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simulamet

Easily Setting up 4G/5G Testbeds with OpenAirInterface using OSM

Thomas Dreibholz, dreibh@simula.no
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5G PPP



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5G-VINCI

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OpenAirInterface (OAI)

- OpenAirInterface (OAI):
 - Open Source software for EPC and eNodeB (i.e. packet core and base stations)
 - Details: <https://www.openairinterface.org>
 - 4G LTE available, 5G under development
 - Ongoing work, with many different Git branches
- Idea:
 - Manage OAI setups in OSM (at least, the EPC part)
 - Automatic setup and deployment
 - Easy to add additional features (e.g. Mobile Edge Computing components)
 - Open Source, of course! → <https://github.com/simula/5gvinni-oai-ns>



Setting Up a 4G/5G Testbed

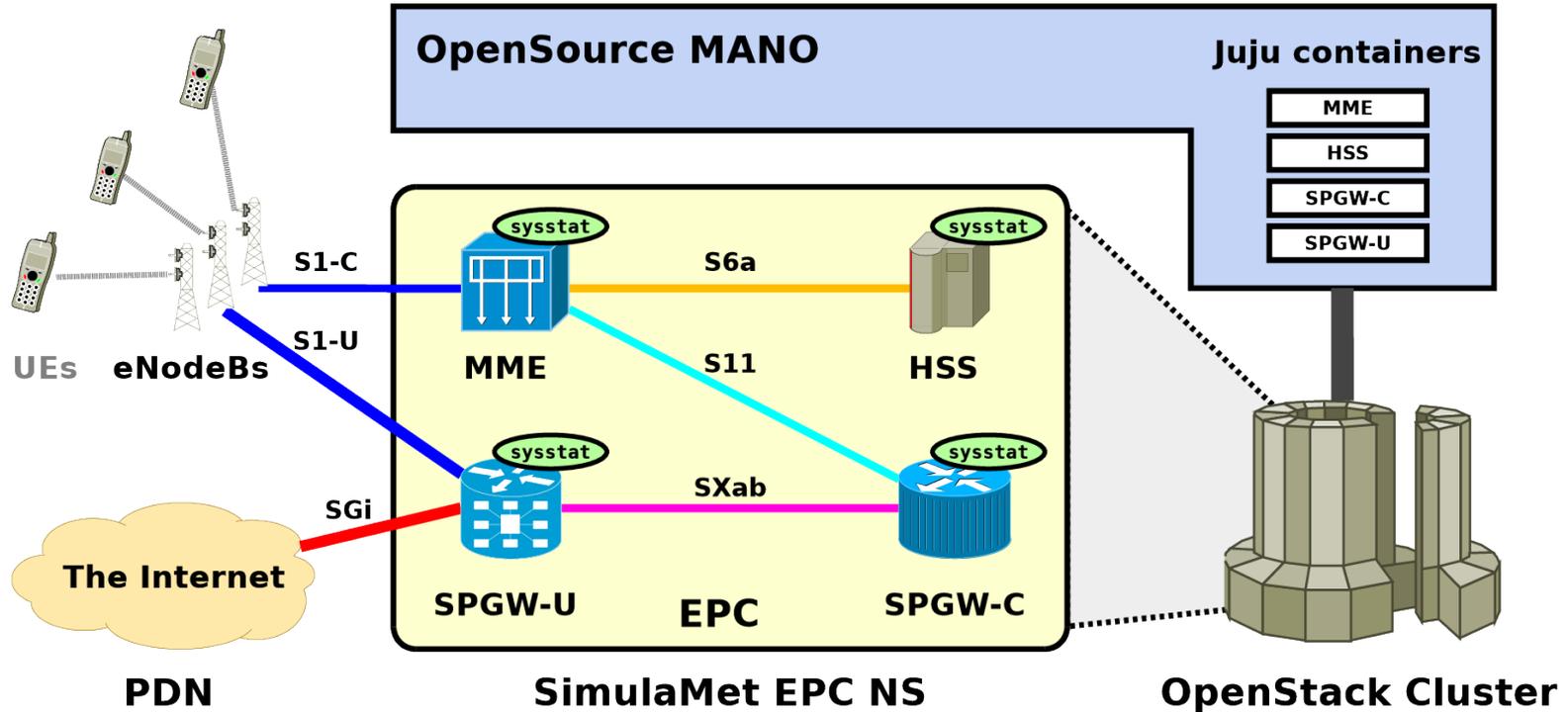
- Hardware:
 - User Equipment (modems, smartphones, etc.)
 - Programmable sim cards
 - Software-Defined Radio boards
- For the rest (eNodeBs, EPC):
 - OpenAirInterface Open Source software
 - Running on regular Linux PCs
 - **But: difficult to install and maintain!**



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
- NSs using the VNF and possibly other VNFs
 - Example 1: add Mobile Edge Computing services to EPC
 - Example 2: get basic EPC to test extended eNodeB software
 - ...

Basic Testbed Setup



What is needed for the VNF?

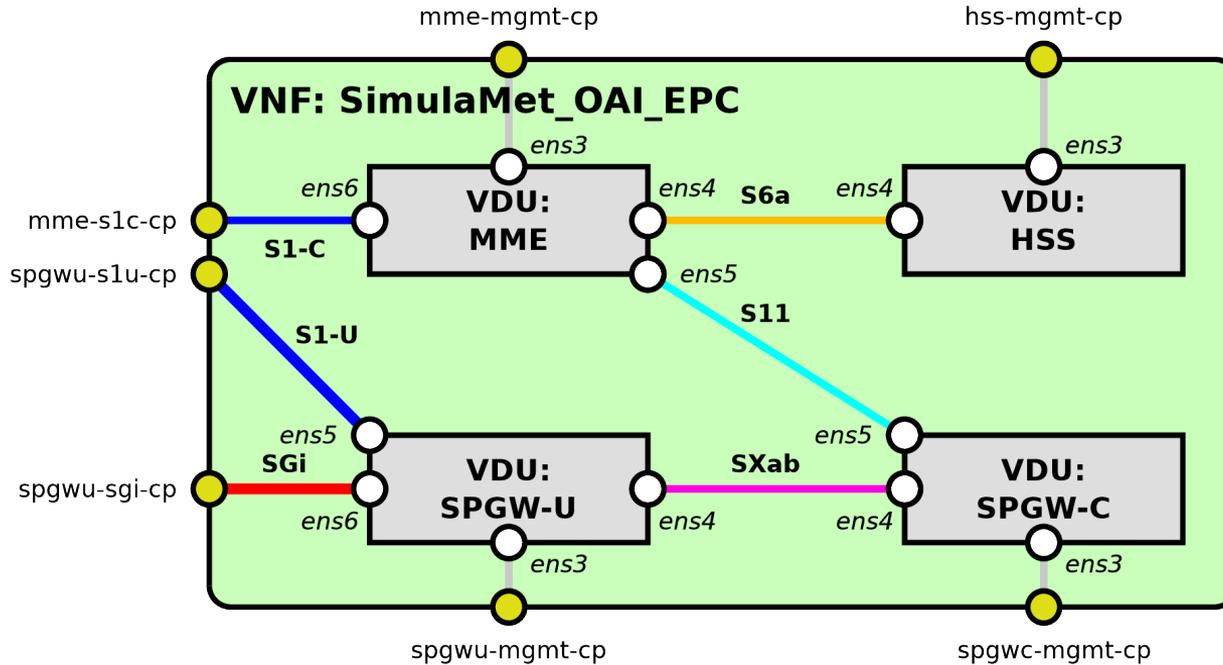
- Base VDU image
- The VNF itself
- Juju Charms to configure the components
- Management of the build process

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)
- Preseeding script:
 - Fully automatic Ubuntu installation from scratch (using virt-install)
 - Preseed configuration to include all necessary base packages
 - “late_command”: mainly work-arounds for bugs in the Ubuntu installer
 - add PPAs, update keyboard layout, ensure updates are installed



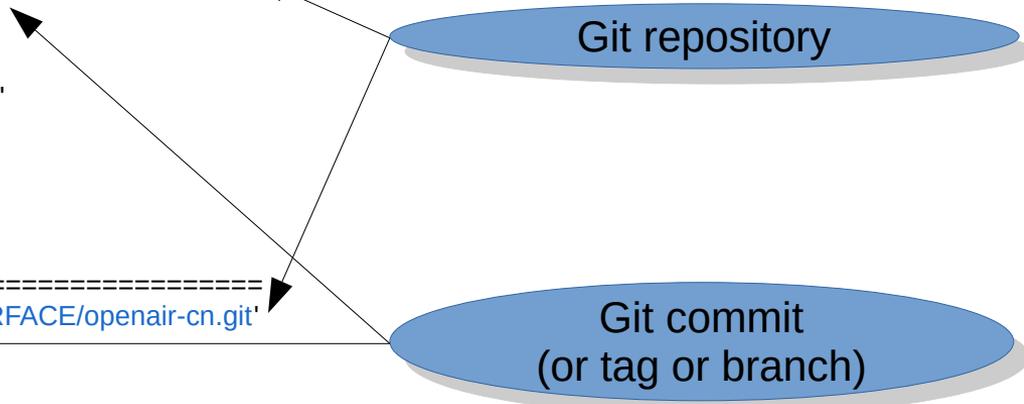
The SimulaMet EPC VNF



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/OPENAIRINTERFACE/openair-cn.git'
hss_git_commit: 'dreihh/cassandra-build-fix-17feb2020'
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/OPENAIRINTERFACE/openair-cn.git'  
mme_git_commit: '2019.w45'  
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'
```
- ...



Configuration with Juju

- Day-0/1: For each VDU (EPC component, i.e. HSS, MME, SPGW-C, SPGW-U):
 - Install necessary additional packages (depends on component)
 - Set up network configuration
 - Clone component sources (Git repository and commit)
 - Build the sources
 - Create/update component's configuration files
 - Write systemd unit file (for “sudo service <component> start|stop|restart”)
 - Start the component
- Day-2: actions to start/stop/reconfigure components



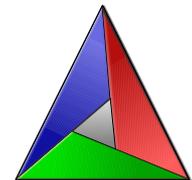
Juju Proxy Charm Challenges

- `charms.sshproxy._run(COMMAND STRING)`
- String is processed in Python, then it is processed by ssh/bash shell of VDU
 - Escaping/double escaping required:
 - `$` \Rightarrow `\$` ; `\` \Rightarrow `\\` ; `"` \Rightarrow `\\\"` ; `\'` \Rightarrow `\\\\\''`
 - Result: writing charm commands gets ugly and error prone
 - Wishlist: automatic escaping!
- Juju errors passed to OSM are usually not very helpful
 - Something went wrong, but not saying what went wrong
 - Wishlist: improved error reporting!

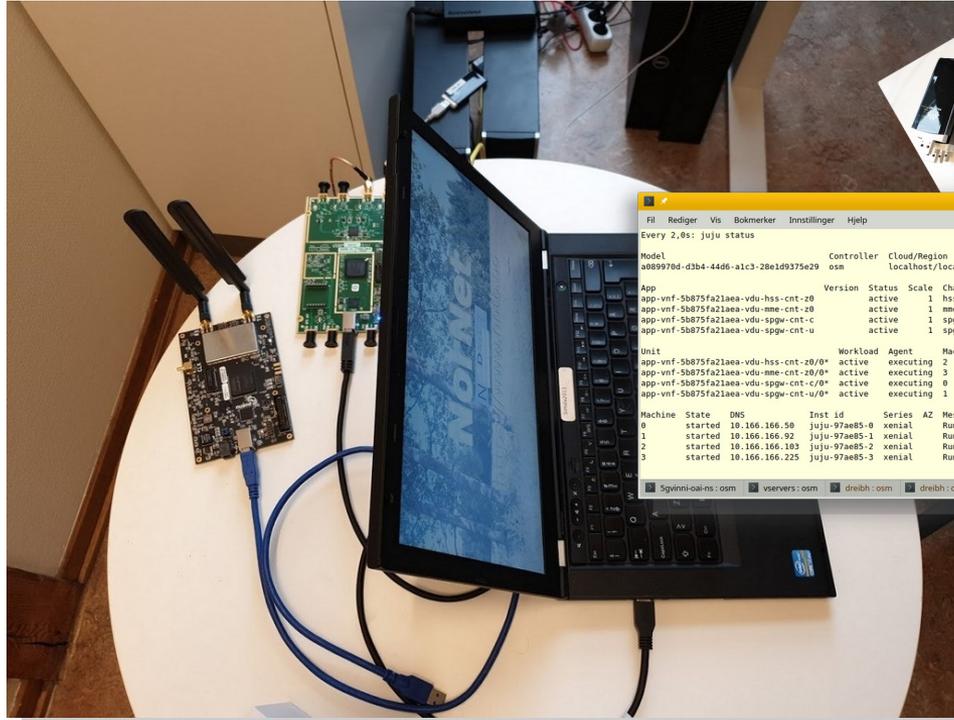


Managing VNFD/NSD Builds

- Multiple manual steps to generate and deploy VNFs and NSs
 - Strictly verify all YAML files with yamllint (useful, to avoid problems!)
 - Copy Charm files to VNFDs and build Charms (charm build ...)
 - 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:
 - Use Git for source management ⇔ information about all relevant source files
 - Use CMake to write Makefiles and take care of dependencies!



Demo



```
dreih: osm -- Konsole
FI Rediger Vis Bokmerker Innstillinger Hjelp
Every 2.0s: juju status
frigg.simula.nornet: Wed Mar 11 16:55:03 2020

Model          Controller  Cloud/Region  Version  SLA  Timestamp
a089970d-d3b4-44d6-a1c3-28e1d9375e29  osm        localhost/localhost  2.7.0   unsupported  16:55:04+01:00

App            Version  Status  Scale  Charm  Store  Rev  OS  Notes
app-vnf-5b875fa21aea-vdu-hss-cnt-z0  active  1       hsscharm  local  0     ubuntu
app-vnf-5b875fa21aea-vdu-mme-cnt-z0  active  1       mmecharm  local  0     ubuntu
app-vnf-5b875fa21aea-vdu-spgw-cnt-c  active  1       spgwecharm  local  0     ubuntu
app-vnf-5b875fa21aea-vdu-spgw-cnt-u  active  1       spgwucharm  local  0     ubuntu

Unit           Workload  Agent  Machine  Public address  Ports  Message
app-vnf-5b875fa21aea-vdu-hss-cnt-z0/*  active    executing  2      10.166.166.103
app-vnf-5b875fa21aea-vdu-mme-cnt-z0/*  active    executing  3      10.166.166.225
app-vnf-5b875fa21aea-vdu-spgw-cnt-c/*  active    executing  0      10.166.166.50
app-vnf-5b875fa21aea-vdu-spgw-cnt-u/*  active    executing  1      10.166.166.92

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  10.166.166.103  juju-97ae85-2  xenial  Running
3  started  10.166.166.225  juju-97ae85-3  xenial  Running
```

The screenshot shows the OpenStack dashboard interface. The main heading is 'Instances'. Below it, there is a table listing several instances. The table has columns for Name, ID, Flavor, Status, Task, Power State, Age, and Actions. The instances listed are:

Name	ID	Flavor	Status	Task	Power State	Age	Actions
SimulaMet-OAI-EPC	81723535102	m1.xlarge	Active	None	Running	1 minute	Reboot Instance
SimulaMet-OAI-EPC	81723535101	m1.xlarge	Active	None	Running	1 minute	Reboot Instance
SimulaMet-OAI-EPC	81723535100	m1.xlarge	Active	None	Running	1 minute	Reboot Instance
SimulaMet-OAI-EPC	81723535103	m1.xlarge	Active	None	Running	1 minute	Reboot Instance
SimulaMet-OAI-EPC	81723535104	m1.xlarge	Active	None	Running	1 minute	Reboot Instance

The screenshot shows the Open Source MANO dashboard. The main heading is 'NS Instances'. Below it, there is a table listing a single NS Instance. The table has columns for Name, Identifier, Nsd name, Operational Status, Config Status, Detailed Status, and Actions. The instance listed is:

Name	Identifier	Nsd name	Operational Status	Config Status	Detailed Status	Actions
SimulaMet-OAI-EPC	a089970d-d3b4-44d6-a1c3-28e1d9375e29	SimulaMet-OAI-EPC_nsd	OK	OK	Deploying ns at VM	Refresh Instance Details



Sources

- Get the sources here: <https://github.com/simula/5gvinni-oai-ns>
 - Open Source, GPL-licensed
 - README: how to set up a testbed
 - images/: 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

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