

From zero to automation

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NORLYS

Who is Norlys?

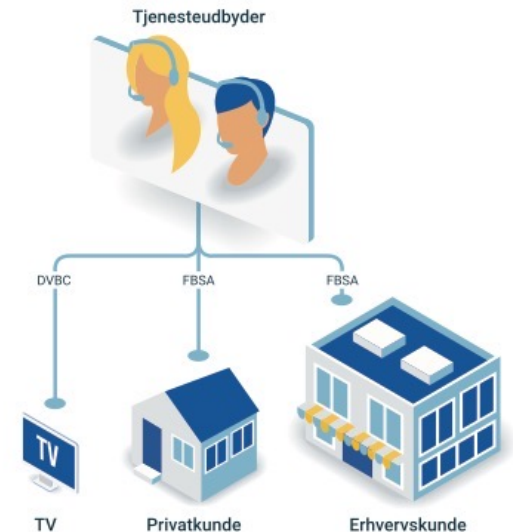
- Merger of Eniig and Sydennergi in 2019
- Largest FTTH provider in Denmark (750.000+ HP)
- Second largest DOCSIS provider in Denmark
- Service provider and infrastructure owner
- Power utility business known as N1
- Network operator for several networks
- Several requirements from KFST for approval of the merger
- Focus of this presentation is the enabling of the network for wholesale – the original Eniig network was already open



Opennet

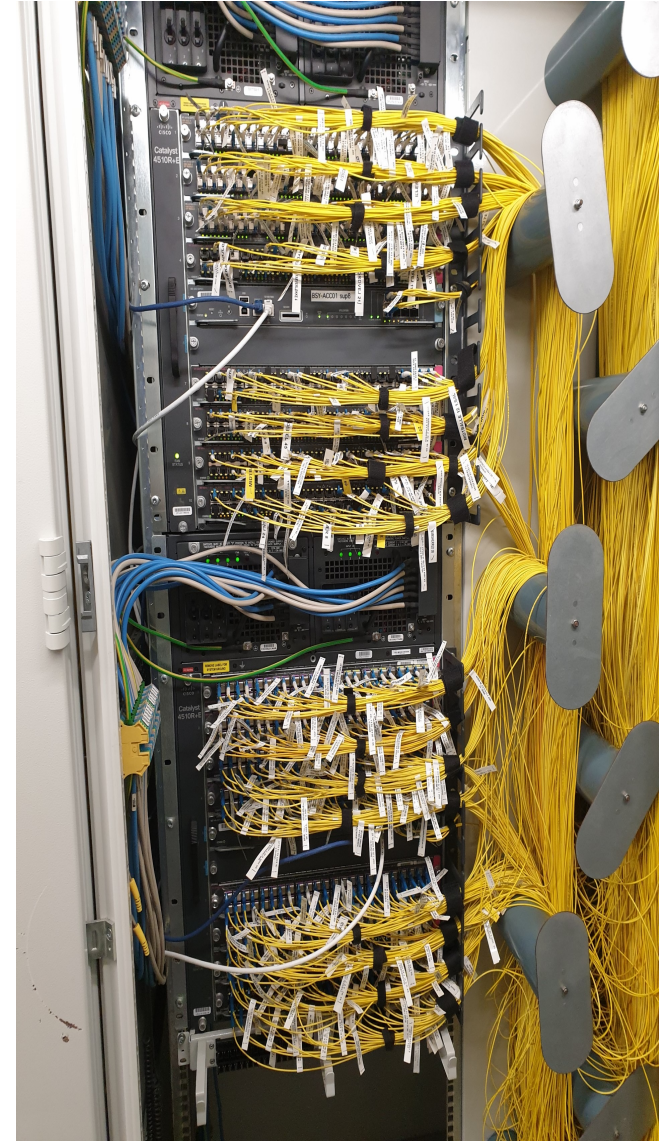


- Opennet is a broker platform for ISP wholesale
- Offers a common API for serviceproviders to order across multiple infrastructure owners
- 8 infrastructure owners
- 10+ serviceproviders onboarded
- H1: Residential and SMB (speeds up to 1G, limited SLA)
- H2: Business (Speeds up to 10G, additional QoS and SLA)
- H3: CATV



Norlys network – early 2020

- Access network, Cisco 4500 in 10G rings
- Configs mainly based on template files – copy and paste
- IP addresses in Excel and several IPAM systems
- Allocation of addresses – manual process
- Day 0 config through laptop and console cable
- Routers deployed with factory installed software, then upgrade
- OOB network only in some locations
- No common inventory of networks assets
- New network architecture designed during DOCSIS DAA rollout



The Great Plan

- Deploy in 270 locations, in 10 months
- Green field deployment
- Create one blueprint – use everywhere
- PON instead of PtP – align across footprint
- PE routers in all locations – needed for EVPN
- 100G between sites – reduce size of rings
- Automate as much as possible
- OOB network
- Not all PoP build by same standards (power etc)
- Use of external field techs – different skillsets

How to get there?

- Re-use overall network design from DAA network (DOCSIS 3.1 rollout)
- Re-use OOB network design
- Deploy Netbox as SSOT – both for active and passive components
- Automatic config for routers and switches
- Configs build based on templates and data from netbox
- All site data/config generated by scripts/tools
- Provide serial numbers, PoP+rack and type of power – everything is generated
- Rack drawing and cable plans supplied to field techs



Use of netbox

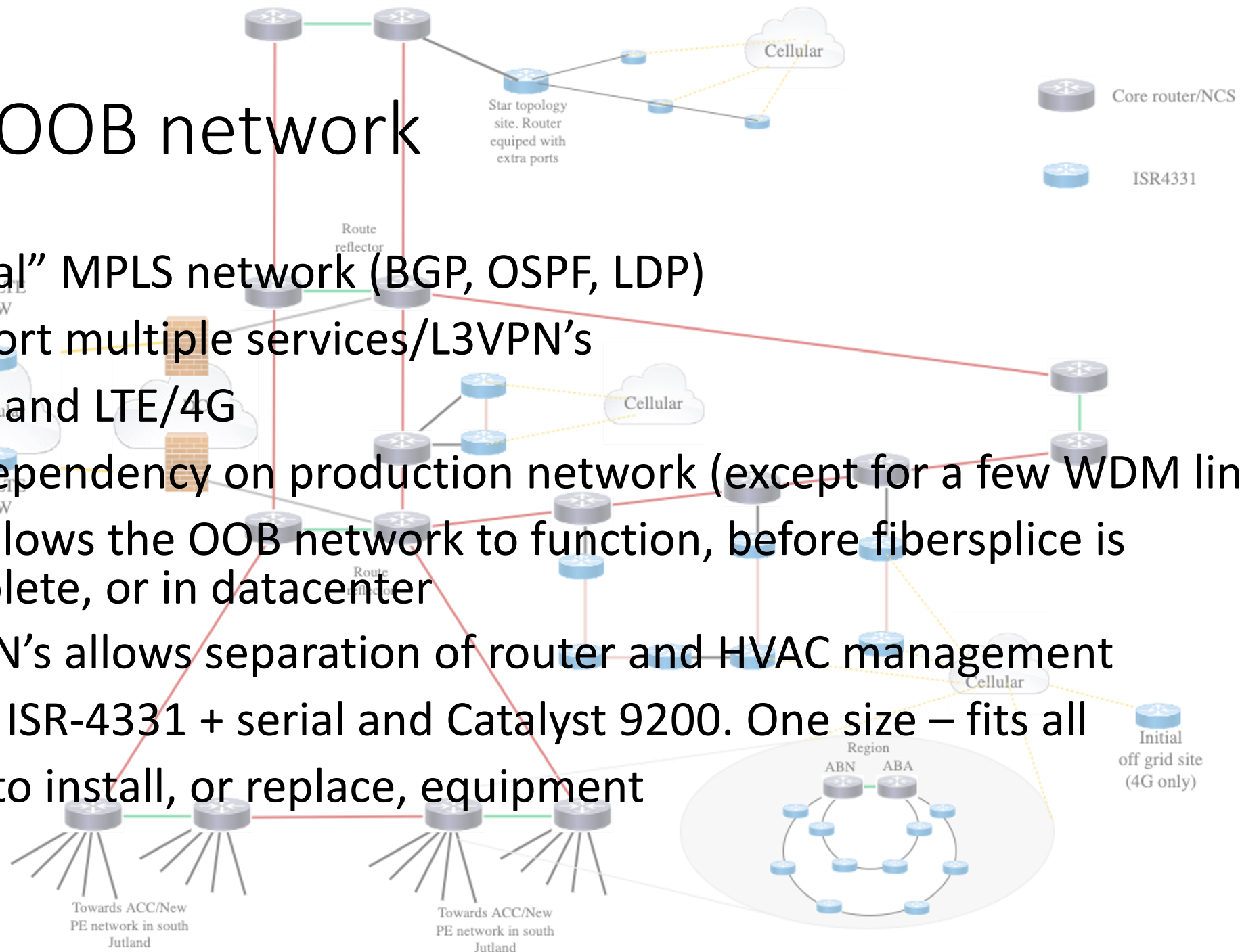
- IP prefixes/adresses, vlans, serials and route-targets
- Interface allocations and PON splitters + capabilities
- PoPs, racks and positions
- Cables/connections (ethernet, console and power),
- Console speed/settings
- MS-ISDN's, WDM channels, license tokens
- POI and vlan mappings (required for Opennet)
- Software versions
- Extensive use of tenants – both for SP's and IO's
- Scripts and reports
- AAA, monitoring and backup (in progress)



Device	
Site	Sydestjylland / HJO
Rack	AR03
Position	U35 / Front
Tenant	Infrastruktur / Norlys Infrastruktur
Device Type	Cisco NCS-55A2-MOD-S (2U)
Serial Number	FOC: <input type="text"/>
Asset Tag	—
Management	
Role	PE router
Platform	IOS-XR
Status	Active
Primary IPv4	212: <input type="text"/>
Primary IPv6	2a03: <input type="text"/>

The OOB network

- A "real" MPLS network (BGP, OSPF, LDP)
- Support multiple services/L3VPN's
- Fiber and LTE/4G
- No dependency on production network (except for a few WDM links)
- LTE allows the OOB network to function, before fibersplice is complete, or in datacenter
- L3VPN's allows separation of router and HVAC management
- Cisco ISR-4331 + serial and Catalyst 9200. One size – fits all
- Easy to install, or replace, equipment



The turn up process (day 0 + day 1)

- OOB router - Cisco PNP + LTE
- OOB switch – Cisco PNP
- PE router – Cisco ZTP
- GPON OLT – does not support ZTP/PNP
- If device fails/get replaced, just change serial in netbox and start ZTP
- Main point of this slide – no console cable or router config skills required by field tech – routers/switches upgraded to correct software, before config is applied



Hardware

- Hardware for 15 PoP's ready for deployment



PNP flow (IOS devices)

- PNP server developed inhouse
- Written in Python+Flask – uses Jinja2 for templating
- Device contacts PNP server, and provides serialnumber, platform, software version etc
- PNP server assigned by DHCP option, or through Cisco cloud for LTE clients. Cisco cloud redirects to Norlys PNP server
- Upgrade software, if required
- License activation
- Obtain config
- Onboard device in NSO and report progress to Teams
- Jinja2 templates + netbox data = full config

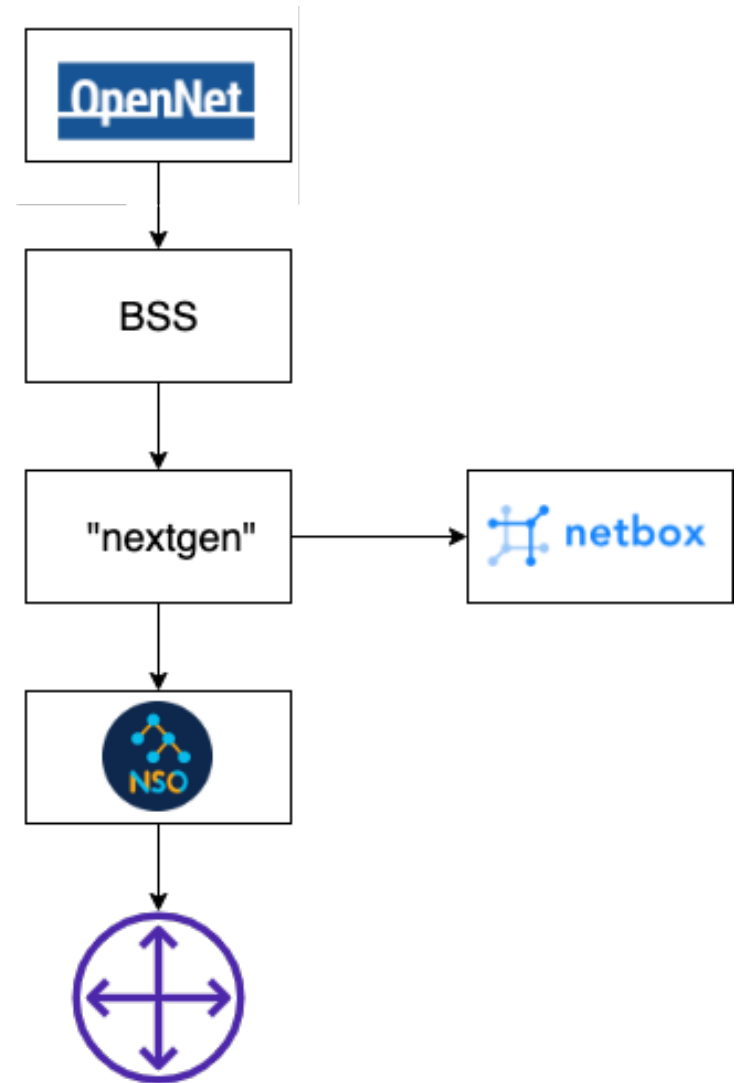


ZTP flow (IOS XR)

- Router obtains mgmt IP by DHCP and initiates iPXE boot
- Network boot with correct software
- Downloads ZTP script
- Script generates SSH key, admin account, fetches GISO and installs
- GISO image contains 2. stage ZTP script to fetch and apply config
- Config generator for IOS XR is another Python/Flask application – supports different configs (PE, LSR etc) based on device roles in netbox
- Generates both complete config and specific interfaces (including MPLS + multicast)

Day 2 config - NSO

- Day 2 config (customer specific config) is done using NSO
- Services described using Yang models
- Create model and deploy across several platforms
- Atomic changes across platforms that does not implement commit/rollback
- Services configured across Cisco, Juniper and Nokia



Did it work?



- Yes! All sites ready before xmas of 2020
- Significant reduction in errors – both in config and physical install
- Hardware replacement much easier, and faster
- Scripts and reports in netbox helps planning and operations
- Has since been deployed for other networks managed by Norlys
- Netbox has since been adopted by brown field network
- Continously removing manual processes in support systems



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