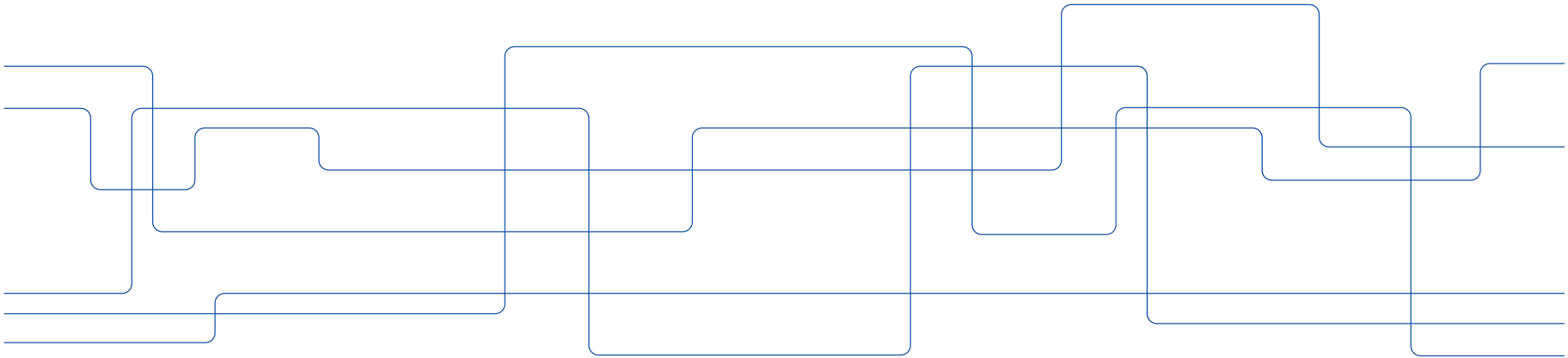
ExPECA Testbed

Overview and Configuration



Agenda

09:00 Overview of the testbed

- What and where is ExPECA?
- Hardware
- Software
- Observability / Monitoring
- GPS/GNSS synchronization
- Software-Defined Radio (SDR)

09:30 5G / Openairinterface

- Main components in OAI 5G
- Main 5G services in OAI

10:00 Configuration of the testbed

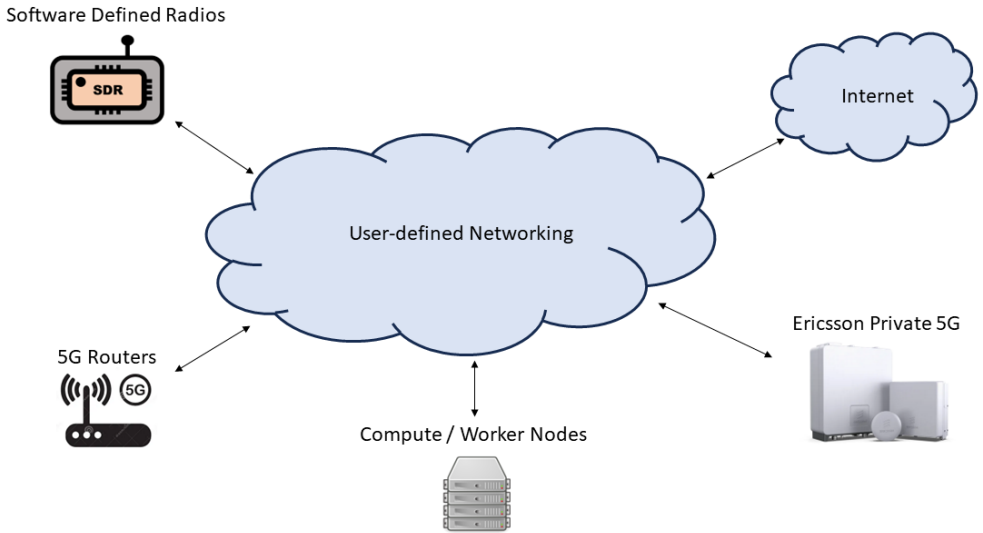
- ExPECA Experimental Workflow
- Experimental Scenarios
- Configuration with GUI

10:30 Group assignment

- Configuration with Python Notebook
- 5G Core setup
- GNodeB setup
- Verification
- Research example: EDAF

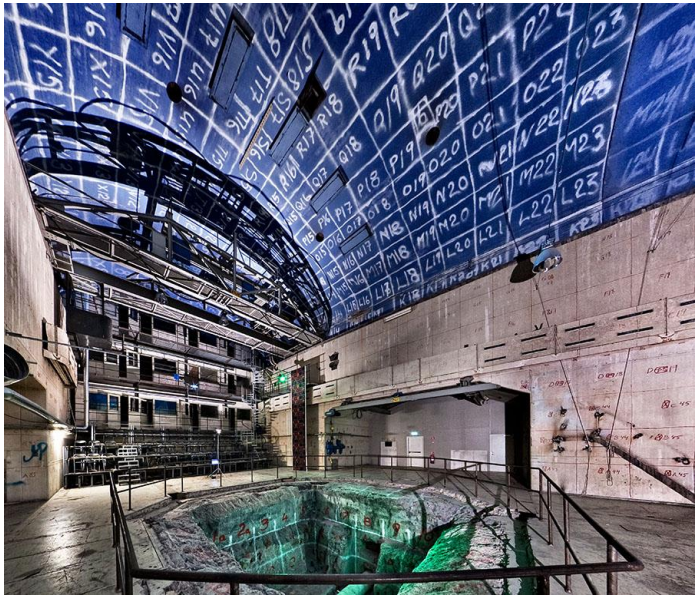
What is ExPECA?

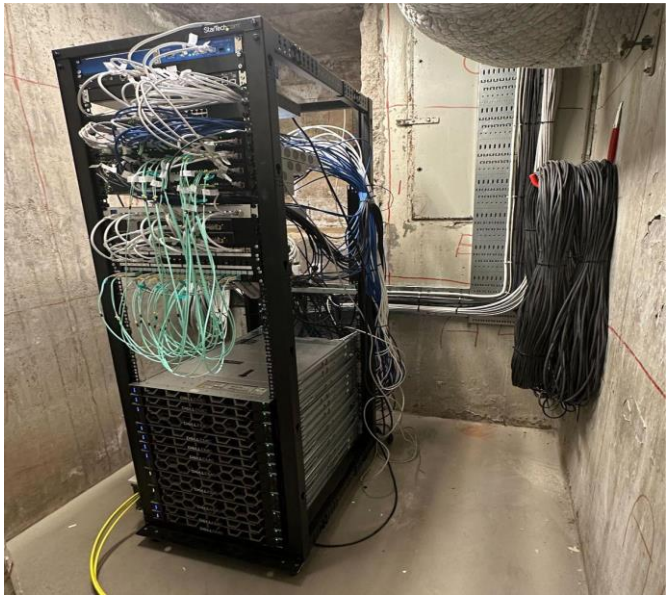
- An Experimental Platform for Edge Computing Applications
- Connects wireless devices, SDRs, and an Ericsson Private 5G system with networking and compute resources, to form a highly configurable research environment



Where is ExPECA?

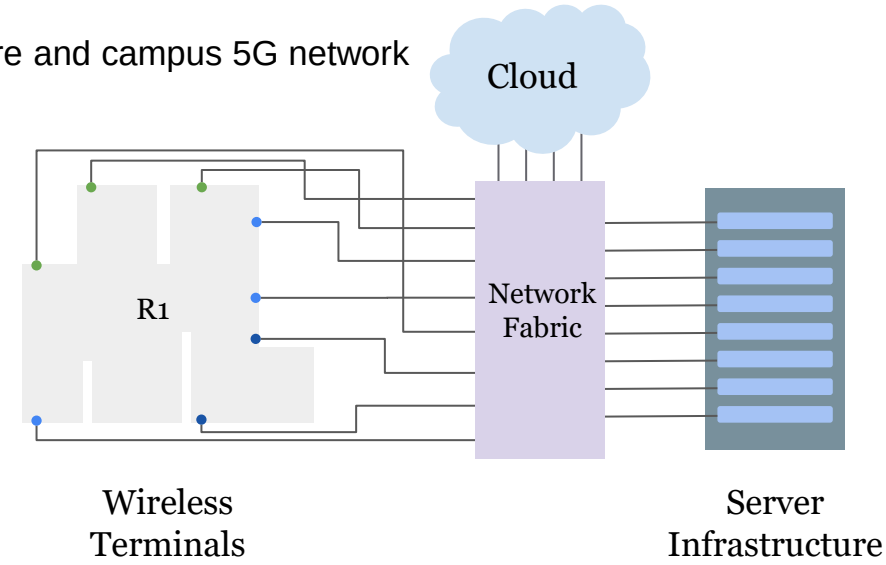
- Located in R1, the old reactor hall on KTH campus
- Provides a disturbance-free environment for wireless experimentation
- Provides a large area for distribution of wireless equipment





Hardware

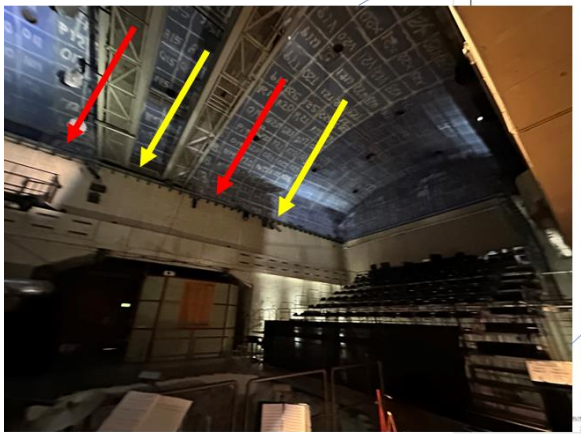
- 10 SDRs, 8 5G COTS UEs, 4 Ericsson Private 5G Radio Dots
- 1 Controller server, 10 Worker servers, Ericsson Private 5G servers
- GPS sync system, including antenna, cables, and 1 PTP Grandmaster clock
- Networked by routers and switches
- Public internet address and connection
- Fiber connection to Telenor Edge infrastructure and campus 5G network

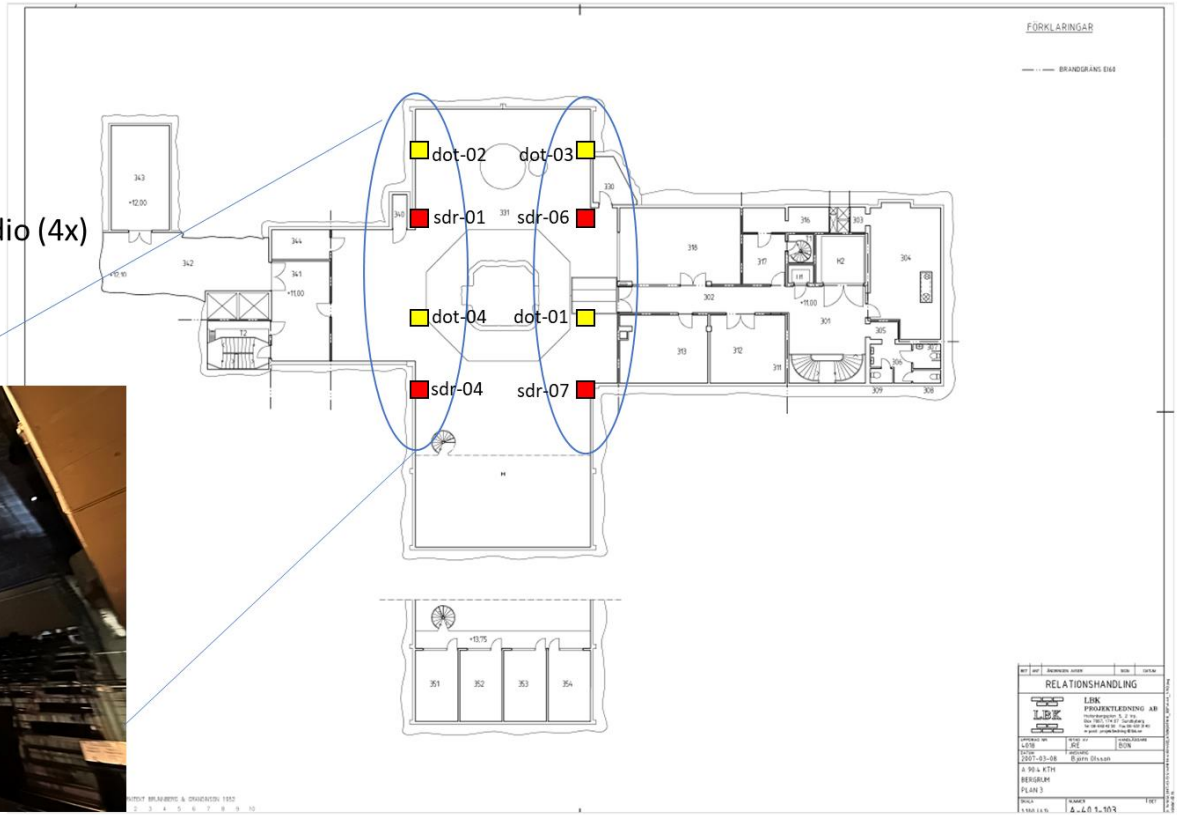


High Location Nodes (8m height)

= 5G Radio Dot (4x)

= Software Defined Radio (4x)

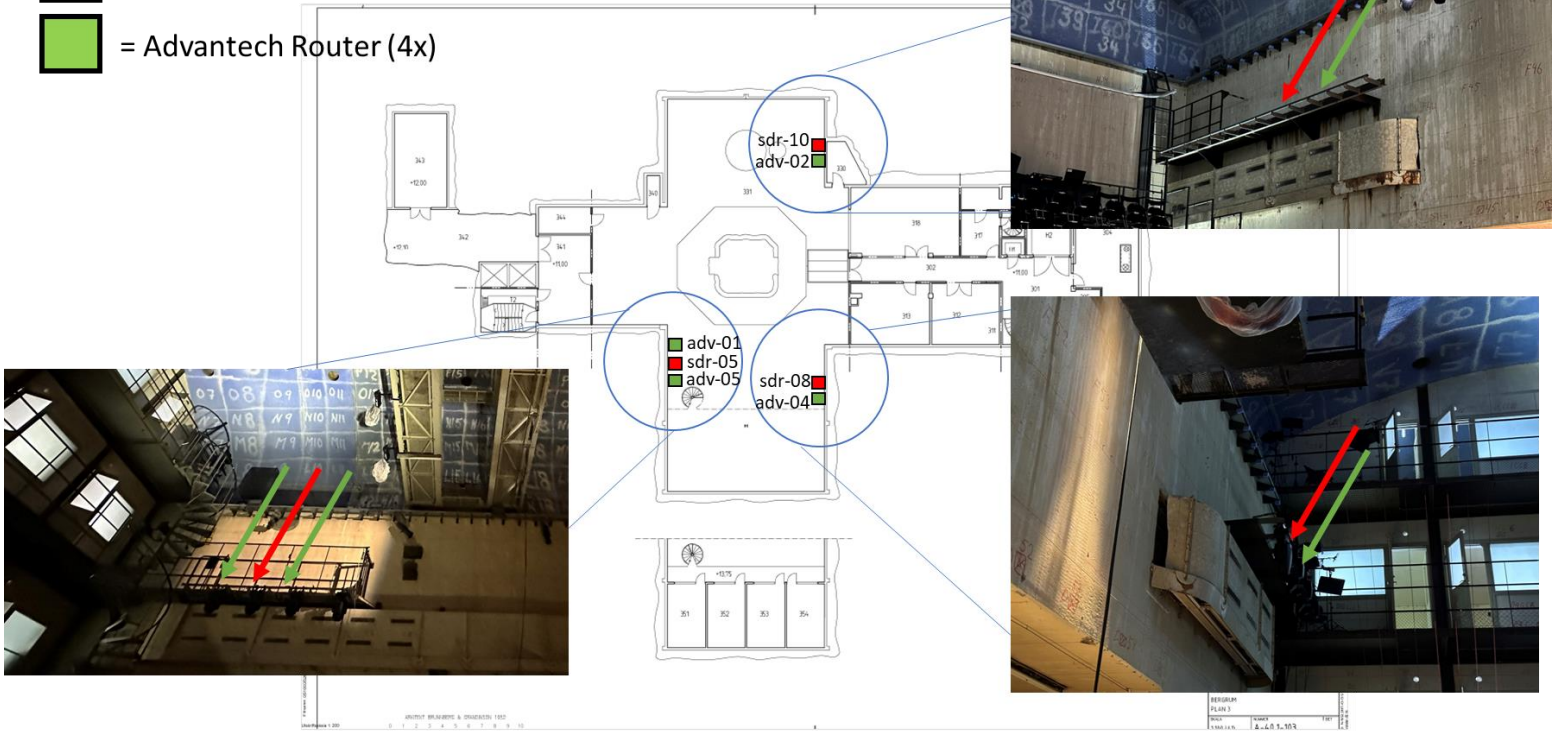




Medium Location Nodes (6m height)

= Software Defined Radio (3x)

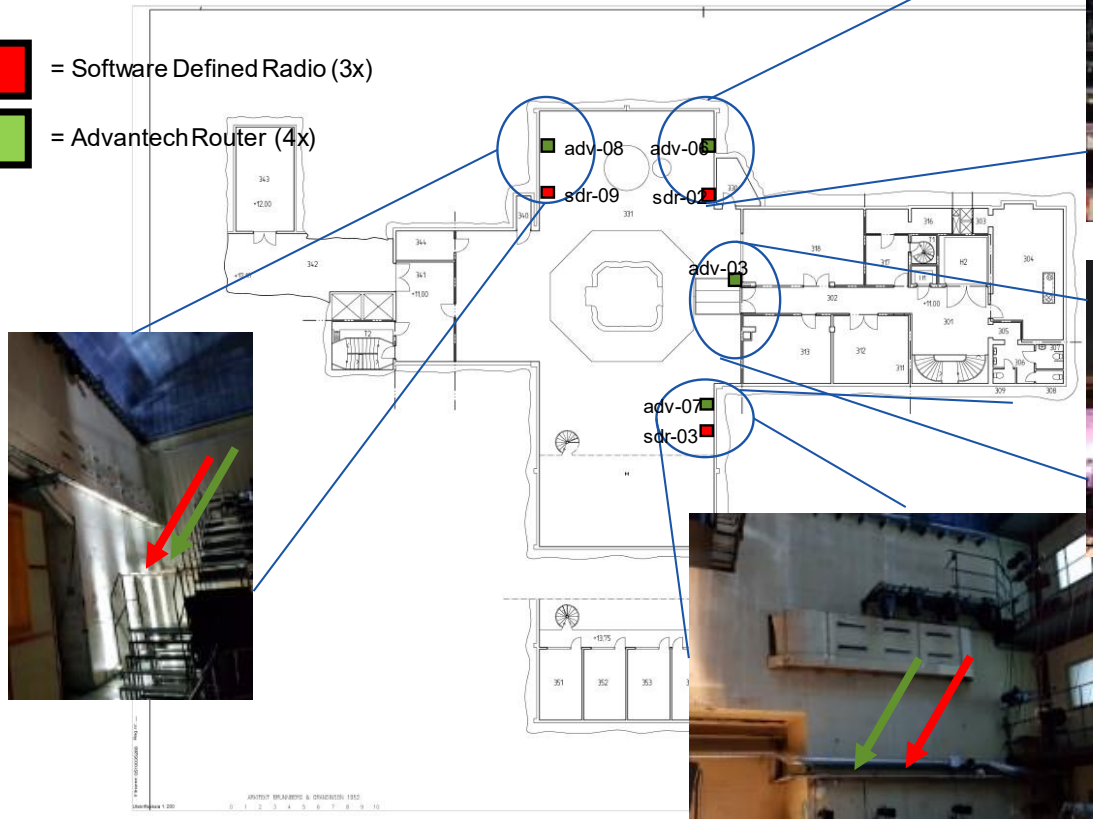
= Advantech Router (4x)



Low Location Nodes (2m height)

= Software Defined Radio (3x)

= Advantech Router (4x)



Software

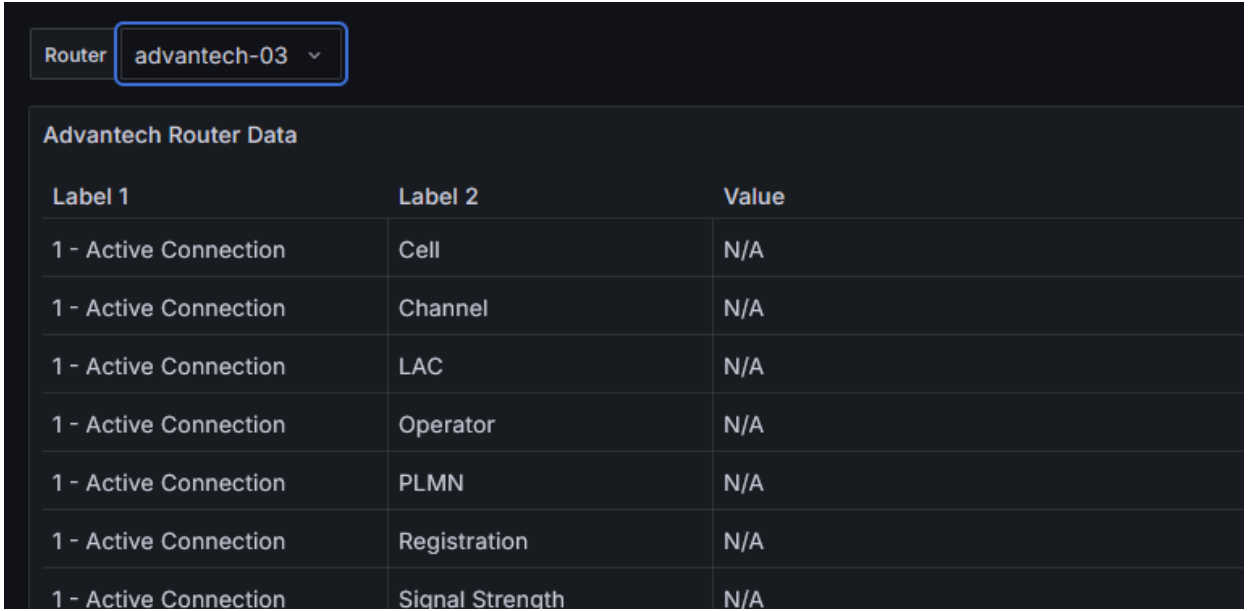
- Orchestration adapted from Chameleon testbed, using Openstack
- Applications packaged as Docker images, distributed by Kubernetes

Observability / Monitoring

- Collects performance / status data from various parts of the testbed
- Displays them via Grafana dashboard for easy monitoring

Observability / Monitoring, continued

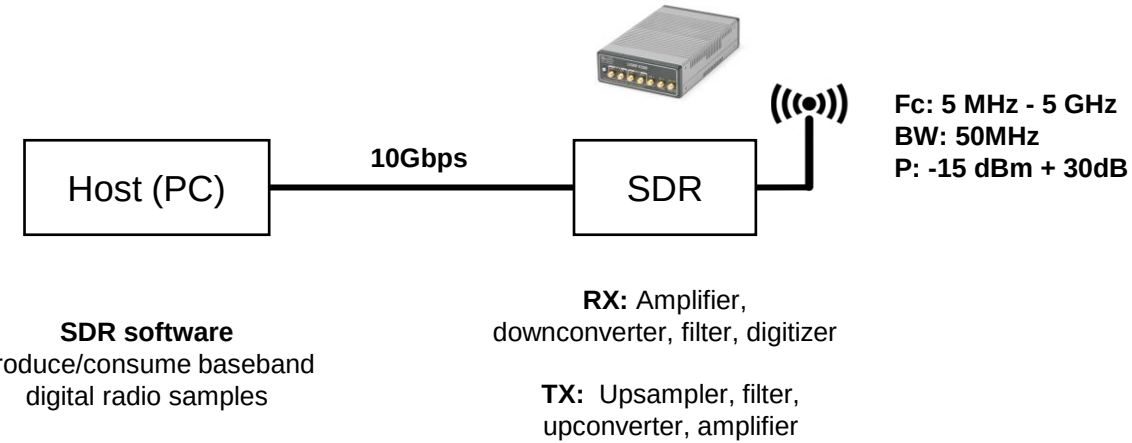
- Data for the Advantech 5G routers



GPS / GNSS Synchronization

- Use GPS / GNSS signal to time sync our servers and devices
- Better than µs precision
- Enables research that requires high precision time stamping
- Necessary for Ericsson Private 5G

Software-Defined Radio (SDR)



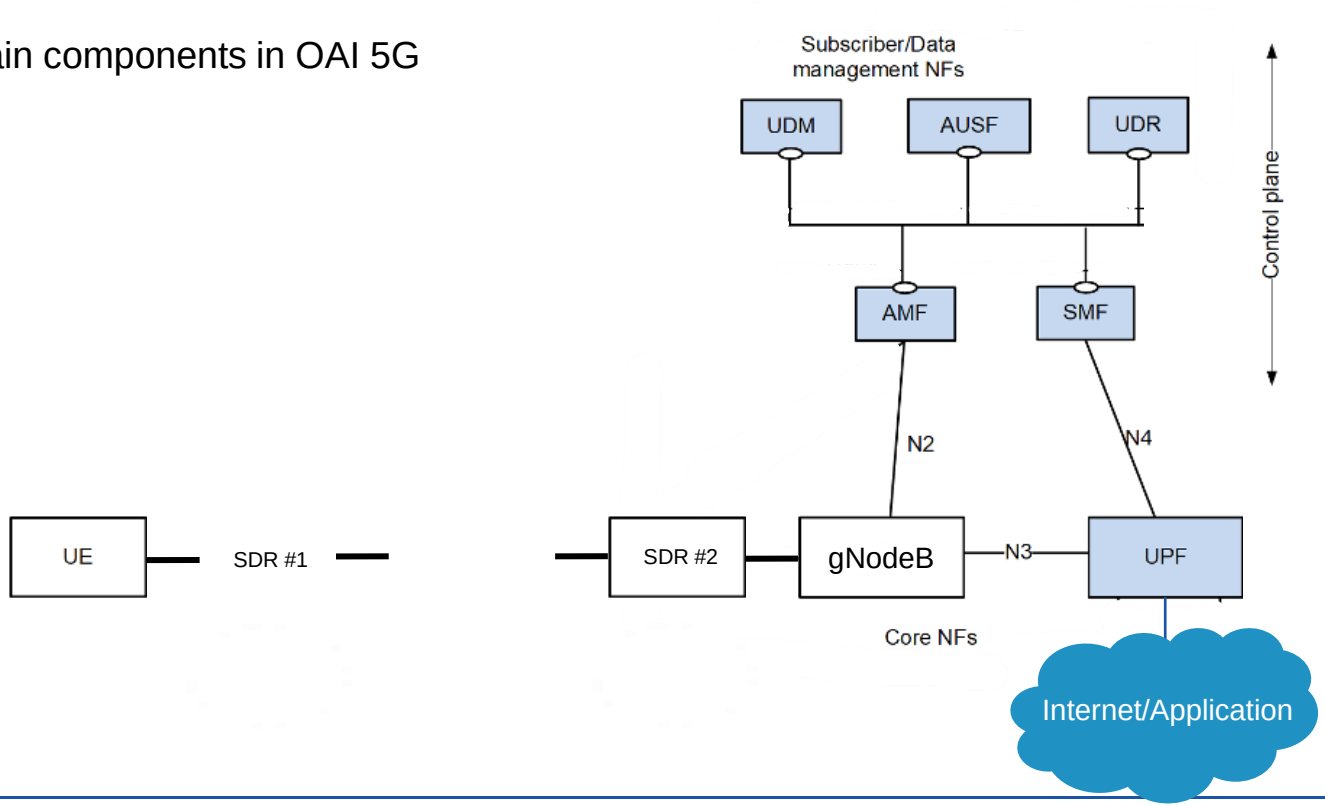
SDR hardware: *USRP E320*

SDR software:

- Openairinterface 5G/LTE, Mangocomm WiFi
- SRS 5G/LTE
- GNU Radio, etc

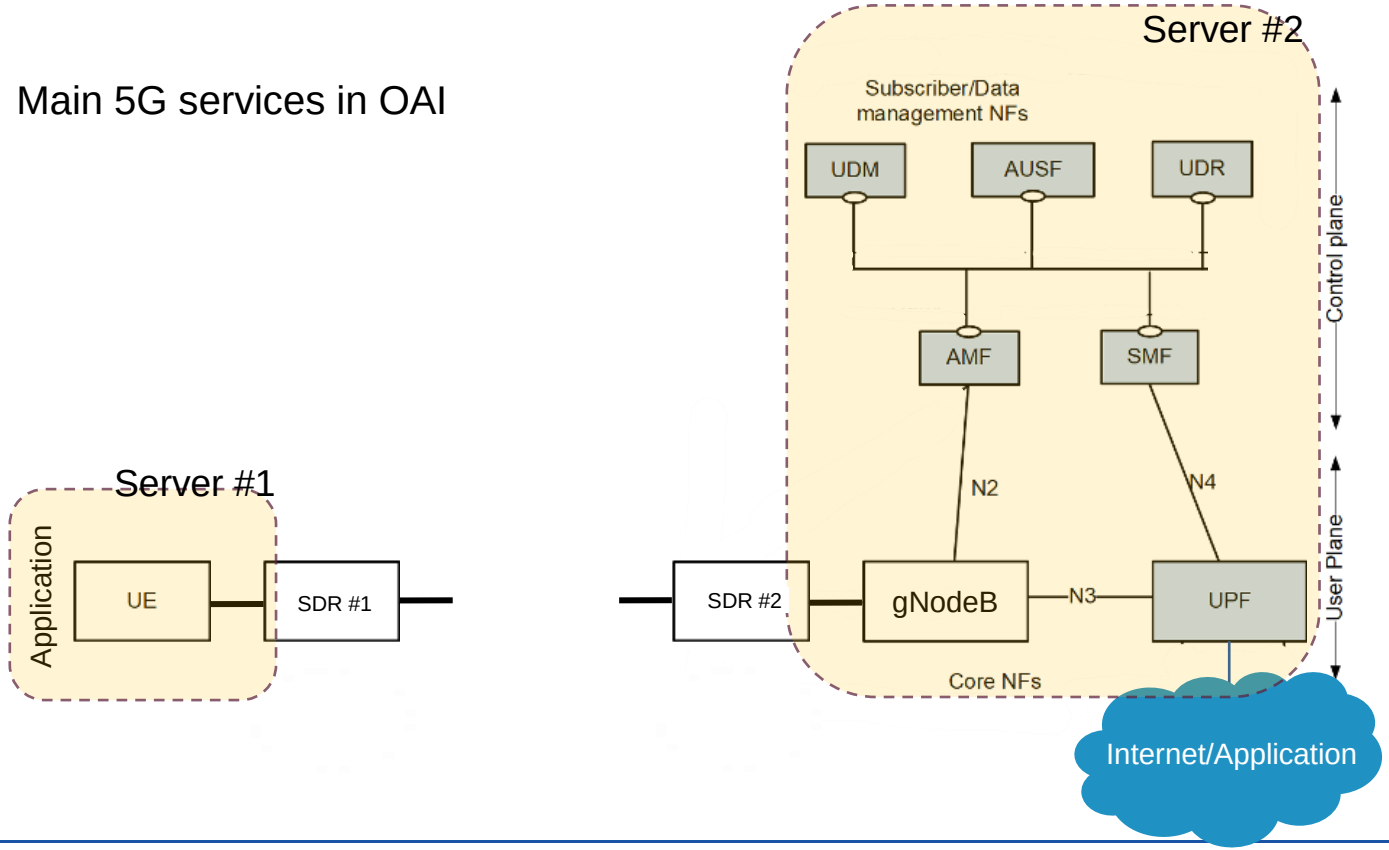
5G / Openairinterface

- Main components in OAI 5G



5G / Openairinterface, continued

- Main 5G services in OAI



ExPECA Experimental Workflow

Reservation

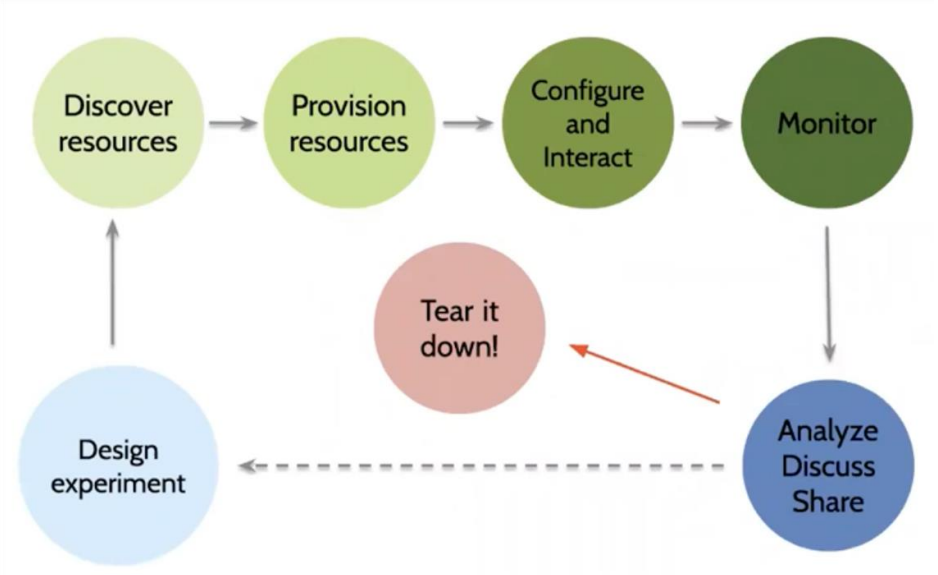
- Reserve workers
- Reserve radios
- Reserve storage

Configuration

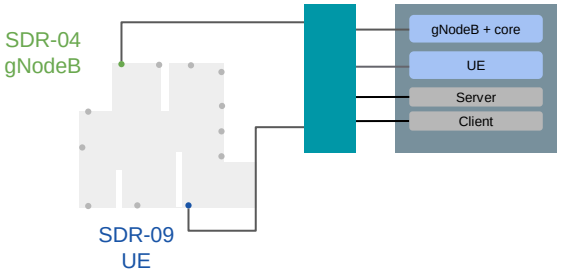
- Provision the network
- Run applications as containers

Extract the results

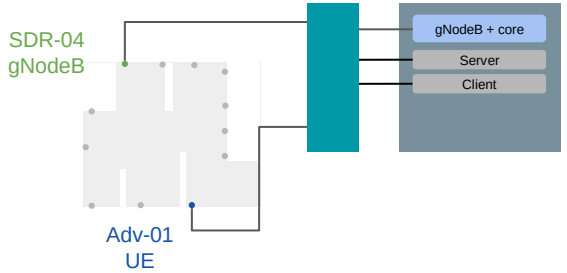
- Object and block storage



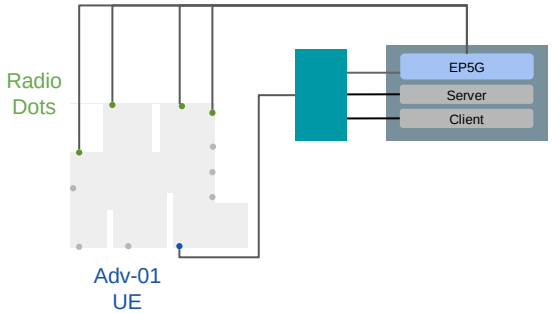
Experimental Scenarios



1) SDR-SDR 5G



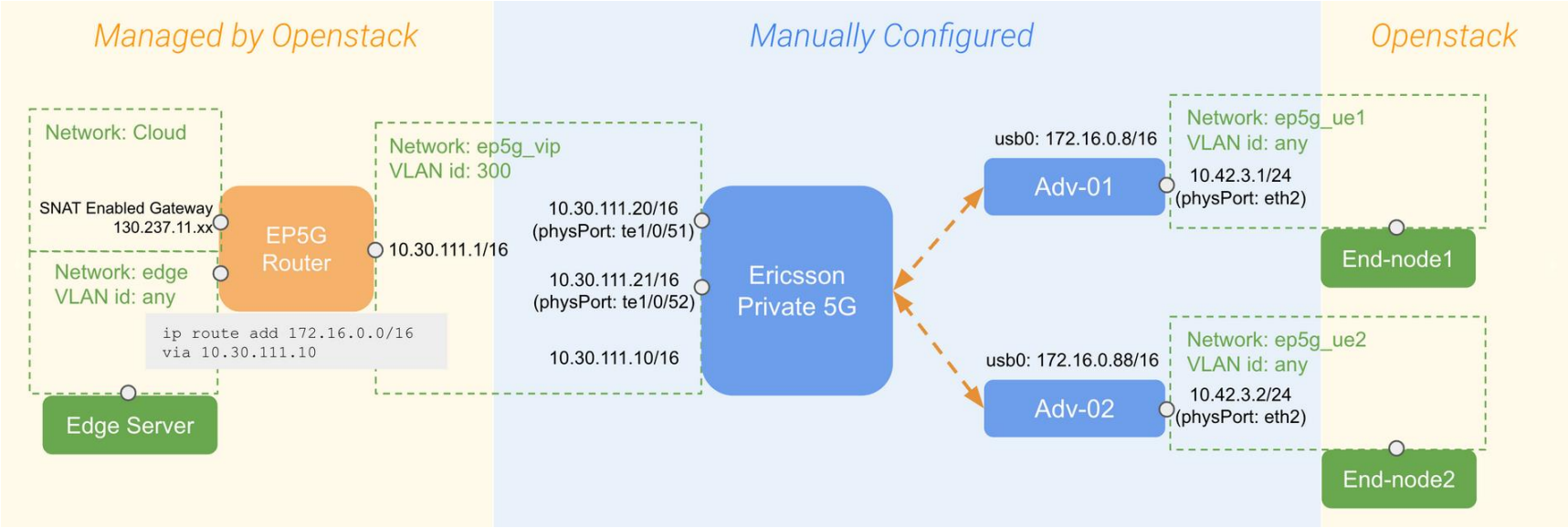
2) SDR-COTS 5G



3) EP5G-COTS 5G

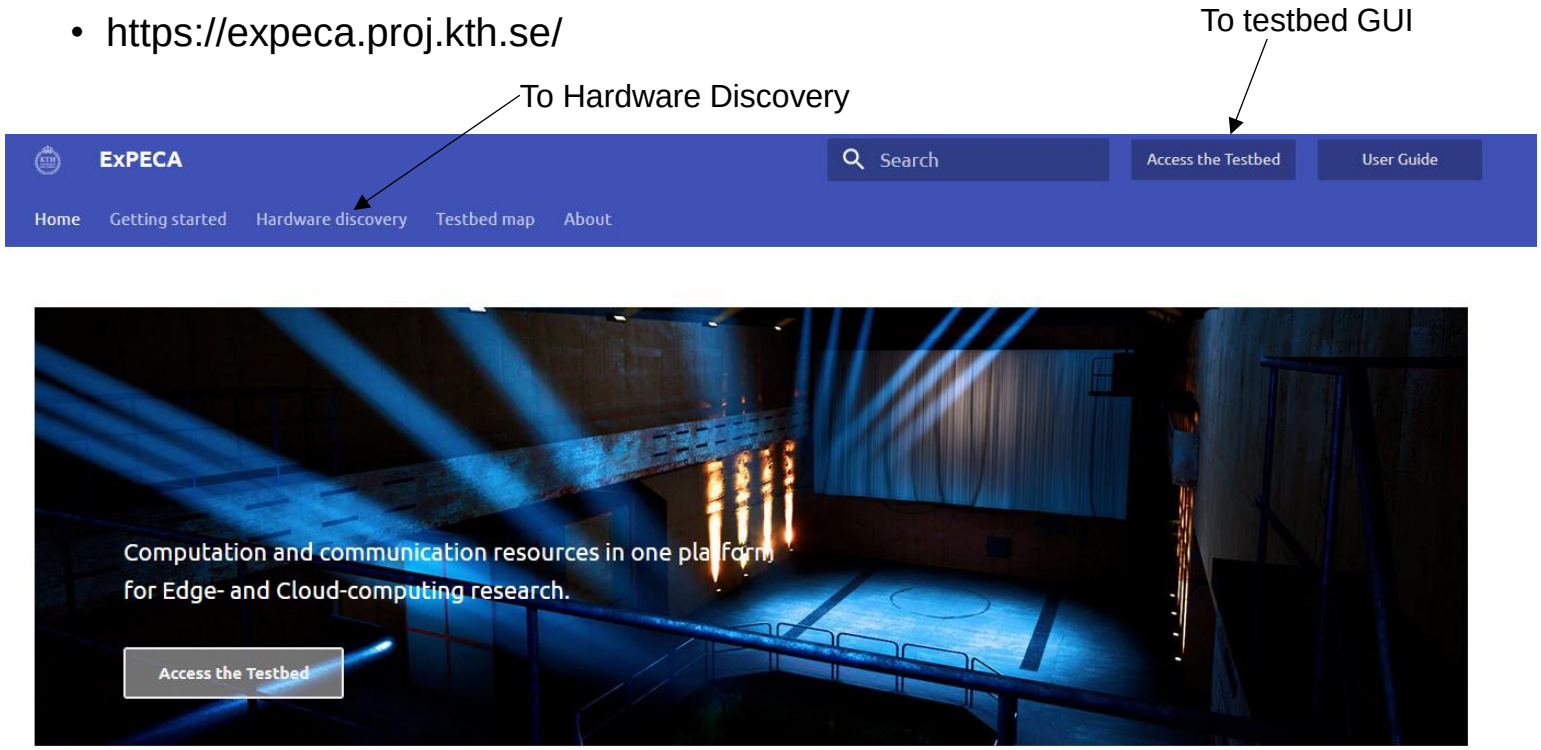
Configuration with GUI

- Plan your setup
- In this case: EP5G + Adv. router + Container at edge server



ExPECA Home Page

- https://expeca.proj.kth.se/



Hardware Discovery

- Hardware discovery
  - SDRs
    - sdr-01
    - sdr-02
    - sdr-03
    - sdr-04
    - sdr-05
    - sdr-06
    - sdr-07
    - sdr-08
    - sdr-09
    - sdr-10
  - Adv Routers
    - adv-01
    - adv-02
    - adv-03
    - adv-04
    - adv-05
    - adv-06
    - adv-07
    - adv-08
  - Worker Nodes
    - worker-01
    - worker-02
    - worker-03
    - worker-04

adv-03

ID	MODEL	LOCATION	SIMCARD1 IMSI	SIMCARD2 IMSI	EP5G IP Address
advantech-03	ICR-4453 5G Router	?	999080000000099	001010000000011	172.16.0.40

INTERFACE	INTERFACE NAME	IP	INTERFACE SPEED	INTERFACE MTU	SEGMENT ID	TYPE
SFP	eth2	10.42.3.1/24	10Gbps	9000	133	sfp

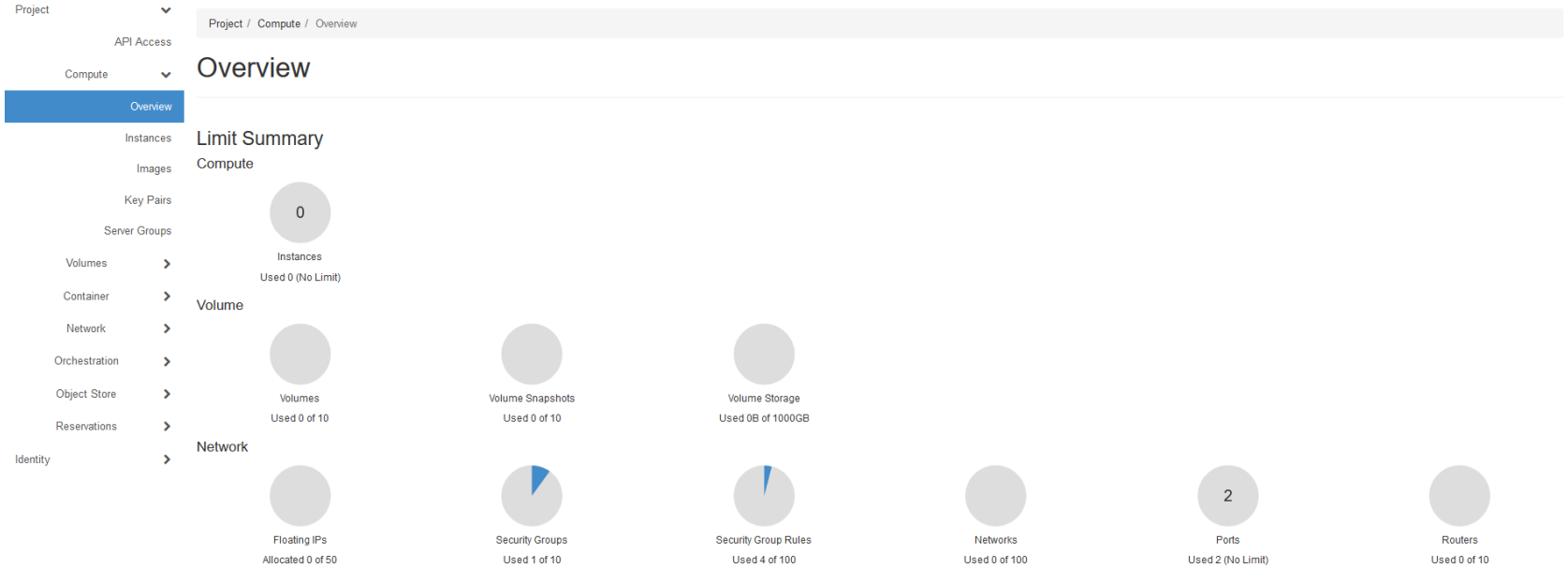
Remember for lease creation

adv-04

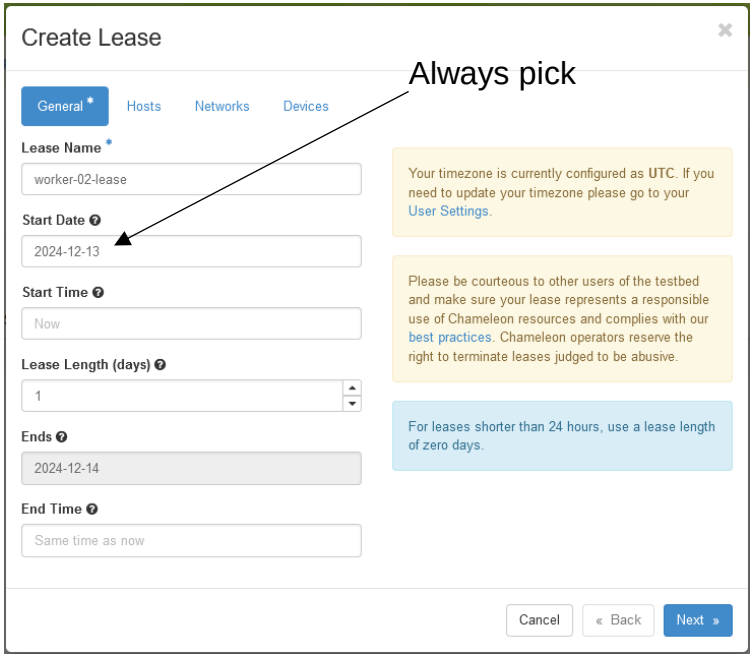
ID	MODEL	LOCATION	SIMCARD1 IMSI	SIMCARD2 IMSI	EP5G IP Address
advantech-04	ICR-4453 5G Router	?	999080000000010	001010000000010	172.16.0.96

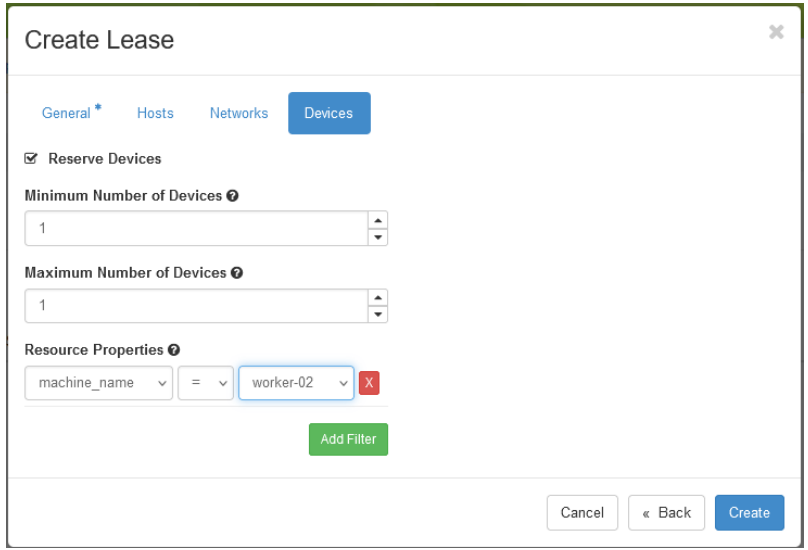
INTERFACE	INTERFACE NAME	IP	INTERFACE SPEED	INTERFACE MTU	SEGMENT ID	TYPE
SFP	eth2	10.42.3.1/24	10Gbps	9000	134	sfp

GUI Overview / Starting Point

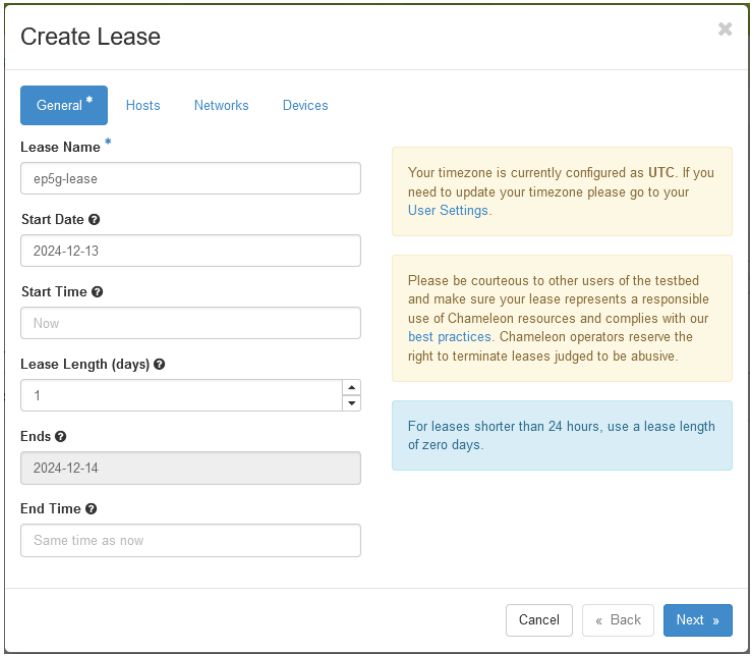


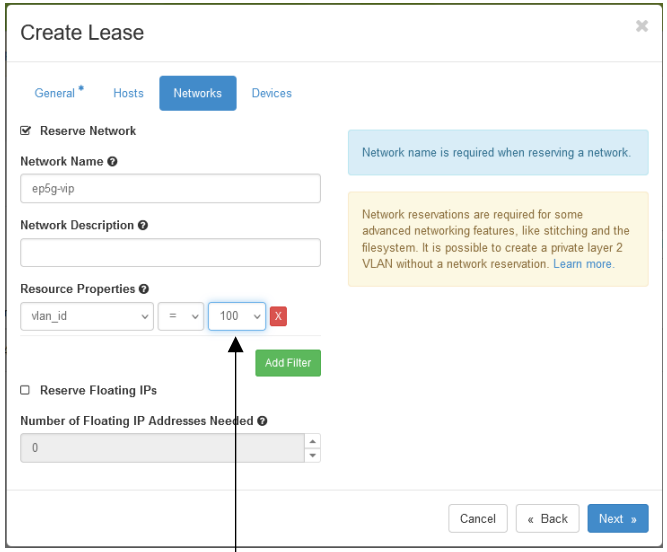
Step 1: Reservation / Lease Creation





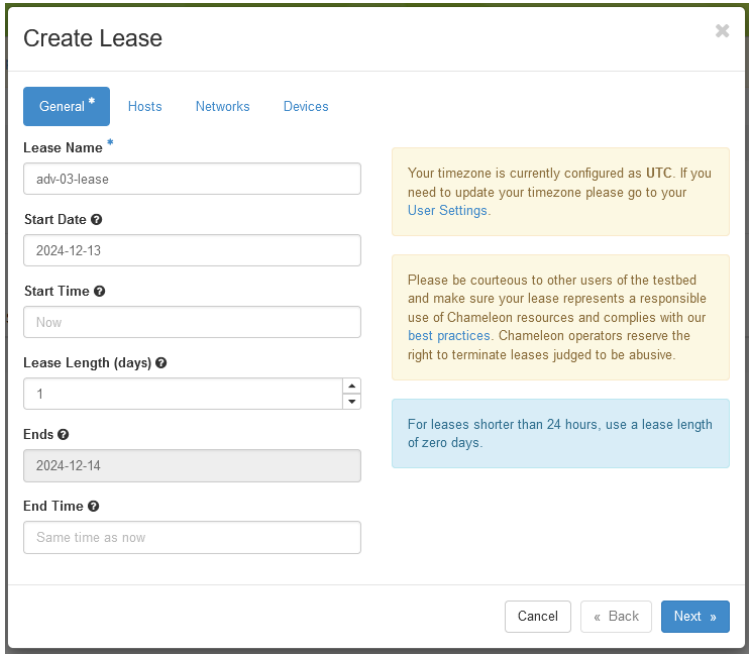
Step 1: Reservation / Lease Creation, continued

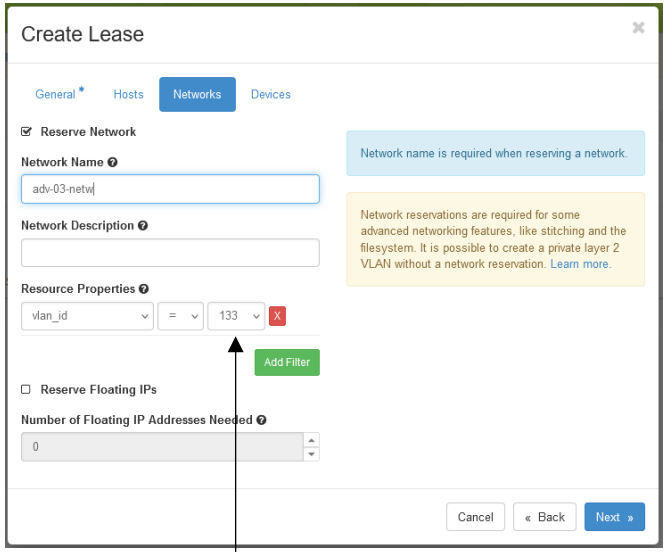




For EP5G, use 100

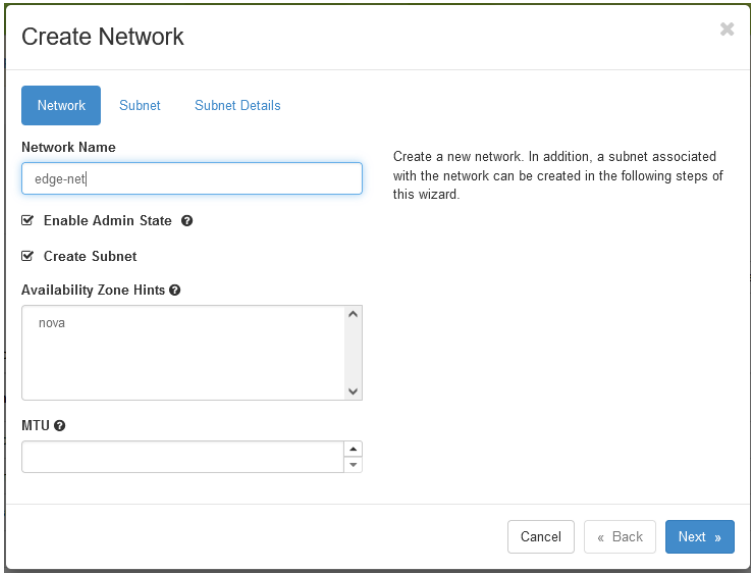
Step 1: Reservation / Lease Creation, continued

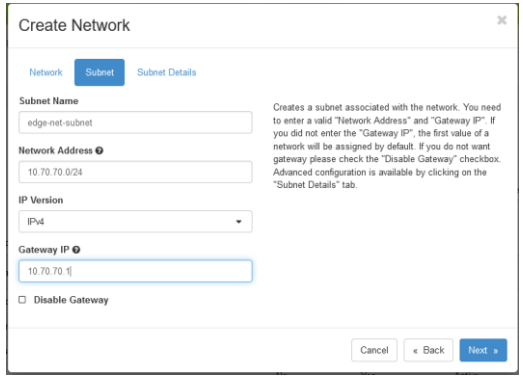


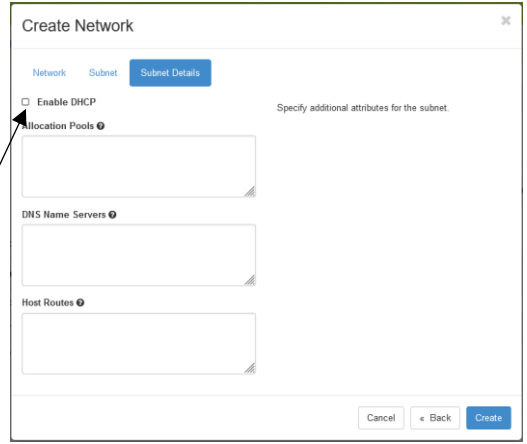


From ExPECA home page,
hardware discovery (segment ID)

Step 2: Network Creation

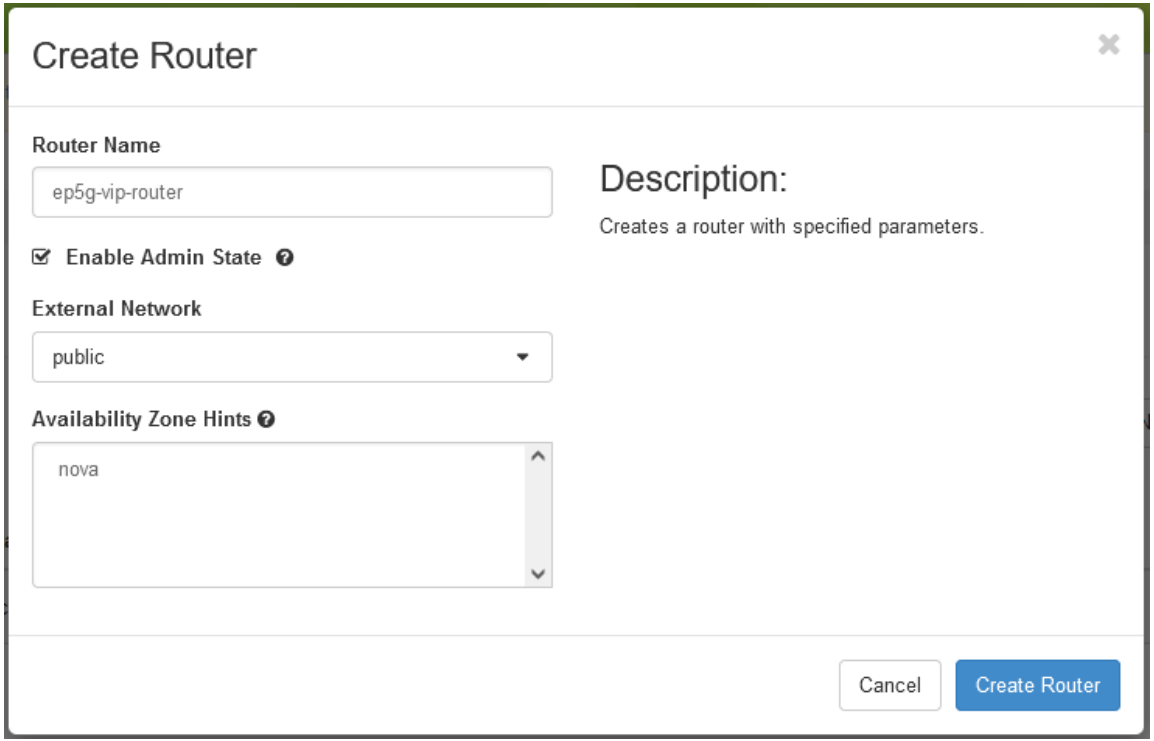




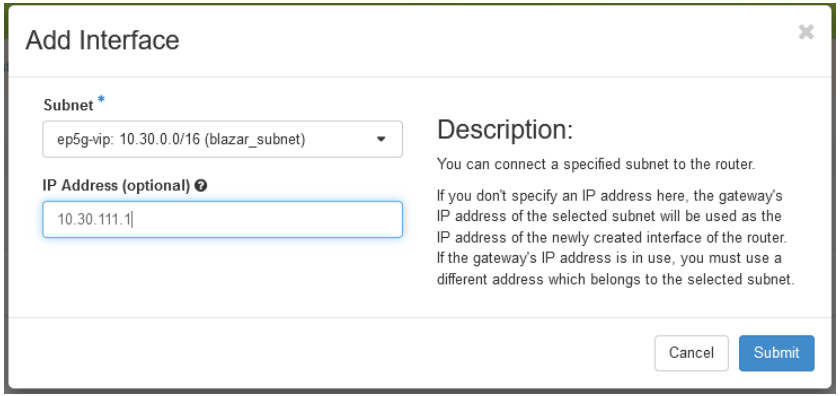


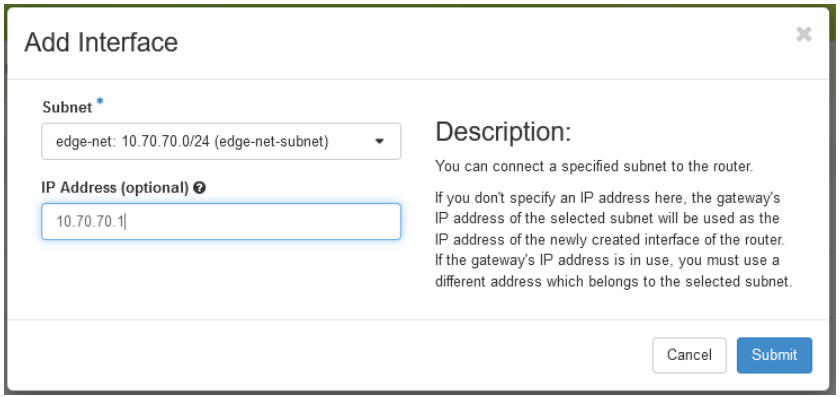
Uncheck box

Step 3: Router Creation

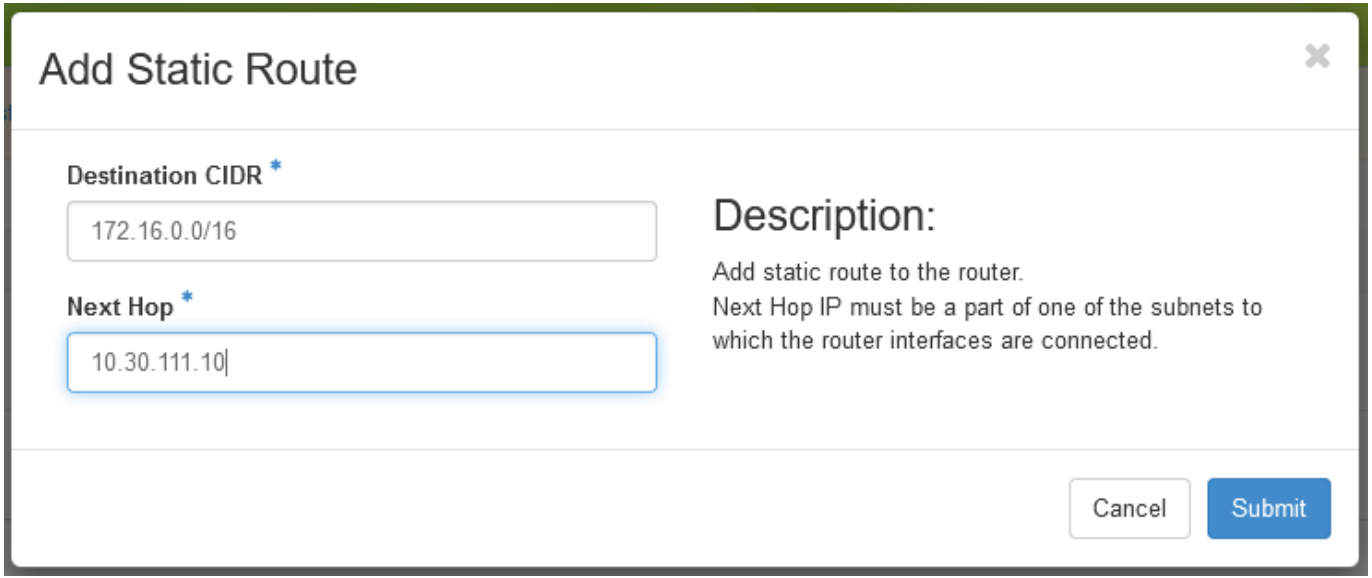


Step 4: Router Interfaces

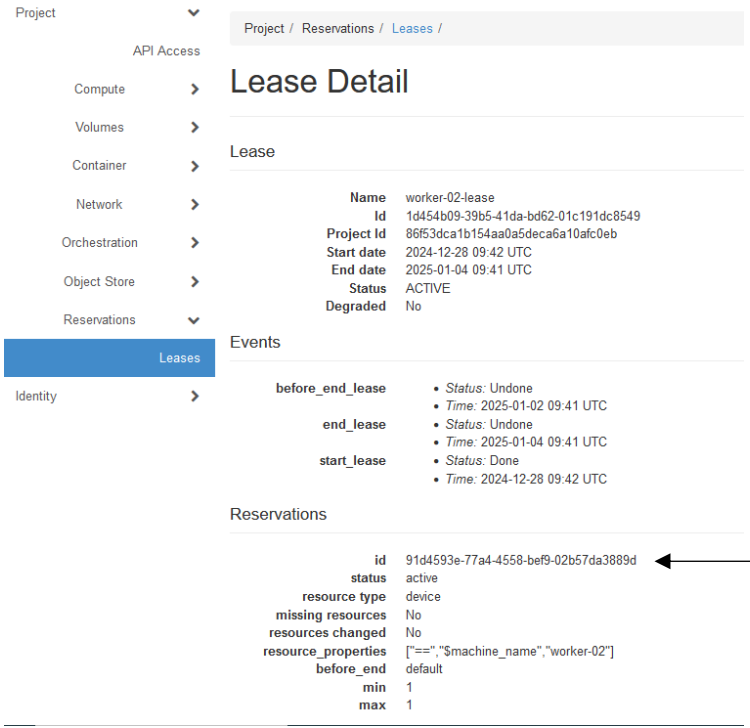




Step 5: Router Static Route

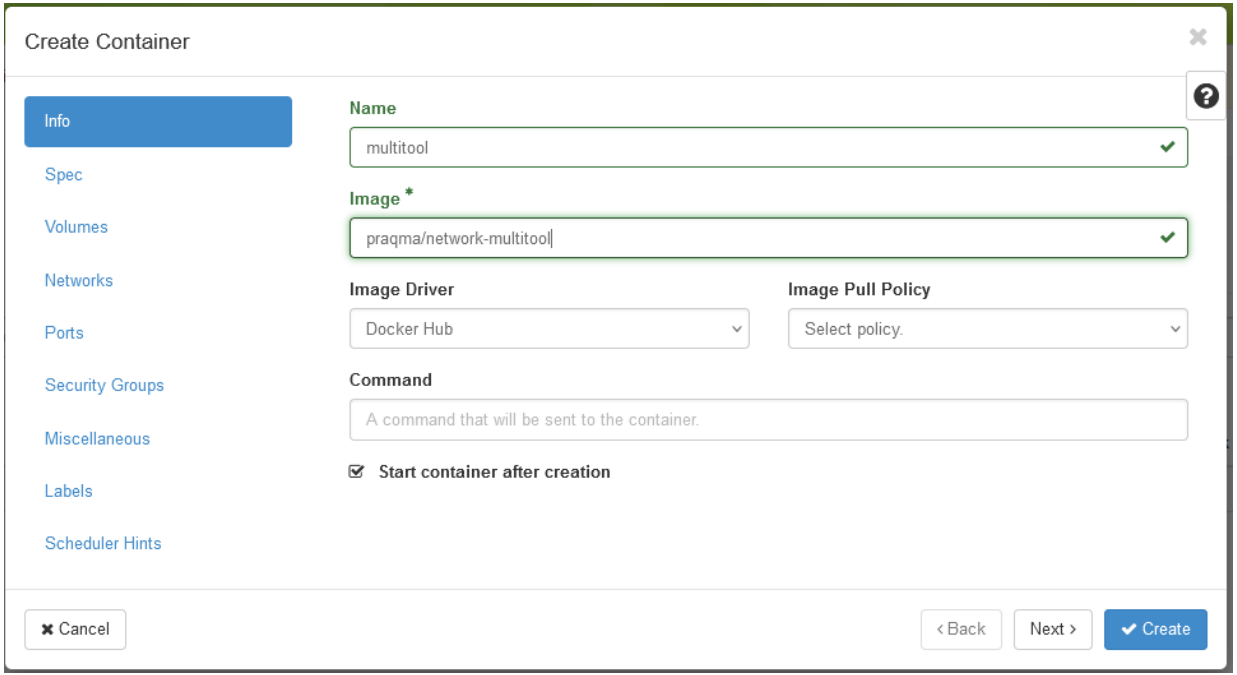


Step 6: Running a Container

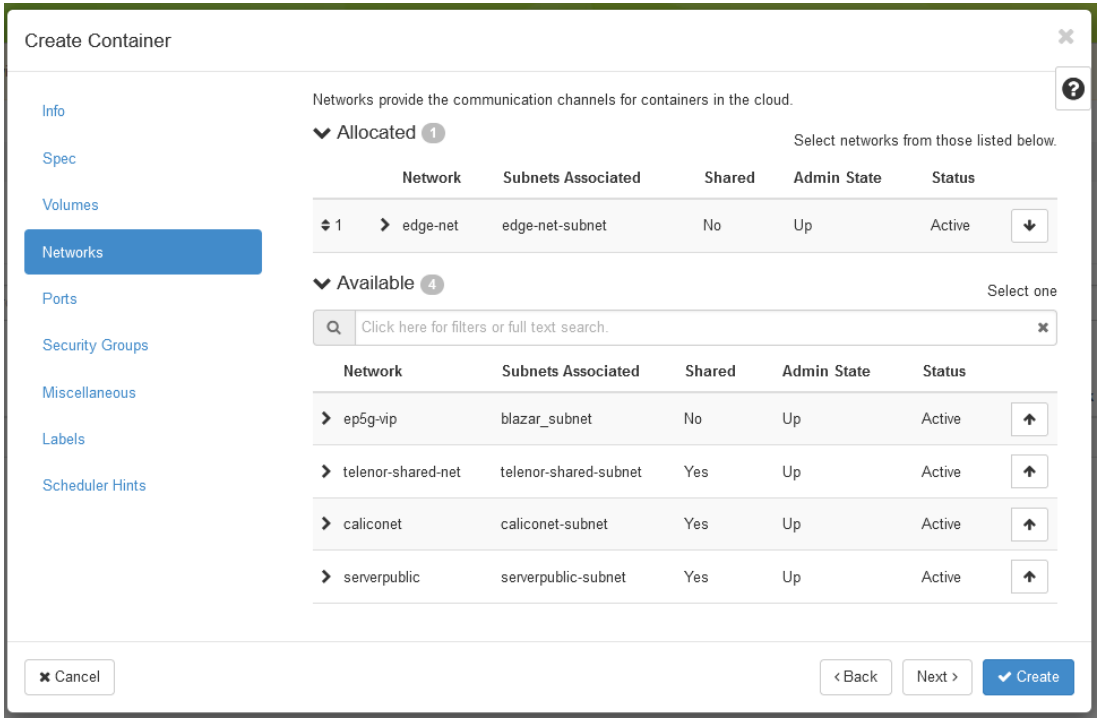


Copy reservation ID

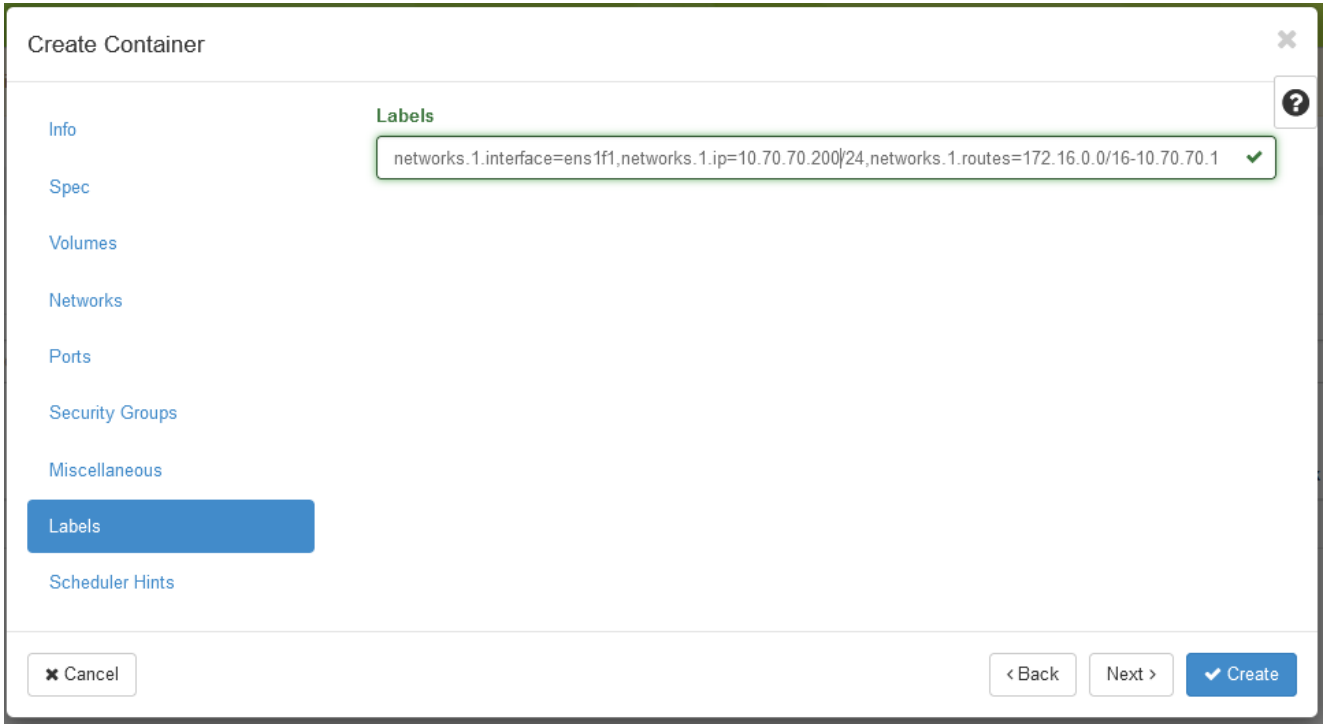
Step 6: Running a Container, continued



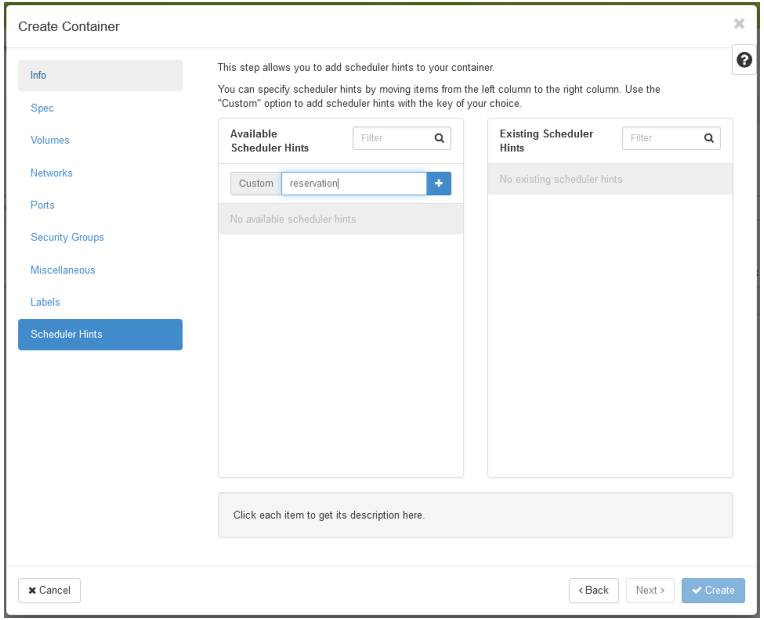
Step 6: Running a Container, continued

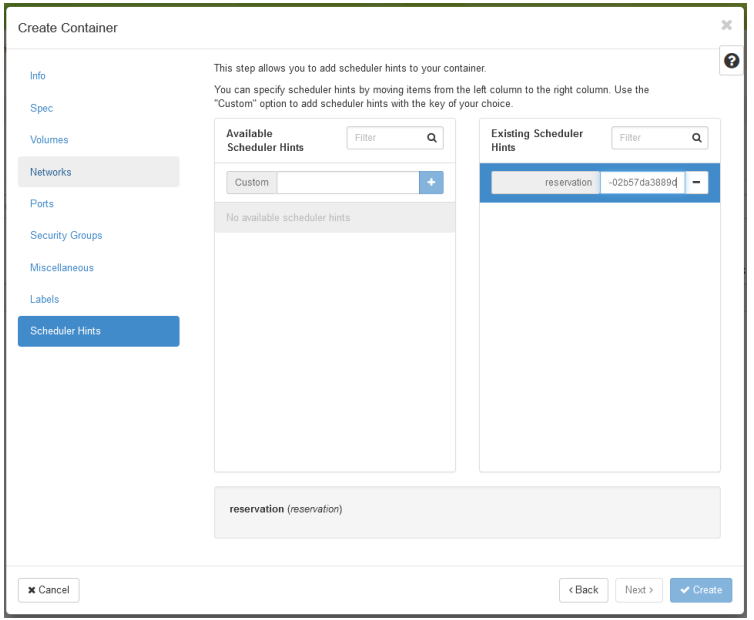


Step 6: Running a Container, continued



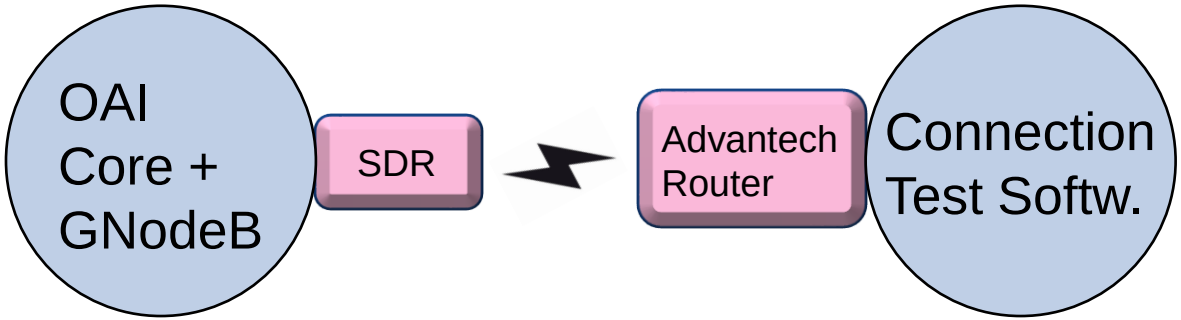
Step 6: Running a Container, continued





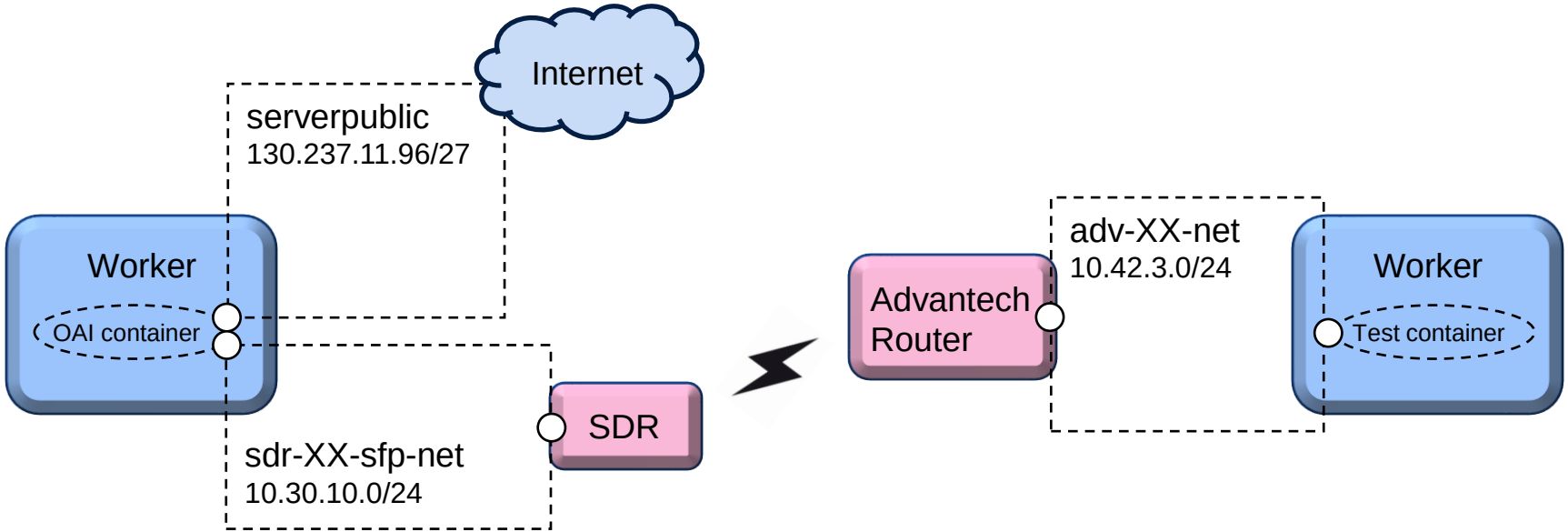
Group Assignment

- Openairinterface 5G network (Core Network + GNodeB) + 5G Router UE
- Configuration with Python Notebook
- https://github.com/KTH-EXPECA/examples/blob/main/workshop/workshop_setup.ipynb



Group Assignment, continued

- Testbed configuration plan



Group Assignment, continued

- Prerequisite: Google account, login on browser
- Prerequisite: SSH client on computer
- Python notebook: Configure ExPECA testbed via Python interface
- Colab: Google execution environment for Python notebook
- Python notebook uses API towards the testbed, via function calls

Group Assignment, continued

- Configure OAI Core + GNodeB in container via SSH
- Test 5G connection from container associated with 5G router
- https://github.com/KTH-EXPECA/examples/blob/main/workshop/workshop_gnbcoreinone.md
- For SSH to Core/GNodeB container, 2 SSH terminals will be used
- ssh root@<Public IP>
- Communication with Advantech router container will be via GUI container log + console

Group Data

Group	User	SDR	Adv Router	Worker	Band
1	workshop01	sdr-04	adv-08	worker-01	41
2	workshop02	sdr-09	adv-06	worker-02	48
3	workshop03	sdr-05	adv-07	worker-03	77
4	workshop04	sdr-02	adv-02	worker-04	78
5	workshop05	sdr-03	adv-04	worker-06	79