5G Service Modeling & 5G Service Creation

- R8 Honolulu Use Cases

Benjamin Cheung, PhD

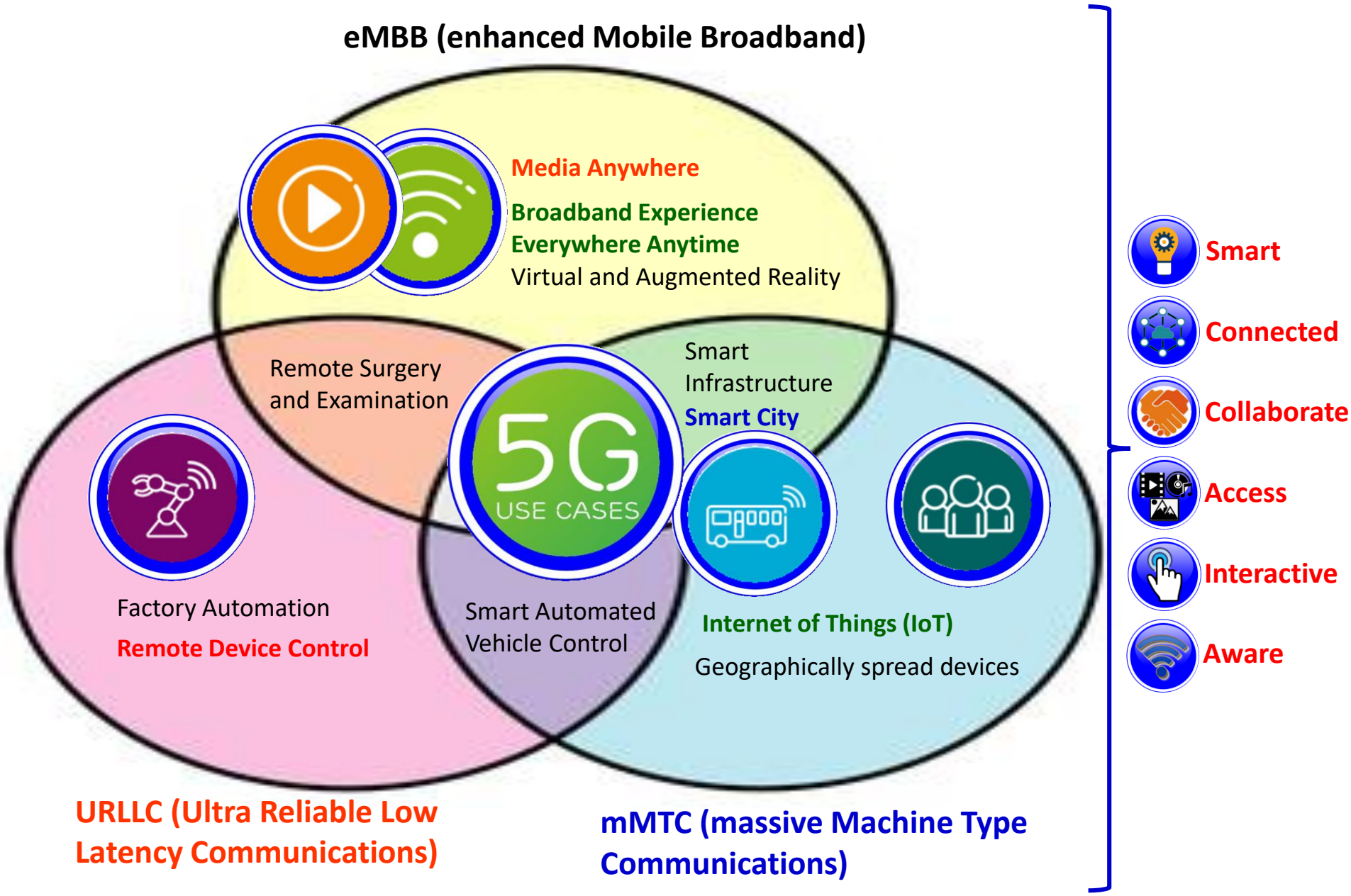
August 31, 2020 version 4

ONAP
OPEN NETWORK AUTOMATION PLATFORM

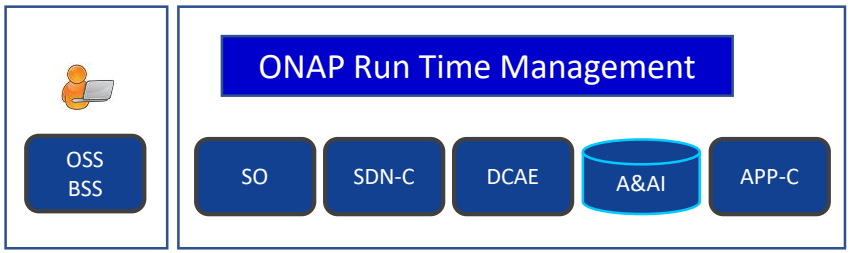
5G Basics & 5G RAN

Benjamin Cheung, PhD

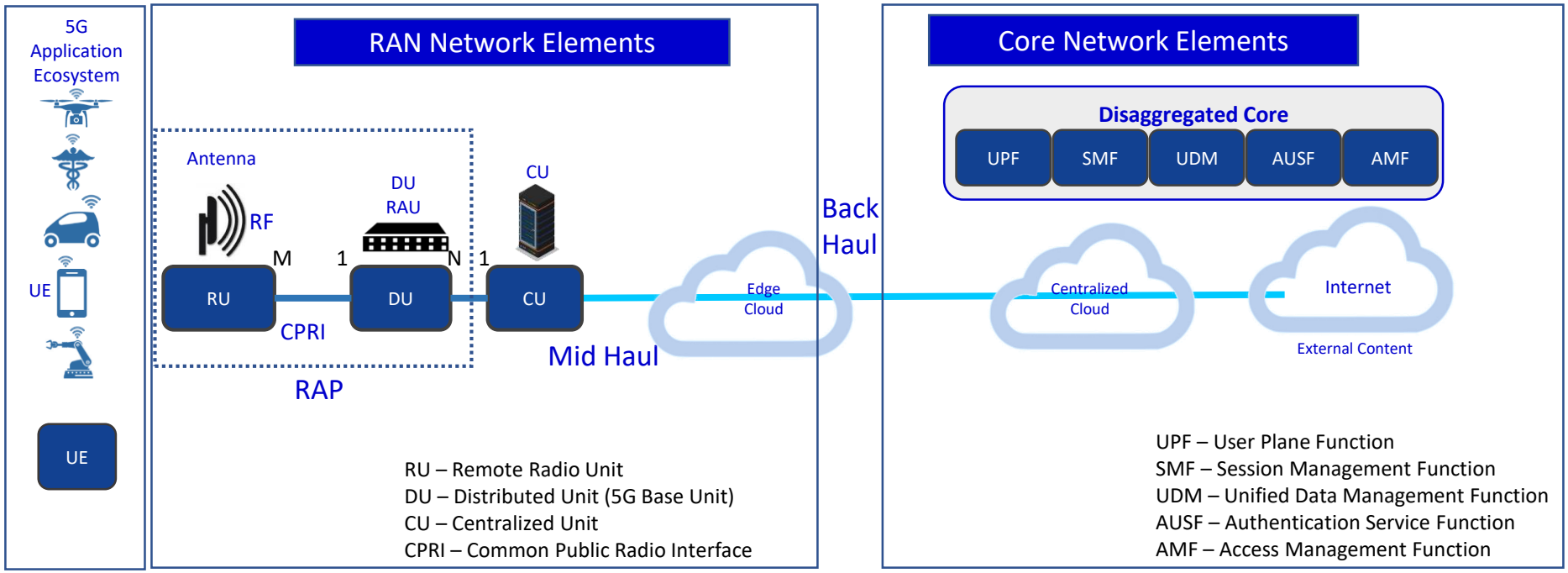
3GPP Release 15, IMT-2020 = 5G



5G RAN Wireless Network

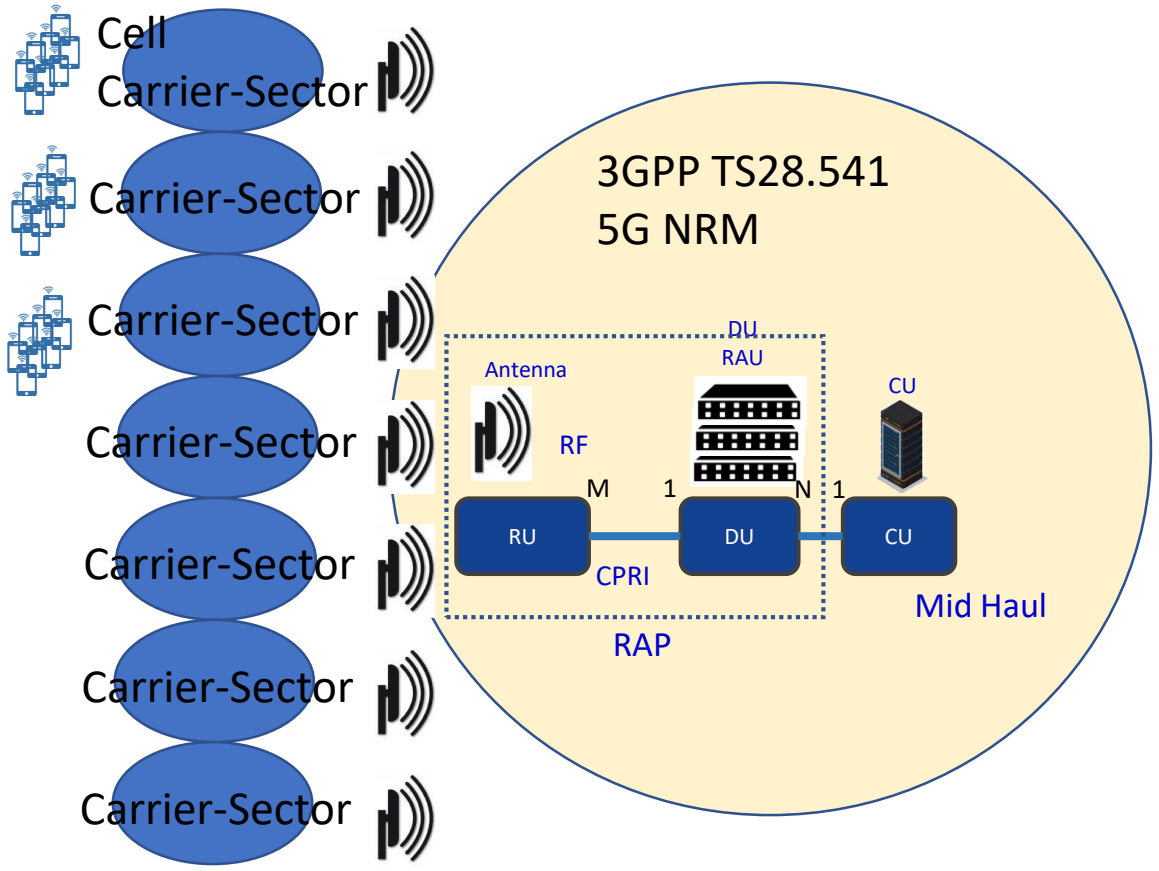


SO – Service Orchestrator
SDN-C – Service Design Network Controller
DCA&E – Data Collection Analytics & Events
A&AI – Available & Active Inventory
APP-C – Application Control



RU – Remote Radio Unit
DU – Distributed Unit (5G Base Unit)
CU – Centralized Unit
CPRI – Common Public Radio Interface

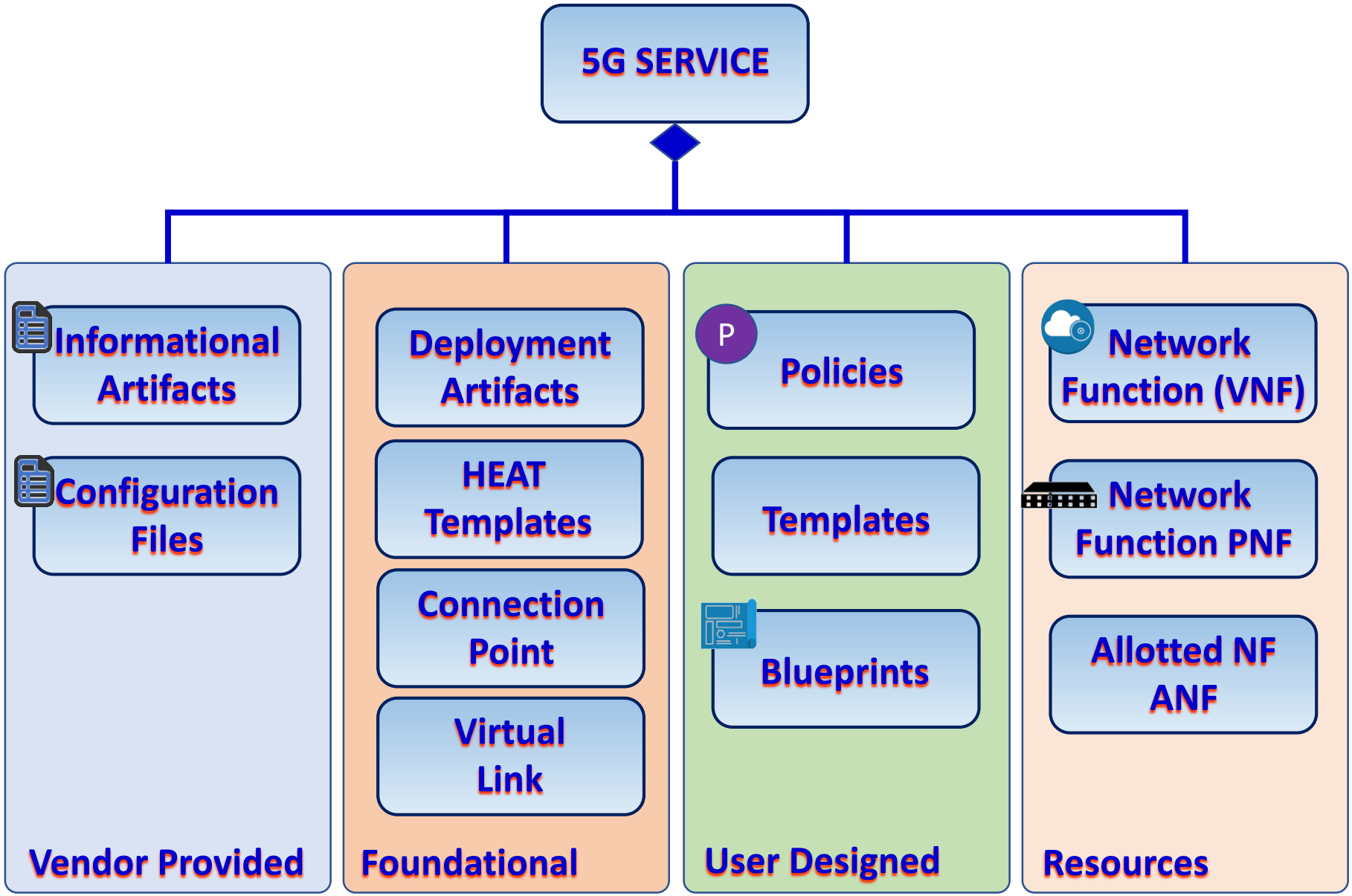
UPF – User Plane Function
SMF – Session Management Function
UDM – Unified Data Management Function
AUSF – Authentication Service Function
AMF – Access Management Function


Cell
Carrier-Sector
Carrier-Sector
Carrier-Sector
Carrier-Sector
Carrier-Sector
Carrier-Sector
Carrier-Sector
3GPP TS28.541
5G NRM
DU
RAU
Antenna
RF
CU
M
1
N
1
RU
DU
CU
CPRI
Mid Haul
RAP

5G Service Modeling & 5G Service Creation

Benjamin Cheung, PhD

R7: Modeling a 5G Service



R8: 5G Service Modeling

EXECUTIVE SUMMARY - This requirement introduces platform information model enhancements to document new ISOMII experimental classes from 3GPP TS28.541, the 5G Network Resource Model (NRM).

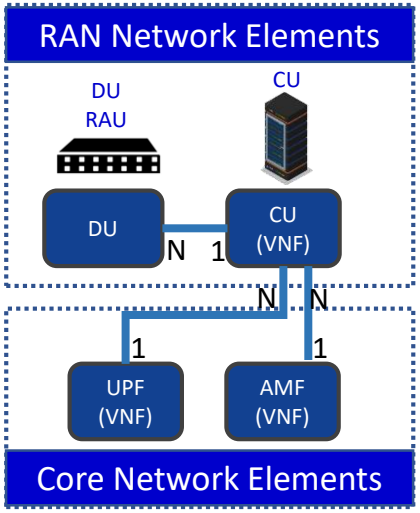
BUSINESS IMPACT - The requirement, is a critical because it will serve to lay the ground-work for actually "turning on" a real 5G DU (PNF) that might be installed by a Vendor.

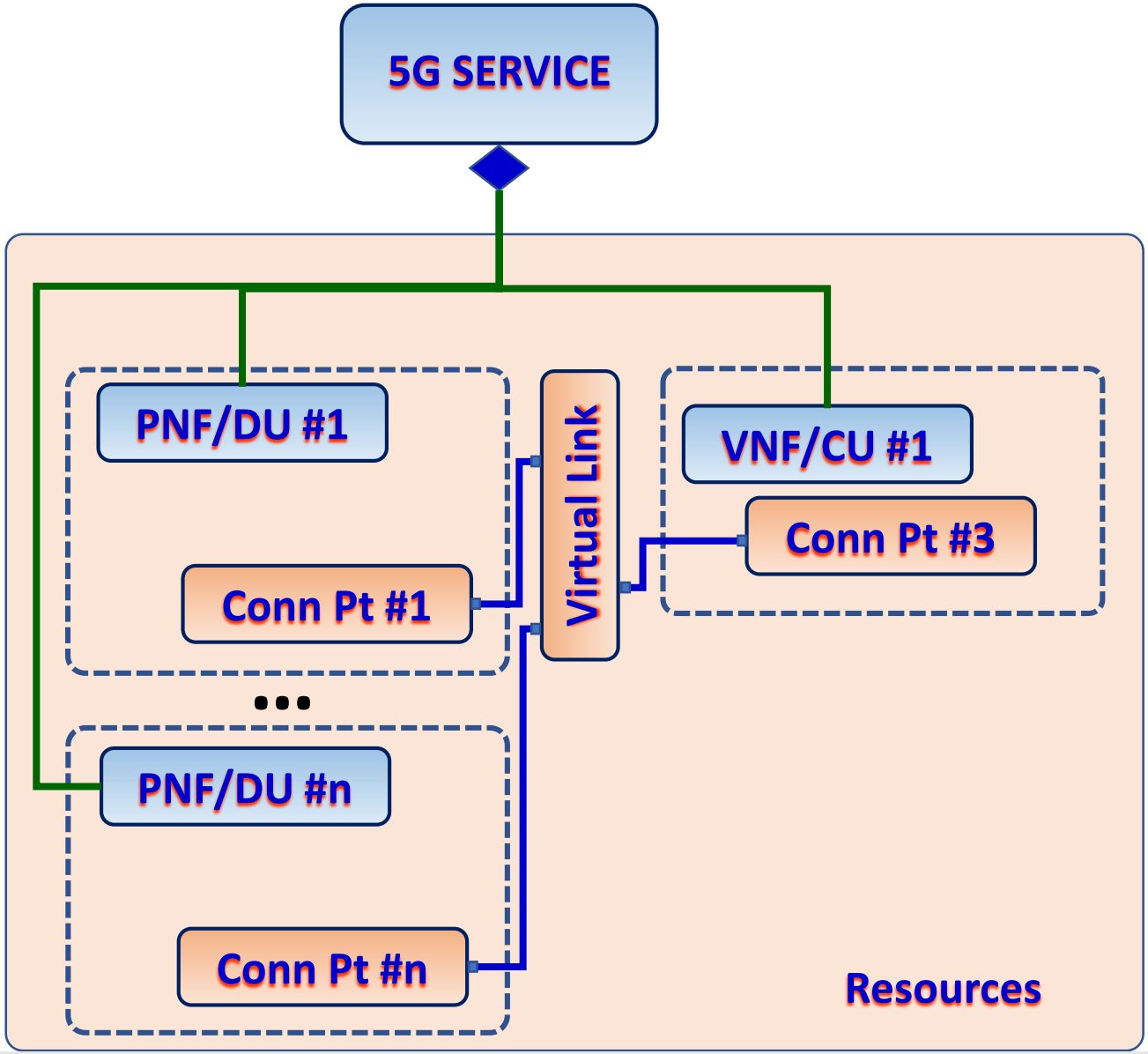
BUSINESS MARKETS - This project applies to any domain (wireless, transport, optical, and wireline) that ONAP may manage.

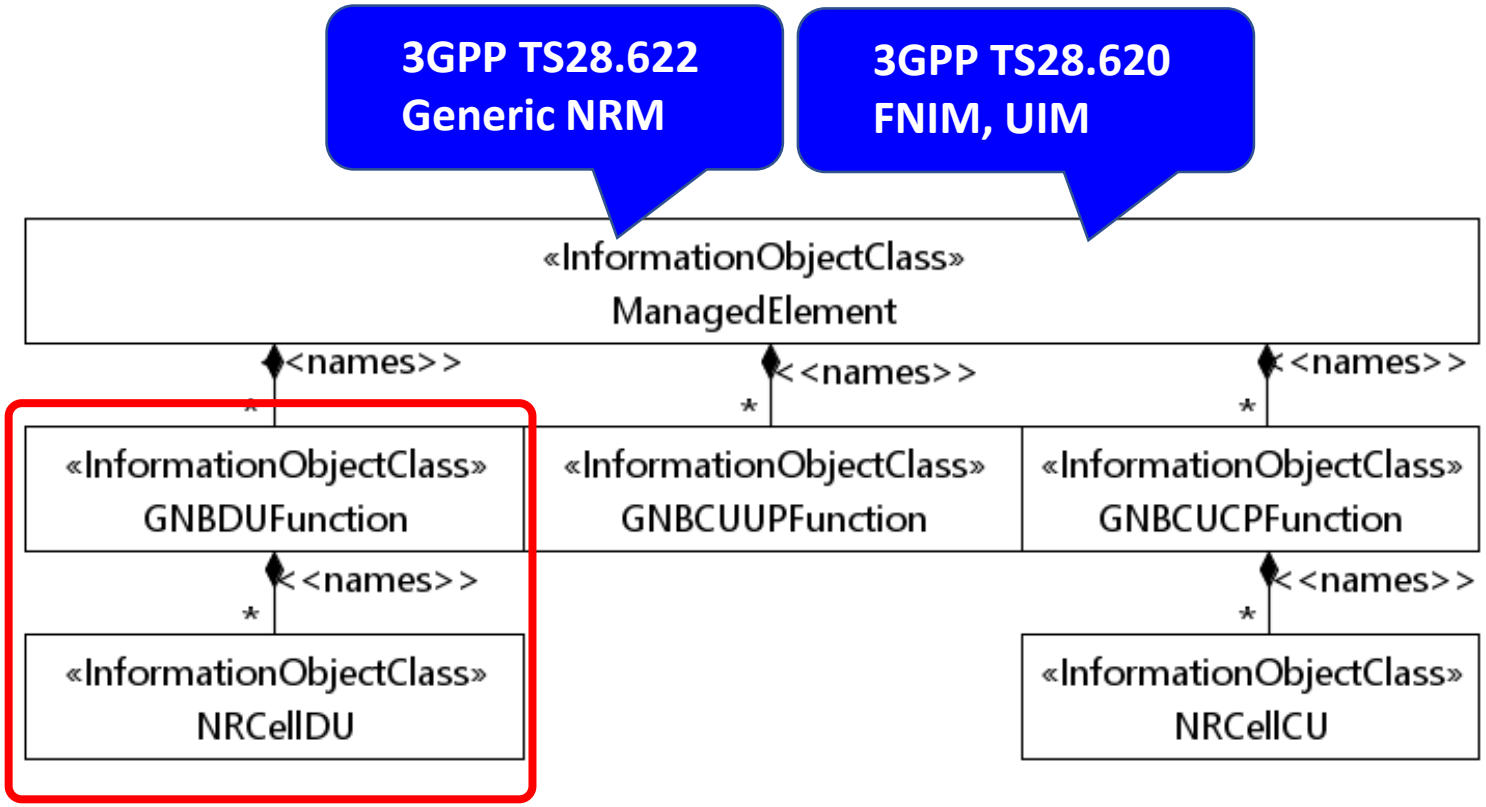
FUNDING/FINANCIAL IMPACTS - Without the groundwork laid down for information model management of a 5G Service, operators will not be able to "turn on" a real live 5G network using "live" PNF resources. No Network. No Business. High OPEX impact.

ORGANIZATION MGMT, SALES STRATEGIES - There is no additional organizational management or sales strategies for this use case outside of a service providers "normal" ONAP deployment and its attendant organizational resources from a service provider.

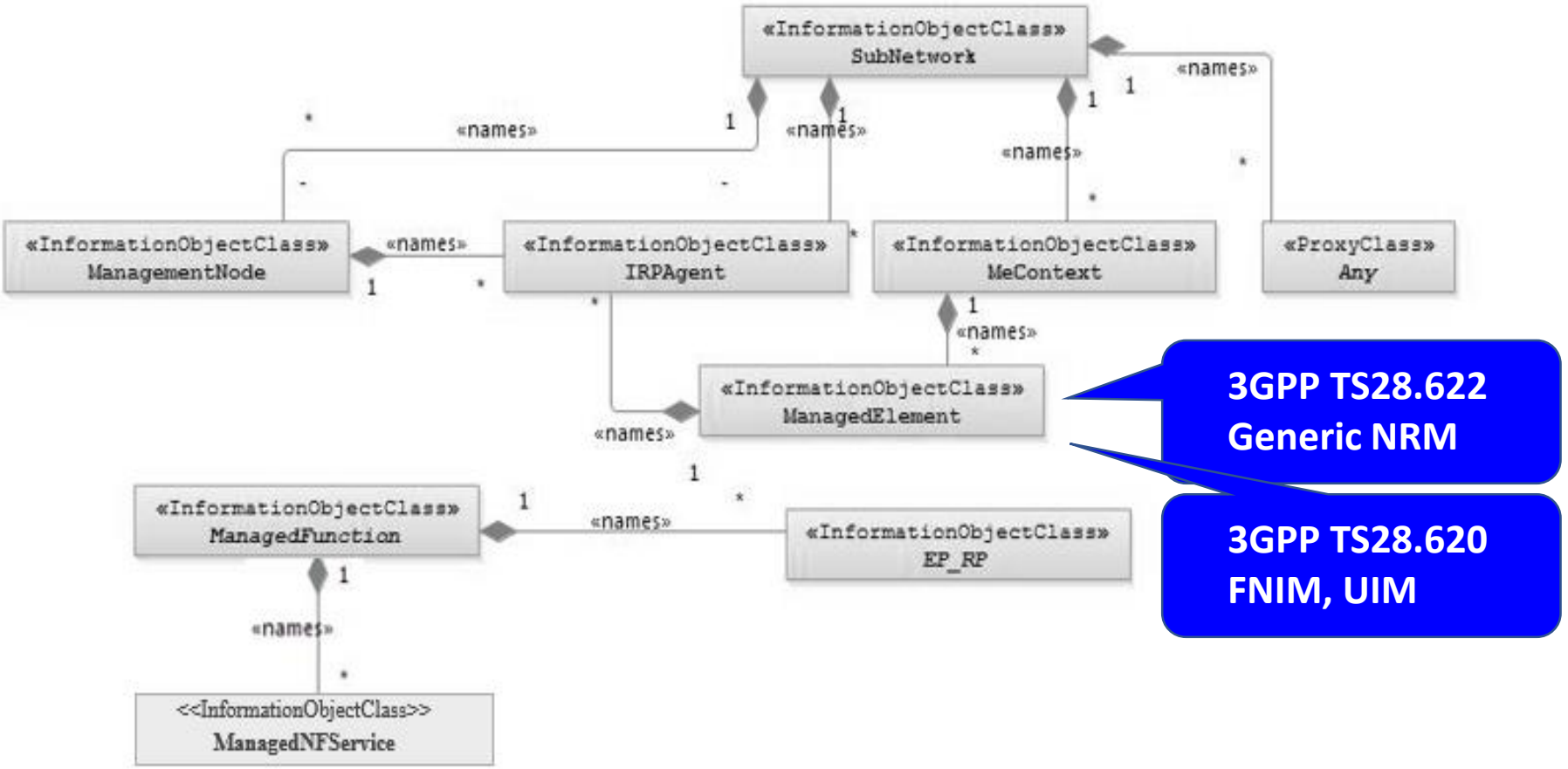
R4: 5G Base Station (gNodeB)



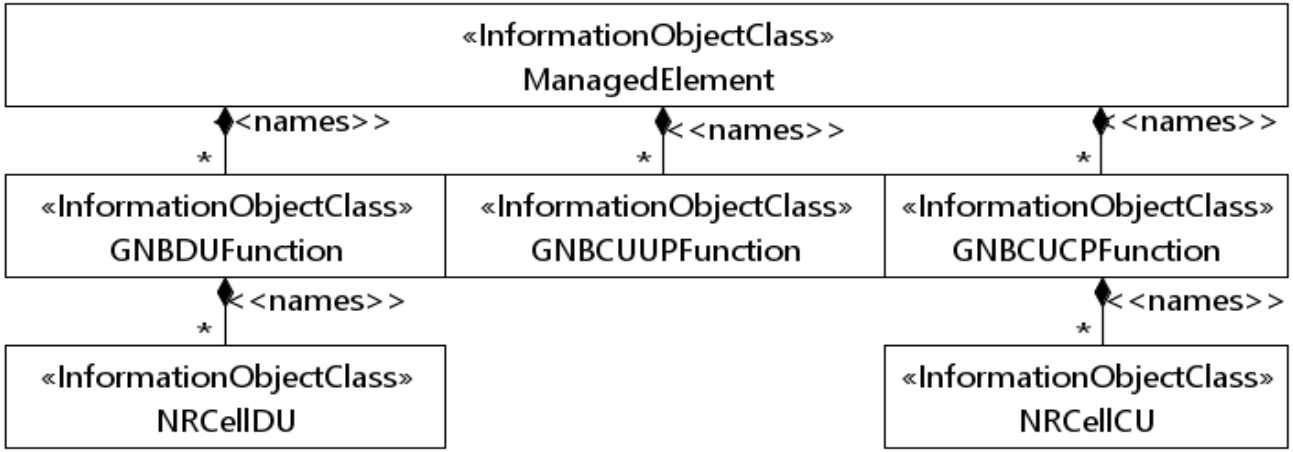


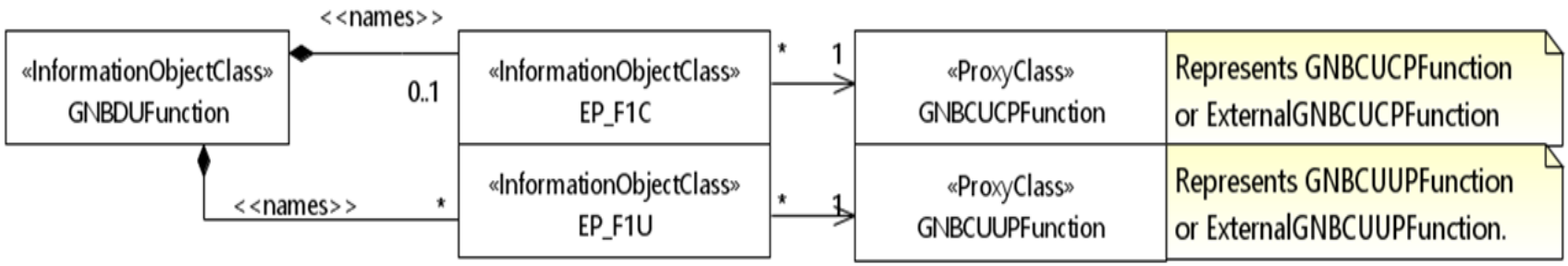


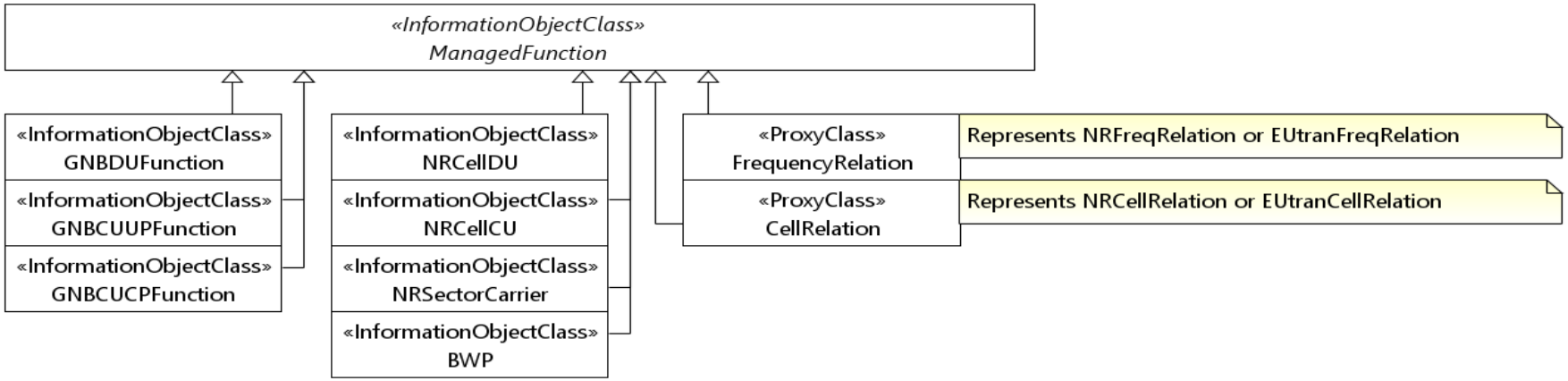
* Federated Network Information Model (FNIM) , Umbrella Information Model (UIM)


«InformationObjectClass»
SubNetwork
«names»
«InformationObjectClass»
ManagementNode
«InformationObjectClass»
IRPAgent
«InformationObjectClass»
MeContext
«ProxyClass»
Any
«InformationObjectClass»
ManagedElement
«InformationObjectClass»
ManagedFunction
«InformationObjectClass»
EP_RP
<<InformationObjectClass>>
ManagedNFService
3GPP TS28.622
Generic NRM
3GPP TS28.620
FNIM, UIM

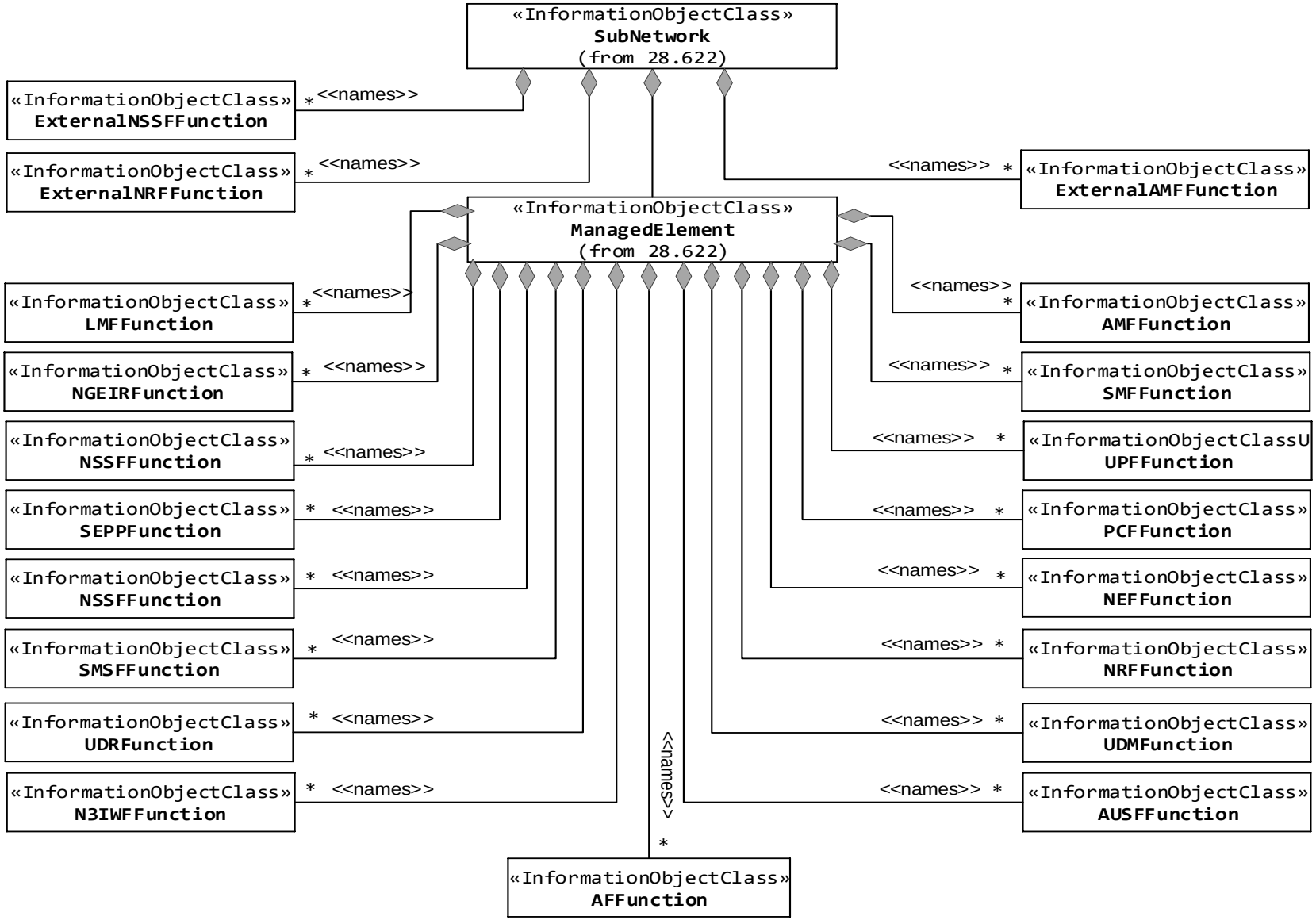
3GPP DU Models from TS28.541, 620, 622



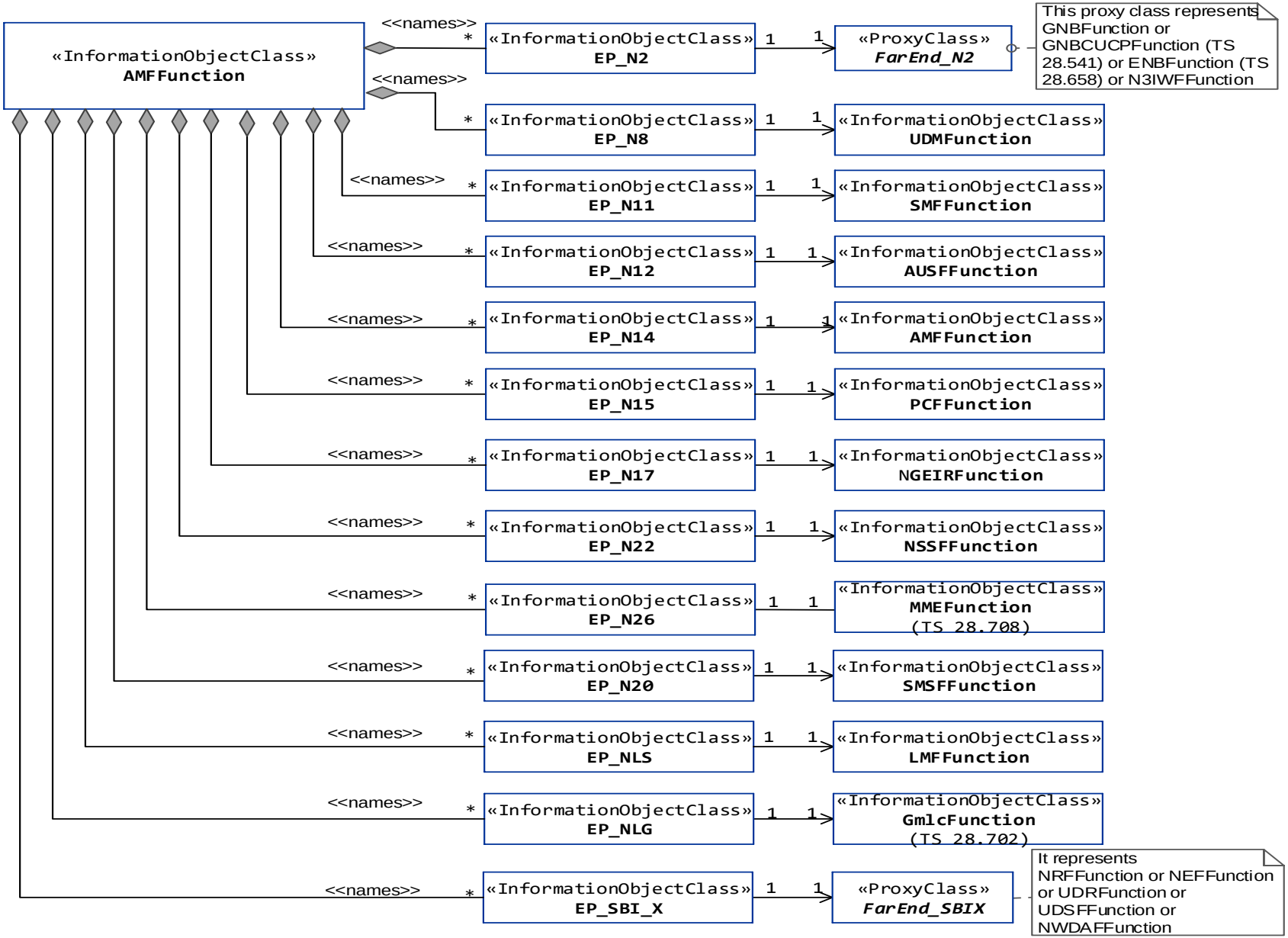




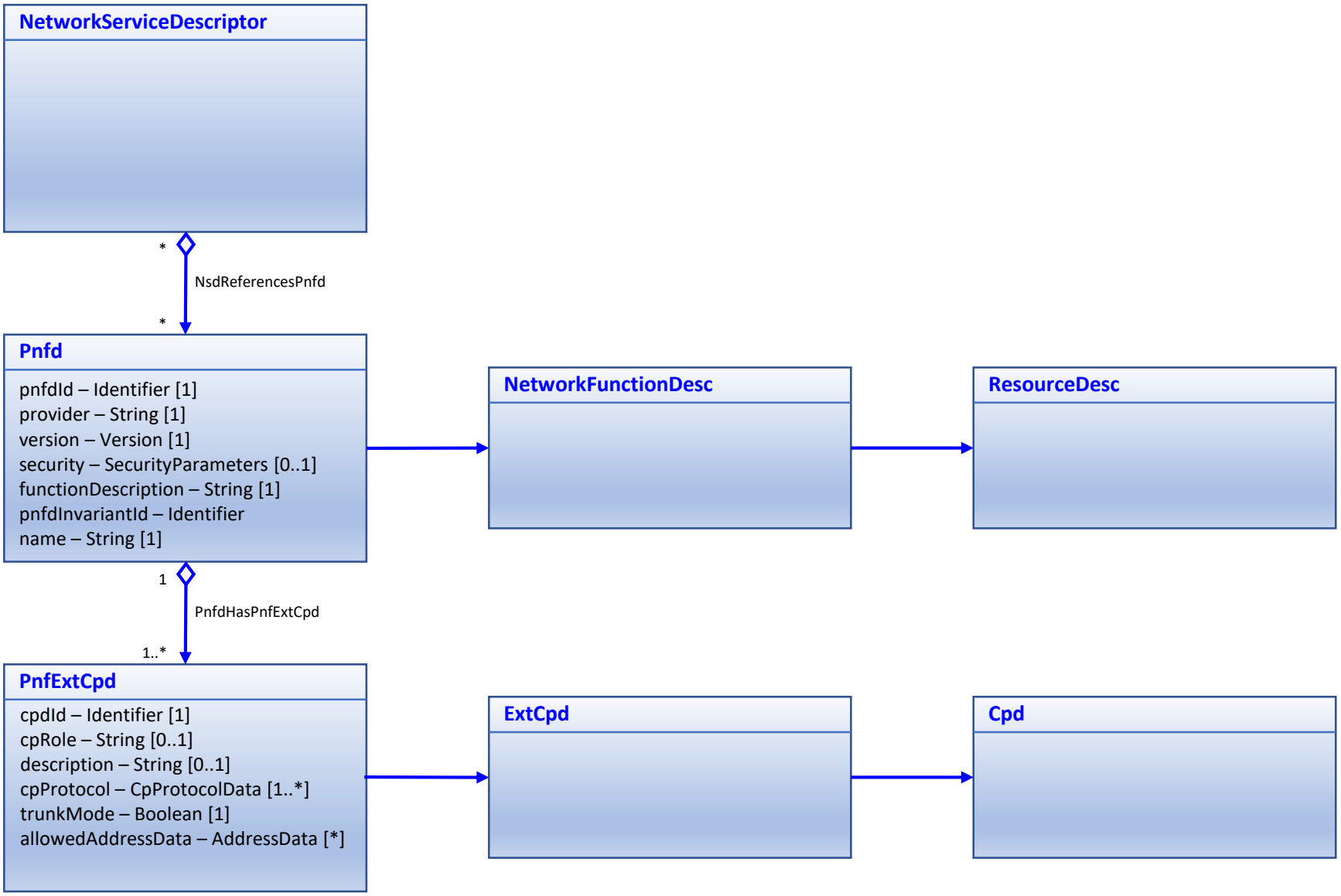
3GPP TS28.541 Model (Transport)



3GPP TS28.541 Model (Transport)

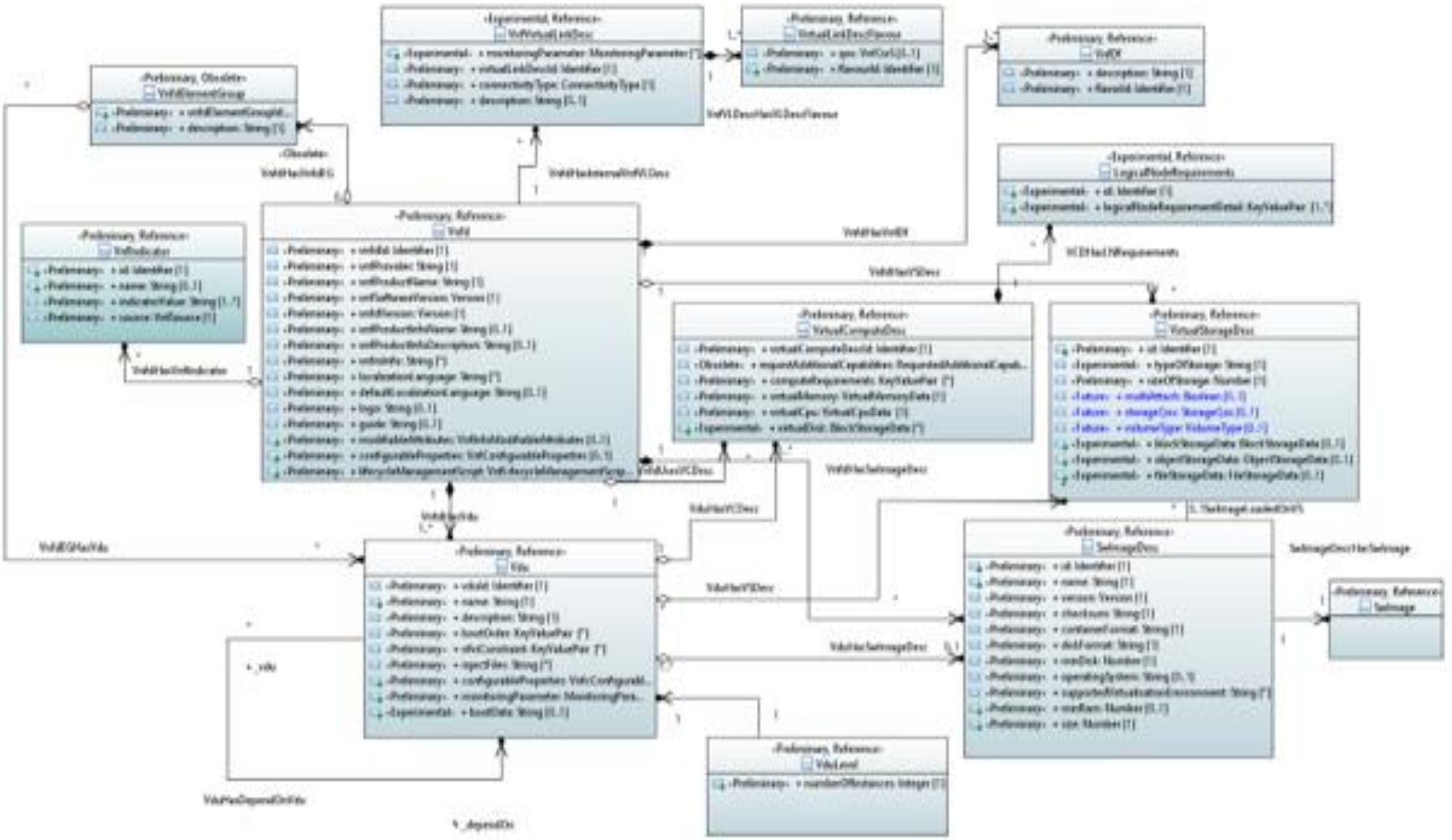


PNF Descriptor Model



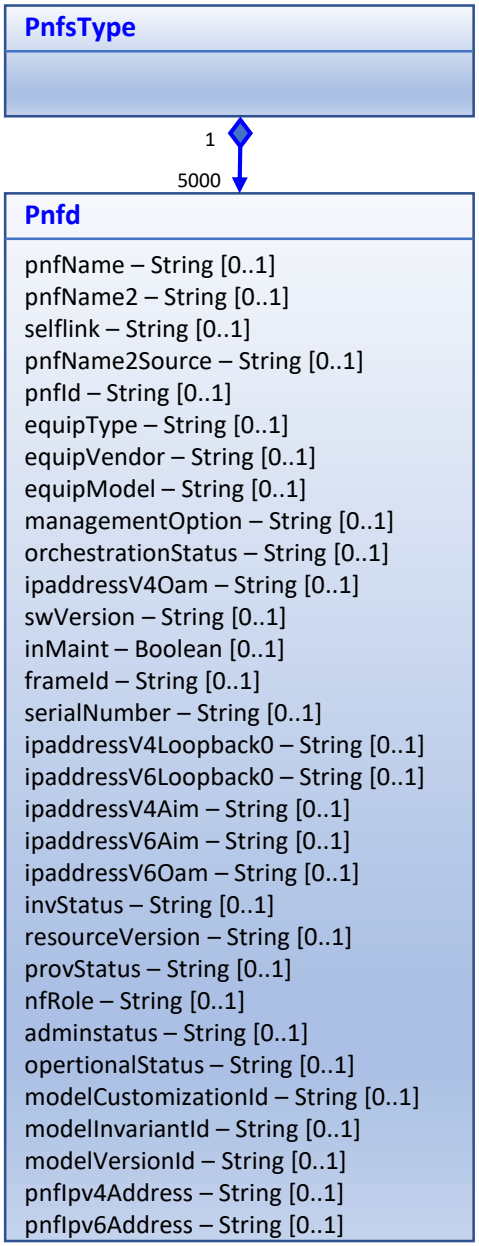
https://wiki.onap.org/display/DW/Agreed+PNFD+Model

VNFD Model



https://wiki.onap.org/display/DW/Updated+V2.5.1+VNFD+Model

PNF A&AI Model



https://wiki.onap.org/display/DW/Example%3A+PNF+in+AAI

Sources

3GPP TS28.501

3GPP TS32.106

3GPP Inventory

ITUT X.731 Op/Admin

3GPP Operational

ONAP

OPEN NETWORK AUTOMATION PLATFORM

A&AI Schema

SDC AID

ONAP Platform Information Model

Complex Object Place object

ORAN WGx

Civic Address/GeoLoc

TMF GB922 Location (Place)

RFC 6225 Geo Location

ETSI SOL 001 Civic Address

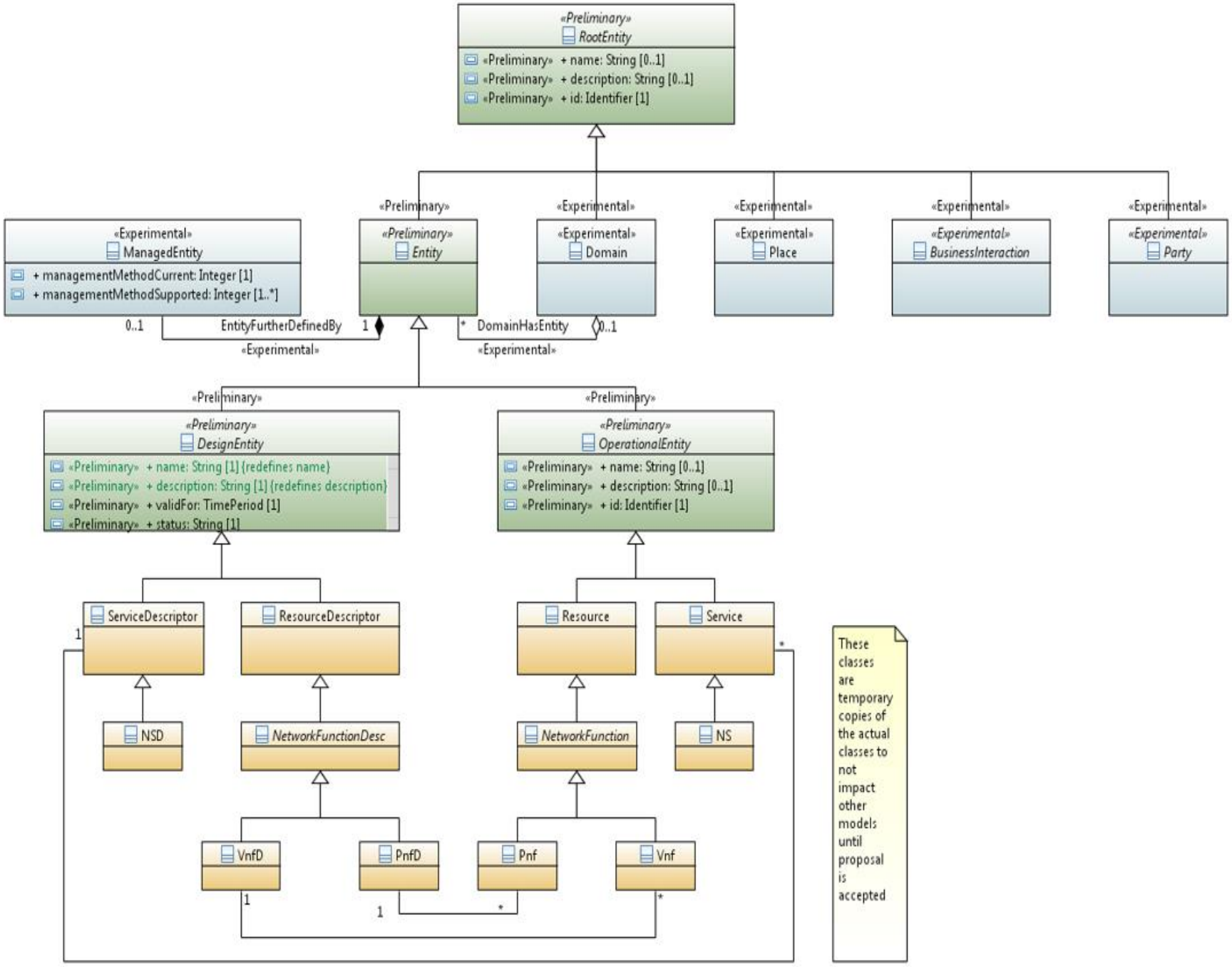
5G NRM

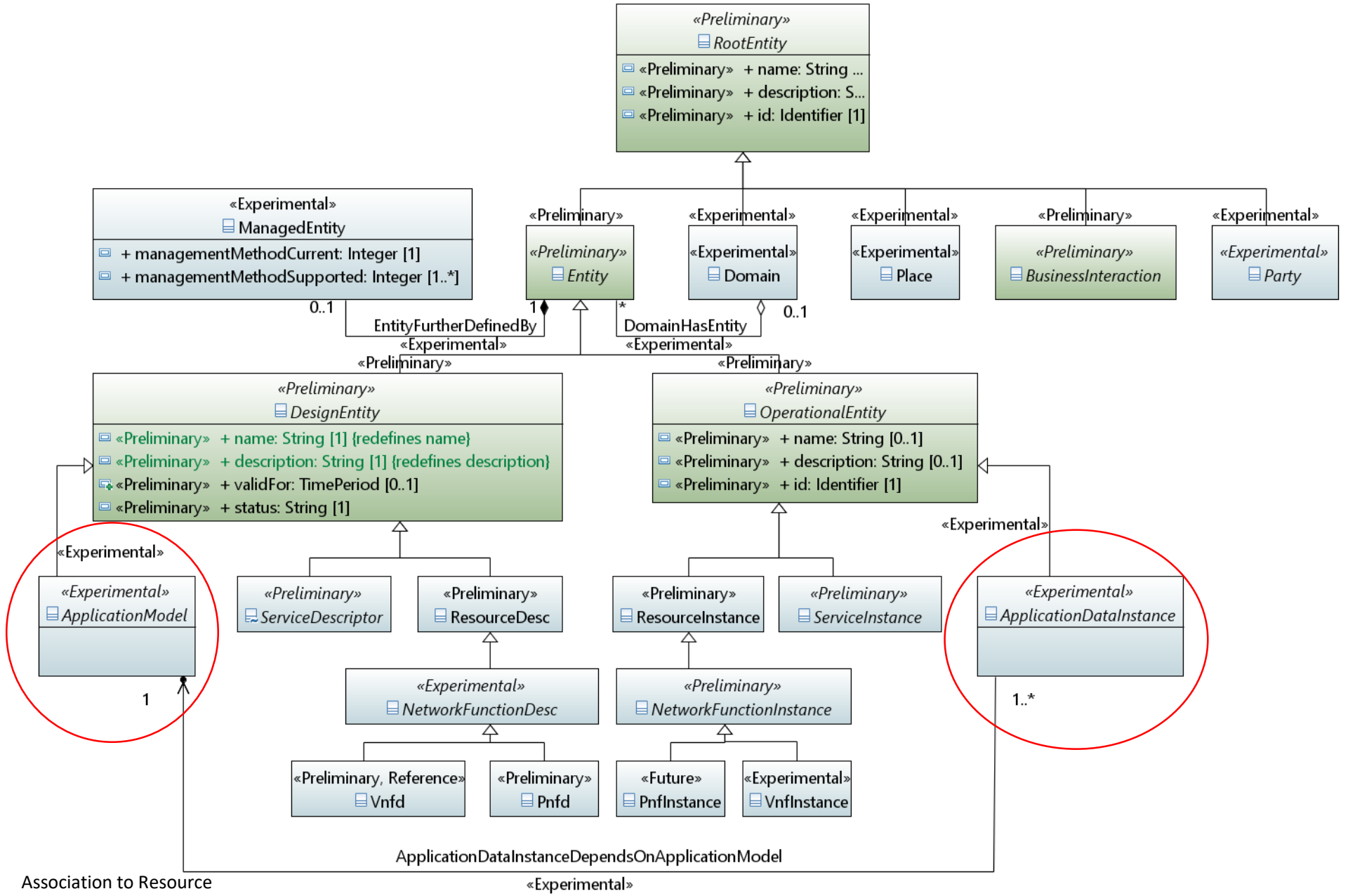
3GPP TS28.620 FNIM UIM

3GPP TS28.540 5G NRM

3GPP TS28.622 Generic NRM

3GPP TS28.541 5G NRM


«Preliminary»
RootEntity
«Preliminary» + name: String [0..1]
«Preliminary» + description: String [0..1]
«Preliminary» + id: Identifier [1]
«Experimental»
ManagedEntity
+ managementMethodCurrent: Integer [1]
+ managementMethodSupported: Integer [1..*]
«Preliminary»
«Preliminary»
Entity
«Experimental»
Domain
«Experimental»
Place
«Experimental»
BusinessInteraction
«Experimental»
Party
0..1
EntityFurtherDefinedBy
1
«Experimental»
*
DomainHasEntity
0..1
«Experimental»
«Preliminary»
«Preliminary»
DesignEntity
«Preliminary» + name: String [1] {redefines name}
«Preliminary» + description: String [1] {redefines description}
«Preliminary» + validFor: TimePeriod [1]
«Preliminary» + status: String [1]
«Preliminary»
«Preliminary»
OperationalEntity
«Preliminary» + name: String [0..1]
«Preliminary» + description: String [0..1]
«Preliminary» + id: Identifier [1]
ServiceDescriptor
ResourceDescriptor
Resource
Service
1
*
NSD
NetworkFunctionDesc
NetworkFunction
NS
VnfD
PnfD
Pnf
Vnf
1
1
*
*
These classes are temporary copies of the actual classes to not impact other models until proposal is accepted



Association to Resource
Type of artifact (Yang/Ansible)
Connection to Resource Desc
Need to Query for Model

Enhance Platform Information Model

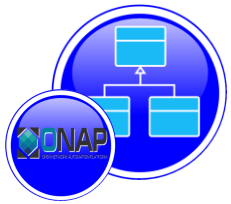
3GPP TS28.540 5G NRM

3GPP TS28.541 5G NRM

3GPP TS28.620 FNIM UIM

TS28.622 Generic NRM

5G NRM
Generic NRM

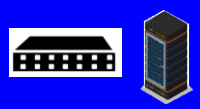


Platform Information Model ++

DESIGN TIME

Domain & Vendor specific

xNF Resource



Service CSAR

RUN TIME

SDN-C (etc)

Cell Carrier-Sector

C&PS Database

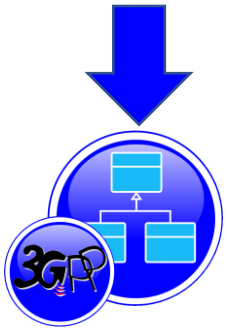
Generic Application Model

3GPP TS28.540 5G NRM

3GPP TS28.541 5G NRM

3GPP TS28.620 FNIM UIM

TS28.622 Generic NRM



5G NRM
Generic NRM

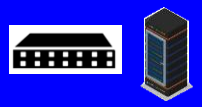
Optical ISOMII

DESIGN TIME

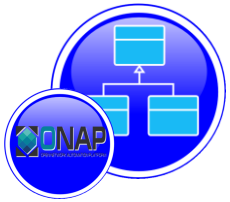
Application Model

+ Domain & Vendor specific

xNF Resource



Service CSAR



Platform Information Model

RUN TIME

SDN-C (etc)

PNF#106

C&PS Database

Generic Application Model / Hybrid

3GPP TS28.540 5G NRM

3GPP TS28.541 5G NRM

3GPP TS28.620 FNIM UIM

TS28.622 Generic NRM

Define new artifact type, Design time & Run time
Uses that type to retrieve info from 5G NRM artifact
Framework is there, minor impact to code.
M#1 SDC (onboarding) CBA read yang model from onboarding package
M#2 CDS (manually load NRM into CBA)

5G NRM (RAN)
Generic NRM

Optical

DESIGN TIME

Application Model

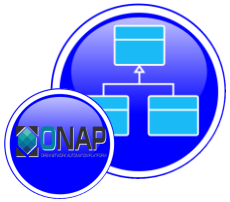
+ Domain & Vendor specific

Pointer to Application Model

xNF Resource

PNFd (descriptors) Connectionpts
PNF Parameters
Application Parms in Artifacts

Service CSAR



Platform Information Model++

(Minor) connections

RUN TIME

SDN-C (etc.)

U/C μ-Service

C&PS Database

StndDef VES

PNF#106

Generic Application Model / Hybrid – R7

ACTIONS: SDC team – S/W change support **new nonMANO artifact type**
ACTION: Jacqueline mapping from onboarded NRM to the C&PS Record (modeling Subcommittee). Gen. Application Modeling defined.
ACTION: new nonMANO artifact types (defined in Modeling SubCommittee)
ACTION: C&PS team to describe solution
ACTION: VNF-SDK to validate
ACTION: VNF-REQTS

NRM . (Yang/Ansible) Artifact

Vendor Onboarded CSAR

Network Slice (Class)

serviceProfileList (Attribute)
networkSlideSubnetRef

5G NRM
Generic NRM

Optical Model

DESIGN TIME

Application Model

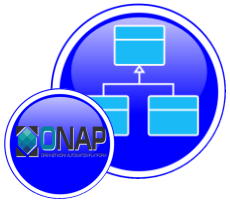
+ Domain & Vendor specific

xNF Resource

PNF#106

NRM

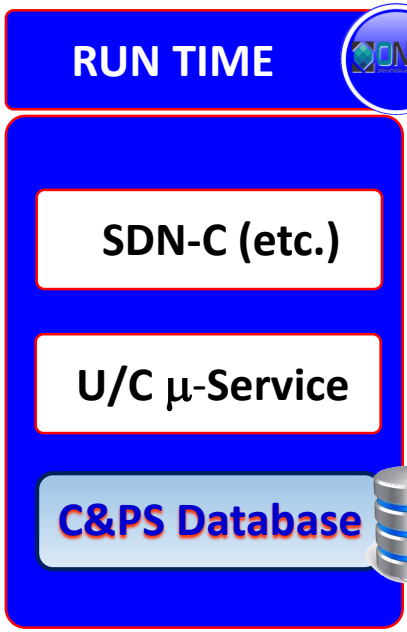
Service CSAR



Platform Information Model++

(optional if needed)

RUN TIME



SDN-C (etc.)

U/C µ-Service

C&PS Database

C&PS Record
xNF instance
(looks at) NRM arti

NRM

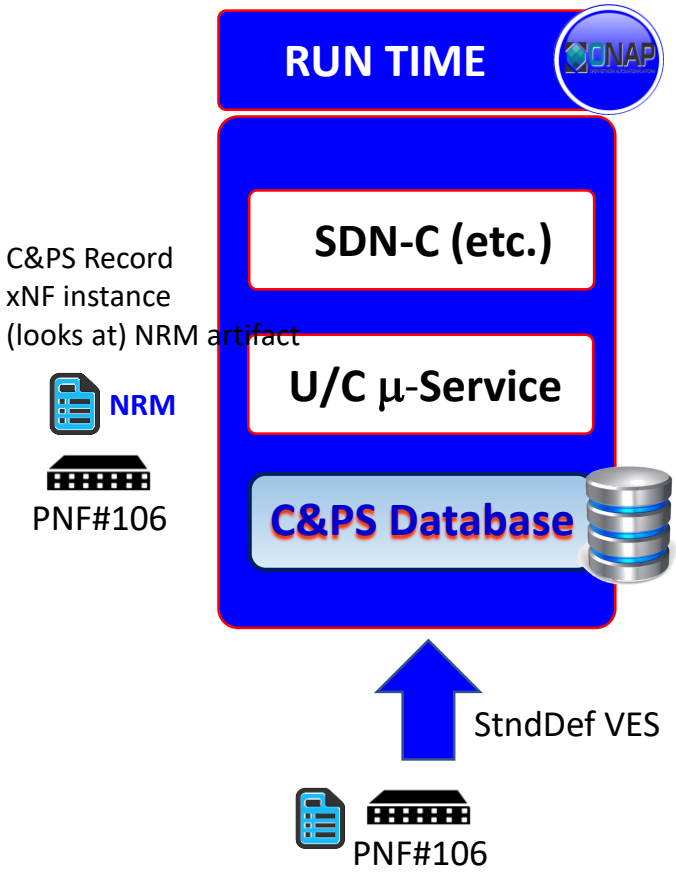
PNF#106

StndDef VES

PNF#106

RT
odel w/ svc descriptor
end points. Subsvcs.

Generic Application Model / Hybrid – R7



Service Instantiation

What kind of xNF Resource do I have?

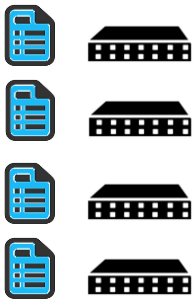
Do I have a NRM Artifact for it?

C&PS Data R/W

What kind of xNF Resource do I have?

DOMAIN Bit "I'm 5G NRM compatible"

Do I have this kind of data for it? Can I understand it?



M-S interested in particular kinds of xNFs
Kind of data in xNF
Can I identify a model associated w/ the xNF
That the mS process.
How to tag models that are incorporated useful in a catalog to make a decision point to decide if a model is useful to it.
How to automatically set the Domain Bit/Flag
* Meaningful classification – defining a classification of the model & filling it. / Meta-Model Cladistic Topology Model (Meta-Categorization)
* Model & resource descriptor link.

M-S#1 SDC>CSAR > creates CPSDB records “owner” (Mirror svc) gets model in raw form. mS#1 Hua mS#2 Er mS#3 nok

mS#4 “analytics”/”correlation” … across domains/ across multiple vendors installations … needs to ASK for access from mS#1,mS#2, mS#3 … wants to traverse the data lake. Code will be coupled to different models. READ ONLY

Mechanism / **Registration component** “I am x” and I have models that relate to “a”, “b”, “c”
I am publishing the model
mS can **Query the Registry** – and can ask for access.
mS#1 Ericsson RAN -> body of RAN related PNF records -> “owns them”
-> register function -> publish ownership -> I’ve created these records, they are of this type, if you want access talk to me.

mS#5 BT (service provider’s mS) -> certain kinds of data … -> **query/crawl/search the registry** -> “all RAN record” -> mS#1
Once mS#5 has been given access, mS#1 grants access to mS#5 access to the data.
mS#5 “release access” done using the data.

When you request reg users, anyone who wants access needs to call the reg
Expose the reg, grant all read requests.

C&PS READING: PNF Reports Configuration

DU/PNF CU/VNF

PNF VNF

VES Event

Standards Defined VES Event for Configuration

1

ONAP RUN-TIME

DCAE VES Collector

DCAE Inventory

DCAE

Analytics

DMaaP

Configuration NameSpace topic 3GPP-Provisioning

C&PS Update

Config & Persist Service

C&PS Database

Run-Time Operational Data
Configuration Info
Exo-Inventory Data
RT Logical & Physical Connections

The PNF has a parameter update to report. The update originates from the PNF and is reported through a Standards Defined VES event with a configuration NameSpace (3GPP-Provisioning)

Standards Defined VES Event is received by the *DCAE VES Collector*. DCAE publishes the VES Event onto the DMaaP Bus.

In R8+: CPS as a stand-alone component, subscribes to the DMaaP Topic and gets the DMaaP event from the DMaaP bus to update the internal database. The VES event has a Configuration namespace topic, 3GPP-Provisioning

3GPP Mapper (DCAE)
Map stndDef VES event onto existing VES event

C&PS Roadmap & R6-R8 Plan

Configuration & Persistency Service (CPS) Roadmap –

R6 Frankfurt → **R7 Guilin** → **R8 Honolulu**

C&PS 1.0

R6 C&PS

- CC-SDK/SDN-C solution
- Evolution of "ConfigDB"

Supporting R6 Use Cases:

- SON/OOF/PCI U/C

June 5, 2020

C&PS 1.1

R6 C&PS Extensions

- Evolution of CC-SDK/SDN-C solution REQ322

Supporting R7 Use Cases:

- SON/OOF/PCI U/C
- 5G E2E Network Slicing
- A1 Policy extension (Ericsson)

Model-Driven PoC

- Write "base" C&PS
- Write NE *Data*
- Read NE Data
- Access Control

State Management PoC

- State Management PoC (BellCA) self-contained

December, 2020

C&PS 2.0

R8 C&PS stand-alone project proposal

- Deprecate C&PS 1.0 & 1.1
- Project proposals TSC/Architecture S/C
- Setup Project Repo

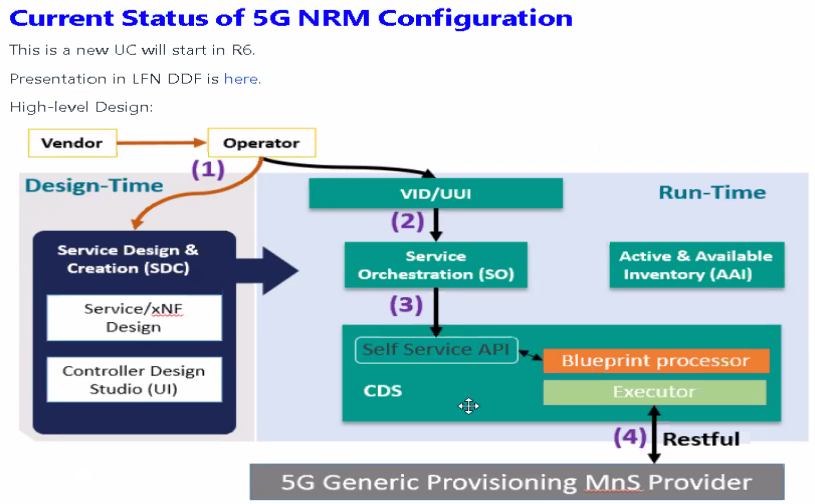
CPS FUNCTIONALITY:

- Data Recovery
- Model Adaption (Dynamic Schema)

June 2021

Legend:
RED text is CC-SDK/SDN-C solution
BLUE text is the PoC & stand-alone project

U/C Realization call with Yuriy



https://wiki.onap.org/display/DW/5G+Network+Resource+Model+%28NRM%29+Configuration+in+R6+Frankfurt

Modeling, extend CDS. … database can model itself use CBA package to capture that file
Don't intro a specific artifact in SDC.
Include as part of the CBA artifact.
Onboard the yang model … in the onboarding module, the CBA blueprinting script can read the module from the Package.
The CB script read yang model from local CBA package, could read yang model file from OB package.
Instance data – instance PNF – don't involve the models (capabilities of xNF); creating data to apply CM data.
The data itself must be compatible w/ what the xNF supports. No checks usages of model info on ONAP side.
Responsibility of the user to verify to operate correct.
Responsibility of vendor modify the xNF. File w/ configuration to apply , needs compatibility w/ xNF.
SO API. Users of SO API needs to supply data compatibility w/ VNF.

CDS input information to CBA doesn't need modeling input.
For C&PS is doesn't need CDS, a macro-service to get & create dynamic schema.

PNF Onboarding Package (CSAR)

PNF Onboarding (CSAR file)

Note:
- Package Example
- Not all files are listed.
- Folder / file name in blue is requested by SOL004.
- Folder / file name in black is example only.

TOSCA-Meta-Version: 1.0
CSAR-Version: 1.1
Created-By: Ericsson (Zu Qiang 2018-12-03)
Entry-Definitions: Definitions/MainServiceTemplate.yaml
Entry-Manifest: MainServiceTemplate.mf
Entry-Change-Log: Artifacts/ChangLog.txt
Entry-Tests: Artifacts/Tests
Entry-Certificate: Artifacts/License_term.txt

ROOT

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

TOSCA.meta

NF descriptor

MainServiceTemplate.yaml

NonMANO artifacts (keyword)
NRMYang or NRMAnsible
5GNRM . (Yang/ansible)

- ~~Images~~
- Deployment
- Scripts
- Tests
- ChangeLog.txt
- MainServiceTemplate.cert
- License_term.txt

(one possible location)
NRM.Ansible

- Configuration
- Yang_module
- Measurements
- Events
- ...

- Install.csh
- ...

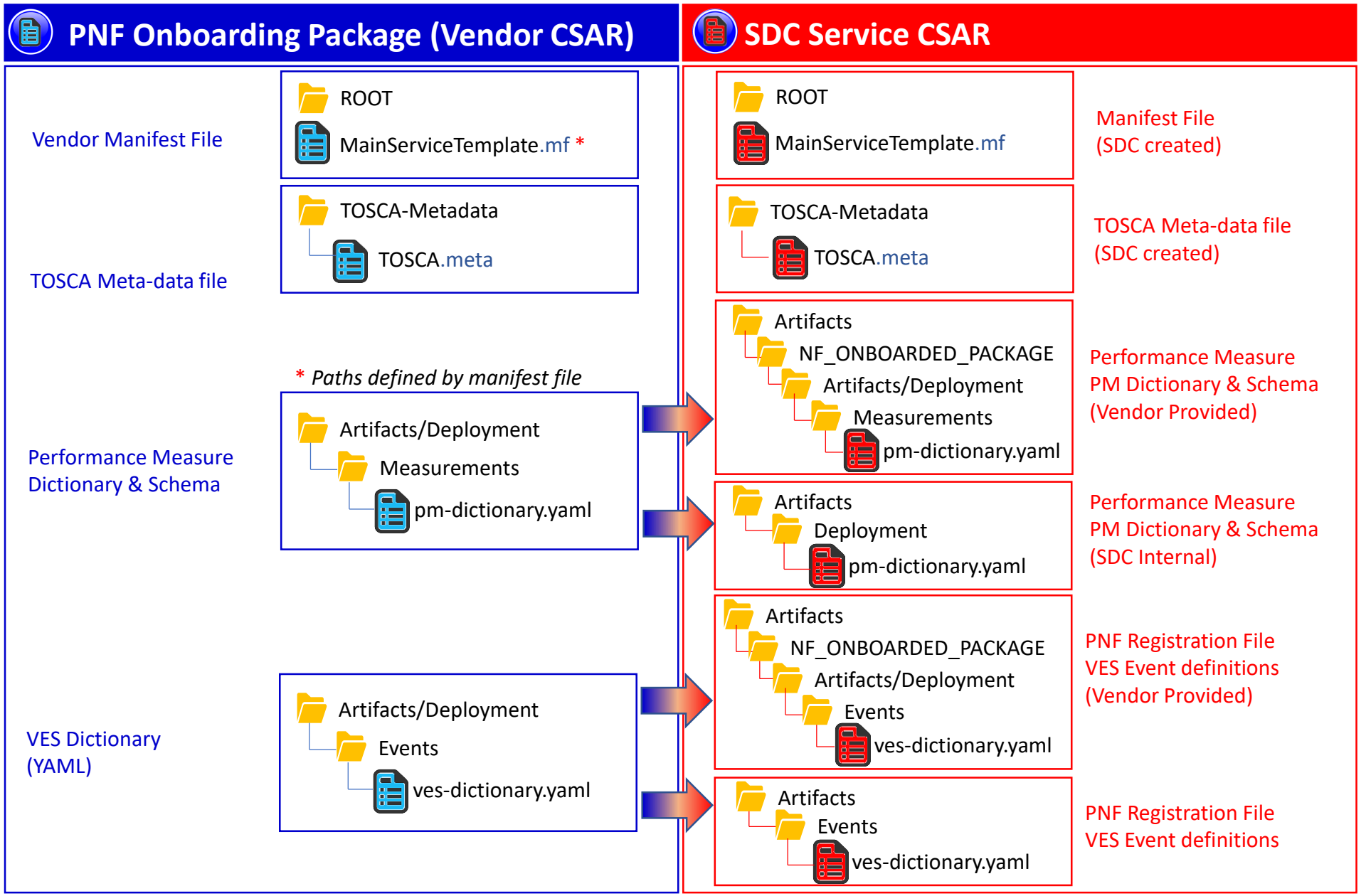
(one possible location)
NRM.Yang

- yang-module.yang
- pm-dictionary.yaml
- ves-dictionary.yaml

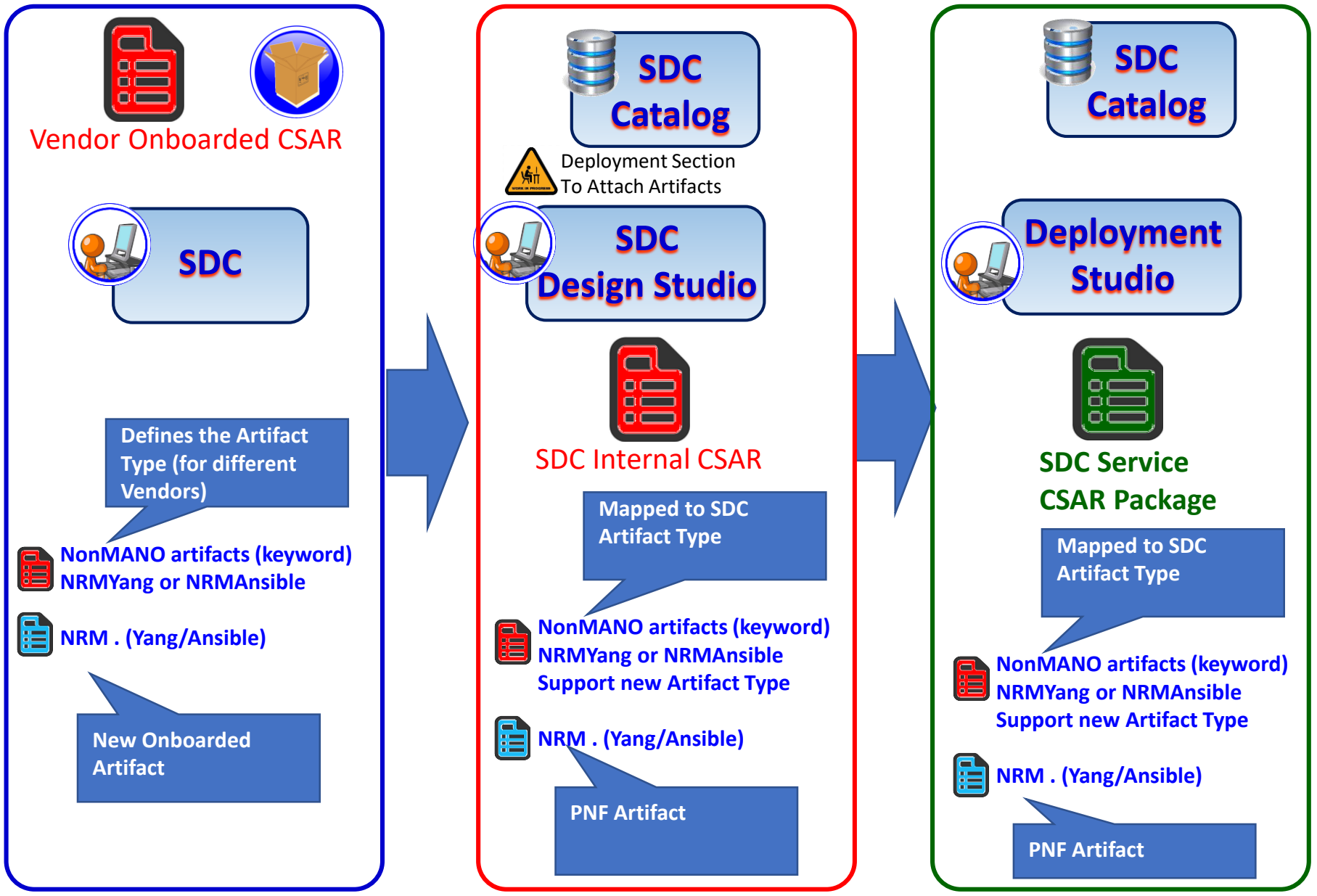
metadata:
pnf_product_name: gNB
pnf_provider_id: Ericsson
pnf_package_version:1.0
pnf_release_date_time:2018-12-03T08:44:00-05:00
non_mano_artifact_sets:
Events:
source: Artifacts/Deployment/Events/VES_registration.yaml

el
edicated NONMano artifact keyword

Onboarded Package to SDC Internal Mapping



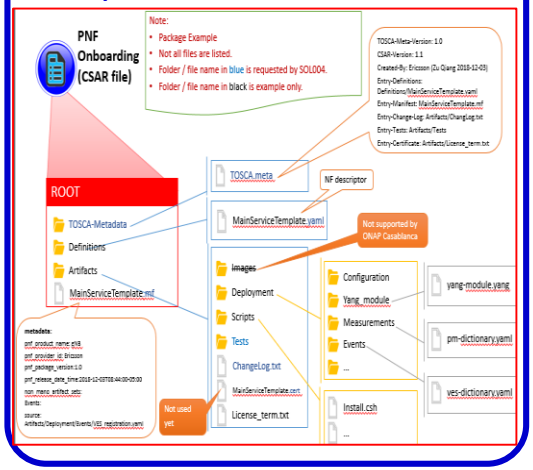
VNF/PNF PACKAGES



PNF PACKAGES

VNF SDK

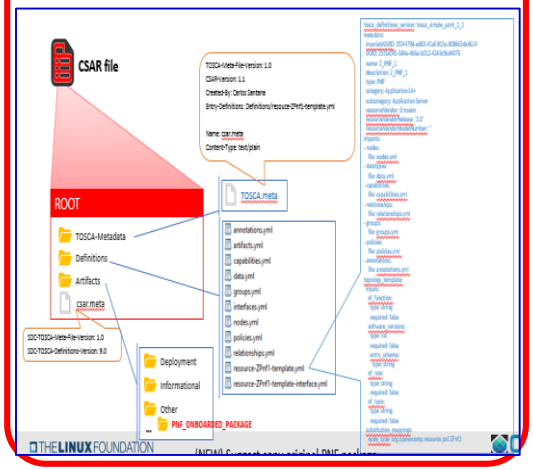
PNF Package
(Vendor onboarded)
VSP [vendor s/w product]



SDC Catalog

SDC Design Studio

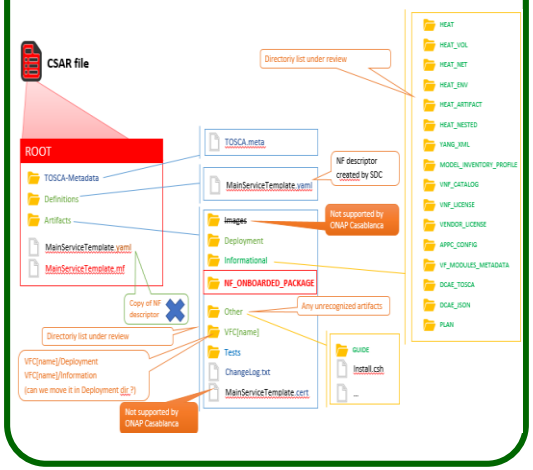
SDC Internal CSAR
PNF Package



SDC Catalog

Deployment Studio

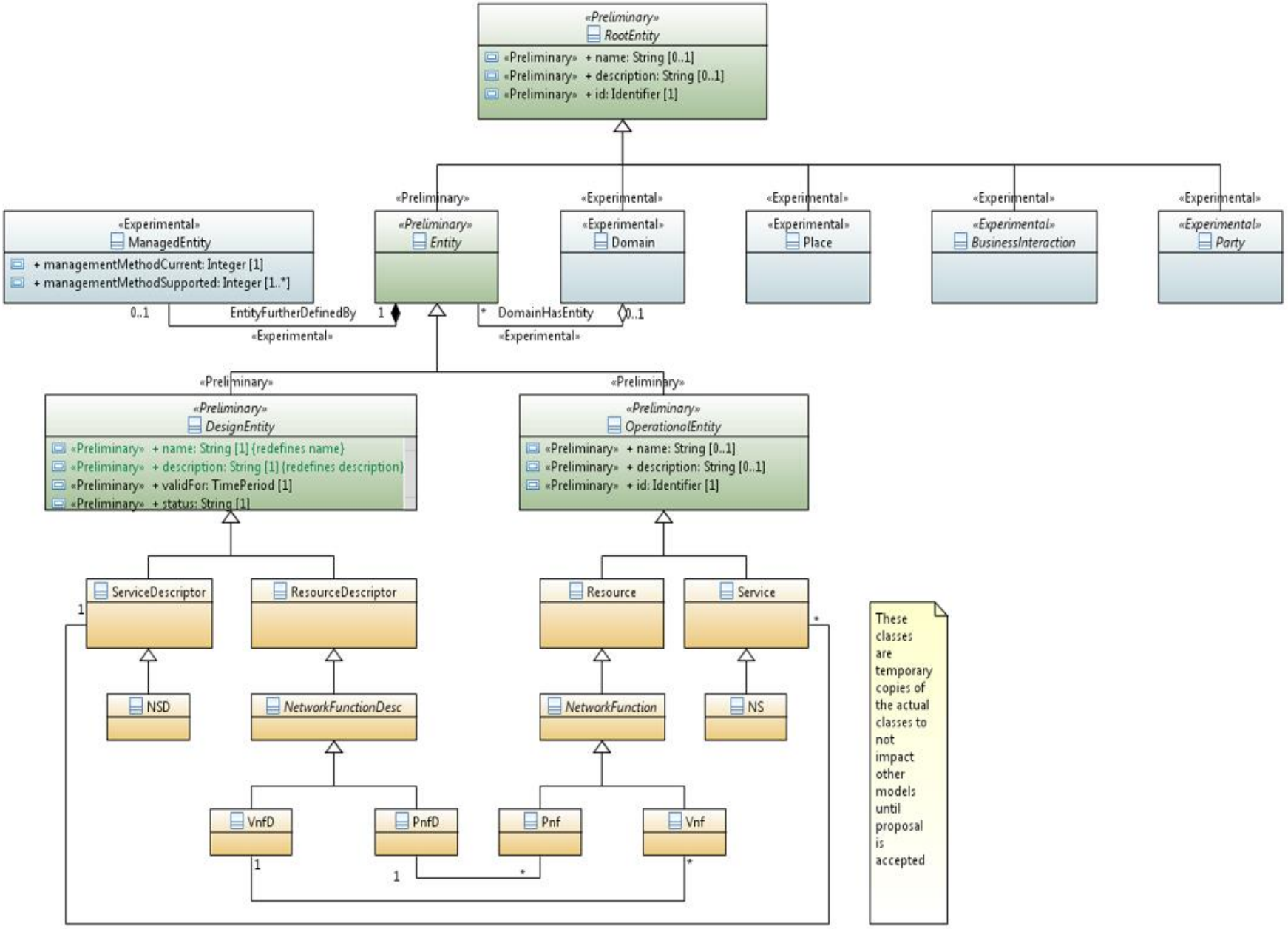
SDC Service
CSAR Package



(Zu) Use case driven, in current use cases, use SDN-C
For node configuration, C&PS stores the config data
Need to understand the application model, no other run-time component
Needs this model, so it would be nice to **NOT** significantly change the PlfrmInfoModel
The 3GPP model is well-defined, doesn't make sense for ONAP to redefine it.

CNF/VNF (Fred) the generic APP-C using CDS as the modeling approach would fit this model well. Intended to Encompass application model, and deal w/ configuration manipuatlion of application model > turn into Specific implementations. CDS & APP-C . xNF consideration. General abstraction problem
Unification strategy to join SDN-C and APP-C into one entity. Yuriy for CDS.
CDS – GUI – define the (3GPP model) model that you can import; enable you to input the model and instance specific configuration to talk to each instance. Define models for manip application data. Define a model (importing the 3GPP model) and have the manipulation svc to implement the configuration associated w/ the xNF.
ACTION ITEM: PNF resource instantiated by ONAP. The issue of non-unification. Could interact w/ PNF. Yuriy.

(Andy) Maybe we introduce "core" sub-model to the Platform information that might accompany the G-A-M solution. Creating a "hybrid" solution, where the G-A-M serves the MAIN data model for xNFs, and this adjunct model maybe a way to SUPPLEMENT the P.I.M. w/ information that G-A-M solution falls short on, (1) isolates the changes thus there is not a big change to the P.I.M. (2) covers all the bases, "management level" that G-A-M 100% sufficient.


«Preliminary»
RootEntity
«Preliminary» + name: String [0..1]
«Preliminary» + description: String [0..1]
«Preliminary» + id: Identifier [1]
«Experimental»
ManagedEntity
+ managementMethodCurrent: Integer [1]
+ managementMethodSupported: Integer [1..*]
«Preliminary»
«Preliminary»
Entity
«Experimental»
Domain
«Experimental»
Place
«Experimental»
BusinessInteraction
«Experimental»
Party
0..1
EntityFurtherDefinedBy
1
«Experimental»
*
DomainHasEntity
«Experimental»
0..1
«Preliminary»
«Preliminary»
DesignEntity
«Preliminary» + name: String [1] {redefines name}
«Preliminary» + description: String [1] {redefines description}
«Preliminary» + validFor: TimePeriod [1]
«Preliminary» + status: String [1]
«Preliminary»
«Preliminary»
OperationalEntity
«Preliminary» + name: String [0..1]
«Preliminary» + description: String [0..1]
«Preliminary» + id: Identifier [1]
ServiceDescriptor
ResourceDescriptor
Resource
Service
1
*
NSD
NetworkFunctionDesc
NetworkFunction
NS
VnfD
PnfD
Pnf
Vnf
1
1
*
*
These classes are temporary copies of the actual classes to not impact other models until proposal is accepted

PNFD Model

CP1

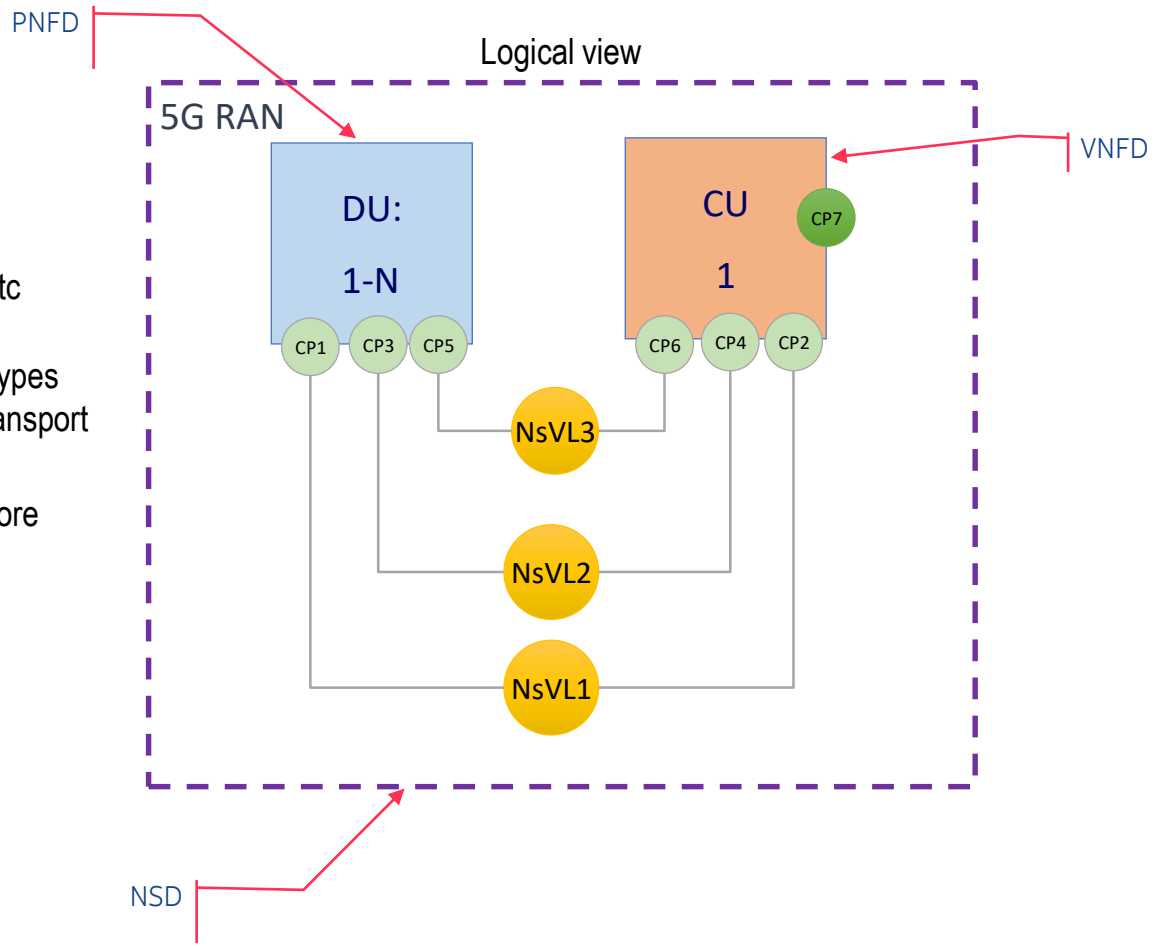
CP1 to CP6: Ext connection points (e.g. Control plane, data plane, management, etc

NsVL1

NsVirtual link for each type of connection types
Note: These VL may also can represent transport network technologies used.

ECP7

CP7: Ext connection point(s) for network core elements.



Example: TOSCA Service Template

```
tosca_definitions_version: tosca_simple_yaml_1_2
description: 5G RAN simple example
imports:
  - etsi_nfv_sol001_nsd_2_6_1_types.yaml
node_types:
  tosca.5gexample_NS:
    derived_from: tosca.nodes.nfv.NS
    properties:
      descriptor_id:
      flavour_id:
topology_template:
  substitution_mappings:
    node_type: tosca.5gexample_NS
    requirements:
       virtual_link: [ CU, virtual_link_XYZ ] # the External connection point of CU
  node_templates:
    my_5gservice:
      type: tosca.5gexample_NS
      properties:
      interfaces:
        Nslcm:
    CU:
      type: tosca.nodes.nfv.5Gexample_VNF1 # this type is described in another service template
      properties:
        flavour_id: simple
        vnf_profile:
      requirements:
        - virtual_link_1: NsVirtualLink_1
        - virtual_link_2: NsVirtualLink_2
        - virtual_link_3: NsVirtualLink_3
    DU_1_to_N:
      type: tosca.nodes.pnf.5gexample_DU # the description of this type is described in another service template
      properties:
      requirements:
        - virtual_link_1: NsVirtualLink_1
        - virtual_link_2: NsVirtualLink_2
        - virtual_link_3: NsVirtualLink_3
        - dependency: CU

    NsVirtualLink_1:  #
      type: tosca.nodes.nfv.NsVirtualLink
      properties:
        connectivity_type:
        vl_profile:
NsVirtualLink_2:  #
      type: tosca.nodes.nfv.NsVirtualLink
    NsVirtualLink_3:  #
      type: tosca.nodes.nfv.NsVirtualLink
# omitted here for brevity
```

Creating a 5G Service

Need to create a 5G service in R6

- Currently individual services can be created using VNFs and PNFs
- Modeling of 5G NFs is work ongoing in Platform (Internal) Info Modeling Committee
- Architecture sub-committee needs to approve modeling committee proposal before requirements can go to SDC
- SDC needs to receive requirements so service models can be created
- Schedule in R6 M0 (Sept 5 2019).
- 5G Use Case Proposed for R6.
- “Target” 5G Service. Multiple options. 3GPP options 2/7/8. Based on U/C.

Creating a 5G Service

- Config DB (MariaDB) used by PCI-H-MS (step 4b) and OOF (step 7)
- Query API (swagger JSON spec) exposed to other ONAP modules
- cellId needs to be globally unique (assumed eCGI) and align with ONAP YANG model, ORAN, 3GPP
- pnf-name/pnf-id indicates netconf server to be used for interactions regarding cells
- 'ho' property added to support ANR use case

Cell (Object)

Attribute	Format
networkId	string
cellId	string
pciValue	uint64
nbrList	list of cellId
lastModifiedTS	timestamp
pnf-id	string

Cell_Nbr_Info (Object)

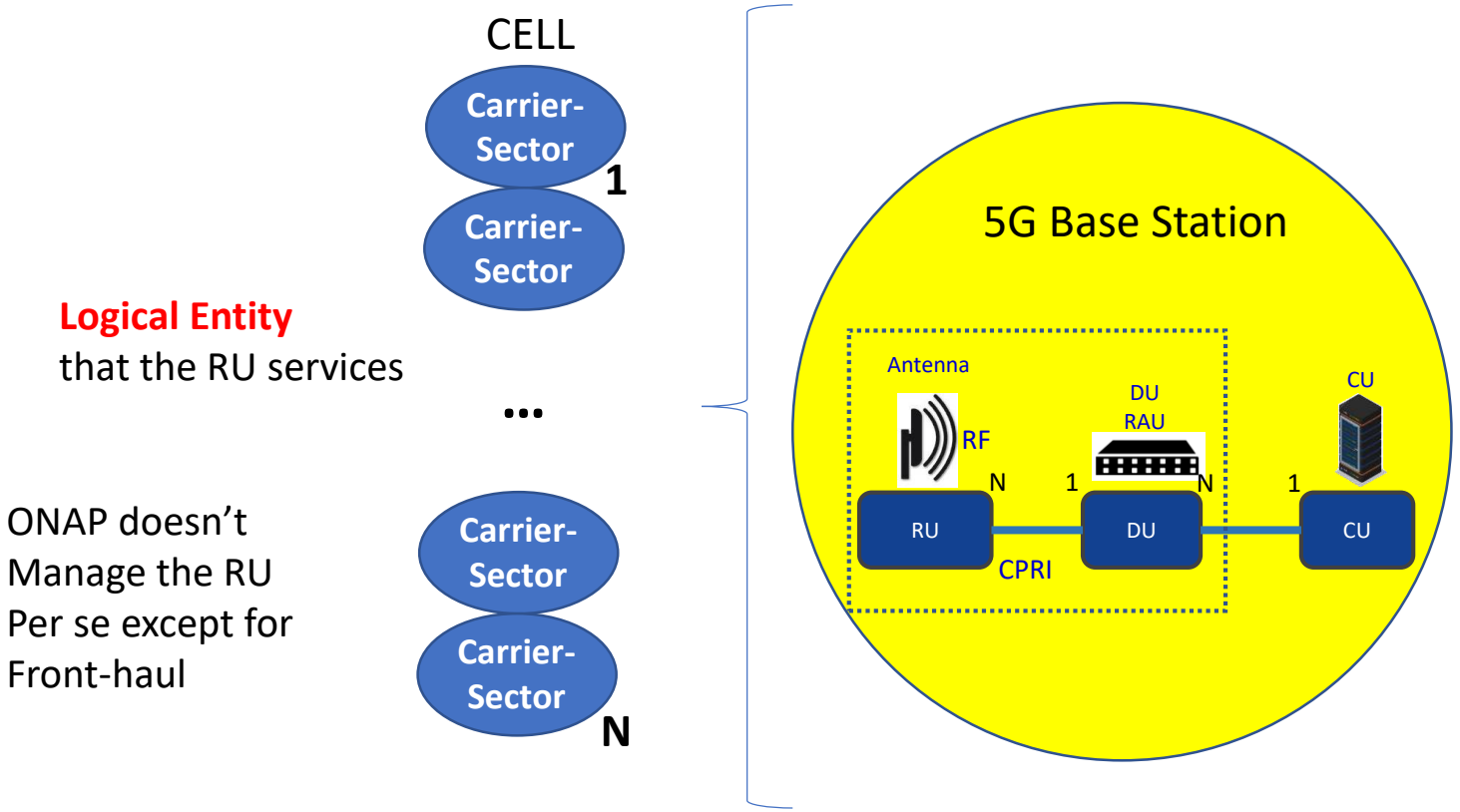
Attribute	Format
cellId	String
target_cell_id	String
ho	BIT(1)

Cell Management, Cell object, Cell Configuration

Benjamin Cheung, PhD

Cell Definition

DEFINITION: Cell in wireless communication technologies, the geographical region that is covered by a transmission facility. The term «cell» is most often used in reference to cellular phone technology, but it can also be used in reference to the coverage areas for transmission of cordless telephones, satellite transmissions, wireless local area networks (LANs), packet radio, and paging technologies.
https://networkencyclopedia.com/cell-in-wireless-communication/



Cell Management

VISIBILITY / EXISTENCE OF CELL

1 **USE CASES** –

1a **E2E Network Slicing -** Slicing – xNFs involved in a slice (TA/RA), where is the "slice" stored? NSI in A&AI. Alloted NF (ANF). Slice Service.

1b **OOF/SON/PCI** What use cases are Using it – OOF/SON/PCI which needs to store some cell info, KPI HO success rate. CellID. What Attributes to update. Key Identifiers. Neighbor Lists.

2 **EXISTENCE** - does ONAP need to know of existence of Cell? What does it need to know about a Cell?

MANAGEMENT OF CELL

1 **LIFE CYCLE** - Life Cycle of a Cell (FCAPS); OA&M interface at ONAP (no interface) **all the information related to a cell is reported/retrieved from the DU**. -> ONAP command "xyz Cell" (add/del/ onboard). ONAP would not "manage" a cell at all; it would manage a DU -> rather information for a cell (adds/deletes) are covered by the C&PS database solution.

2 **FUNCTION** - What would it do with a Cell

3 **ADD/DELETE** - For add/delete Cell case -> the corresponding activity in ONAP is to add/delete C&PS database entry. The DU informs ONAP that a Cell is added/deleted, then C&PS updates database accordingly. ONAP management level to add/delete would be a configuration update.

4 **MODELING** - How would it Model it? (Info Model). A DU is a MOC. A Cell is a Logical object. -> No modeling is needed.

INFORMATION ABOUT CELL

1 **PERFORMANCE MANAGMENT** - Cell specific KPIs, PM generated & reported from **DU**. COUNTERS collected & reported by the **DU**. KPI derived from counters. ONAP doesn't need to interact with a RU/Cell w.r.t. PM (Counters & KPI).

2 **CONFIGURATION MGMT** - Cell configuration info - Cell related information stored in C&PS.; Cell – A cell is a logical object. CDS. Cell related information is use case specific (PCI and E2ENS). (1) define, (2) store, (3) loop back to the xNF.

C&PS Database (Run-Time View)

C&PS Database

PNF #106

Cell #1 – Logical Object

Cell #2

Cell #3

RECORD ELEMENT
INDEX = PNF #106
Parameter #1
Parameter #2
Parameter #3
Logical object, Cell #1
Cell Parameter #1
Cell Parameter #2
Cell Parameter #3

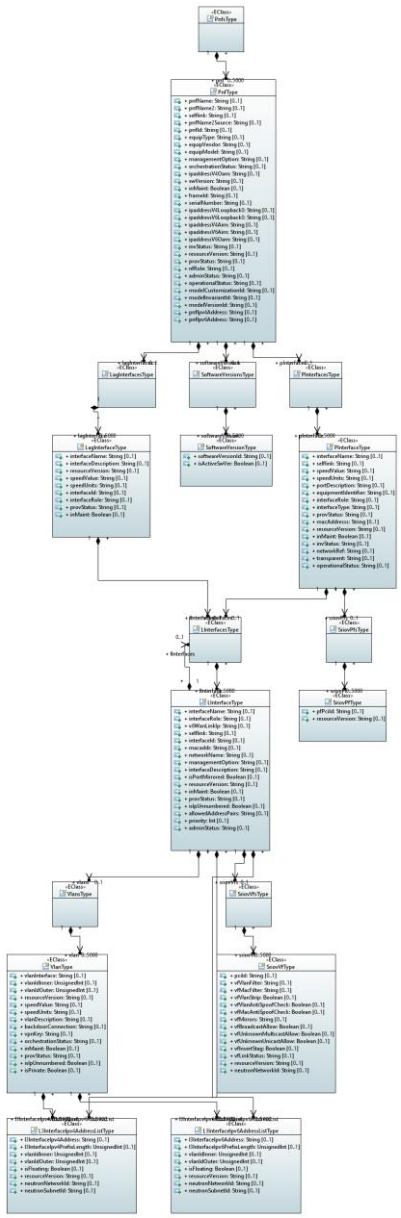
RECORD ELEMENT
INDEX = PNF #106
Parameter #1
Parameter #2
Parameter #3
State Info X.733
Associations
{ Logical Object #111 Cell #2 }
Cardinality Rules
Linking Restrictions

RECORD ELEMENT
INDEX = Logical Object #111
Parameter #1
Parameter #2
Parameter #3
State Info
Associations
{ PNF #106 } List
Cardinality Rules
Linking Restrictions

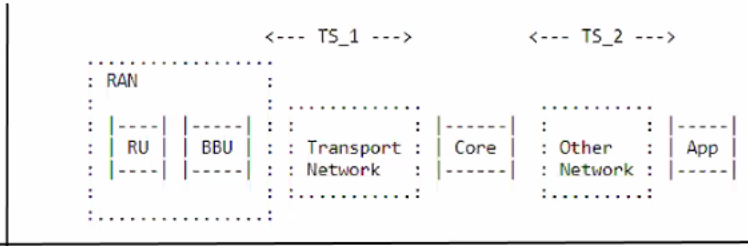
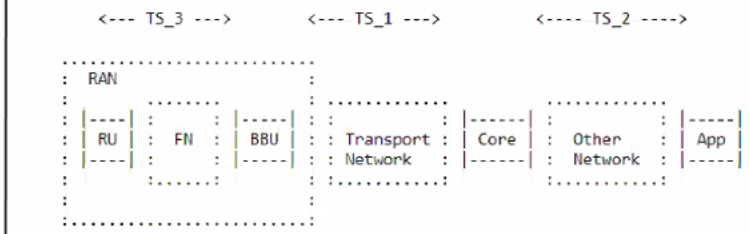
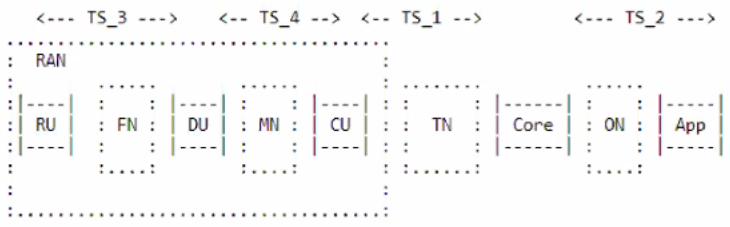
Appendix

Benjamin Cheung, PhD

PNF (Full) A&AI Model



https://wiki.onap.org/display/DW/Example%3A+PNF+in+AAI

Distributed RAN	
Centralized RAN	
Cloud RAN	

- An E2E Network Slice may consists of a set of TS instances, depending on the scenarios. Each TS instance defines the connectivity between two 5G domains. For example, TS_1 defines backhaul connectivity; TS_2, CORE to APP; TS_3, Fronthaul; TS_4, Midhaul.
- One TS consists of a set of networks (connectivity graphs). Each network has its own SLA. See next slide.
- One TS model for all TS instances in all scenarios.
- TSCi defines the TS model. And TSCi is the interface of the TN MD. It follows that the consumers of the TN MD could be E2E MD and/or RAN MD, depending on the scenarios. The TN MD does not care who the consumer is.

TS: Transport Slice
RS: RAN Slice
CS: Core Slice
FN: Fronthaul network
MN: Midhaul network
TN: Transport network
ON: Other network