# From zero to automation

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### Who is Norlys?

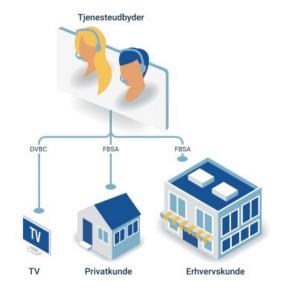
- Merger of Eniig and Sydenergi in 2019
- Largest FTTH provider in Denmark (750.000+ HP)
- Second largest DOCSIS provider in Denmark
- Service provider and infrastructure owner
- Power utility business known as N1
- Network operator for several networks
- Several requirements from KFST for approval of 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+ service providers on boarded
- H1: Residential and SMB (speeds up to 1G, limited SLA)
- H2: Business (Speeds up to 10G, additional QoS and
- H3: CATV





### Norlys network – early 2020

- Access network, Cisco 4500 in 10G rings
- Configs mainly based on template files copy and paste
- IP adresses in Excel and several IPAM systems
- Allocation of adresses 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

	TIOIL					
42	PDU HJO-AR03 nobreak					
41	PDU HJO-AR03 bystrøm hjoor01.ip.stofa.net hjoow01.ip.stofa.net Cableguide HJO-AR03-38					
40						
39						
38						
37	DDF HJO-AR03-37					
36	biope20 in stafe not					
35	hjope30.ip.stofa.net					
34	Cableguide HJO-AR03-34					
33	hjoac01.ip.stofa.net					
32						
31						
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28						
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26						

Front

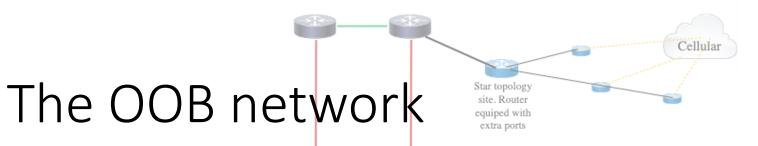
4444	-	hjoor01.ip.stofa.net	Async0/2/20	DDF HJO-AR03-37	Port 21	Connected	CAT6	
4445	-	hjoor01.lp.stofa.net	Async0/2/21	DDF HJO-AR03-37	Port 22	Connected	CAT6	
4446	-	hjoor01.ip.stofa.net	Async0/2/22	DDF HJO-AR03-37	Port 23	Connected	CAT6	
4447	-	hjoor01.ip.stofa.net	Async0/2/23	DDF HJO-AR03-37	Port 24	Connected	CAT6	
4448	-	DDF HJO-AR03-37	Port 2	hjoow01.ip.stofa.net	console	Connected	CAT6	
4449	-	DDF HJO-AR03-37	Port 4	hjope30.ip.stofa.net	con0/RP0/CPU0	Connected	CAT6	
4450	-	DDF HJO-AR03-37	Port 5	hjoac01.ip.stofa.net	nt-a:LCRT	Connected	CAT6	
4451	-	hjoor01.ip.stofa.net	GigabitEthernet0/0/1	hjoow01.ip.stofa.net	GigabitEthernet1/1/4	Connected	CAT6	
4452	-	hjoow01.ip.stofa.net	GigabitEthernet1/0/2	hjope30.ip.stofa.net	Mg0/RP0/CPU0/0	Connected	CAT6	
4453	_	hjoow01.ip.stofa.net	GigabitEthernet1/0/3	hjoac01.ip.stofa.net	nt-a:eth:1	Connected	CAT6	
4454	-	hjope30.ip.stofa.net	TenGigE0/0/0/0	hjoac01.ip.stofa.net	nt-a:xfp:1	Connected	Singlemode Fiber	
4455	-	hjoac01.ip.stofa.net	1/1/1/1	hjoap01.ip.stofa.net	PON uplink	Connected	Singlemode Fiber	
4456	-	hjoac01.ip.stofa.net	Bat A	Nobreak 48V panel HJO	48V forsyning til hjoac01 bat A	Connected	Power	
4457	-	hjoac01.ip.stofa.net	Bat B	Nobreak 48V panel HJO	48V forsyning til hjoac01 bat B	Connected	Power	
4458	-	hjoor01.ip.stofa.net	PSU0	PDU HJO-AR03 nobreak	Out 4	Connected	Power	
4459	-	hjoow01.ip.stofa.net	PSU0	PDU HJO-AR03 nobreak	Out 3	Connected	Power	
4460	-	hjope30.ip.stofa.net	0/PM0	PDU HJO-AR03 nobreak	Out 2	Connected	Power	
4461	-	hjope30.ip.stofa.net	0/PM1	PDU HJO-AR03 bystrøm	Out 2	Connected	Power	

## 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	Sydøstjylland / HJO			
Rack	AR03			
Position	U35 / Front			
Tenant	Infrastruktur / Norlys Infrastruktur			
Device Type	Cisco NCS-55A2-MOD-S (2U)			
Serial Number	FOC			
Asset Tag	-			
Management				
Role	PE router			
Platform	IOS-XR			
Status	Active			
Primary IPv4	212			
Primary IPv6	2a03:			





ISR4331

Initial off grid site

(4G only)

- 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)

Cellular

- 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

PE network in south

Jutland

Towards ACC/New PE network in south Jutland

#### 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

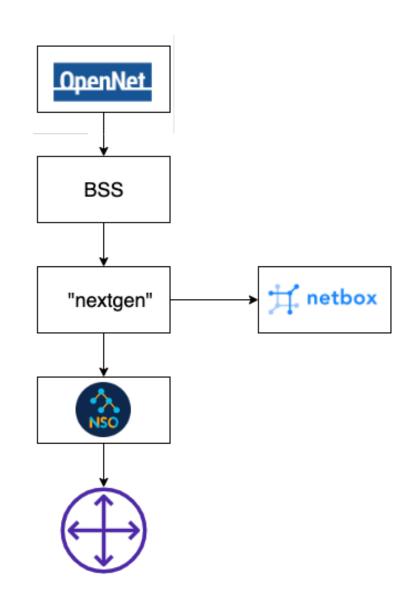


# ZTP flow (IOS XR)

- 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



