Configuration & Persistency Service

- Design Developers Forum presentation

June 25, 2020 version 8

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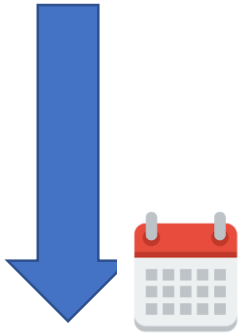
DDF June 22-25, 2020 – C&PS Agenda

TIME	JUNE 25, 2020 C&PS DDF AGENDA
20 min	**Overview of C&PS & Agenda** – Introduction to C&PS
20 min	**Model Driven C&PS Proof of Concept (PoC)** – Overview of the Model-Driven C&PS PoC for R7
3 min	**R7 & Beyond Roadmap** – Model Driven Proof of Concept (PoC) in R7, way forward in R8 Honolulu, New plan & roadmap
12 min	**Use Cases using C&PS Database** – Overview of C&PS Applications
5 min	**Questions & Answers** – Q&A



TIME	Q&A Session Post-Session(
(1 hour)	**Follow-up questions** – Follow-up meetings at C&PS Team Call (Fridays)

ONAP
OPEN NETWORK AUTOMATION PLATFORM

Overview of Configuration & Persistency Service

Business Case

Architecture S/C

Overview

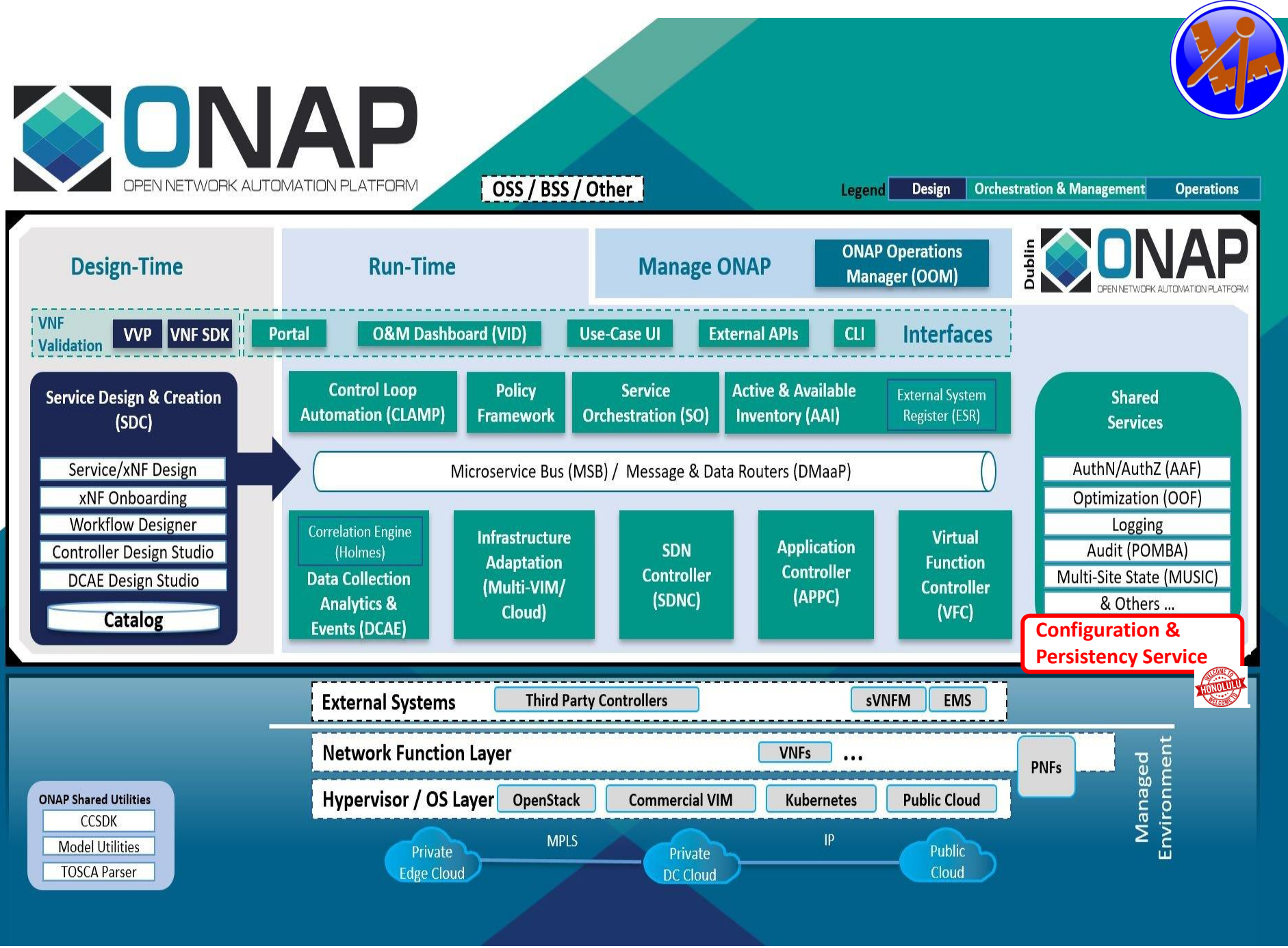
Technical Flows

Configuration & Persistency Service

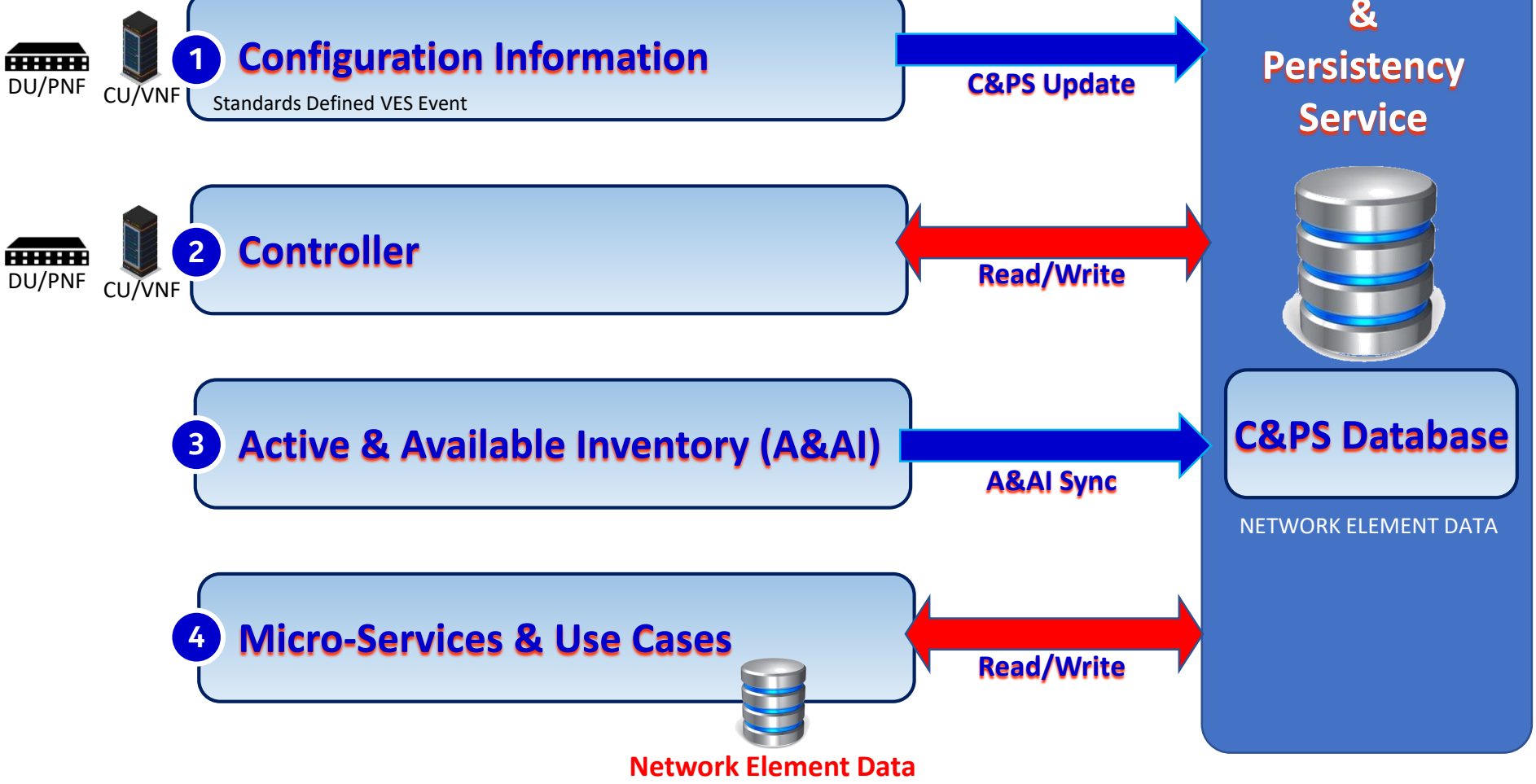
Executive Summary - The Configuration & Persistency Service is a *real-time service* that is designed to serve as a data repository for Run-time data that needs to be persistent. This will be explored as a PoC. R4/R5/R6 functionality from ConfigDB will be enhanced to continue to serve Use Cases. *Focus on storing run-time DATA RELATED to NETWORK ELEMENT instances.*

Business Impact - The ability for service operators to *visualize and manage network element data in a network (PNFs, VNFs, and logical constructs)* with ONAP is a critical business function because they are key Life Cycle Management (LCM) and OA&M operations. The project has business impacts to enhance the operation of data-handling within ONAP by providing efficient data layer services.

Business Markets - This project applies to any domain (wireless, transport, optical, and wireline) that ONAP may manage. It is not a market or geographical specific capability. It is expected that scaled ONAP installations such as Edge & Core ONAP deployments will also deploy the database across each installation.
Funding/Financial Impacts - This project represents a large potential Operating Expense (OPEX) savings for operators because of the ability to configure networks saving time and expenses.


ONAP
OPEN NETWORK AUTOMATION PLATFORM
OSS / BSS / Other
Legend
Design
Orchestration & Management
Operations
Design-Time
Run-Time
Manage ONAP
ONAP Operations Manager (OOM)
Dublin
ONAP
OPEN NETWORK AUTOMATION PLATFORM
VNF Validation
VVP
VNF SDK
Portal
O&M Dashboard (VID)
Use-Case UI
External APIs
CLI
Interfaces
Service Design & Creation (SDC)
Service/xNF Design
xNF Onboarding
Workflow Designer
Controller Design Studio
DCAE Design Studio
Catalog
Control Loop Automation (CLAMP)
Policy Framework
Service Orchestration (SO)
Active & Available Inventory (AAI)
External System Register (ESR)
Microservice Bus (MSB) / Message & Data Routers (DMaaP)
Correlation Engine (Holmes)
Data Collection Analytics & Events (DCAE)
Infrastructure Adaptation (Multi-VIM/ Cloud)
SDN Controller (SDNC)
Application Controller (APPC)
Virtual Function Controller (VFC)
Shared Services
AuthN/AuthZ (AAF)
Optimization (OOF)
Logging
Audit (POMBA)
Multi-Site State (MUSIC)
& Others ...
Configuration & Persistency Service
External Systems
Third Party Controllers
sVNFM
EMS
Network Function Layer
VNFs
...
PNFs
Hypervisor / OS Layer
OpenStack
Commercial VIM
Kubernetes
Public Cloud
Managed Environment
ONAP Shared Utilities
CCSDK
Model Utilities
TOSCA Parser
Private Edge Cloud
MPLS
Private DC Cloud
IP
Public Cloud

Configuration & Persistency Service (C&PS)



Configuration & Persistency Service (C&PS)

Management Framework Data
ONAP
RUN-TIME

Policy DB

DCAE Inventory

1

PNF
VNF

VES
Event

DCAE VES
Collector

DCAE

Standards Defined
VES Event
for Configuration

DU/PNF

CU/VNF

2

SO

SO
Service Orchestration

PNF
VNF

Netconf
O1

Controller DB

Controller

SDN-C, VF-C, APP-C

CM Notification
Change Config

DU/PNF

CU/VNF

3

A&AI DB

A&AI

Real-Time Inventory

Network Element Data

4

U/C DB

Micro-Service

PCI, E2ENS, A1P, MD PoC

DMaaP

Configuration NameSpace topic
3GPP-Provisioning

C&PS Update

Read

Read/Write

A&AI Sync

Read/Write

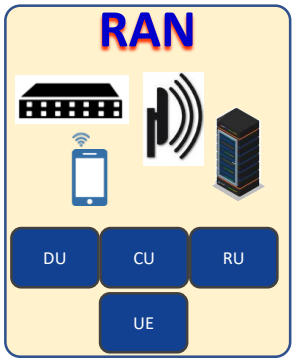
Network Element Data

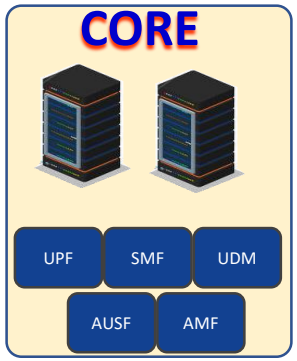
Configuration
&
Persistency
Service

C&PS Database

Run-Time Operational Data
Configuration Info
Exo-Inventory Data
State Information

Configuration & Persistency Service (C&PS)





Network Element Data
Application Parameters
Configuration Parameters

1 C&PS Update

Network Element Data

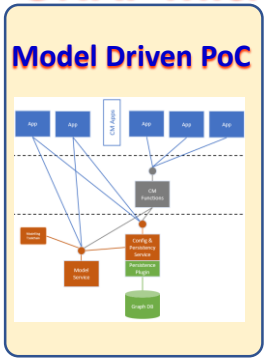
Configuration & Persistency Service

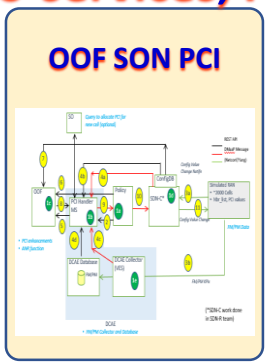
C&PS Database

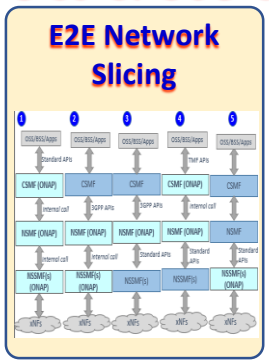
Run-Time Operational Data
Configuration Info
Exo-Inventory Data
State Information

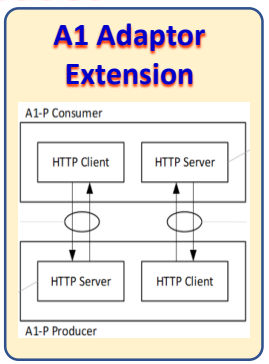
GUI Access

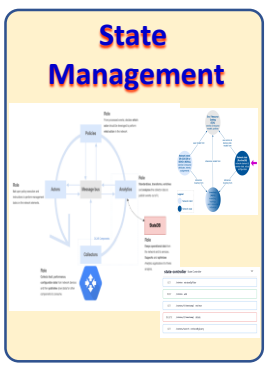
ONAP Micro-services, POCs & Use Cases











U/C Data

4

C&PS READING: PNF Reports StndDef VES

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 R6/R7: RTCDB is part of CC-SDK part of SDN-R. Thus, SDN-R receives the VES Event and writes to RTCDB

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

Data Persistency Service (Run-Time View)

ONAP RUN-TIME

DMaaP

Config & Persist Service

(1) During Network setup "getall" retrieves from A&AI the ENTIRE A&AI graph. Used to setup the initial view of C&PS
(2) Updates additions/deletions of xNFs. "AAI-Event" (operation Addition / delete)

In R6/R7: "getall" A&AI update, individual A&AI update
In R8+: RTCDB is a stand-alone component. Performs "getall" A&AI update and atomic A&AI update. Atomic "updates" from A&AI add/remove of xNF is published by A&AI as an update on DMaaP bus

3

A&AI DB

A&AI

Inventory, Listener

A&AI Sync

C&PS Database

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

C&PS WRITING: Micro Service Update

ONAP RUN-TIME

DMaaP

Config & Persist Service

C&PS Database

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

A Micro-Service, for example OOF/SON/PCI determines that an update is needed to RTCDB from operation/algorithm. It publishes to the DMaaP bus an update event.

In R6/R7: RTCDB is in CC-SDK (part of SDN-R). Thus, SDN-R receives the VES Event and writes to RTCDB
In R8+: RTCDB is a stand-alone component. RTCDB subscribes to the DMaaP topic and gets the DMaaP event off the DMaaP bus to update itself.

4

Micro Service

OOF/SON/PCI

Read/(Write)

C&PS WRITING: From Controller SDN-R

ONAP RUN-TIME

DMaaP

Config & Persist Service

A SO, Policy, or Control Loop has determined a parameter update is needed to the xNF. The Controller (SDN-R) eventually gets the configuration update. SDN-R publishes to the DMaaP bus an update event.

B The Controller (SDN-R) also sends a message to the xNF to update the parameter. This may be done via NetConf/O1/Ansible

DU CU

PNF VNF

Netconf O1

Ansible, Chef
CM Notification
Change Config

2 Controller DB

Controller

SDN-R, VF-C, APP-C

C Controller (SDN-R) gets an ACK back from the xNF that the parameter change was successful.

D xNF would may send a CMNotify unless xNF configured to suppress event on ONAP origination

E **In R6/R7:** RTCDB is in CC-SDK (part of SDN-R). Thus, SDN-R receives the VES Event and writes directly to RTCDB

Read/Write

C&PS Database

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

C&PS WRITING: From Controller SDN-C

ONAP RUN-TIME

DMaaP

Config & Persist Service

A SO, Policy, or Control Loop has determined a parameter update is needed to the xNF. The Controller (SDN-C) eventually gets the configuration update. SDN-C publishes to the DMaaP bus a configuration update event.

B The Controller (SDN-C) also sends a message to the xNF to update the parameter. This may be done via NetConf/O1/Ansible

DU/PNF CU/VNF

PNF VNF

Netconf O1

CM Notification
Change Config

2 Controller DB

Controller

SDN-C, VF-C, APP-C

C Controller (SDN-C) gets an ACK back from the xNF that the parameter change was successful.

D xNF would may send a Standards Defined VES unless xNF configured to suppress event on ONAP origination

E R8+ The configuration & standards service as a stand-alone component subscribes to the DMaaP topic and gets the DMaaP event off the DMaaP bus to update the internal database. A configuration namespace topic is used, 3GPP-Provisioning

Read/Write

Configuration NameSpace topic
3GPP-Provisioning

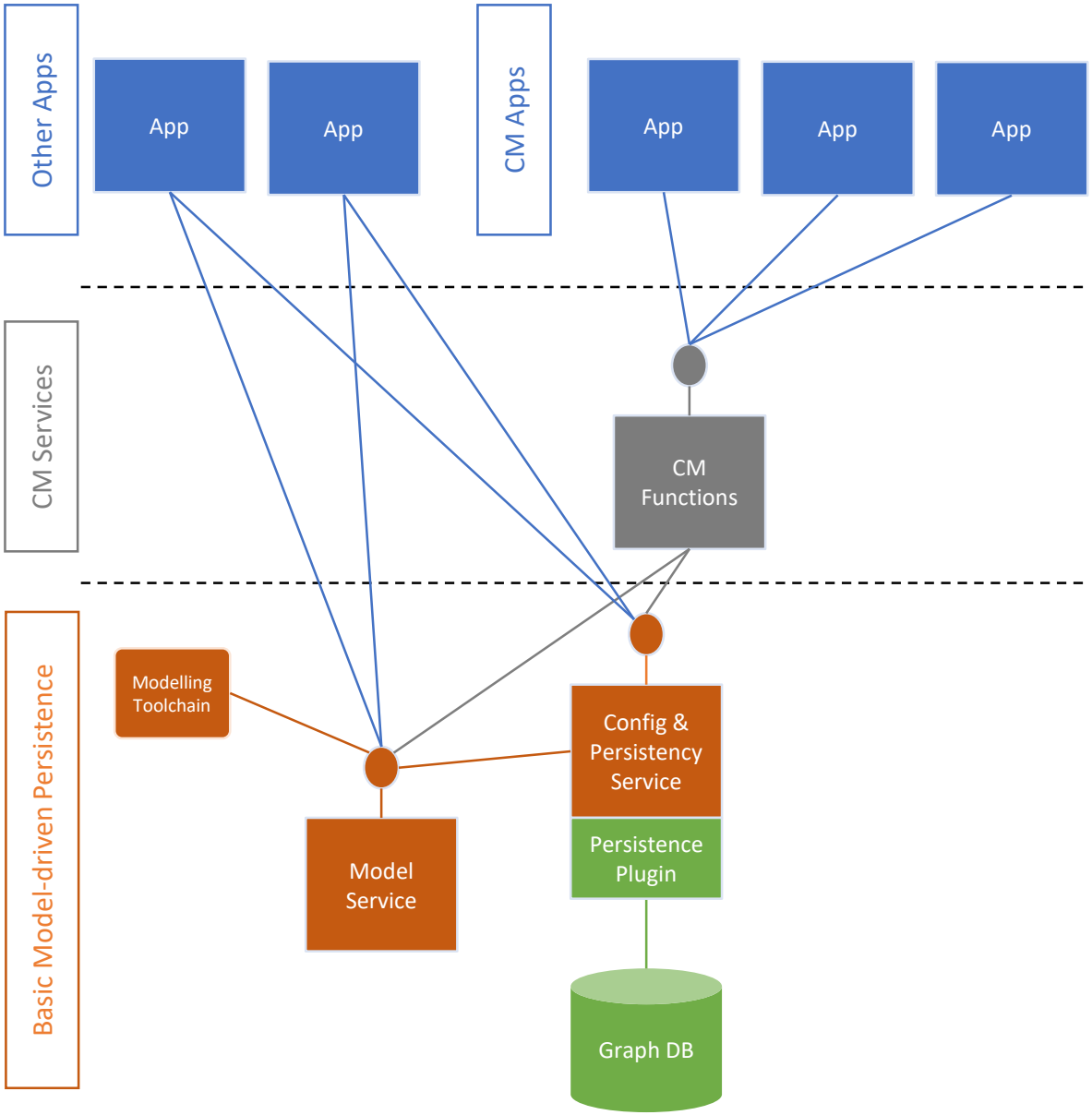
C&PS Database

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

R7 – Model Driven Configuration & Persistency Service Proof of Concept

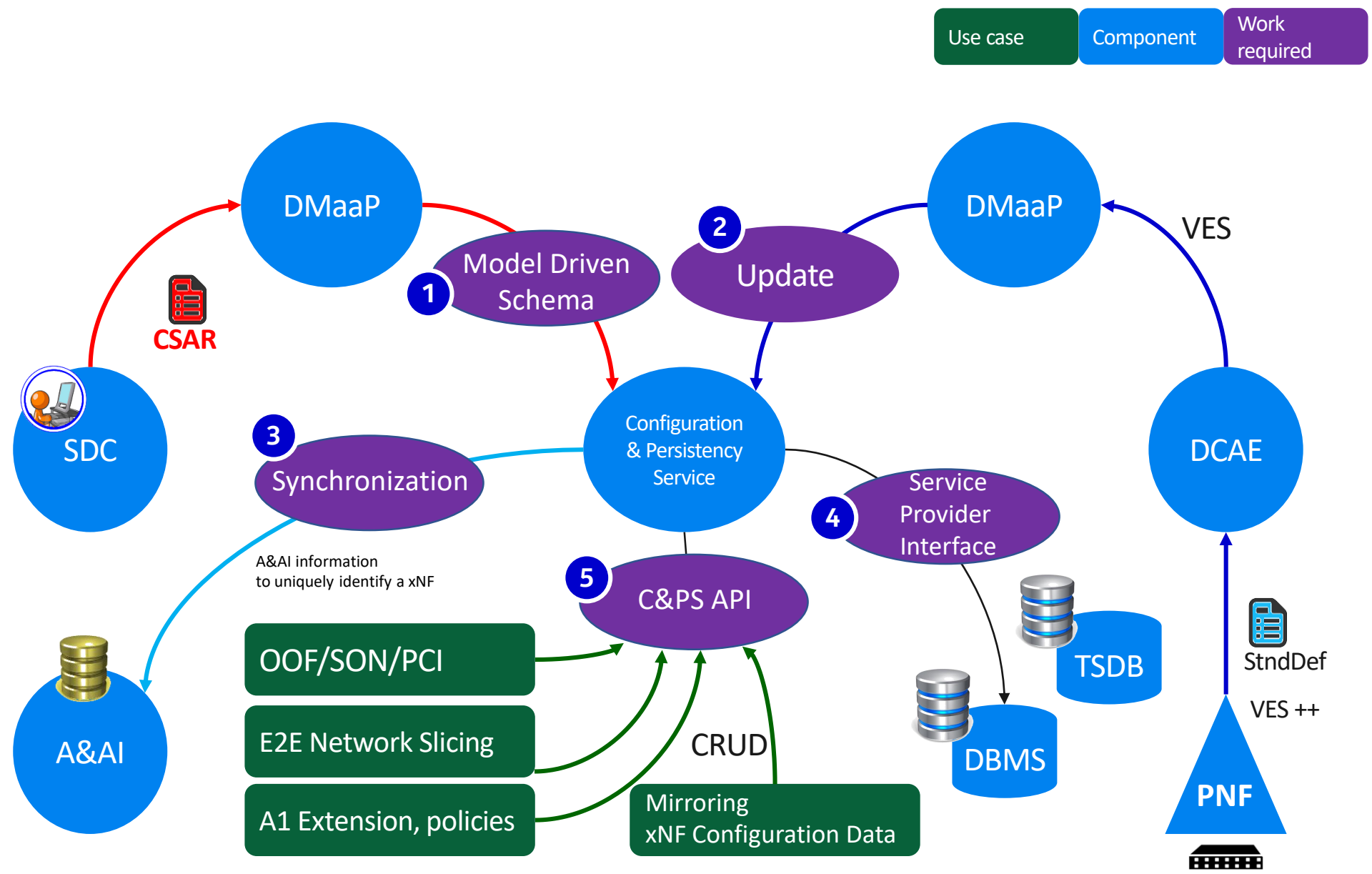
Proof of Concept

R7 Model Driven C&PS PoC (Ericsson)

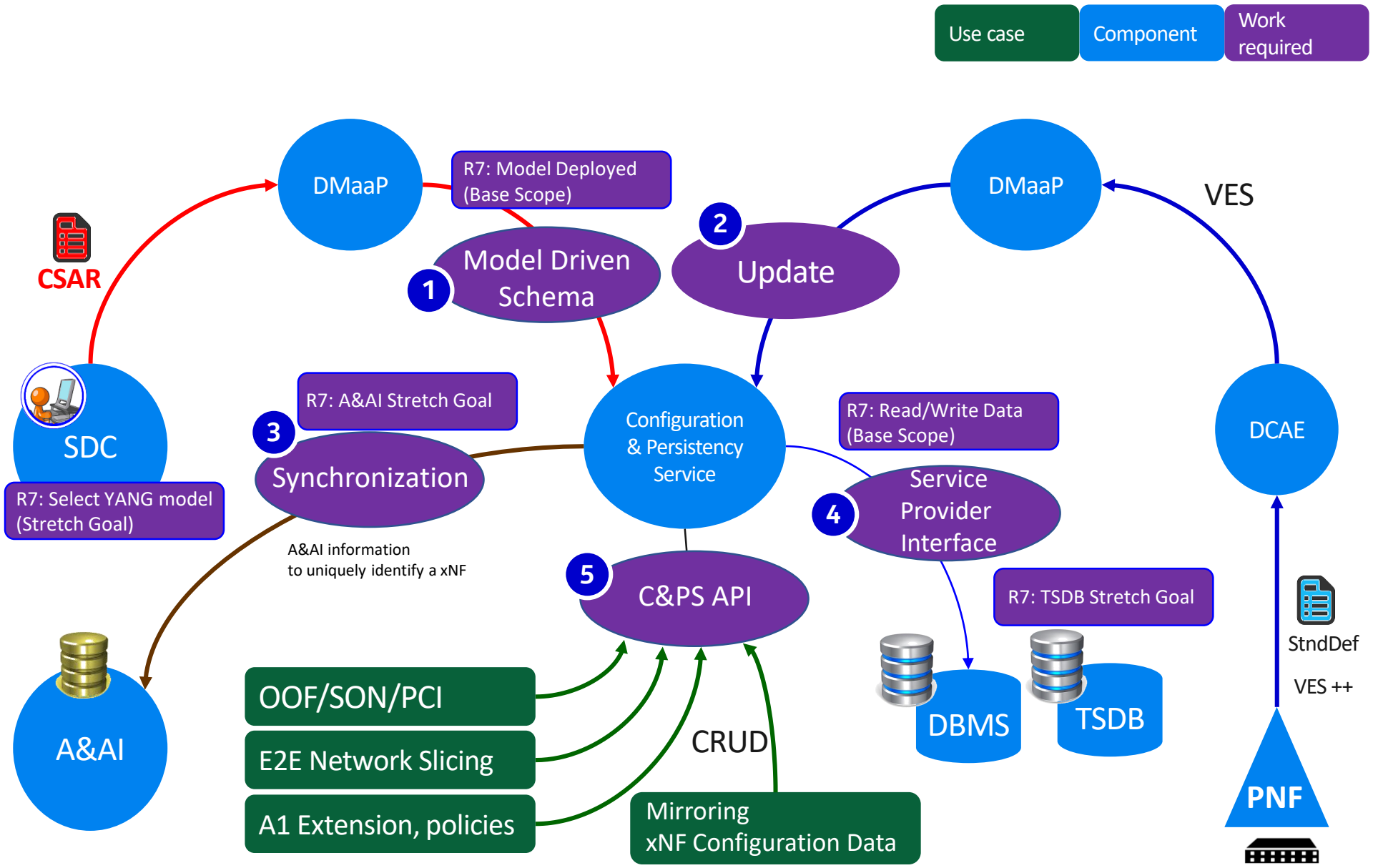


- Provide schema-less model-driven (type safe) access to data which is owned by applications or indirectly by network functions
  - Applications own their own subset of the data according to cloud native principles ; in a separate logical or actual CPS instance
- Provide a model-driven specification for integrating external data sources
- Persisted data can be normalized or non-normalized
- Supports bulk, incremental and attribute value change reconciliation. It is best suited to data that is hierarchical and/or highly connected.
- New model versions can be introduced on-the-fly to the model repository to allow for evolution of the management platform to support network function versions without the need for a software change
- The Model Service is populated in multiple ways
  - Network function models are automatically injected by the Design and Onboarding component when the software packages are onboarded to it
  - Models are discovered from the network functions on instantiation
  - Application-specific models are injected by the App Manager when the app is deployed

R7 Model Driven C&PS PoC (Ericsson)



R7 Model Driven C&PS PoC



C&PS Roadmap

Roadmap

C&PS Roadmap & R7-R8 Plan

Configuration & Persistency Service (CPS) Roadmap –

R7 Guilin → **R8 Honolulu** → **Rx Future**

R6 C&PS Extensions

Model-Driven PoC

- Establish key components for C&PS
- Write Real-Time NE *Configuration Data*
- Read (same) Data
- Access Control

Supporting R7 Use Cases:

- SON/OOF/PCI U/C,
- 5G E2E Network Slicing
- A1 Policy extension
- State Management
- Model Driven C&PS PoC

December 2020

R8 C&PS project proposal

CPS FUNCTIONALITY:

- Data Recovery
- Model Adaption (Dynamic Schema)

July 2021

Rx (future) development

CPS FUNCTIONALITY:

- Data Auditing
- Topology Traversal
- Data History
- Roll-Back
- Database Backup
- Data Syncing
- Performance Optimization (Scaling)

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

ONAP
OPEN NETWORK AUTOMATION PLATFORM

Use Cases & Proof of Concepts

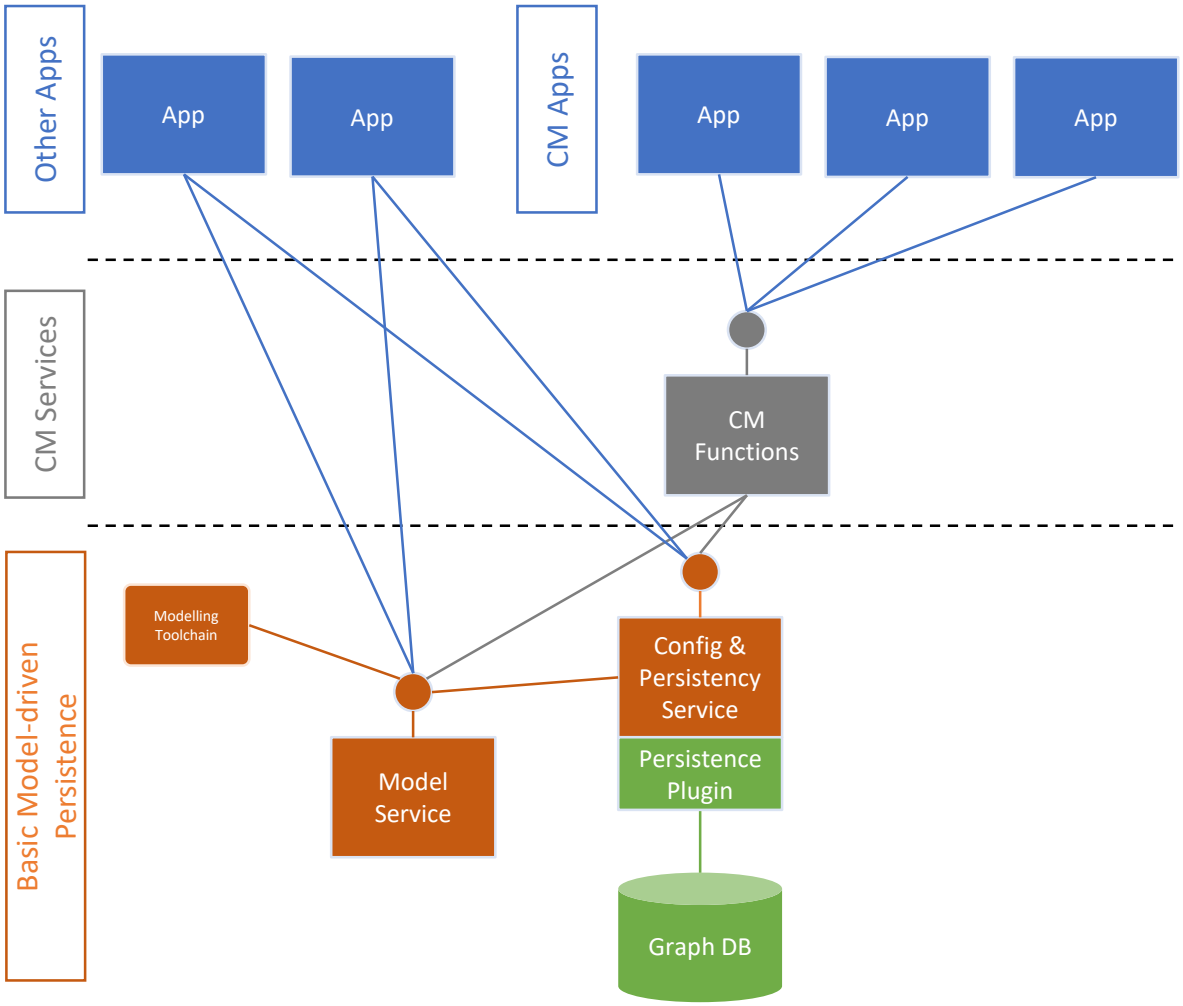
Use Cases

Proof of Concept

C&PS Use Cases and Proof of Concepts

5G USE CASE	DESCRIPTION
MODEL DRIVEN C&PS POC	Proof of Concept development to showcase model-driven Configuration & Persistency Service operation. It schema-less model-driven (type safe) access to data which is owned by applications or indirectly by network functions
OOF - SON (5G)	Optimization and SON functions for 5G RAN. Self-optimization, Self-Healing, Self-configuration.
NETWORK SLICING (5G Use Case)	Network Slicing defines Slices for 5G RAN systems. Network Slicing is a long-lead (multi-release) development. (will be presented in its own lecture at the Virtual Face to Face)
MOBILITY STANDARDS HARMONIZATION/ A1 adapter	A1 adapter: Enhancing the A1 adapter/interface capabilities in ONAP to manage A1 Policies, support multiple A1 targets in the RAN and multi-version A1 interface for different A1 targets, introduce secure TLS communication.
STATE MANAGEMENT POC	Bell Canada led PoC for State tracking and State management using C&PS

Model Driven C&PS PoC (Ericsson)



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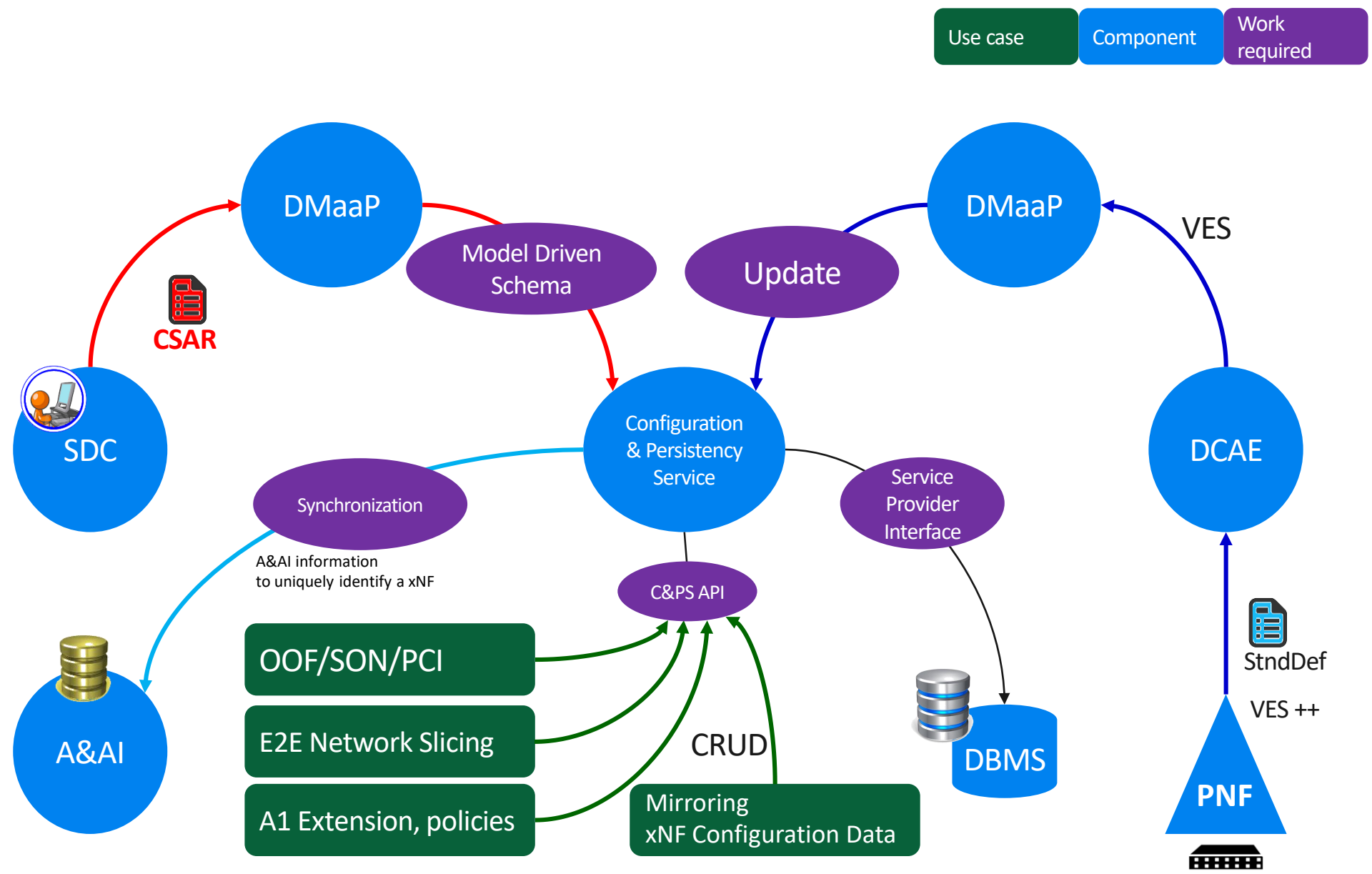
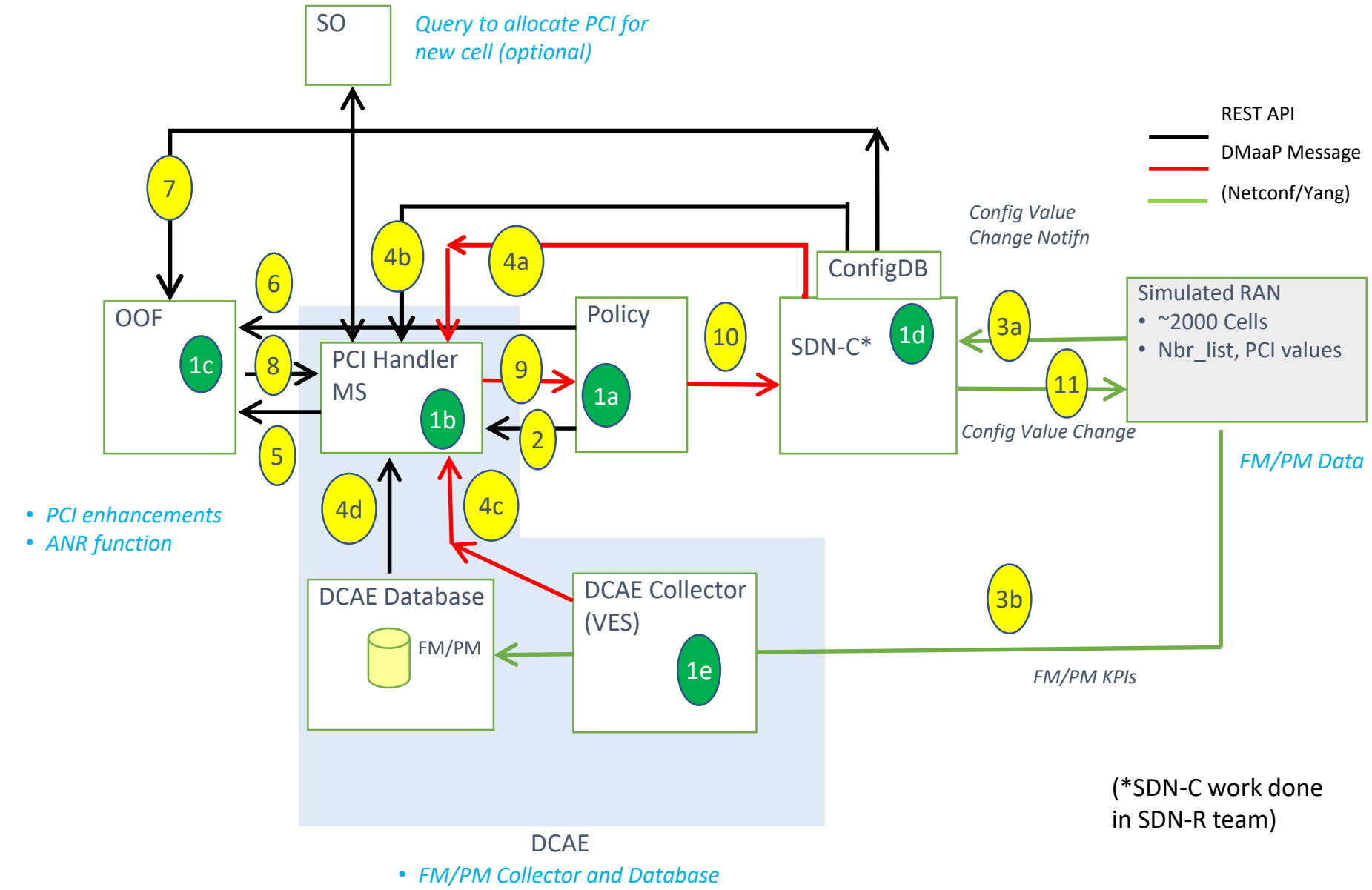


OOF / SON / PCI Use Case



(*SDN-C work done in SDN-R team)

OOF / SON / PCI Use Case

- 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 indicates netconf server to be used for interactions regarding cells
- Pnf object (pnf-name, pnf-id) to be aligned with A&AI (A&AI/ConfigDB interaction to be finalized in Dublin release)

Cell (Object)

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

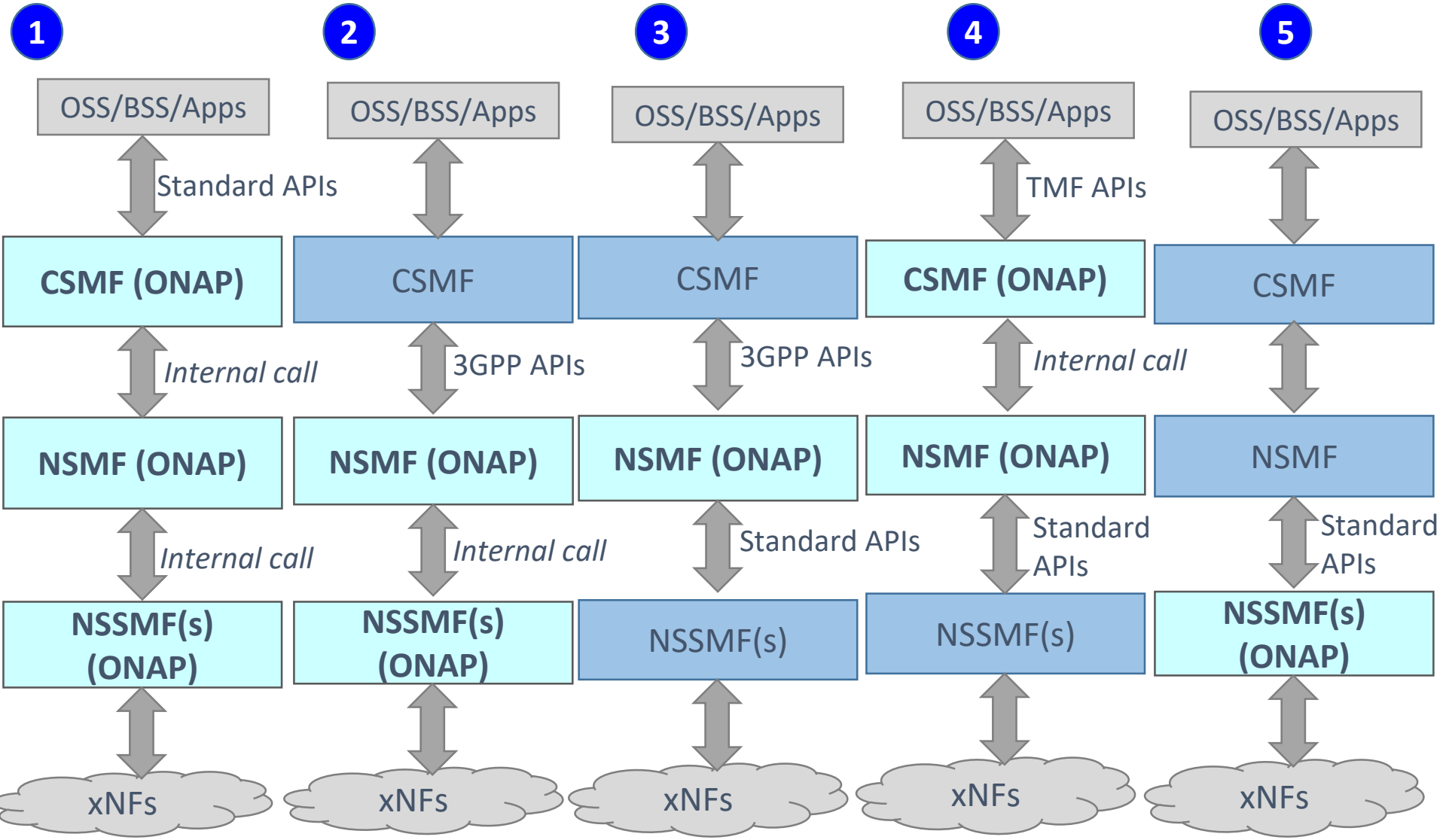
pnf (Object)

Attribute	Format
pnf-name	String
cells	List of cellID's
lastModifiedTS	timestamp

ConfigDB API

API	Input	Output
GET cellList	networkId, ts	List of cellIds
GET PCI	cellId, ts	PCI Value
GET nbrList	cellId, ts	List of cellIds and their PCI values
GET pnf-name	cellID, ts	pnf-name

End to End Network Slicing Use Case



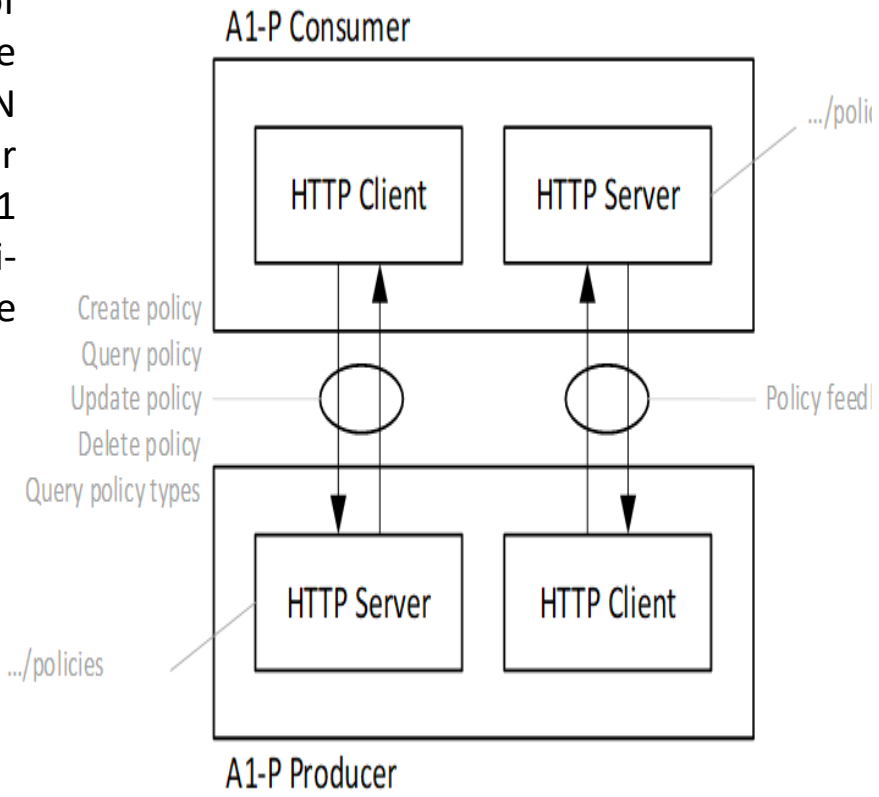
3rd party component

End to End Network Slicing Use Case

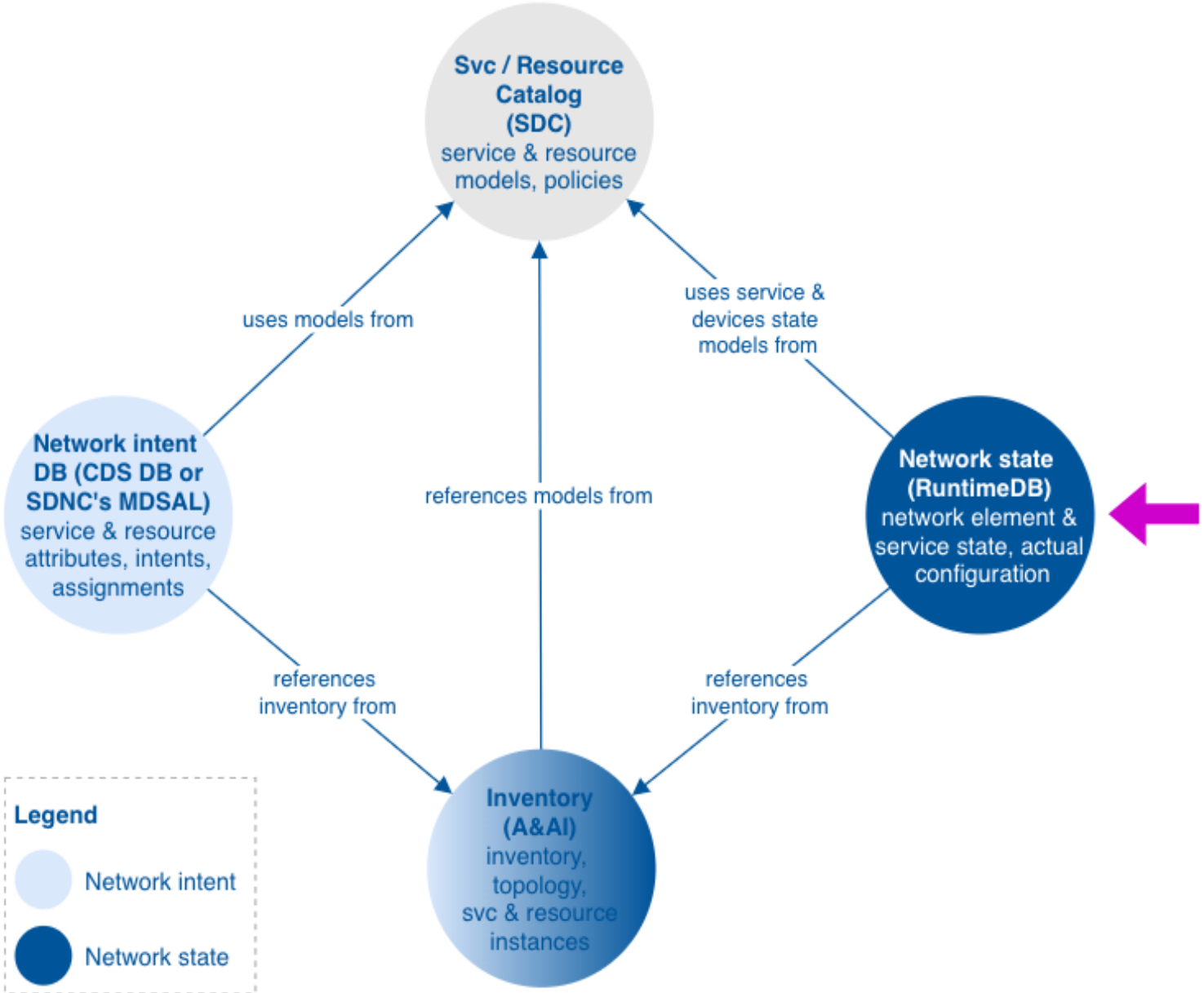
NetworkSlice	Network Slice NRM	operationalState
NetworkSlice	Network Slice NRM	administrativeState
NetworkSlice	Network Slice NRM	serviceProfileList
NetworkSlice	Network Slice NRM	networkSliceSubnetRef
NetworkSliceSubnet	Network Slice NRM	operationalState
NetworkSliceSubnet	Network Slice NRM	administrativeState
NetworkSliceSubnet	Network Slice NRM	nsInfo
NetworkSliceSubnet	Network Slice NRM	sliceProfileList
NetworkSliceSubnet	Network Slice NRM	managedFunctionRef
NetworkSliceSubnet	Network Slice NRM	networkSliceSubnetRef
ServiceProfile	Network Slice NRM	serviceProfileId
ServiceProfile	Network Slice NRM	sNSSAIList
ServiceProfile	Network Slice NRM	pLMNIdList
ServiceProfile	Network Slice NRM	perfReq
ServiceProfile	Network Slice NRM	maxNumberofUEs
ServiceProfile	Network Slice NRM	coverageAreaTAList
ServiceProfile	Network Slice NRM	latency
ServiceProfile	Network Slice NRM	uEMobilityLevel
ServiceProfile	Network Slice NRM	resourceSharingLevel
ServiceProfile	Network Slice NRM	sST
ServiceProfile	Network Slice NRM	availability
SliceProfile	Network Slice NRM	sliceProfileId
SliceProfile	Network Slice NRM	sNSSAIList
SliceProfile	Network Slice NRM	pLMNIdList
SliceProfile	Network Slice NRM	perfReq
SliceProfile	Network Slice NRM	maxNumberofUEs
SliceProfile	Network Slice NRM	coverageAreaTAList
SliceProfile	Network Slice NRM	latency
SliceProfile	Network Slice NRM	uEMobilityLevel
SliceProfile	Network Slice NRM	resourceSharingLevel

A1 Policy Extension ORAN-ONAP Harmonize

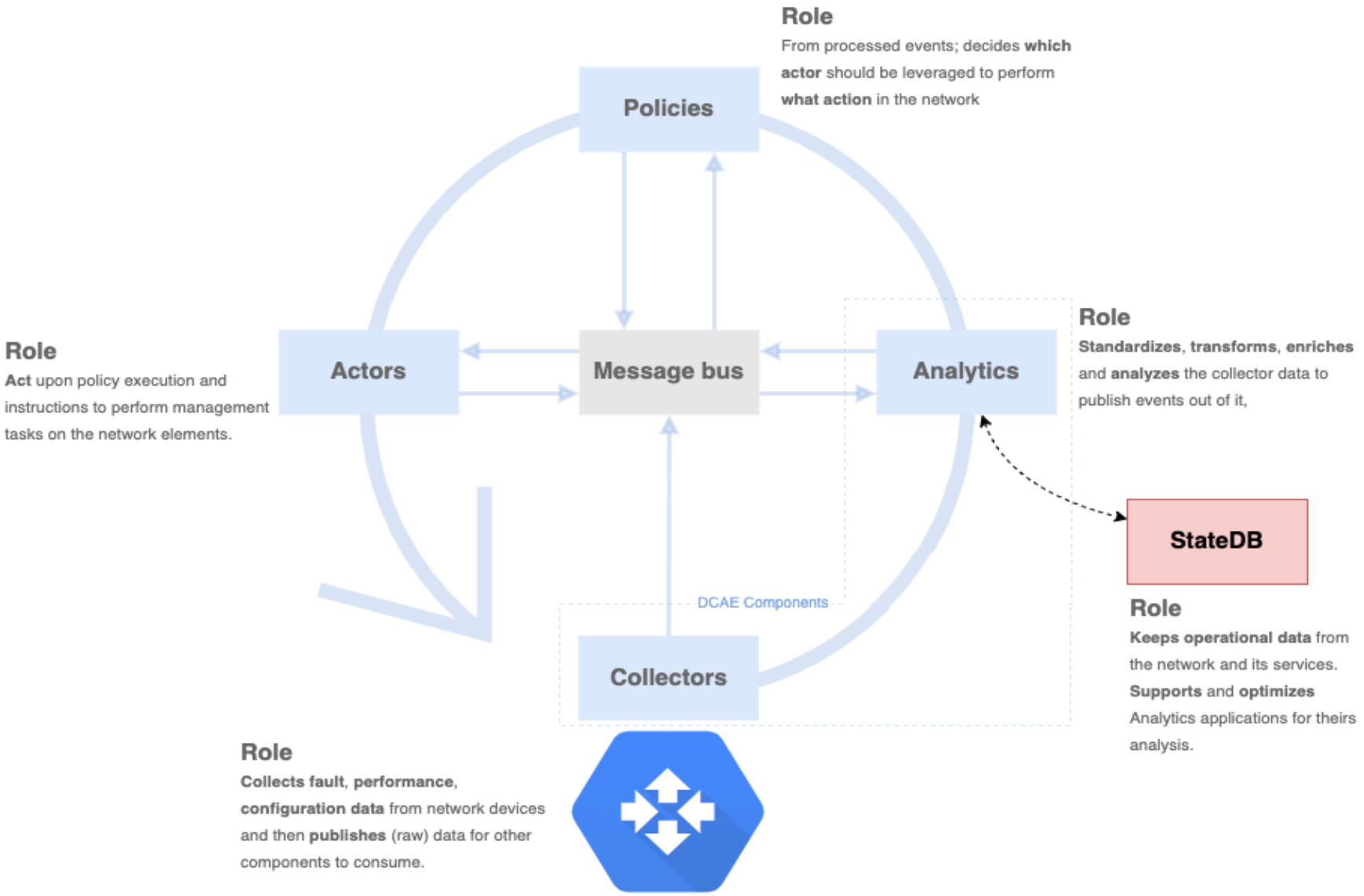
Executive Summary - This requirement enhances the A1 adapter/interface capabilities provided in Rel 6 as part of 5G/ORAN & 3GPP Standards Harmonization requirement (REQ-38). O-RAN has defined A1 interface specification in the context of the management of 5G RAN elements to provide intent based policies for optimization of the RAN network performance. Planned enhancements for Rel 7 include additional support for managing A1 Policies, multiple A1 targets in the RAN, multi-version support for different A1 targets, and secure TLS communication.



State Management PoC (Bell Canada)



State Management PoC (Bell Canada)



State Management PoC (Bell Canada)

state-controller State Controller

GET	/states	retrieveByFilter
POST	/states	add
GET	/states/{timestamp}	retrieve
DELETE	/states/{timestamp}	delete
GET	/states/search	retrieveByQuery

ONAP
OPEN NETWORK AUTOMATION PLATFORM

APPENDIX

Benjamin Cheung

Access, Syncing, Indexing Runtime Config DB

ACCESS TO C&PS Database (READ/WRITE):

READ ONLY - Run-Time parameters can be READ by any ONAP platform component and any ONAP plug-in. Examples of ONAP platform components are A&AI, SDC, SDNC etc.

READ/WRITE - Parameters can be READ/WRITE from Controllers, DCAE (future), VES Collector/DMaaP, A&AI, Policy/CLAMP (future) and other components with permission settings.
DEFAULT - SO (future), DCAE, A&AI (indirectly), Controllers (CDS, APPC, SDNC) will have default read/write access to C&PS Database
DEFINABLE - Other components will have default read-only access to Config & Persist Service but can be given Read/Write access on a per record basis.

SYNCING NEW xNF ADDED or DELETED (A&AI):

ELEMENT SYNC - Software keeps the A&AI elements with the elements in the RunTime Config DB in Sync. When the network first being established, a *GetAllPNFs* function from A&AI can be used on startup.
A&AI - A&AI is still the master of valid entities in the network and provides a dynamic view of the assets (xNFs) available to ONAP
C&PS Database - The C&PS Database is a master of the associate (exo-inventory) data associated with the entities.
DYNAMIC VIEW - When a xNF appears or is removed from the system, C&PS Database records will be added/removed based on A&AI entries.
LOGIC - When a xNF appears is removed there is logic to determine how and when something is to be updated. There is some intelligence to know what elements of update.

INDEXING:

INDEXING - Data Records will be indexed by xNF (VNF, PNF, ANF). It would be an objective to have a similar indexing mechanism as A&AI. May also need an index to be a logical object ID.

RETRIEVAL - How are data records retrieved efficiently. This relates how the records are indexed.

Dependencies vs Scope

DEPENDENCIES – need to operate

SDC Yang Model (to load schema)
ability to process & translate yang models into schemas
AAF (intra-ONAP security)
Database implementation for Data Persistency
(for example MariaDB)

DEPENDENCIES – value added

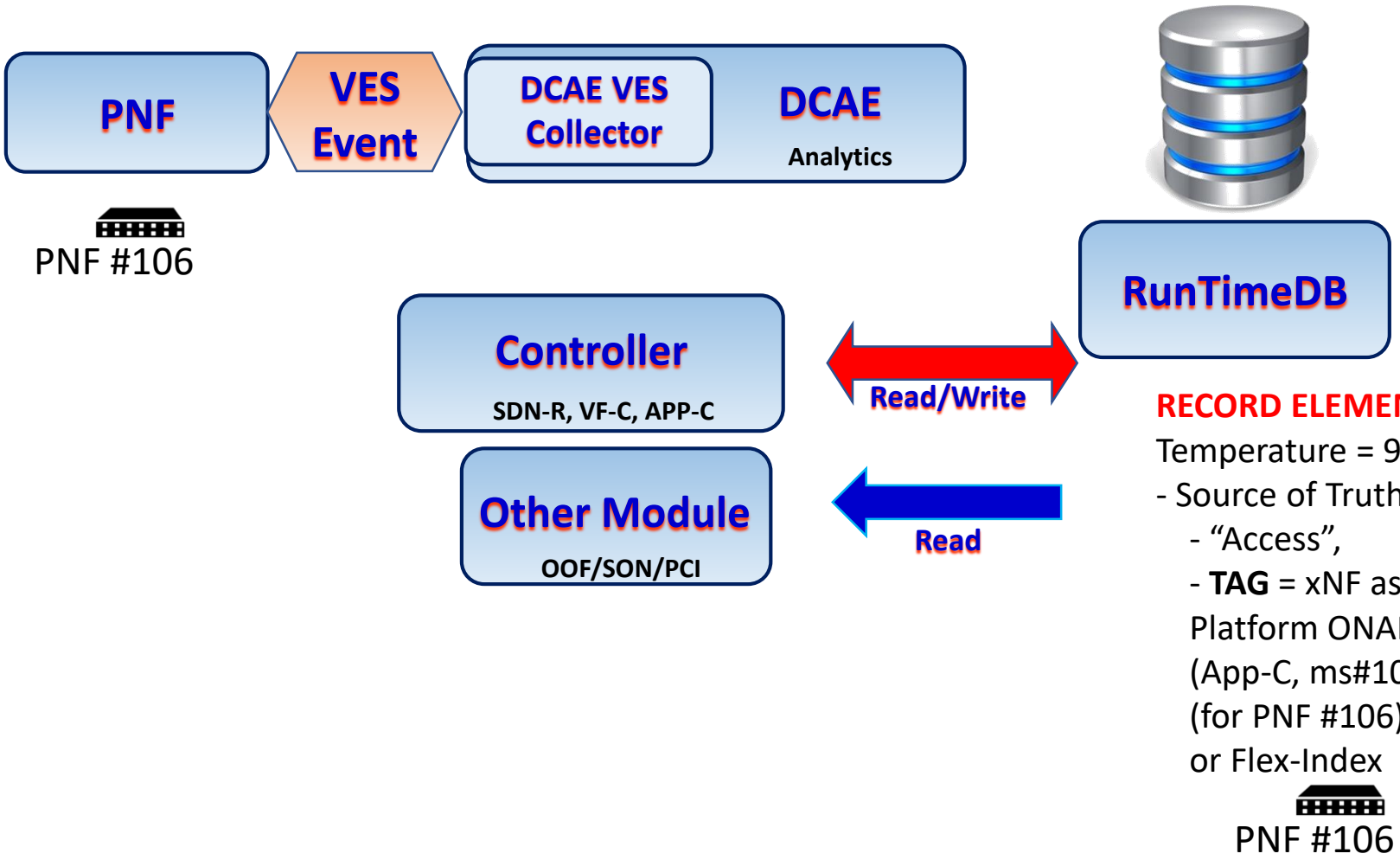
DMaaP (some use cases to work / indirect dependency)

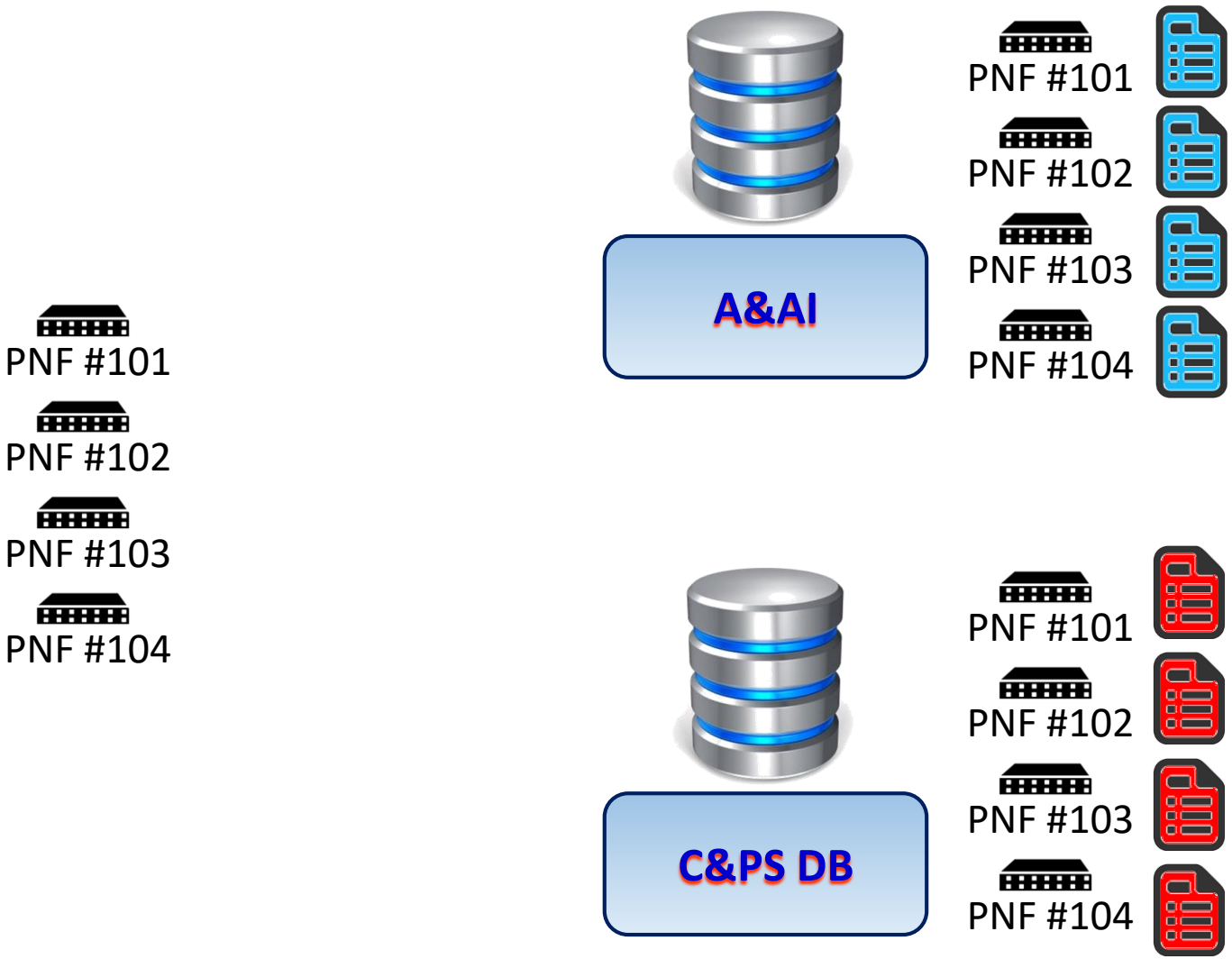
SCOPE

C&PS Database

RECEIVE INFORMATION
WRITE INFORMATION
PUBLISH CHANGES
REFERENTIAL INTEGRITY
INGEST PACKAGES
LOGICAL OBJECTS
ASSOCIATIONS
CARDINALITY RULES
LINKING RESTRICTIONS
SYNCHRONIZATION
DATA INTEGRITY & RECOVERY

Config & Persist Service (Run-Time View)

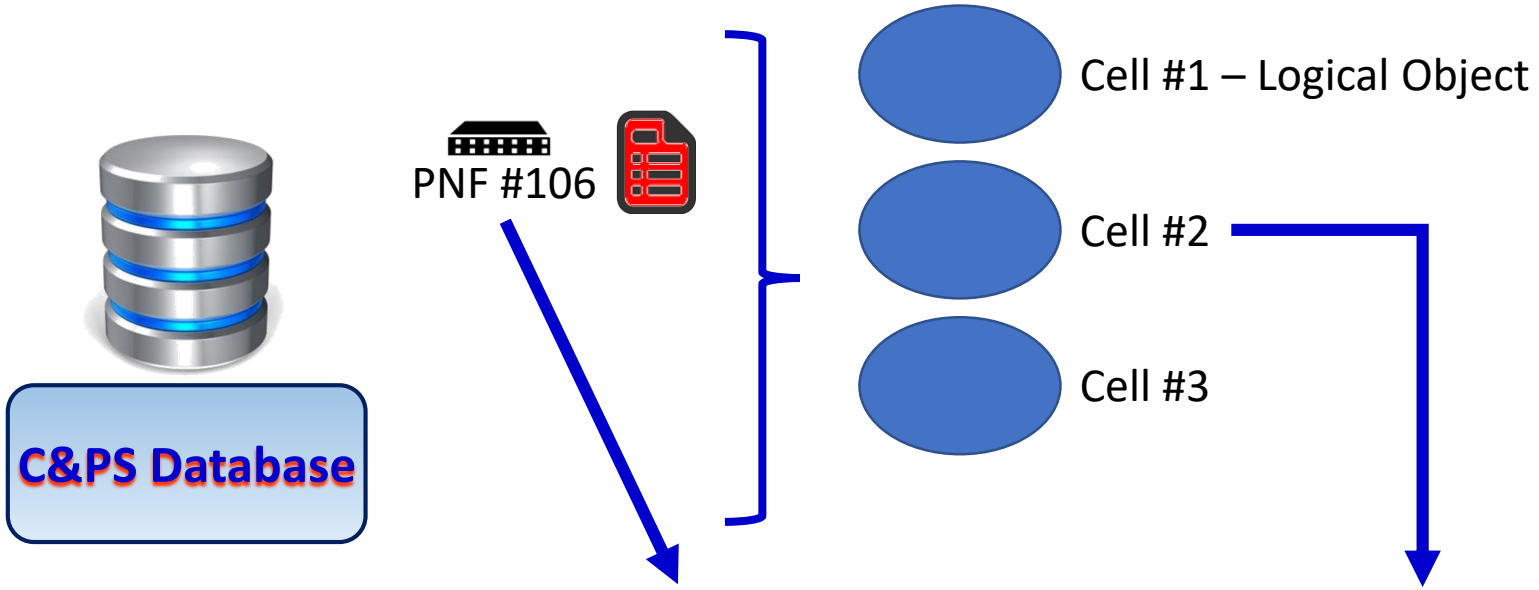




A&AI correlated/Index to RunTimeDB
Publish changes in A&AI, notification on DMaaP

Indices into Config & Persist Service may also use Flex-Index (such as CellID)

C&PS Database (Run-Time View)



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 }
Cardinality Rules
Linking Restrictions

June 25 2020 Attendees