HEAnet
Ireland's National Education & Research Network

CONNECTING EDUCATION EMPOWERING RESEARCH

Our journey to a vendor agnostic …

Workflow Orchestrator

INEX Members Meeting / Dublin / 20th March 2025

Agenda

Who am I and who are we?

Where we've come from?

Where are we now?

Demo

HEAnet
Ireland's National Education & Research Network

CONNECTING EDUCATION EMPOWERING RESEARCH

Who is Mick O'Donovan?

- Doing network engineering stuff since around 2003
- Joined HEAnet networks team in 2021 (yes that was during lockdown!)
- Some may know me from my former employer (which is now a former company!) BT Ireland.
- Coming to INEX meetings since 2012 but never presented (until now!!!)
- You may have seen us present at TNC2024 (https://tnc24.geant.org/recordings/?session=s520)

HEAnet
Ireland's National Education & Research Network

CONNECTING EDUCATION EMPOWERING RESEARCH

Who are we?

IR&D:

Andy Byrne (PM)

Donal Cunningham

Networks:

Garwin Liu

Mick O’Donovan

Architecture:

Anna Wilson

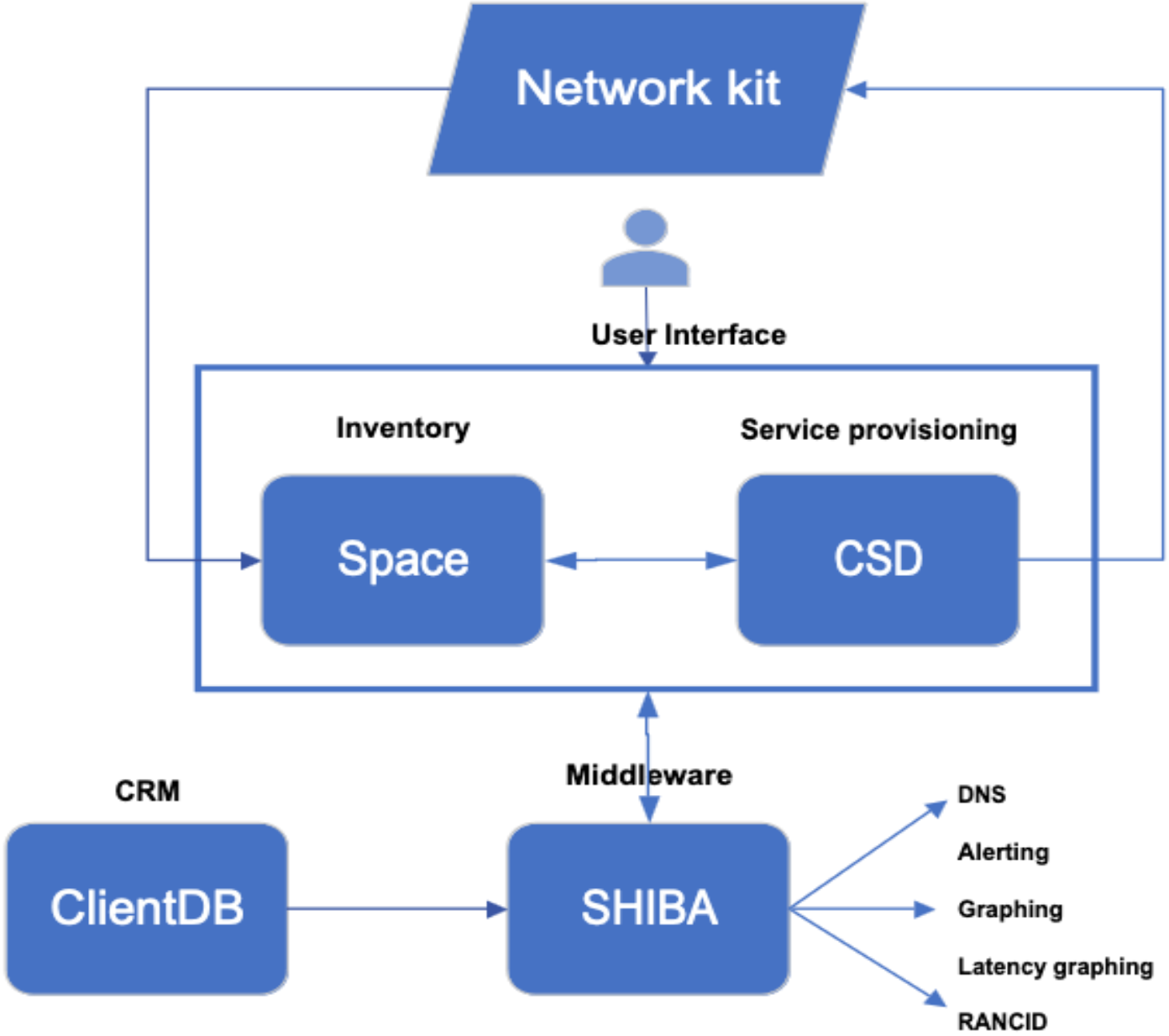
Brian McArdle

Erick Lopez

Valentine Hayes

HEAnet
Ireland’s National Education & Research Network

Where we've come from?



HEAnet
Ireland's National Education & Research Network

CONNECTING EDUCATION EMPOWERING RESEARCH

Junos Space Connectivity Services Director Dates & Milestones

Support | Downloads | Knowledge Base | Juniper Support Portal | Community

The following Junos Space Connectivity Services Director hardware products have all been announced as End of Life (EOL). The End of Support (EOS) milestone dates for the five (5) year support model are published below.

quired).

6connect ProVision – © 2024 v6.1.1 – (HEAnet)

HEAnet | IPAM Admin | VLAN Admin | Data Import | Users

This product is licensed to **noc@heanet.ie** and expires in 660 days.

A new version is available: 8.1.0. Upgrade now.

Interim solution

Ansible CLI / AWX
YAML

SHIBA

JunOS SPACE

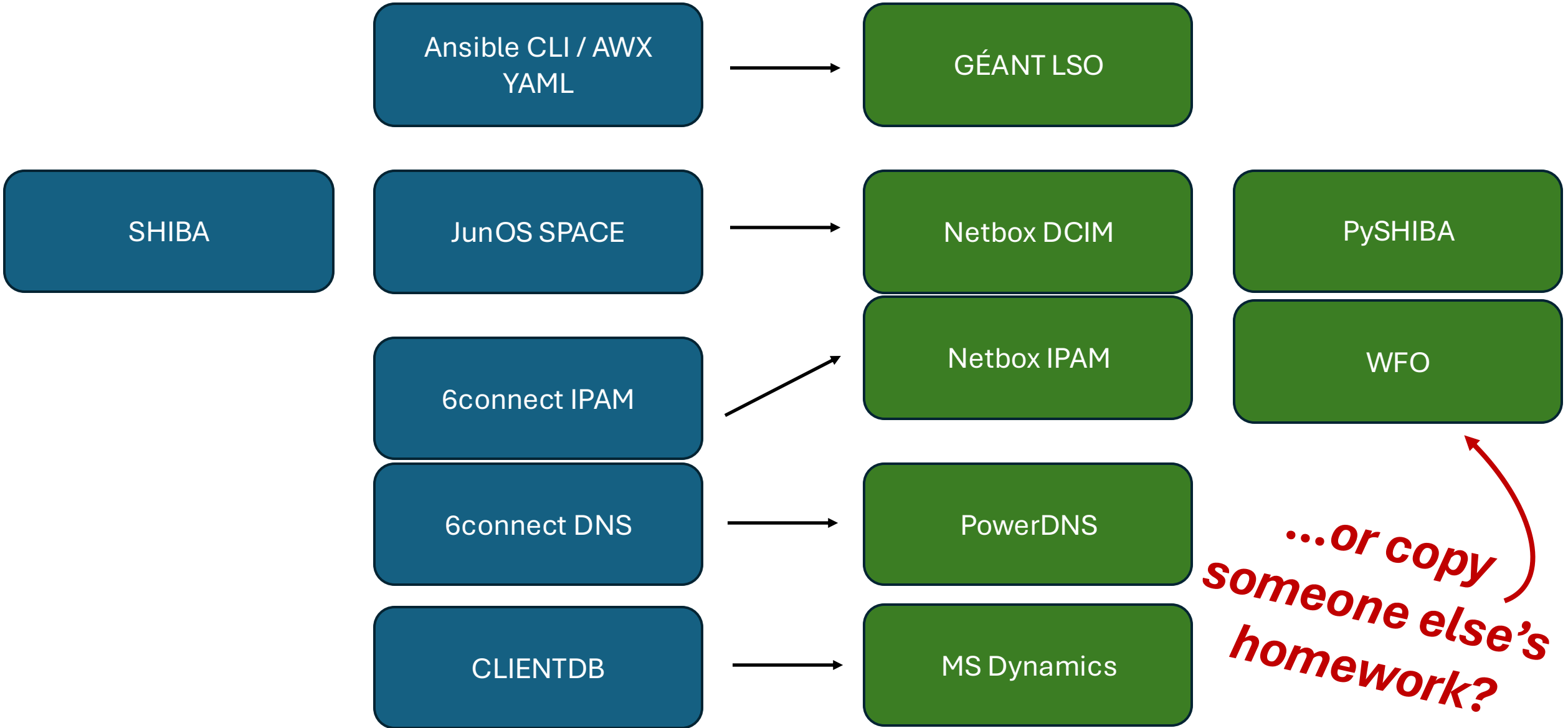
6connect IPAM

6connect DNS

Provision services

Still working… sorta?

Future solution



Workflow Orchestrator

```python
@create_workflow("Create L2vpnPP", initial_input_form=initial_input_form_generator)
def create_l2vpn_pp() -> StepList:
    return (
        begin
        >> construct_l2vpn_model
        >> store_process_subscription(Target.CREATE)
        >> ims_create_l2vpn
        >> ims_crea
        # >> ims_up
        >> ims_crea
        >> lso.indi
        >> lso.indi
        >> create_i
        >> create_s
        >> set_stat
    )
```

```python
@step("Create L2VPN terminations in Netbox")
def ims_create_l2vpn_terminations(subscription: L2vpnPPProvisioning) -> State:
    payloads = []
    l2vpn = netbox.get_l2vpn(id=subscription.virtual_circuit.ims_id)
    for sap in subscription.virtual_circuit.saps:
        subint_ims_id = netbox.get_interface(
            name=f"{sap.port.port_name}.0", device=sap.port.node.node_name
```

```python
def _call_ansible_playbook(
    subscription: L2vpnPPProvisioning,
    callback_route: str,
    *,
    dry_run: bool,
    commit_changes: bool,
) -> None:

    port_A = subscription.virtual_circuit.saps[0].port
    port_B = subscription.virtual_circuit.saps[1].port

    inventory = f"{port_A.node.node_name}.nn.hea.net\n{port_B.node.node_name}.nn.hea.net"
    extra_vars = {
        "vc_id": subscription.virtual_circuit.vc_id,
        "interface_description": f"(UN) {title(subscription)} vpn/l2vpns/{subscription.virtual_circuit.ims_id}",
        "SiteA": f"{port_A.node.node_name}.nn.hea.net",
        "interfaceA": port_A.port_name,
        "p2p_endpointB": f"{port_A.node.node_name}.nn.hea.net",
        "SiteB": f"{port_B.node.node_name}.nn.hea.net",
        "interfaceB": port_B.port_name,
        "p2p_endpointA": f"{port_B.node.node_name}.nn.hea.net",
        "ansible_ssh_user": "{{ lookup('env', 'ANSIBLE_SSH_USER') }}",
        "ansible_ssh_pass": "{{ lookup('env', 'ANSIBLE_SSH_PASS') }}",
        "ansible_network_os": "junos",
        "host_key_checking": False,
        "dry_run": dry_run,
        "commit_changes": commit_changes,
        "verb": "deploy",
    }
```

Lightweight service orchestrator

This page describes the inner workings of the Lightweight Service Orchestrator (LSO), that handles the interaction between GSO and Ansible.

Motivation

For the deployment of new services in the GÉANT network, Ansible playbooks are used to deploy configuration statements onto remote devices. To make this interaction possible, LSO exposes an API that allows for the remote execution of playbooks.

The need to externalise this interaction comes from the fact that the Python library used to execute playbooks, introduces a potential situation where dependency versions could be conflicting. To prevent this from happening, GSO and LSO each are their own Python package, with each their own, independent library dependencies.

Inner workings

LSO uses `ansible-runner` for the execution of Ansible playbooks. This package fully dictates the way in which GAP interacts with Ansible itself. LSO only introduces an API with a single REST endpoint that exposes its functionality.

In the case of GAP, all Ansible playbooks operate without an inventory that contains all relevant `group_vars` and `host_vars`. The inventory is passed to the API endpoint for executing a playbook, which contains all required `host_vars`. For the other information relevant to the playbook, this is passed through the API by making use of `extra_vars`. In virtually all cases, the `extra_vars` will at least consist of the subscription object that is being deployed, and assisting variables, such as 'verb' used to express an operation.

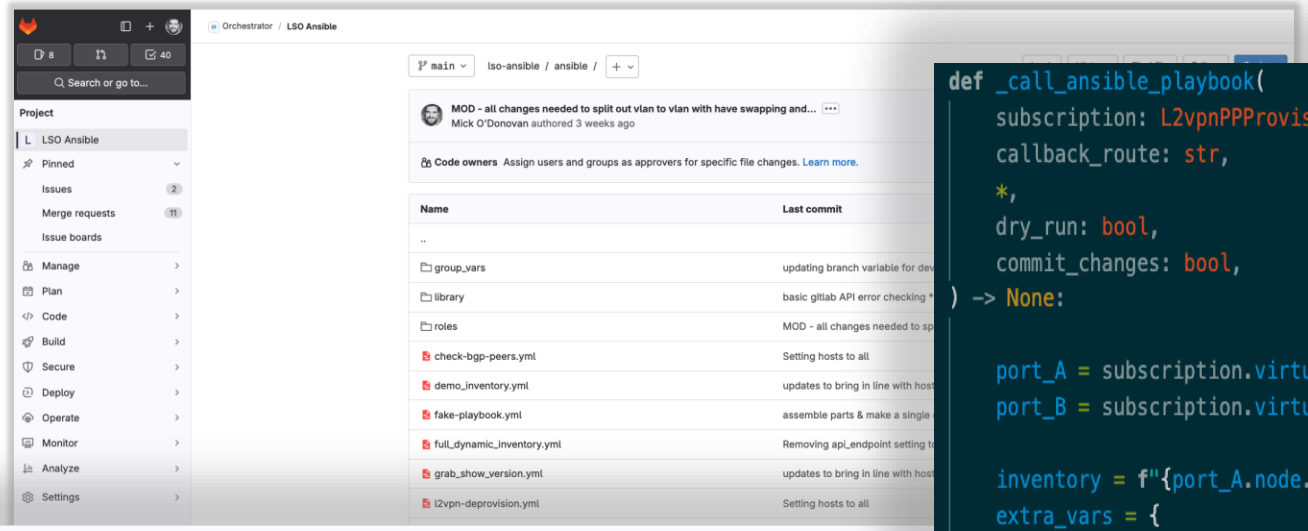
GitLab

A home for

ANSIBLE

HEAnet
Ireland's National Education & Research Network

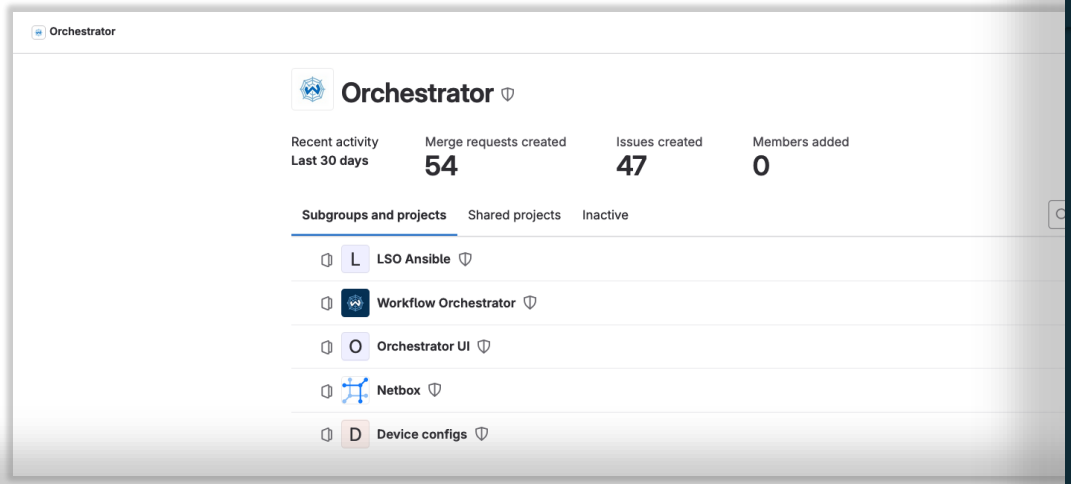
CONNECTING EDUCATION EMPOWERING RESEARCH

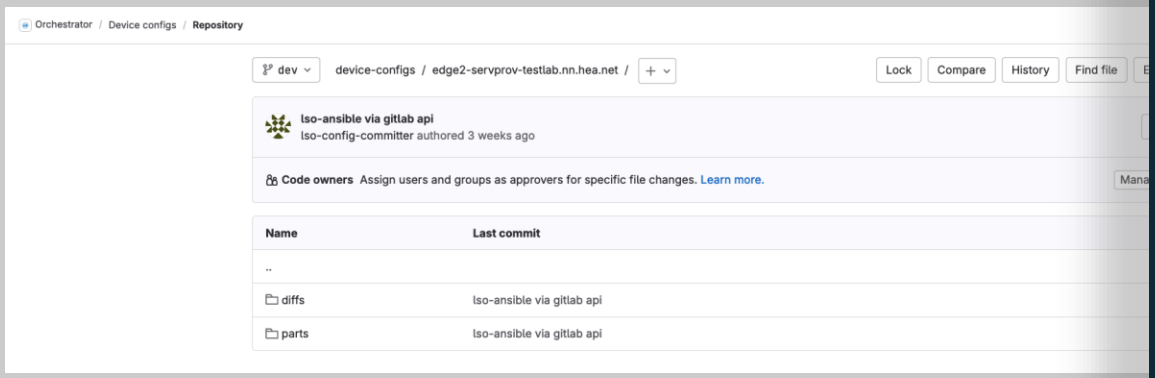


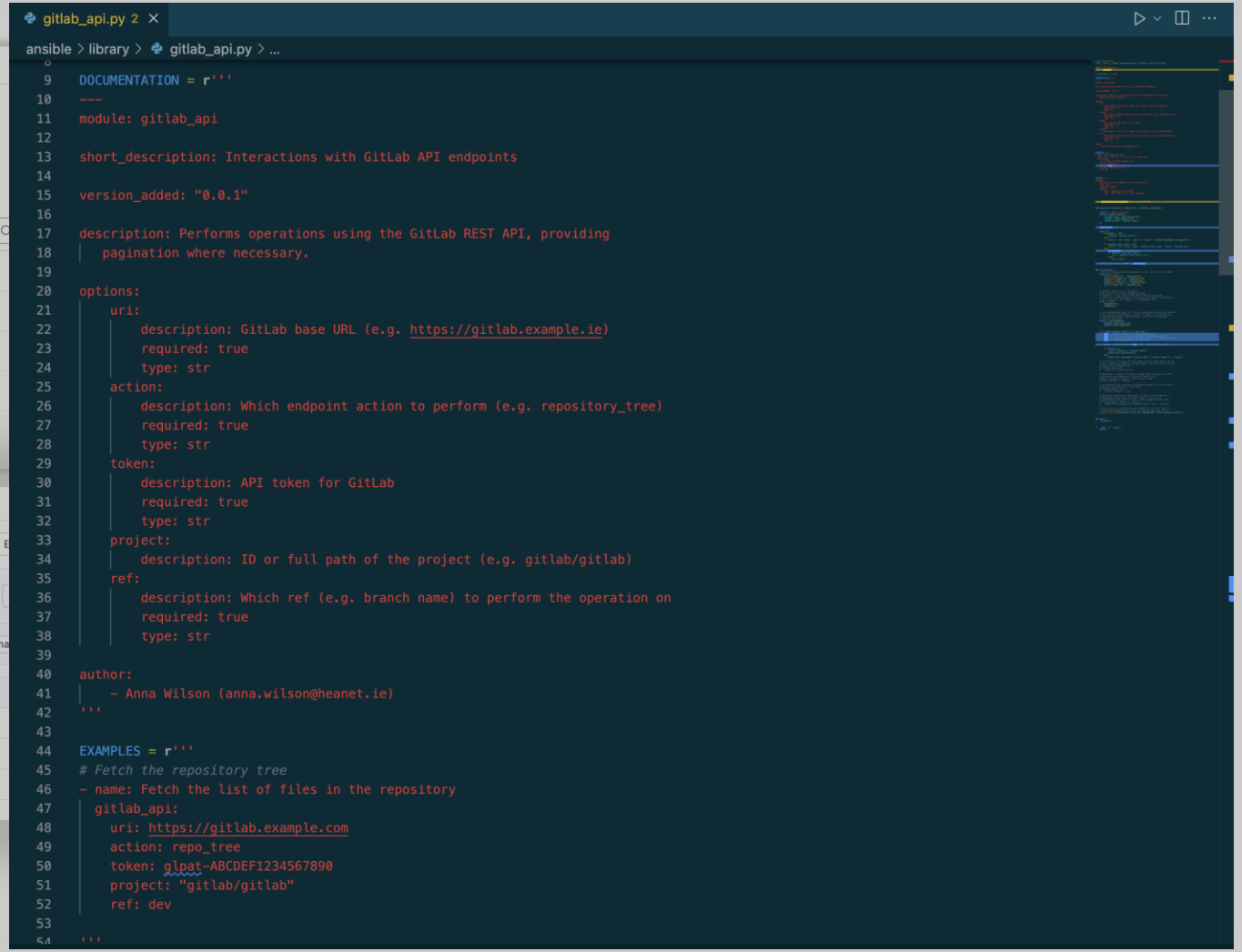
l2vpn-port-to-port.j2 1.05 KiB Blame Edit Lock Replace Delete

```
{% for l2circuit in l2circuits %}

    {% if inventory_hostname == l2circuit.config.nodeA.name  %}
        {% set local= l2circuit.config.nodeA %}
        {% set remote= l2circuit.config.nodeB %}
        {% set common= l2circuit.config.common %}
    {% endif %}
    {% if inventory_hostname == l2circuit.config.nodeB.name  %}
        {% set local= l2circuit.config.nodeB %}
        {% set remote= l2circuit.config.nodeA %}
        {% set common= l2circuit.config.common %}
    {% endif %}

    set interfaces {{ local.interface }} encapsulation ethernet-ccc
    set interfaces {{ local.interface }} mtu {{ common.mtu }}
    set interfaces {{ local.interface }} unit 0 description "{{ common.int_desc }}"
    set protocols l2circuit neighbor {{ remote.p2p_endpoint }} interface {{ local.interface }} mtu 9192
    set protocols l2circuit neighbor {{ remote.p2p_endpoint }} interface {{ local.interface }} pseudowire-status-tlv
    set protocols l2circuit neighbor {{ remote.p2p_endpoint }} interface {{ local.interface }} virtual-circuit-id {{ common.vc_id

{% endfor %}
```

```python
def _call_ansible_playbook(
    subscription: L2vpnPPProvisioning,
    callback_route: str,
    *,
    dry_run: bool,
    commit_changes: bool,
) -> None:

    port_A = subscription.virtual_circuit.saps[0].port
    port_B = subscription.virtual_circuit.saps[1].port

    inventory = f"{port_A.node.node_name}.nn.hea.net\n{port_B.node.node_name}.nn.hea.net"
    extra_vars = {
        "vc_id": subscription.virtual_circuit.vc_id,
        "interface_description": f"(UN) {title(subscription)} vpn/l2vpns/{subscription.virtual_circuit.ims_id}",
        "SiteA": f"{port_A.node.node_name}.nn.hea.net",
        "interfaceA": port_A.port_name,
        "p2p_endpointB": f"{port_A.node.node_name}.nn.hea.net",
        "SiteB": f"{port_B.node.node_name}.nn.hea.net",
        "interfaceB": port_B.port_name,
        "p2p_endpointA": f"{port_B.node.node_name}.nn.hea.net",
        "ansible_ssh_user": "{{ lookup('env', 'ANSIBLE_SSH_USER') }}",
        "ansible_ssh_pass": "{{ lookup('env', 'ANSIBLE_SSH_PASS') }}",
        "ansible_network_os": "junos",
        "host_key_checking": False,
        "dry_run": dry_run,
        "commit_changes": commit_changes,
        "verb": "deploy",
    }
```


Orchestrator
Orchestrator
Recent activity
Last 30 days
Merge requests created
54
Issues created
47
Members added
0
Subgroups and projects
Shared projects
Inactive
LSO Ansible
Workflow Orchestrator
Orchestrator UI
Netbox
Device configs


Orchestrator / Device configs / Repository
dev
device-configs / edge2-servprov-testlab.nn.hea.net /
Lock
Compare
History
Find file
lso-ansible via gitlab api
lso-config-committer authored 3 weeks ago
Code owners Assign users and groups as approvers for specific file changes. Learn more.
Name
Last commit
..
diffs
lso-ansible via gitlab api
parts
lso-ansible via gitlab api

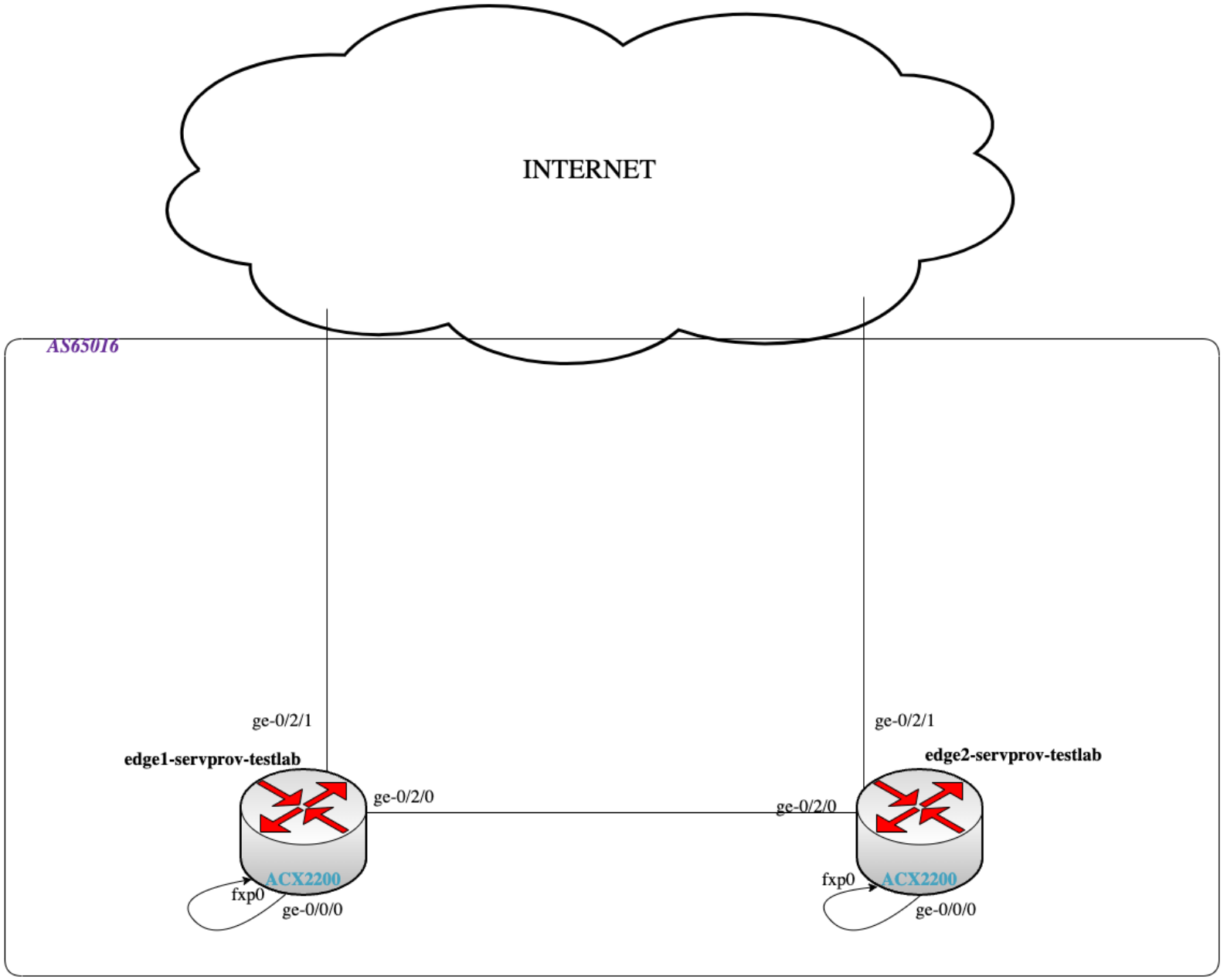

gitlab_api.py 2
ansible > library > gitlab_api.py > ...
DOCUMENTATION = r'''
module: gitlab_api
short_description: Interactions with GitLab API endpoints
version_added: "0.0.1"
description: Performs operations using the GitLab REST API, providing
pagination where necessary.
options:
uri:
description: GitLab base URL (e.g. https://gitlab.example.ie)
required: true
type: str
action:
description: Which endpoint action to perform (e.g. repository_tree)
required: true
type: str
token:
description: API token for GitLab
required: true
type: str
project:
description: ID or full path of the project (e.g. gitlab/gitlab)
ref:
description: Which ref (e.g. branch name) to perform the operation on
required: true
type: str
author:
- Anna Wilson (anna.wilson@heanet.ie)
'''
EXAMPLES = r'''
# Fetch the repository tree
- name: Fetch the list of files in the repository
gitlab_api:
uri: https://gitlab.example.com
action: repo_tree
token: glpat-ABCDEF1234567890
project: "gitlab/gitlab"
ref: dev
'''

Let’s do a Demo

Workflow Orchestrator

HEAnet
Ireland's National Education & Research Network

CONNECTING EDUCATION EMPOWERING RESEARCH



DEMO Network

2x Juniper ACX2200 routers

Both routers running MPLS

Both within the same test ASN

Each fxp0 looped back to ge-0/0/0

HEAnet
Ireland's National Education & Research Network

CONNECTING EDUCATION EMPOWERING RESEARCH

edge1-servprov-testlab (ssh)

```
❯ ssh edge1-servprov-testlab

                    +-------------------------------------------------------------+
                    |                    HEAnet Ltd.                              |
                    |                    -----------                              |
                    |                                                             |
                    |                edge1-servprov-testlab                       |
                    |            Service Provision Project Testlab, RACK5, ND2    |
                    |                                                             |
                    |              Problems to: noc@heanet.ie                     |
                    |                Tel:  +353.1.6609040                         |
                    |                Fax:  +353.1.6603666                         |
                    |                                                             |
                    |            Unauthorised Access Prohibited                   |
                    |                                                             |
                    +-------------------------------------------------------------+
(heanet@edge1-servprov-testlab) Password:
Last login: Tue Mar 18 16:14:46 2025 from 2001:770:b7::101d
--- JUNOS 20.4R3.8 built 2021-09-07 17:14:52 UTC
heanet@edge1-servprov-testlab> show configuration interfaces ge-0/0/0
description "(UN) Link to fxp0 on this router using 192.168.25.1/24";
mtu 9192;
encapsulation ethernet-ccc;

heanet@edge1-servprov-testlab>
```

edge2-servprov-testlab (ssh)

```
❯ ssh edge2-servprov-testlab

                    +-------------------------------------------------------------+
                    |                    HEAnet Ltd.                              |
                    |                    -----------                              |
                    |                                                             |
                    |                edge2-servprov-testlab                       |
                    |            Service Provision Project Testlab, RACK5, ND2    |
                    |                                                             |
                    |              Problems to: noc@heanet.ie                     |
                    |                Tel:  +353.1.6609040                         |
                    |                Fax:  +353.1.6603666                         |
                    |                                                             |
                    |            Unauthorised Access Prohibited                   |
                    |                                                             |
                    +-------------------------------------------------------------+
(heanet@edge2-servprov-testlab) Password:
Last login: Tue Mar 18 16:14:50 2025 from 2001:770:b7::101d
--- JUNOS 20.4R3.8 built 2021-09-07 17:14:52 UTC
heanet@edge2-servprov-testlab> show configuration interfaces ge-0/0/0
description "(UN) Link to fxp0 on this router using 192.168.25.2/24";
mtu 9192;
encapsulation ethernet-ccc;

heanet@edge2-servprov-testlab>

heanet@edge2-servprov-testlab>
```

What about other workflows?

- LIR assignments – most of us need to do this right?
- Let's try to automate the process a bit more
- Have you heard about the RIPE NCC's new REST API endpoint for the database?

RIPE Labs

Ed Shryane > Using API Keys in the RIPE Database

Want to contribute? Learn how

Using API Keys in the RIPE Database

Ed Shryane — 30 Jan 2025
4 min read

ripe database operational

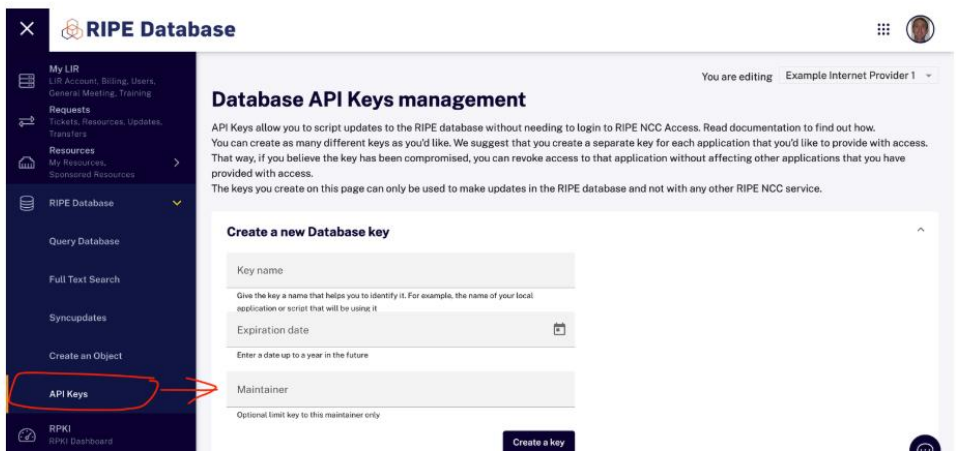
27 2

API keys are a new way to authenticate updates in the RIPE Database. They are associated with a user's RIPE NCC Access account, and are intended to help you script (automate) updates to the RIPE Database.

We are introducing API keys as an easy to use alternative to MD5 hashed passwords, which we plan to deprecate later this year. We plan to extend API keys to other RIPE NCC services in the future.

For anyone reading this who only makes updates using the web interface - you don't need API keys! For everyone else, in this article, I'm going to show you the new API keys feature of the RIPE database.

To start using API keys, the first step is to log in to the LIR Portal and go to the API keys page in the left-hand menu.



More from this author

View more

Impact Analysis for UTF-8 in the RIPE Database
Ed Shryane
12 May 2022

Cleaning Up Locked Person Objects in the RIPE Database
Ed Shryane
30 Apr 2020

Synchronising Users from the LIR Portal to the Default Maintainer in the RIPE Database
Ed Shryane
16 Sep 2019

Source: https://labs.ripe.net/author/ed_shryane/using-api-keys-in-the-ripe-database/

User input
Please submit the form to start this workflow

IPv6 Prefix (LIR Allocation)

Tenants *

INEX

Ip Prefix Settings

Aggregate Block *

2001:db8::/32

To Internet

- [x] To Internet

Autoassign Prefix

- [x] Autoassign Prefix

Manually Assigned Prefix

Set prefix length if auto assigning

Prefix Length

48

Extra Information *

INEX Members Meeting - March 2025 - Additional IPv6 allocation because INEX meetings are a HUGE DEAL!!!!

Tech C *

MO7506-RIPE

Admin C *

MO7506-RIPE

Cancel

Next

+ New subscription

Start
Subscriptions
Workflows
Tasks
Metadata
Settings
Example form

Create ip_prefix

Retry | Abort

IPv6 Prefix (LIR Allocation)

Status	Current step	Customer	Started by	Started on	Last update	Related subscriptions
COMPLETED	Done	Default::Orchestrator-Core Customer	Mick O'Donovan	17:17:56	17:17:58	Prefix allocation for None

Workflow steps

Expand all | Show subscription delta | Options

Start
success - 11/03/2025, 17:17:57
Duration 00:00:00

Construct Subscription model
success - 11/03/2025, 17:17:57
Duration 00:00:00

Create Process Subscription relation
success - 11/03/2025, 17:17:57
Duration 00:00:00

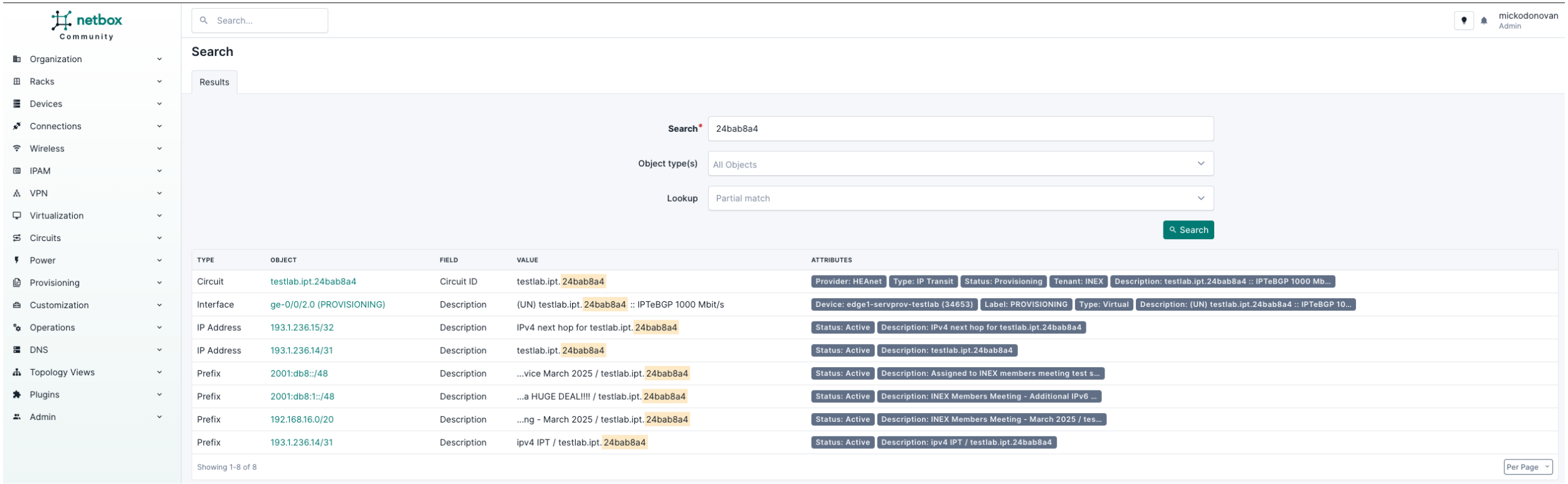
Assign Auto or Manually allocated prefix in NetBox
success - 11/03/2025, 17:17:58
Table view
Duration 00:00:00


```
{
    "subscription": {
        "version": 2,
        "ip_prefix": {
            "assigned_ip_prefix": "2001:db8:1::/48",
            "lir_prefix_ipam_id": 851
        }
    },
    "assigned_ip_prefix": "2001:db8:1::/48",
    "lir_prefix IPAM ID": 851
}
```


Set subscription to 'active'
success - 11/03/2025, 17:17:58
Duration 00:00:00

Set subscription to 'active'
success - 11/03/2025, 17:17:58
Duration 00:00:00

Unlock subscription
success - 11/03/2025, 17:17:58
Duration 00:00:00


netbox
Community
Search...
mickodonovan
Admin
Organization
Racks
Devices
Connections
Wireless
IPAM
VPN
Virtualization
Circuits
Power
Provisioning
Customization
Operations
DNS
Topology Views
Plugins
Admin
Search
Results
Search*
24bab8a4
Object type(s)
All Objects
Lookup
Partial match
Search
TYPE
OBJECT
FIELD
VALUE
ATTRIBUTES
Circuit
testlab.ipt.24bab8a4
Circuit ID
testlab.ipt.24bab8a4
Provider: HEAnet
Type: IP Transit
Status: Provisioning
Tenant: INEX
Description: testlab.ipt.24bab8a4 :: IPTeBGP 1000 Mb...
Interface
ge-0/0/2.0 (PROVISIONING)
Description
(UN) testlab.ipt.24bab8a4 :: IPTeBGP 1000 Mbit/s
Device: edge1-servprov-testlab (34653)
Label: PROVISIONING
Type: Virtual
Description: (UN) testlab.ipt.24bab8a4 :: IPTeBGP 10...
IP Address
193.1.236.15/32
Description
IPv4 next hop for testlab.ipt.24bab8a4
Status: Active
Description: IPv4 next hop for testlab.ipt.24bab8a4
IP Address
193.1.236.14/31
Description
testlab.ipt.24bab8a4
Status: Active
Description: testlab.ipt.24bab8a4
Prefix
2001:db8::/48
Description
...vice March 2025 / testlab.ipt.24bab8a4
Status: Active
Description: Assigned to INEX members meeting test s...
Prefix
2001:db8:1::/48
Description
...a HUGE DEAL!!!! / testlab.ipt.24bab8a4
Status: Active
Description: INEX Members Meeting - Additional IPv6 ...
Prefix
192.168.16.0/20
Description
...ng - March 2025 / testlab.ipt.24bab8a4
Status: Active
Description: INEX Members Meeting - March 2025 / tes...
Prefix
193.1.236.14/31
Description
ipv4 IPT / testlab.ipt.24bab8a4
Status: Active
Description: ipv4 IPT / testlab.ipt.24bab8a4
Showing 1-8 of 8
Per Page

Where are we now?

- Vendor agnostic eco system for provisioning of services
- Once we have an API end-point to talk to we can build a workflow for it
- Network equipment that we can speak ansible to we can provision services on

HEAnet
Ireland's National Education & Research Network

CONNECTING
EDUCATION
EMPOWERING
RESEARCH

THANK YOU

Workflow Orchestrator

https://workfloworchestrator.org

https://workfloworchestrator.org/orchestrator-core/

Begginer workshop: https://workfloworchestrator.org/orchestrator-core/workshops/beginner/overview/

Intermediate workshop: https://workfloworchestrator.org/orchestrator-core/workshops/advanced/overview/

GÉANT Lightweight Service Orchestrator (LSO)

https://gitlab.geant.org/goat/gap/lso

https://workfloworchestrator.org/lso/

NetBox

https://netboxlabs.com

https://netboxlabs.com/oss/netbox/