How do I deploy a snowflake without melting it?

OSM VNF Onboarding Task Force

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Agenda

- What is OSM?
- What is VNF Onboarding?
- Example VNF: NextEPC
- What are the ETSI Specs?
- Wrap Up
What is OSM?

- A community-driven production quality E2E Network Service Orchestrator for telco services
- Capable of modelling and automating real telco-grade services, with all the intrinsic complexity of production environments.
- Provides a way to accelerate maturation of NFV technologies and standards
- Enables a broad ecosystem of VNF vendors
- Tests and validates joint interaction of the orchestrator with the other components:
  - NFVI+VIM
  - Network Functions (either VNFs, PNFs or Hybrid)
Benefits of OSM

• A well-known Information Model (IM), aligned with ETSI NFV
• Capable of modelling and automating the full lifecycle of
  • Network Functions (virtual, physical or hybrid),
  • Network Services (NS)
  • Network Slices (NSI)
• From their initial deployment (Instantiation / Day-0, and Day-1)
• To their daily operation and monitoring (Day-2).
• IM is completely infrastructure-agnostic
  • the same model can be used in a large variety of VIM types and transport technologies
Agenda

- What is OSM?
- What is VNF Onboarding?
- Example VNF: Wordpress
- What are the ETSI Specs?
- Wrap Up
VNF Onboarding Task Force

• OSM Leadership Group proposed creation of the VNF Onboarding Task Force
• Formed in 2019
• In charge of coordination and support of activities related to VNF onboarding
• Open to all OSM members
• Publication of documents
• Repository of VNFs (coming soon)
Onboarding Requirements

• Day 0: VNF Instantiation & management setup
  • Upload Openstack images
  • Confirm IP addresses and initial configuration for network interfaces
• Day 1: VNF Service initialization
  • Perform last mile configuration to localize VNF to deployed environment
  • Start services
• Day 2: VNF Runtime operations
  • Modify running VNF to accommodate changes in environment
  • Monitoring KPIs
VNF Onboarding Workflow

- Network Functions Virtualisation will only scale if all of the functions can be automated.

...specially true for 5G!

1. Instantiate Network Services/Slices, making VNFs manageable ("Day 0")

2. Initialize VNFs so they provide the expected service ("Day 1")

3. Operate the service: monitoring, reconfigurations and (closed-loop) actions ("Day 2")

VNF Packages (unique)

Network Service Instance

VNF-O & VNFM for abstraction and orchestration

VNF1  VNF2

(instantiation with optional parameters)
• What is OSM?
• What is VNF Onboarding?
• **Example VNF: NextEPC**
• What are the ETSI Specs?
• Wrap Up
NextEPC Overview

- **MME | Mobility Management Entity**
  - Keeps track of User Equipment registered on LTE network
  - Handles requests for network access - setting up and tearing down data sessions

- **SGW | Serving Gateway**
  - IP router with GTP support and charging functionality
  - Module for signalling between PGW and MME

- **PGW | Packet Data Network Gateway**
  - Provides access to external Packet Data Networks (i.e. internet)

- **HSS | Home Subscriber Service**
  - Stores subscriber keys and permitted services
EPC - Abbreviated Version

- eNodeB
- UE
- MME
- SGW
- PGW
- HSS
- S1
- S6a
- SGi
- Internet
NextEPC Software
NextEPC Sample Deployment

- eNodeB
- UE
- S1
- MME
- SGW
- PGW
- S6a
- HSS
- SGI
- Internet
Day 0 Requirements

• Objectives of Day 0
  • Provide the guidelines for including all the necessary elements in the VNF Package for its successful instantiation and management setup, so it can be further configured at later stages.

• Requirements
  • Images for OpenStack
  • Networks (already existing in VIM, or need to be created)
  • Hostnames and IP addresses if needed
NextEPC VNF Model

VDU: S/PGW + MME

eth0

eth1

eth2

eth3

VDU: HSS

eth0

eth1

S6a

S1

Existing VIM Networks

SGi

Management
NextEPC VNF Model

VDU: S/PGW + MME
eth0
eth1
eth2

VDU: HSS
eth0
eth1

S1
SGi

S6a

Management

Existing VIM Networks
Internal network, created by OSM
Define Day 0 Requirements for NextEPC

<table>
<thead>
<tr>
<th>VDU</th>
<th>Description</th>
<th>Hostname</th>
<th>IP Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/PGW + MME</td>
<td>Single VDU containing SGW, PGW and MME</td>
<td>spgwmme</td>
<td>S1: 192.168.0.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SGi: 192.168.2.11</td>
</tr>
<tr>
<td>HSS</td>
<td>HSS VDU</td>
<td>hss</td>
<td></td>
</tr>
</tbody>
</table>

Flavours

<table>
<thead>
<tr>
<th>VDU</th>
<th>vCPU</th>
<th>RAM (GB)</th>
<th>Storage (GB)</th>
<th>EPA Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/PGW + MME</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>CPU Pinning, Huge Pages &amp; SRIOV in S1/SGI</td>
</tr>
<tr>
<td>HSS</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>N</td>
</tr>
</tbody>
</table>
NextEPC Day 0 Requirements

- Images are cloud images and contain preloaded software needed to run
- Cloud init used for configuration of base image
  - Define SSH keys, or ssh password for login as desired
  - Define hostnames
Day 1 Requirements

• Objectives of Day 1
  • Provide the guidelines to include all necessary elements in the VNF Package.
  • Allows the exposed services inside the VNF to be automatically initialized right after the VNF instantiation.

• Requirements
  • Identify dependencies between components
  • Define required configuration for service initialization
  • Identify the need for instantiation parameters
NextEPC Day 1 Requirements

- **S/PGW + MME requires:**
  - 4 network interfaces and addresses
  - SSH keys for management
  - Update of MME configuration with IP address of HSS

- **HSS requires:**
  - 2 network interfaces and addresses
  - SSH keys for management
  - Update of HSS configuration with IP address of SPGW
Day 2 Requirements

• Objectives of Day 2:
  • Re-configure the VNF so its behavior can be modified at runtime
  • Monitor its main KPIs and raise alarms

• Requirements:
  • Identify dependencies between components
  • Define possible configurations for runtime operations
  • Define key performance indicators
    • VIM: CPU, memory, network or storage usage
    • VNF/EM: Active sessions, users, application status
  • Define closed loop operations - Scaling or healing
NextEPC Day 2 Requirements

- Configure routes on the PGW
- Add or remove subscribers
- Collect CPU and Memory metrics of the VDU
OSM VNF Onboarding Walkthrough

https://osm.etsi.org/gitlab/vnf-onboarding/vnf-onboarding-guidelines/blob/master/06-walkthrough.md

VNF Onboarding Walkthrough

Introduction

This section uses NextEPC (an open-source implementation of a 4G/5G packet core) to go through most of the steps described in the onboarding guidelines, in order to provide a concrete example on how to build a complete VNF Package from scratch.

The example is meant to be used for educational purposes and not for a real-life implementation of an EPC. It may change over time to cover more use cases. A Linux machine is required to follow the complete procedure. In addition to the procedure, here you can find some resources related to it:

- Resulting packages
- Images
- Video presentation

VNF Requirements

Day-0 Requirements

The following table describes the components description and associated images.

<table>
<thead>
<tr>
<th>VDU</th>
<th>Description</th>
<th>Image name</th>
</tr>
</thead>
<tbody>
<tr>
<td>spgwmmme</td>
<td>Single VDU containing SGW, PGW and MME</td>
<td>nextepc-spgwmmme-base</td>
</tr>
<tr>
<td>hss</td>
<td>HSS VDU</td>
<td>nextepc-hss-base</td>
</tr>
</tbody>
</table>
https://osm.etsi.org/gitlab/vnf-onboarding/vnf-onboarding-guidelines/tree/master/examples/NextEPC
NextEPC Model in OSM
NextEPC Day 0 in OSM

- OSM Automates
  - VM lifecycle
  - Virtual Network lifecycle
  - SSH key injection

- Network Service Descriptor
  - Describes environment around the VNF(s) to be deployed

- Virtual Network Function Descriptor
  - Describes virtual data units (VDU)
Build and Deploy Network Service to OSM
NextEPC Day 1 in OSM

- **VNF Configuration and Abstraction Module (VCA)**
- Communicates with VNF and constituent VDUs
- Implemented by Juju Controller
- Logs into VDU and performs actions
- For NextEPC:
  - Modifies configuration files to add IP addresses for current network
NextEPC Day 2 in OSM

- Monitoring already enabled in VNFD
- Metrics are collected from VIM
  - 5 minute rolling average

**Metrics enabled in demo S/PGW + MME:**
- CPU Usage
- Memory Usage
- Network Packets Received
- Network Packets Sent
NextEPC Day 2 Metrics in OSM
### UE Simulator Generating Traffic

**Client connecting to 45.45.0.1, TCP port 5001**
TCP window size: 95.0 MByte (default)

<table>
<thead>
<tr>
<th>Client Address</th>
<th>Interval</th>
<th>Transfer</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 local 45.45.0.1 port 59442 connected with 45.45.0.1 port 5001</td>
<td>30.0-50.0 sec</td>
<td>2.62 MBytes</td>
<td>4.26 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>0.0-5.0 sec</td>
<td>2.75 MBytes</td>
<td>4.61 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>5.0-10.0 sec</td>
<td>2.38 MBytes</td>
<td>3.98 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>10.0-15.0 sec</td>
<td>3.12 MBytes</td>
<td>5.24 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>15.0-20.0 sec</td>
<td>3.12 MBytes</td>
<td>5.24 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>20.0-25.0 sec</td>
<td>2.25 MBytes</td>
<td>3.77 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>25.0-30.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>30.0-35.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>35.0-40.0 sec</td>
<td>3.00 MBytes</td>
<td>5.03 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>40.0-45.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>45.0-50.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>50.0-55.0 sec</td>
<td>3.50 MBytes</td>
<td>5.87 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>55.0-60.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>60.0-65.0 sec</td>
<td>2.25 MBytes</td>
<td>3.77 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>65.0-70.0 sec</td>
<td>3.00 MBytes</td>
<td>5.03 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>70.0-75.0 sec</td>
<td>1.70 MBytes</td>
<td>2.85 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>75.0-80.0 sec</td>
<td>3.00 MBytes</td>
<td>5.03 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>80.0-85.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>85.0-90.0 sec</td>
<td>3.12 MBytes</td>
<td>5.24 Mbits/sec</td>
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<tr>
<td>3.15</td>
<td>90.0-95.0 sec</td>
<td>3.00 MBytes</td>
<td>5.03 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>95.0-100.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>100.0-105.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>105.0-110.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>110.0-115.0 sec</td>
<td>2.50 MBytes</td>
<td>4.19 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>115.0-120.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>120.0-125.0 sec</td>
<td>2.88 MBytes</td>
<td>4.82 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>125.0-130.0 sec</td>
<td>2.62 MBytes</td>
<td>4.40 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>130.0-135.0 sec</td>
<td>2.50 MBytes</td>
<td>4.19 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>135.0-140.0 sec</td>
<td>3.12 MBytes</td>
<td>5.24 Mbits/sec</td>
</tr>
<tr>
<td>3.15</td>
<td>140.0-145.0 sec</td>
<td>3.00 MBytes</td>
<td>5.03 Mbits/sec</td>
</tr>
</tbody>
</table>

**Server listening on TCP port 5001**
TCP window size: 95.3 MByte (default)

<table>
<thead>
<tr>
<th>Server Address</th>
<th>Interval</th>
<th>Transfer</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 local 45.45.0.1 port 5001 connected with 45.45.0.4 port 59442</td>
<td>4.15</td>
<td>0.0-5.0 sec</td>
<td>1.97 MBytes</td>
</tr>
<tr>
<td>4.15</td>
<td>5.0-10.0 sec</td>
<td>2.37 MBytes</td>
<td>3.98 Mbits/sec</td>
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<tr>
<td>4.15</td>
<td>10.0-15.0 sec</td>
<td>3.08 MBytes</td>
<td>5.17 Mbits/sec</td>
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<tr>
<td>4.15</td>
<td>15.0-20.0 sec</td>
<td>2.97 MBytes</td>
<td>4.99 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>20.0-25.0 sec</td>
<td>2.15 MBytes</td>
<td>3.60 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>25.0-30.0 sec</td>
<td>2.83 MBytes</td>
<td>4.74 Mbits/sec</td>
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<tr>
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<td>30.0-35.0 sec</td>
<td>2.73 MBytes</td>
<td>4.57 Mbits/sec</td>
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<tr>
<td>4.15</td>
<td>35.0-40.0 sec</td>
<td>3.00 MBytes</td>
<td>5.03 Mbits/sec</td>
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<tr>
<td>4.15</td>
<td>40.0-45.0 sec</td>
<td>2.49 MBytes</td>
<td>4.18 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>45.0-50.0 sec</td>
<td>2.77 MBytes</td>
<td>4.65 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>50.0-55.0 sec</td>
<td>3.10 MBytes</td>
<td>5.21 Mbits/sec</td>
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<td>55.0-60.0 sec</td>
<td>2.84 MBytes</td>
<td>4.77 Mbits/sec</td>
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<tr>
<td>4.15</td>
<td>60.0-65.0 sec</td>
<td>2.38 MBytes</td>
<td>4.00 Mbits/sec</td>
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<tr>
<td>4.15</td>
<td>65.0-70.0 sec</td>
<td>2.76 MBytes</td>
<td>4.62 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>70.0-75.0 sec</td>
<td>1.94 MBytes</td>
<td>3.25 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>75.0-80.0 sec</td>
<td>2.77 MBytes</td>
<td>4.65 Mbits/sec</td>
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<td>80.0-85.0 sec</td>
<td>2.83 MBytes</td>
<td>4.74 Mbits/sec</td>
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<td>4.15</td>
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<td>4.94 Mbits/sec</td>
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<td>4.81 Mbits/sec</td>
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<td>4.65 Mbits/sec</td>
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<tr>
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<td>2.67 MBytes</td>
<td>4.47 Mbits/sec</td>
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<tr>
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<td>105.0-110.0 sec</td>
<td>2.55 MBytes</td>
<td>4.30 Mbits/sec</td>
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<tr>
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<td>110.0-115.0 sec</td>
<td>2.81 MBytes</td>
<td>4.71 Mbits/sec</td>
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<tr>
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<td>115.0-120.0 sec</td>
<td>2.58 MBytes</td>
<td>4.33 Mbits/sec</td>
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<tr>
<td>4.15</td>
<td>120.0-125.0 sec</td>
<td>2.74 MBytes</td>
<td>4.60 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>125.0-130.0 sec</td>
<td>2.52 MBytes</td>
<td>4.22 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>130.0-135.0 sec</td>
<td>2.78 MBytes</td>
<td>4.66 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>135.0-140.0 sec</td>
<td>2.90 MBytes</td>
<td>4.87 Mbits/sec</td>
</tr>
<tr>
<td>4.15</td>
<td>140.0-145.0 sec</td>
<td>2.98 MBytes</td>
<td>5.01 Mbits/sec</td>
</tr>
</tbody>
</table>
Alarms and Actions

- OSM can raise alarms on thresholds
  - Memory > 64 GB
  - Network packets/second > 150
  - CPU < 10%
- OSM also has scaling operations
  - Scale in or out on threshold
  - VDUs can be scaled individually
- Day 2 operations can:
  - Execute arbitrary scripts or functions
  - Including healing (restart services, reboot, enable logging) operations
- What is OSM?
- What is VNF Onboarding?
- Example VNF: NextEPC
- What are the ETSI Specs
- Wrap Up
What are the ETSI Specs?

• SOL 001
  • Specifies a data model for NFV descriptors, using the TOSCA Simple Profile in YAML
  • Covers VNFD, PNFD, NSD and requirements for the VIM
  • https://www.etsi.org/deliver/etsi_gs/NFV-SOL/001_099/001/02.06.01_60/gs_NFV-SOL001v020601p.pdf

• SOL 006
  • SOL 001, but specified in YANG
  • Goal is to ensure simple translation from a TOSCA Service Template
  • https://www.etsi.org/deliver/etsi_gs/NFV-SOL/001_099/006/02.06.01_60/gs_nfvsol006v020601p.pdf
Agenda

- What is OSM?
- What is VNF Onboarding?
- Example VNF: NextEPC
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- Wrap Up
Wrap Up

- ETSI OSM
  - Standards Based
  - Open source
  - Automates full network service life cycle
  - Automates configuration of VNFs and VDUs
  - Monitors KPIs
  - Raise alarms and trigger actions
  - Open REST API
Thank you!

Questions:
OSM_VNFONB@list.etsi.org