5G Service Modeling & 5G Service Creation

- R6 Frankfurt Use Cases

Benjamin Cheung, PhD

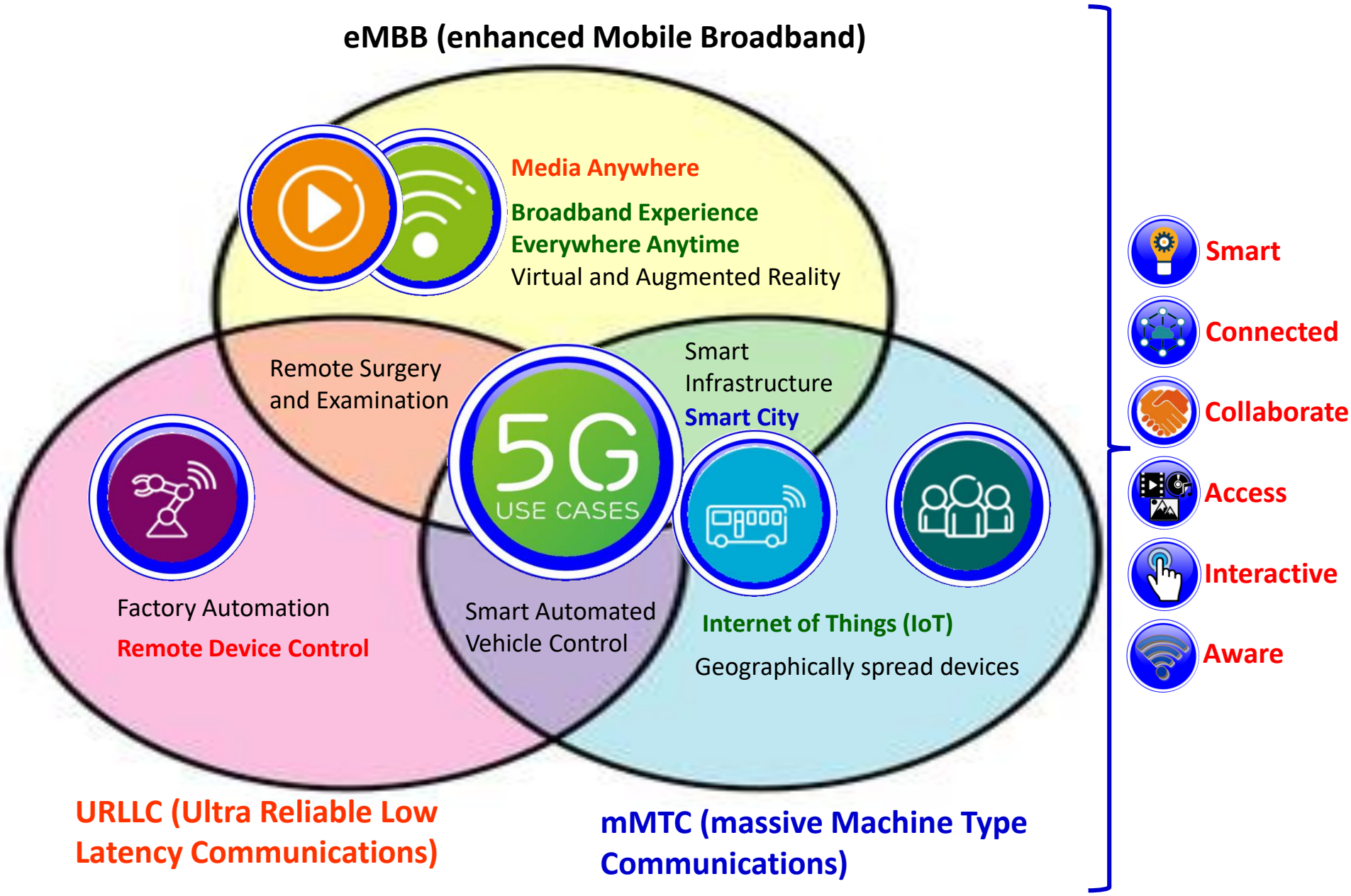
July 20, 2020 version 2

ONAP
OPEN NETWORK AUTOMATION PLATFORM

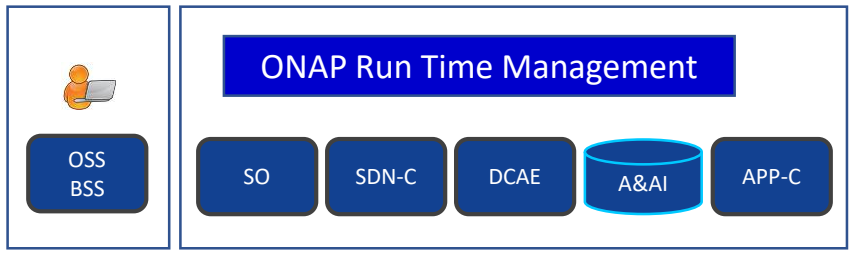
5G Basics & 5G RAN

Benjamin Cheung, PhD

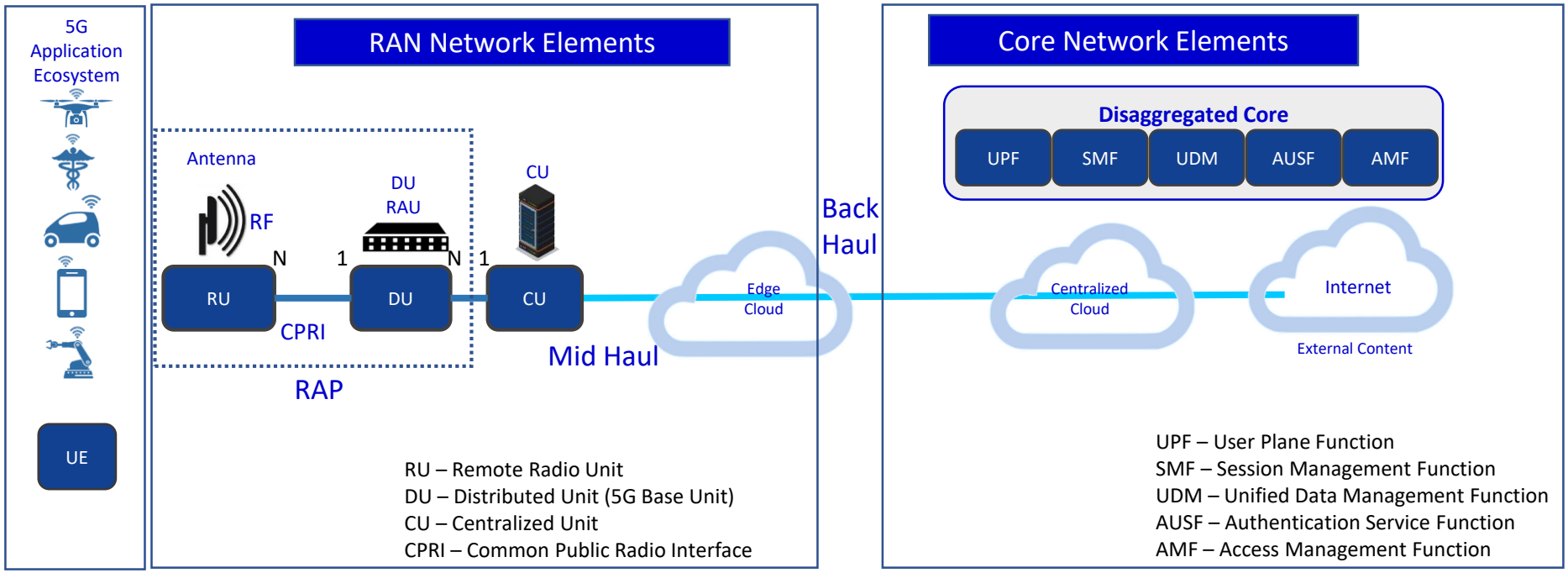
3GPP Release 15, IMT-2020 = 5G



5G RAN Wireless Network

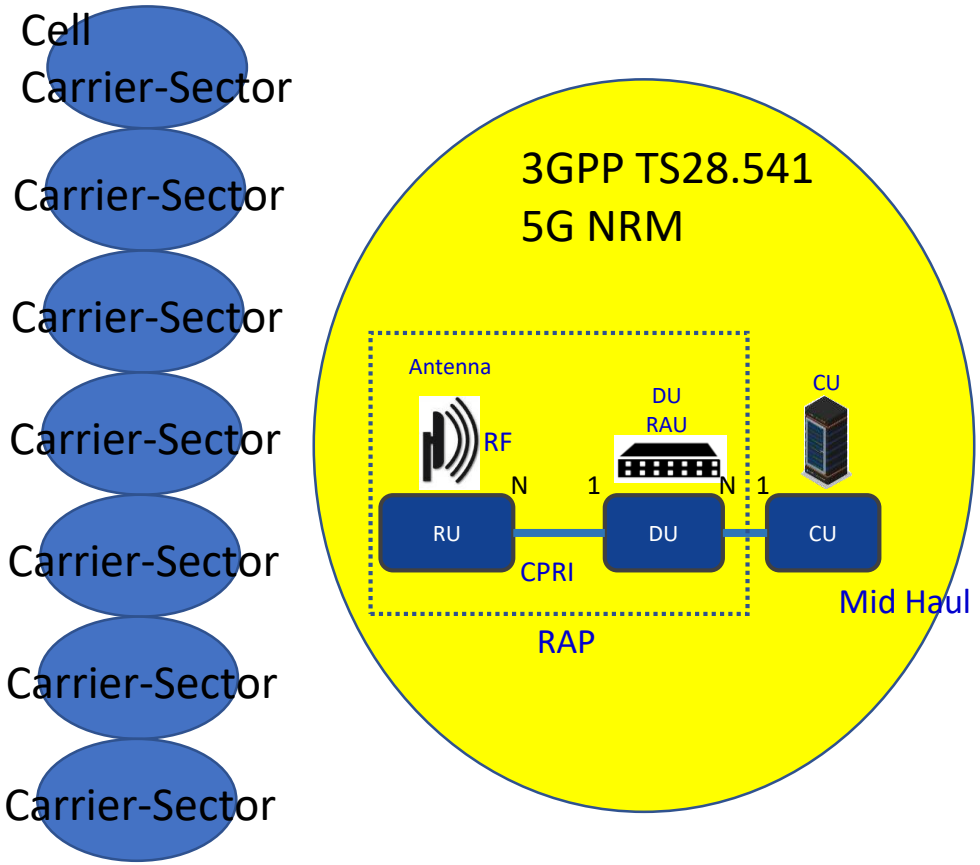


SO – Service Orchestrator
SDN-C – Service Design Network Controller
DCA&E – Data Collection Analytics & Events
A&AI – Available & Active Inventory
APP-C – Application Control



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



GROUPINGS

Kevin

What parameters are common to many functions

Super-class w/ common things and sub-class to particular functions

Configurations & groupings.

Different Domains

Are there common constructs we can use across domains.

Optical Fixed Wireless = same Information

Data Models domain focused?

Fred

RAN management – see it/ performing/ control

Performance, 28.541 as anchor

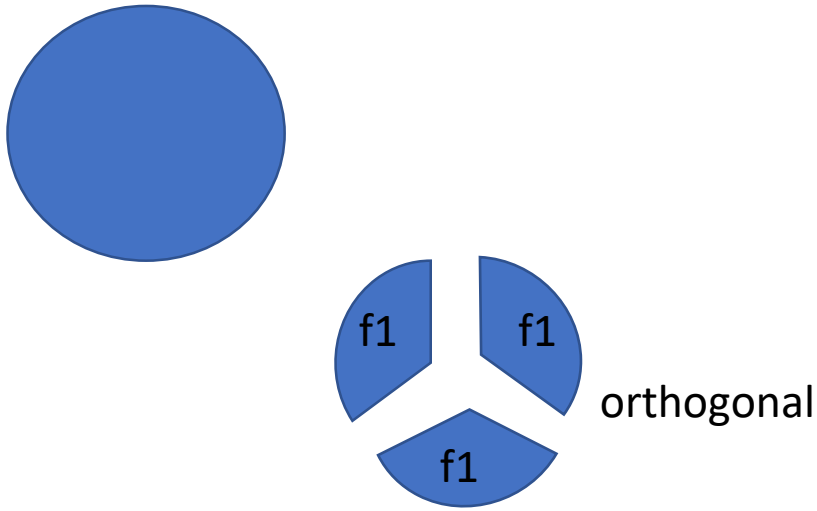
Model for gNB.

Look at other 3GPP documents to capture common for functions

Categorized to lifecycle management; instant. Rtconfig, …

Orchestration / Performance FCAPS. LCM

Fred F.
Bob Pape
Chris Skowronek
Chuyi Guo
Jacqueline Beaulac
Marek Kukulski
S. Ricci
Yaoguang Wang
Andy Mayer
Kevin Skaggs



5G Service Modeling & 5G Service Creation

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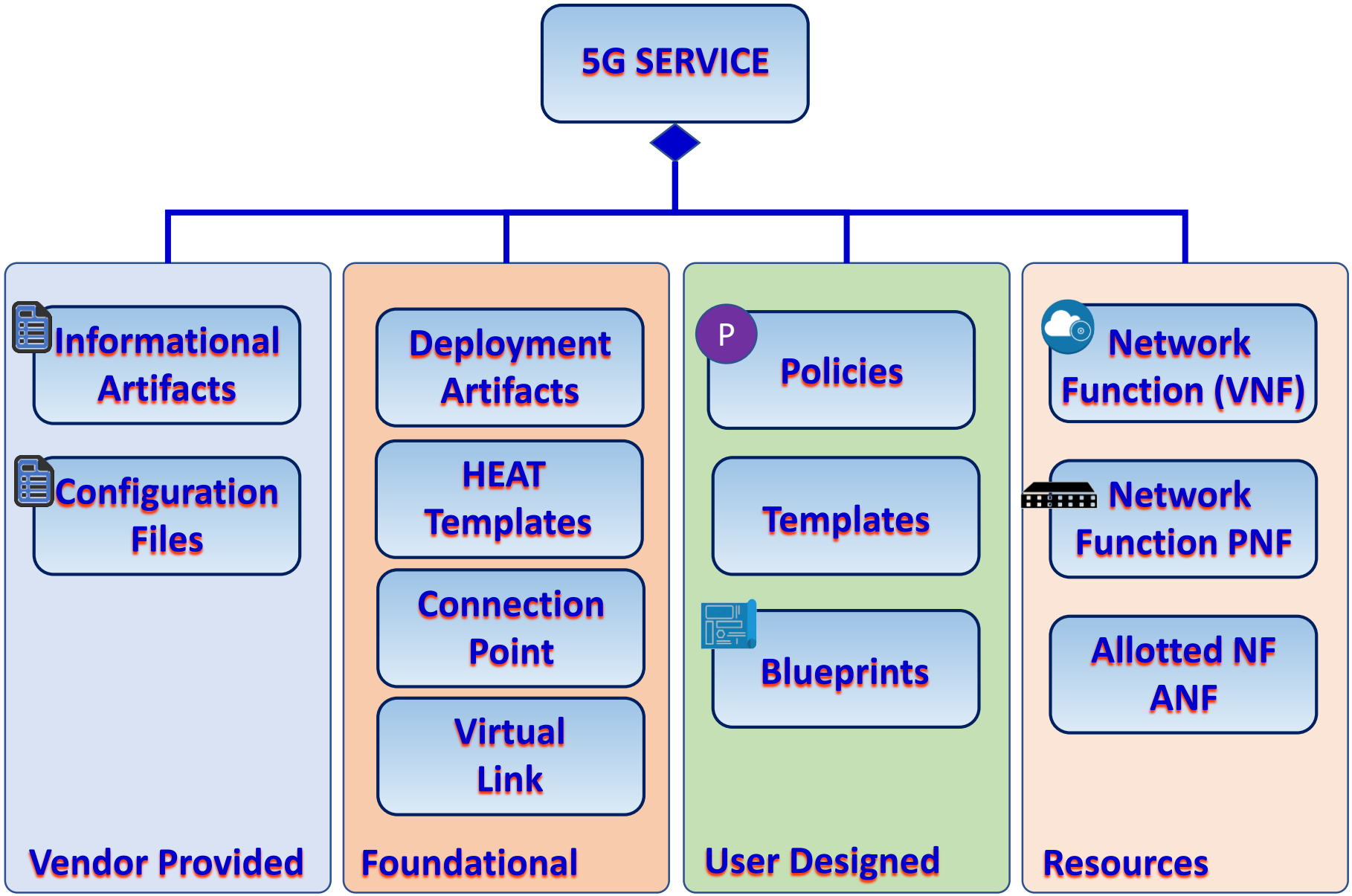
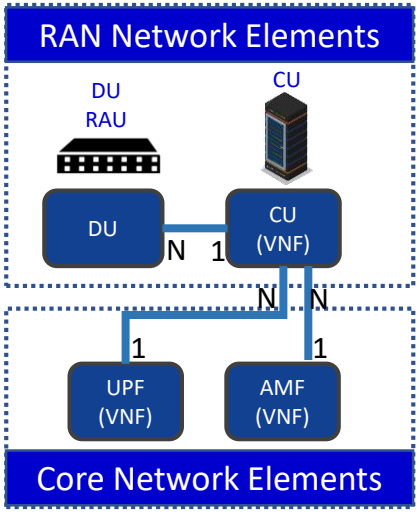
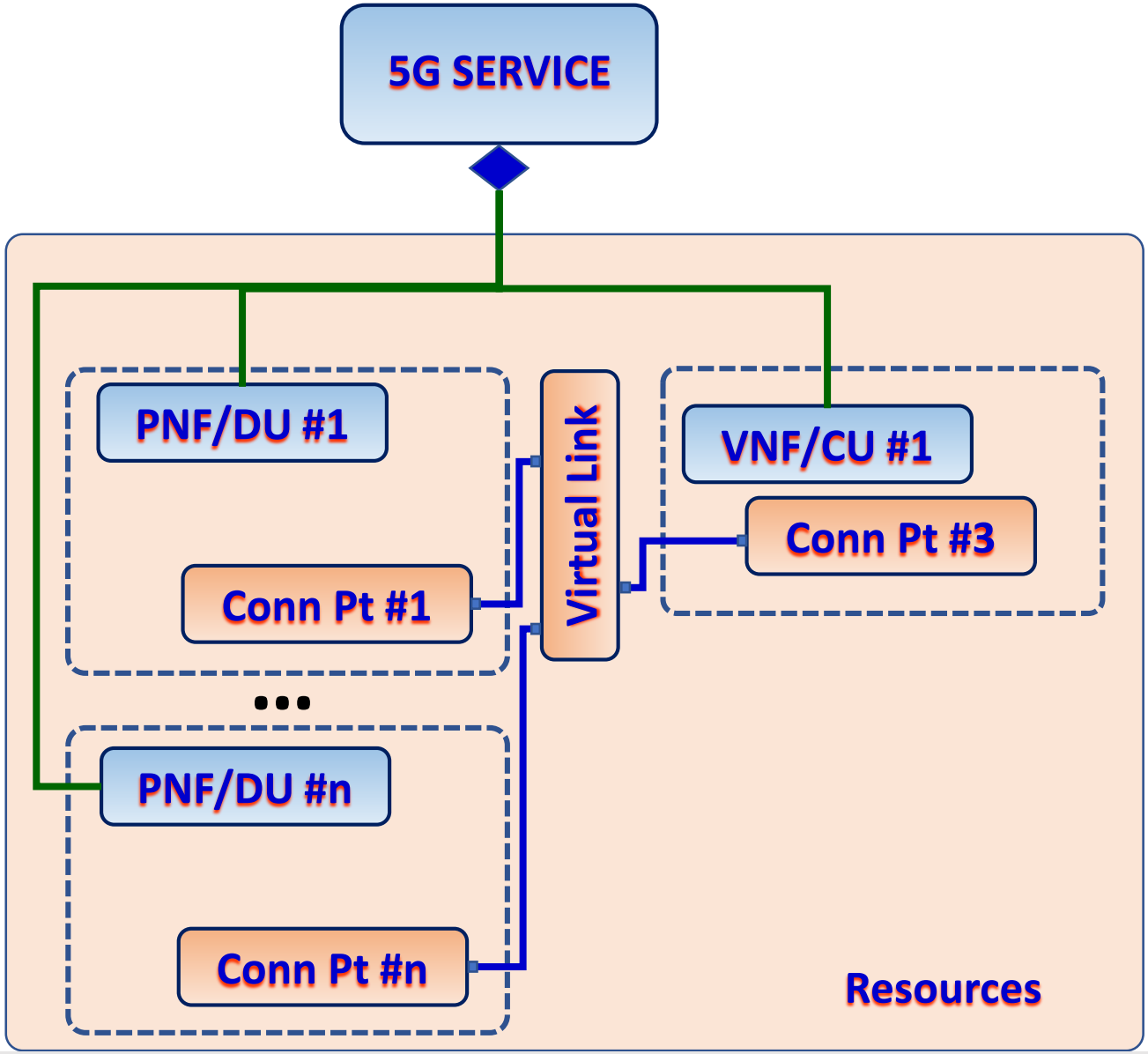
R7: Modeling a 5G Service

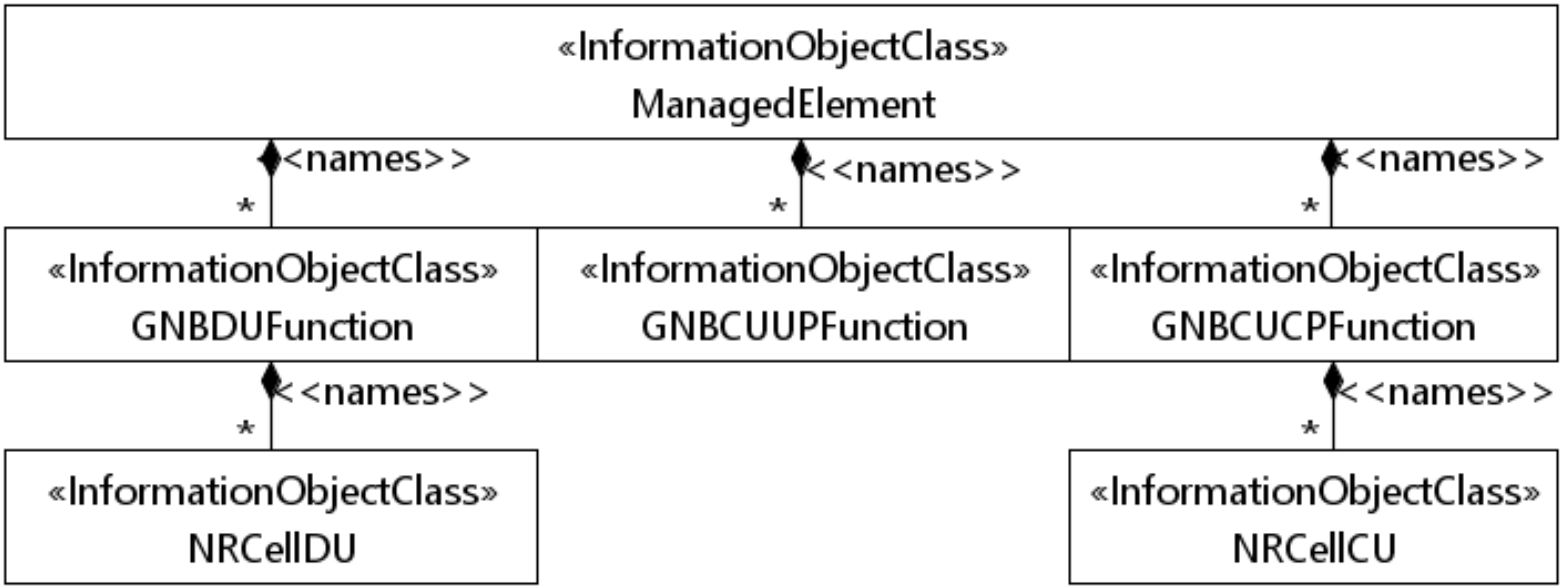


R4: 5G Base Station (gNodeB)

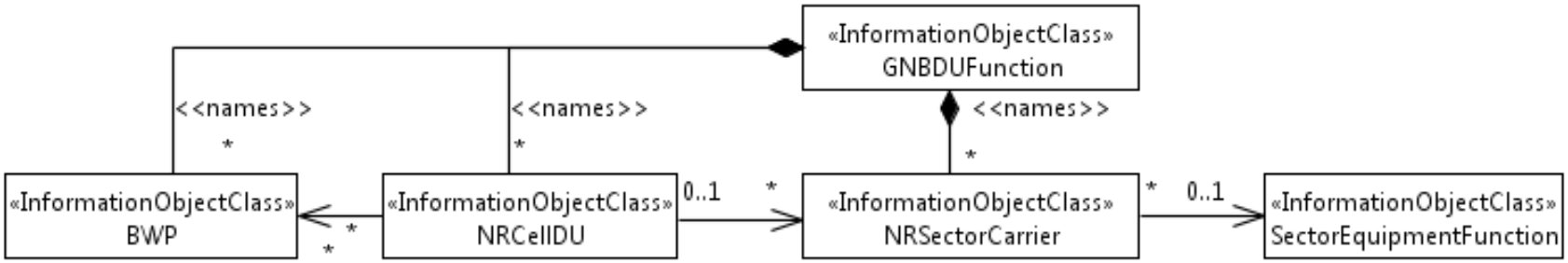


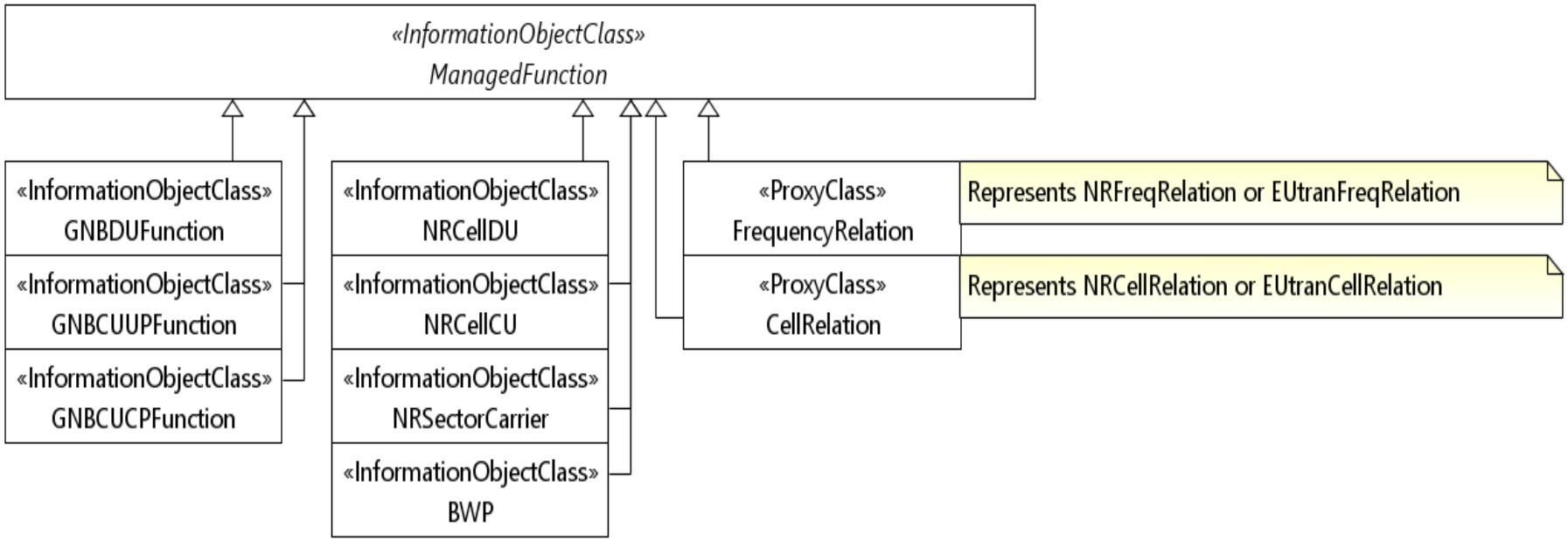


3GPP TS28.541/TS28.622 Model



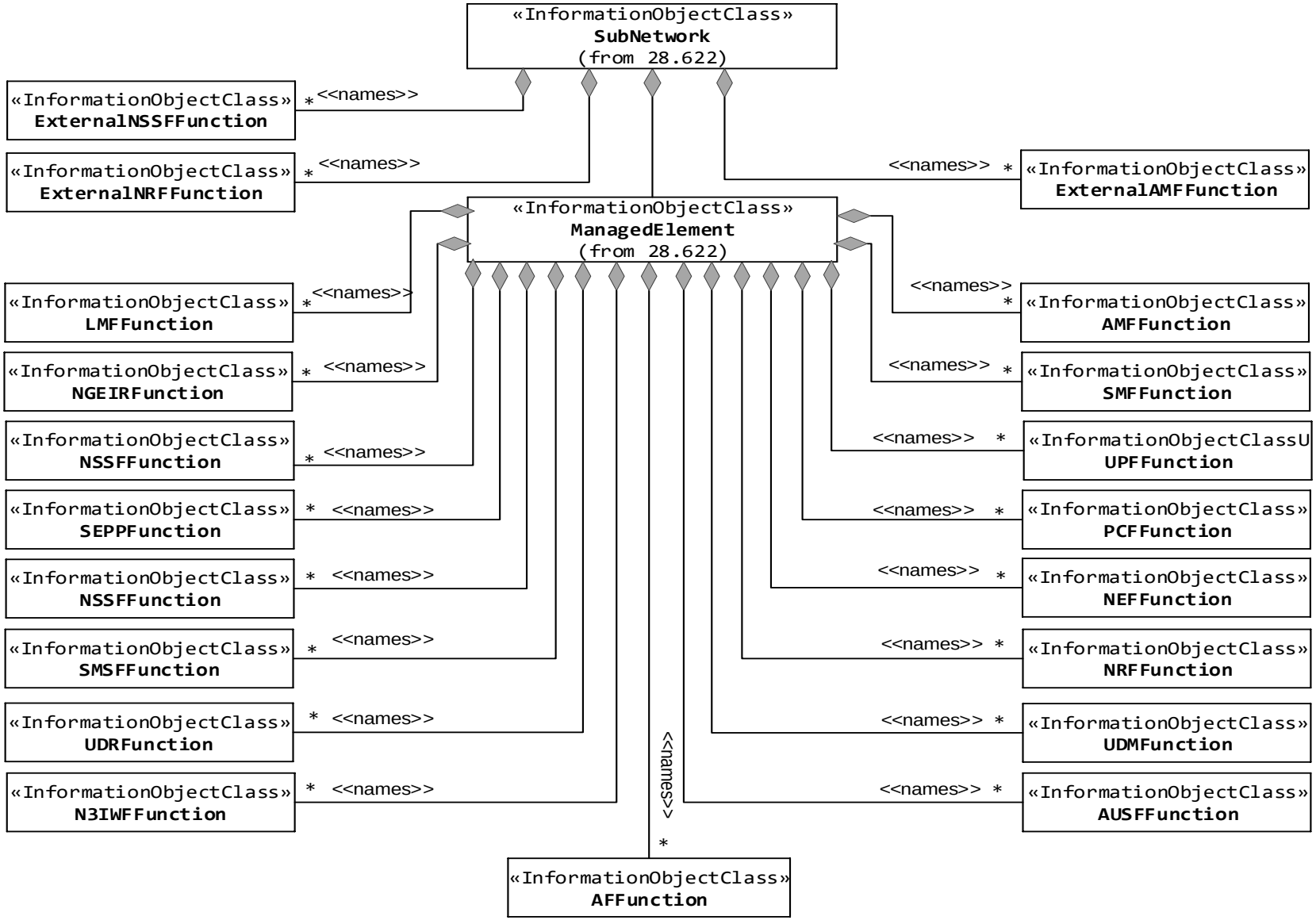
3GPP TS28.541/TS28.622 Model



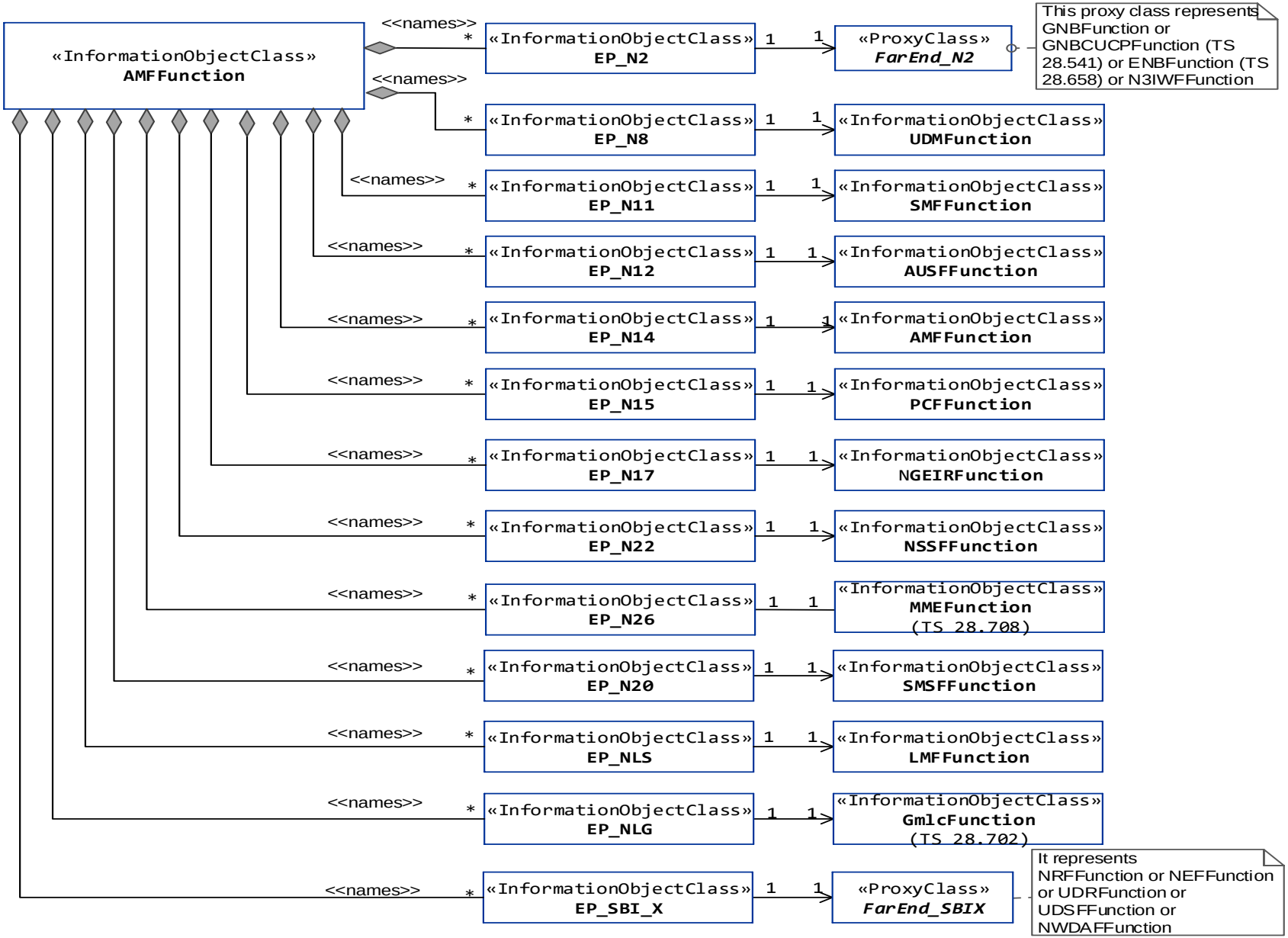


ETSI Alignment R7+ U/C will introduce a CNF version of the gNB DU

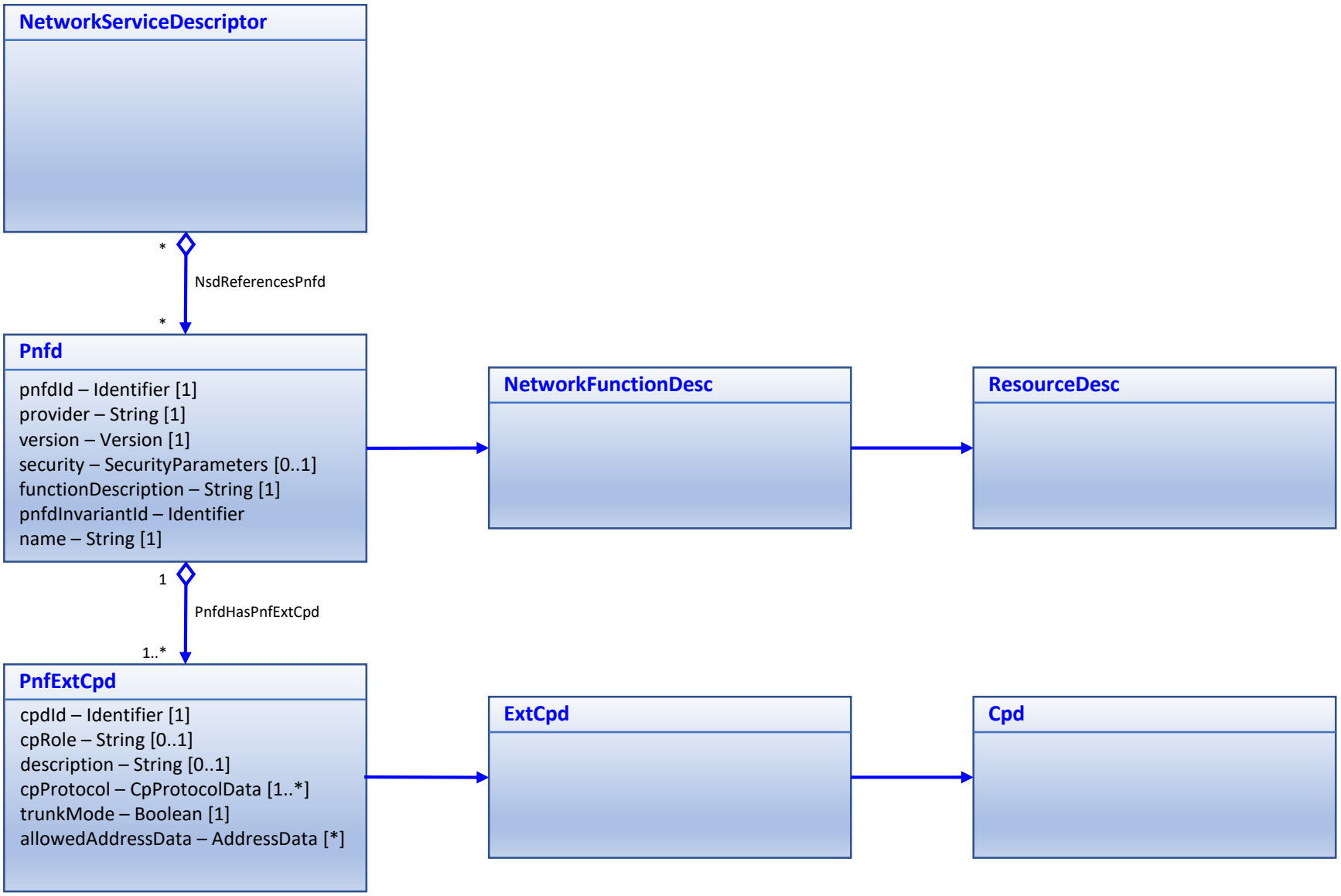
3GPP TS28.541 Model



3GPP TS28.541 Model

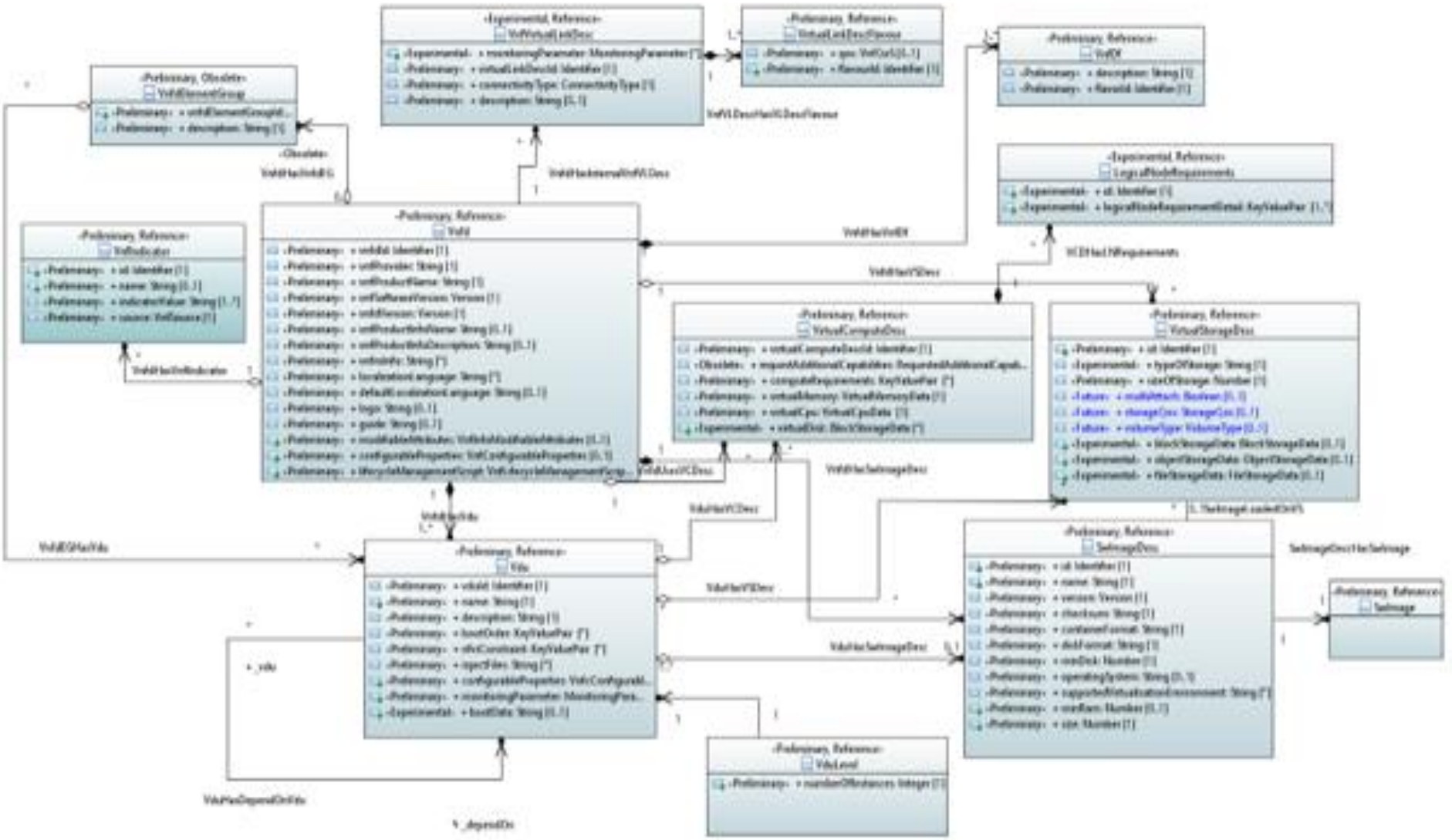


PNF Descriptor Model



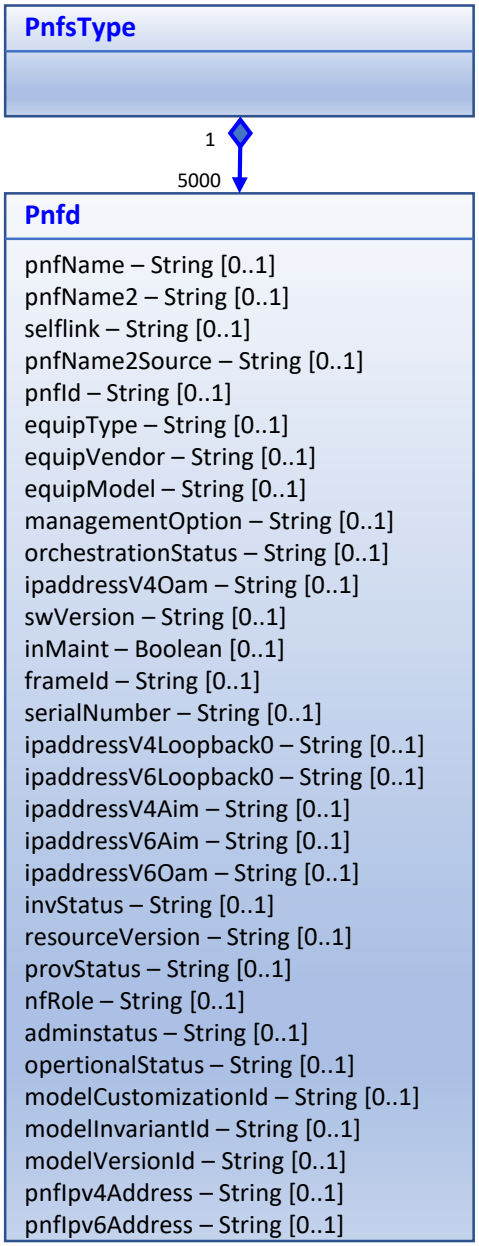
https://wiki.onap.org/display/DW/Agreed+PNFD+Model

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

SOL 001 Civic Address RFC 6225 Geolocation

3GPP TS32.

Some IOC of TS 28.622 are derived from IOCs in TS 28.620 (Federation Umbrella Information Module)

BR,
Jing

From: Andrianov, Anatoly (Nokia - US/Naperville)
Sent: Friday, November 22, 2019 8:29 AM
To: Cheung, Ben (Nokia - US/Murray Hill) <ben.cheung@nokia.com>
Cc: Ping, Jing (NSB - CN/Chengdu) <jing.ping@nokia-sbell.com>; Andrianov, Anatoly (Nokia - US/Naperville) <anatoly.andrianov@nokia.com>
Subject: RE: 5G Configuration / Resource Model

Hi Ben,

Yes, 5G NRM is in TS 28.541. For complete 5G picture you also need to look at TS 28.622 (generic NRM) and TS 28.632 (inventory NRM). There are several NRMs for LTE… for 5G we tried to consolidate all necessary information in one place, but as you may see (28.622 and 28.632) it's not the case now.

-Anatoly
P.S.: I'm CC-ing Jing – she is the rapporteur of 5G NRM

Sources

3GPP TS28.501

3GPP TS32.106

3GPP Inventory

ITUT X.731 Op/Admin

3GPP Operational

A&AI Schema

SDC AID

ONAP Platform Information Model

Complex Object Place object

ORAN WGx

TMF GB922 Location (Place)

RFC 6225 Geo Location

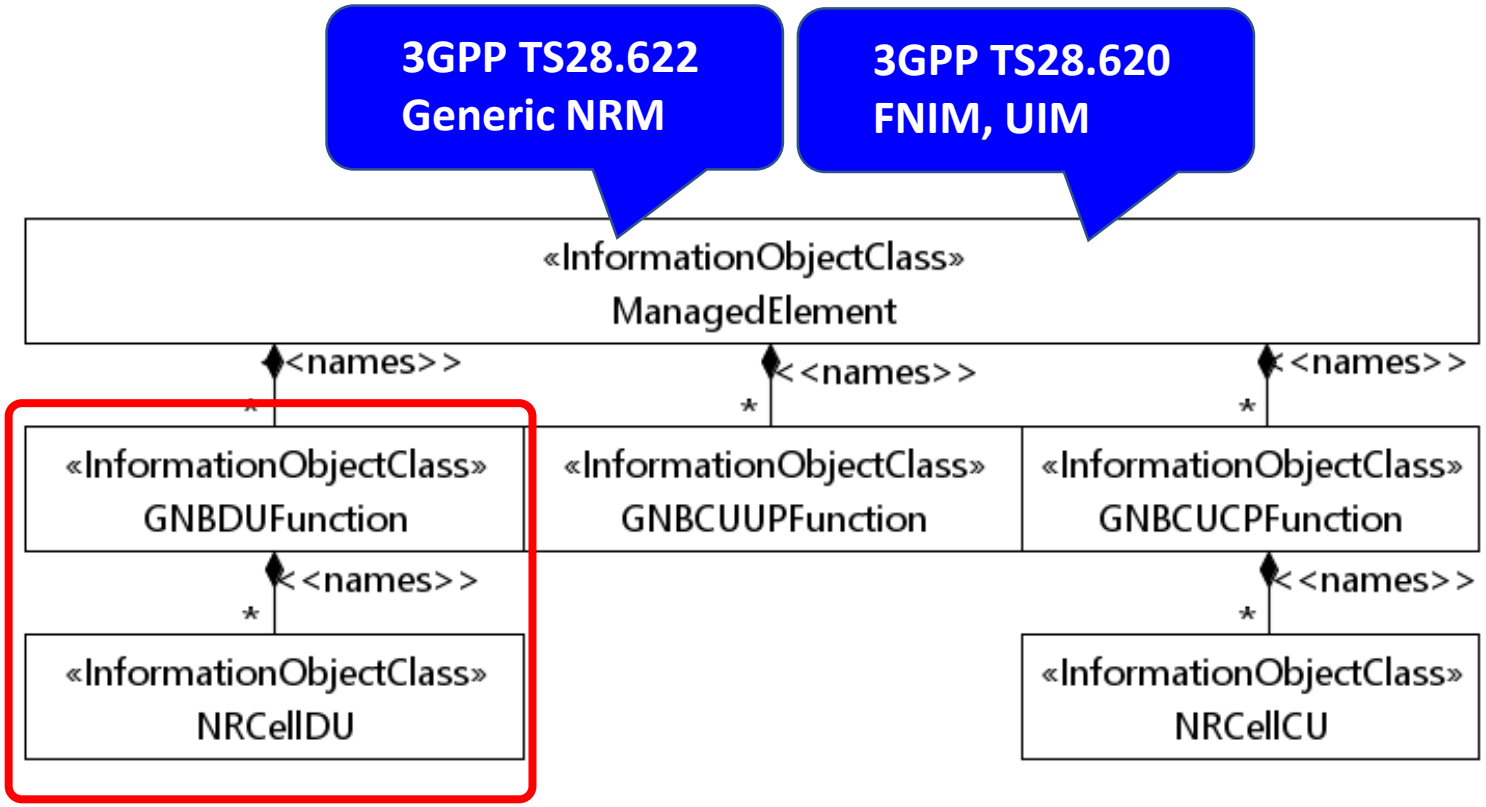
ETSI SOL 001 Civic Address

3GPP TS28.620 FNIM UIM

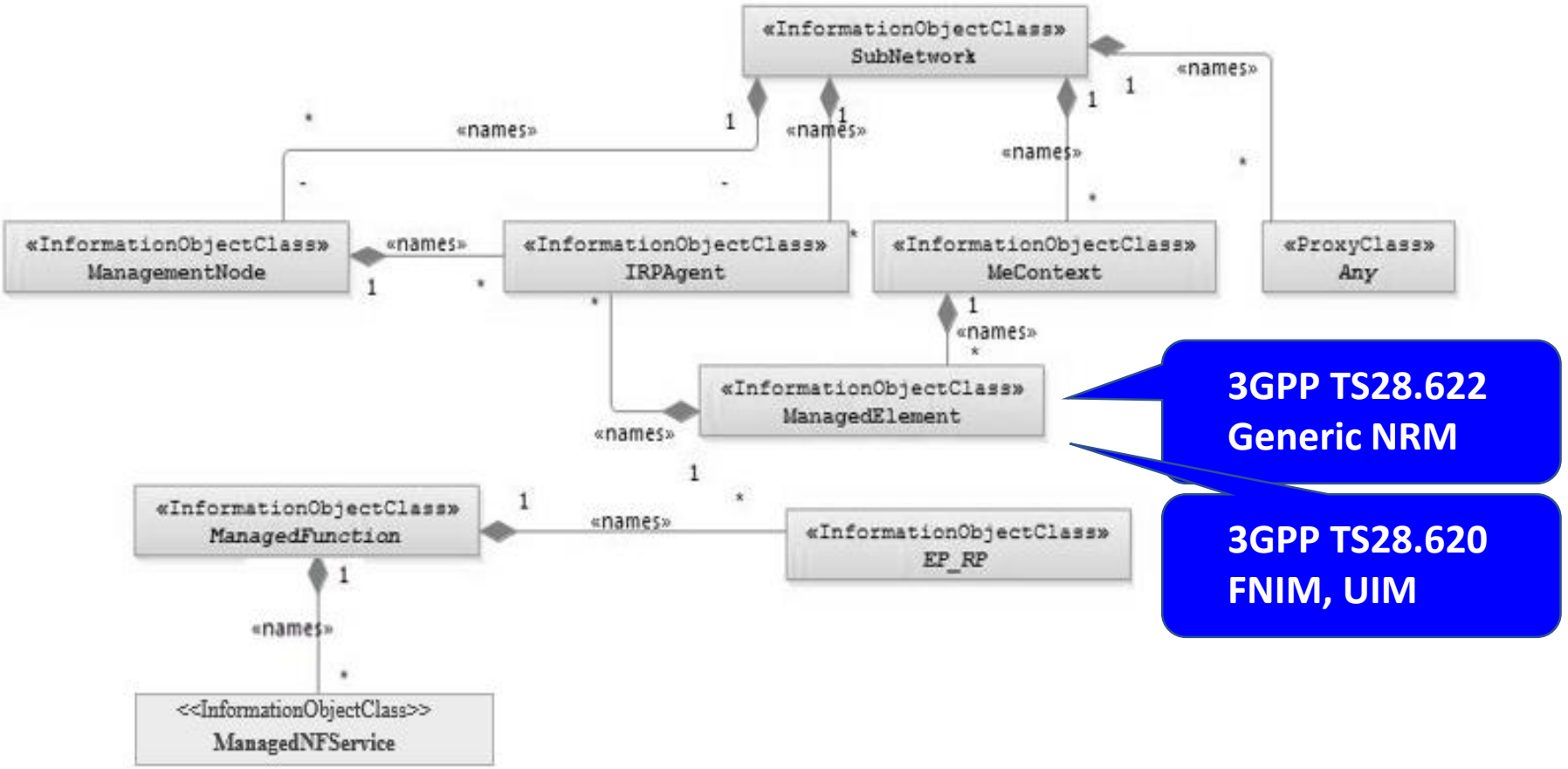
3GPP TS28.622 Generic NRM

3GPP TS28.540 5G NRM

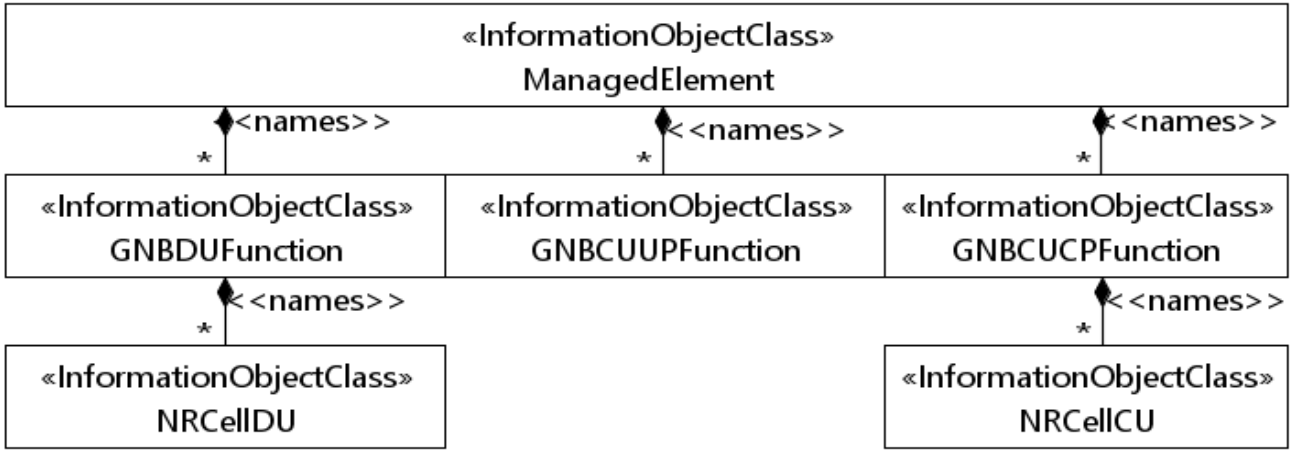
3GPP TS28.541 5G NRM

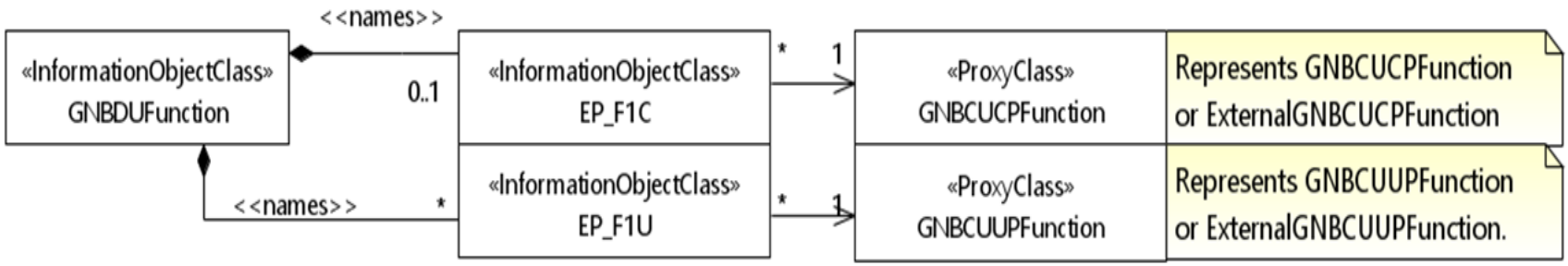


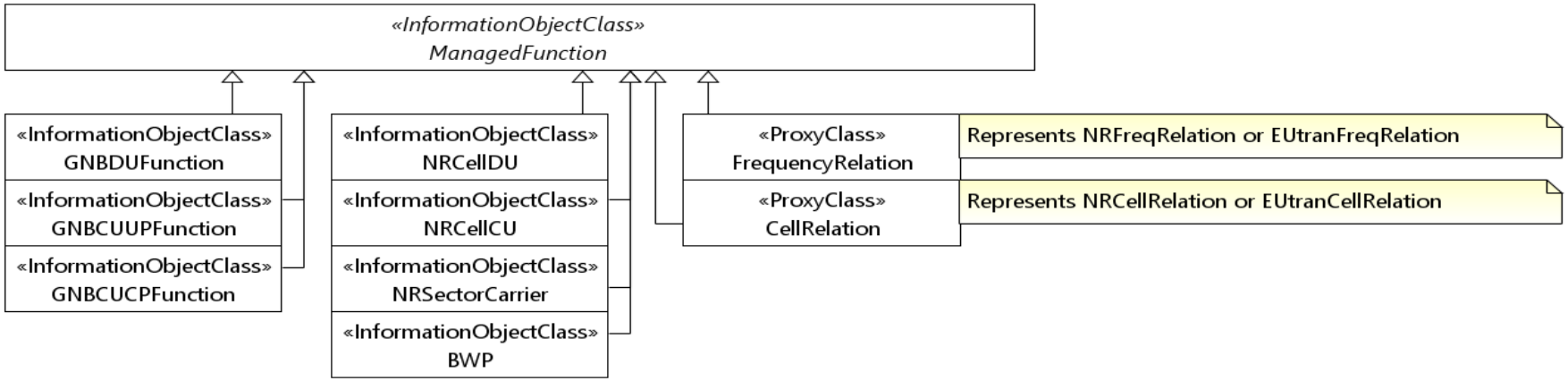
* Federated Network Information Model (FNIM) , Umbrella Information Model (UIM)


«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







Enhance Platform Information Model

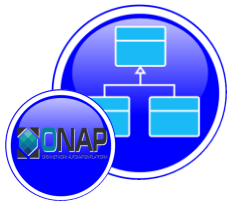
3GPP TS28.540 5G NRM

3GPP TS28.541 5G NRM

3GPP TS28.620 FNIM UIM

TS28.622 Generic NRM

5G NRM
Generic NRM

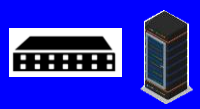


Platform Information Model ++

DESIGN TIME

Domain & Vendor specific

xNF Resource



Service CSAR

RUN TIME

SDN-C (etc)

C&PS Database

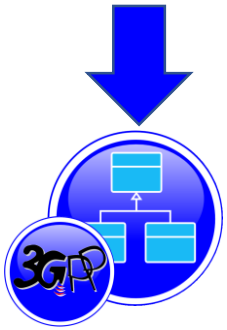
Generic Application Model

3GPP TS28.540 5G NRM

3GPP TS28.541 5G NRM

3GPP TS28.620 FNIM UIM

TS28.622 Generic NRM



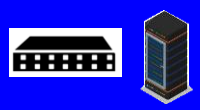
5G NRM
Generic NRM

DESIGN TIME

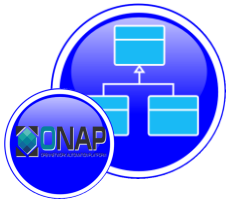
Generic Application Model

+ Domain & Vendor specific

xNF Resource



Service CSAR



Platform Information Model

RUN TIME

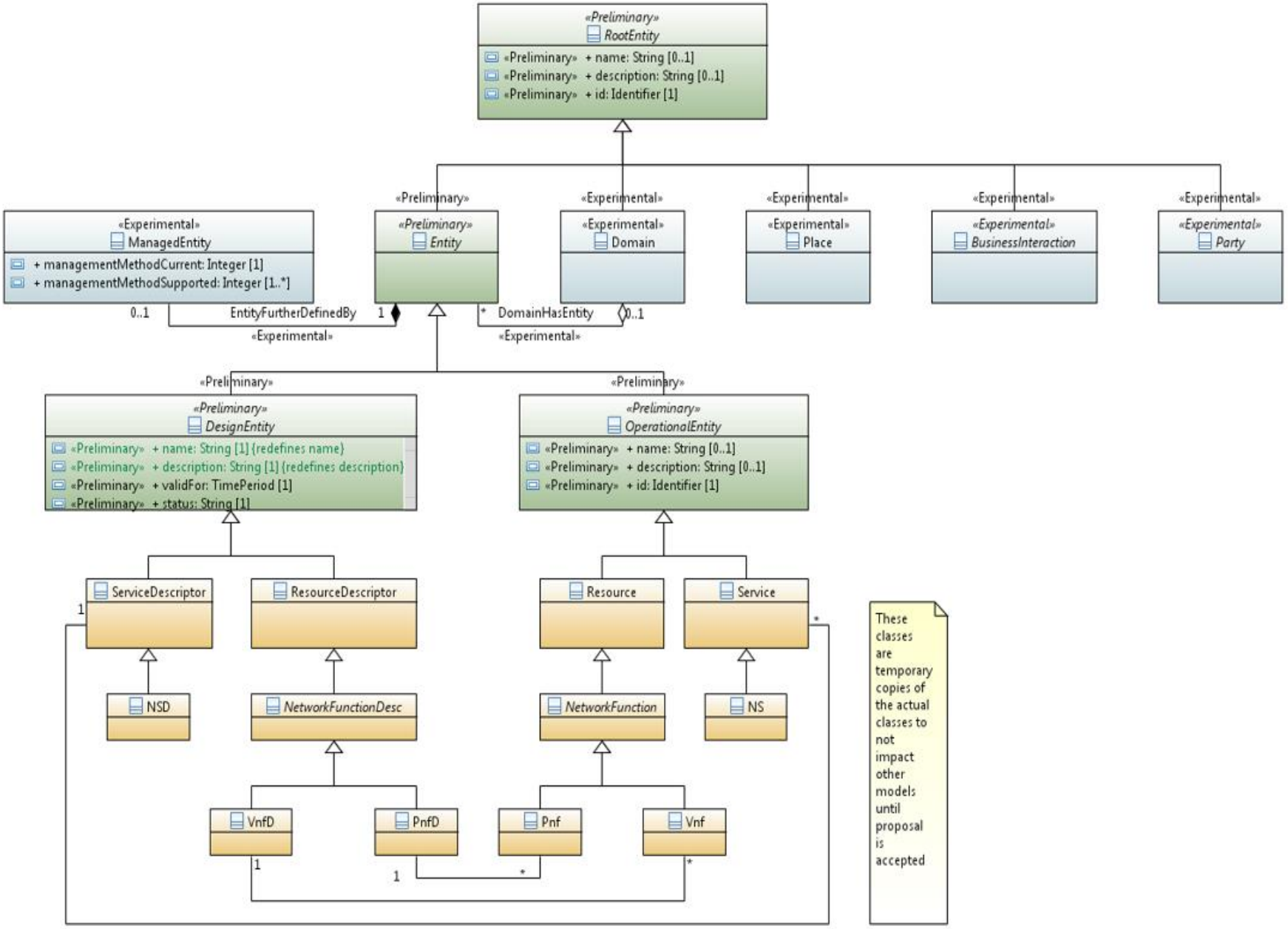
SDN-C (etc)

C&PS Database

(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

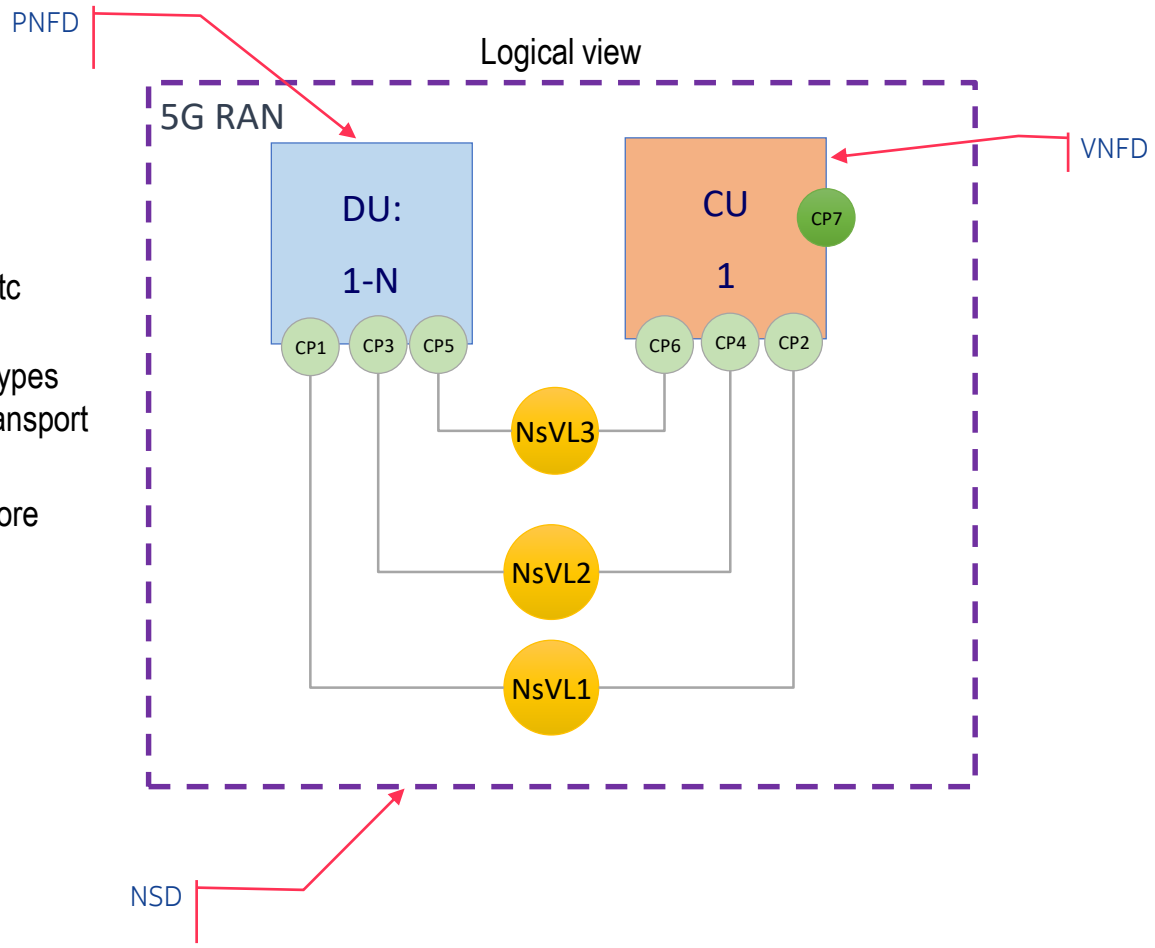
CP1 to CP6: Ext connection points (e.g. Control plane, data plane, management, etc

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

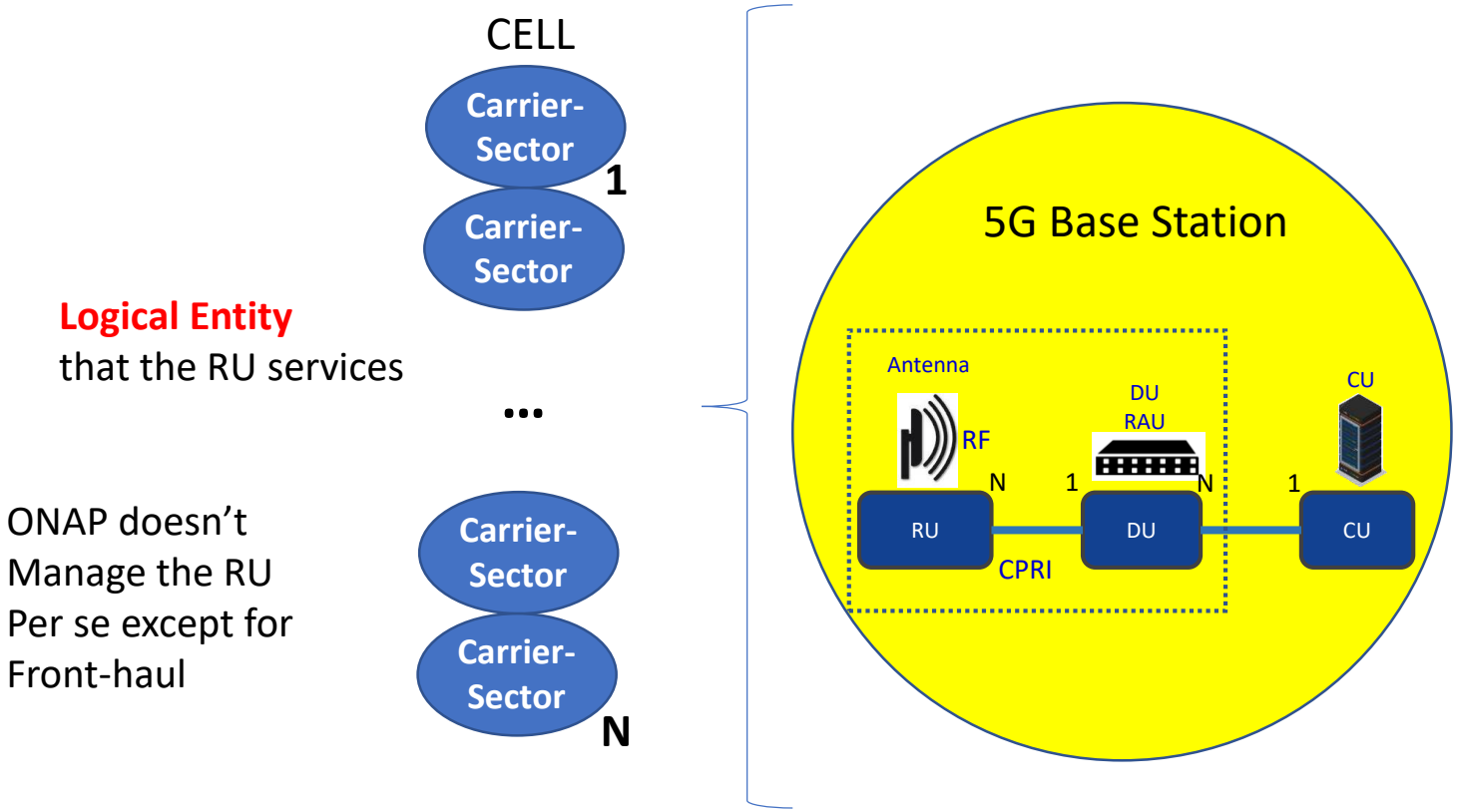
Cell_Nbr_Info (Object)	
Attribute	**Format**
cellId	String
target_cell_id	String
ho	BIT(1)

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

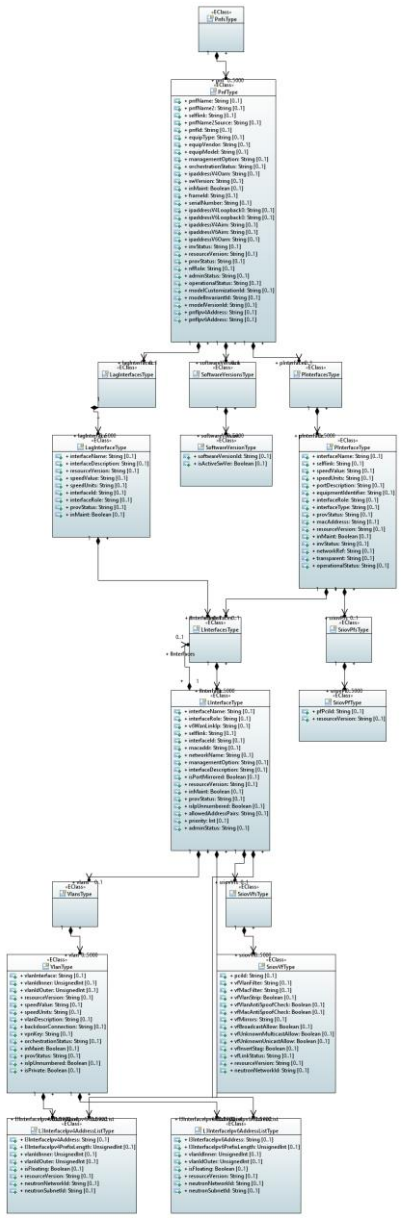
RECORD ELEMENT
INDEX = PNF #106
Parameter #1
Parameter #2
Parameter #3
State Info X.733
Associations
{ Logical Object #111 Cell #2 }
Cardinality Rules
Linking Restrictions

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

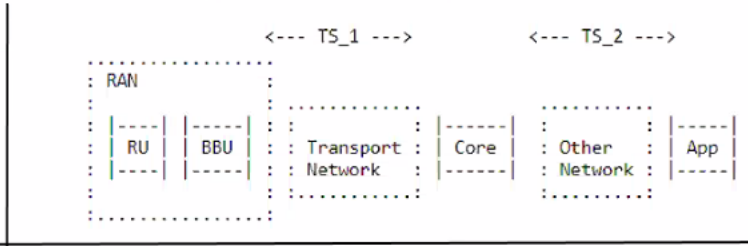
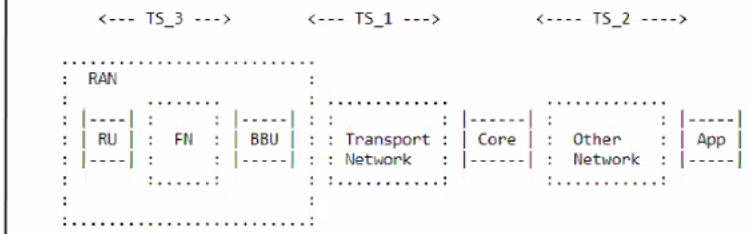
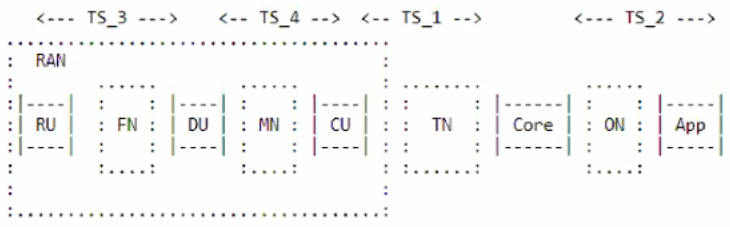
Appendix

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