

# Custom-Made Enhanced Packet Cores as Network Services for 4G/5G Testbeds managed with Open Source MANO

Thomas Dreibholz, dreibh@simula.no  
Mosaic5G Workshop  
December 3, 2020

# Table of Contents

- Introduction and Our Goal
- Basic Testbed Setup
- The SimulaMet EPC VNF
- Managing Builds
- Live Demo

# Setting Up a 4G/5G Testbed

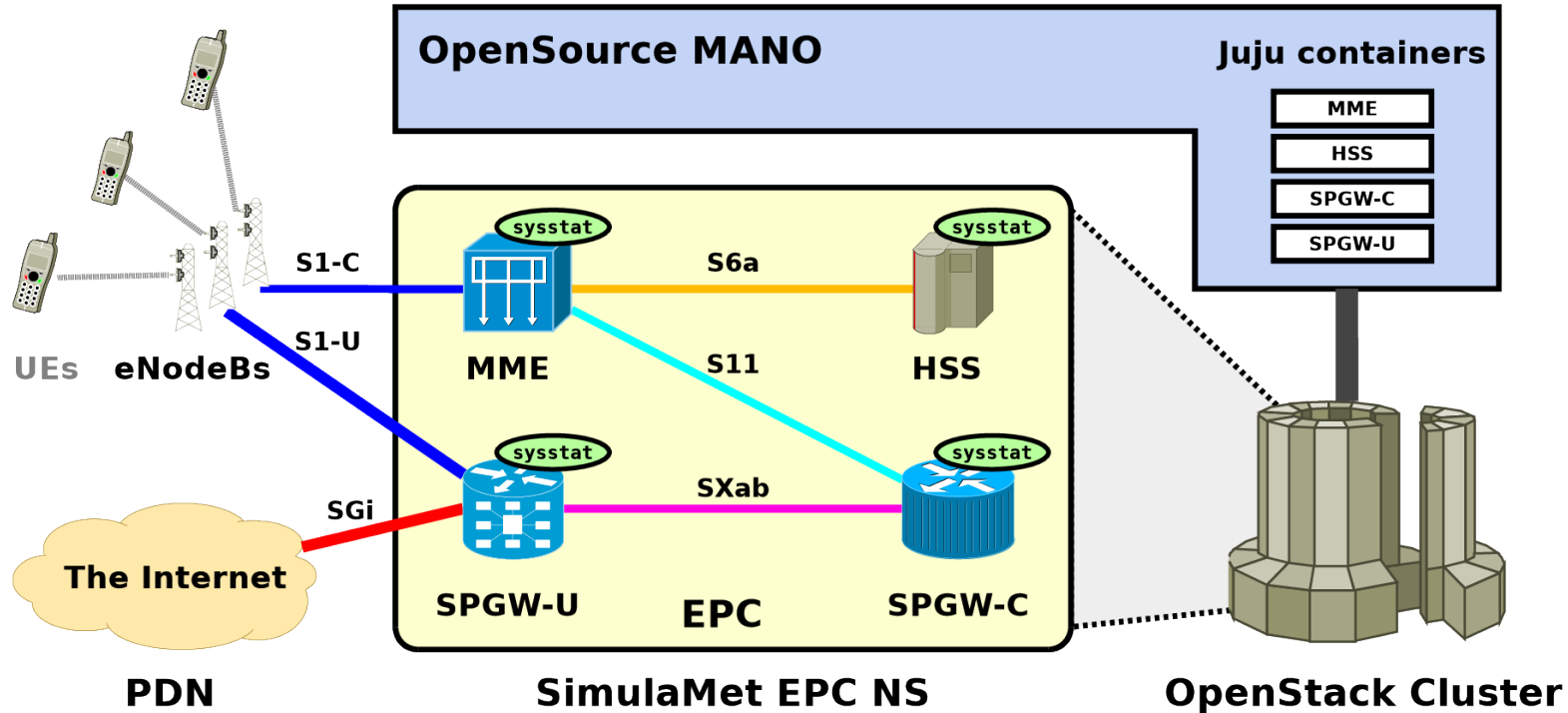
- Hardware:
  - User Equipment (modems, smartphones, etc.)
  - Programmable sim cards
  - Software-Defined Radio boards
- For the rest (eNodeBs, EPC):
  - OpenAirInterface Open Source software
  - Running on regular Linux PCs
  - **But: difficult to install and maintain!**



# Our Goal: An OpenAirInterface VNF

- Main purpose: testbed setups for research and development
- OAI EPC as VNF
  - Easy to use, EPC should (hopefully) work “out of the box”
  - Build of OAI software inside VMs, according to specified Git repositories and commits
    - ⇒ get exactly the desired installation (e.g. using Mosaic5G branches)
- NSs using the VNF and possibly other VNFs
  - Example 1: add Mobile Edge Computing services to EPC
  - Example 2: use FlexRAN for network slicing
  - ...

# Basic Testbed Setup



# What is needed for the VNF?

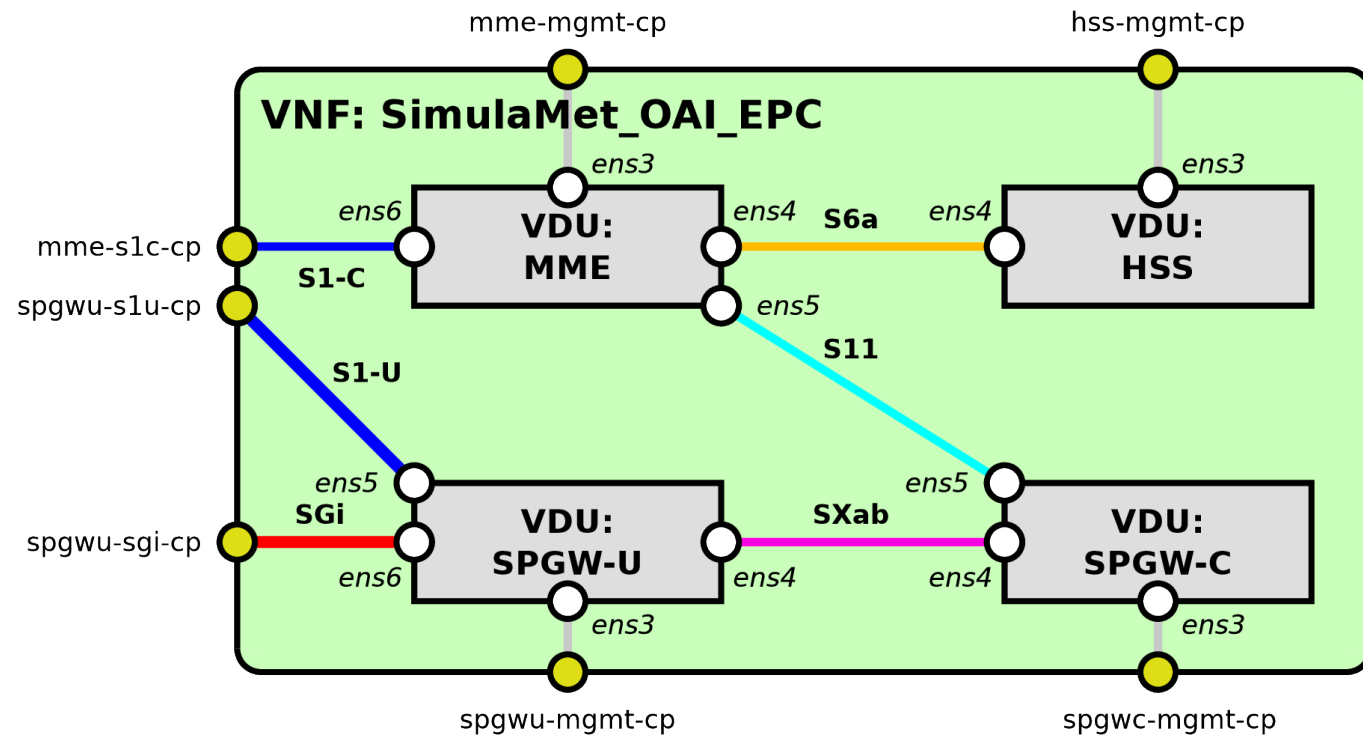
- Base VDU image
- The VNF itself
- Juju Charms to configure the components
- Management of the build process

# Base VDU Image

- VDU image goals:
  - Full-featured base VDU image, including development and debug tools
  - Different versions of Ubuntu LTS (Xenial, Bionic, Focal)
  - Up-to-date (i.e. all updates installed)
- Packer scripting:
  - Fully automatic installation using Packer
  - Preseeding (Ubuntu < 20.04); Subiquity (Ubuntu ≥ 20.04)
    - Additional PPA, keyboard layout setup, EFI boot, etc.
    - All updates installed
    - => Fresh, state-of-the art installation (avoids issues with “old” installations)
  - Details: <https://github.com/simula/nor-net-vmimage-builder-scripts>



# The SimulaMet EPC VNF



HSS: Home Subscriber Server  
MME: Mobile Management Entity  
SPGW-C:  
Control Plane of the  
Packet Data Network Gateway  
SPGW-U:  
User Plane of the  
Packet Data Network Gateway

# VNF Parameters Example

- # ===== HSS =====  
hss\_git\_repository: '<https://github.com/simula/openairinterface-openair-hss.git>'  
hss\_git\_commit: 'dreibh/cassandra-build-fix-22oct2020'  
hss\_S6a\_address: '172.16.6.129'  
network\_realm: 'simula.nornet'  
network\_k: '449C4B91AEACD0ACE182CF3A5A72BFA1'  
network\_op: '1006020F0A478BF6B699F15C062E42B3'  
network\_imsi\_first: '242881234500000'  
network\_msisdn\_first: '242888800000000'  
network\_users: '1024'

- # ===== MME =====  
mme\_git\_repository: '<https://github.com/simula/mosaic5g-openair-cn.git>'  
mme\_git\_commit: 'dreibh/mosaic5g'  
mme\_S1C\_ipv4\_interface: '192.168.247.102/24'  
mme\_S1C\_ipv4\_gateway: '0.0.0.0'  
mme\_S1C\_ipv6\_interface: ''  
mme\_S1C\_ipv6\_gateway: ''  
mme\_S11\_ipv4\_interface: '172.16.1.102/24'  
mme\_S6a\_address: '172.16.6.2'  
network\_mcc: '242'  
network\_mnc: '88'

- ...

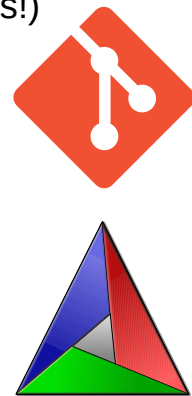
Git repository

Git commit  
(or tag or branch)

Tailor-Made EPC  
Setup according to  
Your needs!

# Managing VNFD/NSD Builds

- Multiple manual steps to generate and deploy VNFs and NSs
  - Strictly verify all YAML files with `yamllint` (very useful, to avoid problems and surprises!)
  - Copy Charm files to VNFDs and build Charms (`charm build ...`)
    - Including our library “VDUHelper”
  - Verify descriptor(s) and generate VNFD package(s) (`validate_descriptor.py`, `generate_descriptor_pkg.sh`)
  - Verify descriptor(s) and generate NSD package(s)
- Initial approach: write a Makefile
- Better approach:
  - Git for source management  $\Rightarrow$  information about all relevant source files
  - Let CMake write Makefiles and take care of dependencies!



# Live Demo

The collage illustrates the Open Source MANO (Multi-managed And Network-orchestrated) system. It features several screenshots of the web interface and a terminal window.

**Open Source MANO Web Interface:**

- NS Instances:** A table showing network service instances.

Name	Identifier	Nsd name	Operational Status	Config Status	Detailed Status	Actions
SimulMet-OAI-EPC	a089970d-d3b4-44d6-a1c3-2be1d9375e29	SimulMet-OAI-EPC	OK	OK	Deploying ns at VIM	Actions

- Instances:** A table showing virtual machine instances.

Project	Host	Name	Image Name	IP Address	Flavor	Status	Task	Power State	Age	Actions
admin	thor.simula.nor.net	SimulMet-OAI-EPC	Template-Ubuntu-18.04	192.168.216.195	m1.xlarge	Active	at None	Running	1 minute	Power Off

- Terminal Window:** Displays system logs and status information.

```
frigg.simula.nor.net: Wed Mar 11 16:55:03 2020
Every 2.0s: juju status
Model a089970d-d3b4-44d6-a1c3-2be1d9375e29 Controller Cloud/Region Version SLA unsupported Timestamp 16:55:04+01:00
App app-vnf-5b875fa21aea-vdu-hss-cnt-0 active 1 hyscharm local 0 ubuntu
app-vnf-5b875fa21aea-vdu-mme-cnt-0 active 1 mmecham local 0 ubuntu
app-vnf-5b875fa21aea-vdu-spgw-cnt-0 active 1 spgwcchar local 0 ubuntu
app-vnf-5b875fa21aea-vdu-spgw-cnt-u0 active 1 spgwcchar local 0 ubuntu
Unit app-vnf-5b875fa21aea-vdu-hss-cnt-0/0* Workload Agent Machine Public address Ports Message
app-vnf-5b875fa21aea-vdu-mme-cnt-0/0* active executing 3 10.166.166.183 (configure-cassandra) configure.cassandra: configuring Cassandra ...
app-vnf-5b875fa21aea-vdu-spgw-cnt-0/0* active executing 0 10.166.166.50 (configure-mme) configure.mme: configuring MME ...
app-vnf-5b875fa21aea-vdu-spgw-cnt-u0/0* active executing 1 10.166.166.92 (configure-spgw) configure.spgw: configuring SPGW-U ...
Machine State DNS Inst id Series AZ Message
0 started 10.166.166.50 juju-97ae85-0 xenial Running
1 started 10.166.166.92 juju-97ae85-1 xenial Running
2 started 10.166.166.183 juju-97ae85-2 xenial Running
3 started 10.166.166.225 juju-97ae85-3 xenial Running
```

A man in a blue "Open Source MANO" t-shirt stands next to a desk with multiple monitors and hardware components, including a smartphone and a tablet.

# Sources

- Get the sources here: <https://github.com/simula/5gvinni-oai-ns>
  - Open Source, GPL-licensed
  - README: how to set up a testbed
  - vmimage-builder-scripts/ (submodule):  
VDU preseeded image build script
  - juju/: The Juju Charms used by the VNF
  - SimulaMet-OAI-EPC\_vnfd/: VNF descriptor
  - SimulaMet-OAI-EPC\_nsd/: NS descriptor for simple example



# Any Questions?

Thomas Dreibholz

[dreibh@simula.no](mailto:dreibh@simula.no)

<https://www.simula.no/people/dreibh>