Configuration & Persistency Service

• TSC presentation – May 28, 2020 version 6a

Ben Cheung (Nokia)  
Marge Hillis (Nokia)  
Joanne Liu-Rudel (AT&T)  
Shankar N K (AT&T)  
Ted Johnson (AT&T)  
Zu Qiang (Ericsson)  
Michela Bevilacqua (Ericsson)  
Toine Siebelink (Ericsson)  
Bruno Sokoto (Bell Canada)  
Tony Finnerty (Ericsson)  
Ciaran Johnston (Ericsson)  
Swami N (Wipro)  
Bruno Sokato (Bell Canada)
# DDF June 22-25, 2020 – C&PS Agenda

<table>
<thead>
<tr>
<th>TIME</th>
<th>JUNE 11, 2020 AGENDA ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 min</td>
<td><strong>Overview of C&amp;PS</strong> – Introduction</td>
</tr>
<tr>
<td>20 min</td>
<td><strong>Model Driven C&amp;PS Proof of Concept (PoC)</strong> – Overview of the Model-Driven C&amp;PS PoC for R7</td>
</tr>
<tr>
<td>10 min</td>
<td><strong>R7 &amp; Beyond Roadmap</strong> – Model Driven Proof of Concept (PoC) in R7, way forward in R8 Honolulu, New plan &amp; roadmap</td>
</tr>
<tr>
<td>10 min</td>
<td><strong>Questions &amp; Answers</strong> – Af</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TIME</th>
<th>Q&amp;A Session Post-Session(</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1 hour)</td>
<td><strong>Follow-up questions</strong> – Follow-up meetings at C&amp;PS Team Call (Friday)</td>
</tr>
</tbody>
</table>
Overview of Configuration & Persistency Service

Business Case
Architecture S/C
Overview
Technical Flows
R7 Configuration Persistency Service

Executive Summary - The Configuration & Persistency Service is a real-time new platform component that is designed to serve as a data repository for Run-time data that needs to be persistent. As a stand-alone ONAP component, this project provides data layer services to other ONAP platform components and use cases that require persistent configuration or operational data. The R6 development will be enhanced as well. Focus on storing run-time DATA RELATED to NETWORK ELEMENT instances.

Business Impact - The ability for service operators to visualize and manage data in a RAN 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.

Organization Mgmt, Sales Strategies - There is no additional organizational management or sales strategies for this use case outside of a service providers "normal" ONAP deployment and its attendant organizational resources from a service provider.
Configuration & Persistency Service (C&PS)

Network Element Data

- Configuration
- Persistency
- Service

Database

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

**ONAP Micro-services, POCs & Use Cases**

- Model Driven PoC
- OOF SON PCI
- E2E Network Slicing
- A1 Adaptor Extension
- State Management

**Network Element Data**

- Application Parameters
- Configuration Parameters

**C&PS Update**
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.

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.
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.

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

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

In R7+: RTCDB is a stand-alone component. RTCDB subscribes to the DMaaP Topic itself and gets the DMaaP event off of DMaaP to update itself.
(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

In R6: “getall” A&AI update, individual A&AI update
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: RTCDB is in CC-SDK (part of SDN-R). Thus, SDN-R receives the VES Event and writes to RTCDB

In R7+: RTCDB is a stand-alone component. RTCDB subscribes to the DMaaP topic and gets the DMaaP event off the DMaaP bus to update itself.
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.

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.

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

xNF would may send a Standards Defined VES unless xNF configured to suppress event on ONAP origination.
The Controller (SDN-R) also sends a message to the xNF to update the parameter. This may be done via NetConf/O1/Ansible.

1. 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.

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

3. In R7+: 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. The Controller (SDN-R) also sends a message to the xNF to update the parameter. This may be done via NetConf/O1/Ansible.

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

6. xNF would send a CMNotify unless xNF configured to suppress event on ONAP origination.
R7 – Model Driven Configuration & Persistency Service
Proof of Concept
- 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 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)

- **SDC**
- **DMaaP**
  - Model Driven Schema
  - Update
- **A&AI**
- **VES**
  - VES ++
- **DCAE**

**Use case**
- Component
- Work required

**Component**
- CSAR
- SDC
- DMaaP
- Update
- VES
- VES ++
- PNF

**Work required**
- Model Driven Schema
- Update
- Service Provider Interface
- C&PS API
- DBMS
- OOF/SON/PCI
- E2E Network Slicing
- A1 Extension, policies
- Mirroring xNF Configuration Data

**Use case**
- A&AI information to uniquely identify an xNF

**A&AI**

**Synchronization**

**CRUD**
C&PS Roadmap
### 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

### R8 C&PS project proposal

**CPS FUNCTIONALITY:**
- Data Recovery
- Model Adaption (Dynamic Schema)

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

---

**R7 Guilin**

**R8 Honolulu**

**Rx Future**

- December 2020
- July 2021

- Rx (future) development

---

**THE LINUX FOUNDATION**
Use Cases & Proof of Concepts

Use Cases  
Proof of Concept
## C&PS Use Cases and Proof of Concepts

<table>
<thead>
<tr>
<th>5G USE CASE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MODEL DRIVEN C&amp;PS POC</strong></td>
<td>Proof of Concept development to showcase model-driven Configuration &amp; Persistency Service operation. It schema-less model-driven (type safe) access to data which is owned by applications or indirectly by network functions</td>
</tr>
<tr>
<td><strong>NETWORK SLICING (5G Use Case)</strong></td>
<td>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)</td>
</tr>
<tr>
<td><strong>MOBILITY STANDARDS HARMONIZATION/A1 adapter</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>STATE MANAGEMENT POC</strong></td>
<td>Bell Canada led PoC for State tracking and State management using C&amp;PS</td>
</tr>
</tbody>
</table>
• 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
Model Driven C&PS PoC (Ericsson)

- SDC
- A&AI
- DMaaP
- DCAE
- VES
- VES ++
- DBMS
- PNF

Use case Components Work required

DMaaP

Model Driven Schema
Update
Service Provider Interface
Configuration & Persistency Service

API

CSAR

Synchronization

A&AI information to uniquely identify a xNF

OOF/SON/PCI
E2E Network Slicing
A1Extension, policies

CRUD

Mirroring xNF Configuration Data
OOF / SON / PCI Use Case

Query to allocate PCI for new cell (optional)

- PCI enhancements
- ANR function

DCAE
- FM/PM Collector and Database

Simulated RAN
- ~2000 Cells
- Nbr_list, PCI values

(*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
- cellld 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)

<table>
<thead>
<tr>
<th>Cell (Object)</th>
<th>Attribute</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>networkId</td>
<td>string</td>
</tr>
<tr>
<td></td>
<td>cellId</td>
<td>string</td>
</tr>
<tr>
<td></td>
<td>pciValue</td>
<td>uint64</td>
</tr>
<tr>
<td></td>
<td>nbrList</td>
<td>list of cellId</td>
</tr>
<tr>
<td></td>
<td>lastModifiedTS</td>
<td>timestamp</td>
</tr>
<tr>
<td></td>
<td>pnf-name</td>
<td>string</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>pnf (Object)</th>
<th>Attribute</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pnf-name</td>
<td>String</td>
</tr>
<tr>
<td></td>
<td>cells</td>
<td>List of cellID's</td>
</tr>
<tr>
<td></td>
<td>lastModifiedTS</td>
<td>timestamp</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ConfigDB API</th>
<th>API</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GET cellList</td>
<td>networkId, ts</td>
<td>List of cellIds</td>
</tr>
<tr>
<td></td>
<td>GET PCI</td>
<td>cellId, ts</td>
<td>PCI Value</td>
</tr>
<tr>
<td></td>
<td>GET nbrList</td>
<td>cellId, ts</td>
<td>List of cellIds and their PCI values</td>
</tr>
<tr>
<td></td>
<td>GET pnf-name</td>
<td>cellId, ts</td>
<td>pnf-name</td>
</tr>
</tbody>
</table>
End to End Network Slicing Use Case

1. OSS/BSS/Apps
   - Standard APIs
   - Internal call
2. NSMF (ONAP)
   - NSSMF(s) (ONAP)
   - xNFs
3. NSSMF(s) (ONAP)
   - xNFs
4. NSMF (ONAP)
   - NSSMF(s)
   - xNFs
5. NSMF
   - NSSMF(s)
   - xNFs

3rd party component
# End to End Network Slicing Use Case

<table>
<thead>
<tr>
<th>NetworkSlice</th>
<th>Network Slice NRM</th>
<th>operationalState</th>
</tr>
</thead>
<tbody>
<tr>
<td>NetworkSlice</td>
<td>Network Slice NRM</td>
<td>administrativeState</td>
</tr>
<tr>
<td>ServiceProfile</td>
<td>Network Slice NRM</td>
<td>serviceProfileId</td>
</tr>
<tr>
<td>ServiceProfile</td>
<td>Network Slice NRM</td>
<td>sNSSAIList</td>
</tr>
<tr>
<td>ServiceProfile</td>
<td>Network Slice NRM</td>
<td>pLMNIdList</td>
</tr>
<tr>
<td>ServiceProfile</td>
<td>Network Slice NRM</td>
<td>perfReq</td>
</tr>
<tr>
<td>ServiceProfile</td>
<td>Network Slice NRM</td>
<td>maxNumberOfUEs</td>
</tr>
<tr>
<td>ServiceProfile</td>
<td>Network Slice NRM</td>
<td>coverageAreaTAList</td>
</tr>
<tr>
<td>ServiceProfile</td>
<td>Network Slice NRM</td>
<td>latency</td>
</tr>
<tr>
<td>ServiceProfile</td>
<td>Network Slice NRM</td>
<td>uEMobilityLevel</td>
</tr>
<tr>
<td>ServiceProfile</td>
<td>Network Slice NRM</td>
<td>resourceSharingLevel</td>
</tr>
<tr>
<td>SliceProfile</td>
<td>Network Slice NRM</td>
<td>sliceProfileId</td>
</tr>
<tr>
<td>SliceProfile</td>
<td>Network Slice NRM</td>
<td>sNSSAIList</td>
</tr>
<tr>
<td>SliceProfile</td>
<td>Network Slice NRM</td>
<td>pLMNIdList</td>
</tr>
<tr>
<td>SliceProfile</td>
<td>Network Slice NRM</td>
<td>perfReq</td>
</tr>
<tr>
<td>SliceProfile</td>
<td>Network Slice NRM</td>
<td>maxNumberOfUEs</td>
</tr>
<tr>
<td>SliceProfile</td>
<td>Network Slice NRM</td>
<td>coverageAreaTAList</td>
</tr>
<tr>
<td>SliceProfile</td>
<td>Network Slice NRM</td>
<td>latency</td>
</tr>
<tr>
<td>SliceProfile</td>
<td>Network Slice NRM</td>
<td>uEMobilityLevel</td>
</tr>
<tr>
<td>SliceProfile</td>
<td>Network Slice NRM</td>
<td>resourceSharingLevel</td>
</tr>
</tbody>
</table>
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.
Bell Canada Leading a PoC related to State management using the C&PS project. Communication via Kafka topic (DMaaP).
**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 – 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**

- 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**
- **VES Event**
- **DCAE VES Collector**
- **DCAE Analytics**
- **Controller** SDN-R, VF-C, APP-C
- **Other Module** OOF/SON/PCI
- **RunTimeDB**

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

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 = Logical Object #111**
- Parameter #1
- Parameter #2
- Parameter #3
- State Info X.733
- Associations
  - { Logical Object #111 Cell #2 }
- Cardinality Rules
- Linking Restrictions

Cell #1 – Logical Object
Cell #2
Cell #3

C&PS Database

PNF #106

THE LINUX FOUNDATION

ONAP