The SPIDER Platform – Deployment and Management of Virtual Topologies in 5G Programmable Environments

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The SPIDER Project

• Goal: deliver a next-generation, extensive and replicable cyber range platform for 5G offering cybersecurity emulation, training and investment decision support.

• SPIDER features integrated tools for cyber testing, including advanced emulation tools, active learning training methods, and real time econometric models.

• SPIDER supports both self-paced and team-based exercises and allows multiple stakeholders to rely on the same platform in a secure and isolated fashion.
The SPIDER Architecture
The SPIDER NFV Platform

- OSS NBI
- NFVCL
- Testbed Manager
- Open Source MANO

- IaaS
  - Juju
  - Ansible

- PaaS
  - Helm

- Virtual Topology

- App and Net Slices

- Virtual Topology

- Web-based remote control of UEs

- Guacamole

- Ubuntu OS
- Debian OS
- Centos OS

- Servers
- Network devices
- Physical devices (base stations, UE emulators, UE hub)

- Testbed Monitoring
- MAAS
- Prometheus

- LibernMS
- Stack

- Netdriver

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The Testbed Manager

• The Testbed Manager allows to manage all the available physical, computing and network components, thanks to a GUI that is linked to all the software tools active in the system.

• It provides the users with a safe and isolated working environment, as well as allows for automatically setting up the platform for an exercise and restoring it when it is finished.

• For each exercise, the starting configuration is saved and includes the OpenStack networks and routers, the required VMs, etc. After an exercise is run, it is possible to automatically restore the whole configuration by clicking on a button. This operation invokes MaaS that proceeds with restoring the saved configuration from the operating system up to the OpenStack instance.
The Testbed Manager Demo
• Build and dynamically manage complete network environments via multiple NSs.
• Blueprint: metamodel that produces generalized NS templates. The number and the type of NFV services is dynamically selected by the blueprint according to the requested parameters.
• Support basic VIM terraforming operations and maintain a topology of the virtual network infrastructure. Networks in the topology can be used as end-points for NFV services.
The Network Service Blueprint

• The NS Descriptor (NSD) specified by ETSI NFV is composed of a pre-determined, unmodifiable number of different VNFs and links.
  • No standard VNF Manager, only a standard “container for VNFM” (i.e., Juju)

• Network service blueprint: a new, generalized structure can be seen as an LCM manager of a coordinated set of NFV NSs to realize a comprehensive network service (e.g., a radio-mobile network, a VoIP system, etc.):
  • Day 0: terraforming VIMs with needed resources, types of PNFs/VNFs/KNFs, their inter-connections, and the virtual networks to be used towards the outside.
  • Day 1/2: run-time information collection (e.g., dynamic IP addresses, KPIs, etc.), configuration files and commands (both as templates filled by run-time data) to run on SW processes inside PNFs/VNFs/KNFs.
  • Day N: cleaning resources and instances (even in a part of NSs within the blueprint).
The NFVCL Workflow

**Day 0**
- Select the Blueprint from the catalogue
- Retrieve which PNFs should be used
- Decide how many and which NSDs has to be generated
- Compose the NSDs and onboard them to OSM

**Day 1**
- Create a NS instance from each onboarded NSD
- Monitor the instantiation process
- In case of errors, rollback
- In case of success, retrieve instantiation parameters (e.g., IP addresses, etc.)

**Day 2**
- Produce any NS level config parameters as need (e.g., tunnel identifiers)
- For each running VNFI select the correct NFVCL Configurator module
- Trigger the Configurator Modules to generate Day2 Config files and commands
- Send to OSM Day2 primitives (one per VNFI) based on the Configurator output
- Monitor the Day2 result and send feedback to the OSS

**Day N**
- Remove one or more NS instance

Intent-based Service Request (REST)
Day-2 Operations with the Flex-charm (for VNFs and PNFs)

1. **Day 2 primitive to the OSM NBI**
   - Send the list of Config files and Ansible Playbooks (including URL at NFVCL, final path, final names, order of execution, …)

2. **Content transfer to the Flexcharm**
   - All the playbooks and configuration files are downloaded (through HTTP) locally in the Flexcharm container in OSM

3. **Ansible Playbook Execution**
   - Performed through SSH or REST
   - Config Files are transferred as part of the commands
   - Commands are executed in the order decided by the NFVCL