

# Configuration & Persistency Service

- Release 8 (Honolulu) Requirements Presentation  
Aug 17, 2020 version 1



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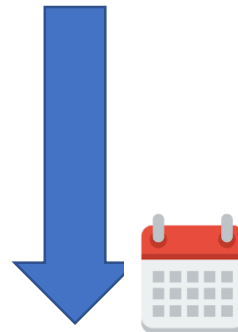
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# R8 Requirements Presentation

TIME	AUG 17, 2020 C&PS REQUIREMENTS SubComm AGENDA
20 min	<b>Overview of C&amp;PS &amp; Agenda</b> – Introduction to C&PS
20 min	<b>Model Driven C&amp;PS Proof of Concept (PoC)</b> – Overview of the Model-Driven C&PS PoC for R7
3 min	<b>R8 &amp; Beyond Roadmap</b> – Model Driven Proof of Concept (PoC) in R7, way forward in R8 Honolulu, New plan & roadmap
12 min	<b>Use Cases using C&amp;PS Database</b> – Overview of C&PS Applications
5 min	<b>Questions &amp; Answers</b> – Q&A



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

# Overview of Configuration & Persistency Service



**Business Case**



**Architecture S/C**



**Overview**



**Technical Flows**

# 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.

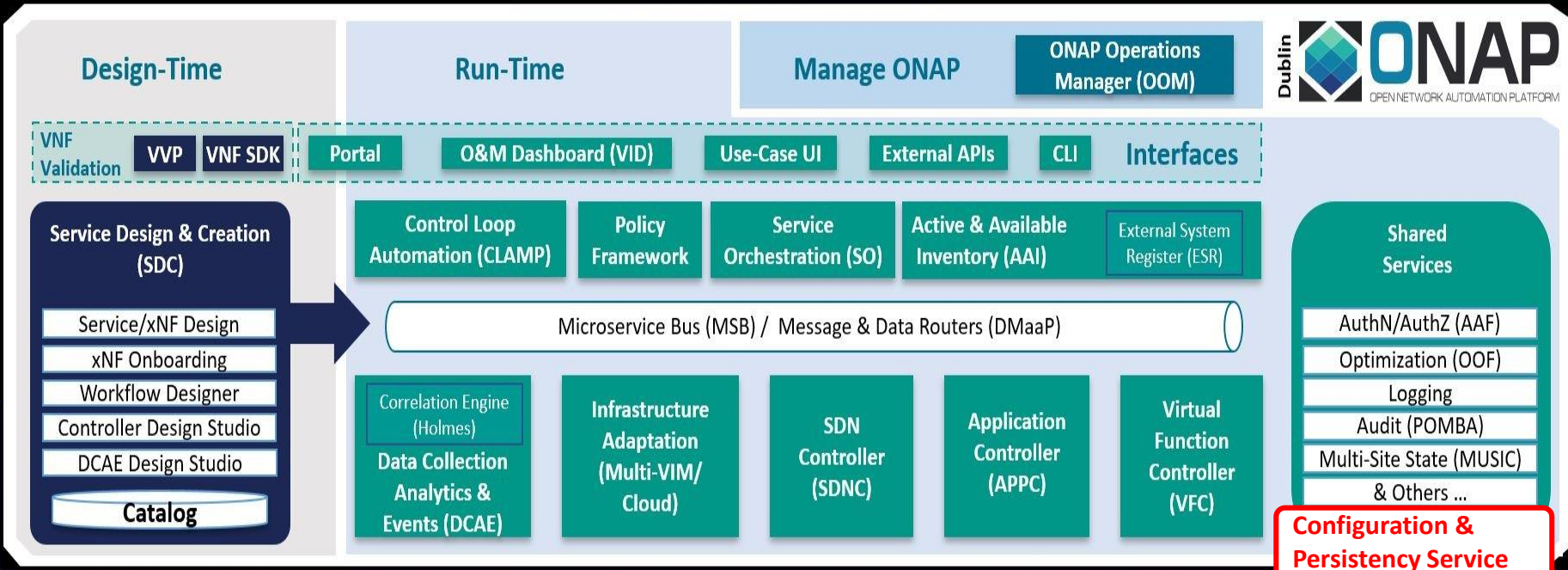
**Business Markets** - This project applies to any domain (wireless, transport, optical, and wireline) that ONAP may manage. It is not a market or geographical specific capability. It is expected that scaled ONAP installations such as Edge & Core ONAP deployments will also deploy the database across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

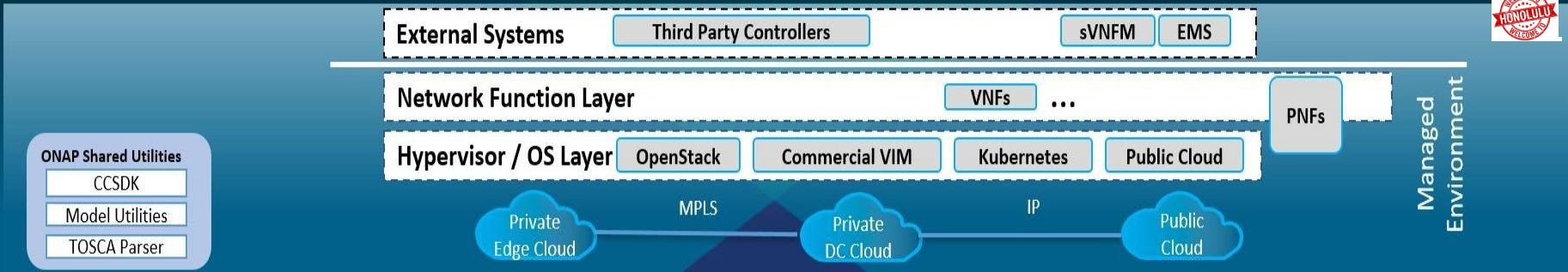


OSS / BSS / Other

Legend **Design** Orchestration & Management Operations

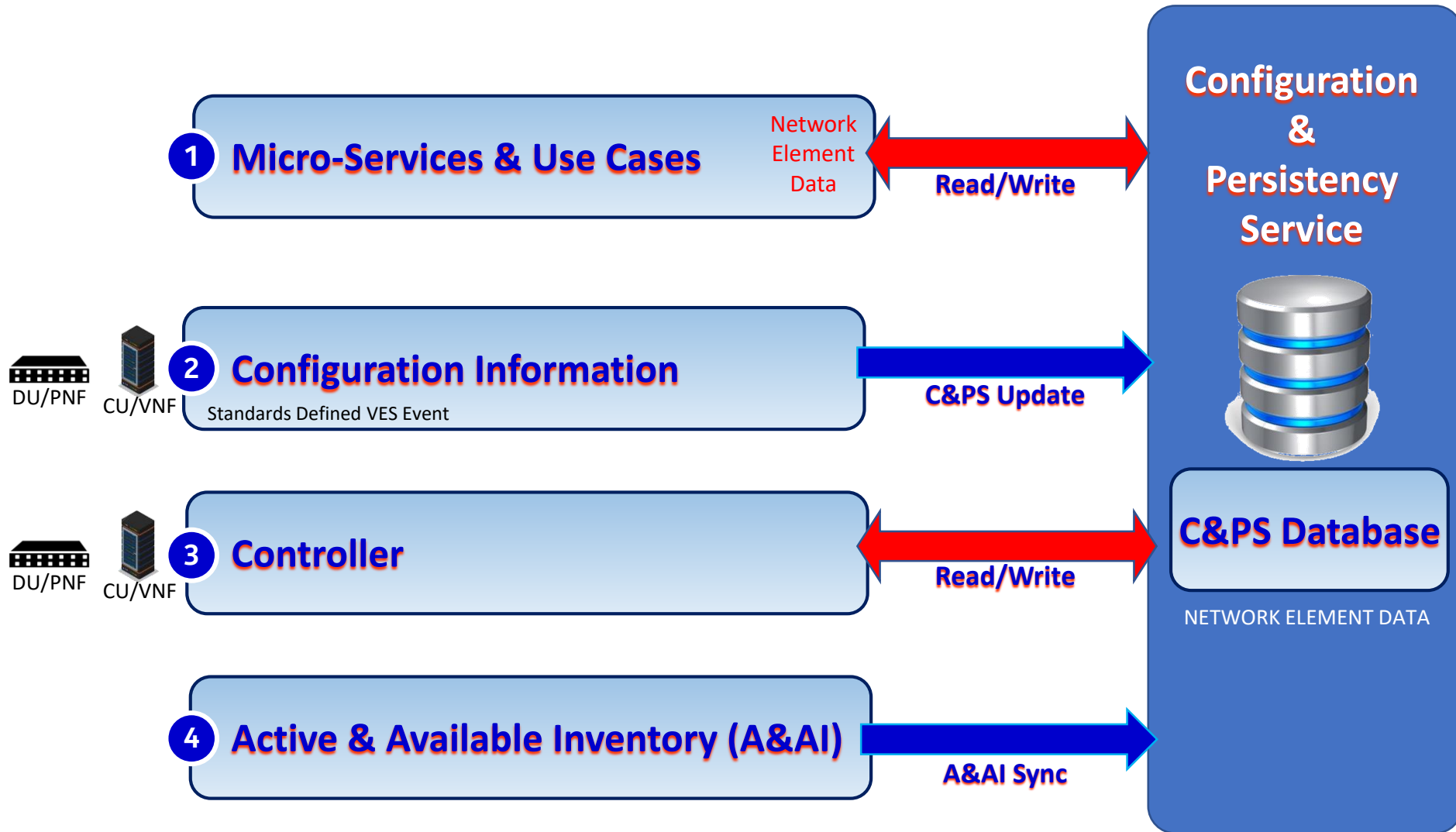


**Configuration & Persistence Service**



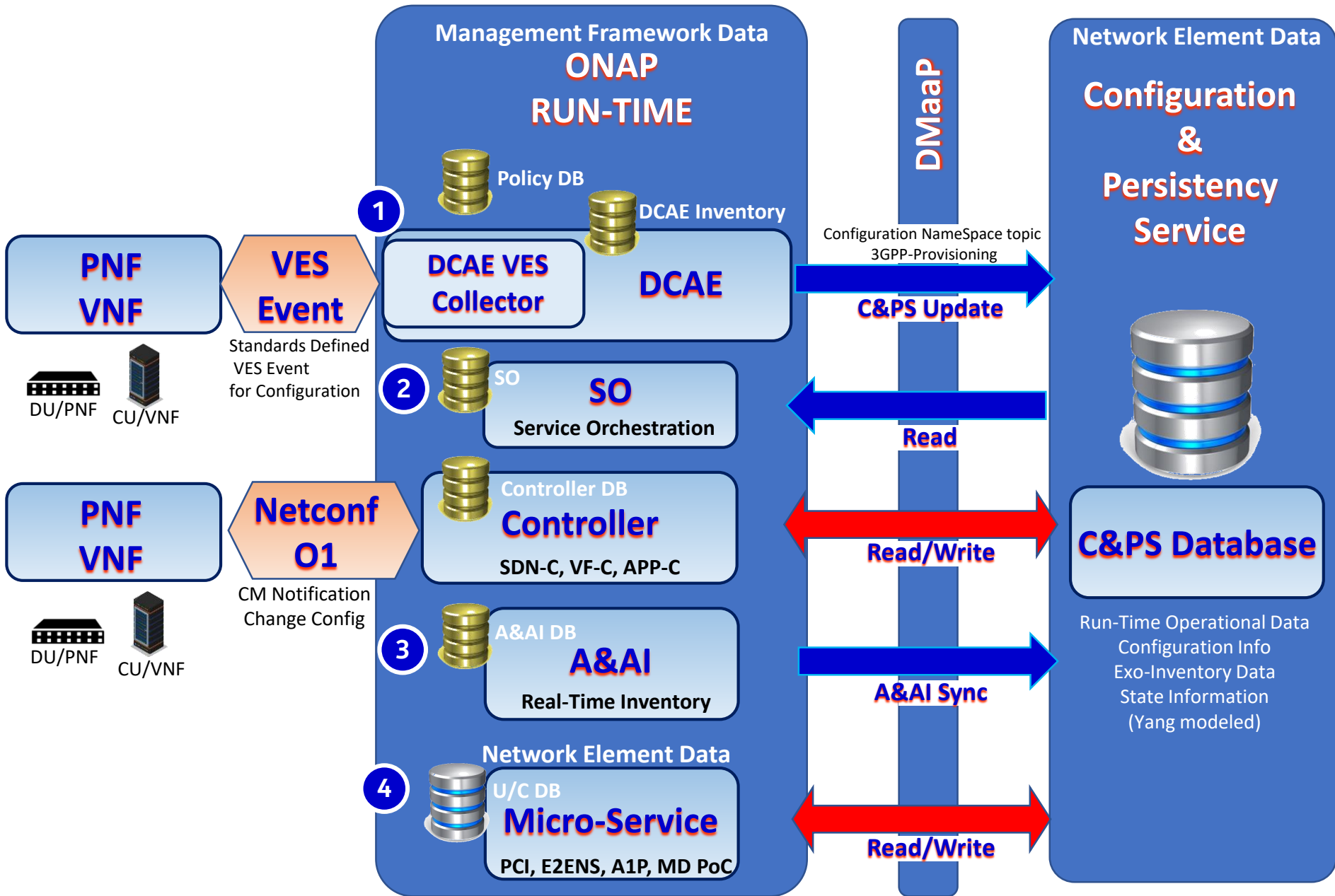
- ONAP Shared Utilities**
- CCSDK
  - Model Utilities
  - TOSCA Parser

# Configuration & Persistency Service (C&PS)

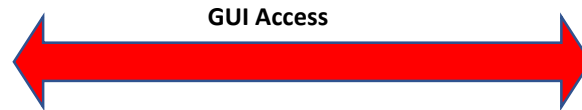
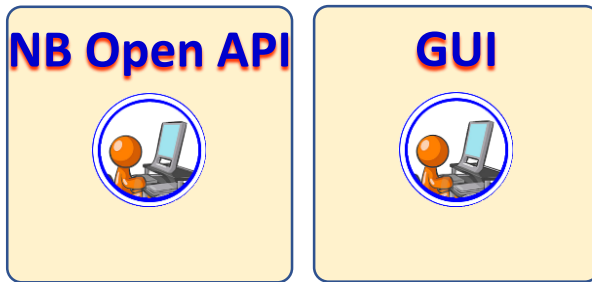
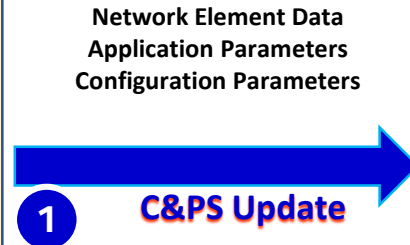
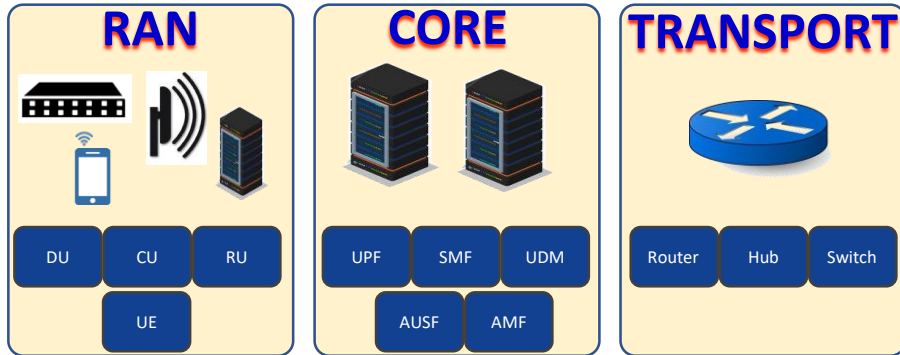




# Configuration & Persistency Service (C&PS)



# Configuration & Persistency Service (C&PS)



Network Element Data

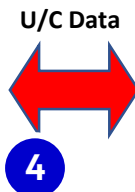
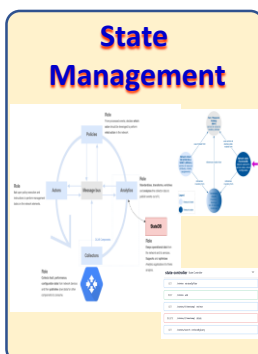
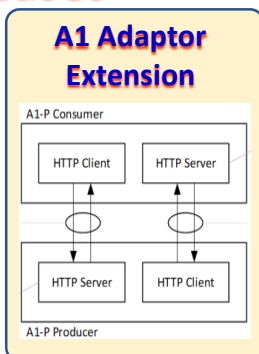
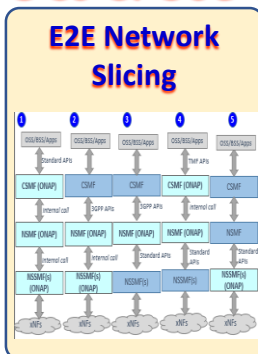
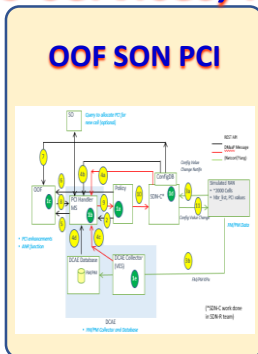
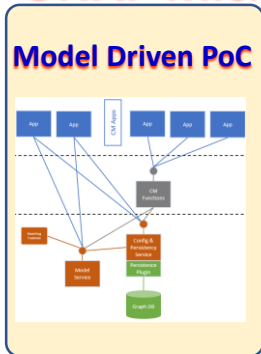
**Configuration & Persistency Service**



**C&PS Database**

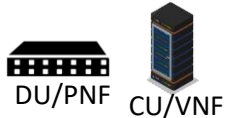
Run-Time Operational Data  
Configuration Info  
Exo-Inventory Data  
State Information

## ONAP Micro-services, POCs & Use Cases





# C&PS READING: PNF Reports StndDef VES



PNF  
VNF

VES  
Event

Standards Defined  
VES Event  
for Configuration

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)

1

DCAE VES  
Collector



DCAE Inventory

DCAE  
Analytics

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

DMaaP

Configuration NameSpace topic  
3GPP-Provisioning

C&PS Update

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

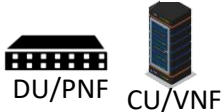
Config & Persist  
Service



C&PS Database

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

# C&PS READING: PNF Reports Configuration



**PNF VNF**

**VES Event**

Standards Defined VES Event for Configuration

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)

1

**DCAE VES Collector**



**DCAE Analytics**

**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

**ONAP RUN-TIME**

**DMaaP**

Configuration NameSpace topic 3GPP-Provisioning

**C&PS Update**

**Config & Persist Service**

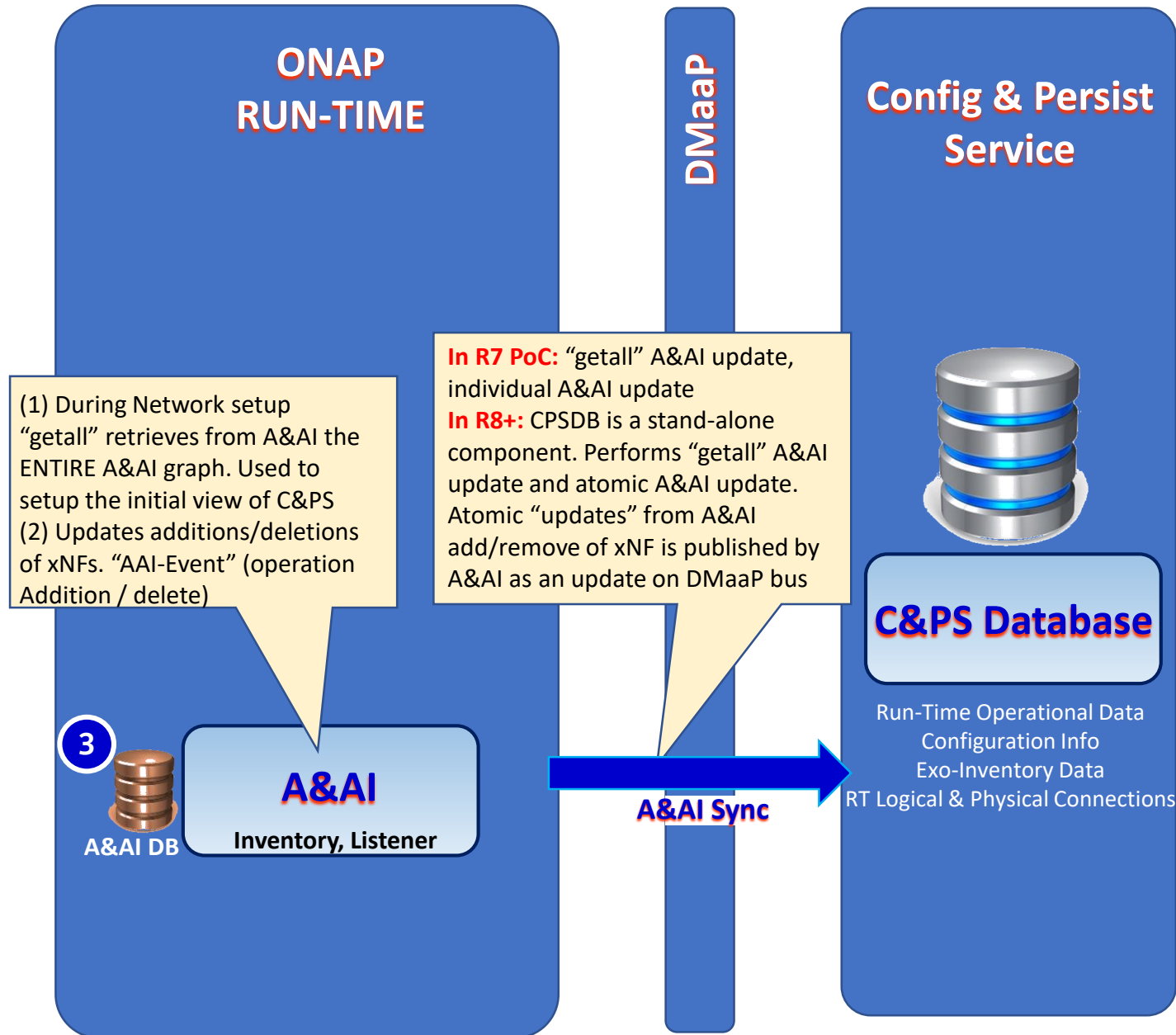


**C&PS Database**

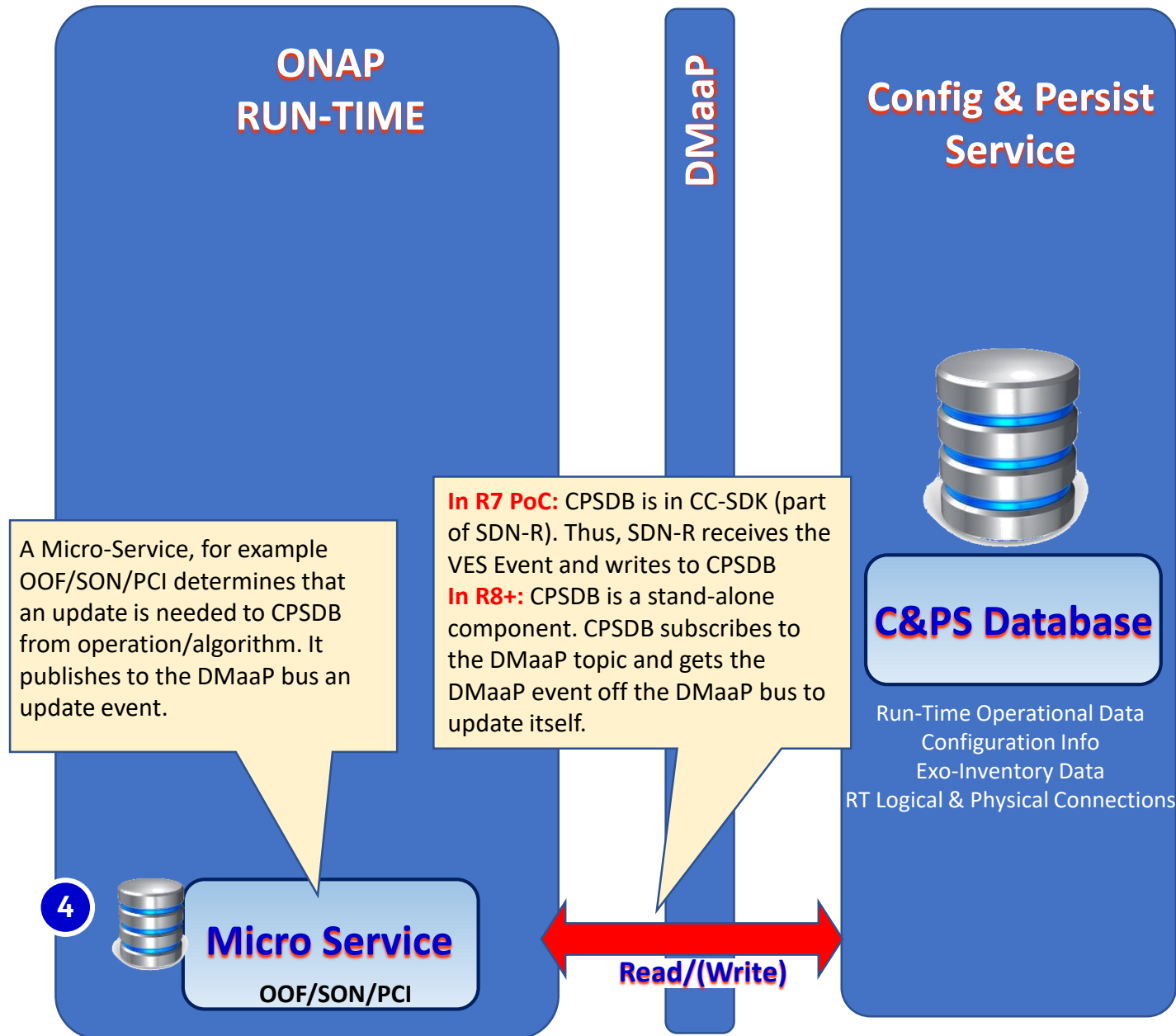
Run-Time Operational Data  
Configuration Info  
Exo-Inventory Data  
RT Logical & Physical Connections



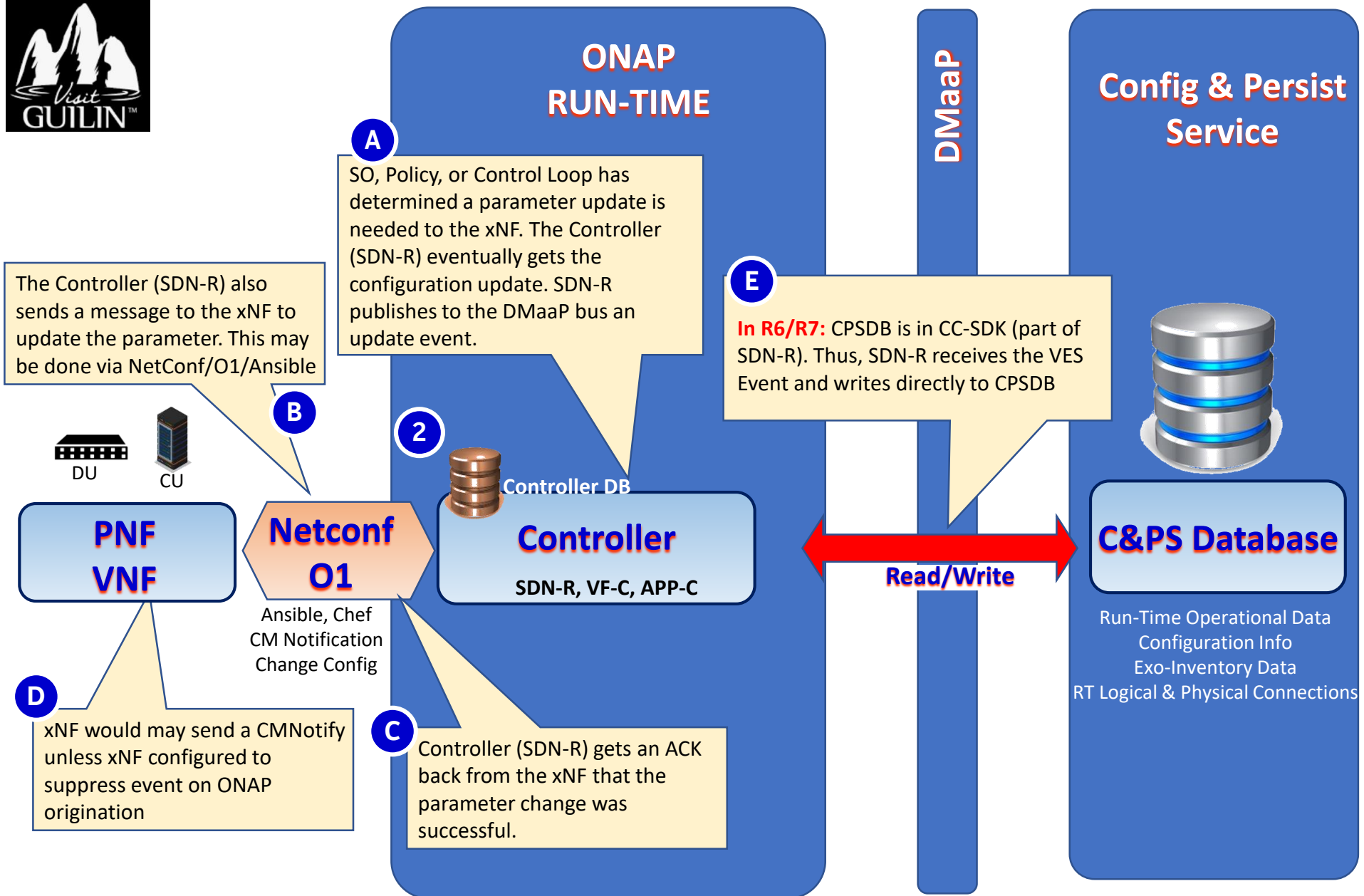
# Data Persistency Service (Run-Time View)



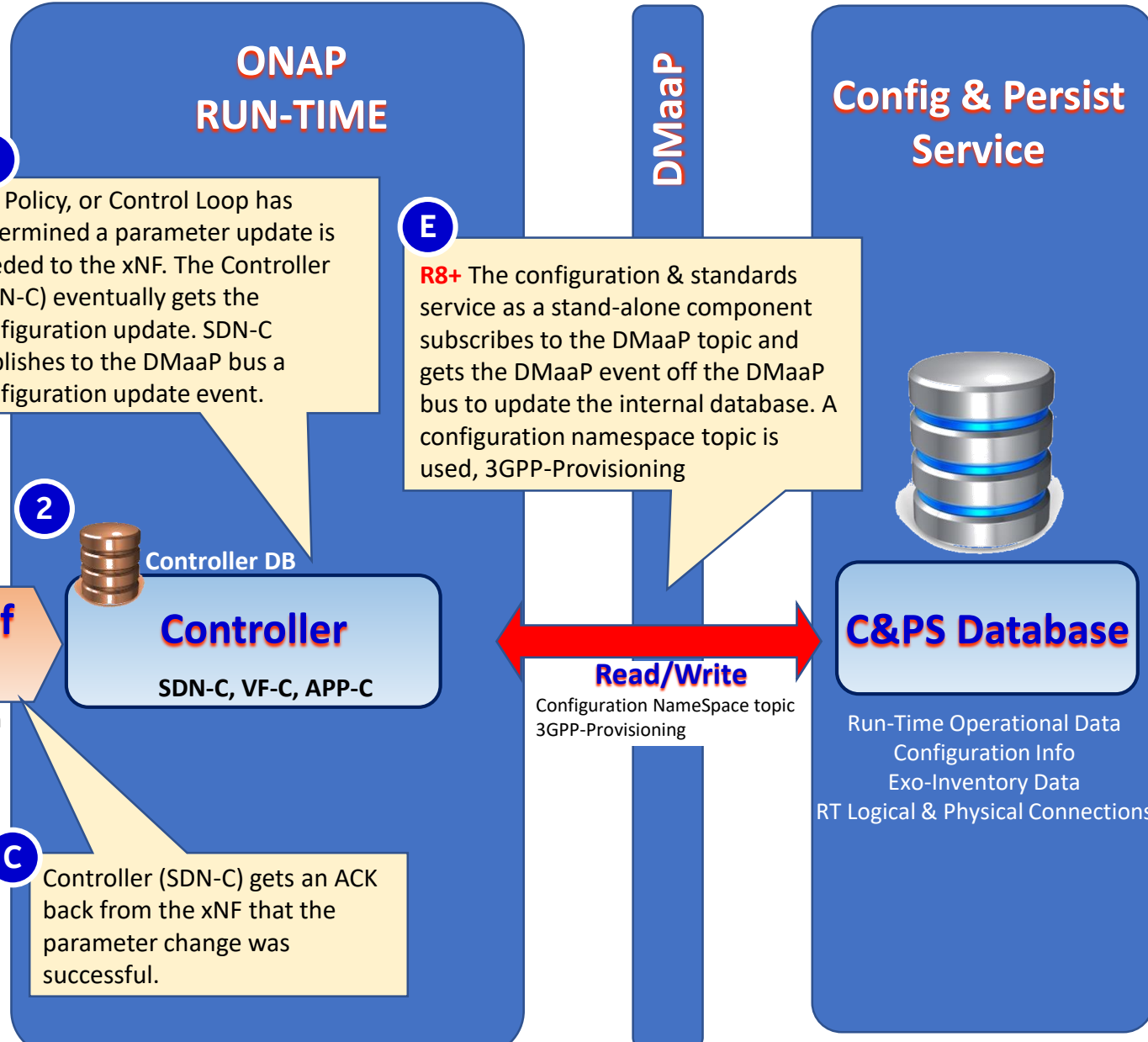
# C&PS WRITING: Micro Service Update



# C&PS WRITING: From Controller SDN-R



# C&PS WRITING: From Controller SDN-C



**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.

**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

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

**B**

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

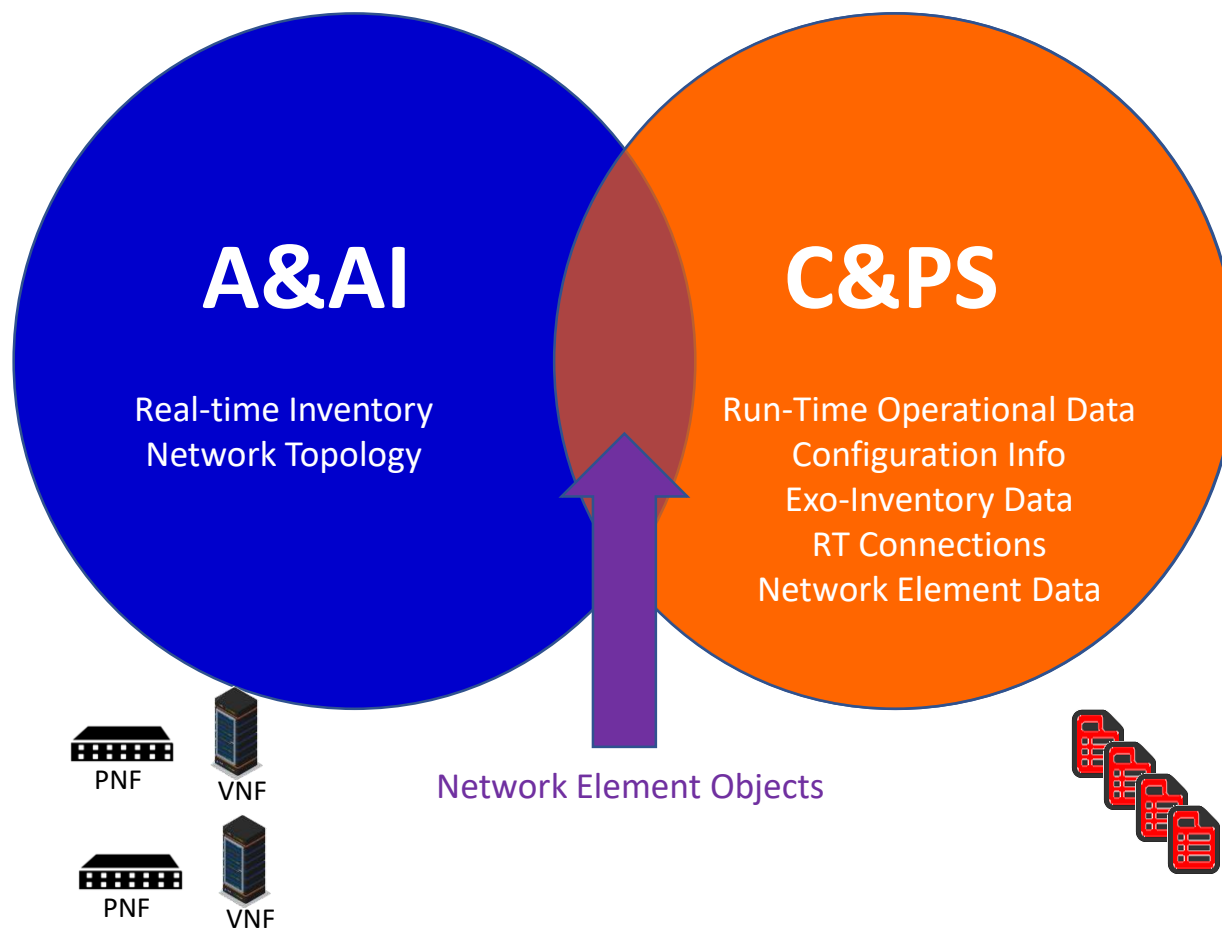
**2**

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



# 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.

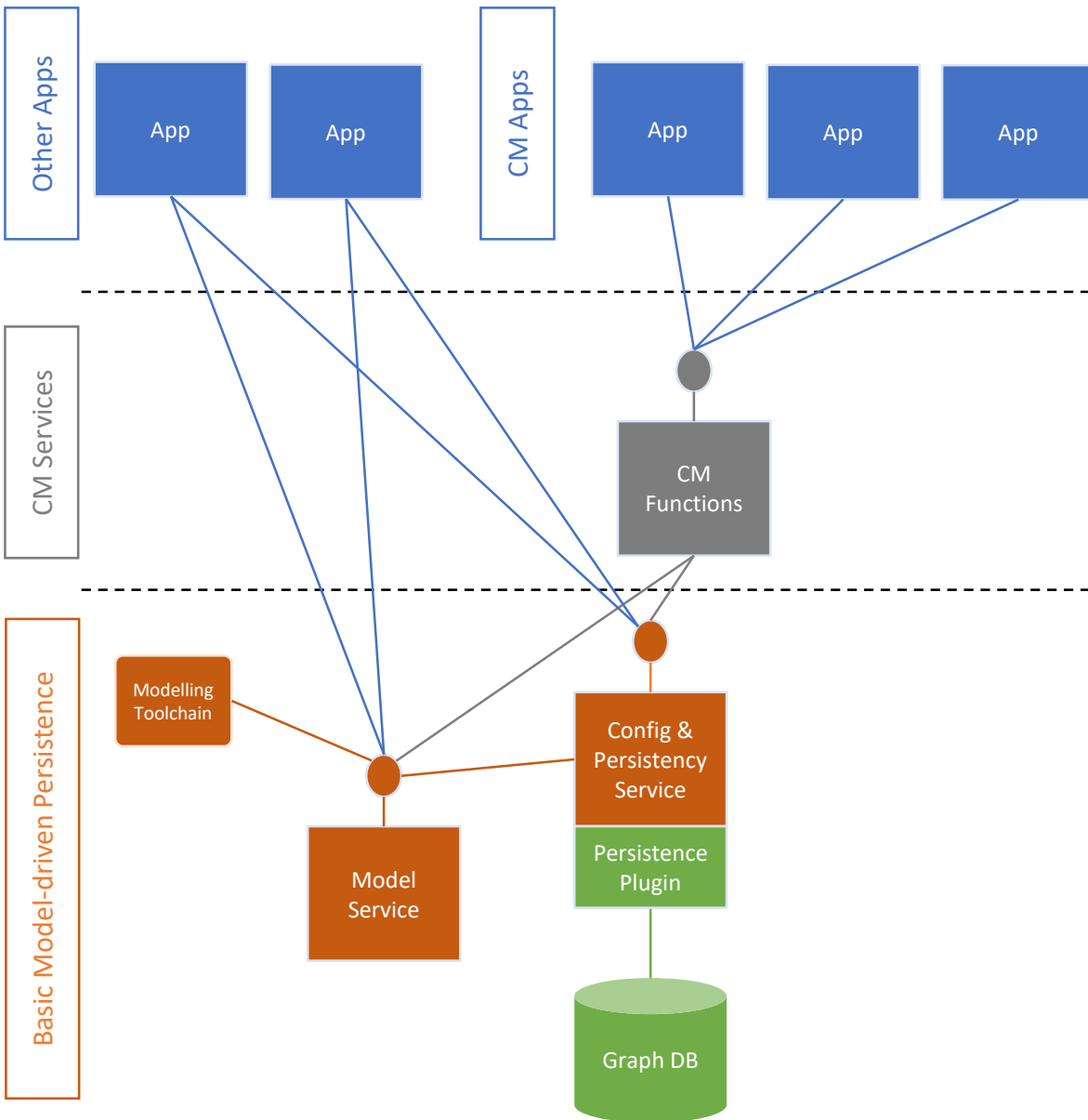


# R7 – Model Driven Configuration & Persistency Service Proof of Concept



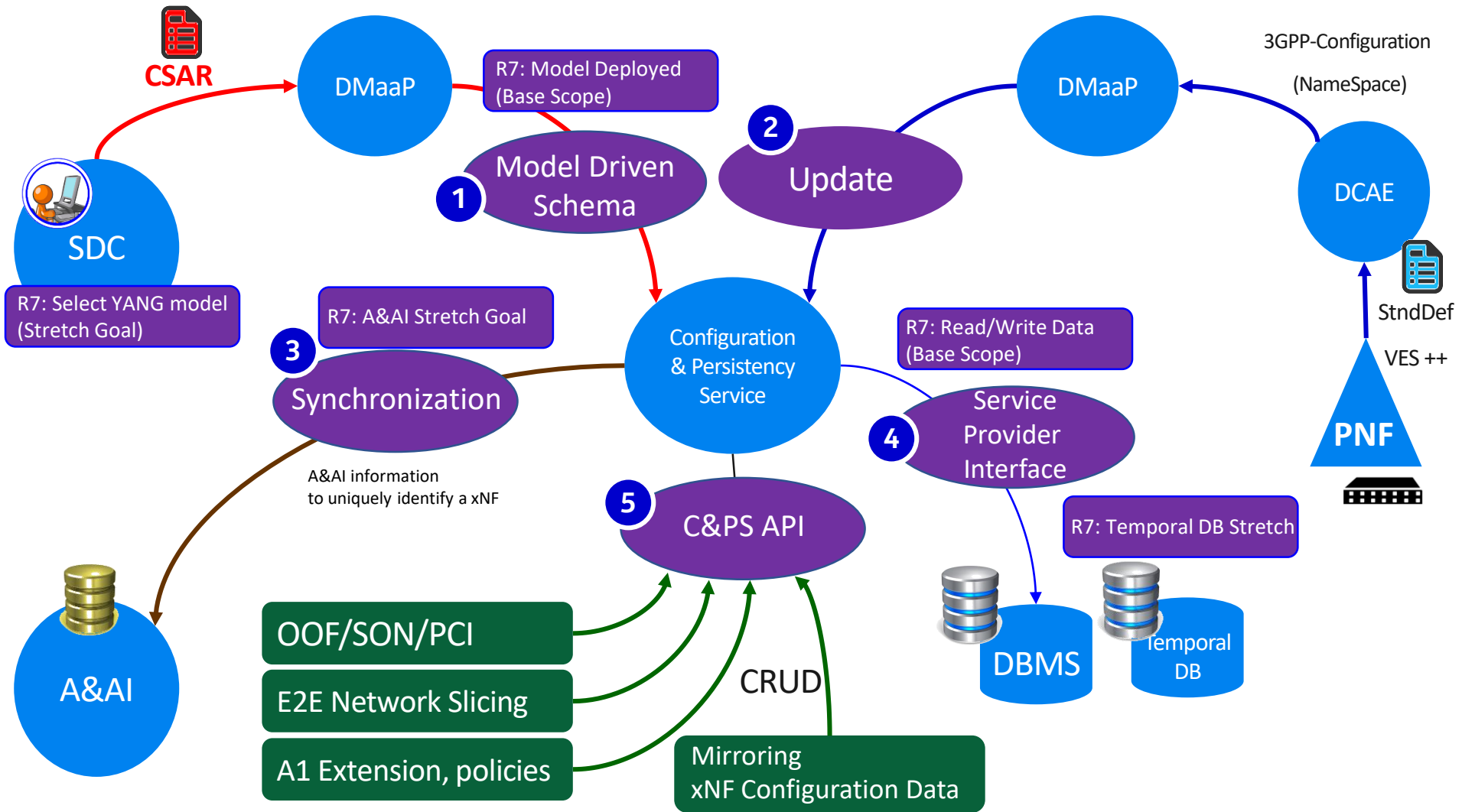
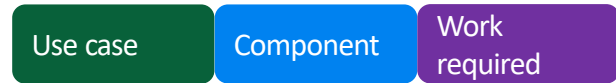
**Proof of Concept**

# 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



# R7 Model Driven C&PS PoC Lessons Learned



- Demonstrate Create/read operations using YANG fragments against a CPS backed by very simple schema / schema-less repository
- Demonstrate ability to deploy / upgrade YANG fragments at runtime
- Demonstrate CPS behavior driven by YANG model
- Provide architecture vision and roadmap for a target architecture, supported use cases, non-functional requirements towards an ONAP Project
- Resolve key architectural Issues necessary for C&PS as a stand-alone project
- Ascertain a sense of Performance and Capacity boundaries

# R7 Model Driven C&PS PoC Lessons Learned



- Base : N/A (new code)  
Main dependency : ODL Yang Tools 5.x (probably)  
<https://javadoc.io/doc/org.opendaylight.yangtools>

- Design and Architecture discussions ongoing  
<https://wiki.onap.org/display/DW/Issues+decisions+and+assumptions>

8	1	MEDIUM	Existing Yang Parser	Is there an existing Yang Parser in ONAP an/or OpenDayLight that can be used for C&PS	No	
9	N/A	AGREED	Location of PoC Code	Dan Timony suggested to use an existing CCSDK repo, he mentioned ccsdk/features. As long as the PoC remains completely independent and doesn't affect delivery of existing artifacts in the same repo.	--	ccsdk/features, see <a href="https://gerrit.onap.org/r/c/ccsdk/features/+/110385">https://gerrit.onap.org/r/c/ccsdk/features/+/110385</a> (awaiting approval)
10	N/A	AGREED	Common information model, Data lake and Access control	How will the CPS help with managing coupling between ONAP components that make use of data lake and common information model	--	We will start with Architectural Approach A in the PoC with the aim of fully supporting Architectural Approach C.  I.e. access to the data lake will be conditional on permission granted by the data owner. In the PoC we will not implement the permission granting mechanism
11	4,5	MEDIUM	Transactional behavior	It needs to be clear to users the level of atomic operations supported by the CPS	Yes	



# C&PS Roadmap



Roadmap



# 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

# C&PS Roadmap & R8-R10 Plan



## Configuration & Persistency Service (CPS) Roadmap –

R8 Honolulu



R9 Istanbul



R10 Kyoto



### **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

June 2021

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**

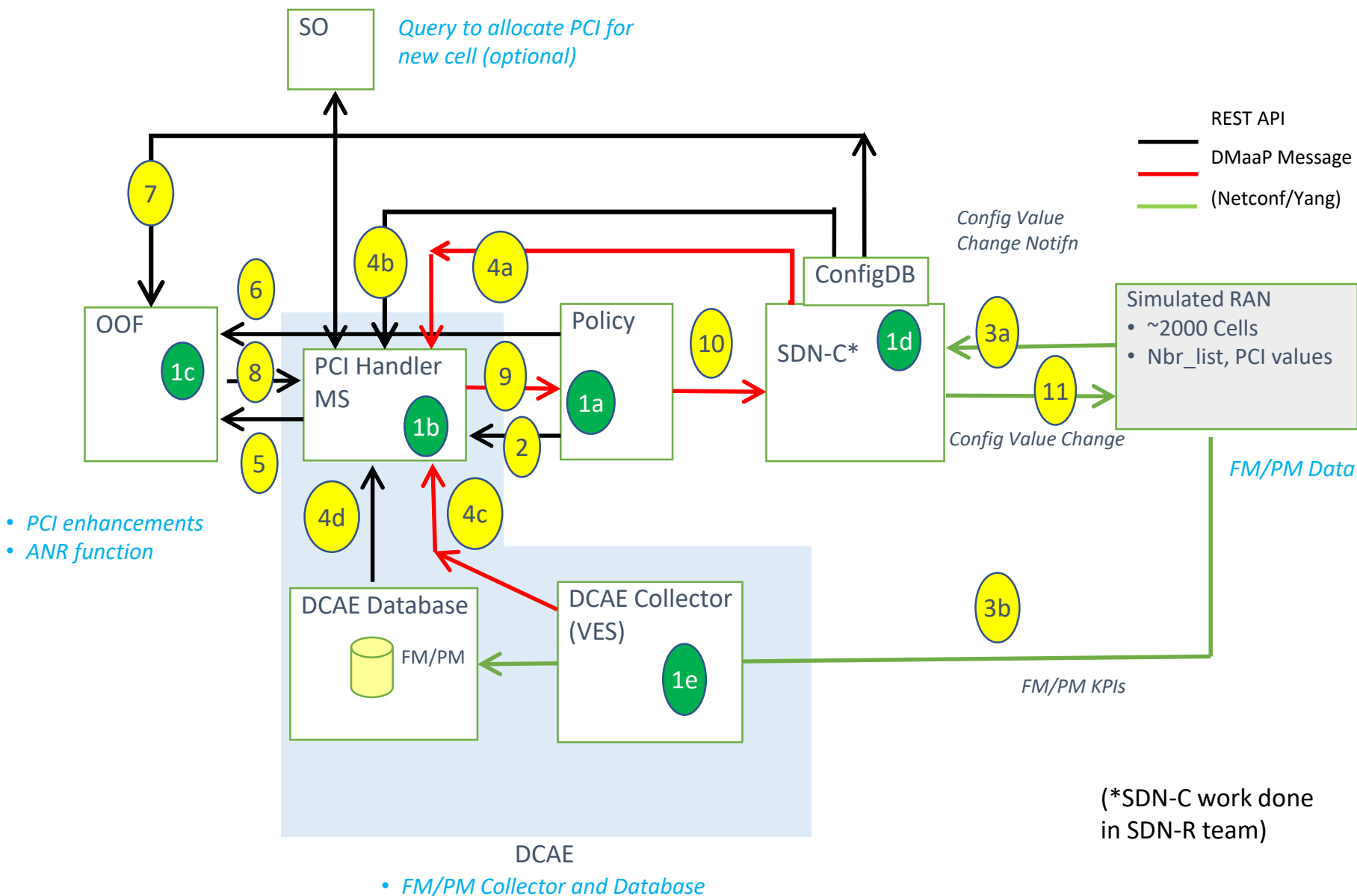


**Proof of Concept**

# C&PS Use Cases and Proof of Concepts in R8

5G USE CASE	DESCRIPTION
<b>OOF - SON (5G)</b>	Optimization and SON functions for 5G RAN. Self-optimization, Self-Healing, Self-configuration.
<b>NETWORK SLICING (5G Use Case)</b>	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)
<b>MOBILITY STANDARDS HARMONIZATION/ A1 adapter</b>	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.
<b>STATE MANAGEMENT POC</b>	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

# OOF / SON / PCI Use Case





# 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

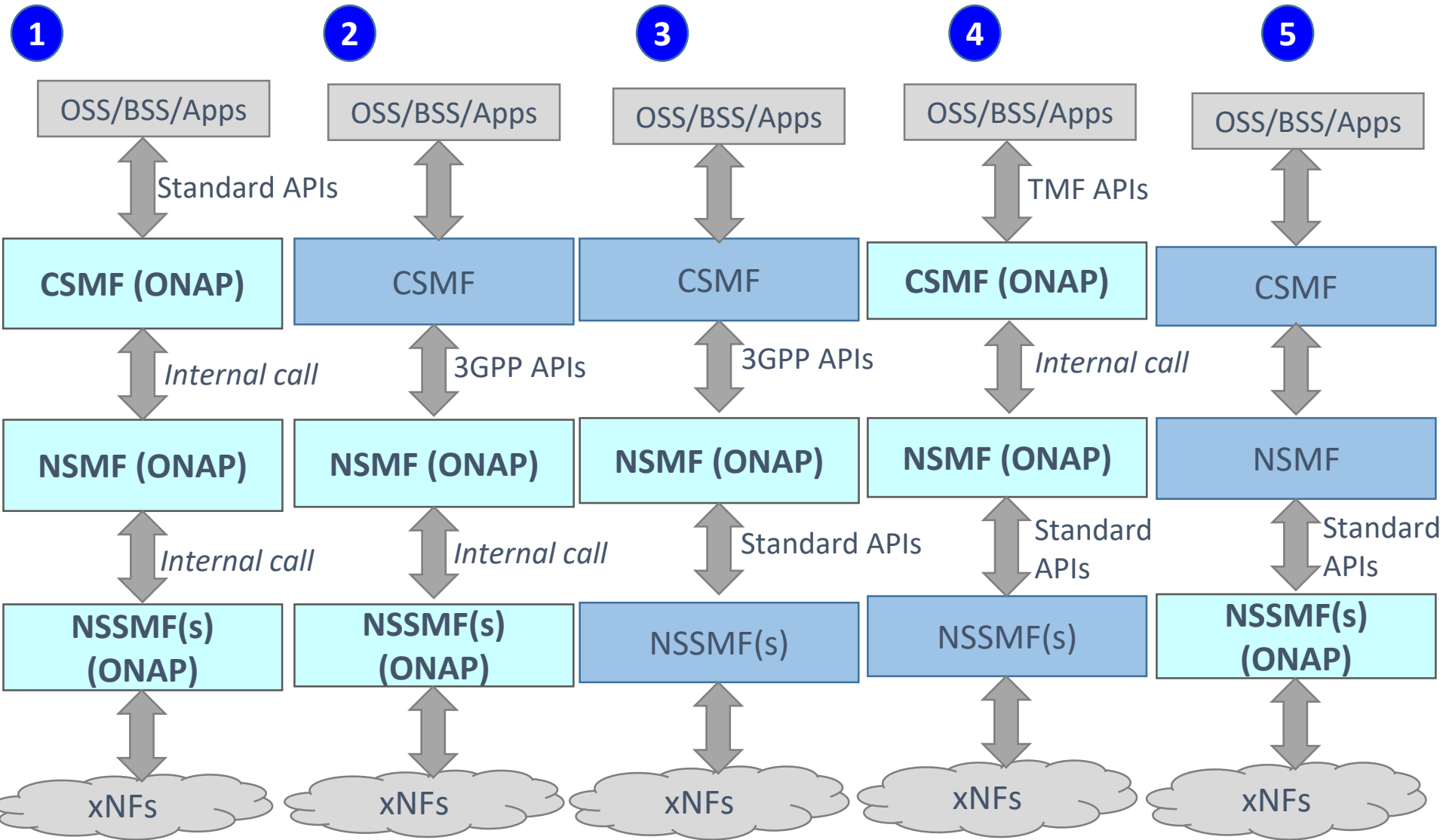
## pnf (Object)

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



3<sup>rd</sup> party component

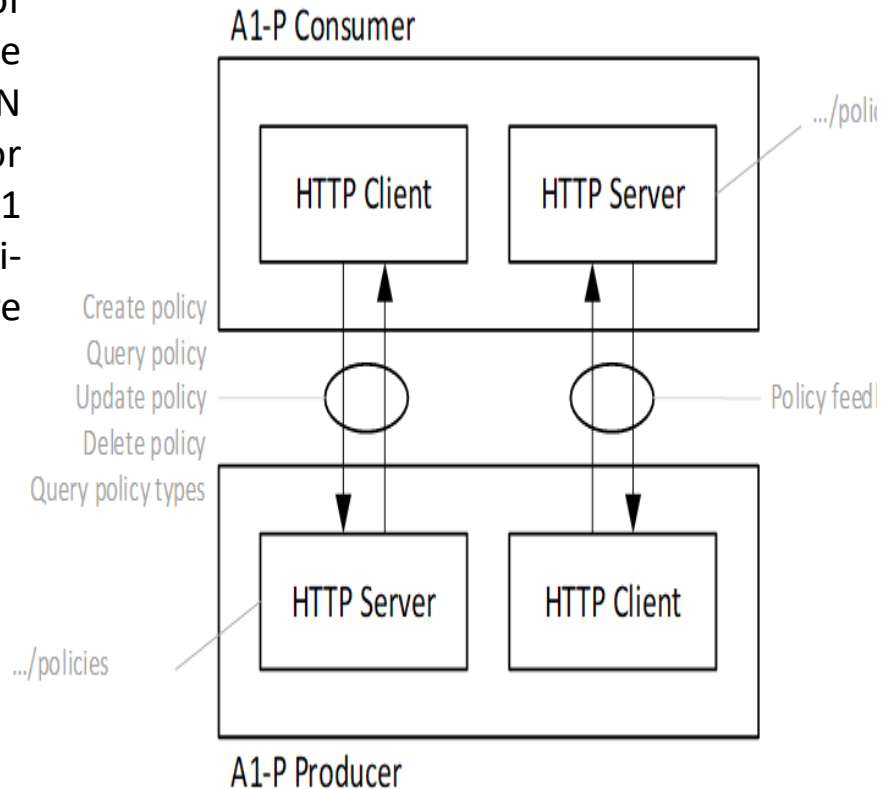
# End to End Network Slicing Use Case



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	sNSSAList
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	sNSSAList
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

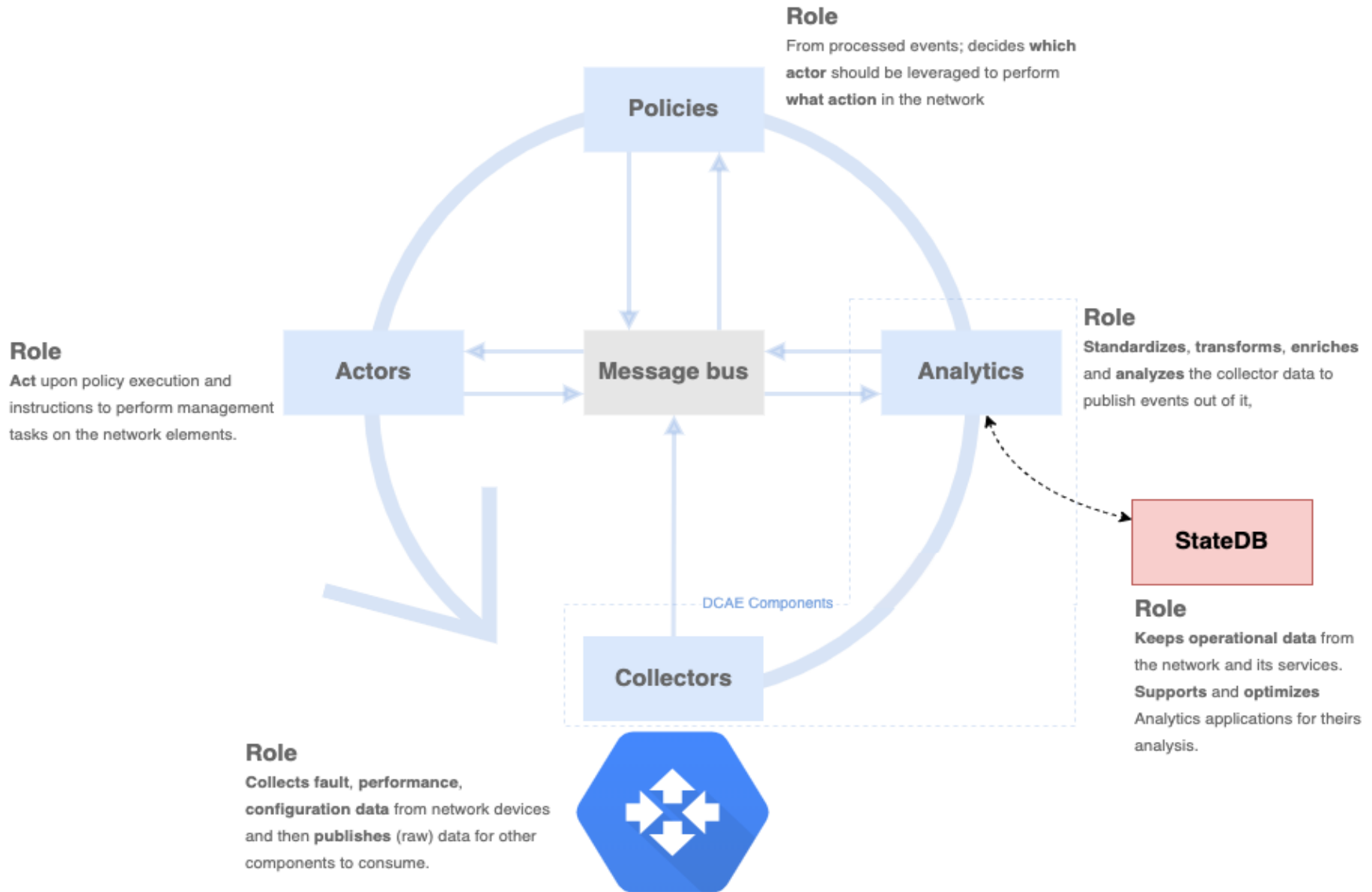
# A1 Policy Extension ORAN-ONAP Harmonize

**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-controller State Controller



**GET** /states retrieveByFilter

**POST** /states add

**GET** /states/{timestamp} retrieve

**DELETE** /states/{timestamp} delete

**GET** /states/search retrieveByQuery

# APPENDIX



# 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:

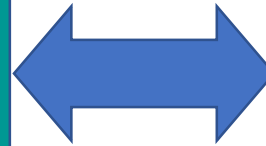
**INDEXING** - Data Records will be indexed by xNF (VNF, PNF, ANF). It would be an objective to have a similar indexing mechanism as A&AI. May also need an index to be a logical object ID.

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

# Dependencies vs Scope

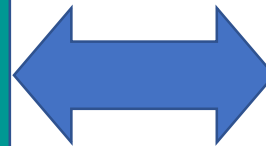
## DEPENDENCIES – need to operate

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)



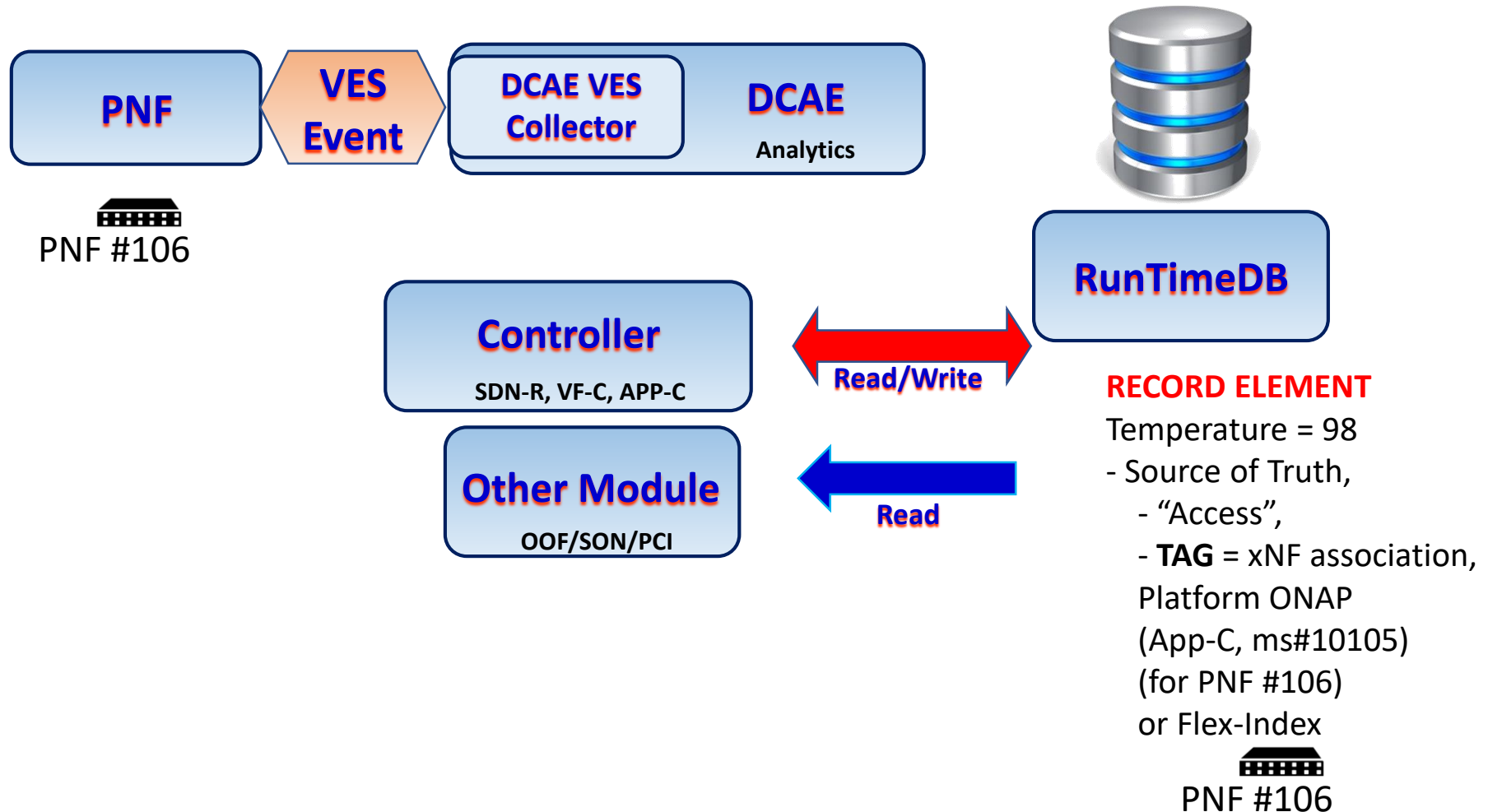
## SCOPE




**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)



-  PNF #101
-  PNF #102
-  PNF #103
-  PNF #104



-  PNF #101 
-  PNF #102 
-  PNF #103 
-  PNF #104 

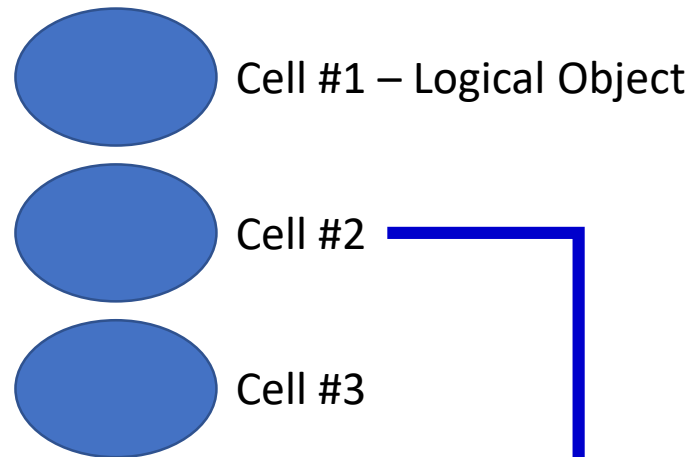


-  PNF #101 
-  PNF #102 
-  PNF #103 
-  PNF #104 

A&I correlated/Index to RunTimeDB  
Publish changes in A&I, 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  
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

## RECORD ELEMENT INDEX = PNF #106

Parameter #1  
Parameter #2  
Parameter #3  
Logical object, Cell #1  
Cell Parameter #1  
Cell Parameter #2  
Cell Parameter #3



# R7 Model Driven C&PS PoC (Ericsson)



Use case	Component	Work required
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