100G NREN Backbone

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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
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
• Keep It Simple & Straightforward!
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
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)
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
• 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
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
Our Terabit POP

- This is 22RU high rack
  - 6RU for network equipment
  - 6RU for UPS + batteries
  - 10RU still free

- Power consumption ~1 kW
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
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
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
Questions?