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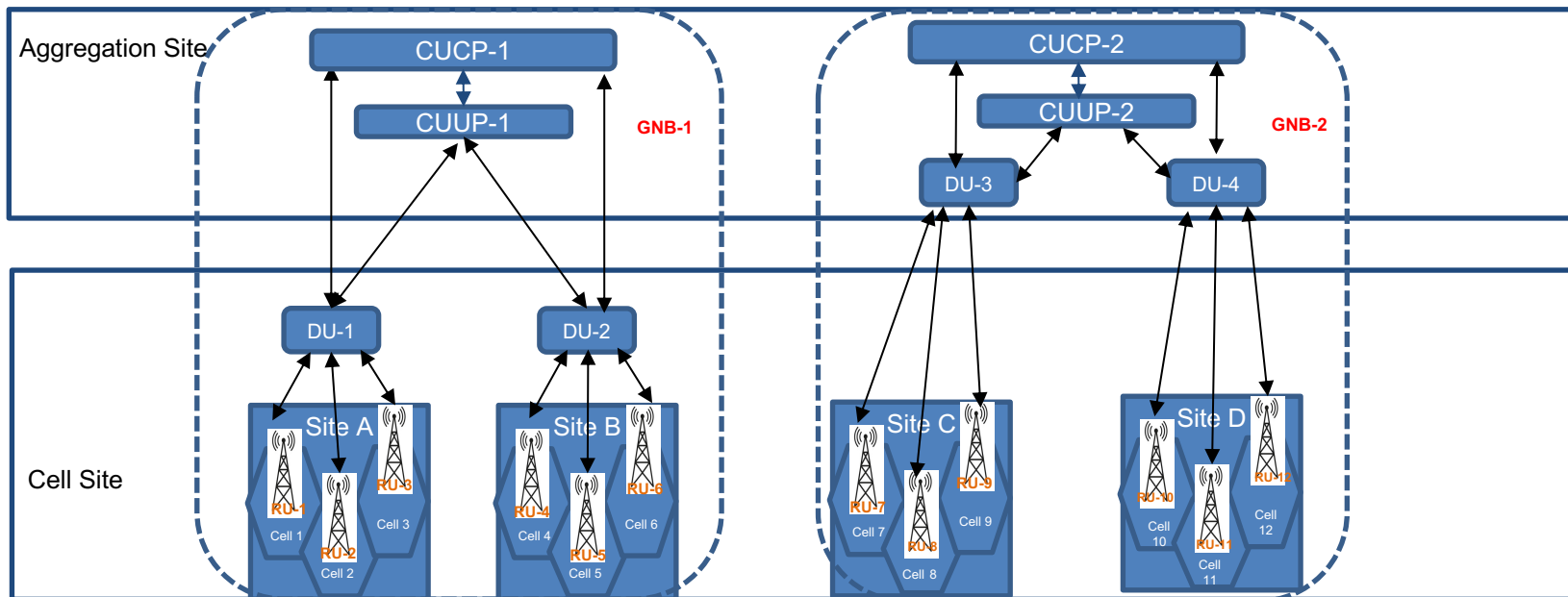
Agenda

Overview

- We present Service modelling and deployment of a 5G RAN GNB using ONAP

  - This model is flexible and can cover all kinds of deployment options and RAN splits e.g. higher-layer (e.g. CUCP-CUUP-DU) and lower-layer splits (DU-RU)

  - In this example today, we consider the RAN disaggregation scenario of a GNB consisting of virtualized CUCP, CUUP, DU and physical RU.

Phases in RAN Deployment and Operations using ONAP

RAN Planning

RAN Service Design In ONAP

RAN Service Deployment By ONAP

RAN Operational Monitoring By ONAP

Planning of Sites, Cells, Nodes, Coverage Area, Quality requirements

Single disaggregated GNB service model composed of a combination of CNF & PNF models

Multi-vendor models

GNB model reusability

One service order for each GNB deployment

Maintain sequence of bring-up of network functions inside GNB

GNB can be deployed over multiple clouds

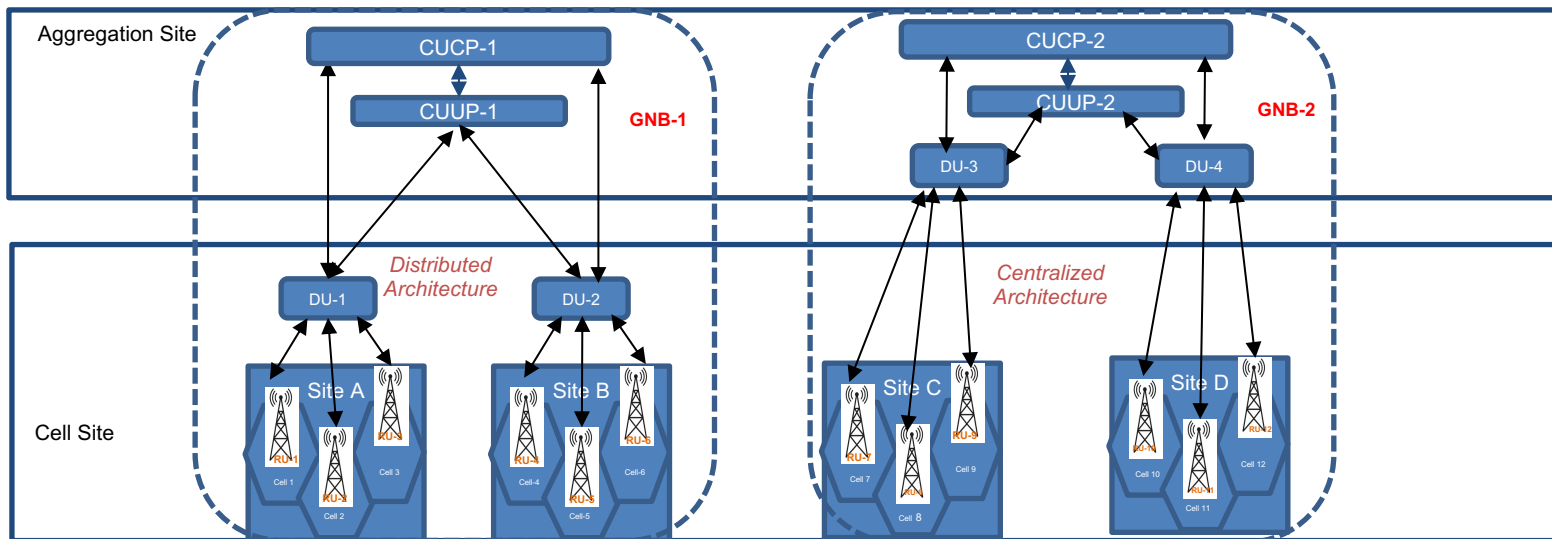Add New Network Functions later for coverage or capacity expansion

Update Inventory with deployed RAN topology

RAN Planning Phase

For RAN coverage planning the following aspects are considered:

- locations and sites are determined,
- cells are planned, with their physical characteristics (e.g. antenna height, tilt, and azimuth), and other parameters.
- nodes and network functions controlling and carrying the traffic through these cells are also planned, as per the deployment options and usage scenarios (e.g. high/low latency & throughput use cases)
- centralized and distributed deployment topologies of the network functions are planned as per the use case requirements
- node and network function identifiers are assigned
- Connections between network functions are also assigned since in a typical 3GPP 5G NR GNB, multiple DUs can connect to a CUUP, and multiple CUUPs can connect to a CUCP

- RAN Planning information should be stored in ONAP , so that this planned network topology can be correlated with the deployed network topology
- Operational use cases such as
  - cell site visualization,
  - alarm root cause analysis,
  - KPI optimization

  are enabled by this information

- Information that is most essential during deployment and operations, is the **relationship** information
  - Cells inside a site
  - Cells controlled by a node / network function
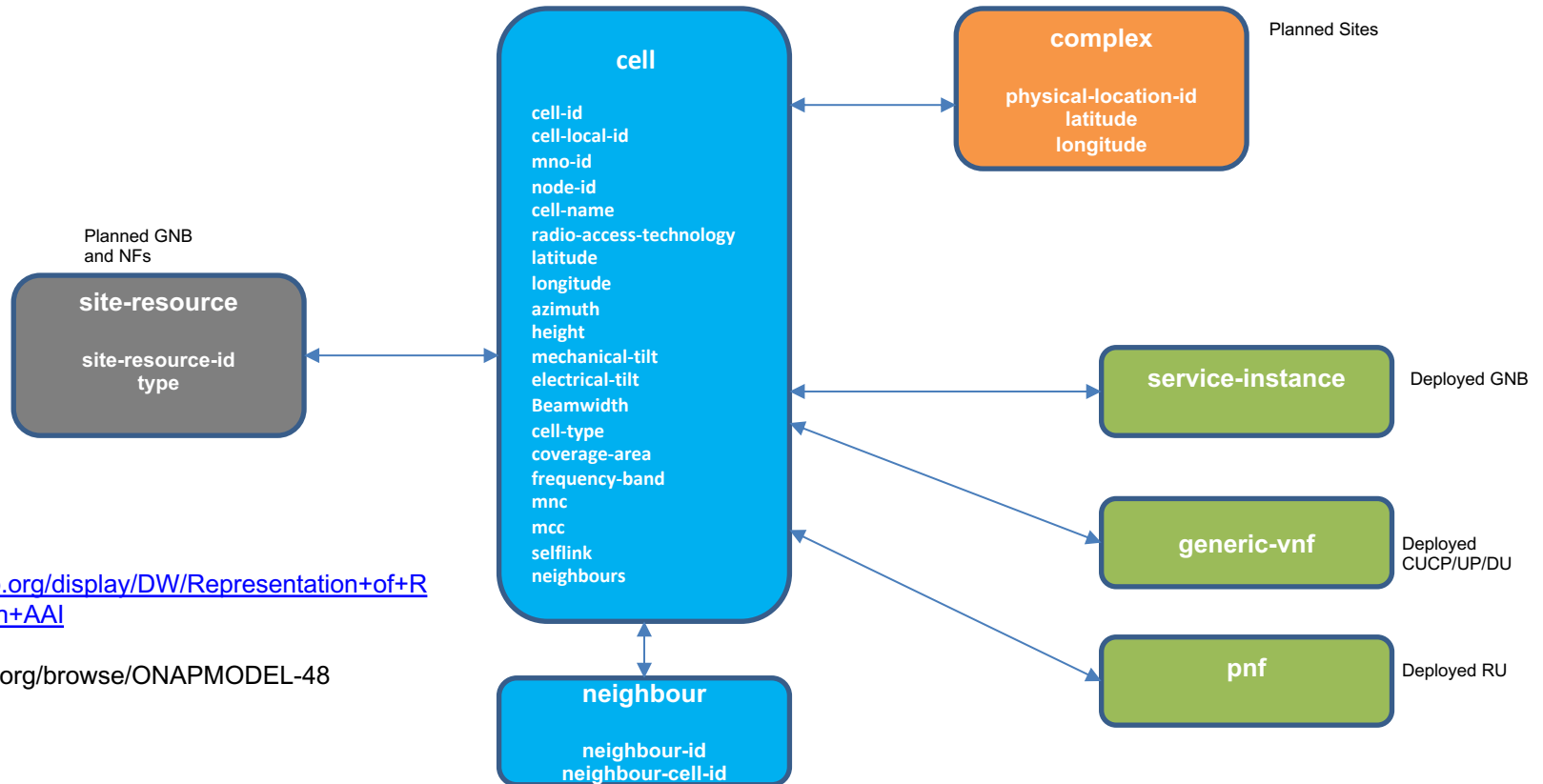 - Dependency between network functions and nodes

RAN Planning Phase

- AAI is a suitable component in ONAP to store RAN planning information, since it is a graph-based database that can manage relationships.
- From London release, AAI will be able to store complete RAN Planning information including Cells
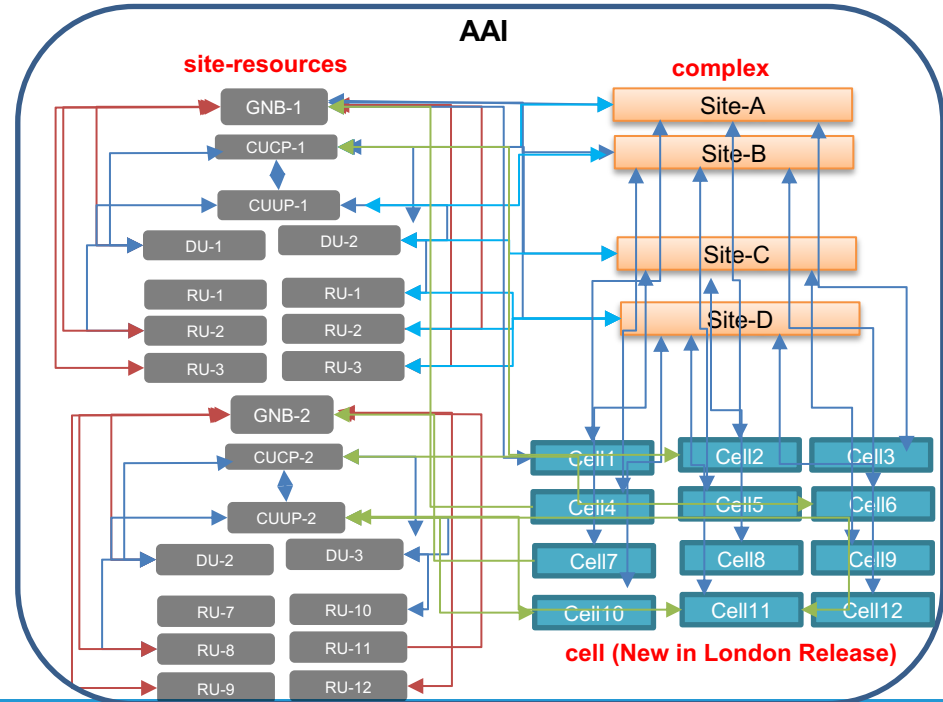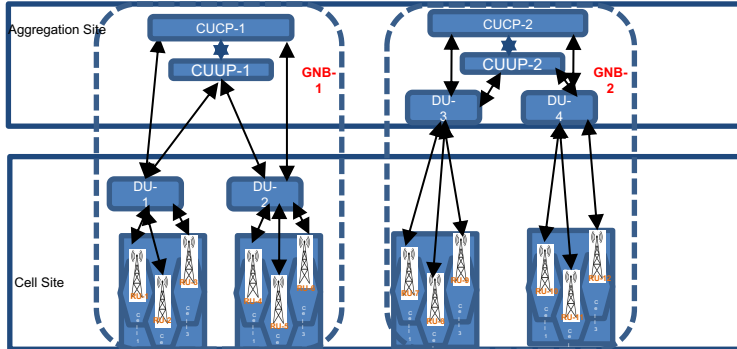
- Planned GNB and NFs are site-resources in AAI
- Planned Sites are complexes in AAI
- Planned Cells are cells in AAI

RAN Cell Representation in AAI

cell

cell-id
cell-local-id
mno-id
node-id
cell-name
radio-access-technology
latitude
longitude
azimuth
height
mechanical-tilt
electrical-tilt
Beamwidth
cell-type
coverage-area
frequency-band
mnc
mcc
selflink
neighbours

complex

physical-location-id
latitude
longitude

Planned Sites

Planned GNB
and NFs

site-resource

site-resource-id
type

service-instance

Deployed GNB

generic-vnf

Deployed
CUCP/UP/DU

pnf

Deployed RU

neighbour

neighbour-id
neighbour-cell-id

More info:

https://wiki.onap.org/display/DW/Representation+of+RAN+Inventory+in+AAI

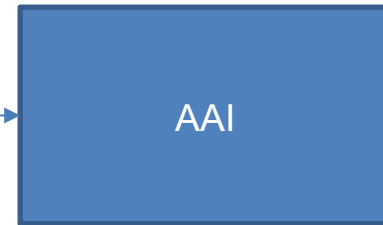https://jira.onap.org/browse/ONAPMODEL-48
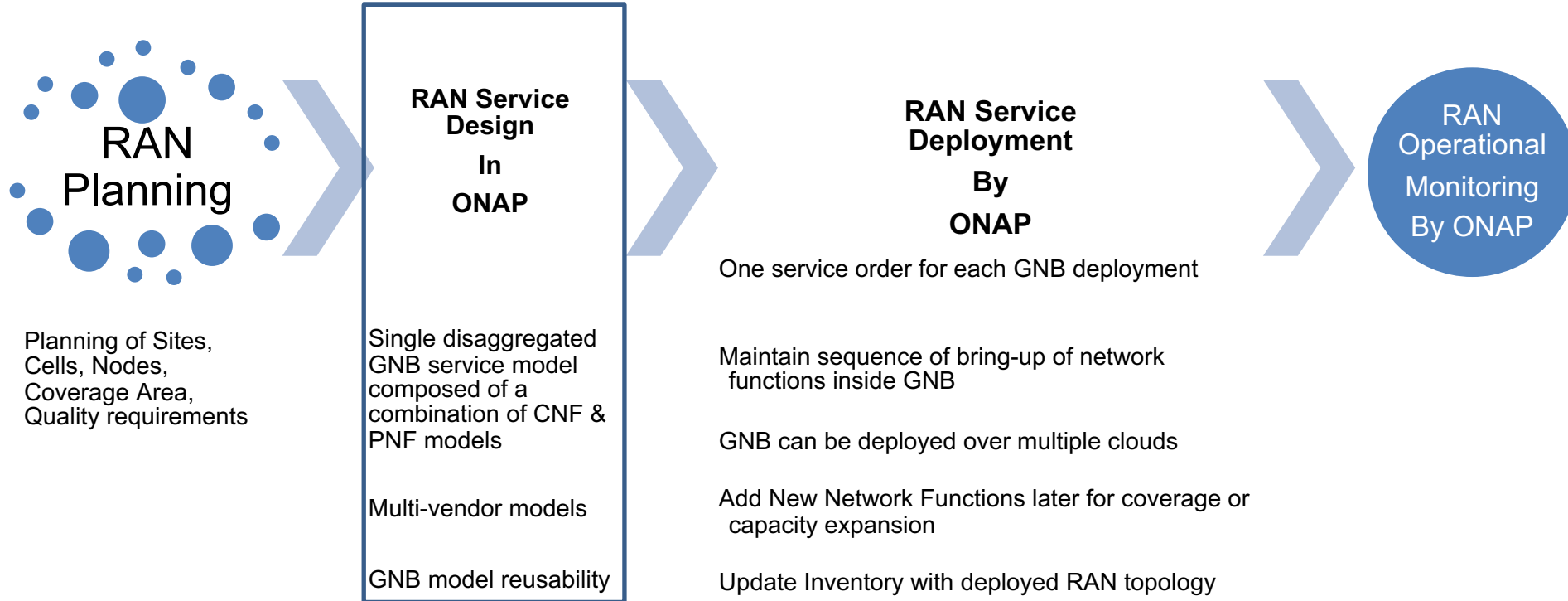
Git for RAN Planning Data Import

- RAN Planning Data can be created by the planning department in the form of a CSV file and stored in a repository such as GitLab
- A CI/CD pipeline can read the data from the CSV and create the corresponding objects in AAI

Region	Site	GNB ID	Cell Local ID	latitude	longitude	azimuth	height	RU ID	CUCP ID	CUUP ID	DU ID
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X

CI/CD Pipeline which reads data from a CSV in Gitlab, and triggers AAI Rest APIs to create planning objects i.e. site-resources, complexes, sites

AAI

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Service Design for RAN GNB Model
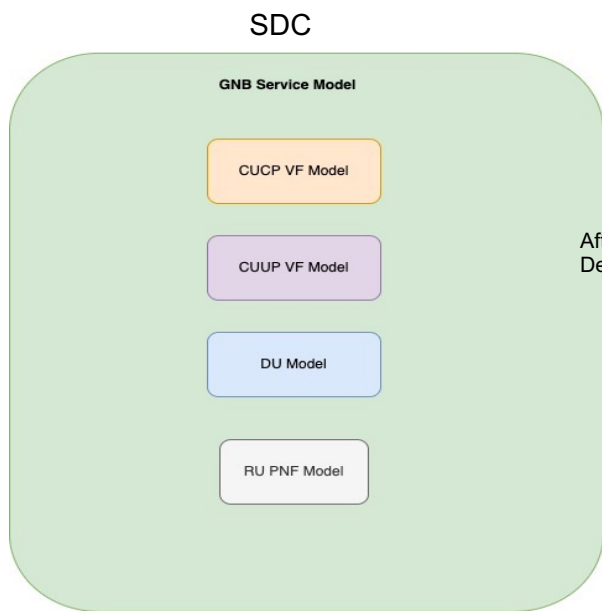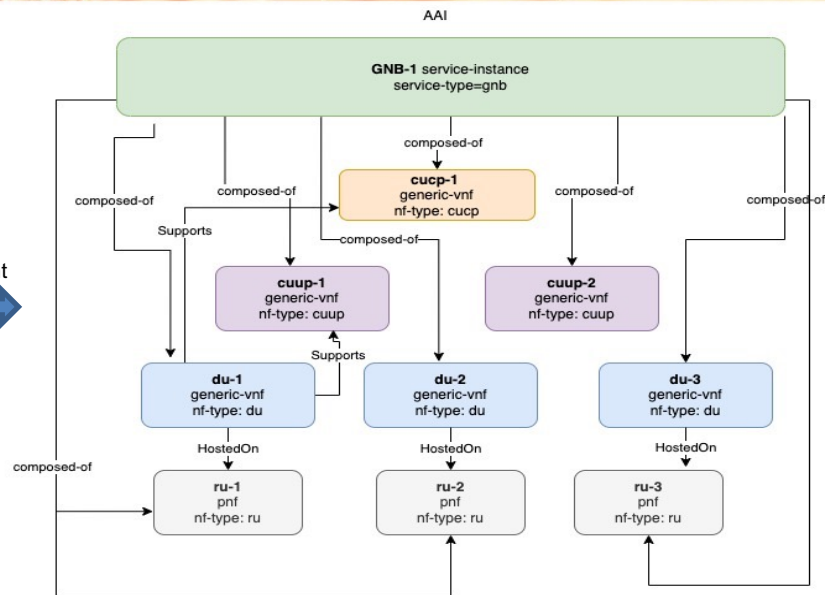
- A GNB is a mix of CNFs and PNFs inside a single service

- For each CNF and PNF model, we specify the nf-type (e.g. cucp, cuup, du , ru)

- There can be multiple instances of each CNF and PNF model in the GNB

- Instance specific values for the CNF models are provided using configuration templates and overriding functionality of Helm charts in CBA packages in CDS

- Day-1 configuration values for each instance of CNF and PNF are stored in CPS and are applied using SDNC/CDS using Netconf

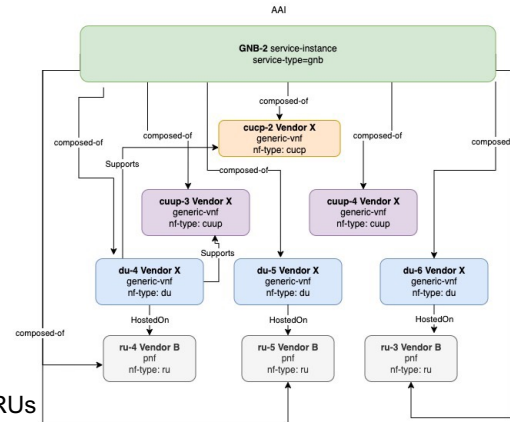# Service Design for RAN GNB Model – Mix & Match

Deployed GNB with Vendor A RUs

SDC

GNB Model with RU Models from Vendor A , B and C

Deployed GNB with Vendor B RUs
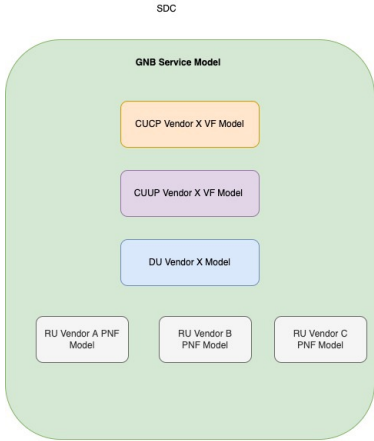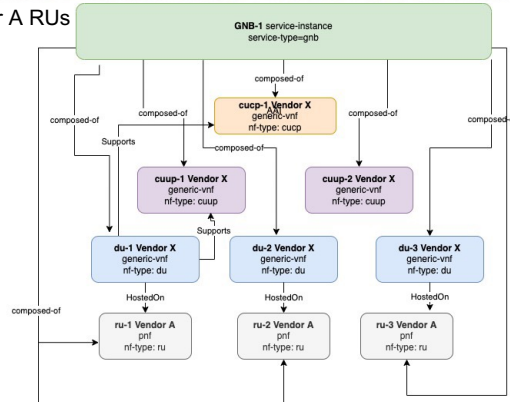
- In a GNB Service Model, the CNF and PNF models can be from multiple vendors

- All feasible combinations of CNF and PNF models can be included in the service model

- During deployment of the GNB, all composed CNF and PNF models can be selected, or a subset as per the requirement

 e.g. to deploy a GNB with RUs from the same vendor, only the specific RU vendor model can be selected, although the service model contains RU models from different vendors

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Service Orchestration of the RAN GNB Model

The GNB Service Model has some requirements which must be taken care of during its bring up and activation

5G GNB REQUIREMENT

- There is an order of instantiation and activation of the network functions inside a GNB i.e.
  - CUCP is brought up before the CUUP and DUs
  - RUs are brought up after the DU that they connect to is active

- CNFs inside a GNB may be required to be deployed on different clouds e.g. DU on cell site, CUUP/CUCP on aggregation site

- The network functions that compose a GNB should be updated in the AAI inventory, along with the inter-dependent relationships and relationships to the cells and sites being controlled by the GNB. Association between deployed nodes and planned nodes is also necessary.

- After a GNB is deployed and active, at a later time, additional CNFs and PNFs can be added to it in case required for RAN site coverage or capacity expansion
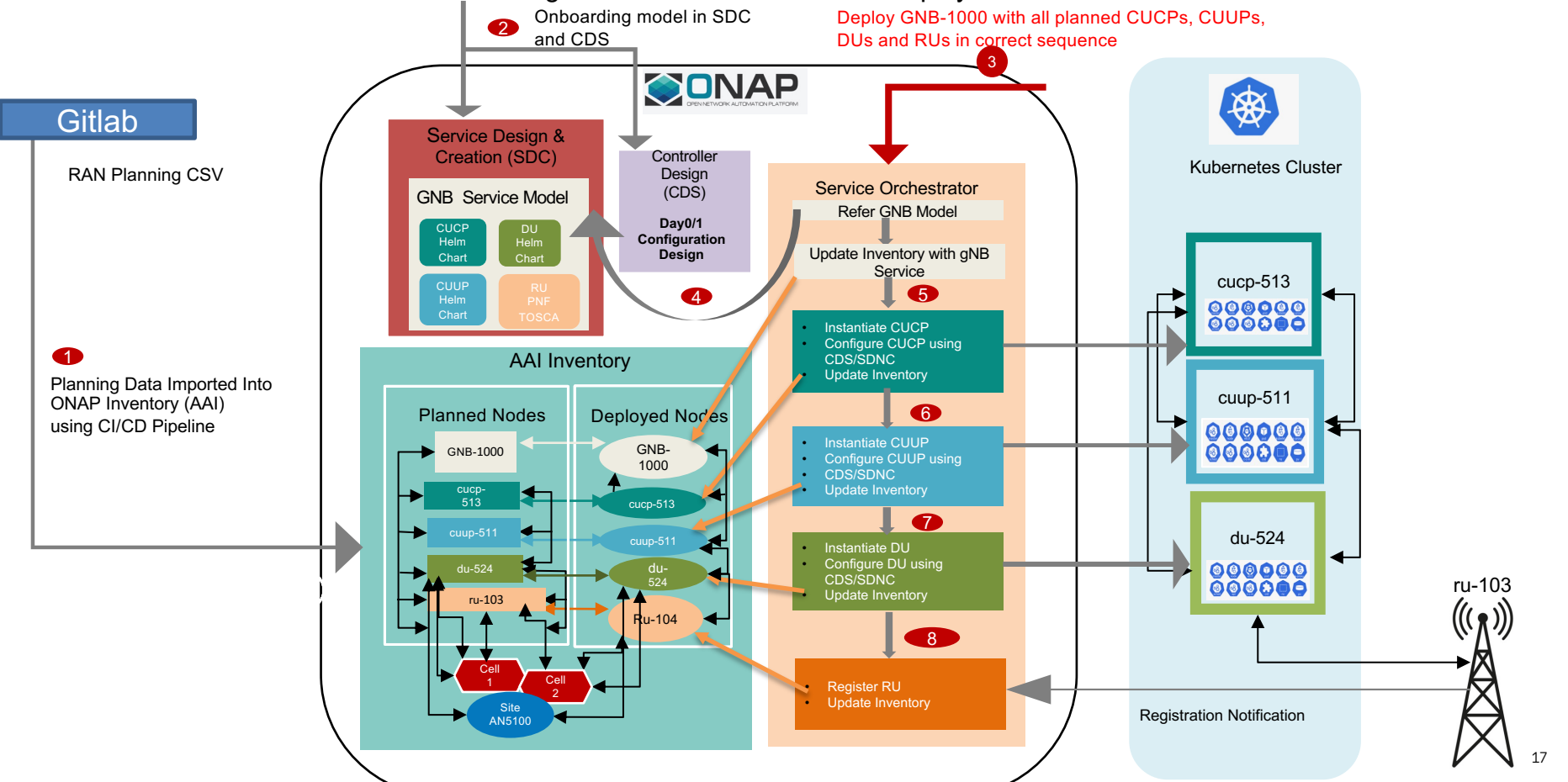
SO MACRO FLOW

- This is enabled in SO Macro Flow by using the parameter **processing_priority** in the SO service order for each CNF
- Orchestration flow can be configured to process PNFs after all CNFs

- This is enabled in the SO Macro Flow by specifying the cloud-region for each CNF in the service order. After deployment, the virtualized resource information (K8S resources) created for each CNF is present in AAI.

- This is supported by the SO Macro Flow with additional GNB-specific relationships created by CDS.

- This is enabled in SO Macro Flow through the endpoint to add CNF to an existing service
- Adding a PNF to a deployed service will be available soon

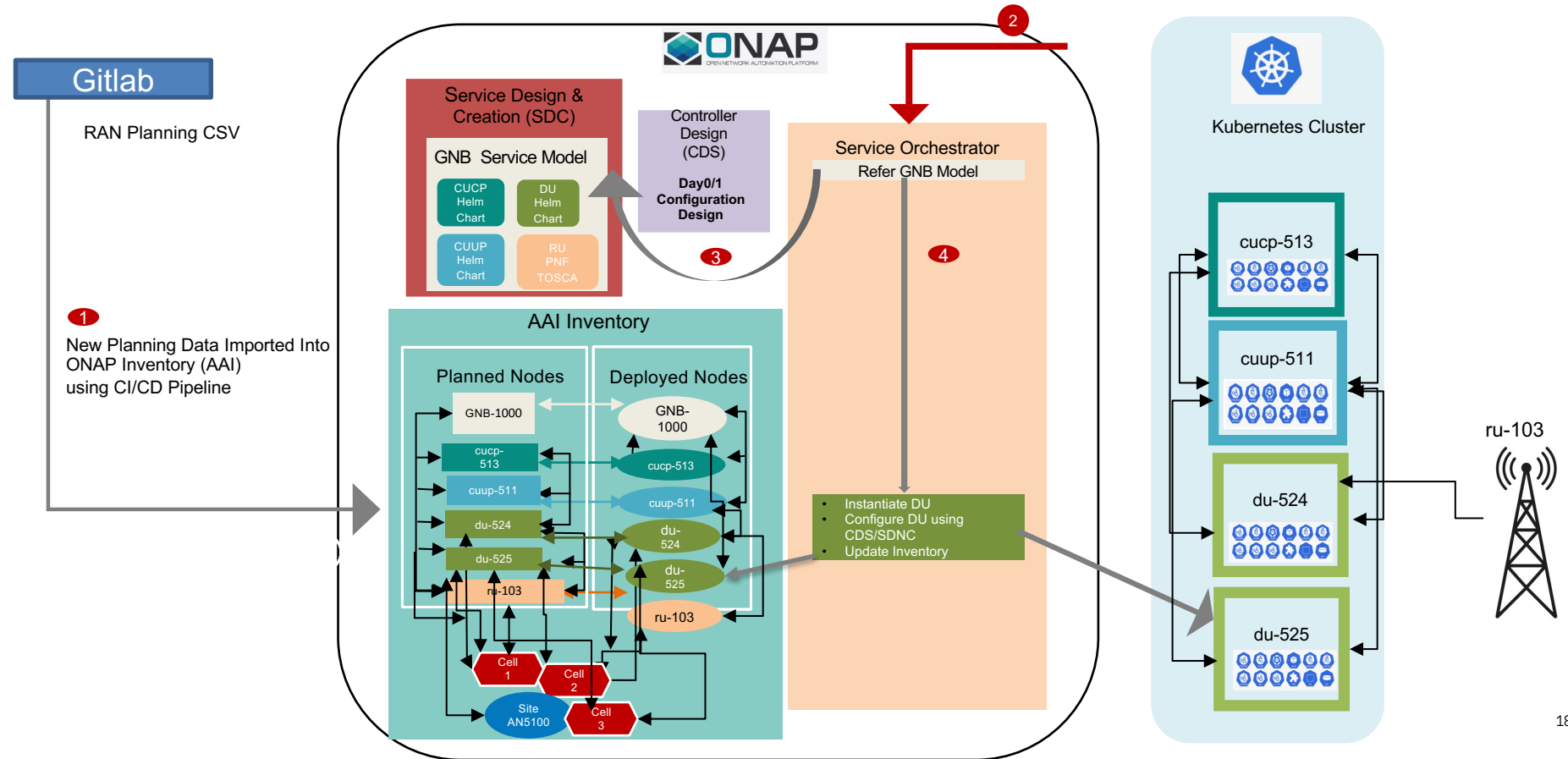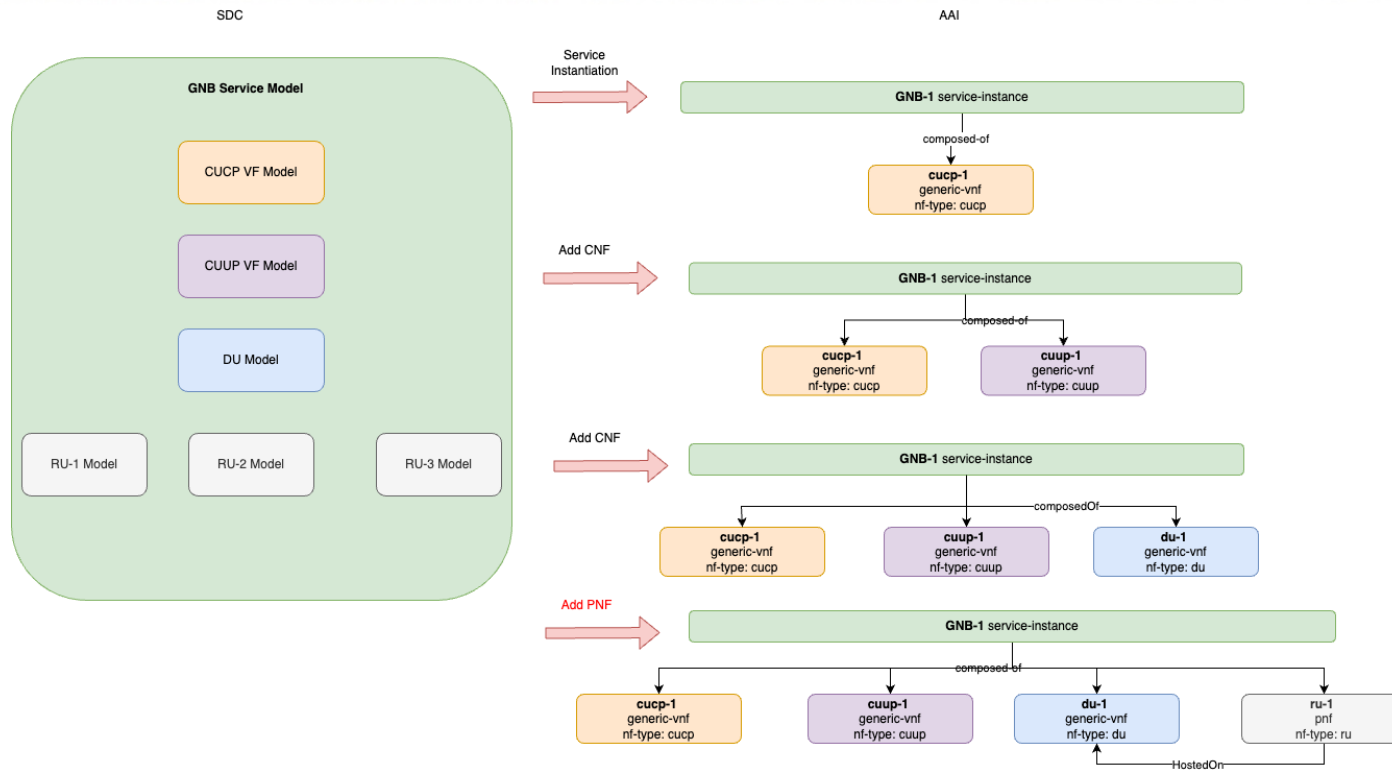# Planning, Design & Deployment of 5G RAN using ONAP

Planning, Design & Deployment of 5G RAN using ONAP (RAN Site Expansion Use Case)

Planning Phase → Service Design Phase → Service Deployment Phase

Add DU-525 to gNB-1000 (Add CNF Service Order)

Phased Deployment of GNB

Conclusion

In Summary:

- As of Jakarta Release, a disaggregated 5G RAN service model can be successfully deployed using ONAP, with day 0/1 configuration done in the correct bring-up sequence of CNFs and PNFs, with all planning and deployed information present in the inventory including sites, nodes, virtual and physical network functions, and Kubernetes resources supporting the RAN virtualized network functions.

- Complete support in AAI for RAN Planning Data (Cells and Planned nodes) as shown in this presentation will be available in London Release

- Further optimization of CNF and PNF LCM will be available in Kohn & London releases