Configuration & Persistency Service

- Release 8 (Honolulu) Requirements Presentation

Aug 17, 2020 version 1

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R8 Requirements Presentation

TIME	AUG 17, 2020 C&PS REQUIREMENTS SubComm 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	**R8 & 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
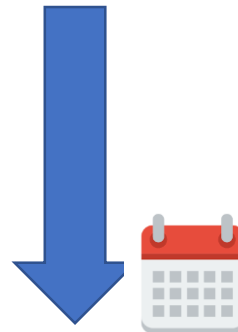
TIME	Q&A Session Post-Session
(1 hour)	**Follow-up questions** – Follow-up meetings at C&PS Team Call (Fridays)

Configuration & Persistency Service in R8

Executive Summary - The Configuration & Persistency Service (C&PS) is a *real-time service* that is designed to serve as a data repository for Run-time Network Element (configuration) data that needs to be persistent applicable to multiple domain (RAN, Transport, and Core). This was explored as a R7 PoC. *Focus on storing run-time DATA RELATED to NETWORK ELEMENT instances.* In R8, this is being proposed as a stand-alone project.

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.
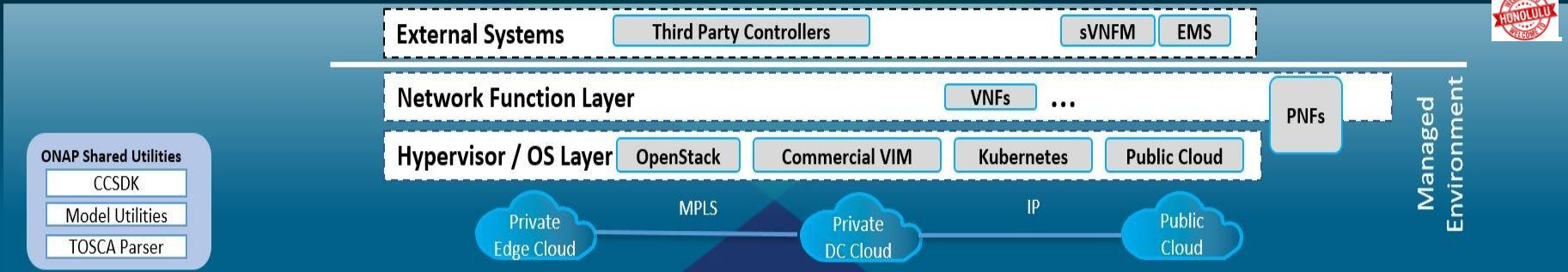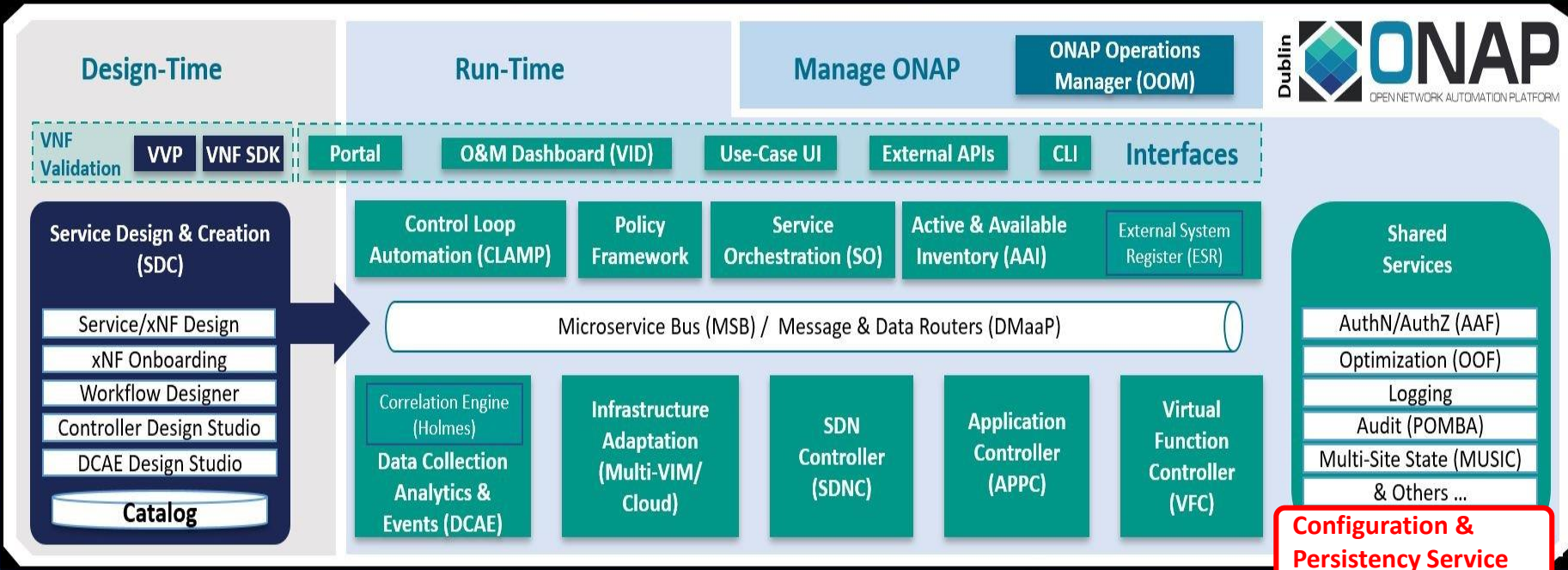
Business Markets - This project applies to any domain (wireless, transport, optical, and wireline) that ONAP may manage. It is not a market or geographical specific capability. It is expected that scaled ONAP installations such as Edge & Core ONAP deployments will also deploy the database across each 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.
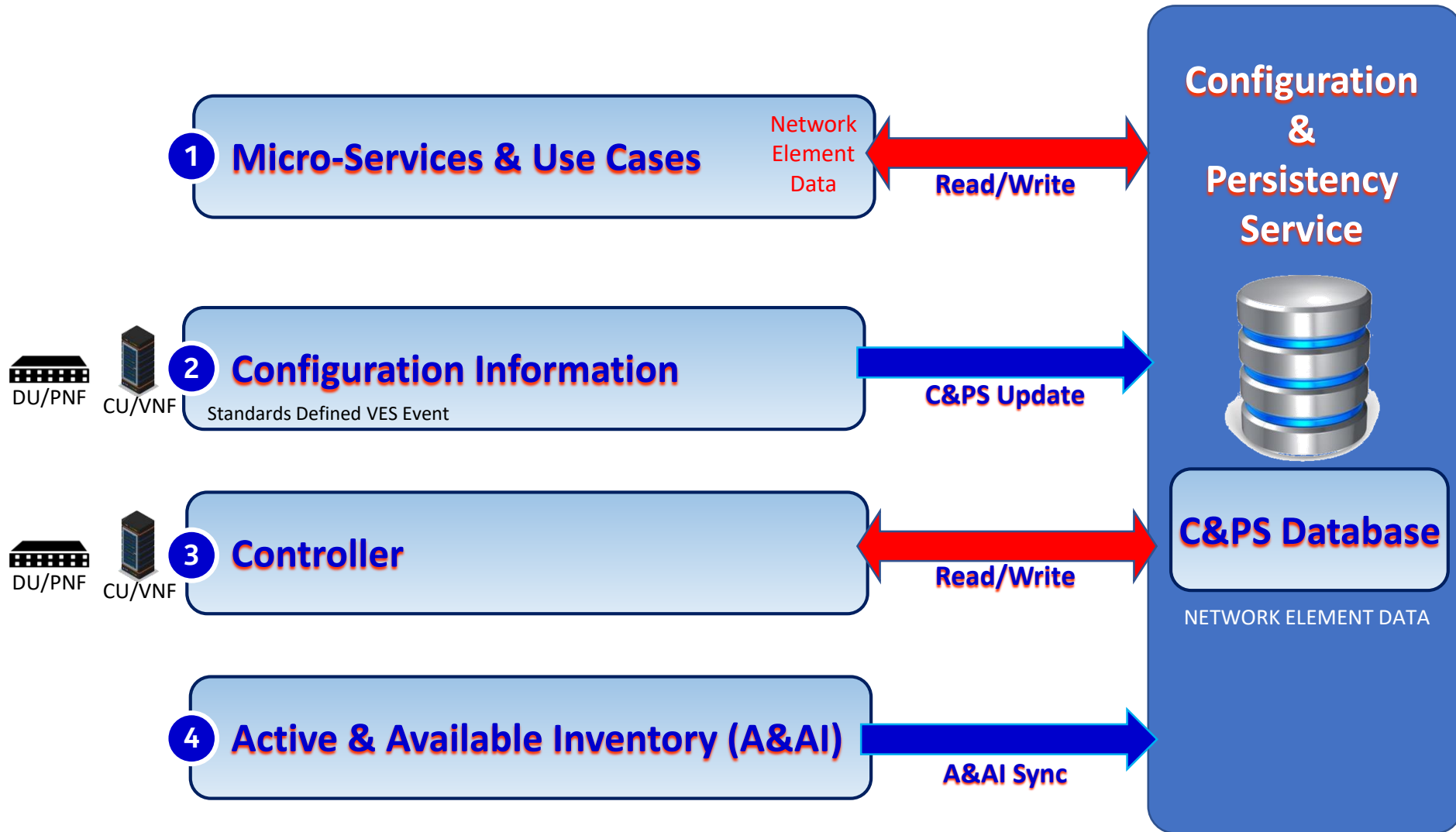
ONAP

Configuration & Persistency Service (C&PS)

1 **Micro-Services & Use Cases**

Network Element Data

Read/Write

Configuration & Persistency Service

DU/PNF CU/VNF **2** **Configuration Information**

Standards Defined VES Event

C&PS Update

DU/PNF CU/VNF **3** **Controller**

Read/Write

C&PS Database

NETWORK ELEMENT DATA

4 **Active & Available Inventory (A&AI)**

A&AI Sync

THE **LINUX** FOUNDATION

ONAP

Configuration & Persistency Service (C&PS)

Management Framework Data

ONAP RUN-TIME

Policy DB

DCAE Inventory

(1) DCAE VES Collector — **DCAE**

PNF VNF → **VES Event** (Standards Defined VES Event for Configuration)

DU/PNF   CU/VNF

(2) SO — **SO** Service Orchestration

Controller DB

PNF VNF → **Netconf O1** (CM Notification Change Config)

DU/PNF   CU/VNF

Controller SDN-C, VF-C, APP-C

(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
(Yang modeled)

Configuration & Persistency Service (C&PS)

RAN

DU	CU	RU
	UE	

CORE

UPF	SMF	UDM
	AUSF	AMF

TRANSPORT

Router	Hub	Switch

Network Element Data
Application Parameters
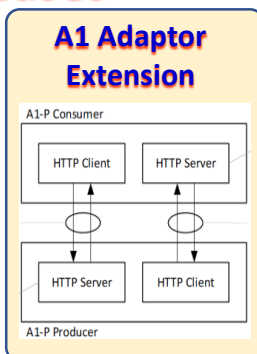**Configuration Parameters**

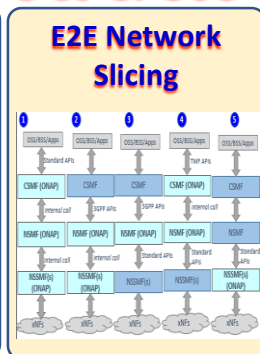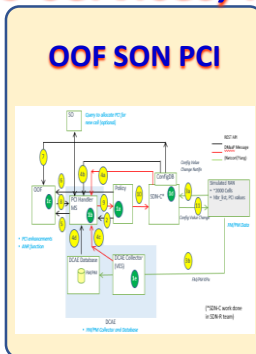**1** → **C&PS Update**

Network Element Data

Configuration & Persistency Service

C&PS Database

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

NB Open API

GUI

← **GUI Access** →

ONAP Micro-services, POCs & Use Cases
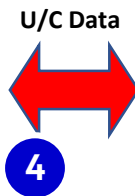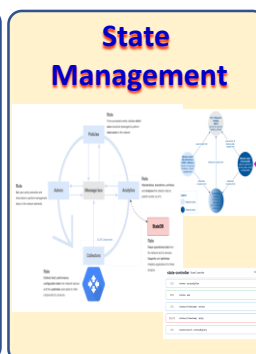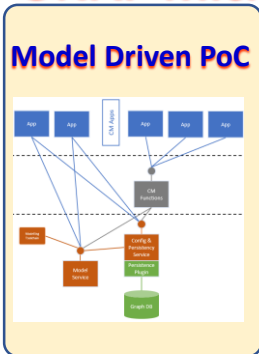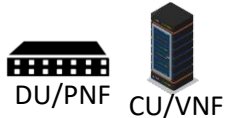
Model Driven PoC	OOF SON PCI	E2E Network Slicing	A1 Adaptor Extension	State Management

U/C Data **4**

ONAP RUN-TIME

DMaaP

Config & Persist Service

DU/PNF CU/VNF

PNF VNF

VES Event

Standards Defined VES Event for Configuration

1

DCAE VES Collector

DCAE Inventory

DCAE

Analytics

Configuration NameSpace topic 3GPP-Provisioning

C&PS Update

C&PS Database

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

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

C&PS READING: PNF Reports Configuration

WELCOME TO HONOLULU WELCOME TO

DU/PNF   CU/VNF

ONAP RUN-TIME

PNF VNF

VES Event

Standards Defined VES Event for Configuration

①

DCAE VES Collector

DCAE

DCAE Inventory

Analytics

DMaaP

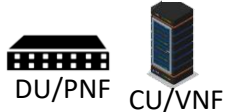Configuration NameSpace topic 3GPP-Provisioning

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
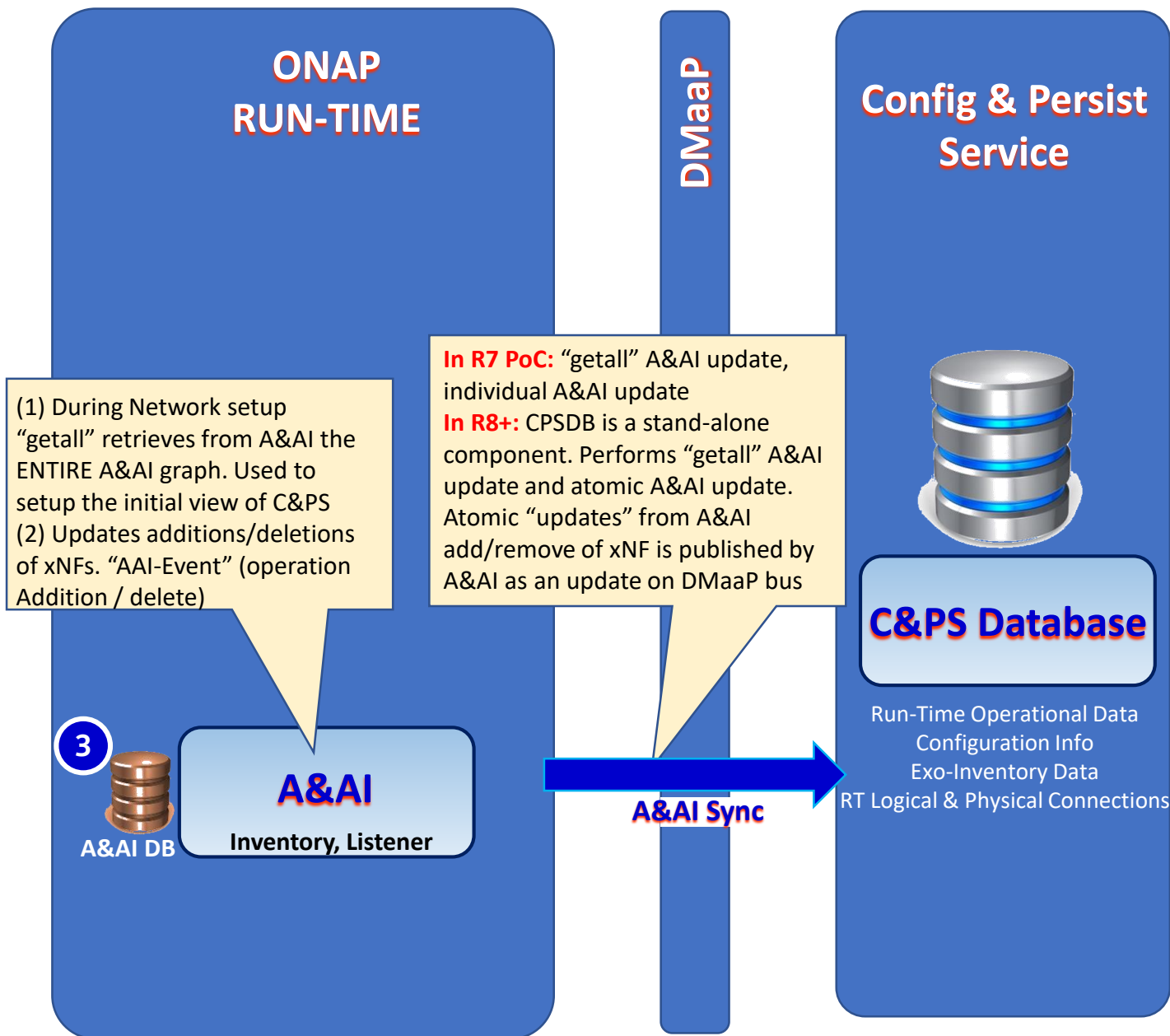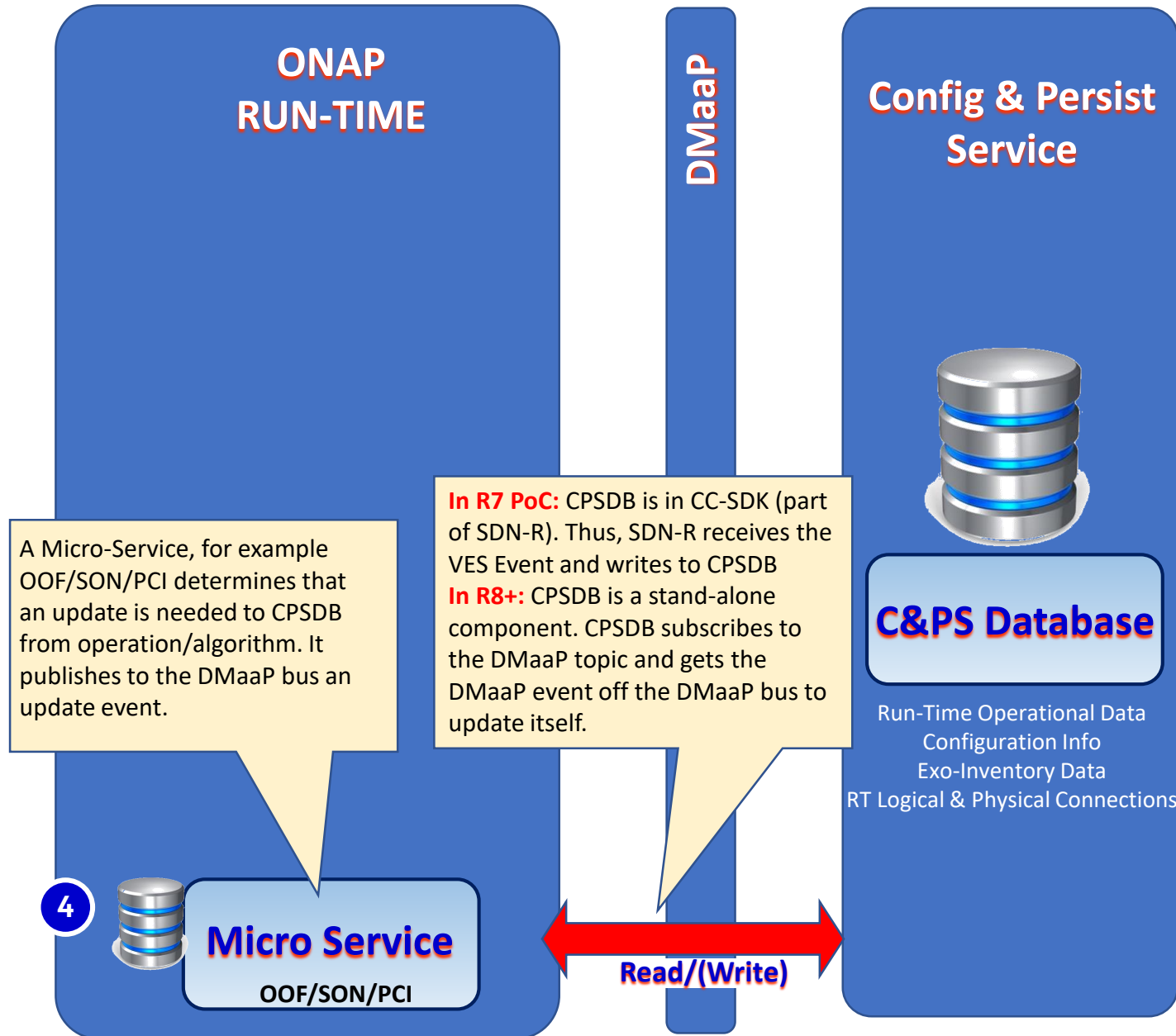
UNDER CONSTRUCTION

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 R7 PoC: "getall" A&AI update, individual A&AI update
In R8+: CPSDB 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

C&PS Database

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

③

A&AI DB
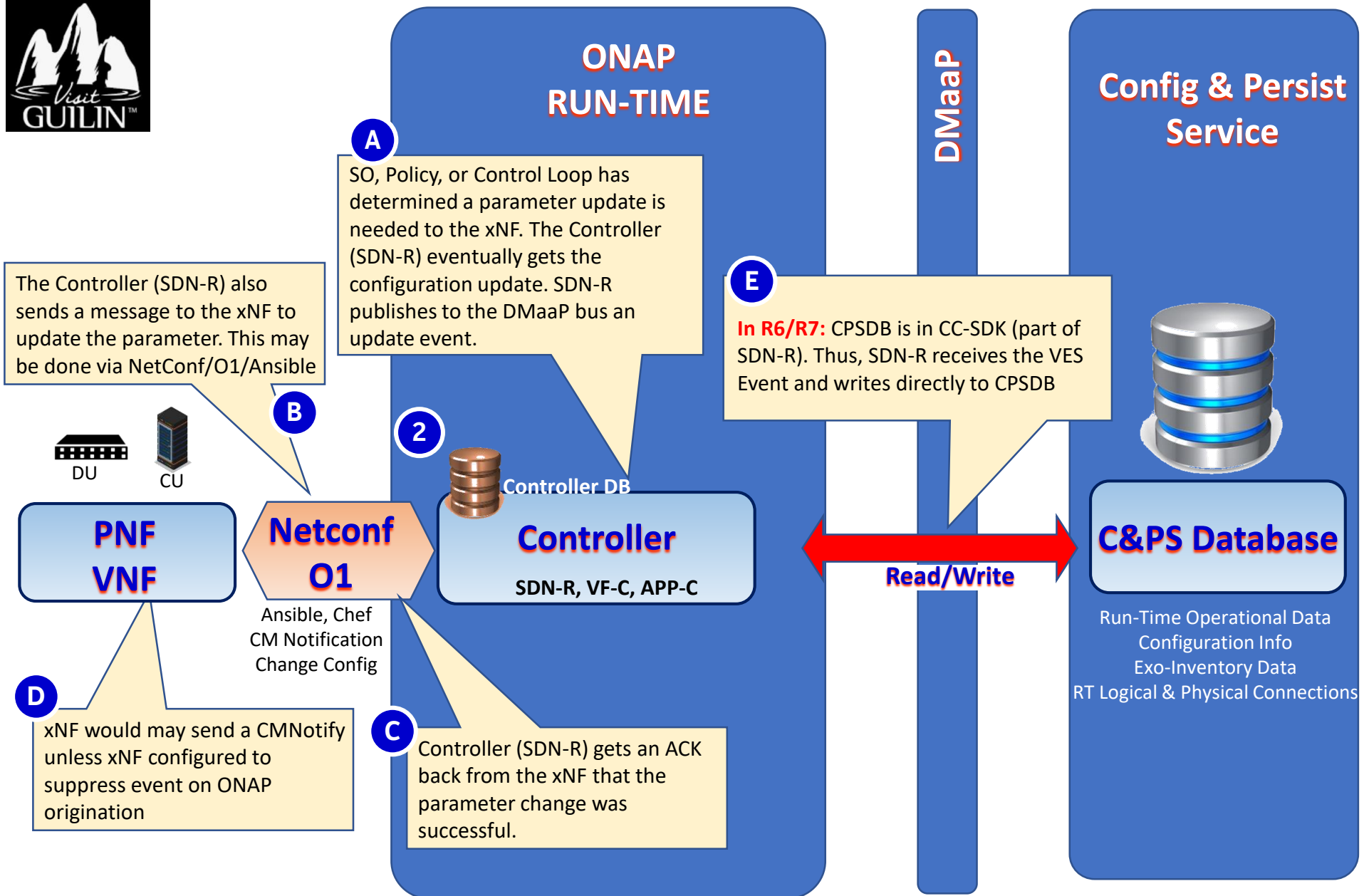
A&AI
Inventory, Listener

A&AI Sync

UNDER CONSTRUCTION

ONAP RUN-TIME

DMaaP

Config & Persist Service

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

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

C&PS Database

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

4

Micro Service
OOF/SON/PCI
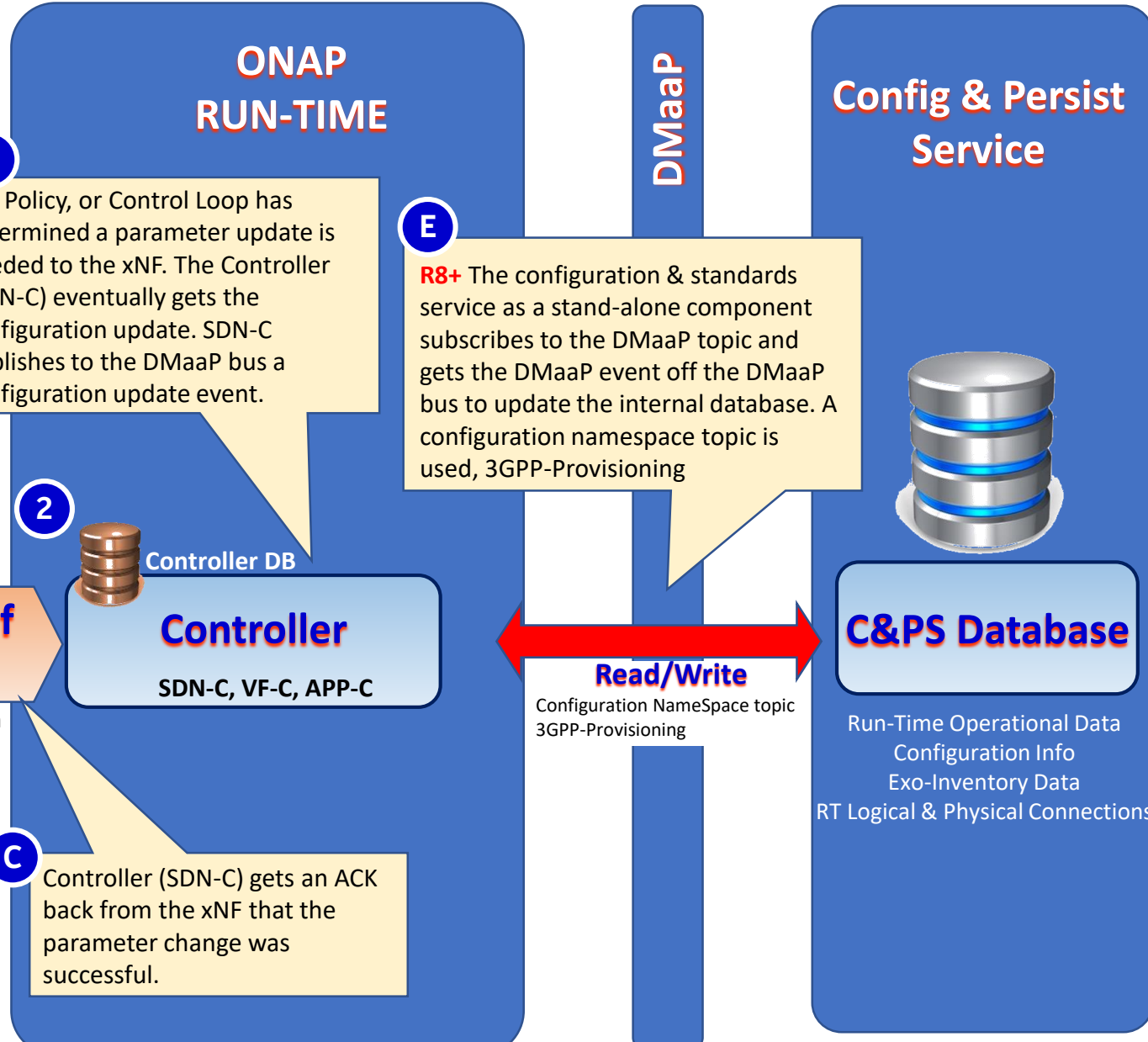
Read/(Write)

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WELCOME TO HONOLULU WELCOME TO

UNDER CONSTRUCTION

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C&PS WRITING: From Controller SDN-R

ONAP RUN-TIME

DMaaP

Config & Persist Service
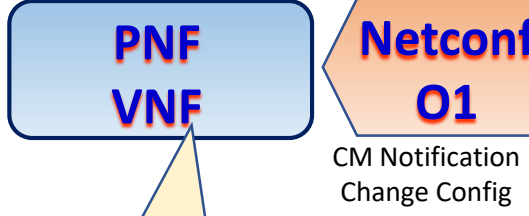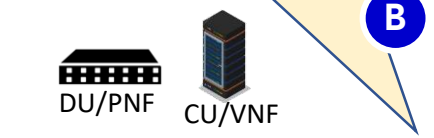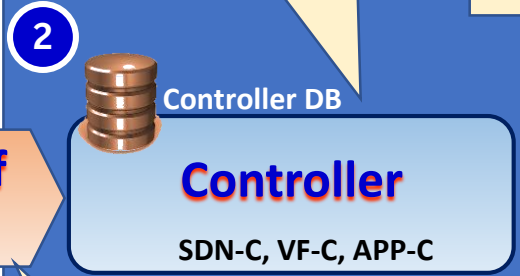
A

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.

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

E

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

B

DU

CU

2

Controller DB

PNF VNF

Netconf O1

Ansible, Chef
CM Notification
Change Config

Controller

SDN-R, VF-C, APP-C

Read/Write

C&PS Database

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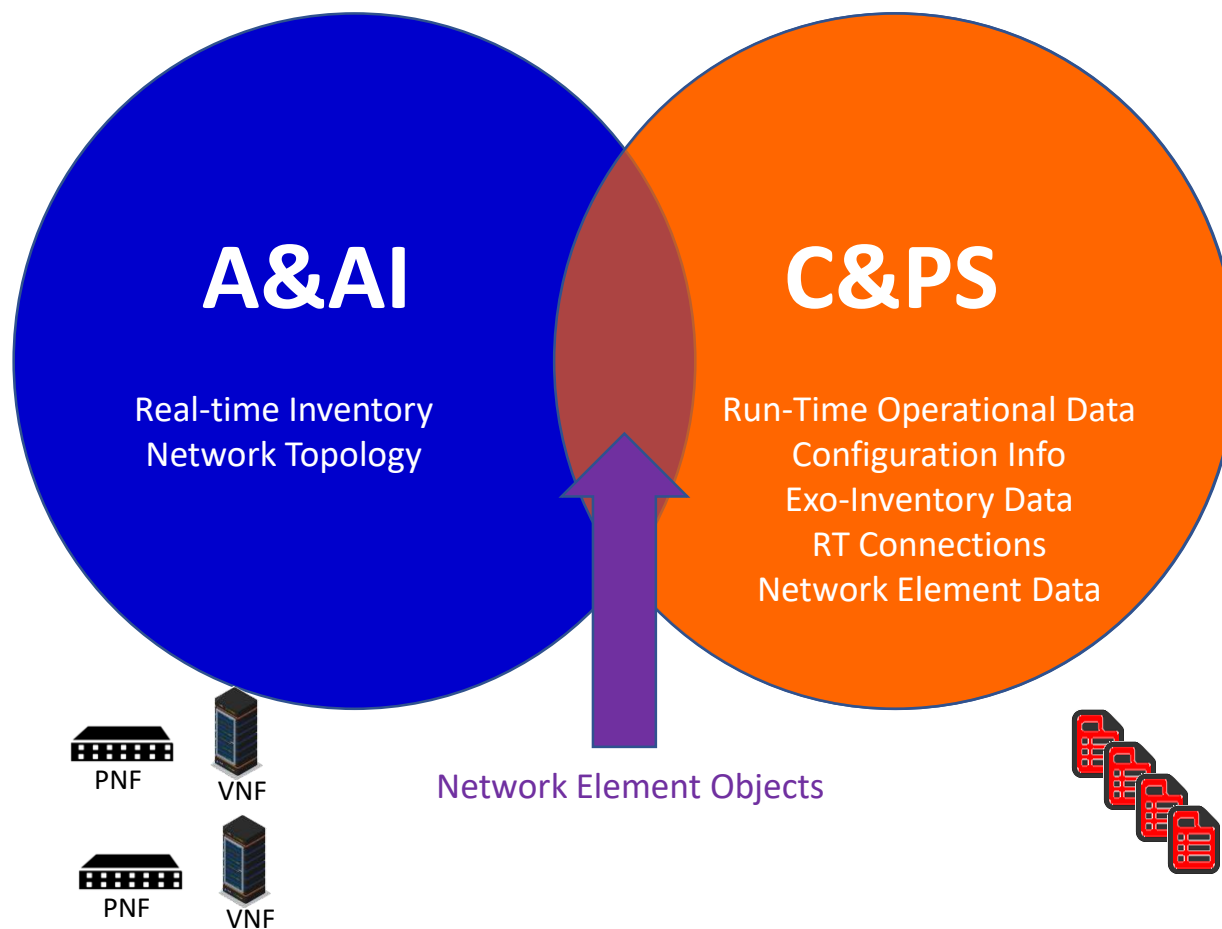Exo-Inventory Data
RT Logical & Physical Connections

D

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

C

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

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A&AI vs C&PS

Concepts – A&AI conceptually stores Real-time inventory view of connected and "topology" of xNFs that ONAP sees. C&PS stores Network Element Data. A&AI and C&PS overlaps because they both need to know about Network Element objects so that can managed & orchestrated.
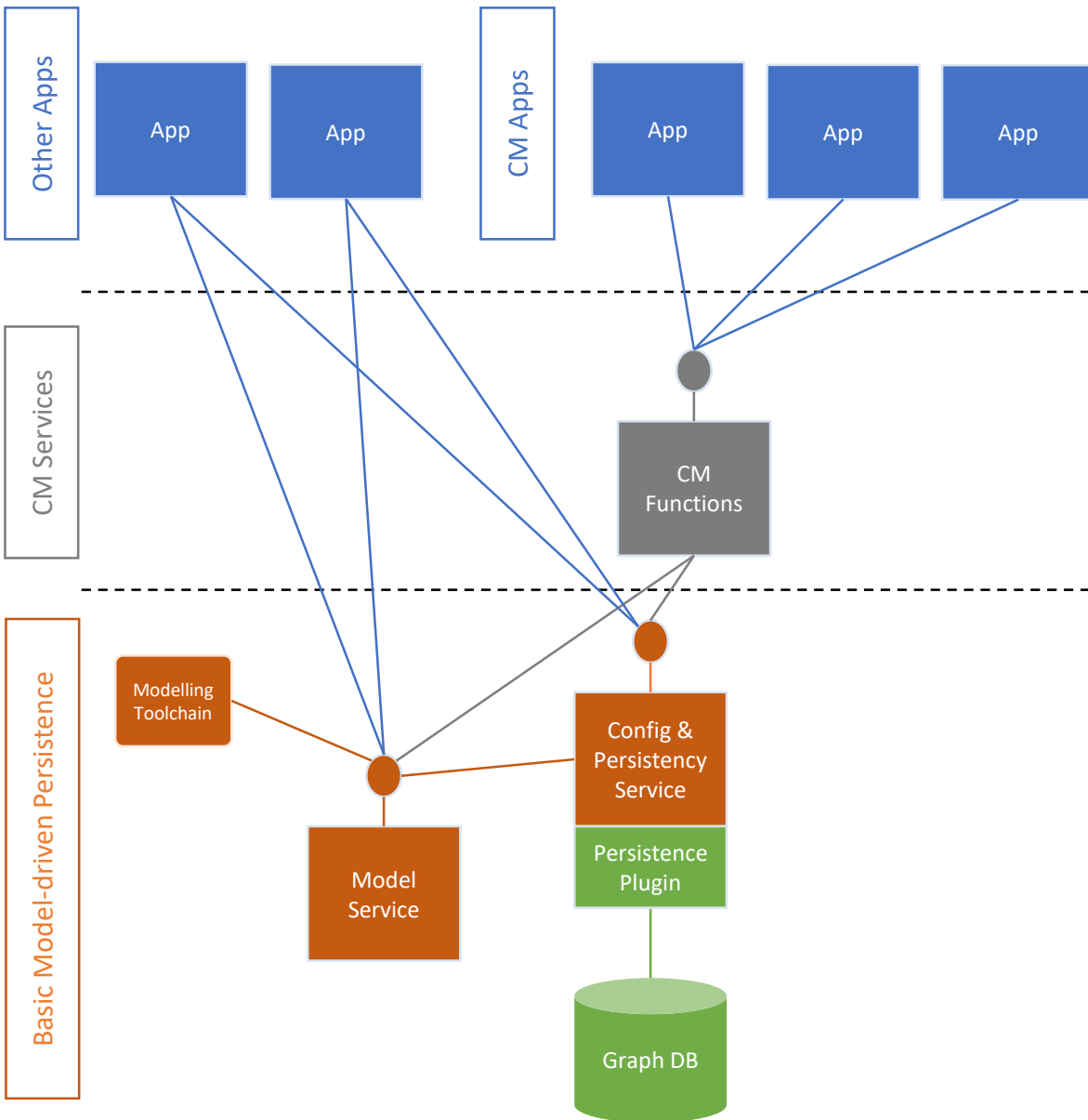

A&AI

Real-time Inventory
Network Topology

C&PS

Run-Time Operational Data
Configuration Info
Exo-Inventory Data
RT Connections
Network Element Data

PNF

VNF

PNF

VNF

Network Element Objects

ONAP

R7 – Model Driven Configuration & Persistency Service Proof of Concept
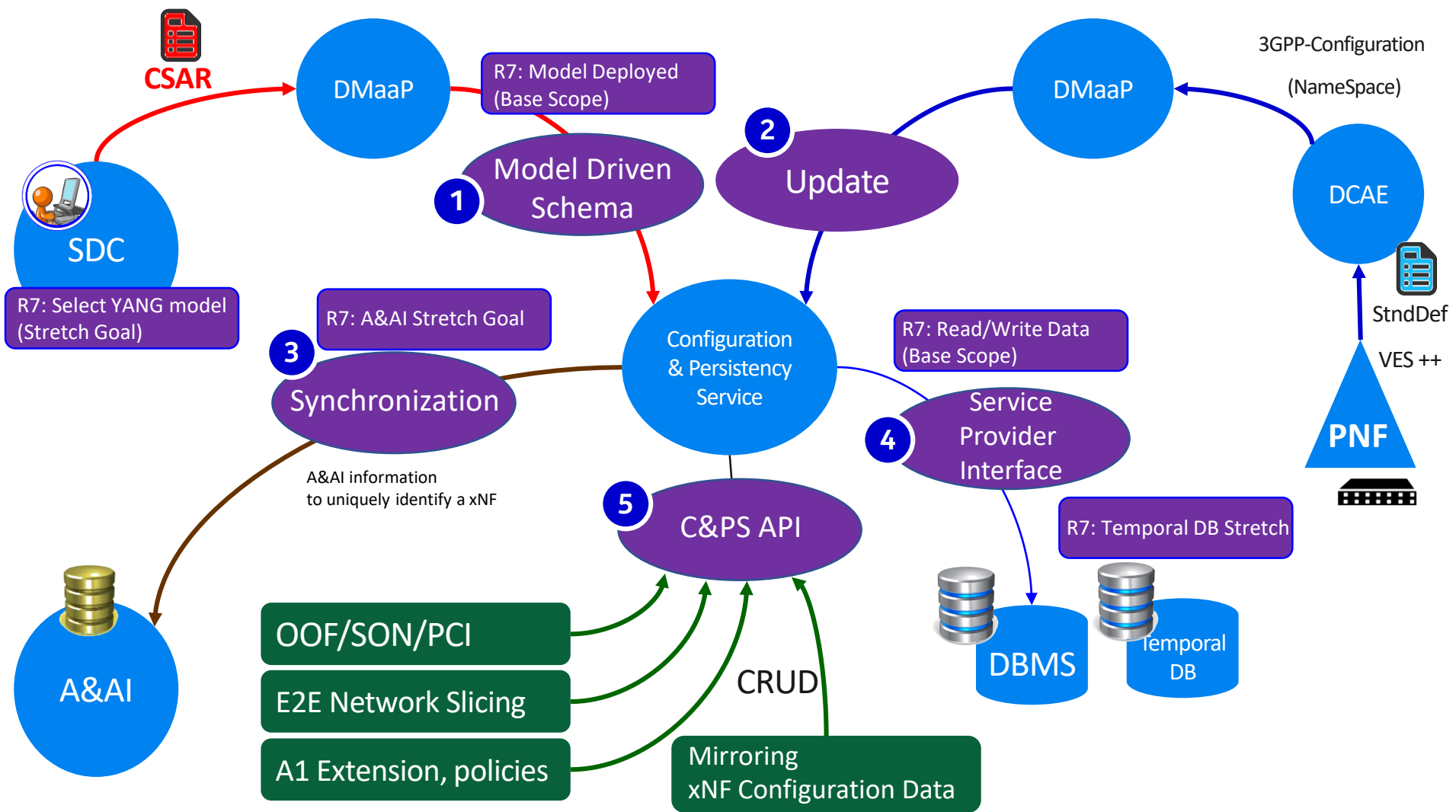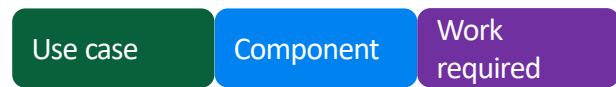
Proof of Concept

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

Diagram labels: Other Apps; CM Apps; App; CM Services; CM Functions; Basic Model-driven Persistence; Modelling Toolchain; Config & Persistency Service; Persistence Plugin; Model Service; Graph DB

R7 Model Driven C&PS PoC

What we we hope to learn what we did learn …

What "base" S/W is there

Decision/Issues resolved into agreements

Performance/Capacity

TSC concerns -> allay fears questions

C&PS Roadmap

Roadmap

C&PS Roadmap & R6-R8 Plan

Configuration & Persistency Service (CPS) Roadmap –

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

June 5, 2020 | **December, 2020** | **June 2021**

C&PS 1.0
R6 C&PS
- CC-SDK/SDN-C solution
- Evolution of "ConfigDB"

Supporting R6 Use Cases:
- SON/OOF/PCI U/C

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

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)

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

C&PS Roadmap & R8-R10 Plan

Configuration & Persistency Service (CPS) Roadmap –

R8 Honolulu	R9 Istanbul	R10 Kyoto

June 2021

C&PS 2.0
R8 C&PS stand-alone project proposal
- Deprecate C&PS 1.0 & 1.1
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CPS FUNCTIONALITY:
- Data Recovery
- Model Adaption (Dynamic Schema)

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

December, 2020

Rx (future) development

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

June 2021
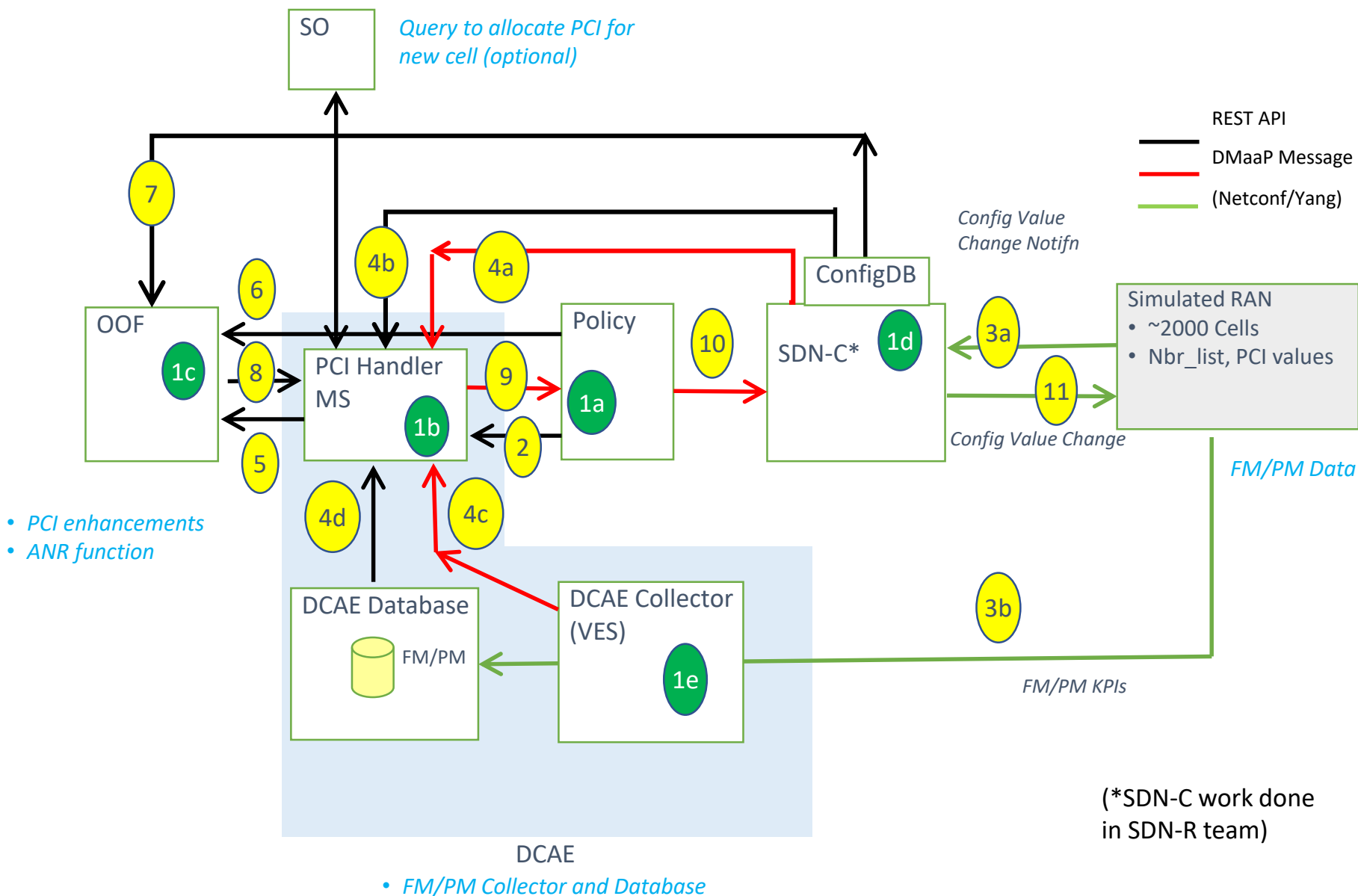
Use Cases & Proof of Concepts

Use Cases

Proof of Concept

C&PS Use Cases and Proof of Concepts in R8

5G USE CASE	DESCRIPTION
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 Integration with C&PS (as a platform). Have the State management S/W now work with C&PS using available swaggers/APIs

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OOF / SON / PCI Use Case

SO — *Query to allocate PCI for new cell (optional)*

REST API
DMaaP Message
(Netconf/Yang)

OOF **1c**

PCI Handler MS **1b**

Policy **1a**

SDN-C* **1d**

ConfigDB

Config Value Change Notifn

Simulated RAN
• ~2000 Cells
• Nbr_list, PCI values

Config Value Change

FM/PM Data

DCAE Database
FM/PM

DCAE Collector (VES) **1e**

FM/PM KPIs

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

• *PCI enhancements*
• *ANR function*

DCAE
• *FM/PM Collector and Database*

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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

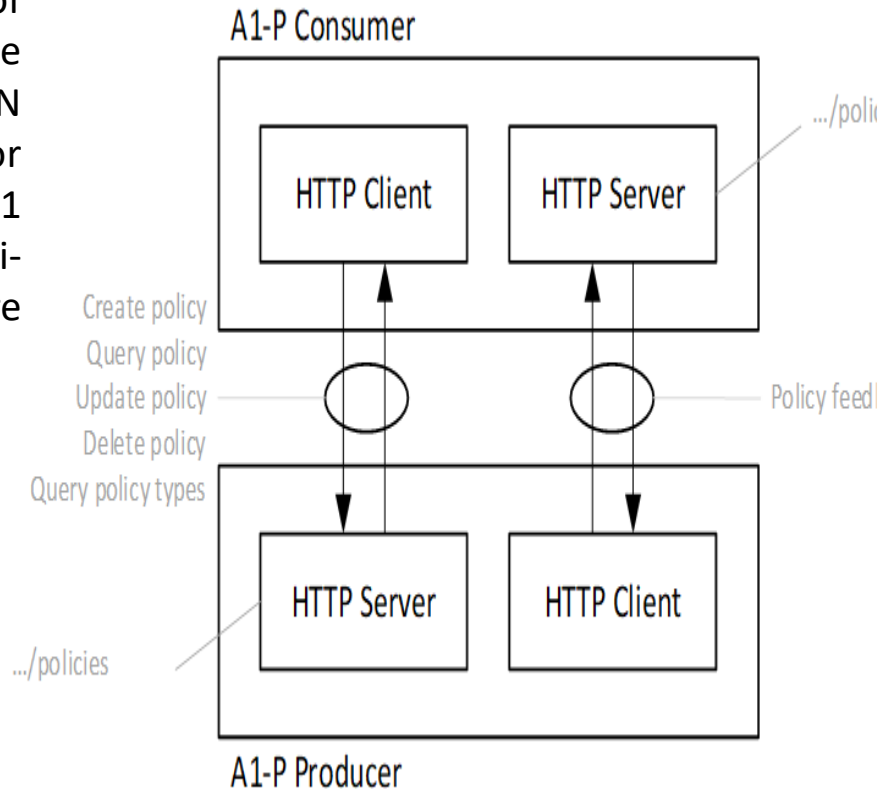| API	Input	Output
GET cellList	networkId, ts	List of cellIds
GET PCI	cellId, ts	PCI Value
GET nbrList	cellId, ts	List of cellIds and their PCI values
GET pnf-name	cellID, ts	pnf-name

End to End Network Slicing Use Case

1 — OSS/BSS/Apps ↕ Standard APIs — **CSMF (ONAP)** ↕ *Internal call* — **NSMF (ONAP)** ↕ *Internal call* — **NSSMF(s) (ONAP)** ↕ — xNFs

2 — OSS/BSS/Apps ↕ — CSMF ↕ 3GPP APIs — **NSMF (ONAP)** ↕ *Internal call* — **NSSMF(s) (ONAP)** ↕ — xNFs

3 — OSS/BSS/Apps ↕ — CSMF ↕ 3GPP APIs — **NSMF (ONAP)** ↕ Standard APIs — NSSMF(s) ↕ — xNFs

4 — OSS/BSS/Apps ↕ TMF APIs — **CSMF (ONAP)** ↕ *Internal call* — **NSMF (ONAP)** ↕ Standard APIs — NSSMF(s) ↕ — xNFs

5 — OSS/BSS/Apps ↕ — CSMF ↕ — NSMF ↕ Standard APIs — **NSSMF(s) (ONAP)** ↕ — xNFs
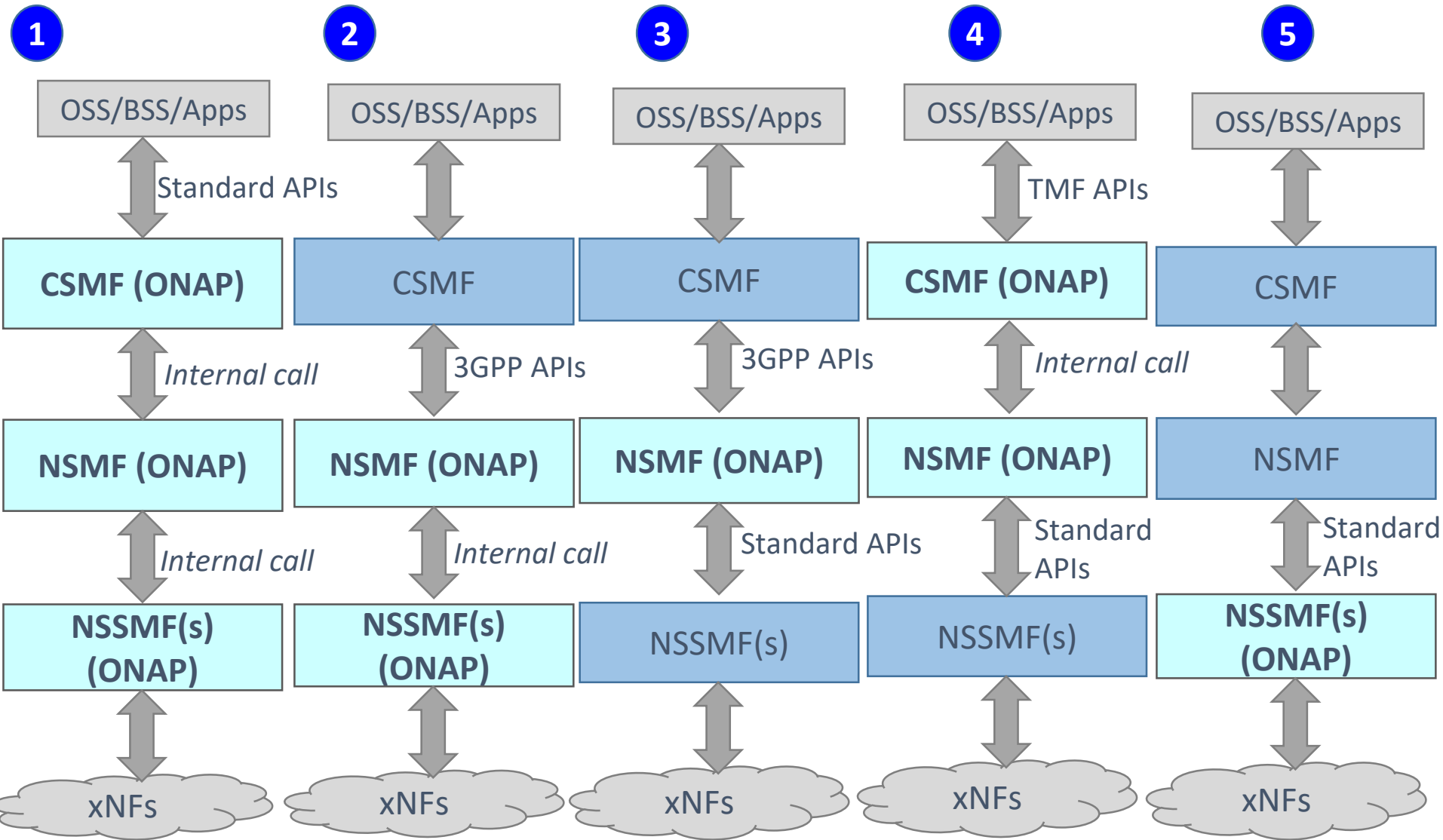
3rd party component

End to End Network Slicing Use Case

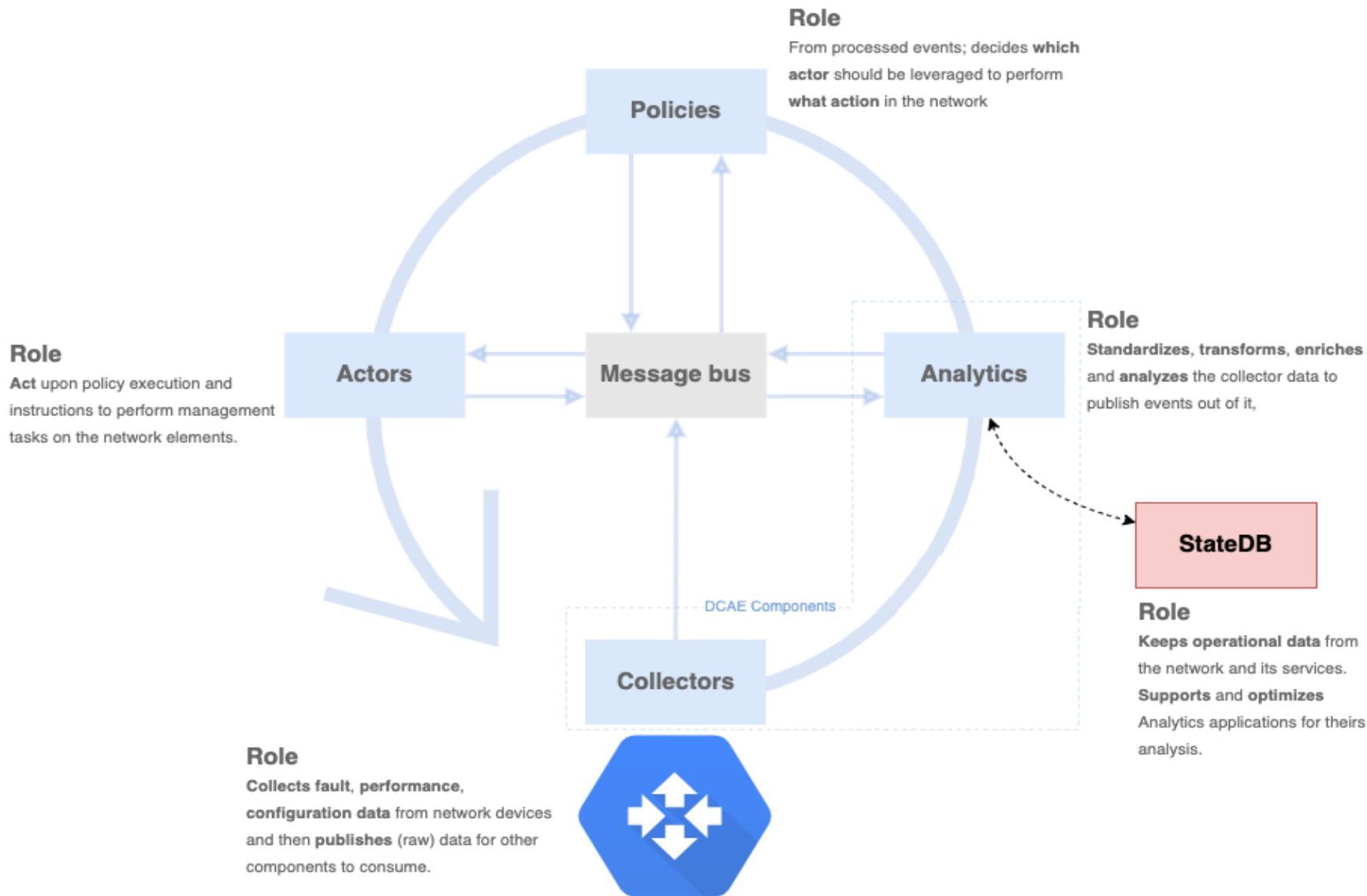|		
NetworkSlice	Network Slice NRM	operationalState
NetworkSlice	Network Slice NRM	administrativeState
NetworkSlice	Network Slice NRM	serviceProfileList
NetworkSlice	Network Slice NRM	networkSliceSubnetRef
NetworkSliceSubnet	Network Slice NRM	operationalState
NetworkSliceSubnet	Network Slice NRM	administrativeState
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

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.

A1-P Consumer

HTTP Client   HTTP Server   .../poli

Create policy
Query policy
Update policy   Policy feed
Delete policy
Query policy types

.../policies

HTTP Server   HTTP Client

A1-P Producer

Svc / Resource Catalog (SDC)
service & resource models, policies

Network intent DB (CDS DB or SDNC's MDSAL)
service & resource attributes, intents, assignments

Network state (RuntimeDB)
network element & service state, actual configuration

Inventory (A&AI)
inventory, topology, svc & resource instances

uses models from

uses service & devices state models from

references models from

references inventory from

references inventory from

Legend

Network intent

Network state

Role

From processed events; decides **which actor** should be leveraged to perform **what action** in the network

Policies

Role

Act upon policy execution and instructions to perform management tasks on the network elements.

Actors

Message bus

Analytics

Role

Standardizes, **transforms**, **enriches** and **analyzes** the collector data to publish events out of it,

DCAE Components

Collectors

StateDB

Role

Keeps **operational data** from the network and its services. **Supports** and **optimizes** Analytics applications for theirs analysis.

Role

Collects **fault**, **performance**, **configuration data** from network devices and then **publishes** (raw) data for other components to consume.

ONAP

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

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)
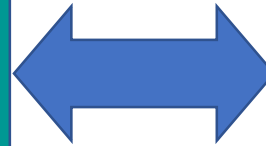
DEPENDENCIES – value added

DMaaP (some use cases to work / indirect dependency)
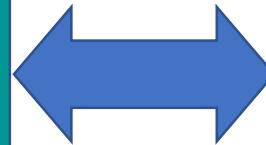
SCOPE

C&PS Database

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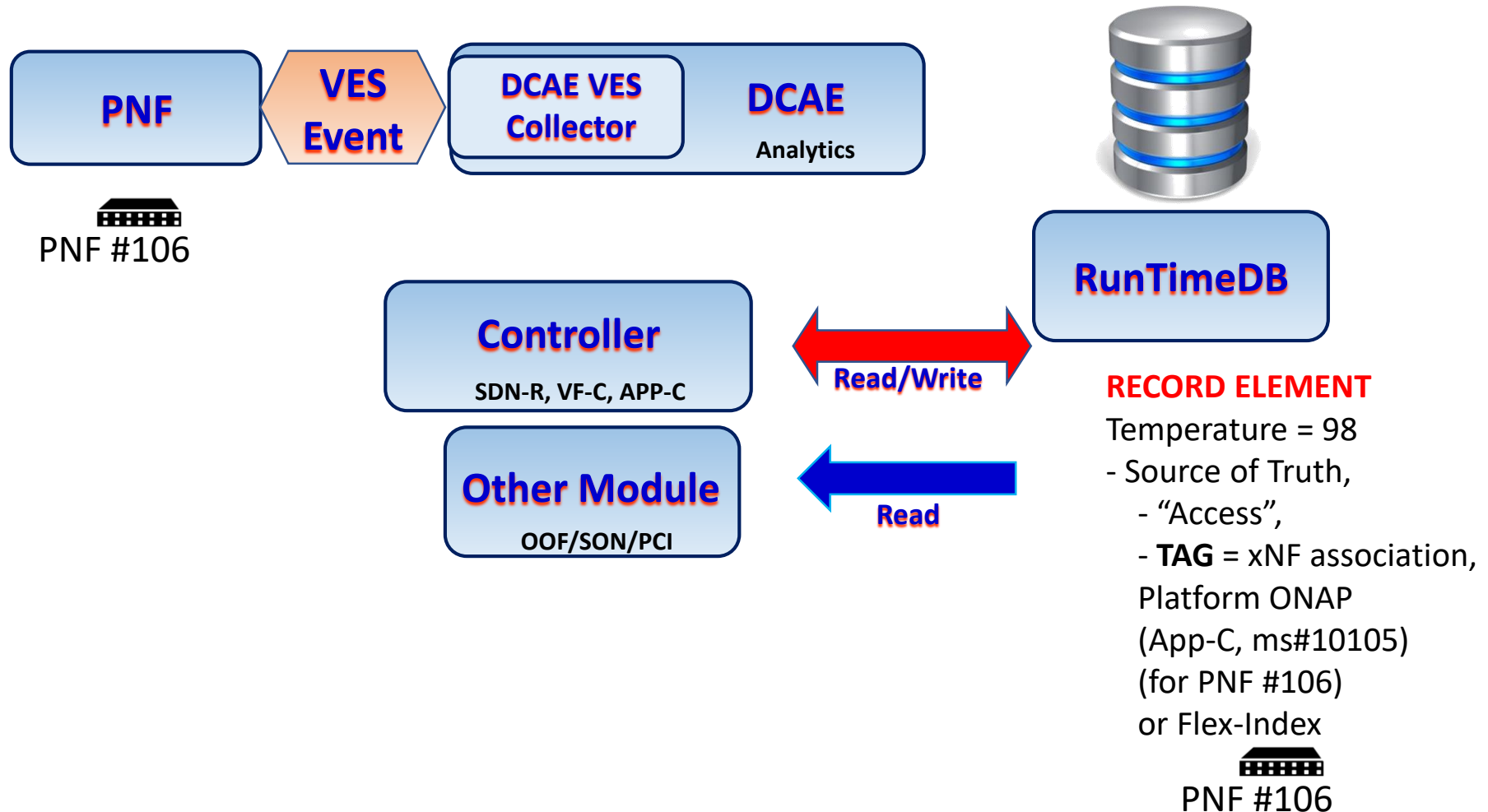
PNF

PNF #106

VES Event

DCAE VES Collector

DCAE

Analytics

RunTimeDB

Controller

SDN-R, VF-C, APP-C

Read/Write

Other Module

OOF/SON/PCI

Read

RECORD ELEMENT
Temperature = 98
- Source of Truth,
   - "Access",
   - **TAG** = xNF association,
Platform ONAP
(App-C, ms#10105)
(for PNF #106)
or Flex-Index

PNF #106

ONAP

PNF #101

PNF #102

PNF #103

PNF #104
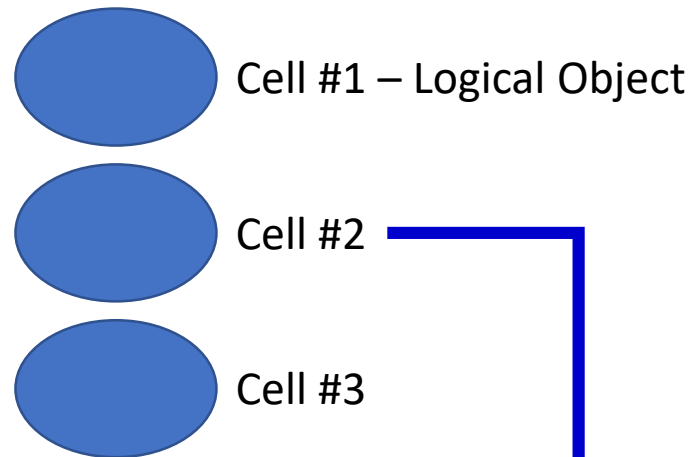
A&AI

PNF #101

PNF #102

PNF #103

PNF #104

C&PS DB
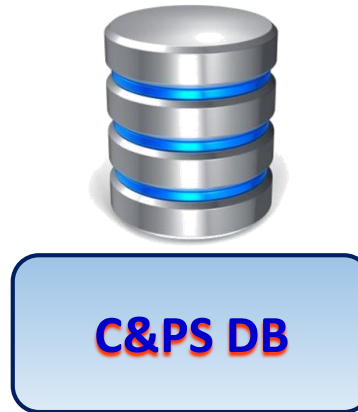
PNF #101

PNF #102

PNF #103

PNF #104

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)

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 }
Cardinality Rules
Linking Restrictions

C&PS Database