Challenges in the last mile
1st E2E Workshop - Establishing Lightpaths
Kurosh Bozorgebrahimi, UNINETT
Agenda

- UNINETTs Network topology
- Relationships with infrastructure owner and our Network business model.
- e2e provisioning process
- Challenges in the last miles
Norway in a nutshell

- ~4.5 mill inhabitants, scattered populated
- Many mountains and fjords
- Coastline of 25 148 km
  - ~62% of the length of the equator
- Shortest distance south to north: 1 752 km
  - approx 3 days by car
  - If we turn Norway upside down Spitsbergen will almost reach Africa.
- Only two owners of national fiber infrastructure...
**UNINETT: IP Topology**

- High capacity, open and resilient network.
- IPv6 and multicast enabled
- Nationwide network covers a wide area from \(N58^\circ\) to the \(N79^\circ\)
  - Probably Internets northernmost PoP at \(N79^\circ\)
- More than 70 locations
hybrid networking in UNINETT

- Agreement with BaneTele (infrastructure owner) consist of:
  - Cost based upgrade option in existing IRU-agreement
  - BaneTele and UNINETT share the DWDM resources
  - UNINETT buy and own the initial DWDM deployment
  - BaneTele make the installations, Equipment commissioning, Operations, Maintenance and equipment housing.

- Solution includes:
  - Lambdas provided for BaneTele as Operations & Maintenance, equipment housing
  - UNINETT’s use the coast optical path between Trondheim and Tromsø.

- Access to 4500km of Installed DWDM path
- With planned installations will UNINETT be able to access more than 7000km of DWDM path at the end of 2009.
  - Amsterdam-Rome is about 1650km
Shared Network Model

why?

- Lack of competition between fiber infrastructure owners
- Long distances and scattered populations
- We could never be able to build and support 7000km of DWDM path by ourselves.
- All other operators are in the same situation, and they have to cooperate in order to have a countrywide network.
Provisioning process

1. Receiving a application
2. Is applicant qualified?
   - No
   - Yes
   - Dedicated or IP connectivity?
     - Dedicated
     - IP connectivity
3. Is there any DWDM node close to the CE?
   - Yes
   - No
4. Is DWDM resource available?
   - No
   - Yes
5. Is there any available fiber access?
   - Yes
   - No
6. Is fiber access the only access medium of choice?
   - Yes
   - No
7. Analyzing which access technology is the most future proof and cost effective. (Radio access, Copper access or fiber)
   - Fiber
   - Radio
   - Copper
   - e.g. DSL lease
8. Get necessary resource available.
   - No
   - Yes
9. Implementation
   - Reject

Analyze whether CWDM, laying new cable or leasing can solve the problem or not.
Pricing model

- There are two different pricing model based on customer categories
- Universities and university colleges (Public)
  - UNINETT receives a certain amount of founding to build, maintenance and support the transport network for universities and university colleges.
  - Each of these organizations pay a annual service fee which is decided by government and depends on organizations size.
- Others
  - There is only a annual service fee for this group.
  - Annual service fee for this group will be decided in the beginning of year and will be based on 95% of the top capacity usage for the year before.
- Each R&E organization have at least one access point to our network.
  - 1Mbit/s to 10Mbit/s
  - Most common capacity are 100Mbit/s and 1Gbit/s
Pricing model, challenges

- The pricing model is build on IP connectivity sort of connections.
- With adding optical layer to the network architecture will new services emerge.
  - We are still working to find a good pricing model for services build over optical domain.
Access Network from an incumbents point of view

Layer 2/3 devices
DSLAM
OLT
P2P Tx/Rx
DWDM (OADM)

Copper based access
Remote DSLAM
PON systems
P2P systems

Fiber based access
OLT
OADM

Wireless access
Others: Cable TV (DOCSIS) and satellite
Copper
Fiber
Access Network from UNINETTs point of view

Copper and TP based access
Fiber based access
Wireless access

In main nodes some CE and PE is collocated
Access challenges

- We are facing to major obstacles
  1. Lack of fiber
     - solution:
       - CWDM
       - More fiber
       - Use alternative transport medium if possible
         - Offered capacity size is the major factor
  2. Long distance between PE and CE
     - solution:
       - Establishing a new PoP near Customer
         - If there are any growth opportunity in the new area.
       - Using long reach SFPs
  3. And sometimes a combination of both 1 and 2
Alien Wavelength and monitoring
Issue regarding 10GbE access

- Alien wavelength is an attractive alternative solution to the traditionally 3R devices (transponders).
  - Cheaper (CAPEX saving)
  - Fewer devices and spares (OPEX saving)
- Transponders have an important role not only as a 3R device but also as wavelength monitoring tools.
- When we replace the transponders with 3rd party colored interface we have to make sure to take over both the 3R functionalities and the monitoring functionalities.
- Colored interface’s monitoring capability is a key issue.
A step toward automatic provisioning?

- Using a integrated ROADM device should be the solution for the most networks.

- The challenge is enabling automatic provisioning when the Operations and maintenance (O&M) of DWDM part of network are outsourced.

- A solution could be to divide the management domain of DWDM from the wavelength switch part.
Thanks for your attentions.

kurosh@uninett.no