

# DC Automation with NetBox

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The Nokia logo is displayed in white, uppercase letters within a large white arrow shape that points to the left. The arrow is set against a blue background that transitions from a darker blue at the top to a lighter teal at the bottom.

# Agenda

1. NESC introduction
2. NetBox introduction
3. Rack creation process
4. Demo

# NESC introduction

## Nokia Engineering and Services Cloud

- Internal private cloud
  - Openstack
  - Kubernetes
  - BMaaS
  - Storage
  - DBaaS
- Hybrid cloud
  - Integration with public clouds
- Cost efficient computing resources



# NESC

7

Datcenters

400

Racks

12k

Devices

720k

Cores

50PB

Storage

4800

Accounts

# Agenda

1. NESC introduction
2. NetBox introduction
3. Rack creation process
4. Demo

# NetBox

- DCIM/IPAM tool
- Development initiated by Digital Ocean network team
- Open source, sponsored by netboxlabs, Equinix, Digital Ocean and Sentry
- <https://github.com/netbox-community/netbox>
- Python, Django, Postgres, Redis



EQUINIX



NOKIA

Nokia internal use

# NetBox

- Actively developed, very active Community  
<https://github.com/netbox-community/netbox>
- Nice GUI, well documented REST API, GraphQL
- Customizable and extendible



# NetBox

## What is it?

- DCIM and IPAM tool
  - Sites: Data center sites and rooms
  - Racks: Organized by location and site
  - Devices: Types of devices and where they are installed
  - Connections: Network, console, and power
  - IPAM: IP addresses/networks, VLANs, VRFs
  - Virtualization: Virtual machines and clusters
  - Power: PSU, PDU, Power panels
  - Data circuits: Long-haul communications circuits and providers
  - Config context: Configurational parameters





# NetBox

## What is it not?

- Network monitoring
- No automation out of the box
- DNS/DHCP server
- Configuration management



However, Netbox data can be used  
for all these use cases and more

# NetBox

## Hosting options

- Manual installation instructions
  - <https://docs.netbox.dev/en/stable/installation/>
- Ansible role
  - <https://galaxy.ansible.com/lae/netbox>
- Docker/compose
  - <https://github.com/netbox-community/netbox-docker>
- Kubernetes / Helm
  - <https://github.com/bootc/netbox-chart>
- Netbox Cloud
  - Hosted solution with free trial



# NetBox

## NetBox at NESC

- NetBox has been used at NESC since 2017
  - DCIM and IPAM
- Various integrations
  - DNS
  - DHCP
  - Dynamic inventories
  - Enrich log events
  - Enrich monitoring data
  - etc.



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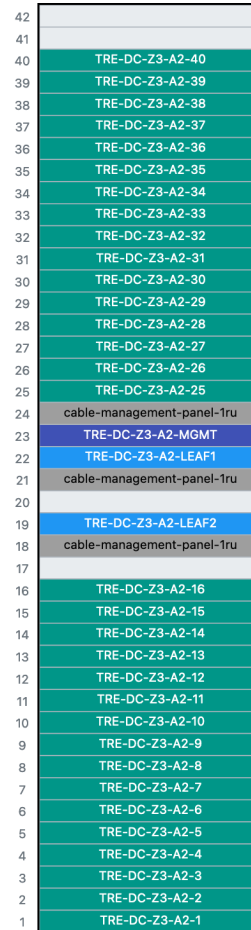
# Rack creation process

- Multiple device types, multiple rack layouts
  - Compute, storage, GPU racks
- Rack creation has to be done with code
  - Rest of the automation processes rely on this information
- Templates
  - Rack layout
  - Cabling
  - IP prefix/address allocation

42	
41	
40	TRE-DC-Z3-A2-40
39	TRE-DC-Z3-A2-39
38	TRE-DC-Z3-A2-38
37	TRE-DC-Z3-A2-37
36	TRE-DC-Z3-A2-36
35	TRE-DC-Z3-A2-35
34	TRE-DC-Z3-A2-34
33	TRE-DC-Z3-A2-33
32	TRE-DC-Z3-A2-32
31	TRE-DC-Z3-A2-31
30	TRE-DC-Z3-A2-30
29	TRE-DC-Z3-A2-29
28	TRE-DC-Z3-A2-28
27	TRE-DC-Z3-A2-27
26	TRE-DC-Z3-A2-26
25	TRE-DC-Z3-A2-25
24	cable-management-panel-1ru
23	TRE-DC-Z3-A2-MGMT
22	TRE-DC-Z3-A2-LEAF1
21	cable-management-panel-1ru
20	
19	TRE-DC-Z3-A2-LEAF2
18	cable-management-panel-1ru
17	
16	TRE-DC-Z3-A2-16
15	TRE-DC-Z3-A2-15
14	TRE-DC-Z3-A2-14
13	TRE-DC-Z3-A2-13
12	TRE-DC-Z3-A2-12
11	TRE-DC-Z3-A2-11
10	TRE-DC-Z3-A2-10
9	TRE-DC-Z3-A2-9
8	TRE-DC-Z3-A2-8
7	TRE-DC-Z3-A2-7
6	TRE-DC-Z3-A2-6
5	TRE-DC-Z3-A2-5
4	TRE-DC-Z3-A2-4
3	TRE-DC-Z3-A2-3
2	TRE-DC-Z3-A2-2
1	TRE-DC-Z3-A2-1

# Rack creation process

- Typical rack
  - 12-36 servers
  - 2 leafs, 1 mgmt switch
  - 2-4 PDUs
    - 1GE, 48 power outlets
  - Connections from each server
    - 2 connections to both leaf switches
    - BMC connection
    - 2 power cables
  - Allocation of IP prefixes and addresses, AS numbers, etc.
  - Adding MAC addresses
  - = impossible to create these manually via GUI



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36	TRE-DC-Z3-A2-36
35	TRE-DC-Z3-A2-35
34	TRE-DC-Z3-A2-34
33	TRE-DC-Z3-A2-33
32	TRE-DC-Z3-A2-32
31	TRE-DC-Z3-A2-31
30	TRE-DC-Z3-A2-30
29	TRE-DC-Z3-A2-29
28	TRE-DC-Z3-A2-28
27	TRE-DC-Z3-A2-27
26	TRE-DC-Z3-A2-26
25	TRE-DC-Z3-A2-25
24	cable-management-panel-1ru
23	TRE-DC-Z3-A2-MGMT
22	TRE-DC-Z3-A2-LEAF1
21	cable-management-panel-1ru
20	
19	TRE-DC-Z3-A2-LEAF2
18	cable-management-panel-1ru
17	
16	TRE-DC-Z3-A2-16
15	TRE-DC-Z3-A2-15
14	TRE-DC-Z3-A2-14
13	TRE-DC-Z3-A2-13
12	TRE-DC-Z3-A2-12
11	TRE-DC-Z3-A2-11
10	TRE-DC-Z3-A2-10
9	TRE-DC-Z3-A2-9
8	TRE-DC-Z3-A2-8
7	TRE-DC-Z3-A2-7
6	TRE-DC-Z3-A2-6
5	TRE-DC-Z3-A2-5
4	TRE-DC-Z3-A2-4
3	TRE-DC-Z3-A2-3
2	TRE-DC-Z3-A2-2
1	TRE-DC-Z3-A2-1

# Rack creation process

- Netbox custom scripts
  - Python code outside of the official NetBox code base
    - Can be run within Netbox UI and REST API
  - Most common use case is to Interact with Netbox database but possible to run any code, e.g interact with other systems
  - Transactions, i.e. there is an exception, the changes are rolled back
  - Dry run
  - Speed
  - Scheduling and cron

The screenshot shows the 'Create a rack' script interface in NetBox. The page title is 'Create a rack' and the subtitle is 'Create a new rack, devices, and connections according to template, version 0.112'. The interface is divided into two tabs: 'Run' and 'Source'. The 'Run' tab is active, showing the 'Script Data' section with the following fields:

- Template \***: A dropdown menu.
- Site \***: A dropdown menu.
- Location \***: A dropdown menu.
- Name suffix \***: A text input field with a note: 'Last part of the rack name'.
- Asset tag \***: A text input field.
- Purchase order \***: A text input field.
- Power panel 1 \***: A dropdown menu with a note: 'Power panel for first power feed'.
- Power panel 2 \***: A dropdown menu with a note: 'Power panel for second power feed'.

Below the 'Script Data' section is the 'Script Execution Parameters' section:

- Schedule at**: A text input field with a note: 'Schedule execution of script to a set time (current time: 2023-04-07 06:14:27)'. The value is 'YYYY-MM-DD HH:mm:ss'.
- Recurs every**: A dropdown menu with a note: 'Interval at which this script is re-run (in minutes)'. The value is 'Recurs every'.
- Commit changes**: A checkbox with a note: 'Commit changes to the database (uncheck for a dry-run)'.

At the bottom right, there are two buttons: 'Cancel' and 'Run Script'.



# Rack creation process

## Config file, rack layout

```
1  - position: "18"  
2    type: "cable-management-panel-1ru"  
3    role: "cable-manager"  
4    name: "CG-18"  
5  - position: "16-1"  
6    type: "rm20-af0321-1u"  
7    role: "openstacknode"  
8  non_racked_devices:  
9    - position: "PDU1"  
10     type: "ap8886x657"  
11     role: "power-distribution-unit"  
12    - position: "PDU2"  
13     type: "ap8886x657"  
14     role: "power-distribution-unit"  
15    - position: "PDU3"  
16     type: "ap8886x657"  
17     role: "power-distribution-unit"  
18    - position: "PDU4"  
19     type: "ap8886x657"  
20     role: "power-distribution-unit"
```

```
1  ---  
2  name: Rack with 32 x RM20-AF0321-1U  
3  height: 42  
4  width: 19  
5  outer_width: 600  
6  outer_depth: 1200  
7  role: compute  
8  power_connections: rm20-compute-power  
9  interface_connections: rm20-compute-s5232f-os10-interfaces  
10 devices:  
11   - position: "40-25"  
12     type: "rm20-af0321-1u"  
13     role: "openstacknode"  
14   - position: "24"  
15     type: "cable-management-panel-1ru"  
16     role: "cable-manager"  
17     name: "CG-24"  
18   - position: "23"  
19     type: "dell_powerswitch_n3248te-on"  
20     role: "management-switch"  
21     name: "MGMT"  
22   - position: "22"  
23     type: "powerswitch-s5232f-on-25g"  
24     role: "leaf-switch"  
25     name: "LEAF1"  
26   - position: "21"  
27     type: "cable-management-panel-1ru"  
28     role: "cable-manager"  
29     name: "CG-21"  
30   - position: "19"  
31     type: "powerswitch-s5232f-on-25g"  
32     role: "leaf-switch"  
33     name: "LEAF2"
```

# Rack creation process

## Config file, interface cabling

- Device A U position in the rack
- Device A interface name for cable label
- Device A interface in netbox device
- Device B U position in the rack
- Device B interface name for cable label
- Device B interface in netbox device
- Cable type

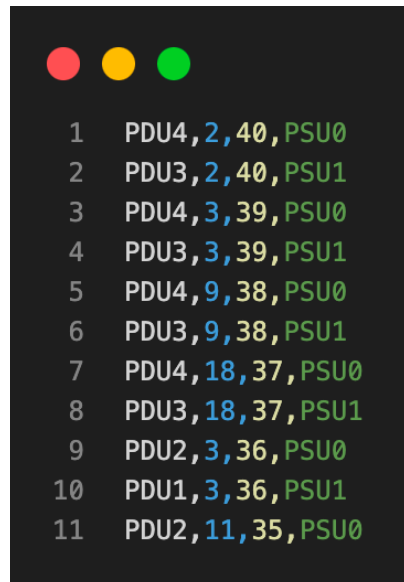
```
1 40,P1,NIC0P1,22,P19/4,Ethernet 1/1/19:4,DAC
```

```
1 40,BMC,BMC,23,P31,Ethernet 1/1/31,CAT6
2 40,P1,NIC0P1,22,P19/4,Ethernet 1/1/19:4,DAC
3 40,P2,NIC0P2,19,P19/4,Ethernet 1/1/19:4,DAC
4 40,P3,NIC3P1,22,P23/4,Ethernet 1/1/23:4,DAC
5 40,P4,NIC3P2,19,P23/4,Ethernet 1/1/23:4,DAC
6 39,BMC,BMC,23,P29,Ethernet 1/1/29,CAT6
7 39,P1,NIC0P1,22,P19/3,Ethernet 1/1/19:3,DAC
8 39,P2,NIC0P2,19,P19/3,Ethernet 1/1/19:3,DAC
9 39,P3,NIC3P1,22,P23/3,Ethernet 1/1/23:3,DAC
10 39,P4,NIC3P2,19,P23/3,Ethernet 1/1/23:3,DAC
11 38,BMC,BMC,23,P27,Ethernet 1/1/27,CAT6
12 38,P1,NIC0P1,22,P19/2,Ethernet 1/1/19:2,DAC
13 38,P2,NIC0P2,19,P19/2,Ethernet 1/1/19:2,DAC
14 38,P3,NIC3P1,22,P23/2,Ethernet 1/1/23:2,DAC
15 38,P4,NIC3P2,19,P23/2,Ethernet 1/1/23:2,DAC
16 37,BMC,BMC,23,P25,Ethernet 1/1/25,CAT6
17 37,P1,NIC0P1,22,P19/1,Ethernet 1/1/19:1,DAC
18 37,P2,NIC0P2,19,P19/1,Ethernet 1/1/19:1,DAC
19 37,P3,NIC3P1,22,P23/1,Ethernet 1/1/23:1,DAC
20 37,P4,NIC3P2,19,P23/1,Ethernet 1/1/23:1,DAC
21 36,BMC,BMC,23,P23,Ethernet 1/1/23,CAT6
22 36,P1,NIC0P1,22,P13/4,Ethernet 1/1/13:4,DAC
23 36,P2,NIC0P2,19,P13/4,Ethernet 1/1/13:4,DAC
24 36,P3,NIC3P1,22,P17/4,Ethernet 1/1/17:4,DAC
25 36,P4,NIC3P2,19,P17/4,Ethernet 1/1/17:4,DAC
```

# Rack creation process

Config file, power cabling

- PDU name
- PDU power outlet
- Device U position
- Device PSU name



```
1 PDU4,2,40,PSU0
2 PDU3,2,40,PSU1
3 PDU4,3,39,PSU0
4 PDU3,3,39,PSU1
5 PDU4,9,38,PSU0
6 PDU3,9,38,PSU1
7 PDU4,18,37,PSU0
8 PDU3,18,37,PSU1
9 PDU2,3,36,PSU0
10 PDU1,3,36,PSU1
11 PDU2,11,35,PSU0
```

# Rack creation process

## IP address allocation

Scripts > Rack\_operations rack\_operations.AllocateIPAddr

### Allocate IP address

Allocate IP address using configuration template, version 0.1.12

Run Source

#### Script Data

Site \*

Location \*

Rack \*

Template \*

Tenant

Choose tenant if new networks are created

#### Script Execution Parameters

Schedule at

Schedule execution of script to a set time (current time: 2023-04-11 05:19:32)

Rekurs every

Interval at which this script is re-run (in minutes)

Commit changes

Commit changes to the database (uncheck for a dry-run)

# Rack creation process

## Config file, IP prefix/address

Prefixes

### 192.168.0.0/20

Created 2023-04-06 11:21 · Updated 11 hours, 23 minutes ago

Prefix Child Prefixes **1** Child Ranges IP Addresses **39** Journal Changelog

**Prefix**

Family	IPv4
VRF	Global
Tenant	Shared / Shared
Aggregate	—
Site	Tampere / Tampere DC
VLAN	—
Status	<b>Container</b>
Role	OOB
Description	—
Is a pool	×

```
1 ---
2 prefixes:
3   OOB:
4     create_new_prefix: true
5     prefix_len: 26
6     prefix_role: OOB
7     tenant: Shared
8
9   ip_addresses:
10    OOB:
11      allocation_start: 4
12      allocation_by_position: true
13      primary_ip: true
14      device_roles:
15        - leaf-switch
16        - management-switch
17        - power-distribution-unit
18        - openstacknode
19      create_interface: false
20      interfaces:
21        - BMC
22        - P1
23        - ManagementEthernet 1/1
24        - Management 1/1/1
25        - mgmt 1/1/1
26        - eth0
```

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