# ONAP NF Modeling in SDC for Casablanca (R3, 4Q 2018)

- NF (VNF/PNF) Modeling for R3
- SDC Project

Sept 14, 2018 version 6

# Modeling ONAP Links

| PAGE | LINK |
|---|---|
| **Use case proposal: 5G- RAN deployment, Slicing, SON** | https://wiki.onap.org/display/DW/Use+case+proposal%3A+5G-+RAN+deployment%2C+Slicing%2C+SON |
| **5G Functional Requirements Tracking** | https://wiki.onap.org/display/DW/5G+Functional+Requirements+Tracking |
| **Casablanca Release Requirements** | https://wiki.onap.org/display/DW/Casablanca+Release+Requirements |
| **NFModeling-SDC_R324Jul2018v1** | https://wiki.onap.org/display/DW/Casablanca |
| **Service Design & Creation (SDC) Portal Page** | https://wiki.onap.org/display/DW/Service+Design+and+Creation+%28SDC%29+Portal |
| **Common about NFs (PNFs & VNFs and allotted NFs Info-model level "base")** | https://wiki.onap.org/display/DW/Abstract+Base+IM+Class+for+Network+Function |

# PNF PnP: MODELING ENHANCEMENTS

## DESCRIPTION

**(1) PNF MODELING** – Modeling enhancements to support 5G PNF in ONAP. Model Inheritance definitions for PNF. SDC modeling improvements from Beijing PnP use case. Updated NF Model to include software_versions. Integration of software_versions

**(2) PNF SHARING** – SDC model updates for PNF characteristics focusing on PNF inter-connectivity. (Dublin)

**(3) PNF-SDK** – SDK provided from Vendors. This will help modeling the Physical “Box” (PNF) and network functions. (Dublin)

**(4) CDT ENHANCEMENTS** - Improving CDT to handle complex config templates, multiple templates per PNF, identify different sources for template data, integrating CDT into SDC, expanding CDT usage to other controllers. (Dublin)

## PROJECTS

SDC, CDT

# PNF ONBOARDING / PNF PACKAGE

## DESCRIPTION

PNF Onboarding and PNF Package

**(1) PNF PACKAGE DEFINITION** – Defining *PNF Onboarding Package*. Extending framework to work with PNFs. Defining PNF Package framework.

A. PNF ARTIFACTS DEFINITION – Vendor specific/provided artifacts to add to the (new PNF) package. (Dublin)

B. PNF ARTIFACTS DISTRIBUTION – Artifacts are in Dublin

## PROJECTS:

SDC, APP-C

# TERMS, CONCEPTS & PRINCIPLES

- ONAP and NF Plug and Play for 5G RAN
- 5G Use Case Team

# MODELING PRINCIPLES

**Planner Personnel**
Optimization
Network Planning

**Provider Personnel**
Operators
Technicians

**Vendor Personnel**
Technician
Developers
Product Support

## SERVICE MODEL

- Services
- Application Data
- Operational Operator
- Functional Aspects
- Run-Time
- ONAP Service vs ETSI/OPENO/3GPP Service
- Orchestrating ONAP component & resources
- NF Interconnectivity, chaining, relations

## RESOURCE MODEL

- Physical Resources
- Application Data
- Operational Operator
- Physical Aspects
- Run-Time
- Data/Information model
- VNF and PNF resources

## (ONAP) PLATFORM MODEL

- NF Interconnectivity
- ONAP Platform-level information
- Design-time Operator
- Templates
- Meta-data
- SDC Design Studio & Catalog
- ONAP Components (SO, A&AI, APPC/SDNC etc)
- Inventory, Events

**ONAP Personnel**
"Roles" (Operator
Governor
Designer
Administrator
Tester)

# INFORMATION HANDLING PRINCIPLES

**DESIGN TIME INFORMATION**

- Design-time Operator
- NF Interconnectivity
- ONAP platform & component information
- Templates
- Meta-data, TOSCA semantics (policies, cap/req)
- Design Time Model
- Control Loop / Closed loop model

**RUN-TIME INFORMATION / APPLICATION DATA**

- Run-Time Attributes, Run-Time Model
- Accessing NF instance for ONAP components
- Instance of a NF
- Application Data
- Operational Operator
- Functional Aspects
- Orchestrating ONAP component & resources
- States & modes

**CONFIGURATION INFORMATION**

- Service Parameters
- Run-Time parameters
- Functional Configuration
- Data Consistency & Data Validation

Aug 21, 2018

(NK Shankar)
PCI Discussion

If ONAP needs to know about PCI to
Perform control loop functions, ONAP needs to know
As part of a process flow.

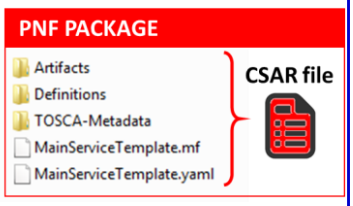
(Arash Hekmat)
5G Architecture
Configuration kept in SDNC/SDNR
Source of 5G configuration information.
Control designer studio feature to **CDT** in Casa/R3
Adding XML or JSON template for configuration to CDT
CDT would move to SDC Design Studio (additional cap)
Consume model/create artifacts.
When you have config you config a port IP@,
Resource Resolution.
Dictionary of resources.
Parameters are tagged ($, #) resolve @ Run time.
As resource resolution **SDNC** > templates > data dictionary
Resolves parameters to configure NF >
Protocol to write config (Ansible, Chef, Netconf)
UI Data dictionary/parameters to resolve at run-time

# VERSION CONCEPT

## Diagram of Software Version Management for a PNF

**PNF-Descriptor (version)**
*Vendor Provided*
PNFD version = 6

**PNF-Package (version)**
Minimal PNFPackage version = 7.1
(SDC Versions the Package)




**PNF Software (version)**
[Detected Software, Expected Software]
**DETECTED PNF S/W –** [Partition1 "Active"] 12345
[Part 2] 67890 [Recovery Partition] 00010
**ONAP EXPECTED PNF S/W** 3.0 (modeling)

**PNF Hardware (version)**
Hardware Version
Firmware Version
Product Model version

Vendor Release – VID match PNF avail in system
S/W version management – Use casa
Troubleshoot
Network Analysis
Correlation Version
Error Checking
Modeling informational
Network Planning

OPENStack – Image Repository in Glance. In VNF service designer request different version of S/W than is one in PNF itself

# ASSETS MANAGED (WIKI)

**Resource**: a fundamental capability, implemented either entirely in software, or as software that interacts with a hardware device. Each Resource is a combination of one or more Virtual Function Components (VFCs), along with all the information necessary to instantiate, update, delete, and manage the Resource. A Resource also includes license-related information. There are three kinds of Resource:

Infrastructure (the Cloud resources, e.g., Compute, Storage)
Network (network connectivity functions & elements); example: a Virtual Network Function (VNF)
Application (features and capabilities of a software application); *e*xample: a load-balancing function

**Service**: a well formed object comprising one or more Resources. Service Designers create Services from Resources, and include all of the information about the Service needed to instantiate, update, delete, and manage the Service

**Product**: includes one or more Services packaged with commercialization attributes for customer ordering, billing, and issue resolution. Products are created by Product Managers, and can have one or more "category" attributes assigned by Product Strategists.

**Offer**: bundling of Products with specific Marketing configurations for selling to customers

# SDC COMPONENTS (WIKI)

There are four major components of SDC:
The **Catalog** is the repository for assets at the Resource, Service and Product levels. Assets are added to the Catalog using the Design Studio.
The **Design Studio** is used to create, modify, and add Resource, Service, and Product definitions in the Catalog.

The **Certification Studio**, available in a future release, is used to test new assets at all levels. It will be used for sandbox experimentation, and will include support for automated testing.

The **Distribution Studio** is used to deploy certified assets. From the Distribution studio, new Product assets, including their underlying Resources and Services, are deployed into lab environments for testing purposes, and into production after certification is complete. In a future release, there will be a way to export Product information to external Business Support Systems for customer ordering and billing.

# SDC COMPONENTS (WIKI)

**1. Resource Model**

(The one, which is defined in SDC, and defines those relevant resource parameters, which characterize services running on top of that resources, or allows these resources to bring relations to other resources in a service definition) Possibly, this is as well an interaction model – how different VNFs interact with each other, what relations are they building?

**2. Inventory Model**

(The one, which defines, which configuration/instance parameters are stored per resource/service instance – e.g. concrete IPs or Serial Numbers, that are assigned to concrete instances)

**3. Configuration Model**

(The one, which defines, which configuration parameters are required/exposed as application parameters to e.g. controllers)

**4. Event "model"**

(How the events, that we`re generating look like – what are their structres/elements/ what is the meta-data that is used around them?)

A side-effect of this one is "interaction model" – so which actions are we taking, when we discover, that there is something wrong with the xNF based on this model contents.

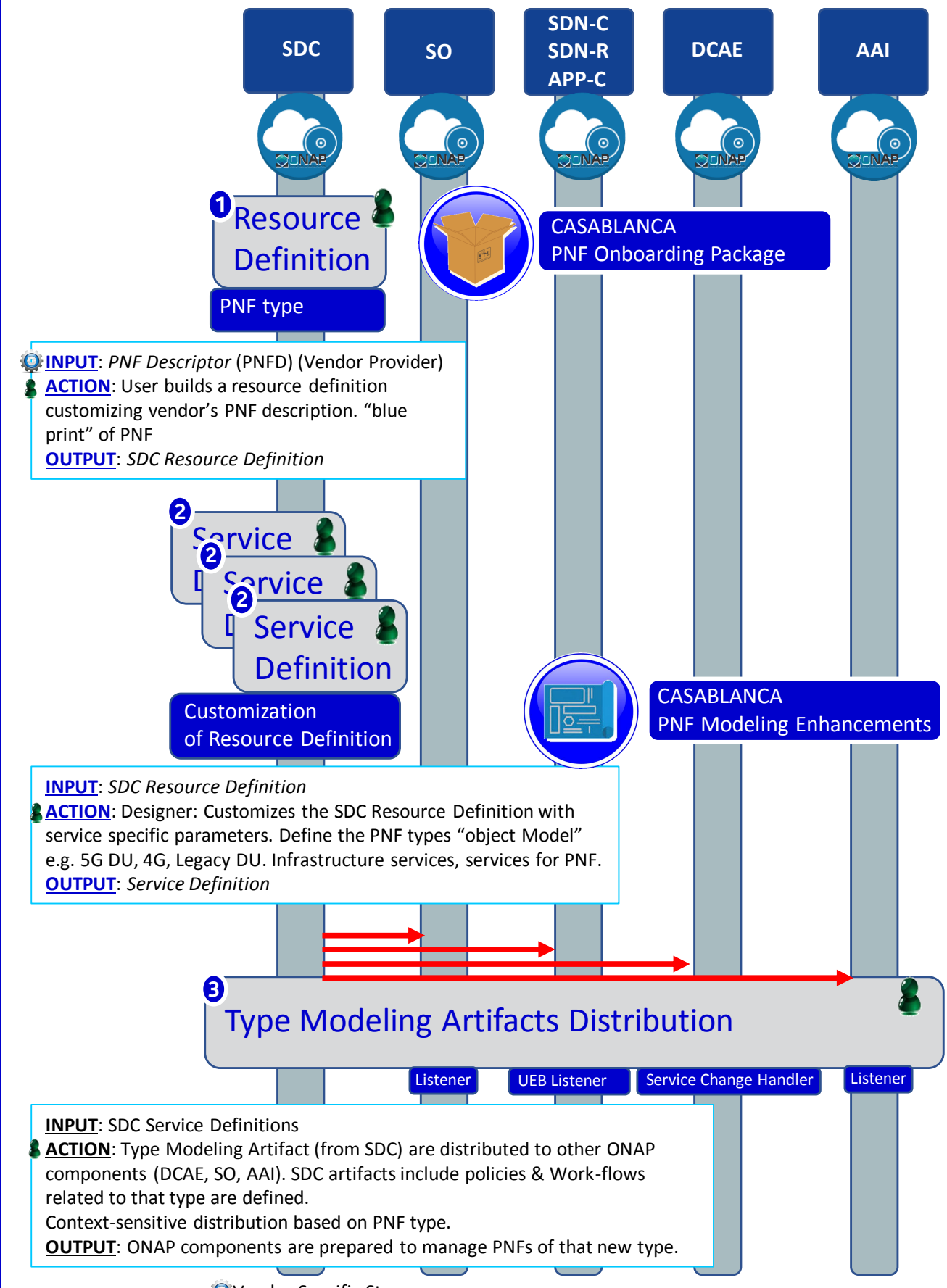
# VNF vs PNF Comparison

| TOPIC | VNF | PNF |
|---|---|---|
| **Concept** | Application fulfills the role of a network function. | It is a network element, a physical entity, which can implements the role of a network function. |
| **Physical Characteristic** | Application without dedicated hardware; Virtualized applications require specific capabilities; Run on different vendor servers. SRIOV, Inter-DPDK. Hardware capabilities. | Has an actual physical asset that is deployed and associated directly with the PNF. |
| **On-boarding** | To onboard a VNF is to "bring it into ONAP" i.e. the VNF images, component VNF-C provide descriptors of these NFs. Deployment model, # components, functions. Configuration parameters. VNF is not tied or optimized for a specific hardware, only requiring perhaps some capability to be supported. | For PNF provide the descriptors. Only provide the meta-data. PNF S/W specifically optimized to run on dedicated hardware. (Now) Not the software image. (Future) ONAP will provide the software image repository. |
| **Plug and Play** | The model triggers the orchestration. | (See this slide package for PNF Plug and Play) at the end of PnP the PNF can provide service. |
| **Characteristics** | 5G CU could be a VNF since there is no need to have an association to a physical environment. | 5G DU must be PNF. PNFs are Elements which may need to interact with the physical environment. PNF is "High-Touch" technology. E.g. Emit radio waves in a geographical area. |
| **Configurability & Deployment** | Easily adaptable to functions that you expect. E.g. Packet gateway to reconfigure as different NFs. Services easily create instances reconfigures including deployments (for different applications). Use a different instances of the VNF to provide a new service. For a VNF you can easily "delete" and "create" a new VNF to perform a new function. Configured dynamically. | PNF has a "fixed" set of capabilities but can't easily reconfigure it. One PNF in multiple services. Different capabilities exposed by the PNF. Reuse the same PNF with different services configuration. For a PNF you would not "destroy" a PNF but rather re-configure it. Can be configured dynamically. |
| **ONAP Interaction** | ONAP is started with VNF. VNF is "deployed" on-demand. Control from the ONAP perspective when a deployment of a VNF happens.<br>DCAE – same<br>Configure – Chef, Ansible | PNF do not "deploy" application. Do not use multi-VIM. Only "configure" the application, the PNF is deployed. A technician goes to site and "deploys" a PNF.<br>DCAE – same<br>Configure –Implementation of PNF client. Communication protocol, Client |
| **Design Time Modeling** | Model VNF. Templates. Onboarded before. In Run-time. Make sure properly identify specific PNF instance already deployed. Vs a dynamically created instances. VNF instances could be created & instantiated dynamically. SDC may assumed instantiation of network function. | PNF cannot be instantiated, a PNF is only instantiated when it "powers up" and connects to ONAP. Service Orchestration. PNF is instantiated by nature of a PNF installation & commission procedure. |
| **Service Orchestration** | VNF cloud, #VM resources consumption, define components implement different functions. Where & What will be deployed. | Physical location, pre-provisioned capabilities, performance monitoring. Components installed. RUs for specific functions. |
| **Resources** | VNF dynamically assigned resources. | PNF statically associated (hardware) resources. |
| **Capacity** | VNF Capacity can be dynamically changed | PNF is static (number of cells supported) |

# NF Modeling in SDC
# IN CASABLANCA (R3)

- ONAP and NF Plug and Play for 5G RAN
- 5G Use Case Team

# Design Time (ONAP)



| STEP | DESCRIPTION |
|---|---|
| 1 | **RESOURCE DECLARATION** – A user on the VID performs a Resource Declaration. This uses the Service definition created in SDC. The user on the VID can define known information about the PNF. The user can (optional) provide the following information<br>**PNF RESOURCE Definition**<br>**Resource Type** – Type of Resource. NEW type: PNF (pre-defined in SDC)<br>**NAME** – Name of the PNF type<br>**CATEGORY** – e.g. Infrastructure<br>**TAGS** – User-definable tags (default name of the PNF)<br>**DESCRIPTION** – Textual description<br>**CONTACT ID** – Designer (user of ONAP)<br>**VENDOR** – PNF Vendor (e.g. Nokia)<br>**VENDOR RELEASE** – Vendor release<br>**VENDOR MODEL NUMBER** – PNF Model value (link to A&AI)<br>**EVENTS** – Monitoring Event definitions. Define design-time templates. CLAMP (runtime monitoring), DCAD (design time design template attach to VNF). Define templates & attach them.<br><br>Note: The user may provide whatever information in the above fields they know.<br>Note: Consumer vs Enterprise deployments. Consumer systems pre-registered, distributed throughout a region. For a consumer deployment you might not know the MAC address/Serial number (PND IF) until the PNF connects to ONAP. |
| 2 | **SERVICE Definition (uses a PNF)**<br>**NAME** – Name of the Service (mandatory)<br>**CATEGORY** – e.g. Network L1…L4, VOIP call Control, Mobility<br>**TAGS** – User-definable tags (default name of the PNF)<br>**DESCRIPTION** – Textual description of service (mandatory)<br>**CONTACT ID** – Designer (user of ONAP) (mandatory)<br>**PROJECT CODE** – ID (mandatory)<br>**Ecomp-Generated Naming** – Name<br>**Naming Policy** – Policy to be used to assign a name to a service by SO/SDNC<br>**SERVICE TYPE** – Type of service<br>**SERVICE ROLE** – The Role of this service.<br>**ENVIRONMENTAL CONTEXT** – distributed environments<br>**Specific Service(?)** – PNF, allotted resource from a CU Service<br><br>The “basic” model are extended. Inherit (OO) from existing model. Vendor takes standard node types and creates their own extension.<br>CDT (Configuration Design Tool) (GUI) to build artifacts to be used by APP-C (Tosca models) for a configure Template. |
| 3 | **DISTRIBUTION** – Event Monitoring Templates distributed. (?) |

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B. PNF ARTIFACTS DISTRIBUTION

**TOSCA Meta data** - main service template, TOSCA template.

**Artifact Package**. Separated by types of artifacts. Separations by folder for different types. Place artifacts in categories. Anyone can choose which artifacts to receive.

**Definitions** – Specifies definitions such as CM, FM and PM definitions

**(1) Protocols Supported** – PNF package. CM Protocol is in PNF onboarding package. (Chef, Ansible, NetConf)

**(2) Controller** – What is the PNF controller

## PROJECTS:

SDC, APP-C

# NF SDC & Modeling
# Project Impacts Overview

- ONAP and SDC NF Modeling for 5G RAN
- 5G SDC Project

# PROJECT IMPACTS FROM ONBOARDING

| ONAP Project | IMPACT |
|---|---|
| **SDC/ Modeling** | Modeling Project -<br>(No License management impact – See **Futures** Section)<br>[See follow-on Slides "MODELING"] |
| **VNF-SDK (PNF-SDK) Validation** | **PNF PACKAGE DEFINITION**<br>PNF packages similar to VNF packages. PNF Descriptors, artifacts.<br>In PNF not doing deployment process in SDC. Only PNF configuration.<br>Model a PNF. Onboard PNFs (create templates service configuration).<br>Orchestrate a service on a PNF. Service provisioning. Life cycle: Template/service orchestrated. For PNF every PNF vendor makes this package. Need specific PNF properties. Image details. ONAP updates the image.<br>**VALIDATION OF A SDK PACKAGE**<br>VNF-SDK (validation, Package definition, verification tool) – package compliant. Allows creation/validation of packages.<br>PNF-SDK *validates* the package. |
| **WORK FLOW (SDC)** | Create work-flow for PNF (Srini)<br>SDC Impacts related to work-flow.<br>ACTION: Sample Work-flow for PNF.<br>vCPE, PnP (Sub) W/F are supported in R3.<br>5G RAN W/F R4. |
| **MONITORING (SDC)** | Monitoring definitions – SDC has a side monitoring template designer. Way to define monitoring alarms etc; In AT&T there is a project; IN ONAP code is there finalizing code; pluggable modeler for monitoring. DCAE as part of onboarding specify what VES template. DCAE-DS [Design Studio] define microservices for monitoring. How is PNF monitored & correlated. If [x] goes down how is this correlated. SDC would define the Modeling what needs to be monitored and how they would correlated with other events from other NE. Thresholds. [Baby step to process get an alarm from PNF, YAML file describes fault VES event, Fault meta-data; alarms generate]. Alarms raises are documented in SDC. Upload an "Artifact" file (Alarm Dictionary / Fault Meta-data / YAML, YANG). Vendor Specific. Demo and separate discussion. How monitored – processing in DCAE-DS (Design Studio time). Based on design time data DCAE is done in.<br>(No open point for Casablanca R3) |

# DCAE-DS IMPACTS

**OVERVIEW** - DCAE-DS generates the **templates** for monitoring the models. DCAE-DS is model-driven. It specifies which monitoring microservice are utilized in monitoring a specific service model. Cloudify blueprints specify the requirements on micro-service and are configured by a user. Configurations are distributed to components who subscribe to that specific type of artifact.

**DCAE-DS TEMPLATES** – monitoring templates composition of micro-service to be used (open/closed loop). The templates are *Cloudify Blueprints*. E.g. Micro-Service collectors, analytics, monitoring. VES collectors, holmes. A micro-service that is part of a monitoring flow that a designer can design that can be reused for difference service models. A building block represented by TOSCA models. First needs to be represented by development team. Monitoring template certified.

**DCAE-DS GUI** - DCAE-DS is a pluggable designer in SDC provides a GUI to the user that selects/composes the micro-services, or use predefined templates, for specific flows. E.g. SNMP type of flow or different protocol. User can configure different micro-services according to requirements to the model.

**PNF PLUG AND PLAY** – Cloudify Blueprints (for a [1:X] service) has (UUID, Micro-service values, Properties, service specific policies). What are we trying to Monitor? SDC Service-Package attached to VF-Level.

# MODELING IMPACTS

Notes:

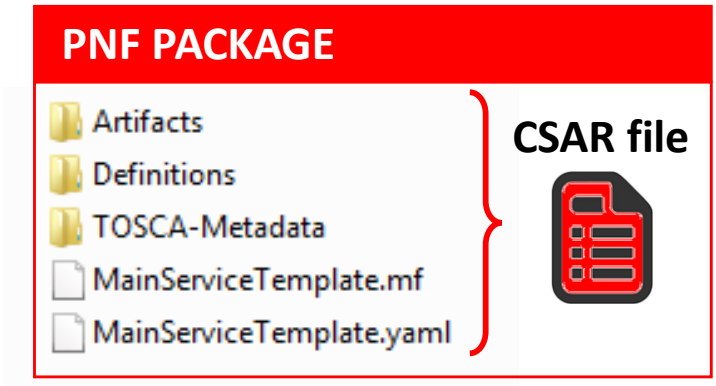
1) **EXTERNALS** - Not trying to model the internals of PNFs. What is exposed by the box is what is modeled.
2) **INTERRELATIONS** - Focus on relations of PNFs/VNFs. Interworking between PNFs/VNFs.
3) **VISIBILITY** - CP/UP visibility
Not M-Plane (as this is 3GPP standardized)
4) **MODELING ANALYSIS** - Modeling activity to assess PNF, and *check SDC model is sufficient to cover Casa use cases* if additional parameters need to be added (e.g. relations between other NFs). Expanding the "Release 0 model" for Casa. PNF type vs PNF instance. Design-time vs Run-time model.

Suggested VES Event Entry - Fault' Domain Datatypes
For Alarm Dictionary Index (in **Dublin**)

| | | | |
|---|---|---|---|
| Alarm Dictionary Index | number | No | Alarm Dictionary Index, (since optional if left blank would mean dictionary is not used) |

# PNF PACKAGE

PNF has no onboarding package.
Just model the PNF from the modeling screens.




CSAR – decompile info stored in SDC model.
In VNF flow. Onboard the VNF. VNF cataloged as a version to be used. Check-in/check-out. After onboarding can add more artifacts and certify the VNF. A "building block" to be used in different services. Generic, the structure will be the same. E.g. 2000 ports vs 10 ports. "Ports". How to comm w/ PNF what to do w/ PNF. Specific work-flow or configuration. PNF & VNF similar. SO will orchestrate, already exists in ecosystem.

Modeling of the Service. E.g. Connection point what will connect to the PNF.

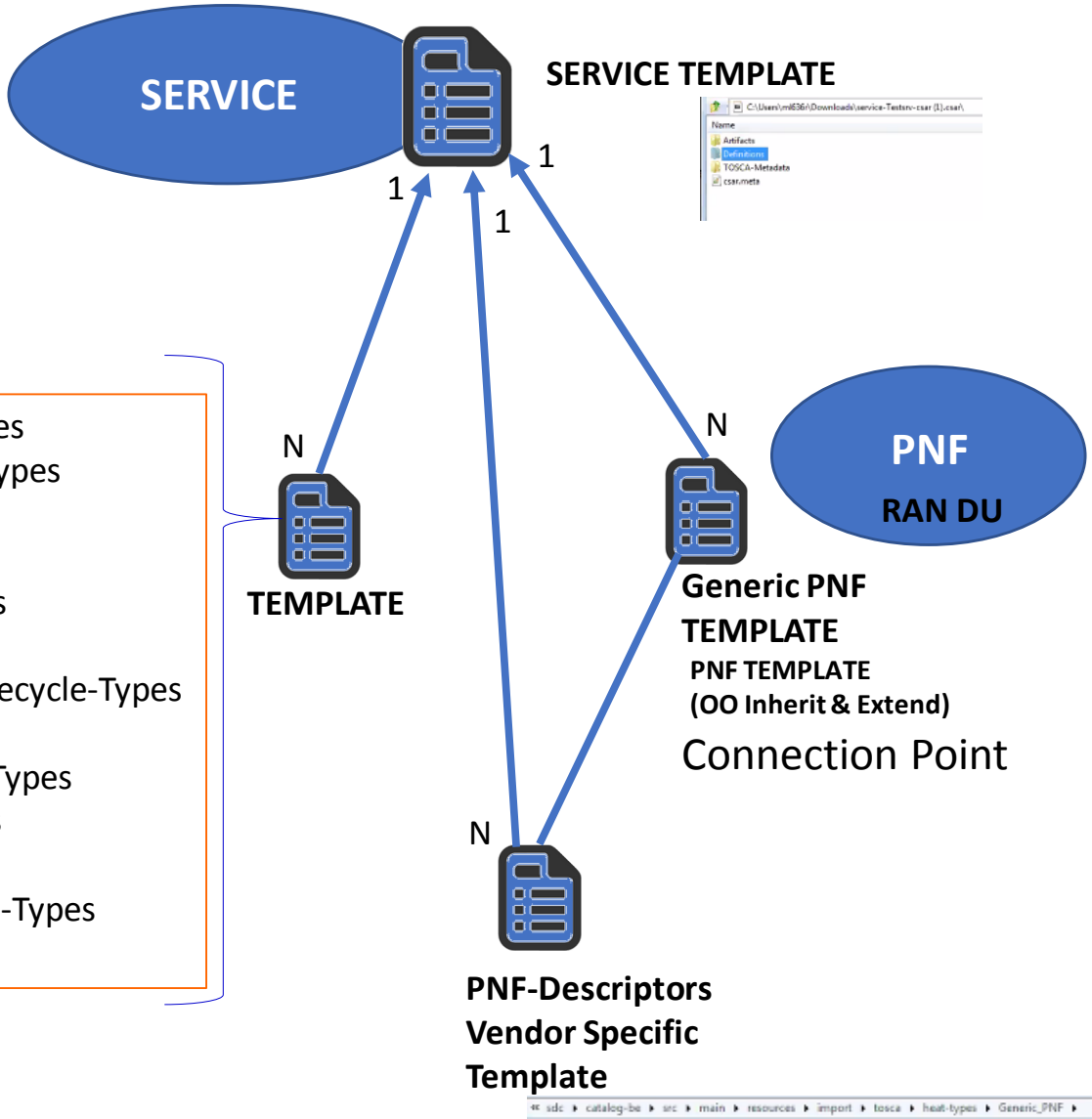
ARTIFACTS

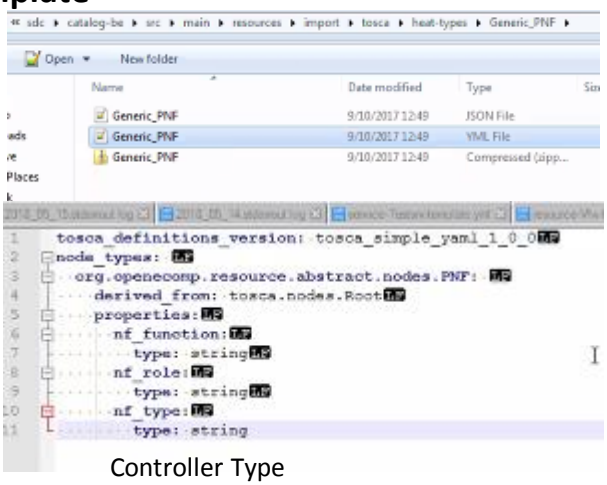
DEFINITIONS

PNF – 5G Base Stations
**Backhaul Ports** – PNF & VNF and want to communicate. In a VNF can describe a port a TOSCA. Model onboarded understand what can connect to what. CP connections. Can see they can connect. Model needs to capture info for modeling parts representing connections. Model allow someone designing service to connections. Or requirements from VNF/PNF from the model. A virtual link. One VNF & PNF connected via virtual network/link.
PNF Work-flows – initialization, triggered when connecting to PNF. Configuration/registration that needs to be done. DNS pre-loaded. Location. Policies attached to PNF, High volume # of PNF deployments, port-allocation. *Capabilities. Triggered by orchestrator as part of the instantiation.*
PNF Policies -
Tilt – (Antenna Tilt - RF) – not related to PNF / VNF communicate.
Software Version

Modeling Project, VNF-SDK (validation, Package definition, verification tool) – package compliant

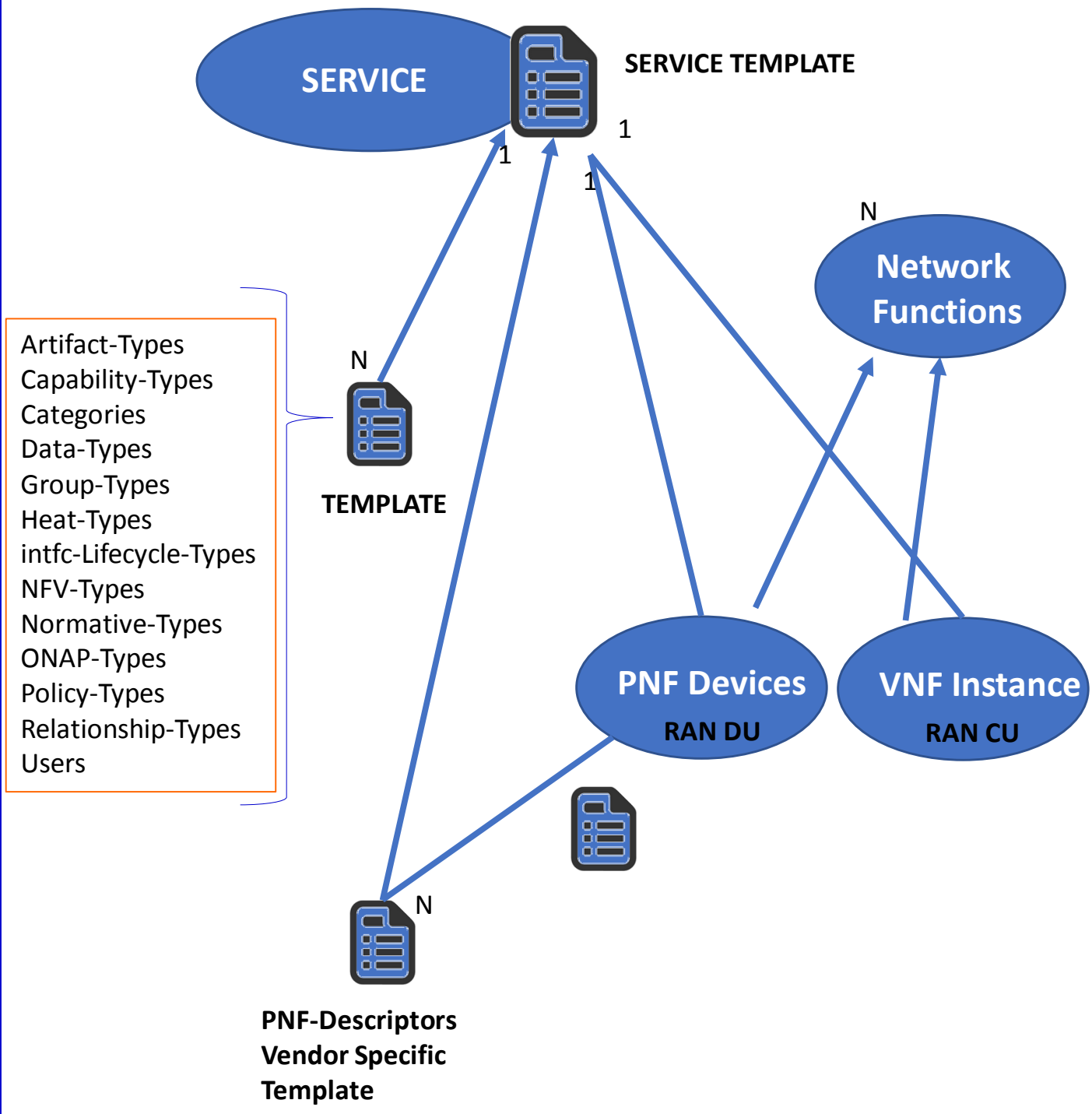
# SDC MODELING (Design Time) – Casa R3



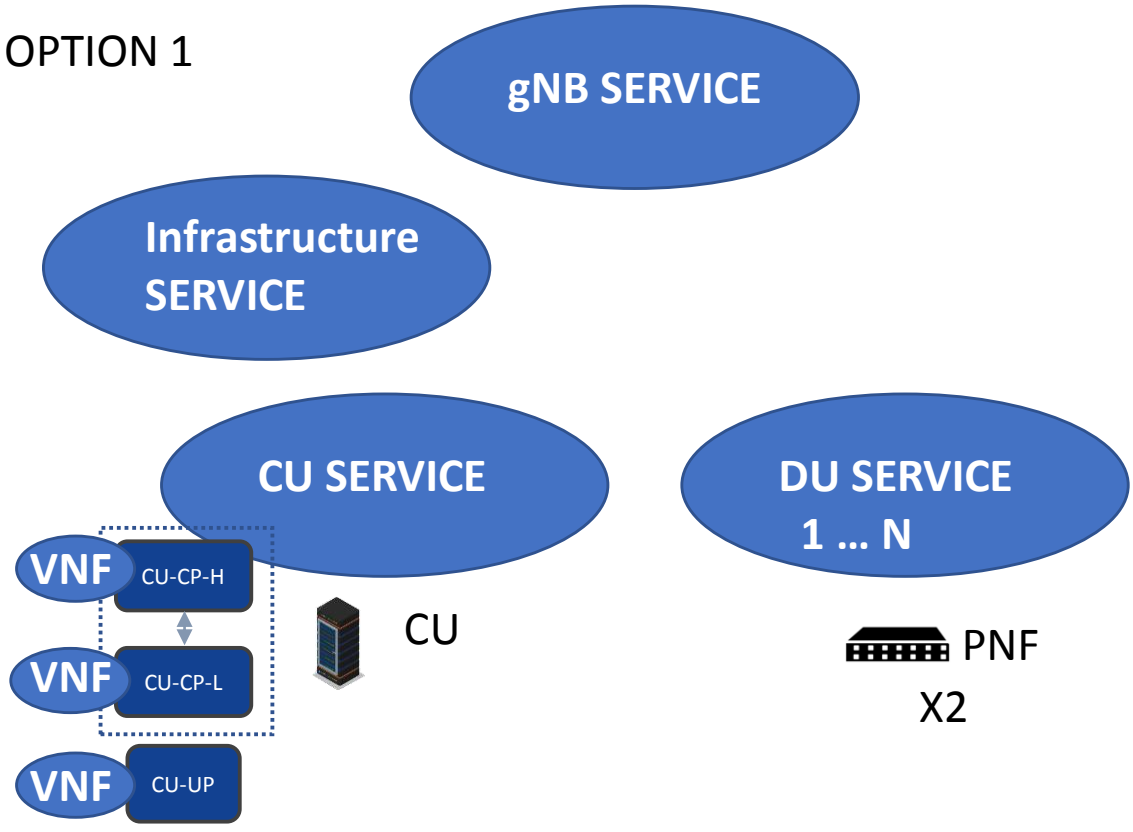

Controller Type
["common fields"] …
Vendor-field1

# SDC MODELING (Design Time) – Casa R3

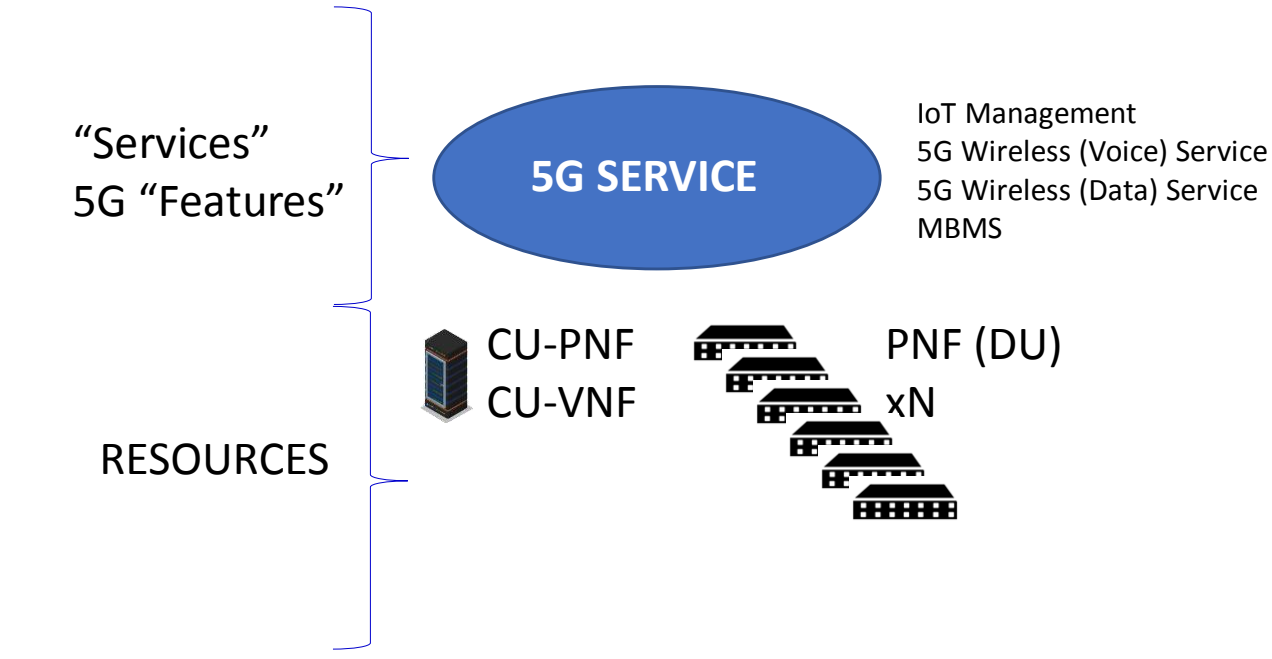


# gNB Model (R4)

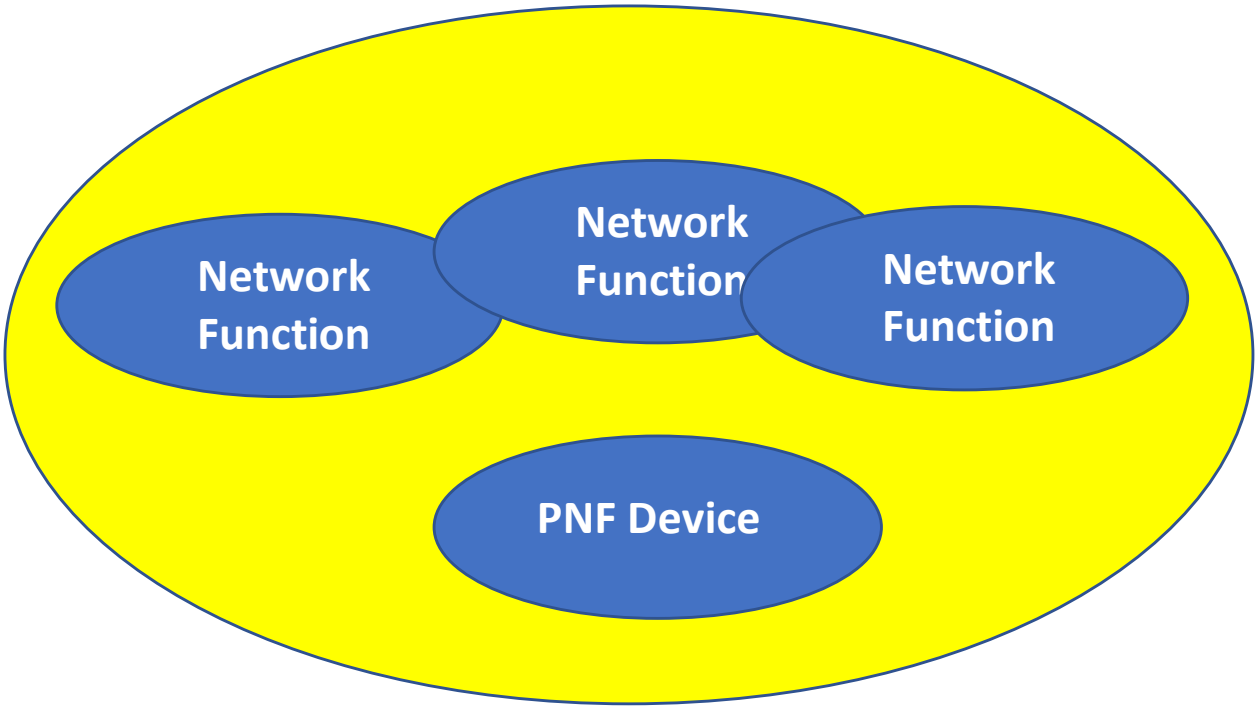
OPTION 1




OPTION 2



# PNF DEVICE Node Type



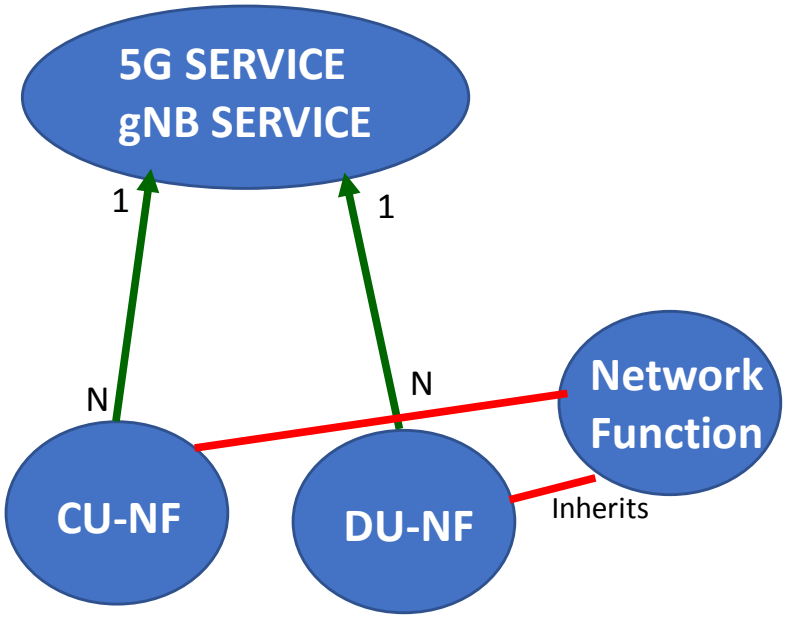

PNF device located physically at a location
Network Function is a resource utilitizing PNFs or VNFs
Multiple NF w/ Licenses
SERVICES (UML) “has a” 1…N PNFs & VNFs.

(conceptually) What is the difference between a NF & a Service?
NF supports the creation of a service.
NF = RESOURCE

# gNB Model (R4)

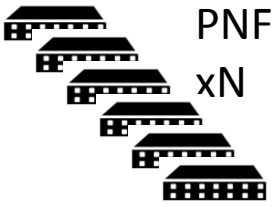
"Services"
5G "Features"

IoT Management
5G Wireless (Voice) Service
5G Wireless (Data) Service
MBMS xyz-features
(Licensing)
Infrastructure Service




Meta-RESOURCES

CU-PNF
CU-VNF



PNF (DU)
xN

Concrete-RESOURCES Catalog

During orchestration time
Find CU/DU-PNF resources catalog
Then Homing function
NF Global types derived DU/CU-NF
Implementations of CU/DUs

Associating CU-instances w/ specific [set of] DU instances

# NFD DESCRIPTOR (PNFD, VNFD)

- ONAP and SDC NF Modeling for 5G RAN
- 5G SDC Project

# PNF Descriptor

**PNFD Definition in ETSI-NFV-IFA014v242**

| Attribute | Qualifier | Cardinality | Content | Description |
|---|---|---|---|---|
| pnfdId | M | 1 | Identifier | Identifier of this Pnfd information element. It uniquely identifies the PNFD. |
| functionDescription | M | 1 | String | Describes the PNF function |
| provider | M | 1 | String | Identifies the provider of the PNFD. |
| version | M | 1 | Version | Identifies the version of the PNFD. |
| pnfdInvariantId | M | 1 | Identifier | Identifies a PNFD in a version independent manner. This attribute is invariant across versions of PNFD. |
| name | M | 1 | String | Provides the human readable name of the PNFD. |
| pnfExtCp | M | 1..N | PnfExtCpd | Specifies the characteristics of one or more connection points where to connect the PNF to a VL. See clause 6.6.4. |
| security | M | 0..1 | SecurityParameters | Provides a signature to prevent tampering. |
| geographicalLocationInfo | M | 0..1 | Not specified | It provides information about the geographical location (e.g. geographic coordinates or address of the building, etc.) of the PNF. The cardinality 0 is used when the location is unknown. |

*From Potential PNF template for PNF S/W management & change management (Lixiang,YaoguangWang, ChangMing Bai Hwawei)*

## Basic Content of PNF template PNF-D (DESCRIPTOR)

| Contents | Description |
|---|---|
| **pnfdId** | Identifier of this Pnfd information element. It uniquely identifies the PNFD. |
| **provider** | Identifies the provider of the PNFD. |
| **PNFD version** | Identifies the version of the PNFD. |
| **~~pnfdInvariantId~~** | ~~Identifies a PNFD in a version independent manner. This attribute is invariant across versions of PNFD.~~ (pnfdInvariatnId would be inside the meta-data in ONAP) |
| **name** | Provides the human readable name of the PNFD. |
| **security** | Provides a signature to prevent tampering. |
| **pnfInformation** | Describes the PNF information |
| **pnfSoftwareVersion** | Software Version supported PNFD. |

# VNF Information Model

Red items are proposed to be deleted.

gold indicates an add or a change

«Experimental»
Vnf

- «Experimental» + vnfInstanceId: Identifier [1]
- «Experimental» + vnfInstanceName: String [1..*]
- «Faulty» + vnfProductName: String [0..1]
- «Faulty» + description: <Undefined> [0..1]
- «Faulty» + vnfProvider: <Undefined> [1]
- «Faulty» + vnfdId: Identifier [1]
- «Faulty» + vnfdVersion: String [1]
- «Faulty» + vnfSoftwareVersion: String [1]
- «Experimental» + onboardedVnfPkgInfoId: Identifier [1]
- «Faulty» + availabilityZone: <Undefined> [1]
- «Experimental» + operationalStatus: OperationalStatus [0..1]
- «Experimental» + orchestrationStatus: OrchestrationStatus [1]
- «Faulty» + oamIpv4Address: <Undefined> [0..1]
- «Faulty» + oamIpv6Address: <Undefined> [0..1]
- «Faulty» + instantiatedVnfInfo: <Undefined> [0..1]
- «Faulty» + inMaint: Boolean [0..1]
- «Faulty» + isClosedLoopDisabled: Boolean [0..1]
- «Faulty» + encryptedAccessFlag: Boolean [0..1]
- «Faulty» + vnfConfigurableProperty: <Undefined> [0..1]
- «Experimental» + nfNamingCode: String [1]
- «Experimental» + vnfNamingPolicyId: String [1]
- «Experimental» + vnfHomingPolicyId: String [1]
- «Experimental» + nfType: String [1]
- «Experimental» + nfFunction: String [1]
- «Experimental» + nfRole: String [1]
- «Experimental» + closedLoopStatus: ClosedLoopStatus [1]

«Experimental»
Vnfc

- «Experimental» + vnfcInstanceId: Identifier [1]
- «Experimental» + nfcNamingCode: String [0..1]
- «Faulty» + description: <Undefined> [0..1]
- «Faulty» + vdudId: Identifier [1]
- «Faulty» + l3InterfaceIpv4AddressList: <Undefined> [*]
- «Faulty» + l3InterfaceIpv6AddressList: <Undefined> [*]
- «Faulty» + vnfcState: <Undefined> [0..1]
- «Faulty» + inMaint: Boolean [0..1]
- «Faulty» + isClosedLoopDisabled: Boolean [0..1]
- «Experimental» + vnfcInstanceName: String [1..*]
- «Experimental» + vnfcNamingPolicyId: String [1]
- «Experimental» + nfcFunction: String [1]
- «Experimental» + operationalStatus: OperationalStatus [1]
- «Experimental» + orchestrationStatus: OrchestrationStatus [1]
- «Experimental» + closedLoopStatus: ClosedLoopStatus [1]

«Enumeration»
«Experimental»
ProvStatus

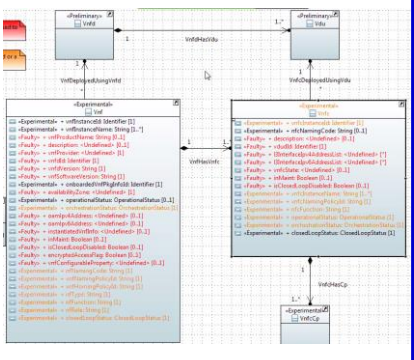
- «Experimental» PROVISIONED
- «Experimental» PREPROVISIONED
- «Experimental» CAPPED

«Enumeration»
«Experimental»
OperationalStatus

- «Experimental» IN-SERVICE-PATH
- «Experimental» OUT-OF-SERVICE-PATH

«Enumeration»
«Experimental»
OrchestrationStatus

- INVENTORIED
- ASSIGNED
- CREATED
- ACTIVE



# NF MODEL

- ONAP and SDC NF Modeling for 5G RAN
- 5G SDC Project

# SDC PNF MODEL (R3 Casablanca)

| Contents | Description |
|---|---|
| pnfId* | Identifier of this Pnf information element. CORRELATIONID (A&AI). ACTION: Discuss further |
| pnfType (template)* | Type of Resource. NEW type: PNF (pre-defined in SDC) |
| Category* | PNF category, e.g. infrastructure |
| Vendor (template)* | Identifies the vendor of the PNF. MANDATORY |
| Name* | Provides the human readable name of the PNF. |
| vendorrelease * | Vendor release. MANDATORY |
| vendormodelNumber* | PNF Model value (link to A&AI) |
| functionDescription* | Describes the PNF function |
| software_versions | The **EXPECTED** software to be supported by the PNF. (see TOPIC: SWVersionList) |

**Sept 4 ACTION** – SDC working with integration team that will use software_versions. Ben will ask on the Thursday (SW Upgrade Use Case Call)

**ACTION** – Coordinate Modeling Calls? (For Michael Lando) (Tues) "Merge" every once in a while to Sync up. Contact: Deng Hui

*Already supported in Beijing

*From Potential PNF template for PNF S/W management & change mgmt. (Lixiang,YaoguangWang, ChangMing Bai Hwawei)*

# TOPIC: SOFTWARE_VERSIONS (R3)

July 31, 2018 Discussion about **software_versions**

**TOPIC:**

**software_versions in the PNF Model (in Casablanca R3)**

Problem Statement: How will it be defined in SDC

Objective want to have a list of S/W versions

**SOLUTION**

Will be a **property (STRING)**

REASON: Meta-Data can't have lists so modeled as a Property.

**TOSCA** model has different sections

Notes: Vendor/resource version as META-DATA for NF

If this is a property has different set of validations

Properties are model information

Inputs to set properties.

Meta-Data (section of TOSCA model of PNF)

Constraints can be imposed upon Properties

An enhancement on "meta-data" which you can impose

Proper / valid values upon the Properties.

New DATATYPES would need to go through Modeling Sub-committee

**Discussion**

Linda Horn (Nokia) "don't we only need ONE Expected S/W version?"

Li Xiang (CMCC) "we need a list"

DESCRIPTION for software_versions – to highlight features in a SW version.

e.g. the set of Services the S/W is targeted for.

- **Content of PNF software version List**

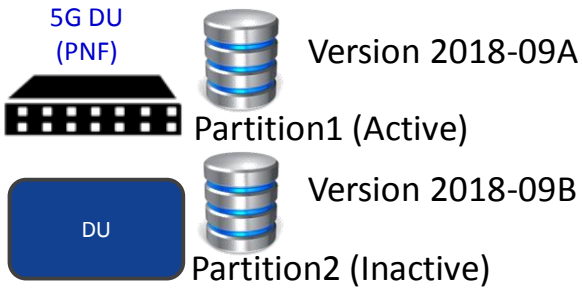
| Contents | | Description |
|---|---|---|
| softwareList | description | Describes the main feature of the this software version |
| | swVersion | Software version **STRING** |

# TOPIC: Use Cases for SWVERSIONLIST (R3)

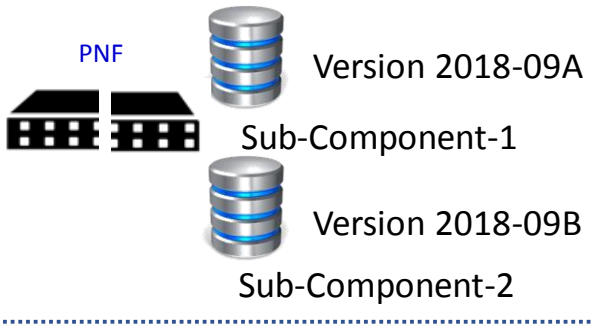
| Use Cases that use Software Version LIST | Description |
|---|---|
| Troubleshooting | Troubleshooting software defects and tracking & isolating problematic software |
| Network Analysis | Metrics, Data-mining, analysis on PNF and VNF based on software developments. |
| Correlation Version | KPI, Performance, and operational analysis based on software version and regional correlation. |
| Error Checking | Mis=deployed software, error correction and analysis. |
| Modeling informational | Modeling software versions and feature planning |
| Network Planning | Regional and area planning for software deployment and rollout. |
| Software Management & Inventory | Feature roll-out and tracking, software management and inventory tracking |
| Software Upgrade (Network wide) | Service Provider wants to upgrade a network (or fallback a network) to a new software version. Region #1 – v1; Region #2 – v2. |

# TOPIC: Use Cases for SWVERSIONLIST (R3)

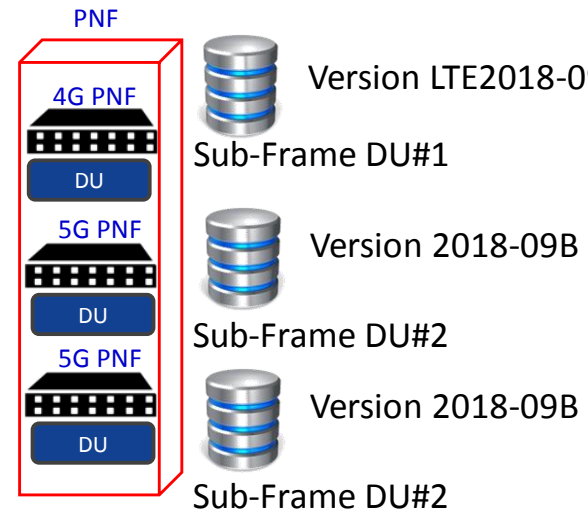
## DRIVE PARTITIONS



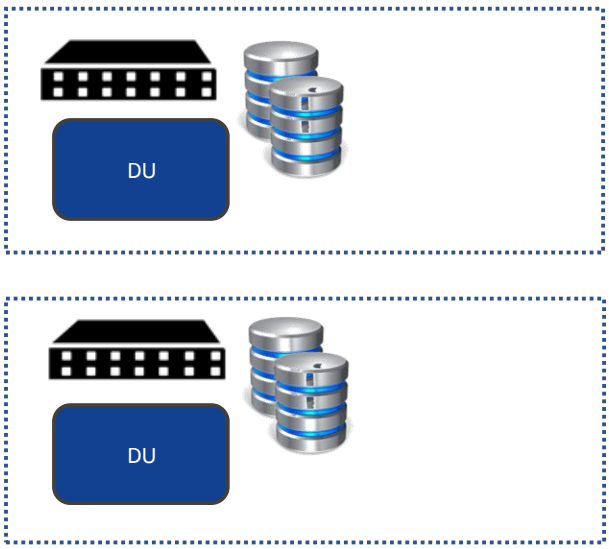

## SUBCOMPONENTS (R4+)




## TANDEM CHASSIS CONFIGURATIONS

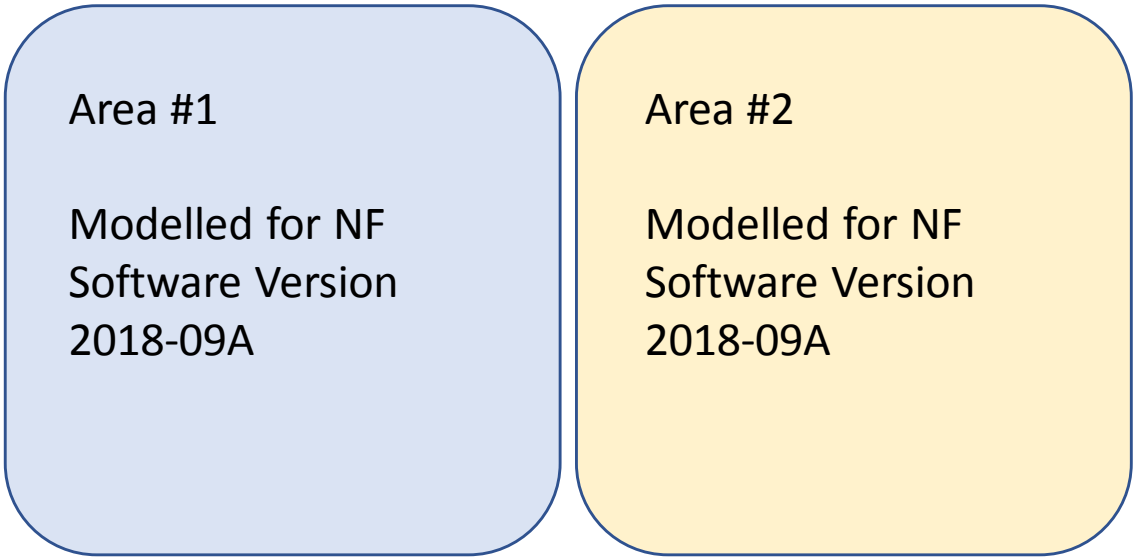



## MULTI-PNF DAISY CHAIN DEPLOYMENT



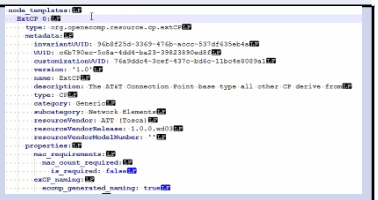
# TOPIC: Use Cases for SWVERSIONLIST (R3)

| Use Cases that use Software Version LIST | Description |
|---|---|
| Software Upgrade (Network wide) | Service Provider wants to upgrade a network (or fallback a network) to a new software version. Region #1 – v1; Region #2 – v2. |




A planner is responsible for an ONAP deployment that covers a set of areas, in this case #1 and #2.
For this particular use case/application (of this parameters), a class of PNFs is allowed to have a set of Software versions in this case 2018-09A and 2018-09B.

# SDC PNF MODEL (R4) Dublin+

| Contents | Description |
|---|---|
| pnfId* | Identifier of this Pnf information element. CORRELATIONID (A&AI). ACTION: Discuss further |
| pnfType (template)* | Type of Resource. NEW type: PNF (pre-defined in SDC) |
| Category* | PNF category, e.g. infrastructure |
| Vendor (template)* | Identifies the vendor of the PNF. MANDATORY |
| Name* | Provides the human readable name of the PNF. |
| vendorrelease * | Vendor release. MANDATORY |
| vendormodelNumber* | PNF Model value (link to A&AI) |
| functionDescription* | Describes the PNF function |
| software_versions (opt) | The **EXPECTED** software to be supported by the PNF. (see TOPIC: SWVersionList) |
| | |
| pnfExtConnPt (modelling def. of connection pt not a template) | Specifies the characteristics of one or more connection points where to connect the PNF to a VL. Align ETSI SOL-001. **ML: connection pt model in TOSCA TEMPLATE not as properties.**  |
| contactId (metadata) | Designer (user of ONAP) ML: Need for this, Audit/tracking, User creates audit log not associated with model itself. 19-Jul – REMOVE THIS PARAMETER |
| PackageVersion | The version of the PNF Package. 19-Jul – Not going to onboard the PNF, model it from scratch. Define in SDC. |
| NF Controller | Controller for PNF (APP-C, SDN-R, SDN-C, VF-C) |
| Technology Domain | Technology Domain |

# TOPIC: R3 NF YAML DEFINITIONS

**August 7, 2018**

**PROBLEM STATEMENT**:
We need to Store a YAML registration event in the SDC Catalog.
Note: The YAML registration event is necessary to validate emitted by PNF Is expected
Emitting what it is supposed to be emitting.

**SOLUTION (Casablanca R3)**
Manually uploaded to different systems
If no monitoring defined, can define information manually

**PnP FLOW (updated Wiki)**
[Added Note & PNP-1310] in Wiki
https://wiki.onap.org/display/DW/5G+-+PNF+Plug+and+Play

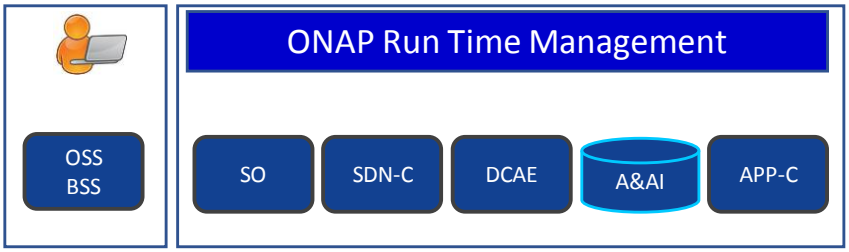
**LONG TERM SOLUTION**
PNF Onboarding – Packages
(See roadmap section)

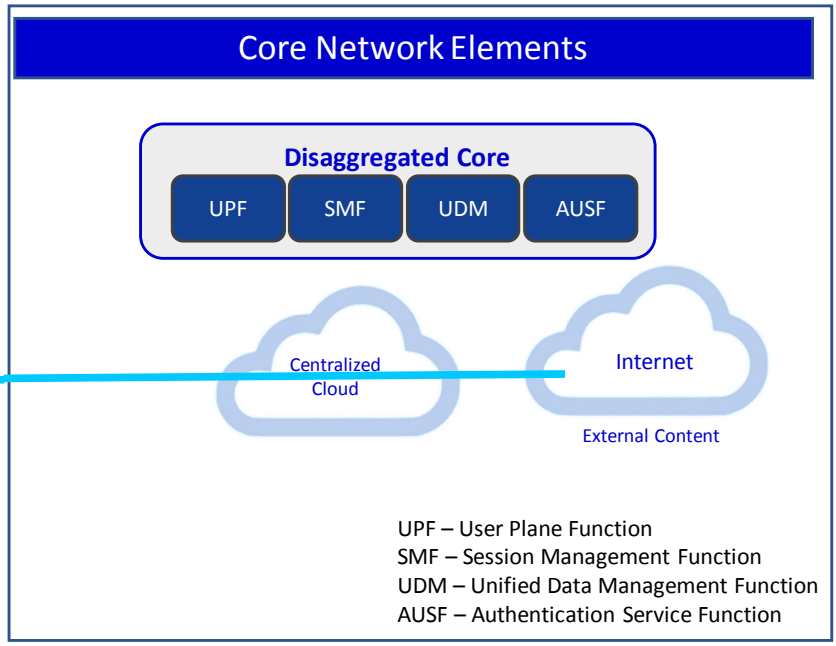
# RAN CONCEPT

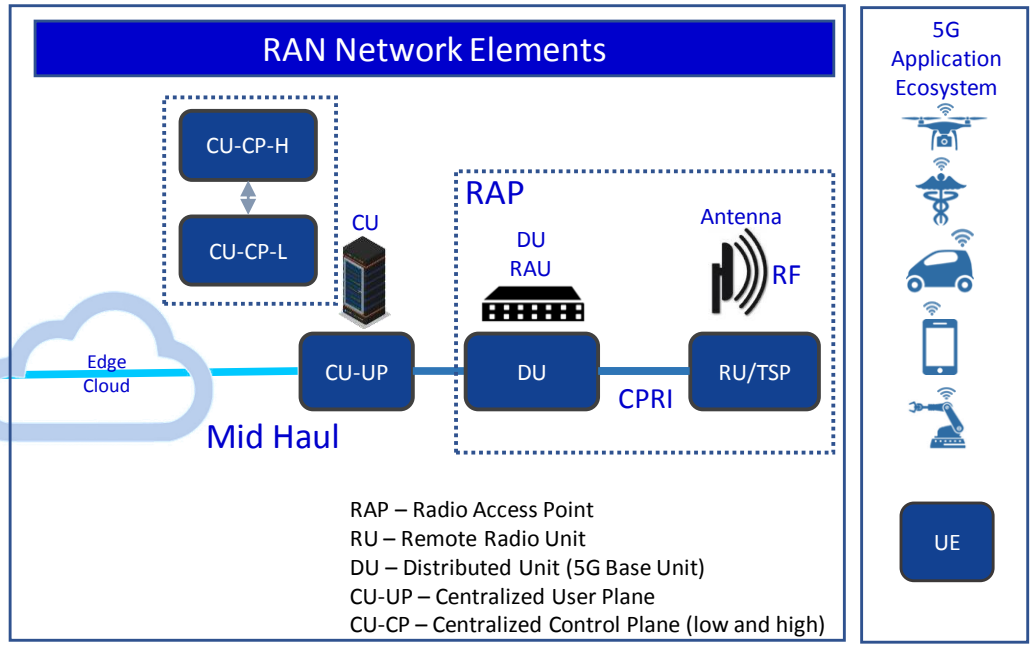
- ONAP and SDC NF Modeling for 5G RAN
- 5G SDC Project

# 5G RAN NETWORK ARCHITECTURE

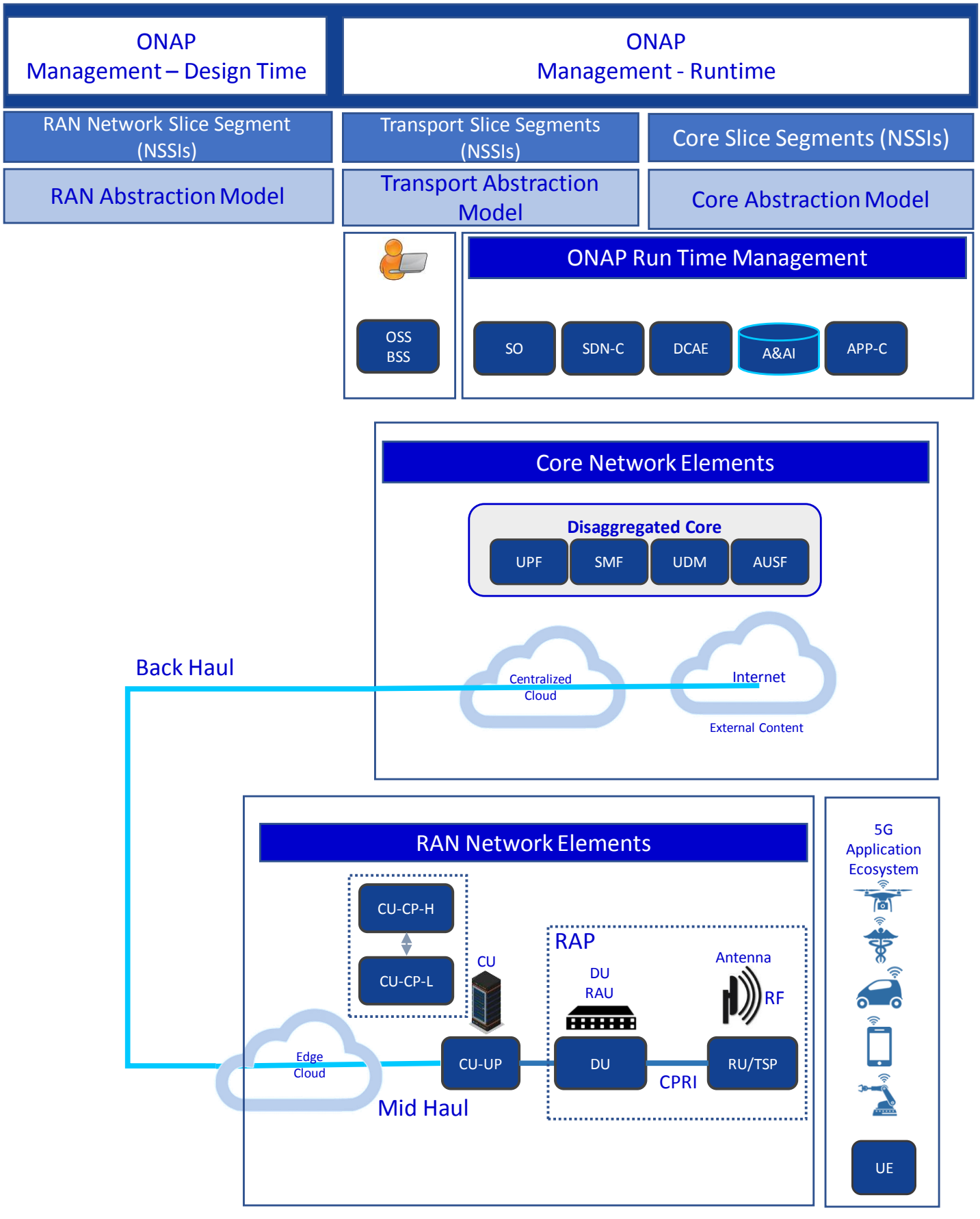
SO – Service Orchestrator
SDN-C – Service Design Network Controller
DCA&E – Data Collection Analytics & Events
A&AI – Available & Active Inventory
APP-C – Application Control



# 5G RAN NETWORK ARCHITECTURE



# Associating a Controller for a NF

- ONAP and PNF Plug and Play for 5G RAN for Dublin R4
- 5G Use Case Team

# NF Controller (R3 Casablanca)

**PROBLEM STATEMENT**

Associating the ONAP Platform Controller (APP-C, SDN-C, VF-C) for a NF

**RESULT**

e.g. SO knows which API to use for NF controller
LCM policy engine, DCAE, Change management

**NF**

OTN PNF (CCVPN), Router PNFs (Optical Domain), 5G DU RAN (Wireless Domain) are PNFs are relevant

**SOLUTION (R3 Casablanca)**

SDN-C, Hard-Code controller to PNF.
"*Hard code*" Generic-API

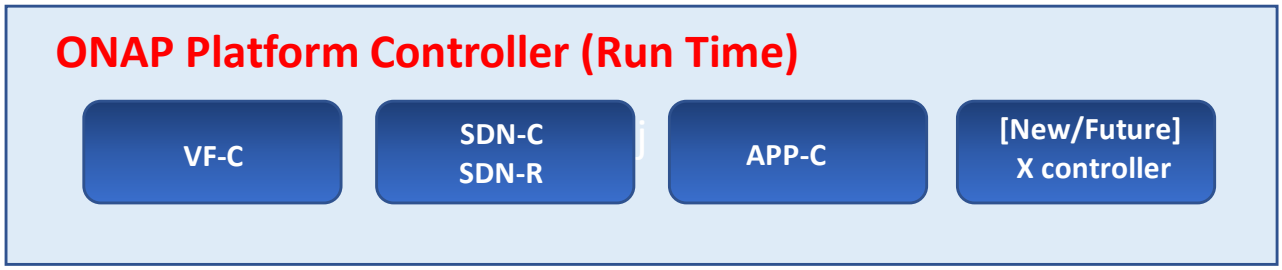
---

**OBJECTIVES (Long-Term Goal)**

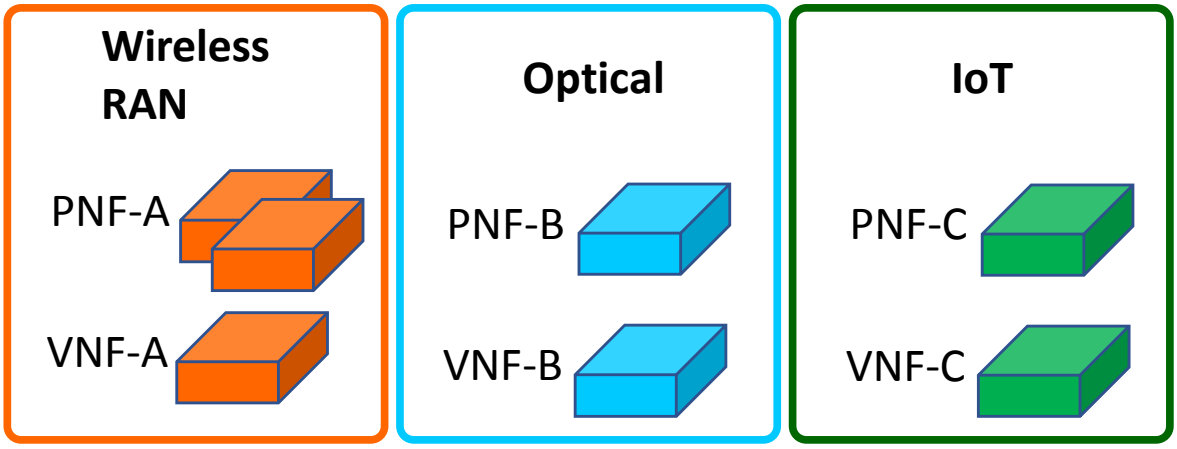
As automated as possible
Using discovery if possible
Flexible operator could design PersonaA for PNF1, PersonaB for PNF2
Take into consideration the capability & functions of the Controller
In general, would not want different controllers handling same NF instance.

# NF Controller Concepts

## ONAP Deployment




**Technology Domain**




**PROBLEM DESCRIPTION**

Pictured above are three different kinds of PNFs. In orange are wireless (RAN) base stations, such as 5G DU units and their corresponding 5G VNFs. For Optical, there are SOTN PNFs for example as used in the CCVPN use case. Then pictured in green are IoT PNFs. These might include things like smart home units, smart doorbells and the like.

Each of these PNFs fall into a domain category, Wireless, Optical, IoT. These categories are just example categories. There will be many other divisions.

Each of these categories of PNFs & VNFs will have attending Controllers.

For any service provider, (w/ a mix of different vendor NFs, they will have the same Controller)

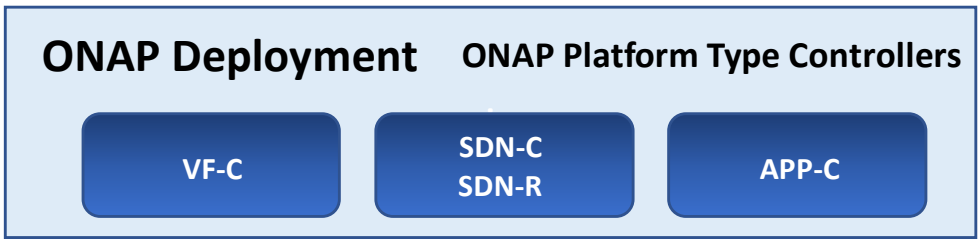
# NF Controller Concepts

**ONAP PLATFORM *CONTROLLERS (Persona)***

(SDN-C (SDN-R), VF-C, APP-C, xyz-C)

**DESCRIPTION**

ONAP Platform-Type controllers are SDN-C, SDN-R, VF-C and APP-C. These are specific types of ONAP projects that are controllers to NFs.



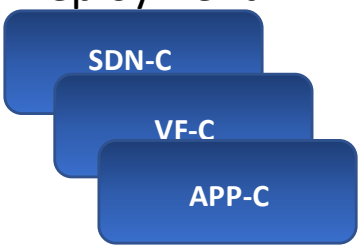

***Regional CONTROLLER (Instances)***

Regional Deployment (instances) of Controllers

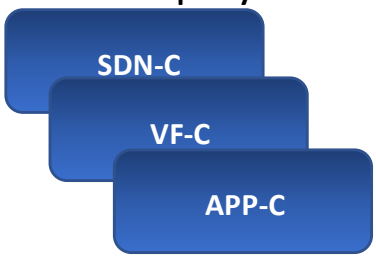
**DESCRIPTION**

Regional Controllers are specific instances of ONAP platform-type controllers deployed to a particular region or responsible for a particular region. For example SDN-C deployment #1 responsible for the western part of a country, and SDN-C deployment #2 responsible for the eastern part of a country

ONAP Deployment #1



ONAP Deployment #2




**External (to ONAP) *CONTROLLERS***

(OSS): EMS, NMS, Vendor proprietary controllers, etc

**DESCRIPTION**

ONAP External Controllers that reside outside of ONAP that perform management functions with the PNF and VNFs. Incl. Vendor-proprietary controllers e.g. SDN-C

# NF Controller PROPOSALS (Goal)

**PROPOSAL #1**

NF Model (SDC Design Studio)

**DESCRIPTION**

To have the Controller as an attribute as a NF model is specified in the NF Model.
Differences between PNFs & VNFs. The PNF has a req for a physical device, VNF does not. Both NFs need controllers.
Objection to model in SDC is that the VID user may not know the controller. The model designer & The Network Engineering should know.
Problem #1 - Requires designer to know the controller
Problem #2 - How is this managed (a hard-coded list) e.g. a 3rd party External Controller

**PROPOSAL #2**

Policy Driven

**DESCRIPTION**

A policy is designed which has the Controller used by the NF.
Problem #1 – That's not what the policy function does
Meta-Data of the Table (combined w/ idea #3)
Run-time Policy (to take up additions)

**PROPOSAL #3**

**Dynamic Association** (Table-Driven Approach)

**DESCRIPTION**

Table-Driven Look-up solution based on NF function type. For example a controller may support a particular technology domain (wireless/wireline/optical). Controller support domain and auto-populates the tables. Could be a GUI in SDC (a run-time catalog table). The Table could be onboarded. Design-time field. The PNF needs to have a "Technology" domain (a user or designer). Specific images (S/W loads) to specific Controllers.

NOTES/IDEAS
1 "ONAP platform type Controller" SDN-C (SDN-R) VF-C APP-C
2. Domain Controller - Controller-Instances (regional dependent)
ONAP deployment [controller] – Domain Controller – ONAP Controller
OTN PNF = "optical" domain = controller-z
  OTN PNF w/ S/W load 1.1.1.2 = controller-X
  OTN PNF w/ S/W load 1.1.1.3 = controller-y
Scale, US/Europe, W-E coast. REGIONAL
3. Vendor / External Controller
Question – who defines the "Domain". Defined by Service Provider.

# Dynamic Association Approach

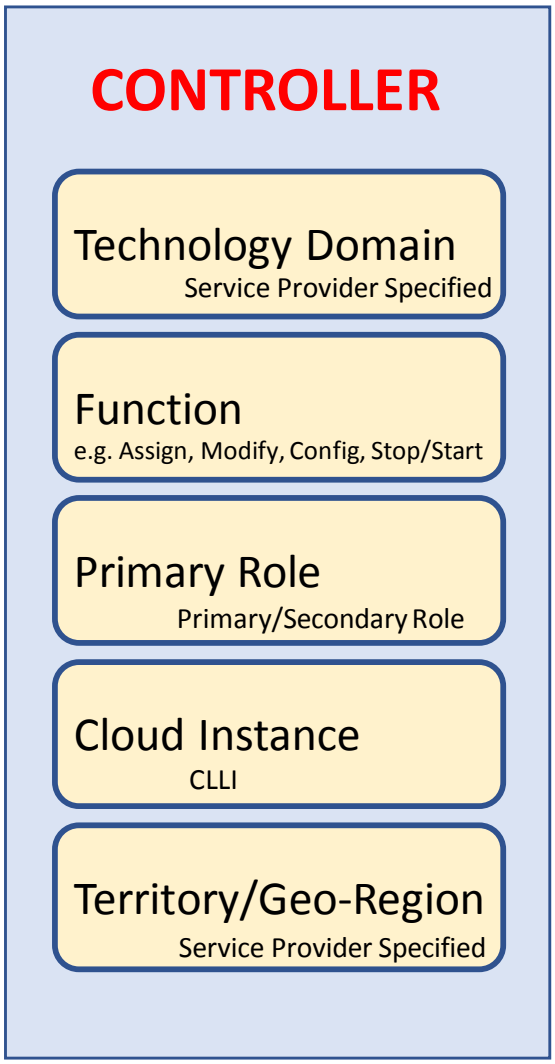
Design Time / Model Level

| Tech Domain | NF (PNF/VNF) | ONAP Platform Controller | Function (API) |
|---|---|---|---|
| Wireless | E// 5G DU | SDN-C | SDN-C<br>Generic API |
| Wireless | Nokia 5G DU | SDN-C | SDN-C<br>Generic API |
| Wireless | Huawei 5G DU | SDN-C | SDN-C<br>Generic API |
| Wireless<br>(Vendor xyz) | Xyz 5G DU | SDN-C | SDN-C |
| Wireless<br>Subdomain 1 | Xyz 5G DU | VF-C | VF-C |
| Wireline | Wireline PNF | APP-C | APP-C<br>Assign > APP-C<br>Modify<br>Config<br>Restart<br>Stop/Start |
| Optical | OTN PNF#2 | SDN-C | SDN-C |
| | | | |

SO Recipe different controller per flow
Lifecycle Management vs CM
SSH key to NF to authenticate controller
Data structure/Platform-Application Data
Mechanism that SP to configure for their operation
Choose to have APP-C vs SDN-C to do something
Controllers configured to handle domain & function
Controllers could publish to the table
Controller register to give provide input for auto-population
Controller when created can state its capabilities

# Dynamic Association Approach

**CONTROLLER REGISTERS IS ABILITIES**




In Run-time the controller can "register" with the *Dynamic Association Handler* which would specify its capabilities

Controller created specifies its abilities.

When you onboard a controller
It should self-identify the capabilities
It supports. SDNC might support modify config doesn't support stop/start LCM.

SO Work-flows. Not only at controller level but at different level (resource level).

SAS – A service comes up, dependencies / capabilities. Based on capabilities resolve dependencies & corresponding API used.
PNP "on the fly" addition. 3rd party controller.
OSDF/SAS Technology based.

Registry w/ Table-metaphor is dynamic. Do controller stuff in controllers. Bootup time register controller. Possible to Re-run registry (during runtime). Register/ Re-Register/ Deregister.

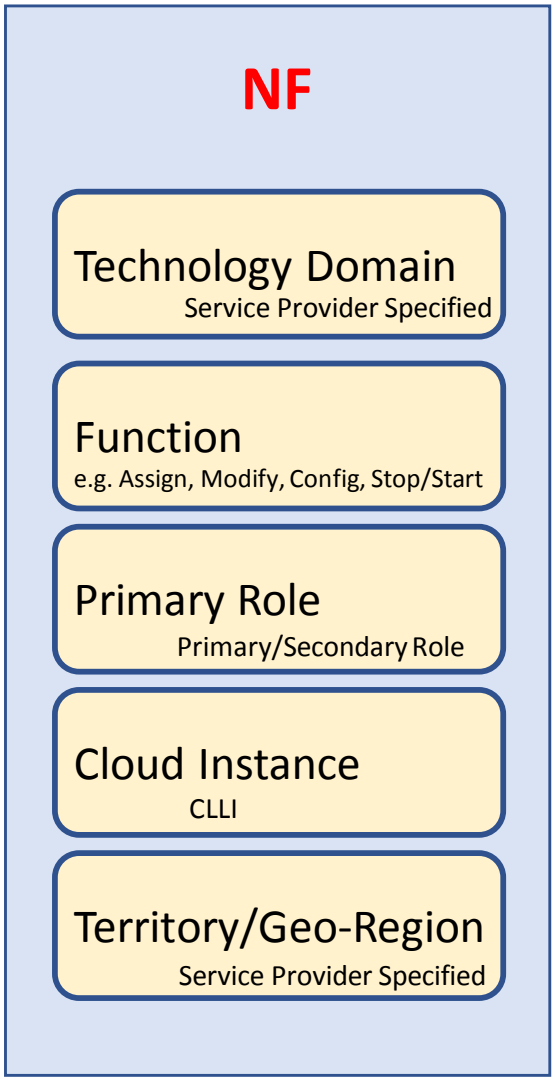
Table should be outside of SO or in Consul. E.g. Healthcheck where SO is not involved. Anyone should be able to do a look-up. CC-SDK.

RUN TIME CATALOG (SDC created artifacts) vs CONSUL (Southbound of ONAP controller & capabilities)

VNF is a collection of VFCs. VNF one API endpoint. All VFCs are within same cloud instance. A service can be composed of VNFs from multiple vendors or the same.

# Dynamic Association Approach

**PNF Plug and Play**
**VNF Instantiation**




A NF is a VNF or PNF that can interact with a Controller.

**Corner Case**: VNF w/ multiple VNF-Cs spanning multiple regions.

Service provider defines “Major” technology domains (e.g. Wireless), the Vendor can define “Minor” technology domain (e.g. 5G RAN)

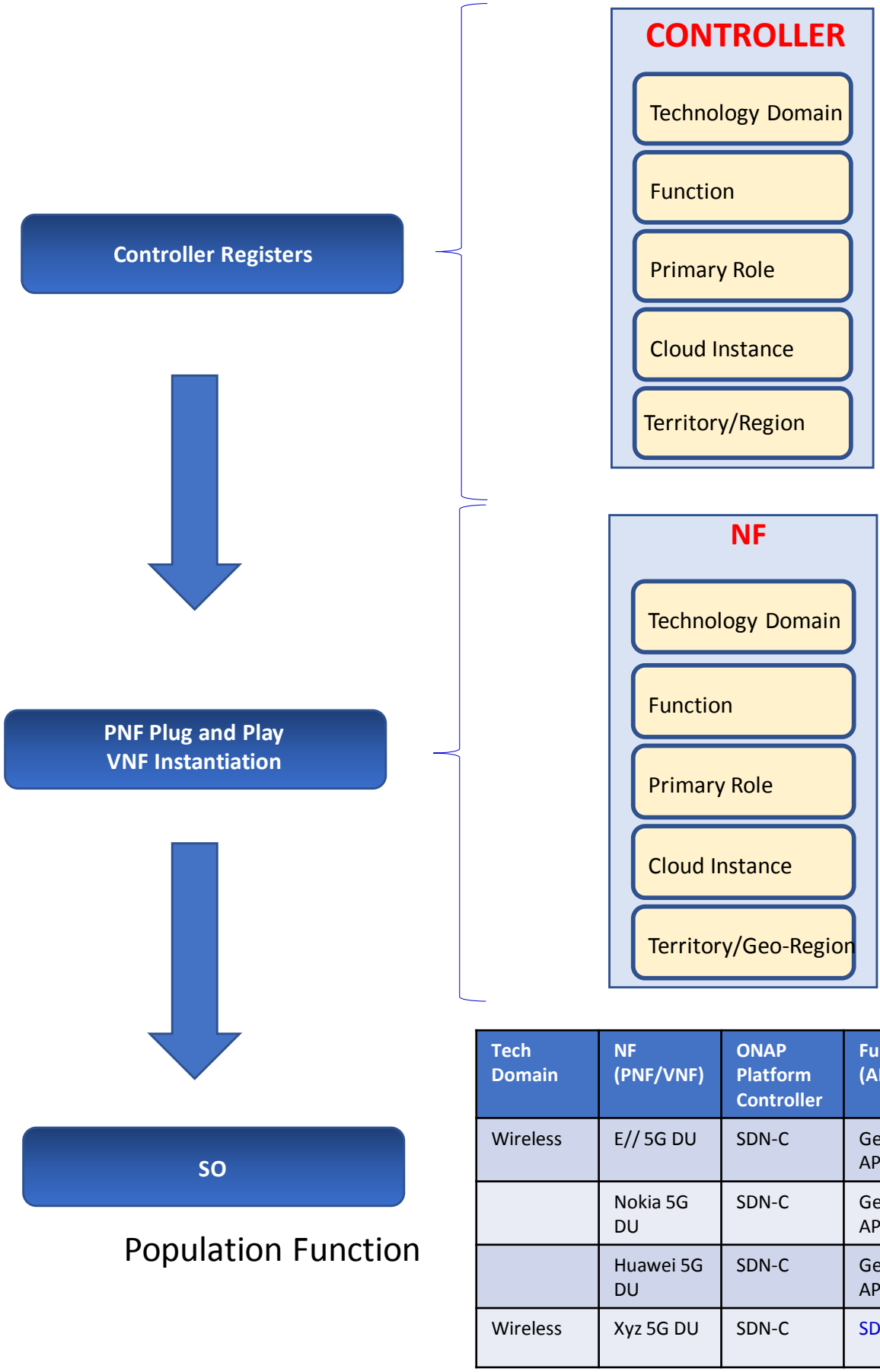
“Lookup” we have a NF … and its part of this xyz Domain.
DU in SDC (Model)
DU in A&AI (Instance)
SO looks up what controller should be used?
DU says “I’m in this tech domain”
Tech domain are “main lookup key”
Function are supporting attributes

SO would know the Cloud Region, Territory.
When it comes time to call a controller.
Via Homing & Complex-Object

QUERY into the “Table” returns Tech domain-Function – Primary – Cloud –Georegion

SDC, VID, OOF, A&AI dependencies.

# Dynamic Association Flow




| Tech Domain | NF (PNF/VNF) | ONAP Platform Controller | Function (API) |
|---|---|---|---|
| Wireless | E// 5G DU | SDN-C | Generic API |
| | Nokia 5G DU | SDN-C | Generic API |
| | Huawei 5G DU | SDN-C | Generic API |
| Wireless | Xyz 5G DU | SDN-C | SDN-C |

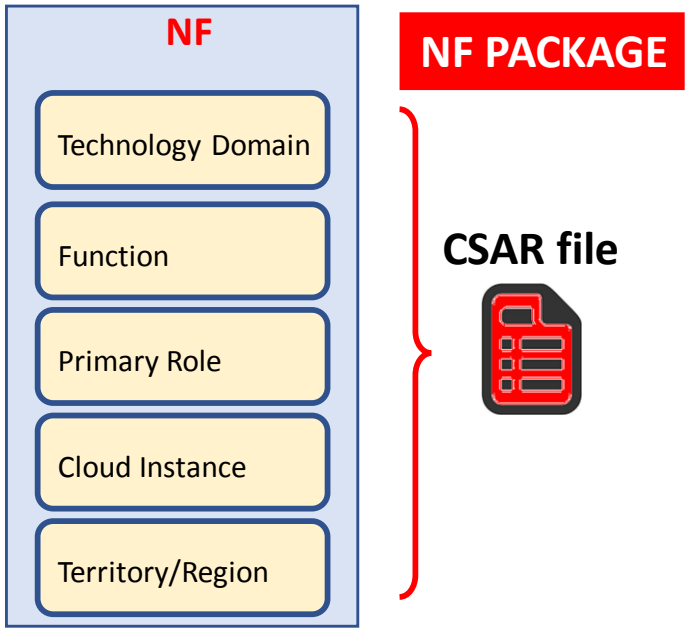
# Dynamic Association – Design Time

SDC

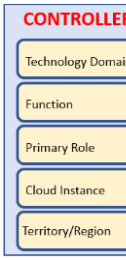
**STEP 1:**
**INSTANTIATE CONTROLLER (DT)**
1a. VNF SDK describe attribute functionalities needed within the TOSCA model those capabilities are mapped into a controller based on the table.
1a. In the ONAP build, Empty Table is Created.
1a. SP provisioning/setup of ONAP instance/installation. i.e. SO, SDN-C, APP-C configuration
1b. SP Create instances of Controller
1c. Profile Controller (tech fun role instance)
1d. Filling in the Controller part of Table.

**STEP 2:**
**NF MODEL (DT)**
NF Model ingestion/onboarding
NF part of table updated
CSAR > VNF SDK

| Tech Domain | NF (PNF/VNF) | ONAP Platform Controller | Function (API) |
|---|---|---|---|
| Wireless | E// 5G DU | SDN-C | Generic API |
| | Nokia 5G DU | SDN-C | Generic API |
| | Huawei 5G DU | SDN-C | Generic API |
| Wireless | Xyz 5G DU | SDN-C | SDN-C |

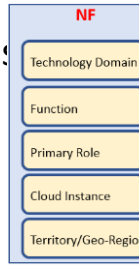


**STEP 1:**
**INSTANTIATE CONTROLLER (ONAP Installation)**
**WHO:** Capacity/Network Planning Team (Service Provider), ONAP Installation Team (Service Provider)




1a. The Table is Created with no value (Empty)
1b. SP provisioning/setup of ONAP instance/installation. i.e. SO, SDN-C, APP-C configuration
1c. SP Create instances of ONAP Platforms Controller (SDN-C, APP-C, VF-C)
1d. Onboard Profile Controller (tech fun role cloud instance loc)
1e. Filling in the Controller part of Table.

**STEP 2 (DESIGN TIME ACTIVITIES)**
**WHO:**
**SDC Design Studio, CDT, DCAE-DS … etc**




1a. Input to SDC TOSCA template from VNF-SDK (or manual) that specifies what the NF needs from a controller and NF properties
1b. Onboarding PNF-D, Defining Models & Artifacts, Updating SDC Catalog
1c. NF information put into the SDC artifacts/CSAR Package
1d. (optional) SDC could also update the Controller section of the table (by specifying controller information). Tool/Script to controller information if necessary (due to typos, adaptations for congestion, migrations, new technology domains, etc).
1e. SDC distributes Artifacts (CSAR) to ONAP components & listeners
1f. Process of ingesting the model (SDC artifacts), SO populates the table (NF part of the table “new”, UPDATES the rest of the table from Optional updates [in step 1d.]).

**STEP 3: (RUN TIME OPERATION)**
1a. Components in ONAP (e.g. SO, policy) USE the table to find the appropriate controller & APIs for a NF.
1b. When policy’s action require a controller look at the table.
When policy’s action is to consult w/ SO it knows how to talk to SO
EXAMPLE: Message from NF, executing a Use Case. e.g. Threshold > NF > DCAE > Policy > Action > SO: Controller to interact w/ NF

DISCUSSION

NOTE: Once initial instantiation takes place & mapping, that mapping needs to be maintained for the lifecycle of the NF.

Q: Stability of Table? Will answers change?
A: For same data in will get same answer out.
A: Updates to the table can be made

Q: (Ben) case: conflict race condition (operator#1 updating / operator#2 updating table).
A: Transaction control
ONAP installation team updates. Should own data integrity of the table.
Maria DB transaction control.

Q: (Oskar) case: granularity of look-up, look-up based on a specific action.
Restart but can't do config modify.
For a particular instance of NF handled by one controller instances.
Cases w/ dynamic look-up hard to guarantee.
If you have granularity on operation-level get two answers depending on which operation you want to perform.
Locking in A&AI to block other things.
Operations lock out ONAP from doing changes while maintenance
Course locking/ Finer locking (future)
NF#12 two active Policies
Policy #1 Restart Policy #2 Config-Modify. Trigger at same time.
Table lookup > Get Controller Instances.

# NF Controller PROPOSALS (Goal)

DESIGN-TIME

SDC – Design Studio
Onboard a resource (type, role, function, [tech domain])
Deduce tech domain? From type-role-function?
Operator specifies the Technology Domain of the NF
Operator specified the Technology domains
(or possibly Techdomain is deduced from type-role-function)
Service Provider defines the possible Technology Domains
Assign every NE and Service to a Technology Domain
TD1 = SDN-C TD2 = VF-C manually modeled, table created.
TechDomain to ONAPPlatformController
SDC – Model “mapping” > Catalog

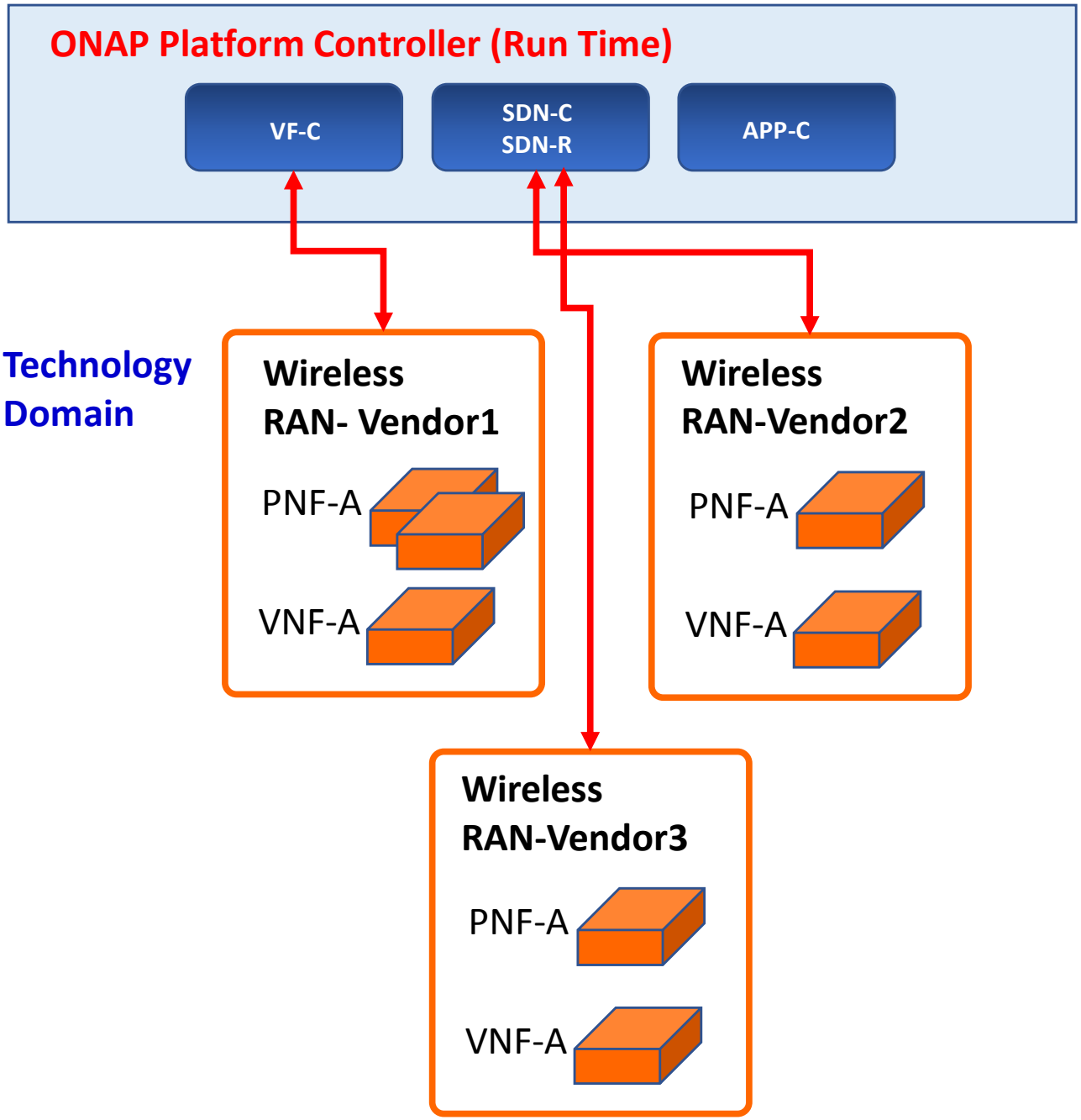
RUN-TIME

As a NF registers, the (managing ONAP entity e.g. SO for PNF)
would look up the TD > OPC mapping)

3 Technology Controllers (Wireless, Enterprise, Other)
When generate controller it populates the table.
Dynamically populate table

# Who Chooses the Controller?

Who Choose the ONAP controller type for the NF?



# NF Controller - Notes

Identifying the NF controller
For VNF is part of the Call Flow
    VNF gets orchestrated through recipe & DG & Yang models (assumption is SDNC is the controller)
    VNF can have own domain controller
    DG pass control VN adaptor to 3rd party controller
PNF controller to be discovered as part of the PnP Flow
Provision PNF manually specify the Controller
SO passes to APPC service instance
SO pulls service info
PNF (CU) must be configured first
CU configuration process (could identify the ONAP controller)

PNF (routers, access pts, RAN 5G DU, CU)
- SDN-C, VF-C, x-controllers
- ONAP SO needs to know what API & Controller for PNF.
-

# NF Controller - Notes

NOTES: July 17th Modeling Discussion

Seshu
We have talking of a TOSCA event-based flavor given
To the WF entity-based;
SO Trying to adapt – The NF controller modeled-
User on client side selects the controller (also has problems)
If not the UI, the modeler who can understand this is the case
Information that something is a missing point – trying to
Can we have a understanding in des-time; for the controller
SDN-C, APP-C, VF-C, GNF-C etc
Resources compatible w/ this resource type
A designer driven
Designer may not know
PNF PNP does not use OOF
This is a RECURRENT problem (also encountered in Scaling use case)

Alex Vul
PLACEMENT POLICY – POLICY FRAMEWORK
Design times generic, bind specific VNF
Map to OOF.
Mechanism exists.
Log des; phys infrastructure; binding between 2 (by OOF)
Heirarchical orchestration
Policy design by a Human Operator, designs the policy of PNF.
Designer doesn't know controller;

Chaker AlHakim
Restate the problem
Add an attribute in A&AI
Register a SERVICE. Add service in A&AI.
Best way to register the service controller is providing.
Creating the service don't know physical/virtual resources.

Srini Vellanki
Workflow designer
SERVICE MODEL – which controller to use

# A&AI (Reference)

- ONAP and PNF Plug and Play for 5G RAN
- 5G Use Case Team

# ACTIVE INVENTORY (A&AI) R3/Casa

| ACTIVE & AVAILABLE INVENTORY (A&AI) PROJECT IMPACTS | |
|---|---|
| **New A&AI PNF Parameters** | ~~**PNF GEOLOCATION**~~ - geographical location (e.g. coordinates or address of the building, etc.). Latitude/Longitude. ***THIS ALREADY EXISTS VIA ASSOCIATION TO THE "COMPLEX" OBJECT.*** The Complex Object represents a BUILDING or location with geographical information. The AAI PNF will have a UML association to the Complex object. |
| **Software Version** | **DETECTED SOFTWARE PNF VERSION(S) – swVersionList**.<br>**R3 Casablanca** – This will be a list of software versions. In Run-Time when PNF registers with ONAP it can report its (list) of PNF Software that is currently has installed. This will be tracked in A&AI entry for that PNF. Entry will also an indication that one is *Active.*<br>**R4 Dublin** – proposing software Object which could be linked by SDC and A&AI.<br>**swVersion [1…x] (Array)**<br>**{**<br>**swVersion (String)**<br>**activeSw (Boolean)**<br>**}** |
| **Homing** | **PNF [#1:CU/#2:ONAP] CLOUD HOME (CLOUD SERVER LOCATION)** – PNF is served by some regional ONAP cloud servers. Serves in "Rehome" PNF. **CLLI Code** (specifies location, street address, **CloudID**, physical server is deployed). [Potentially a list of locations]<br>OOF determine the homing of a NF. Anything you home is determined in the context of a deployment. (Homing) Policy used as a f(service). Data center might have been divided into cloud regions. Service VMME running in NE area (distances, regions, tenants where to instantiate PNF). AAI has **COMPLEX node**. "Physical Location ID" (8 char CLLI code, lat/long = geolocation info of data center. Cloud region doesn't span data centers. |
| **External Manager IP Address** | **External Manager IP Address** – provides an additional IP address for the BTS that is vendor-specific and relevant to the OAM management of the BTS.<br>SUGGESTION (from Christina A&AI) model the NMS as a PNF itself (and the NMS will have parameters to represent itself; and then PNF can be associated with it). |

# S/W Image Repository / R3 Casa

| ACTIVE & AVAILABLE INVENTORY (A&AI) PROJECT IMPACTS | |
|---|---|
| **S/W Image Repository** | **S/W Image Repository** – Where the S/W is located.<br>Configuration Parameter. |

https://wiki.onap.org/pages/viewpage.action?pageId=25431491

# Create a Complex Object

```
PUT /aai/v11/cloud-infrastructure/complexes/complex/clli2 HTTP/1.1
Host: <AAI_VM1_IP>:8443
X-TransactionId: 9999
X-FromAppId: jimmy-postman
Real-Time: true
Authorization: Basic QUFJOkFBSQ==
Content-Type: application/json
Accept: application/json
Cache-Control: no-cache
Postman-Token: 734b5a2e-2a89-1cd3-596d-d69904bcda0a
```


```
{
   "physical-location-id": "clli2",
   "data-center-code": "example-data-center-code-val-6667",
   "complex-name": "clli2",
   "identity-url": "example-identity-url-val-28399",
   "physical-location-type": "example-physical-location-type-val-28399",
   "street1": "example-street1-700MountainAvenue",
   "street2": "example-street2-GlenSideRoad",
   "city": "example-city-MurrayHill",
   "state": "example-state-NewJersey",
   "postal-code": "example-postal-code-07974",
   "country": "example-country-UnitedStates",
   "region": "example-region-val-28399",
   "latitude": "111.1",
   "longitude": "234.2,
   "elevation": "example-elevation-538feet",
   "lata": "example-lata-val-28399"
}
```

# PNF A&AI Entry

| PARAMETER | DESCRIPTION |
|---|---|
| **PNF-NAME** | *pnf-name* is the Key in AAI. pnf-name is the first three letters of the Vendor and PNF serial number. This is a unique identifier for the PNF instance. It is also called the Correlation ID. Note: MAC address & serial number are unique per vendors; not across vendors, so the Vendor name is added to insure uniqueness. |
| **EQUIP-TYPE** | The *equip-type* parameter gives the type of the PNF. |
| **EQUIP-VENDOR** | The *equip-vendor* is an optional parameter which indicates the vendor for the PNF. For example, Nokia or Ericsson. |
| **EQUIP-MODEL** | The *equip-model* is an optional parameter which indicates the model of the PNF. |
| **PNF-ID** | UUID = Service provider assigned number from network planner. |
| **MANAGER IP ADDRESS** | adds *ipaddress-v4-oam*; *ipaddress-v6-oam* This is the "manager IP Address" which for a DU might be a CU IP address; (FYI/ *ipaddress-v4-loopback-0*). |
| **MAC ADDRESS** | This is the MAC address of the PNF. This is a service field. |
| **SERIAL NUMBER** | This is the serial number of the PNF. This is a service field. |
| **PROXY IP ADDRESS** | This field contains the *proxy IP address* for the PNF. |

# PNF Plug and Play
# ROADMAP (After Casablanca)

- ONAP and PNF Plug and Play for 5G RAN
- 5G Use Case Team

# TOPIC: SWVERSIONLIST (R4+)

**TOPIC:**

**Adding Description to software_versions (after Casablanca R4+)**

Problem Statement: Adding Description to SWVersionList

Problem Statement: Add new **DATATYPE**

(going through the modeling subcommittee)

**SOLUTION**

- **Content of PNF software version List**

| Contents | | Description |
|---|---|---|
| softwareList | description | Describes the main feature of the this software version |
| | swVersion | Software version |

Want a DATA STRUCTURE in the TOSCA MODEL for the NF Model

**Discussion**

# (SDC) software_versions data type (R4+)

New Data Type for modeling PNF Software Versions

## Software (object)

| FIELD | TYPE | DESCRIPTION |
|---|---|---|
| software-id | String | Index key for this object |
| swDescription | String | Descriptive text of the software |
| swVersion | String | The version of this software |
| swVendor | String | Vendor for this software |
| swVersionLabel | String | Semantic label for the software |

# PNF PACKAGE (R4)

## ALARM DEFINITIONS

YAML Definitions
(Vendor provided)
Alarm Dictionary
& Sub-tending faults
[Static Info]

## MEASUREMENT DEFS

YAML Definitions
(Vendor provided)
Meas. Dictionary

Measurement
Schema
(Vendor provided)

## CONFIGURATION DEFS

Configuration
Schema
(Vendor provided)

YAML Definitions
(Vendor provided)

## EVENT DEFS

Events
YAML Definitions
(pnfRegistration, HVVes)

## PLAYBOOK DEFS

NF Ext Controller
Playbooks

## WORK-FLOWS

Work-Flows

## POLICY

Identity Controller

UNDER DISCUSSION

## NF PACKAGE

- Artifacts
- Definitions
- TOSCA-Metadata
- MainServiceTemplate.mf
- MainServiceTemplate.yaml

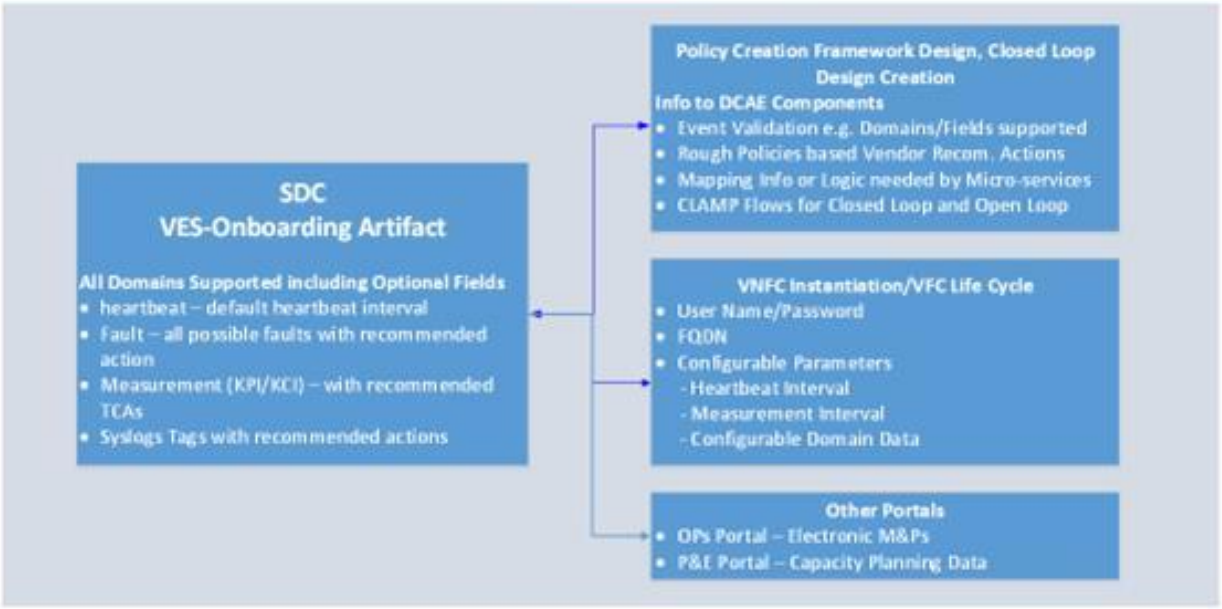
**CSAR file**

Need to define a common “template” that all vendors Provide dictionaries for. DCAE-DS responsible for reading these files. Closed Loop. Vendor describe alarms being sent. Definition what alarms correlated to (collecting, triggers). CLAMP performs analysis, design of who uses it is SDC. Holmes monitoring micro-services (to receive alarms).

Communication STANDARDS we want to support?
[Data Format]

PNF Alarm #22
#22 S/W problem xyz
VES = fault fields; “fault’ domain publish DMaaP
Clamp, Analytic, Holmes – [#22 event]
Dictionary looks up #22 ->

# VES On-Boarding Artifact Use





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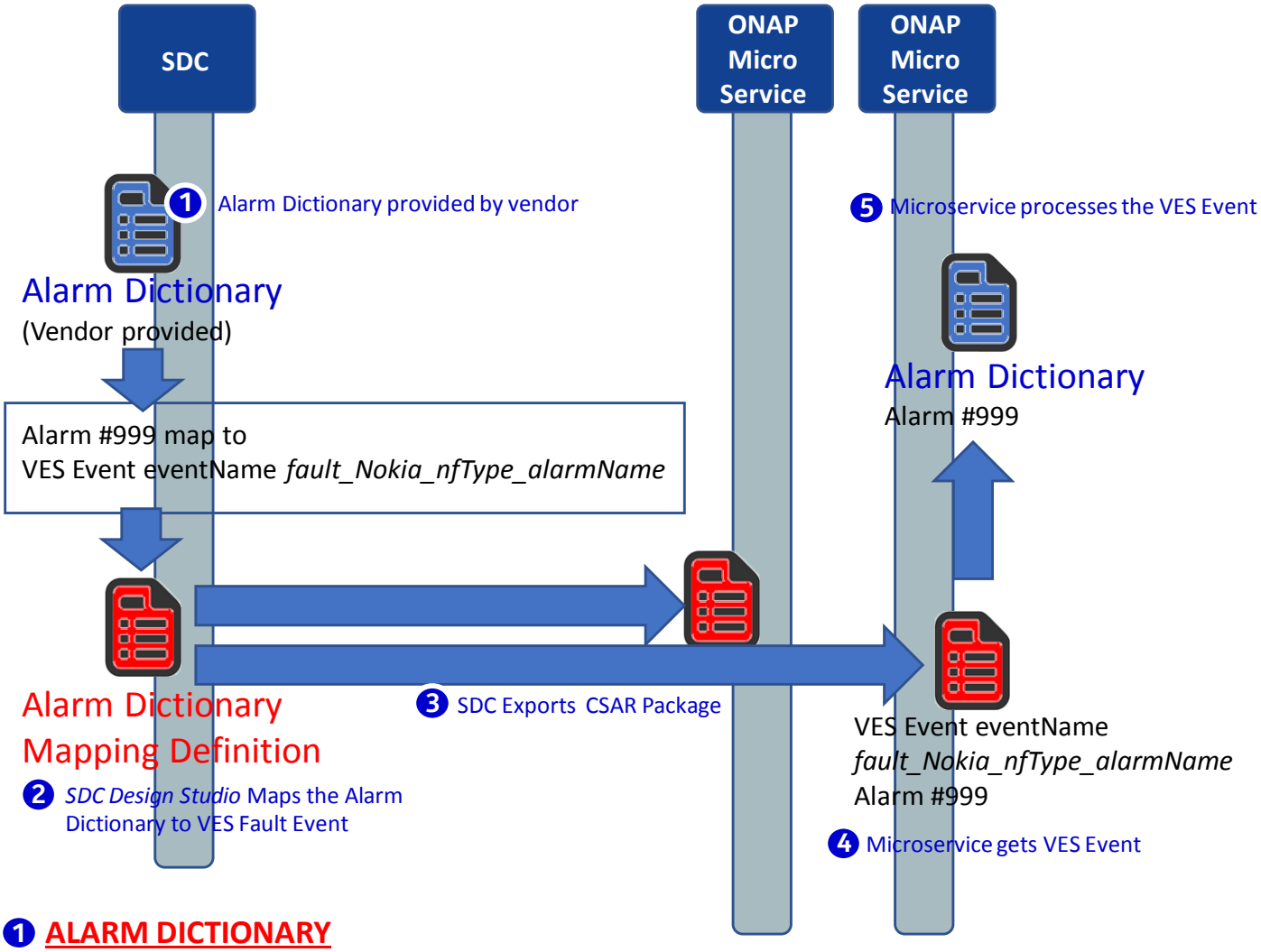
# Alarm Dictionary Usage




1. **ALARM DICTIONARY**
   Alarm Dictionary defines all alarms/faults published by xNF (x=V or P)
   Based on 3GPP TS32.111, ETSI, and VES document (v6.0)
2. **SDC DESIGN STUDIO MAPS VES FAULT Event to Alarm Dictionary**
   SDC Design studio does mapping of Alarm dictionary entries to VES Fault Events to produce a "mapping" definition in the CSAR package. (RATHER than mS doing the mapping because it is more model driven)
3. **SDC DISTRIBUTES DEFINITIONS**
   SDC creates a definition of how to start-up service. SDC exports the *CSAR package* with the VES Fault to Alarm dictionary mapping definitions.
   **DEFINITIONS & ARTIFACTS (CSAR PACKAGE)**
   1. VES-Alarm mapping definition passed by SDC (CSAR Package) to ONAP components
   2. DCAE micro-service gets CSAR package
4. **MICRO SERVICE GETS FAULT EVENT**
   Microservice has subscribed to fault domain DMaaP Topic and receives the VES Fault Event from xNF in run-time.
5. **MICRO SERVICE PROCESSES EVENT**
   Microservice processes the VES Event using the Alarm Dictionary

# Alarm Dictionary Usage

**ALARM DICTIONARY (Fault YAML File) PURPOSE**

(1) **DICTIONARY** - it allows for a readily accessible body of the entire set of alarms & faults that are managed by a PNF. It would allow for an operator to see all of the alarms & faults of a PNF without having to wait for individual alarms & faults to arrive in ONAP.

(2) **Analytics facilitator** – A dictionary would allow for a variety of vendor specific (or vendor agnostic) analytics applications to be developed. There are a variety of fields in the Alarm Dictionary that would facilitate such analytics capabilities as correlation, escalation, isolation, recovery actions, self-healing, and life cycle management functions.

(3) **GENERAL ANALYTICS** – The strength of ONAP is the potential ability to coordinate information from multiple sources, different vendors, and disparate types of NFs. A dictionary can form the foundation for generalized analytics that are vendor agnostic.

**FAULT DICTIONARY PURPOSE**

(1) **FAULTS vs ALARMS** - Fault can be a condition encountered in run-time that does not necessarily create a customer-facing alarm. An alarm is intended to result in a visual notification to a service provider to take action. An analogy would be the “Check engine” light in your car which would correspond to an Alarm. A solenoid, a carburetor, or distributor fault all might lead to a “Check engine” light. A driver (service provider) may not be able to directly act on the specific fault (or indeed care about the fault); but when the “check engine” light went on would know to take some action (go to the service station).

# NF ALARM DICTIONARY FIELDS (Template)

| ALARM FIELD | DESCRIPTION |
|---|---|
| **Alarm Dictionary Index** | Gives the Identifier for the alarm. This is also the Identifier that is used in the VES event so it can be used to associate the event with the definition entry.<br>The VES Event *EventID* would encode the Alarm number which will correspond to the Alarm Index.<br>EXAMPLE: 12345 |
| **Alarm Name** | Alarm Name which will be used in the Event Name. **Note** *this maps to the alarmCondition in the VES Fault Event in faultevent fields.*<br>EXAMPLE: Synchronization Lost |
| **Event Type** | Indicates the type of alarm. The types are: Communications Alarm, Processing Error Alarm, Environmental Alarm, Quality of Service Alarm, Equipment Alarm, Integrity Violation, Operational Violation, Physical Violation, Security Service Violation, Mechanism Violation, or Time Domain Violation. **Note** *this maps to the eventCategtory in the VES Fault Event in faultevent fields.*<br>EXAMPLE: Quality of Service Alarm |
| **Meaning of Alarm** | Provides a descriptive meaning of the alarm condition. This is intended to be read by an operator to give an idea of what happened.<br>EXAMPLE: Synchronization has been lost |
| **Effect of Alarm** | Provides a description of the consequence of the alarm condition. When this alarm condition occurs. This is intended to be read by an operator to give a sense of the effects, consequences, and other impacted areas of the system.<br>EXAMPLE: Loss in Quality of Service |
| **Managed Object(s)** | Managed object (MO) associated with this Alarm. **Note** *this maps to the eventSourceType in the VES Fault Event in faultevent fields.*<br>EXAMPLE: Clock (MO) |
| **Probable Cause** | Provides the probable cause qualifier for the alarm. Probable causes are found in 3GPP TS 32.111 Annex B drawn from ITU-T M.3100 and from ITU-T Recommendation X.721, X.733, and X.736<br>EXAMPLE: lossOfSynchronisation |
| **Probable Cause Number** | Probable Cause Number the numeric value associated with the Probable Cause<br>EXAMPLE: 76 |
| **Specific Problem** | (Optional) It provides further qualification on the alarm than probable Cause. This attribute value shall be single-value and of simple type such as integer or string. Defined in ITU-T Recommendation X.733 Clause 8.1.2.2. **Note** *this is the 3GPP Specific problem not be confused with the specificProblem field of the VES Fault Event in faultevent fields.* |
| **Proposed Repair Actions** | It indicates instructions for proposed repair actions. These are defined in ITU-T Recommendation X.733 clause 8.1.2.12.<br>EXAMPLE: Reset the BTS, ONAP Controller does x |
| **Clearing Type** | Indicates whether the alarm is automatically or manually cleared<br>EXAMPLE: Automatic |
| **Additional Text** | This field contain further information on the alarm. This attribute provides *vendor specific* alarm information. A specific condition for this optional population is when an alarm presented by the EM has different values of perceived severity, and / or alarm type.<br>EXAMPLE: Specific data 10 |
| **Associated Fault(s)** | Indicates the associated faults that triggered this alarm. List of fault(s) associated with the alarm cross indexed against a vendor provided fault information.<br>EXAMPLE: Fault 99999 |

# NF FAULT DICTIONARY FIELDS (Template)

| DEFINITION FIELD | DESCRIPTION |
|---|---|
| **Fault Id** | Gives the Identifier for the alarm. This is also the Identifier that is used in the VES event so it can be used to associate the event with the definition entry.<br>EXAMPLE: 99999 |
| **Fault Name** | Alarm Name which will be used in the Event Name. **Note** *this maps to the alarmCondition in the VES Fault Event in faultevent fields.*<br>EXAMPLE: Loss of Synchronization |
| **Fault Description** | Provides a descriptive meaning of the alarm condition. This is intended to be read by an operator to give an idea of what happened.<br>EXAMPLE: Synchronization due to PTP IEEE1588 Failure |
| **Managed Object(s)** | Managed object (MO) associated with this Alarm. **Note** *this maps to the eventSourceType in the VES Fault Event in faultevent fields.*<br>EXAMPLE: Clock (MO) |
| **Effect of Fault** | Provides a description of the consequence of the alarm condition. When this alarm condition occurs. This is intended to be read by an operator to give a sense of the effects, consequences, and other impacted areas of the system.<br>EXAMPLE: Loss of synchronization affect QoS |
| **Associated Alarm(s)** | Indicates the associated faults that triggered this alarm. List of fault(s) associated with the alarm cross indexed against a vendor provided fault information.<br>EXAMPLE: 12345 |
| **Proposed Repair Actions** | It indicates instructions for proposed repair actions. These are defined in ITU-T Recommendation X.733 clause 8.1.2.12.<br>EXAMPLE: Reset BTS |
| **Additional Text** | This field contain further information on the alarm. This attribute provides *vendor specific* additional fault information. |

event: {presence: required, action: {any, any, AlarmID 71xx RECO-contact Nokia technical support },
comment: "

MEANING = A fault has occurred in the base station synchronization. For example: the base station reference clock signal is lost or is unstable/inaccurate, ....,

EFFECT = The effect of the fault on the functioning of the network element depends on the fault id raised. See fault effect below in registration YAML,

CLEARING TYPE = automatic

",

structure: {
commonEventHeader: {presence: required, structure: {
version: {presence: required, value: 3.0},
domain: {presence: required, value: fault},
eventName: {presence: required, value: Fault_5gBts_Nokia_baseStationSynchronizationProblem},
eventId: {presence: required},
sourceName: {presence: required},
reportingEntityName: {presence: required},
priority: {presence: required},
startEpochMicrosec: {presence: required},

}},
faultFields: {presence: required, structure: {
faultFieldsVersion: {presence: required, value: 3.0},
eventCategory: {presence: optional, comment: "Quality of service"},
alarmCondition: {presence: required, value: 'baseStationSynchronizationProblem'},
eventSourceType: {presence: required},
alarminterfaceA: {presence: required},
specificProblem: {presence: required},
eventSeverity: {presence: required},
nfStatus: {default: Active},
alarmAdditionalInformation: {presence: required, array: {
keyValuePair: {presence: required, structure: {
key: {presence: required, value: 'Fault ID'},
value: {presence: required}},
comment: "

**FAULT ID** = 9,

FAULT NAME = 'BTS time not corrected',
comment: "

**FAULT ID** = 9,

FAULT NAME = 'BTS time not corrected',

FAULT DESCRIPTION = 'The reference frequency that the BTS master clock receives has changed by about 200 ppb or more (which equals the change magnitude of 204 DAC steps or more (with 12bit DAC)) during the measurement period, compared to the BTS master clock frequency.

Causes can be:

1. The reference frequency .....

2. The reference frequency fluctuates ...',

EFFECT = 'This fault does not immediately affect the operations of the BTS, but it is a notification ...',

PROPOSED ACTION = 'access the ....follow the instructions below:

1. In case of a fault in the transmission network synchronization, ...

3. In case of a BTS equipment fault, the location might be:

4. After the fault situation has been cleared, ....',

**FAULT ID**= 1818,

FAULT NAME = 'BTS master clock tuning failure',

FAULT DESCRIPTON = 'Master clock frequency is tuned to within 5% of its minimum or maximum tuning limit.',

EFFECT = 'The BTS can operate properly for months ....

Effects in Frequency Synchronization mode: ...

Effects in Phase Synchronization mode: ....',

PROPOSED ACTION = 'Perform the steps below in the listed order until the fault disappears.
Not tracking satellites:

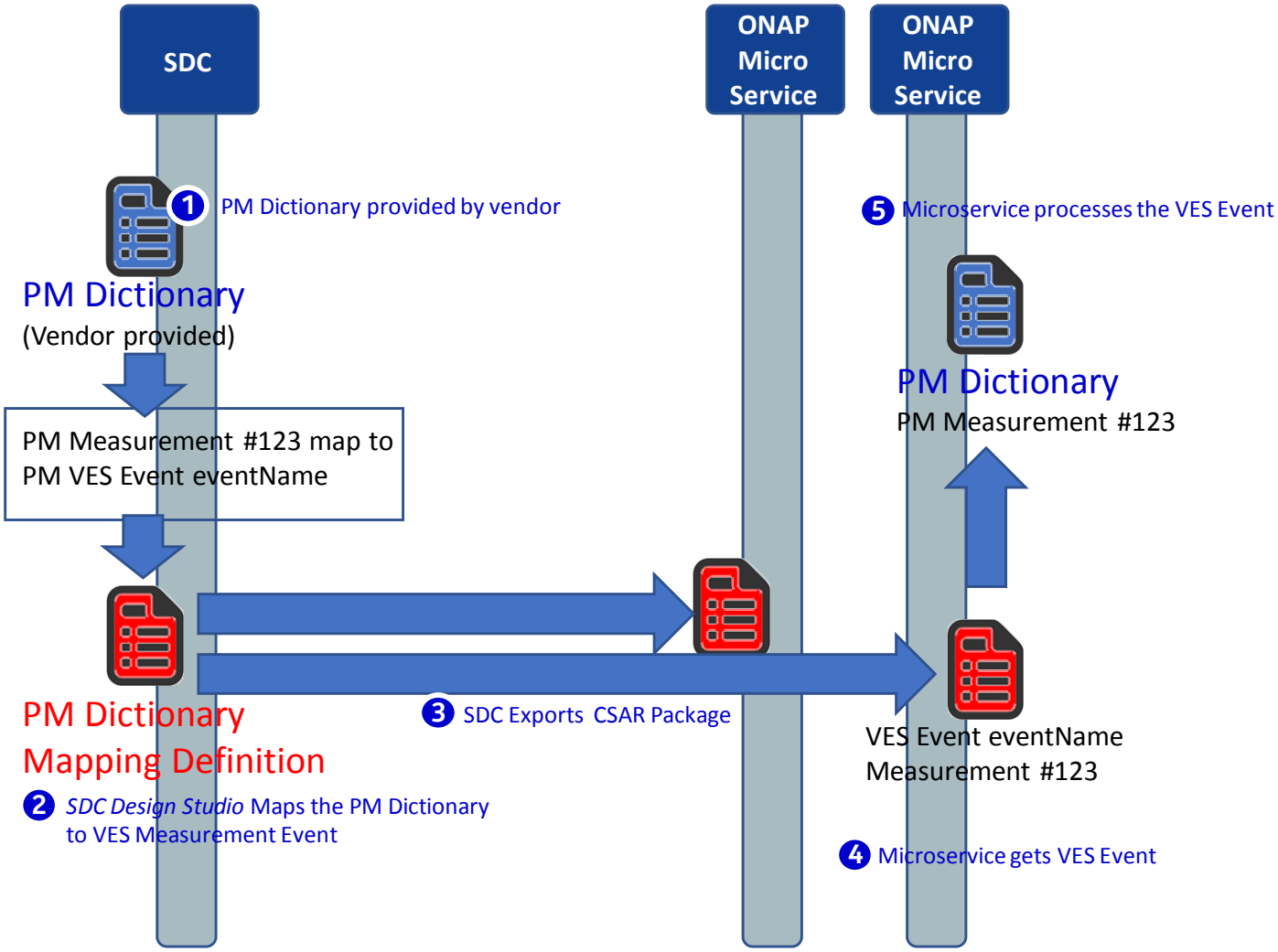
1. The most common reason ....

2. There might be a malfunction in the GPS receiver. Perform a (remote) power reset for the GPS receiver.

3. There might be a HW fault in the GPS receiver. Check the operation and change the GPS module, if needed.'

",

# PM Dictionary Usage

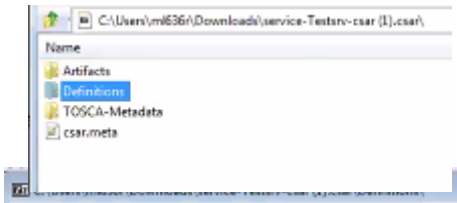


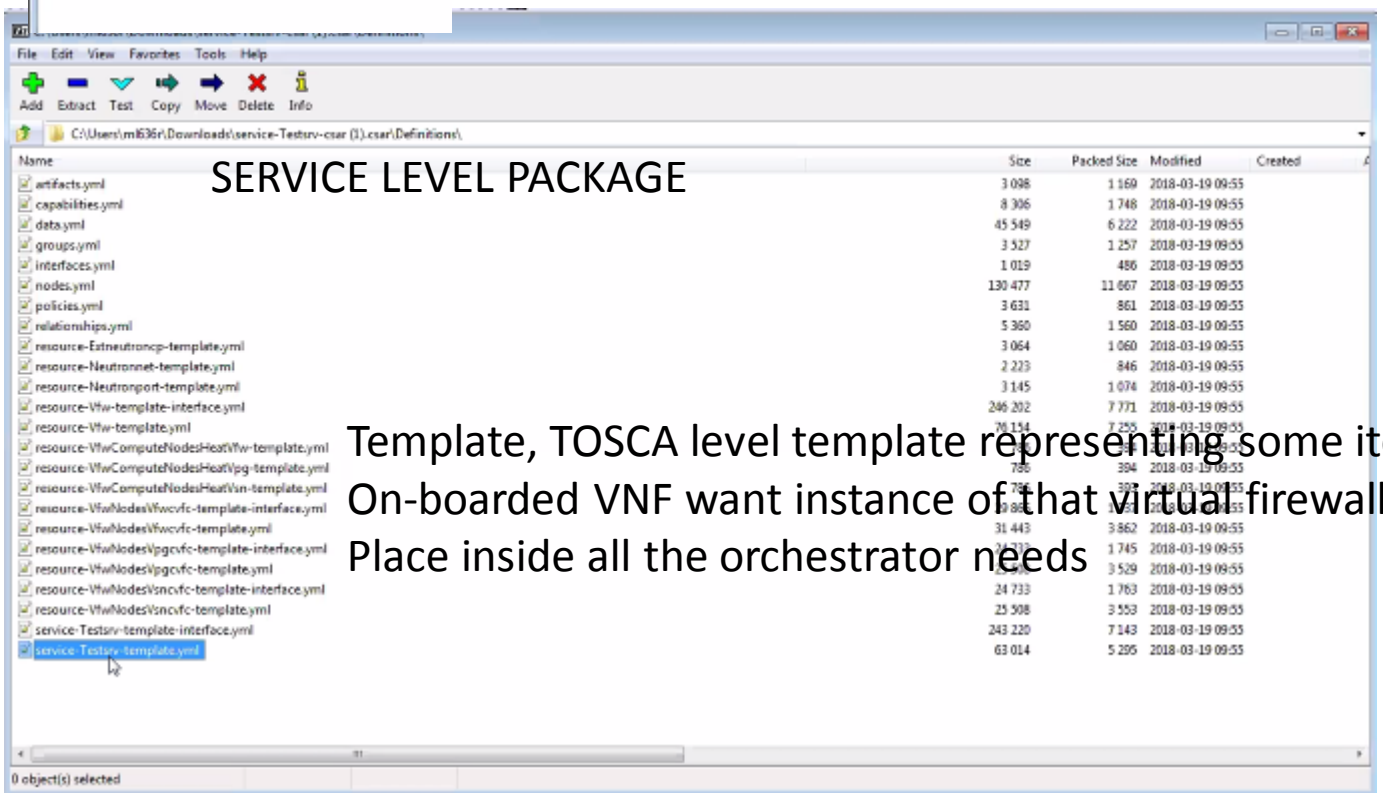

1. **PM DICTIONARY**
   PM Dictionary defines all measurements published by xNF (x=V or P)
   Based on 3GPP TS32.503, ETSI, and VES document (v6.0) [has Cloud scaling counters]
2. **SDC DESIGN STUDIO MAPS VES FAULT Event to PM Dictionary**
   SDC Design studio does mapping of PM dictionary entries to VES Fault Events to produce a "mapping" definition in the CSAR package.
3. **SDC DISTRIBUTES DEFINITIONS**
   SDC creates a definition of how to start-up service. SDC exports the *CSAR package* with the VES Fault to PM dictionary mapping definitions.
   **DEFINITIONS & ARTIFACTS (CSAR PACKAGE)**
   1. VES meas mapping definition passed by SDC (CSAR Package) to ONAP components
   2. DCAE micro-service gets CSAR package
4. **MICRO SERVICE GETS MEASUREMENT EVENT**
   Microservice has subscribed to fault domain DMaaP Topic and receives the VES Fault Event from xNF in run-time.
5. **MICRO SERVICE PROCESSES EVENT**
   Microservice processes the VES Event using the PM Measurements Dictionary

# PM Dictionary Usage

ONAP
OPEN NETWORK AUTOMATION PLATFORM

# APPENDIX
# & Meeting Notes



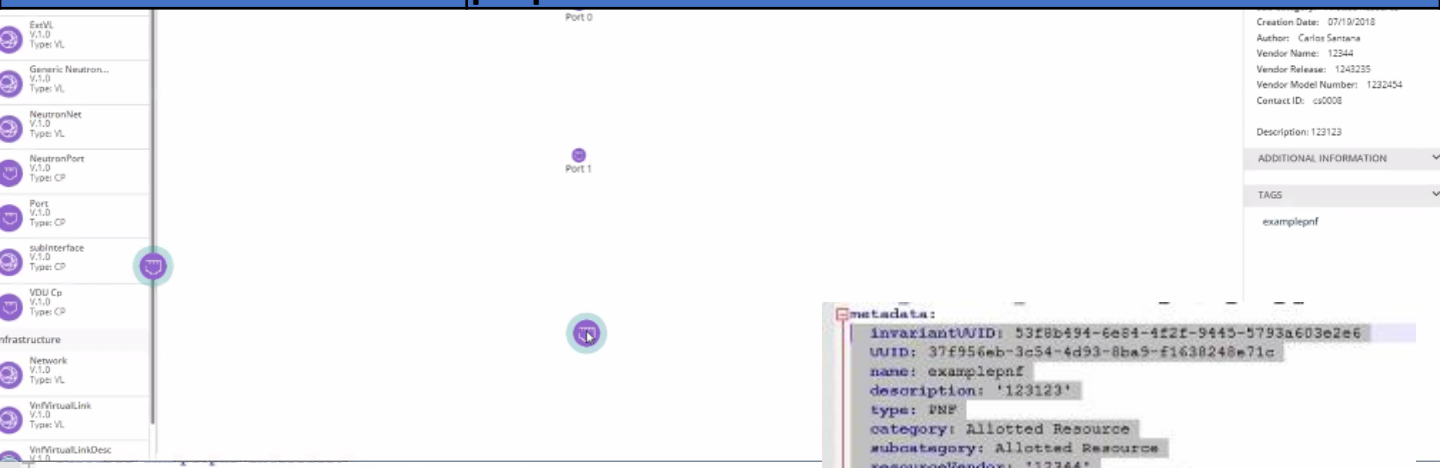




SERVICE LEVEL PACKAGE

Template, TOSCA level template representing some iten
On-boarded VNF want instance of that virtual firewall
Place inside all the orchestrator needs

```
topology_template:
  node_templates:
    vfw_0:
      type: org.openecomp.resource.vf.Vfw
      metadata:
        invariantUUID: fa9f72b3-d656-4e08-ae5e-9482ab165d5c
        UUID: 0a9e817b-4c98-455a-95d4-71e24713f73d
        customizationUUID: f7432b08-ad4a-43fa-b179-40d2c5ff1b1e
        version: '0.2'
        name: vfw
        description: saad
        type: VF
        category: Network L4+
        subcategory: Common Network Resources
        resourceVendor: example
        resourceVendorRelease: '1.0'
        resourceVendorModelNumber: ''
      properties:
        nf_naming:
          ecomp_generated_naming: true
        multi_stage_design: false
        availability_zone_max_count: 1
        vfw_flavor_name: 4 GB General Purpose v1
        public_net_id: 00000000-0000-0000-0000-000000000000
        vfw_image_name: Ubuntu 14.04 LTS (Trusty Tahr) (PVHVM)
      capabilities:
        network.incoming.bytes.rate_vpg_vpg_private_1_port:
          properties:
            unit: B/s
            description: Average rate of incoming bytes
            type: Gauge
            category: network
        disk.read.bytes_vpg:
```

| | |
|---|---|
| pnfExtConnPt (modelling def. of connection pt not a template) | Specifies the characteristics of one or more connection points where to connect the PNF to a VL. Align ETSI SOL-001.<br>ML: connection pt model in TOSCA TEMPLATE not as properties. |




```
    file: resource-Examplepnf-template-interface.yml
- resource-Port:
    file: resource-Port-template.yml
topology_template:
  inputs:
    nf_function:
      type: string
    nf_role:
      type: string
    nf_type:
      type: string
  node_templates:
    Port 0:
      type: tosca.nodes.network.Port
      metadata:
        invariantUUID: 941e0b80-67df-4866-95dd-3a841a2861a8
        UUID: 20da15c2-22c8-4cf8-a6ad-eb974d87f6c8
        customizationUUID: f5aae209-2d33-4651-9a12-0ac16d6b17cb
        version: '1.0'
        name: Port
        description: Represents a logical entity that associates between Compute and Network normative types.
        type: CP
        category: Generic
        subcategory: Network Elements
        resourceVendor: ATT (Tosca)
        resourceVendorRelease: 1.0.0.wd03
        resourceVendorModelNumber: ''
      properties:
        is_default: false
        order: 0
  substitution_mappings:
    node_type: org.openecomp.resource.pnf.Examplepnf
    capabilities:
      port0_feature:
```

```
topology_template:
  inputs:
    nf_function:
      type: string
    nf_role:
      type: string
    nf_type:
      type: string
  node_templates:
    Port 0:
      type: tosca.nodes.network.Port
      metadata:
        invariantUUID: 941e0b80-67df-4866-95dd-3a841a2861a8
        UUID: 20da15c2-22c8-4cf8-a6ad-eb974d87f6c8
        customizationUUID: f5aae209-2d33-4651-9a12-0ac16d6b17cb
        version: '1.0'
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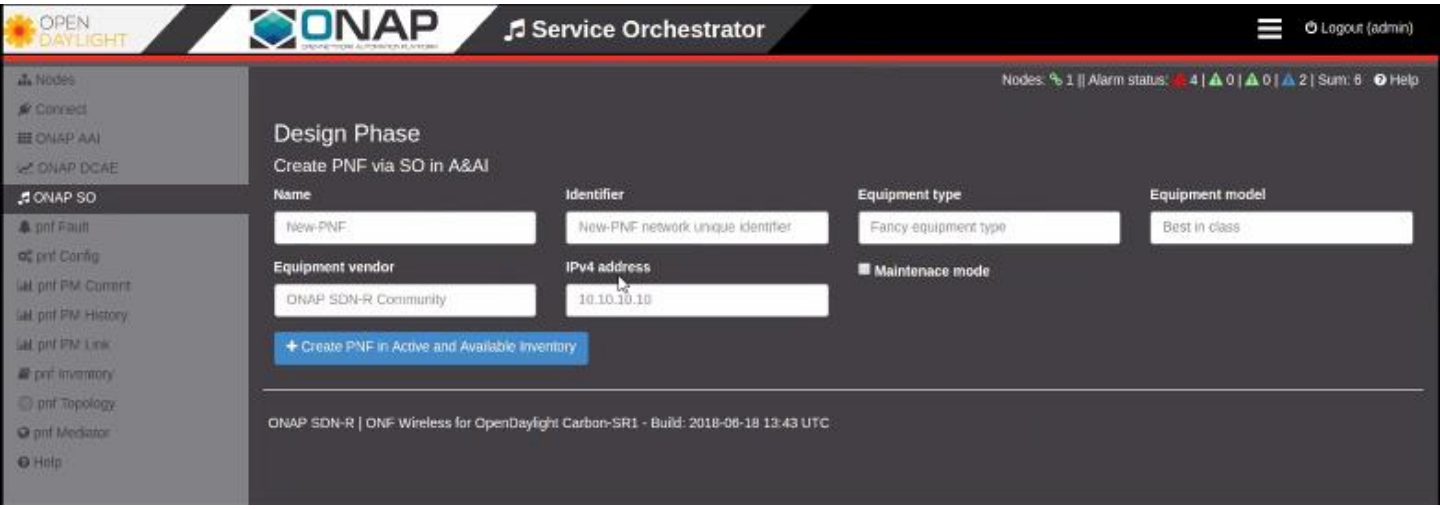
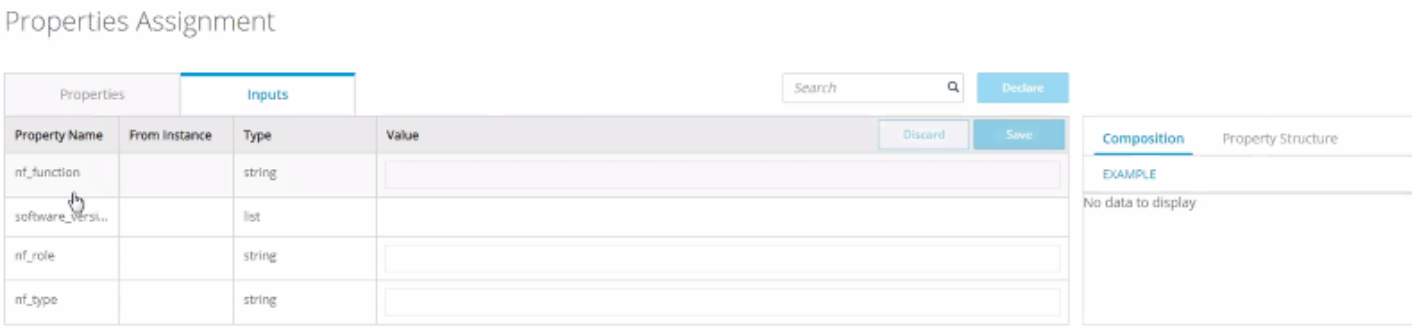
        type: CP
        category: Generic
        subcategory: Network Elements
        resourceVendor: ATT (Tosca)
        resourceVendorRelease: 1.0.0.wd03
        resourceVendorModelNumber: ''
      properties:
```

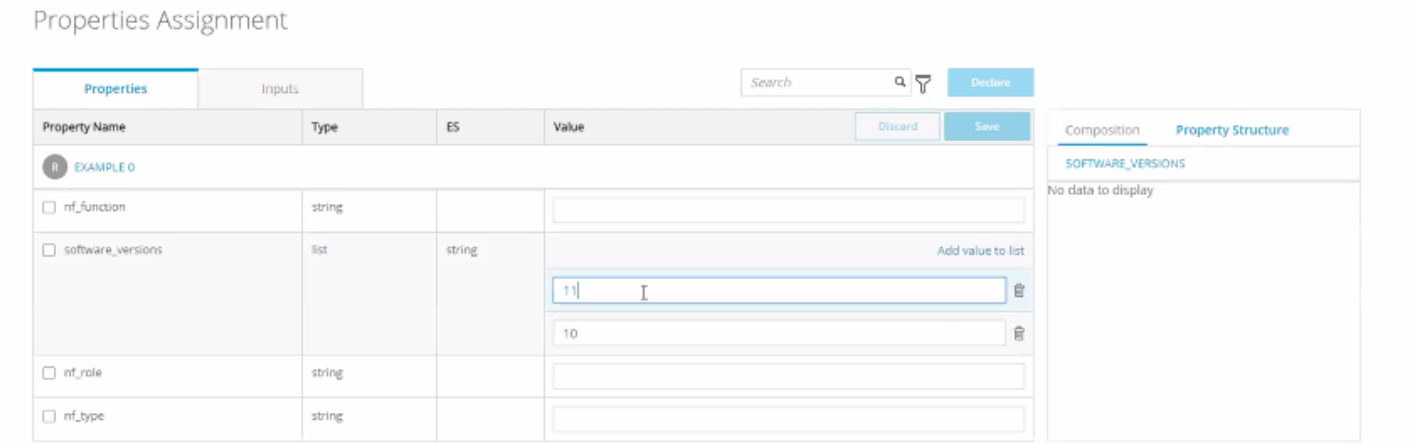


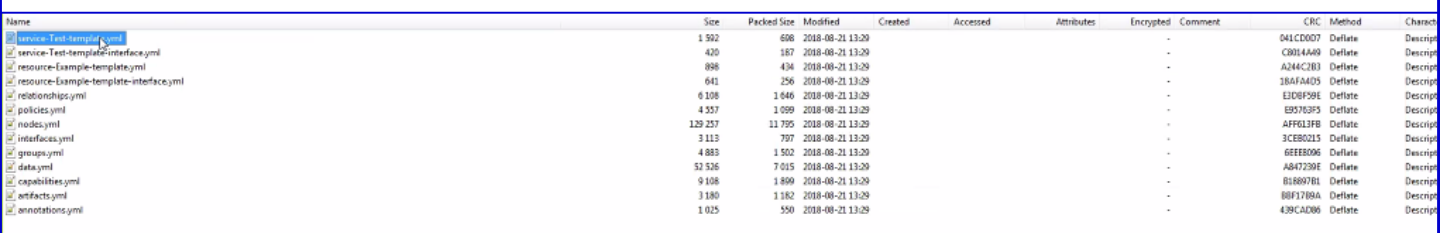

SDN-R in Open Daylight create a A&AI PNF entry

# software_versions (SDC Demo)

Demo given by Michael Lando (Aug 21, 2018)
Demonstrating software_versions in SDC Design Studio



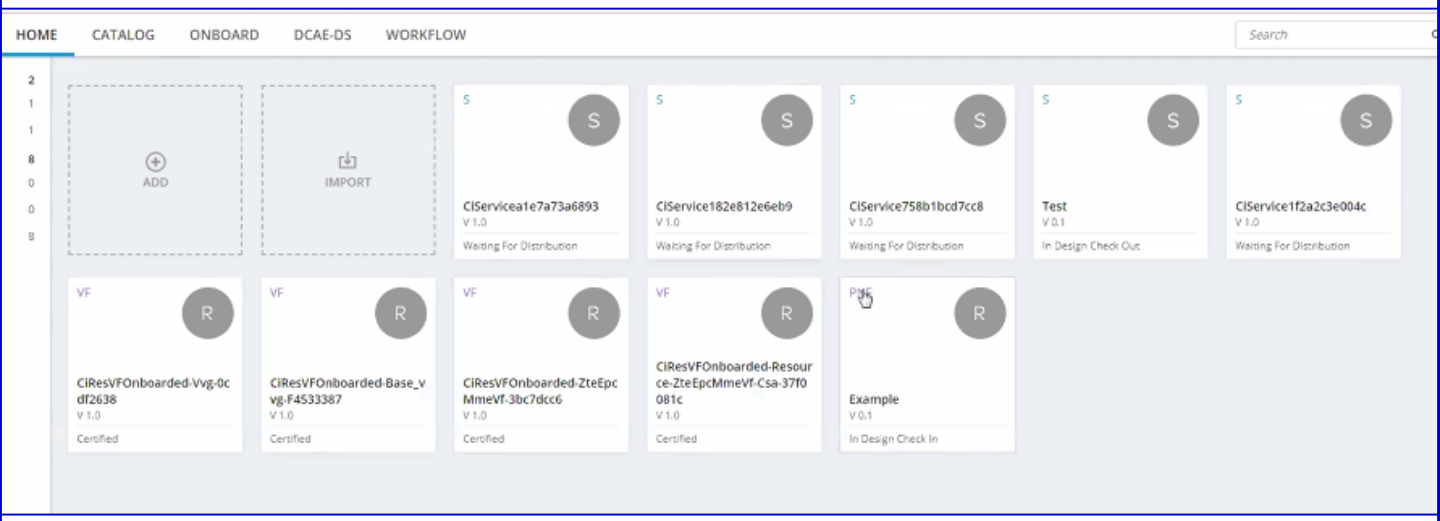





# software_versions (SDC Demo)

```
- policies:
    file: policies.yml
- annotations:
    file: annotations.yml
- service-test-interface:
    file: service-Test-template-interface.yml
- resource-example:
    file: resource-Example-template.yml
- resource-example-interface:
    file: resource-Example-template-interface.yml
topology_template:
  node_templates:
    example 0:
      type: org.openecomp.resource.pnf.Example
      metadata:
        invariantUUID: 5718362c-ac6a-431b-afd7-f5ab63bf3039
        UUID: b553ba24-f006-494a-96c8-d1642a3401e0
        customizationUUID: 634e2a1e-1fac-4bb3-aca5-35f3a0b00c5e
        version: '0.1'
        name: example
        description: '123'
        type: PNF
        category: Application L4+
        subcategory: Web Server
        resourceVendor: '123'
        resourceVendorRelease: '123'
        resourceVendorModelNumber: ''
      properties:
        software_versions:
        - '11'
        - '10'
  substitution_mappings:
    node_type: org.openecomp.service.Test
```

```
Search "dmaap" (3 hits in 1 file)
  C:\Users\ml636r\AppData\Local\Temp\scp27333\data\logs\BE\SDC\SDC-BE\error.log (3 hits)
    Line 28255: 2018-08-21T12:17:49.551Z|main|SDC catalog||ExecuteRestRequest||INFO|0|Starting to consume topic topic for DMAAP consumer with the next parameters DmaapConsumerConfiguration [hosts=localhost:3905, consumerGroup=sdc, cons
    Line 28258: 2018-08-21T12:17:49.551Z|main|SDC catalog||ExecuteRestRequest||INFO|0|Starting to consume topic topic for DMAAP consumer with the next parameters DmaapConsumerConfiguration [hosts=localhost:3905, consumerGroup=sdc, cons
    Line 28256: 2018-08-21T12:17:49.556Z|main|SDC catalog||ExecuteRestRequest||ERROR|500|An error occurred upon consuming topic by Dmaap consumer client.: null|
Search "dmaap" (0 hits in 0 files)
```




```
tosca_definitions_version: tosca_simple_yaml_1_1
imports:
- nodes:
    file: nodes.yml
- datatypes:
    file: data.yml
- capabilities:
    file: capabilities.yml
- relationships:
    file: relationships.yml
- groups:
    file: groups.yml
- policies:
    file: policies.yml
- annotations:
    file: annotations.yml
node_types:
  org.openecomp.resource.pnf.Example:
    derived_from: org.openecomp.resource.abstract.nodes.PNF
    properties:
      nf_function:
        type: string
      software_versions:
        type: list
        entry_schema:
          type: string
      nf_role:
        type: string
      nf_type:
        type: string
```


```
Search "dmaap" (3 hits in 1 file)
  C:\Users\ml636r\AppData\Local\Temp\scp27333\data\logs\BE\SDC\SDC-BE\error.log (3 hits)
    Line 28255: 2018-08-21T12:17:49.551Z|main|SDC catalog||ExecuteRestRequest||INFO|0|Starting to consume topic topic for DMAAP consumer with the next parameters DmaapConsumerConfiguration [hosts=localhost:3905, consumerGroup=sdc, cons
    Line 28258: 2018-08-21T12:17:49.551Z|main|SDC catalog||ExecuteRestRequest||INFO|0|Starting to consume topic topic for DMAAP consumer with the next parameters DmaapConsumerConfiguration [hosts=localhost:3905, consumerGroup=sdc, cons
    Line 28256: 2018-08-21T12:17:49.556Z|main|SDC catalog||ExecuteRestRequest||ERROR|500|An error occurred upon consuming topic by Dmaap consumer client.: null|
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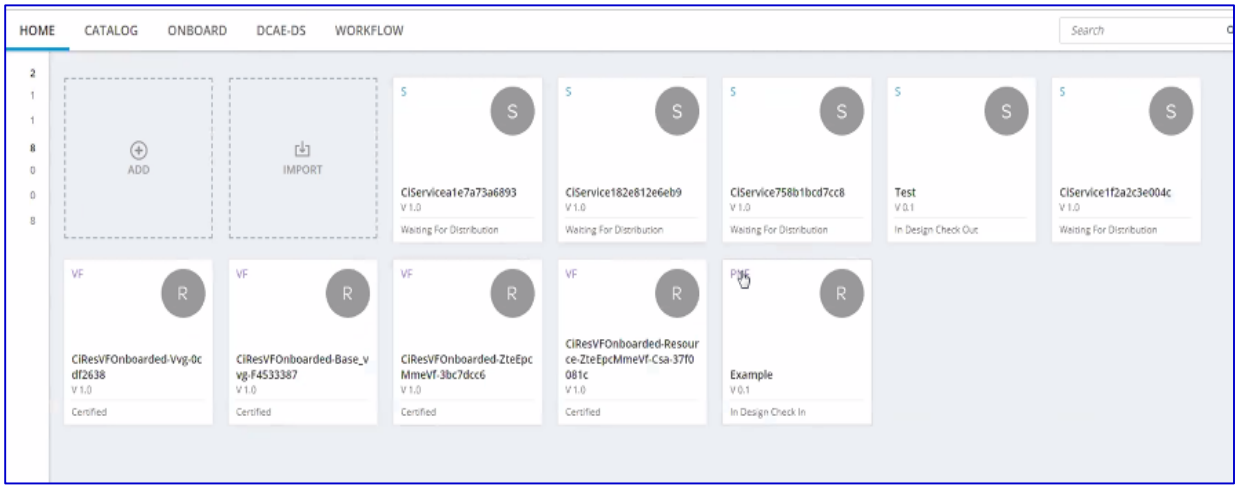
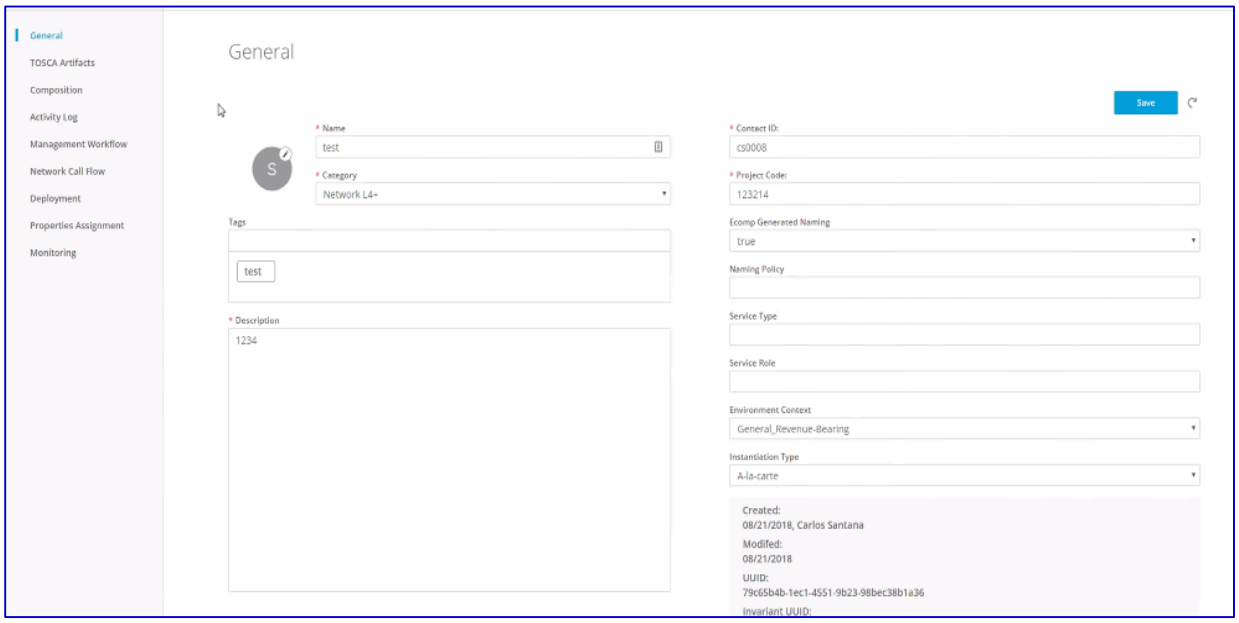
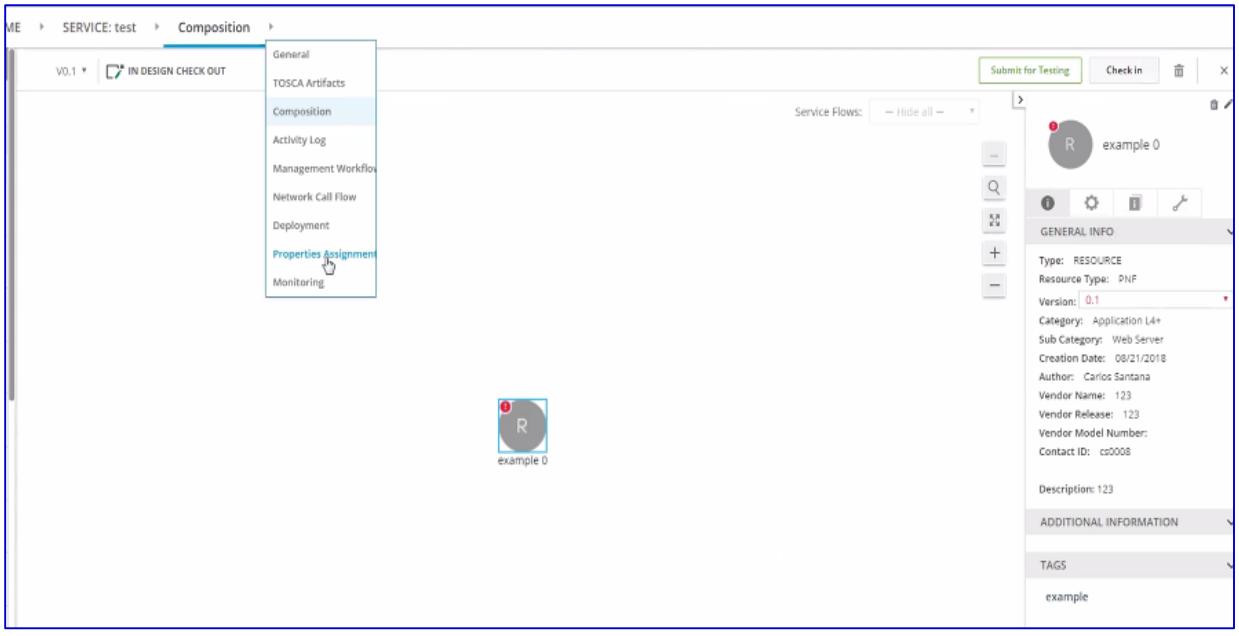
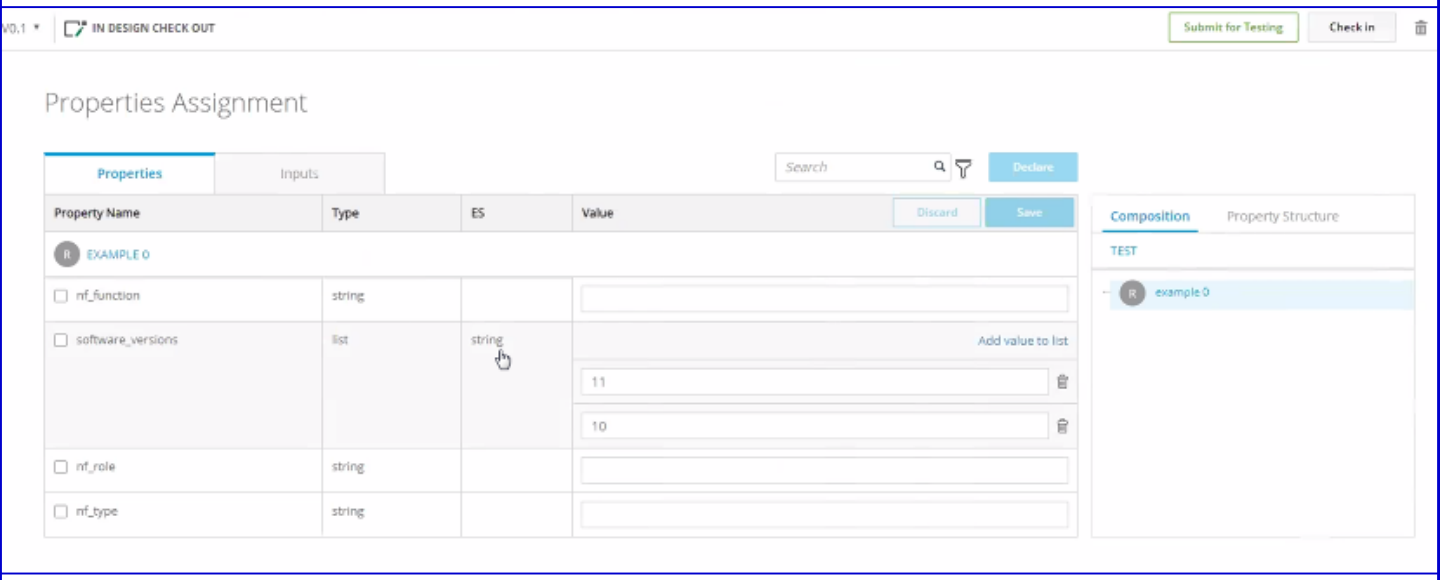
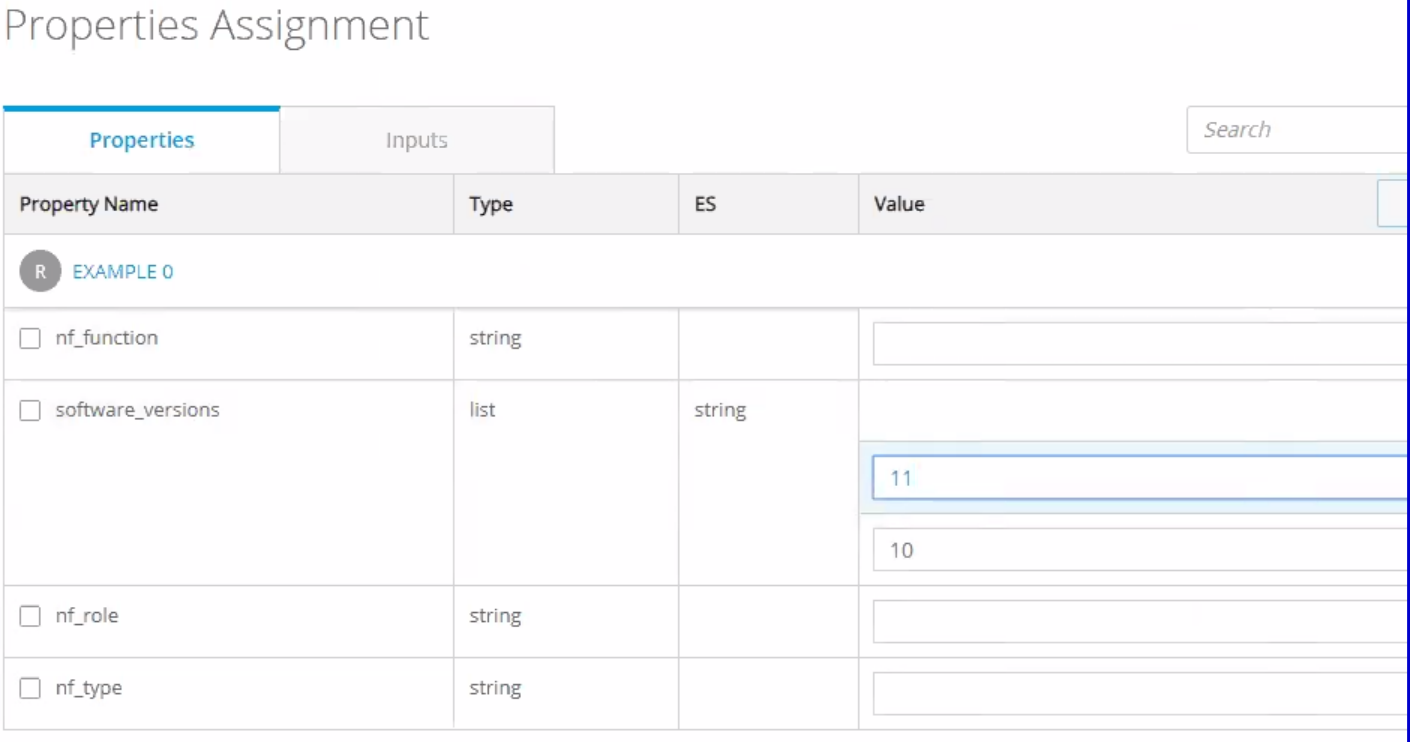
# software_versions (SDC Demo)






# software_versions (SDC Demo)