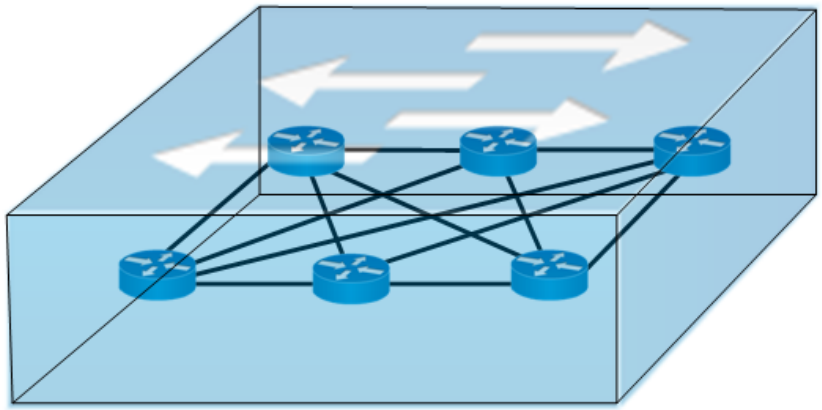
- Ethernet networks typically use Spanning-tree protocol
  - Forms a simple tree by blocking all redundant links
  - Protocol failure leads to network meltdown
  - Legacy approach, hardly usable in backbone today



sanet.
Slovak academic network

Protocol Innovation (2)

- We decided to use TRILL instead:
  - Brings well-known IP routing principles to ethernet
  - Natively uses all available links (including parallel paths)
  - Dynamic routing via shortest path by IS-IS protocol
  - Much less complexity and lower costs than MPLS
  - External devices just see a huge ethernet switch



sanet.
Slovak academic network

Our Terabit POP

- This is 22RU high rack
  - 6RU for network equipment
  - 6RU for UPS + batteries
  - 10RU still free
- Power consumption ~1 kW

sanet.
Slovak academic network

Overall Experience

- Clear separation of tasks between devices
  - No task duplicated at multiple OSI layers
- Much simpler configuration at all levels
  - Large portion of former router config was deleted
- Easy to understand for people operating the network
- Fast reconvergence in case of e.g. fibre cut
- Network in production & stable for ~6 months

sanet.
Slovak academic network

Future Plans

- Extend coverage of 100G backbone to more POPs
  - Deliver 100G services to additional users
  - Improve network resilience
- Activate more 100 Gb/s channels as needed
  - Done by SW licenses (not necessary to install new HW)
- Replace legacy routers by cloud-scale devices
  - 48 x 10GE + 6 x 100GE in 1U pizza box

sanet.
Slovak academic network

Conclusions

- Innovation driven by the cloud sector brings disruptive change to traditional network design
- Cost of 100GE coming down to levels acceptable for massive deployment
- Very good environment for new ideas & concepts
- Remember the KISS principle

sanet.
Slovak academic network

Questions?