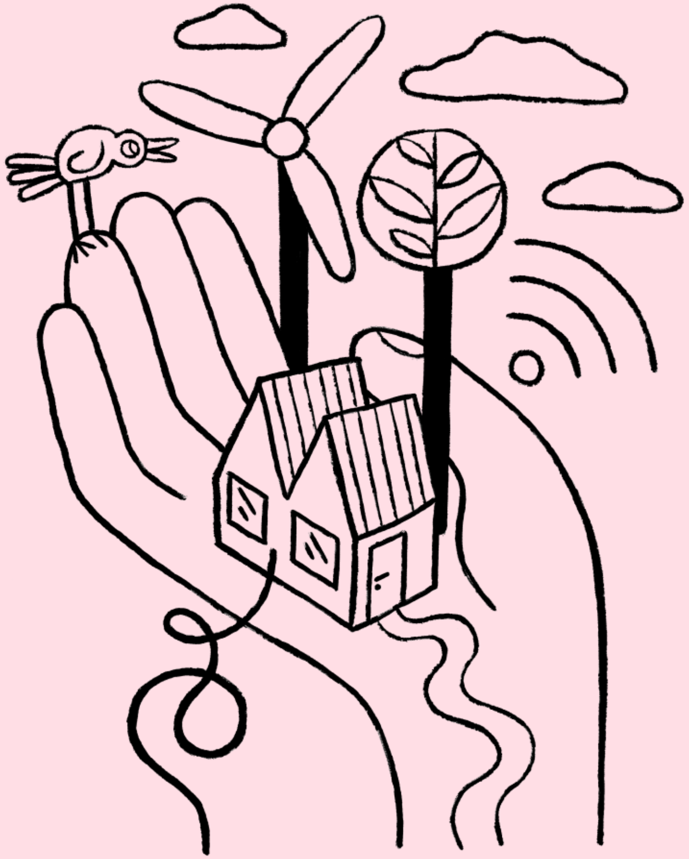
NORLYS

Netbox<->NSO Integration

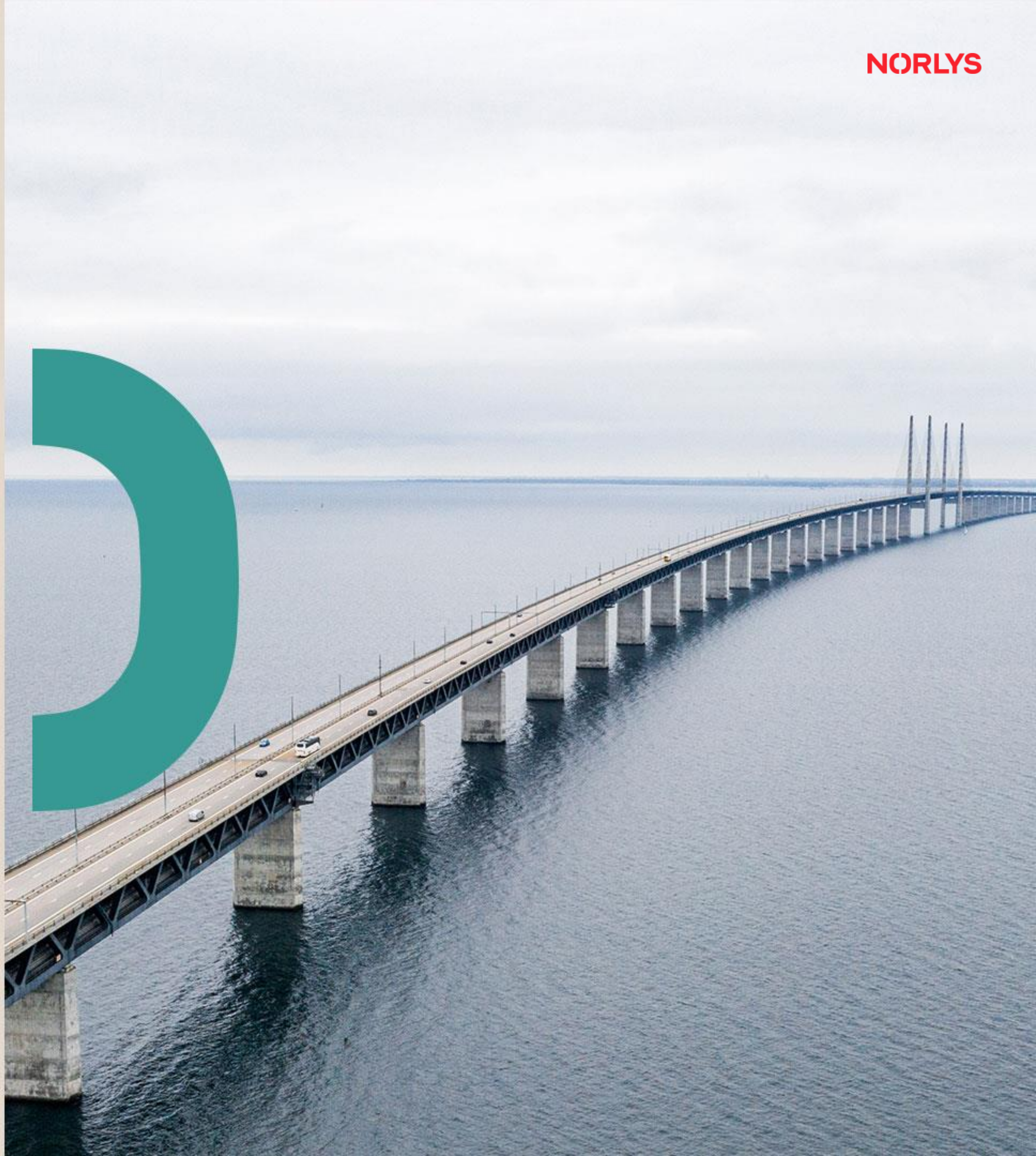
25/03/2024



Agenda

- Short intro to Norlys Fibernet
- Sync of Devices
- Sync of Services
- Future plans

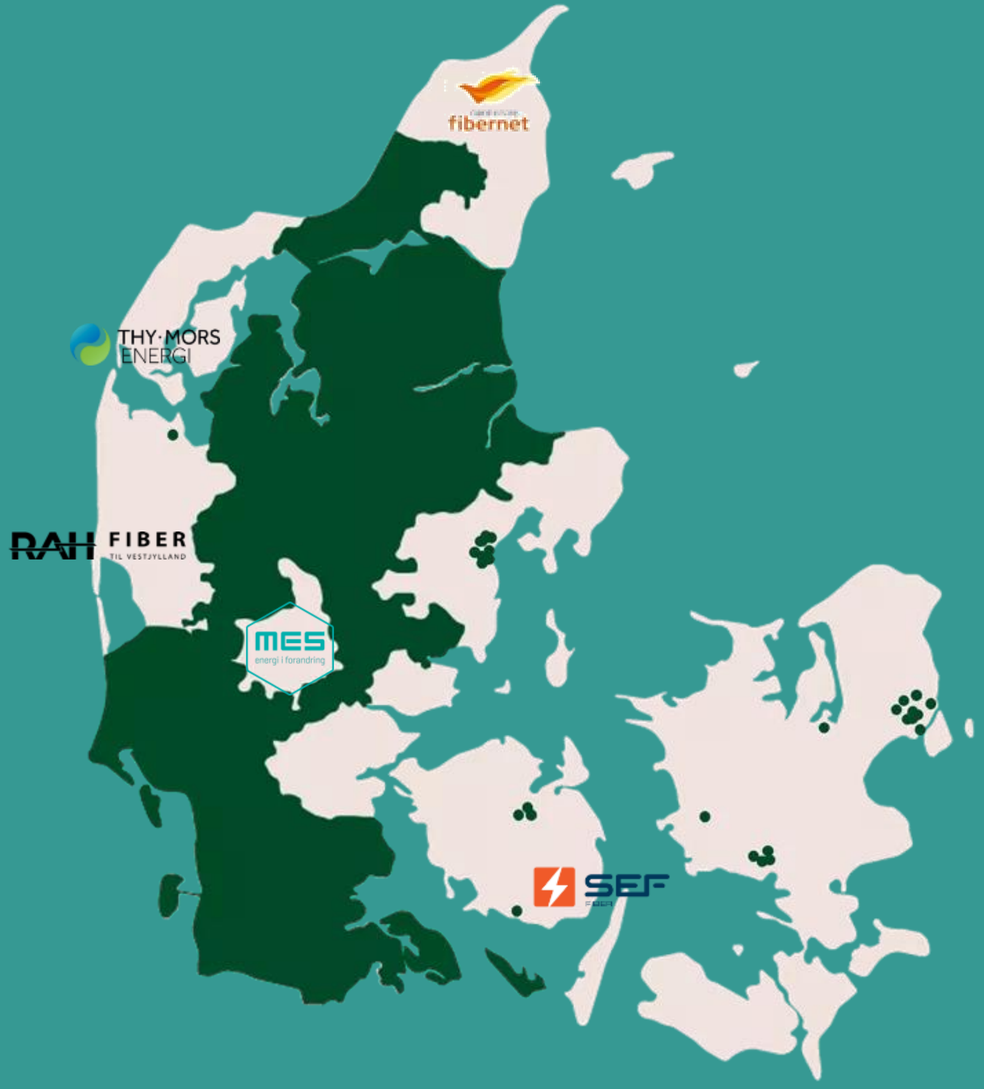
Short intro to Norlys Fibernet



Who is Norlys Fibernet?

- Norlys Fibernet **owns, operates and maintains the largest fibre network in Denmark**, which accounts for more than 43% of the total of Denmark
- The fibre network is available to **860,000 addresses**
- Norlys Fibernet also **operates several other fibre networks**, including SEF, RAH, ThyMors Energi, Nord Energi and MES
- Norlys Fibernet **owns 45% of RAH Fiber and 25% of SEF Fiber**

→ The green area roughly corresponds to Norlys' electricity supply area



Norlys Fibernet 2022 – in figures

Revenue (mDKK)
1.104

Contribution margin (mDKK)
819

EBITDA II (mDKK)
607

Result before tax (mDKK)
54

Investments (mDKK)
1.478

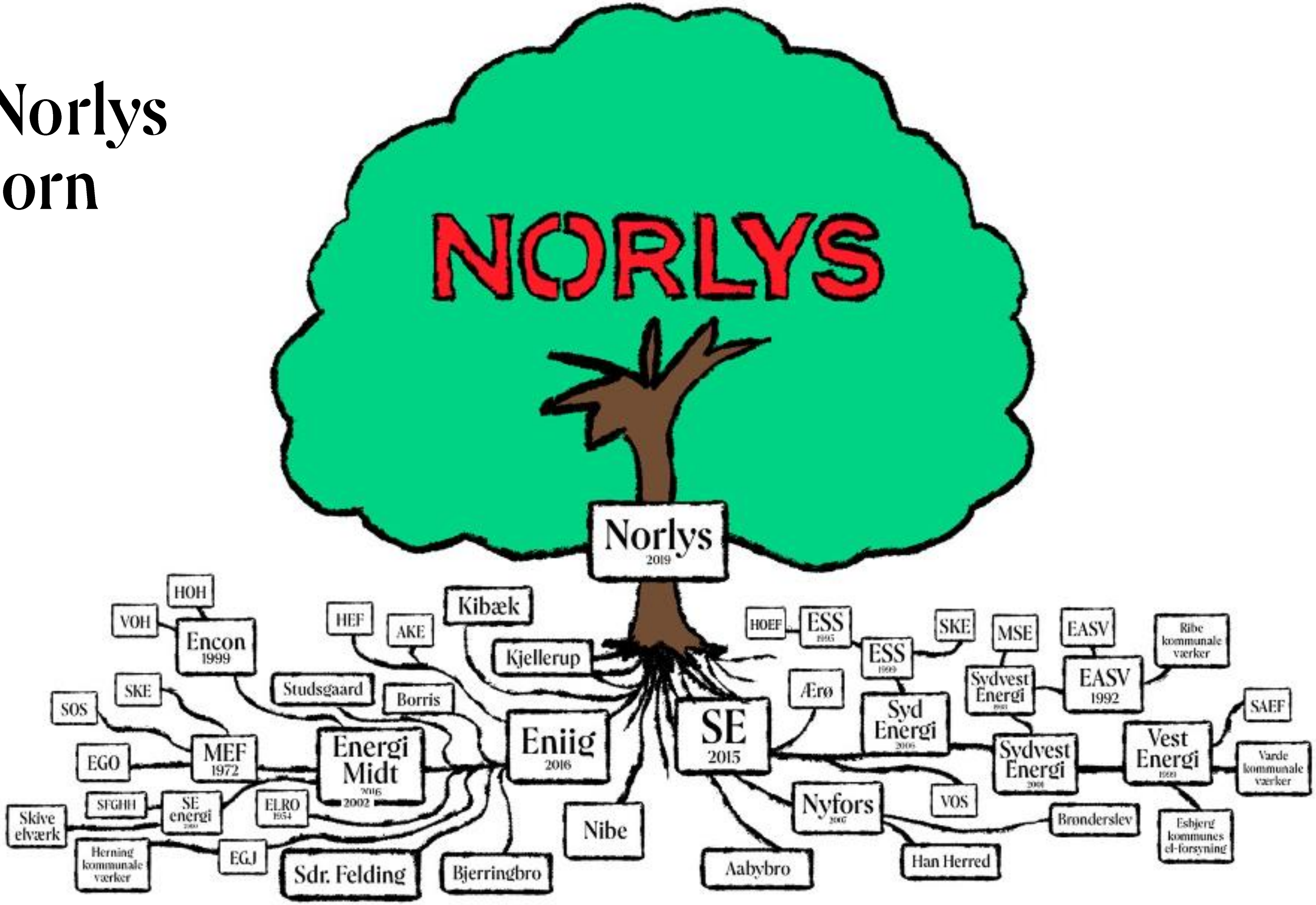
Employees (2022)
674

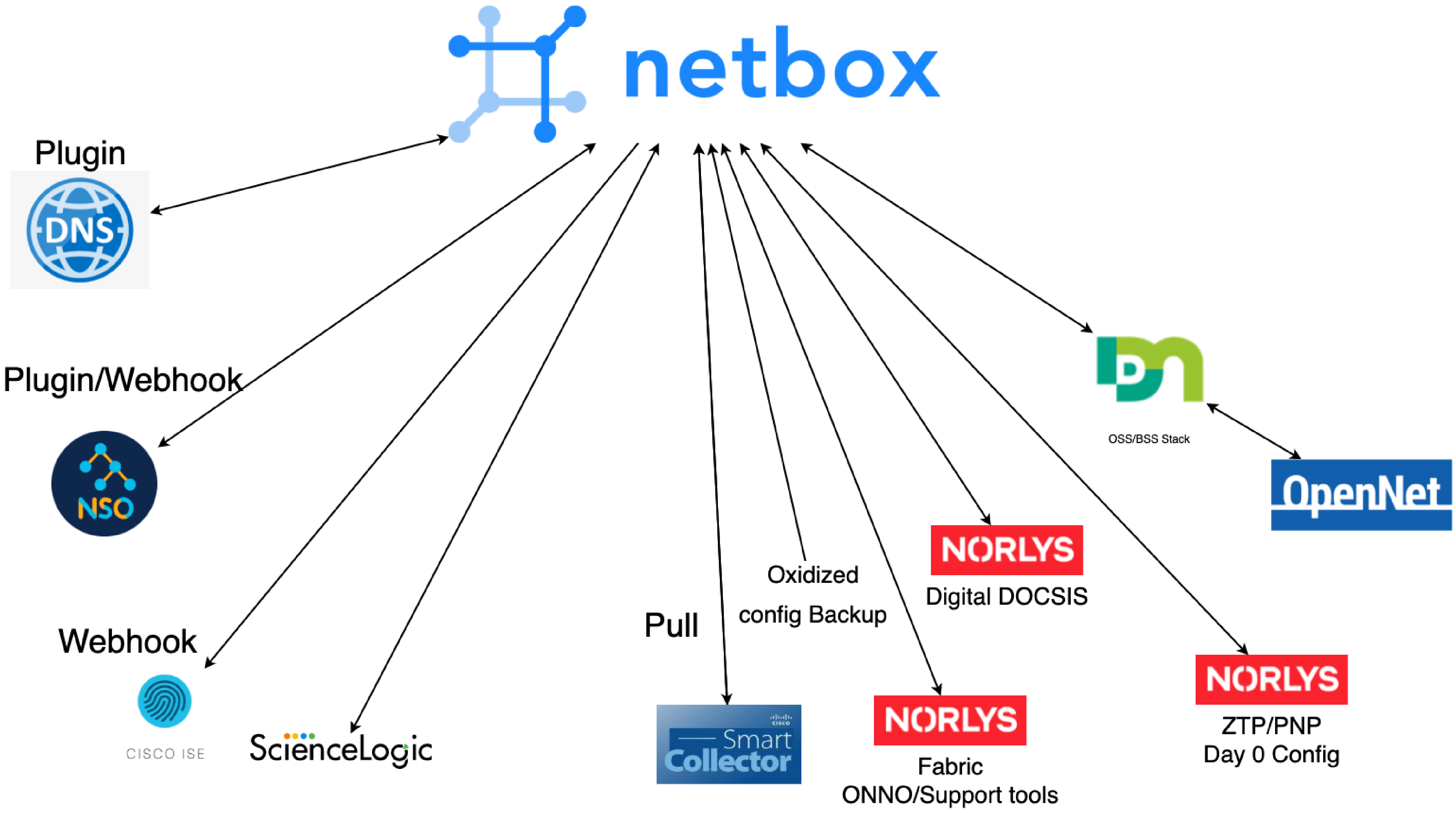
Sellable adresses
~800.000

Connected adresses
~500.000

Active adresses
~400.000

How Norlys was born





Plugin

Plugin/Webhook

Webhook

Pull

Oxidized config Backup

Digital DOCSIS

Fabric ONNO/Support tools

ZTP/PNP Day 0 Config

OSS/BSS Stack

Sync of Devices

Goals and solution

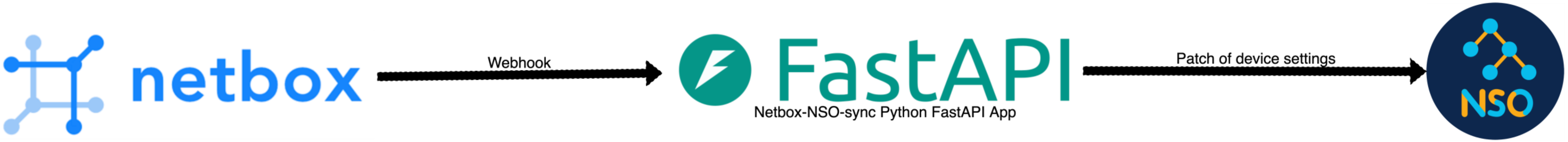
Goals for Device sync

- Netbox SOT based, to add no extra steps to workflow
- Event based, so no wait on next sync
- Scheduled daily sync of devices
- Settings local for device
- Settings addition on a global/group level
- Multi NSO instance capable

Python FastAPI Solution

NORLYS

Device Sync



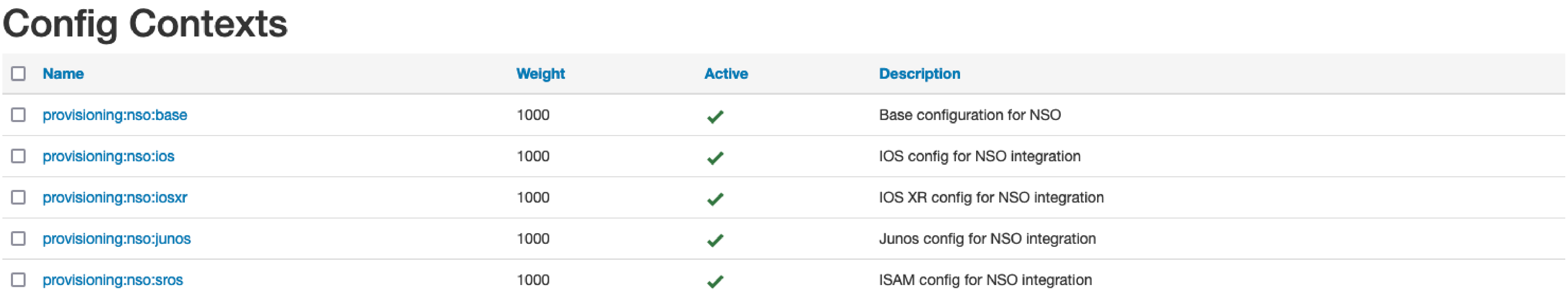
Sync of Devices

Components

Netbox – Config Contexts

Config contexts in Netbox solves the 2 goals about Device and Global/Group data.

```
"nso": {
    "device-automaton": {
      "consistency-guarantor": {
        "enabled": true,
        "sync-method": "sync-from"
      },
      "management-credentials": {
        "authgroup": "prod-auth",
        "create-management-credentials": false
      },
      "ned-id": "cisco-ios-cli-6.83:cisco-ios-cli-6.83"
    },
    "services": {
      {OMITTED}
    }
  },
```

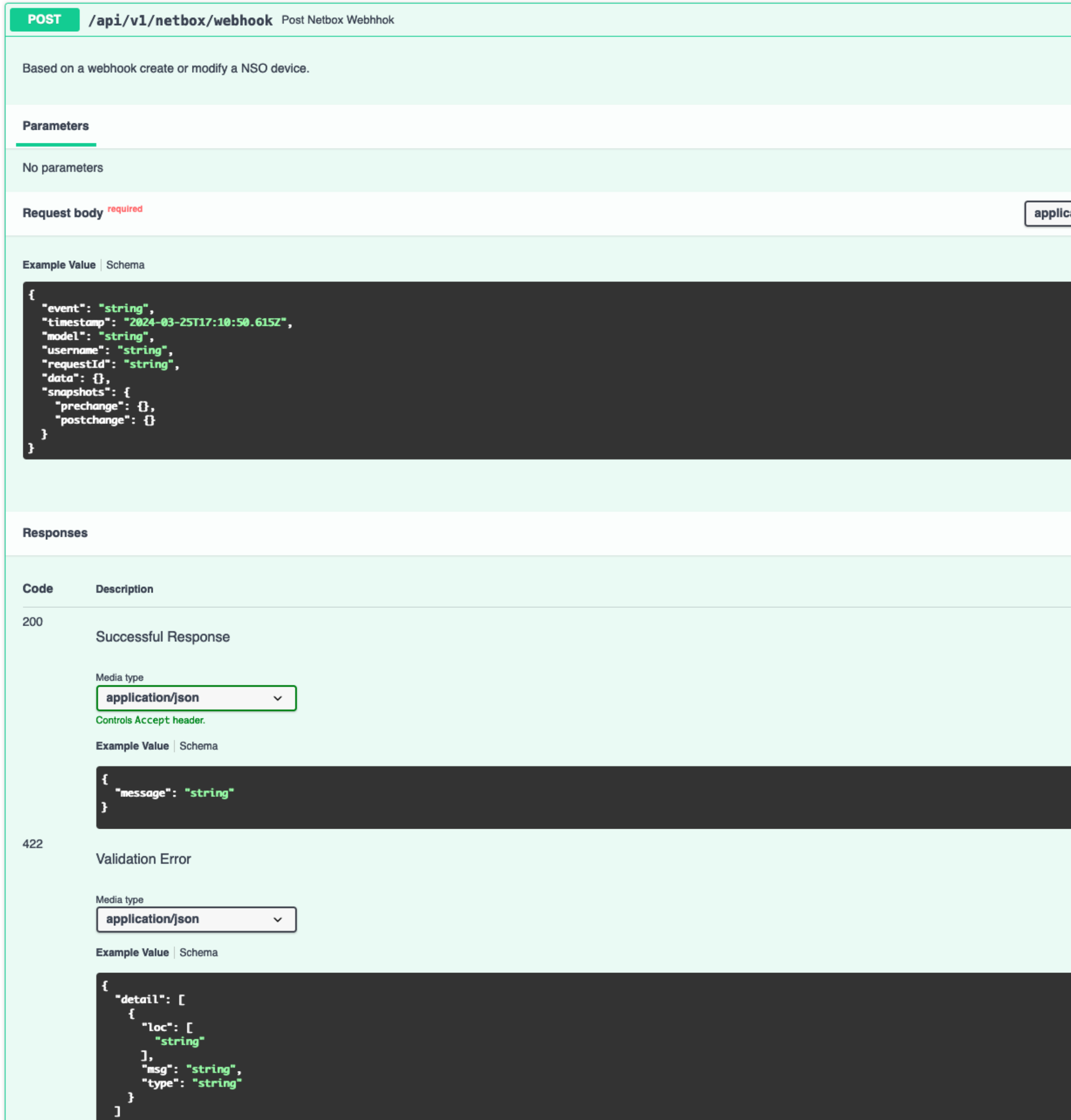


Config Contexts

☐	Name	Weight	Active	Description
☐	provisioning:nso:base	1000	✓	Base configuration for NSO
☐	provisioning:nso:ios	1000	✓	IOS config for NSO integration
☐	provisioning:nso:iosxr	1000	✓	IOS XR config for NSO integration
☐	provisioning:nso:junos	1000	✓	Junos config for NSO integration
☐	provisioning:nso:sros	1000	✓	ISAM config for NSO integration

FastAPI Python Service

Microservice architecture(Scales horizontally)
Queues incoming webhooks(Redis)
Stateless – No data is stored
Uses minimal of data in webhook(Prep for syncing VMs)
Fetches data from Netbox for Device(/VM) Sync



/api/v1/netbox/webhook Post Netbox Webhhok

Based on a webhook create or modify a NSO device.

No parameters

Request body required

```
{
  "event": "string",
  "timestamp": "2024-03-25T17:10:50.615Z",
  "model": "string",
  "username": "string",
  "requestId": "string",
  "data": {},
  "snapshots": {
    "prechange": {},
    "postchange": {}
  }
}
```

Code Description

200 Successful Response

Media type: application/json

Controls Accept header.

```
{
  "message": "string"
}
```

422 Validation Error

Media type: application/json

```
{
  "detail": [
    {
      "loc": [
        "string"
      ],
      "msg": "string",
      "type": "string"
    }
  ]
```

NSO – device manager

Built in Device manager inside NSO
Handles everything about devices in NSO
Needs to know device info like

- Address to reach device
- Login to Device
- NED to use (Network Element Driver)
- Other settings

```
show configuration devices device hvinor01 | de-select config | display json
{
 "data": {
  "tailf-ncs:devices": {
   "device": [
    {
     "name": "hvinor01",
     "address": "10.146.6.19",
     "ssh": {
      "host-key": [
       {
        "algorithm": "ssh-rsa",
        "key-data": "{OMITTED}"
       }
      ]
     },
     "authgroup": "hvinor01",
     "device-type": {
      "cli": {
       "ned-id": "cisco-ios-cli-6.83:cisco-ios-cli-6.83"
      }
     },
     "commit-queue": {
      "enabled-by-default": false
     },
     "state": {
      "admin-state": "unlocked"
     }
    }
   ]
  }
 }
}
```

NSO Package - Device Automaton

Features:

- **Declarative interface**
- **Device connectivity monitoring**
- **SSH host key management**
- **Device credential management**
- **Device configuration sync**
- Automatic device type detection & ned-id selection
- Automatic NED migration
- Commit-queue error handling
- Automatic service re-deploy

We currently use features marked with bold

```
show configuration devices automaton hvinor01 | display json
{
 "data": {
  "tailf-ncs:devices": {
   "device-automaton:automaton": [
    {
     "device": "hvinor01",
     "ned-id": "cisco-ios-cli-6.83:cisco-ios-cli-6.83",
     "management-endpoint": [
      {
       "address": "10.146.6.19"
      }
     ],
     "management-credentials": {
      "username": "svc_nsoconf",
      "password": "{OMITTED}",
      "create-management-credentials": false
     },
     "consistency-guarantor": {
      "enabled": true,
      "sync-method": "sync-from"
     }
    }
   ]
  }
 }
}
```

NSO Package – netbox-nso-sync

Simple service to store values so middleware is stateless

- Connects Netbox device ID to device
- Stores device facts
- Stores device service ids(more info later)

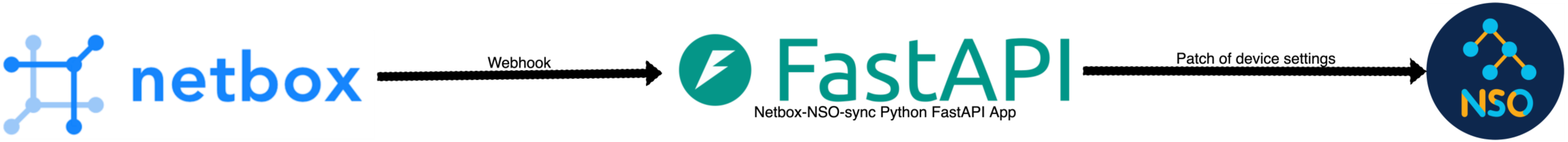
```
show configuration services netbox-nso-sync 44331 | display json
{
  "data": {
    "tailf-ncs:services": {
      "netbox-nso-sync:netbox-nso-sync": [
        {
          "netbox_id": "44331",
          "device": "hvinor01",
          "device_facts": {
            "platform": "ios",
            "device_type": "c8300-1n1s-6t",
            "manufacturer": "cisco"
          },
          "services": [
            {
              "service": "oob-router-vrf-subint:oob-router-vrf-subint",
              "service_ids": [
                "DevID44331-IntId878233",
                "DevID44331-IntId951188",
                "DevID44331-IntId951193”
              ]
            }
          ]
        }
      ]
    }
  }
}
```

Sync of Devices

Process

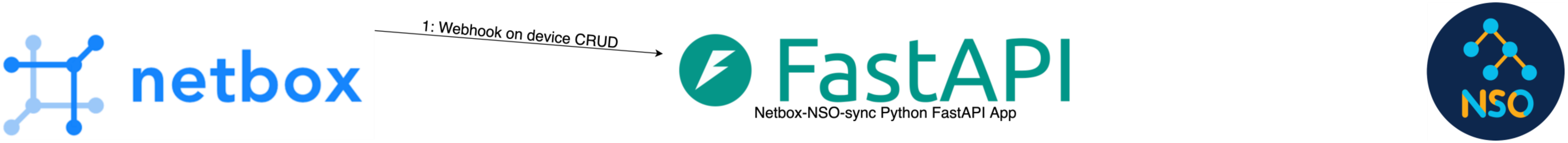
Python FastAPI Solution

Device Sync



Python FastAPI Solution

Device Sync

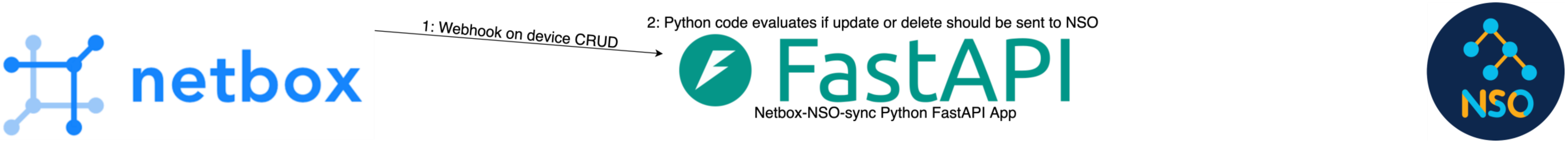


1: Webhook on device CRUD

Netbox-NSO-sync Python FastAPI App

Python FastAPI Solution

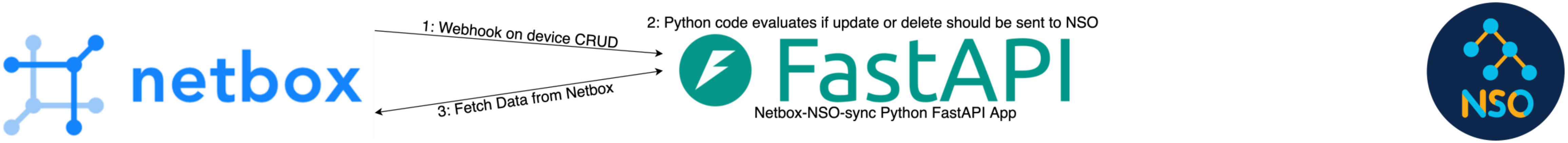
Device Sync



netbox
1: Webhook on device CRUD
2: Python code evaluates if update or delete should be sent to NSO
FastAPI
Netbox-NSO-sync Python FastAPI App
NSO

Python FastAPI Solution

Device Sync



netbox
1: Webhook on device CRUD
3: Fetch Data from Netbox
2: Python code evaluates if update or delete should be sent to NSO
FastAPI
Netbox-NSO-sync Python FastAPI App
NSO

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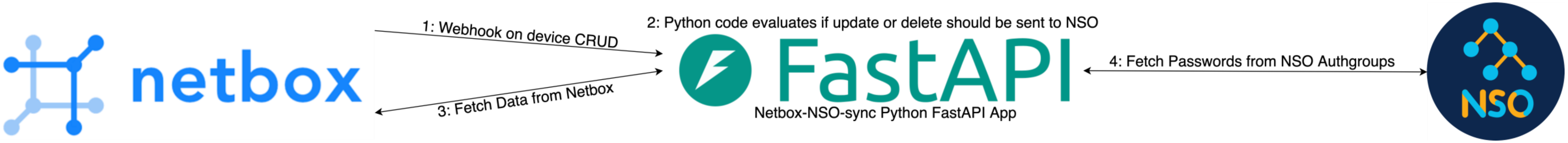
Python FastAPI Solution

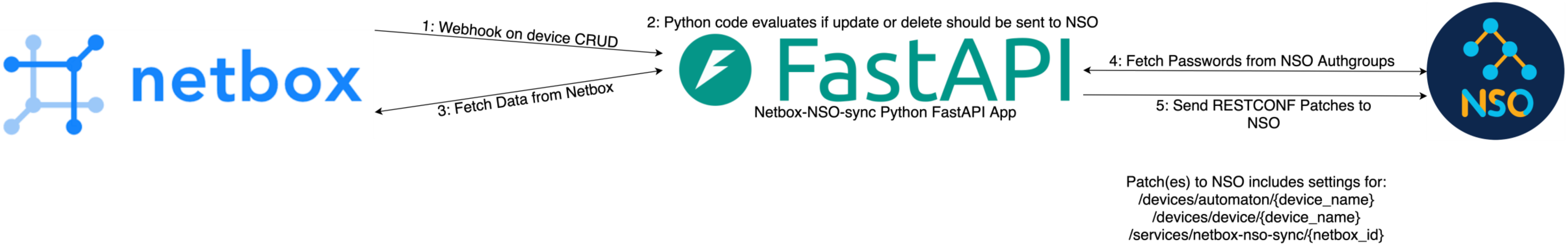
Device Sync



netbox
1: Webhook on device CRUD
3: Fetch Data from Netbox
2: Python code evaluates if update or delete should be sent to NSO
FastAPI
Netbox-NSO-sync Python FastAPI App
4: Fetch Passwords from NSO Authgroups
NSO

Python FastAPI Solution

Device Sync



1: Webhook on device CRUD

2: Python code evaluates if update or delete should be sent to NSO

3: Fetch Data from Netbox

Netbox-NSO-sync Python FastAPI App

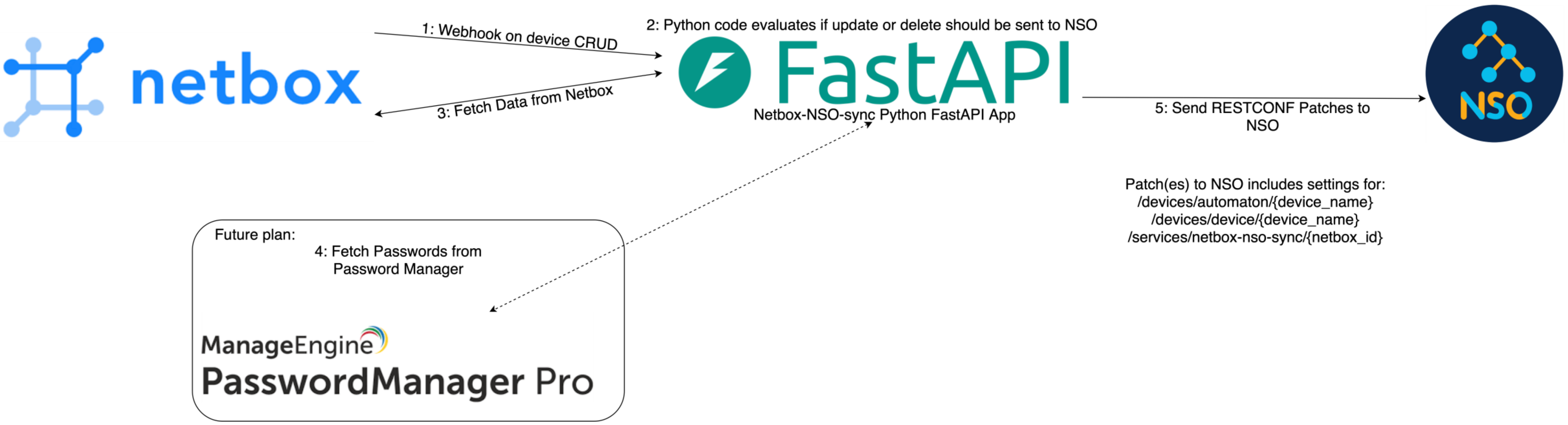
4: Fetch Passwords from NSO Authgroups

5: Send RESTCONF Patches to NSO

Patch(es) to NSO includes settings for:
/devices/automaton/{device_name}
/devices/device/{device_name}
/services/netbox-nso-sync/{netbox_id}

Python FastAPI Solution

Device Sync

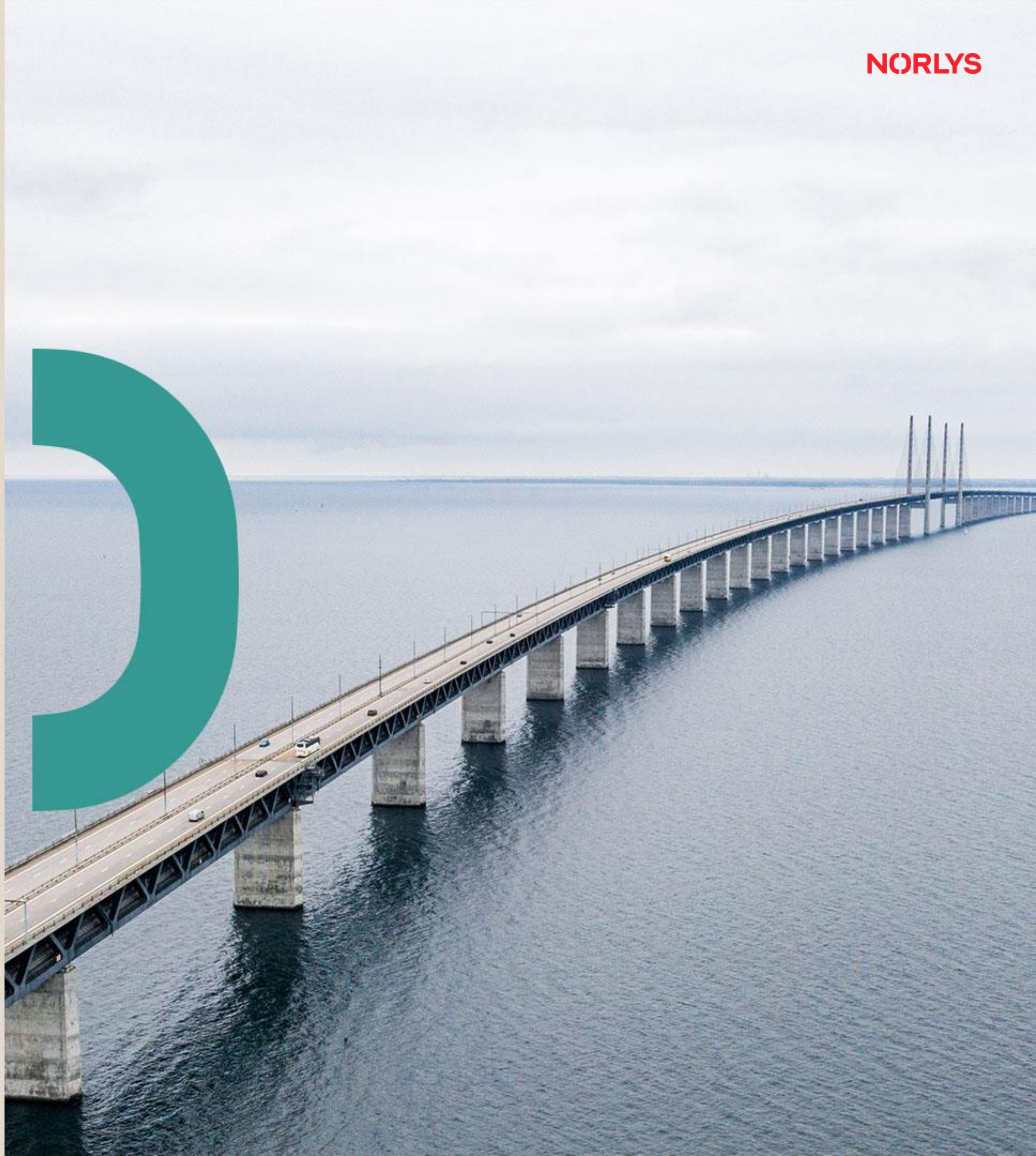

1: Webhook on device CRUD
2: Python code evaluates if update or delete should be sent to NSO
3: Fetch Data from Netbox
netbox
FastAPI
Netbox-NSO-sync Python FastAPI App
5: Send RESTCONF Patches to NSO
NSO
Future plan:
4: Fetch Passwords from Password Manager
ManageEngine
PasswordManager Pro

Patch(es) to NSO includes settings for:
/devices/automaton/{device_name}
/devices/device/{device_name}
/services/netbox-nso-sync/{netbox_id}

NORLYS

Sync of Devices

Demo



Sync of Services

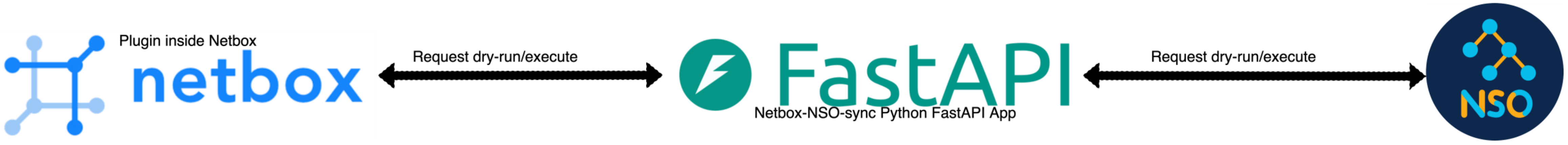
Goals and Solution

Goals for Service sync

- Dry-run verification of config as day 1
- No values should be duplicated if possible.
- Multi SOR ready
- Services local for device
- Services addition on a global/group level
- Multi NSO instance capable

Python FastAPI Solution

Service Sync



Sync of Services

Components

Netbox – Config Contexts

Config contexts in Netbox solves the 2 goals about Device and Global/Group data.
Jinja2 templating used for data duplication

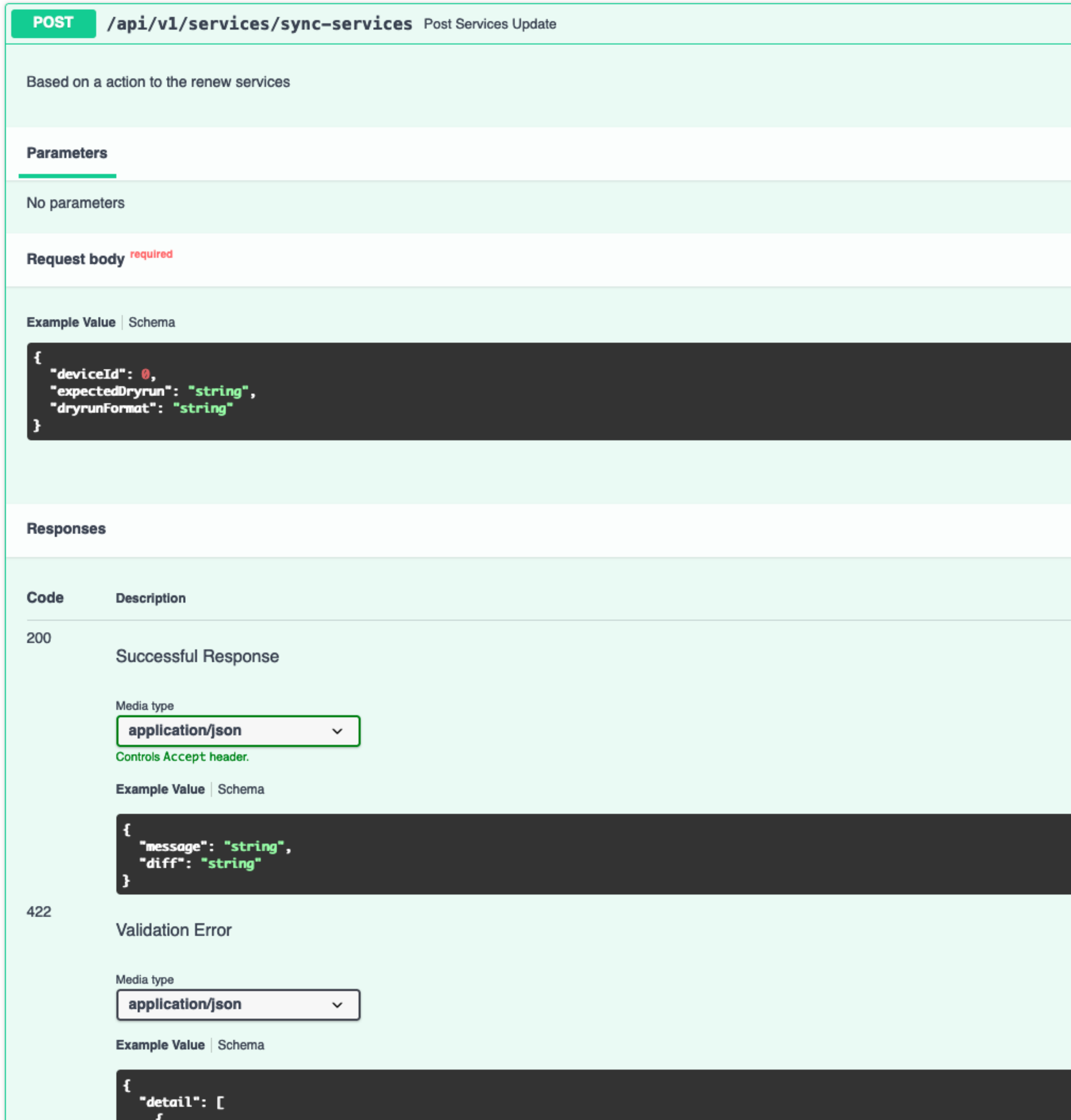
As local_context can be used for Device specific Global Config contexts allow to apply to all or groups of devices

```
"nso": {
    "device-automaton": {
      {OMITTED}
    },
    "services": {
      "oob-router-vrf-subint:oob-router-vrf-subint": {
        "DevID44331-IntId878233": {
          "device": "{{ netbox.dcim.devices.id.44331.name.short_name }}",
          "dhcp-helpers": [
            ”{OMITTED}"
          ],
          "ipv4-cidr": "{{ netbox.ipam.ip_addresses.interface_id.878233.address }}",
          "loopback-ipv4-cidr": "{{ netbox.ipam.ip_addresses.interface_id.878228.address }}",
          "name": "DevID44331-IntId878233",
          "netbox-nso-sync": 44331,
          "physical-interface": {
            "description": "{{ netbox.dcim.interfaces.id.878223.description }}",
            "interface": "{{ netbox.dcim.interfaces.id.878223.name }}"
          },
          "sub-interface": {
            "description": "{{ netbox.dcim.interfaces.id.878233.description }}",
            "interface": "{{ netbox.dcim.interfaces.id.878233.name }}"
          },
          "vlans": {
            "tagged-vlans": "{{ netbox.dcim.interfaces.id.878233.tagged_vlans.vlan_data_v1 }}",
            "untagged-vlan": "{{ netbox.dcim.interfaces.id.878233.untagged_vlan.vlan_data_v1 }}"
          },
          "vrf": "{{ netbox.ipam.ip_addresses.interface_id.878233.vrf.vrf_data_v1  }}"
        },
        {OMITTED}
```

FastAPI Python Service

Microservice architecture(Scales horizontally)
Stateless – No data is stored
Template engine implemented

- This allow future integration with multiple SOR
- Allows deduplication of data



/api/v1/services/sync-services Post Services Update

Based on a action to the renew services

No parameters

Request body required

```
{
  "deviceId": 0,
  "expectedDryrun": "string",
  "dryrunFormat": "string"
}
```

Code	Description
200	Successful Response Media type: application/json Controls Accept header.
422	Validation Error Media type: application/json

```
{
  "message": "string",
  "diff": "string"
}
```

```
{
  "detail": [
```

NSO Package – netbox-nso-sync

Simple service to store values so middleware is stateless

- Stores names of services and service instances
  Used to generate delete/update list

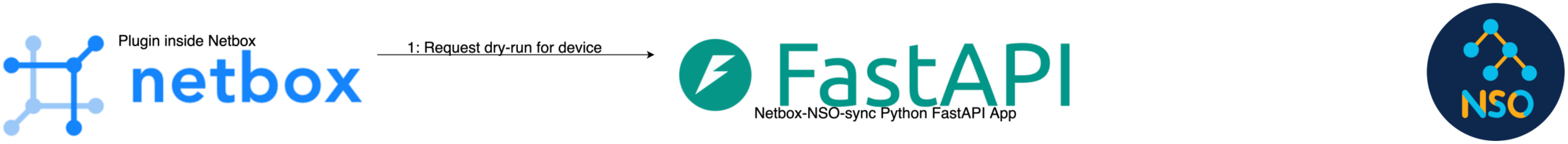
```
show configuration services netbox-nso-sync 44331 | display json
{
  "data": {
    "tailf-ncs:services": {
      "netbox-nso-sync:netbox-nso-sync": [
        {
          "netbox_id": "44331",
          "device": "hvinor01",
          "device_facts": {
            "platform": "ios",
            "device_type": "c8300-1n1s-6t",
            "manufacturer": "cisco"
          },
          "services": [
            {
              "service": "oob-router-vrf-subint:oob-router-vrf-subint",
              "service_ids": [
                "DevID44331-IntId878233",
                "DevID44331-IntId951188",
                "DevID44331-IntId951193”
              ]
            }
          ]
        }
      ]
    }
  }
}
```

Sync of Services

Process

Python FastAPI Solution

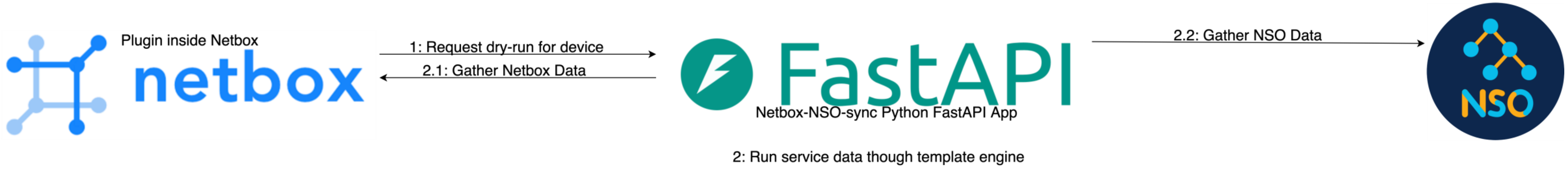
Service Sync



Plugin inside Netbox
netbox
1: Request dry-run for device
FastAPI
Netbox-NSO-sync Python FastAPI App
NSO

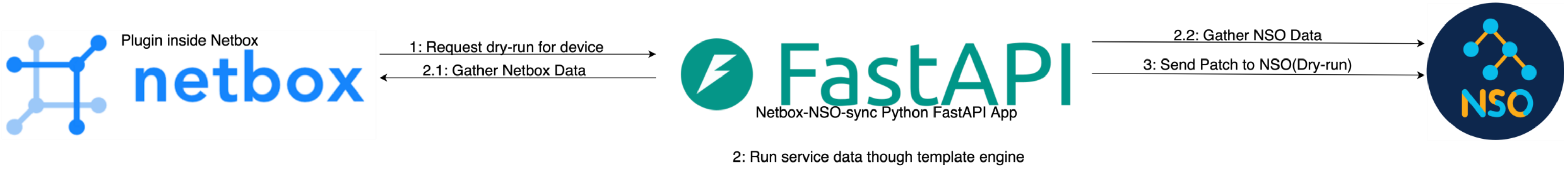
Python FastAPI Solution

Service Sync


Plugin inside Netbox
netbox
1: Request dry-run for device
2.1: Gather Netbox Data
FastAPI
Netbox-NSO-sync Python FastAPI App
2: Run service data though template engine
2.2: Gather NSO Data
NSO

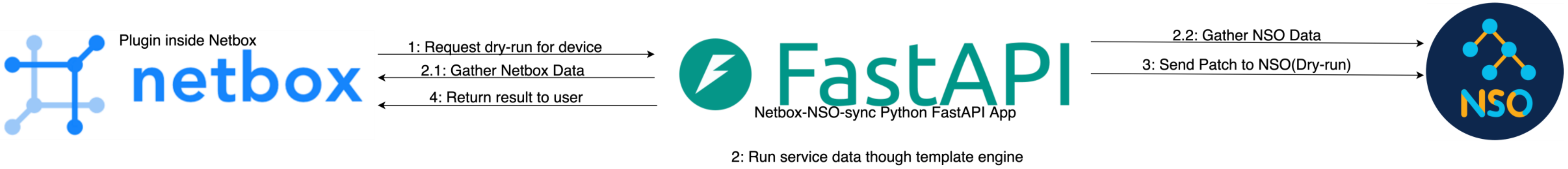
Python FastAPI Solution

Service Sync


Plugin inside Netbox
netbox
1: Request dry-run for device
2.1: Gather Netbox Data
FastAPI
Netbox-NSO-sync Python FastAPI App
2: Run service data though template engine
2.2: Gather NSO Data
3: Send Patch to NSO(Dry-run)
NSO

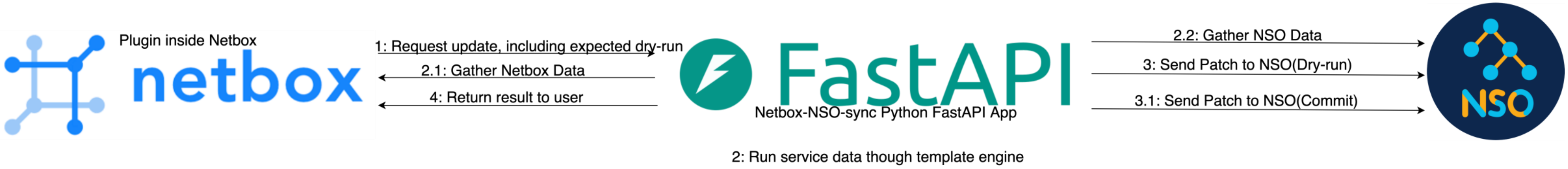
Python FastAPI Solution

Service Sync


Plugin inside Netbox
netbox
1: Request dry-run for device
2.1: Gather Netbox Data
4: Return result to user
FastAPI
Netbox-NSO-sync Python FastAPI App
2: Run service data though template engine
2.2: Gather NSO Data
3: Send Patch to NSO(Dry-run)
NSO

Python FastAPI Solution

Service Sync

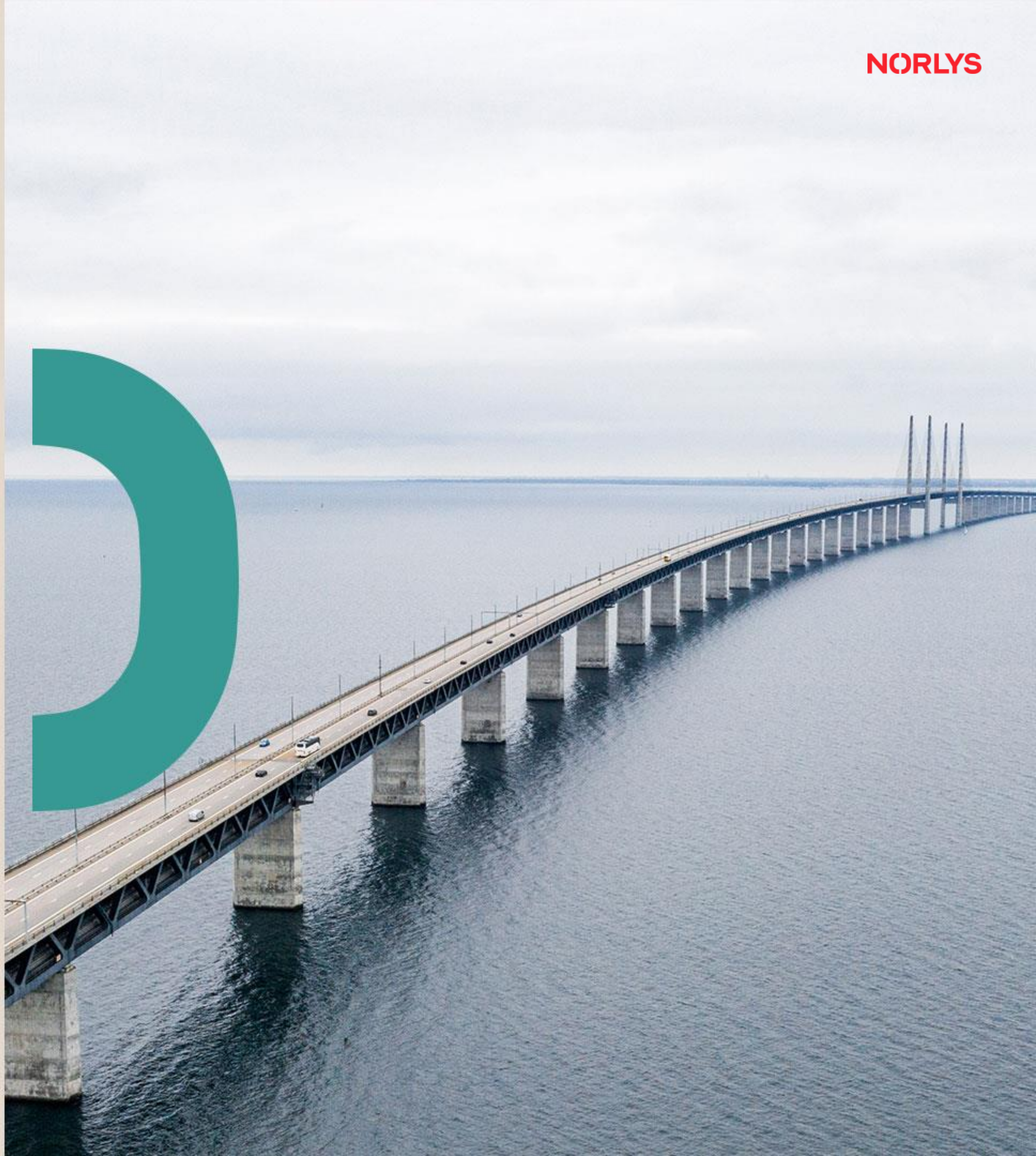


Plugin inside Netbox
netbox
1: Request update, including expected dry-run
2.1: Gather Netbox Data
4: Return result to user
FastAPI
Netbox-NSO-sync Python FastAPI App
2: Run service data though template engine
2.2: Gather NSO Data
3: Send Patch to NSO(Dry-run)
3.1: Send Patch to NSO(Commit)
NSO

NORLYS

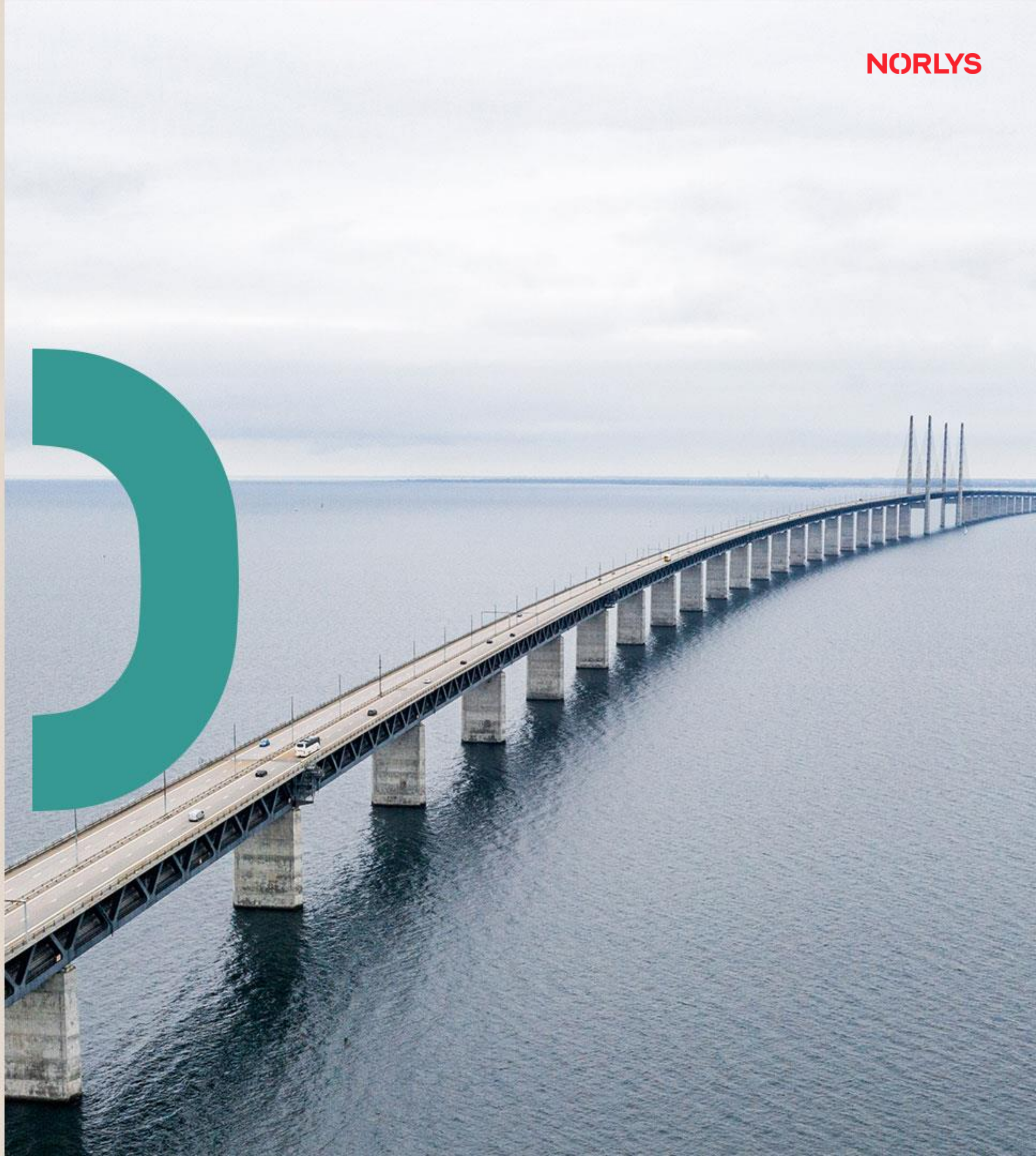
Sync of services

Demo

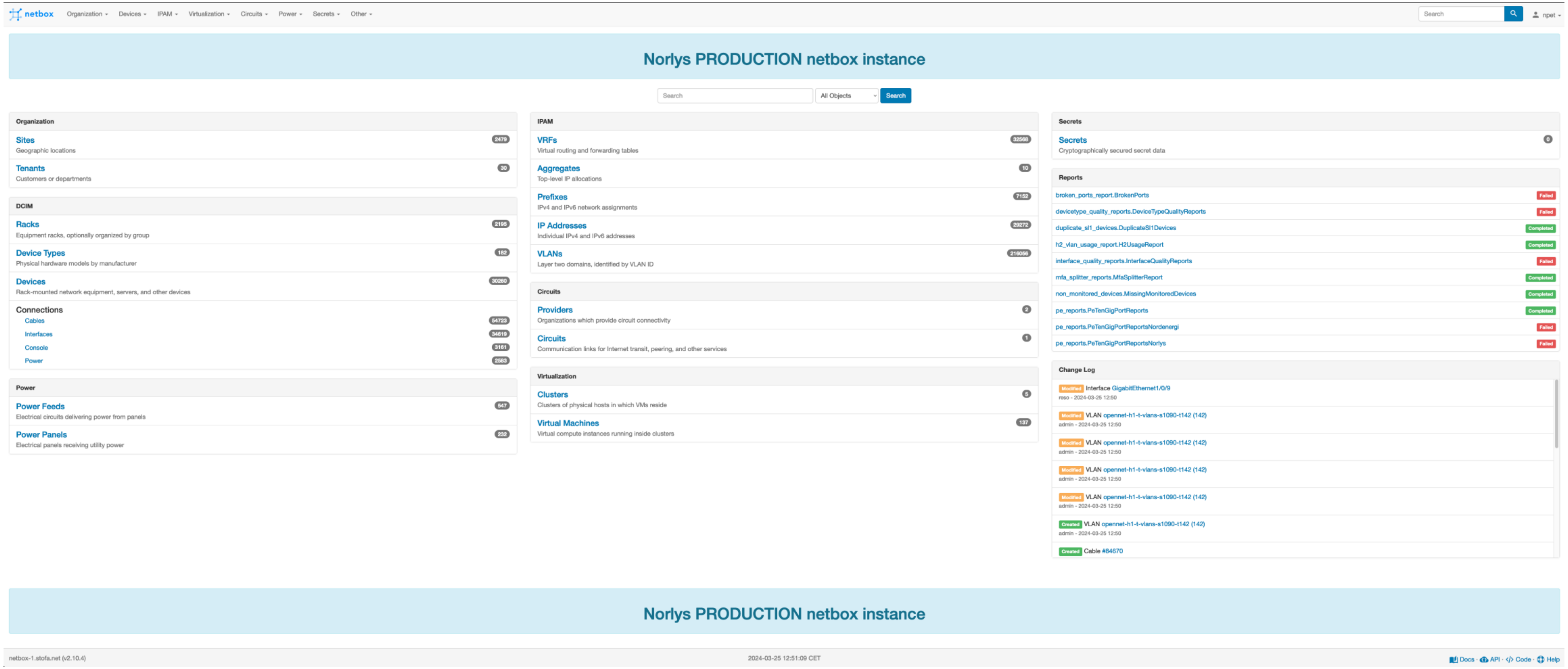


Questions?

Netbox



Netbox instance



Norlys PRODUCTION netbox instance

Organization

Sites Geographic locations	2479
Tenants Customers or departments	30

DCIM

Racks Equipment racks, optionally organized by group	2195
Device Types Physical hardware models by manufacturer	182
Devices Rack-mounted network equipment, servers, and other devices	30260
Connections	
Cables	54723
Interfaces	34619
Console	3161
Power	2583

Power

Power Feeds Electrical circuits delivering power from panels	547
Power Panels Electrical panels receiving utility power	232

IPAM

VRFs Virtual routing and forwarding tables	32568
Aggregates Top-level IP allocations	10
Prefixes IPv4 and IPv6 network assignments	7152
IP Addresses Individual IPv4 and IPv6 addresses	29272
VLANs Layer two domains, identified by VLAN ID	216056

Circuits

Providers Organizations which provide circuit connectivity	2
Circuits Communication links for Internet transit, peering, and other services	1

Virtualization

Clusters Clusters of physical hosts in which VMs reside	5
Virtual Machines Virtual compute instances running inside clusters	137

Secrets

Secrets Cryptographically secured secret data	0

Reports

broken_ports_report.BrokenPorts	Failed
devicetype_quality_reports.DeviceTypeQualityReports	Failed
duplicate_sl1_devices.DuplicateSl1Devices	Completed
h2_vlan_usage_report.H2UsageReport	Completed
interface_quality_reports.InterfaceQualityReports	Failed
mfa_splitter_reports.MfaSplitterReport	Completed
non_monitored_devices.MissingMonitoredDevices	Completed
pe_reports.PeTenGigPortReports	Completed
pe_reports.PeTenGigPortReportsNordenergi	Failed
pe_reports.PeTenGigPortReportsNorlys	Failed

Change Log

Modified Interface GigabitEthernet1/0/9
reso - 2024-03-25 12:50

Modified VLAN opennet-h1-t-vlans-s1090-t142 (142)
admin - 2024-03-25 12:50

Modified VLAN opennet-h1-t-vlans-s1090-t142 (142)
admin - 2024-03-25 12:50

Modified VLAN opennet-h1-t-vlans-s1090-t142 (142)
admin - 2024-03-25 12:50

Modified VLAN opennet-h1-t-vlans-s1090-t142 (142)
admin - 2024-03-25 12:50

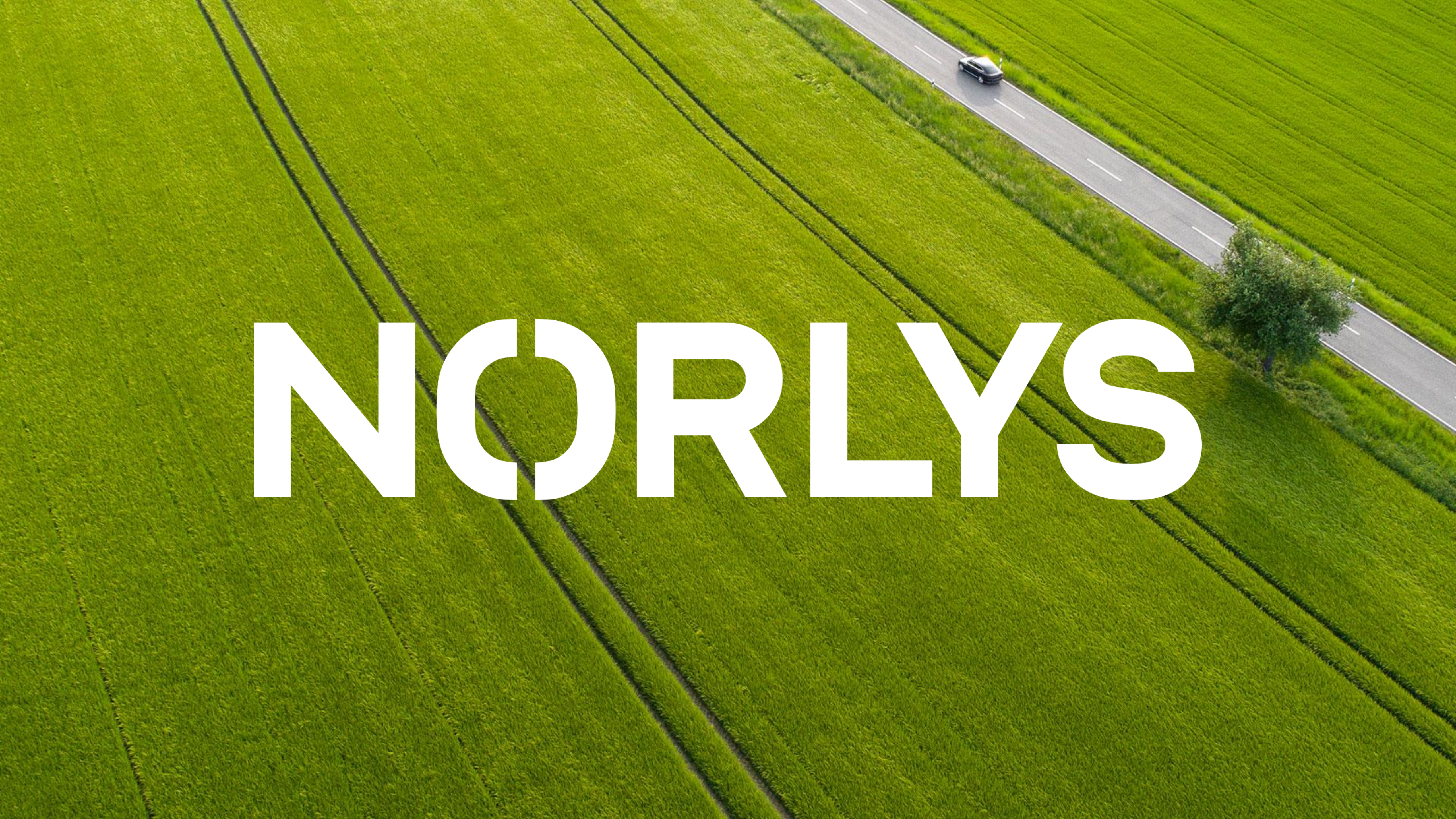
Created VLAN opennet-h1-t-vlans-s1090-t142 (142)
admin - 2024-03-25 12:50

Created Cable #84670

Norlys PRODUCTION netbox instance

netbox-1.stofa.net (v2.10.4)

2024-03-25 12:51:09 CET



NORLYS