Change Management Extensions
Frankfurt and Beyond

Łukasz Rajewski (Orange)
Zu Qiang (Ericsson)
Ajay Mahimkar (AT&T)
Change Management Vision

Zero touch deployment, zero service impact

**Design:**
- Fast
- Easy
- Flexible
- Complete

**Scheduling:**
- Automated
- Intelligent
- Cognitive

**Execution:**
- Automated
- Safe
- E2E
Rolling changes for network-wide deployment

1. Minimize impact during deployment
   • Changes may require interruption to service
   • Leverage redundancy

2. Minimize impact post deployment
   • Unexpected performance
   • Damage control through early halt

Reduced service downtime
   • Deployment optimization
   • Appropriate scheduling
vFW Traffic Distribution UC (El Alto)

- **vFW TD Scenario**
  - Check Traffic on vPKG
  - Determine vFW/vPKG pairs for distribution with OOF
  - Move traffic from vFW 1 to vFW 2 reconfiguring vPGN
  - Check Traffic on vFW 1
  - Check Traffic on vFW 2
vFW Traffic Distribution Workflow (El Alto)

- Algorithm for Traffic Distribution Workflow
  - Traffic Distribution Optimization algorithm aims to deliver extra information for DistributeTraffic LCM in APPC
  - Anchor Point – Firstly VF-module instance that will perform an operation of Traffic Distribution. In the future other methods
  - Destination Point - VF-module instance(s) that will take a traffic
  - A&AI delivers an information about existing VNF instances, VF-Modules instances, V-Servers etc.
  - Policy delivers an information about traffic distribution policies
  - Algorithm delivers an anchor point and list of destinations for distribution
Dynamic selection of vf-module instance with OOF (El Alto)

1. OOF / HAS algorithm used
   a) Selection of vf-module Instance for service/vnf
   b) Selection is policy based
      • Filtering by AAI attributes
      • Relation i.e. by region
      • Exclusion/Inclusion
   c) Exclusion/Inclusion

2. OOF selects vf-module candidates for requested demands
   a) We can find vf-module that satisfies specified criteria
   b) We can find related vf-modules

3. Usefull in workflows when we do not know the exact vf-module to perform action on
vFW In-Place Upgrade & Traffic Distribution Workflow (Frankfurt)

- Workflow and use case modified towards In-Place Upgrade with Traffic Distribution
  - Upgrade (Pre/Post Check, Upgrade), Lock (Check, Lock, Unlock) and Traffic Distribution LCMs
  - For Guilin planned further modifications

- Improvements in APPC for VNFC scope reconfiguration with Ansible
  - APPC is able to auto generate NodeList section for vnf, vf-module or vnfc scope
  - Requires oam Ips configured in AAI (vnf and vnfc-lvl)
  - NodeList is generated from payload/request-parameters section
  - Will evolve into generic vnfc and vf-module identifiers support for APPC LCM actions for any kind of protocol
Current SO Building Blocks Supported Use Cases

SO Building Block implementation:
The SO building blocks are a set of database-driven, configurable and generic process steps to be leveraged through several actions defined as 'Macro' flows. For each of the macro flows, there are a set of actions to the orchestration services and various type of resources orchestrated by ONAP.

Supported Services & Resource types
These resource types are essentially the ones defined in the model - through the SDC framework. SO orchestrates service, vnf and vfModule building block for assign, create configure and activate.

There is a lack of vnfc orchestration in ONAP that is required in order to support complex lifecycle management for various vnf use case.

- Services
- VNF (Virtual Network Function)
- VF modules (i.e. a deployment unit, such as a HEAT stack)
- **VNFC** (virtual network function component)
SO MACRO Generic Building Block Orchestration (Frankfurt)

<table>
<thead>
<tr>
<th>Id</th>
<th>Composite_Action</th>
<th>SEQ_NO</th>
<th>FLOW_NAME</th>
<th>FLOW_VERSION</th>
<th>LOOKUP_ID</th>
<th>SCOPE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Service-Macro-Assign</td>
<td>1</td>
<td>ControllerExecutionBB</td>
<td>1</td>
<td>1</td>
<td>vnf</td>
<td>config-assign</td>
</tr>
<tr>
<td>2</td>
<td>Service-Macro-Assign</td>
<td>2</td>
<td>ControllerExecutionBB</td>
<td>1</td>
<td>1</td>
<td>vfModule</td>
<td>config-deploy</td>
</tr>
</tbody>
</table>

**Scope**
- service
- pnf
- vnf
- vfModule
- vnfc (to be added)

**NOTE**: Scope drives input action identifiers to controller LCM execution such as ssid, vnf-id, vf-module-id, vnfc-name, etc..

Controller BB (BPMN + Java)

- Build Controller Context from inputs
  - Scope
  - Action
  - Actor

Simplified logical flow

APPCC/SDNC Paths

LCM APIs

CDS Path

CDS API
The best option that allows to configure concrete VM for vnf, vf-module and vnfc scope in APPC
vFW / vDNS Build & Replace Upgrade Workflow & UC (Plan)

- Possible change of the use case from vFW to vDNS
- Change of the Instantiation methods to Macro Flow with CDS
- Integration with vDNS ScaleOut/In use Case
  - Depends on the plans of Scaling team for implementation of ScaleIn scenario
  - Without ScaleIn only ScaleOut with new software version
- LCM actions execution through the CDS and APPC
  - Workflow defined in the Orchestration Flow Table in SO
  - Use of ControllerExecutionBB
  - Actions executed on VNFC level with Ansible protocol (but ready for NetConf)
  - Dynamic selection of vf-module instance with OOF
    - Integration with SO (probably in the ControllerExecutionBB)
    - MDSAL as a new source of data for filtering in HAS
E2E PNF Software Upgrade (Frankfurt)

- PNF in-place software upgrade procedure on a single PNF instance without schema update
  - Scenario 1: Using direct Netconf/Yang interface with PNF
  - Scenario 3: Using Ansible protocol with EM
  - Scenario 4: Using Netconf/Yang interface with EM

- Service level schema update is proposed as “Enable service level LCM operations”
  - only “PNF software version onboarding” is committed

Only the 1st part of the E2E solution

The 2nd part of the E2E solution
Update one PNF instance without schema update
(Using direct NetConf/Yang interface with PNF - Frankfurt)

**Pre-condition**
- Vendor
- Operator
- SDC
- CDS

**Design Time**
- SDC catalog
- PNF package X
  - Descriptor
  - Artifacts
- Upload blueprint scripts
  - Add repository folder URL and userID / password
- Associate additional artifacts (e.g. CBA) with the resource A
- Create Service A with resource A

**Run Time**
- VID
- SO
- AAI
- SDNC
- PNF
- SFTP

**Service Instantiation (PnP)**
- Service instance object A
  - service-instance-id 1
  - model-invariant-id 1
  - model-version-id 1
- Netconf / Yang

**Selected workflow, Target software version, and PNF instance ID**
- Software instance id 1
  - model-name A
  - model-invariant-id 1
  - model-version-id 1
  - swVersion 2.0
  - Artifacts

**Updates**
- Software version is updated
- Repeat per SO action

**Repeat per SO action**
- SO Workflow

**Netconf / Yang**
- Retrieve image

**Selected workflow, Target software version, and PNF instance ID**
- Software instance id 1
  - model-name A
  - model-invariant-id 1
  - model-version-id 1
  - software-version 2.0

**Pre-condition**
- Software Image
  - blueprint-name / version are added into the PNF resource model as properties
Upgrade with modification of the schema

- **New VSP -> new/updated resource (PNF model or VF-Model)**
  - Modification of Service Model required to provision new blueprints/artifacts

- **Today we cannot move existing service instances to the new service model**
  - We can only create new service instance for new service model
  - Changing model of existing service instance would not mean only changes in MariaDB and AAI
  - Dedicated procedures required for specific schema transitions (1.0 ->2.0 != 2.0->3.0)

- **Schema update based on the Service Model**
  - Build and replace Pattern to be used for CNFs and VNFs
    - For CNFs controlled by K8s, for VNFs by ONAP controller
  - Data migration and reconfiguration for VNF / PNF
  - Workflow needs to operate on cross-service scope
  - We need cross-service LCM operations
    - For CNFs not required since MultiCloud/K8s will provision that
  - OOF may help to coordinate the upgrade process
1. A vendor shall provide
   - a new VNF/PNF package with updated artifacts, and
   - the new VNF/PNF software image to the operator.

2. At receiving of the new package, the operator shall
   - onboard the new package and create a new resource template or update the existing resource template
   - update the existing service template with the new or updated resource template
   - distribute the updated service template to run time.

3. At run time, the operator shall, based on the updated service template,
   - upgrade a service instance and its resource instances, and
   - update the run time catalog with the updated service/resource template

Schema upgrade must be handled at service level for both design time and run time

Then ONAP can make use of the new artifacts provided by the vendors, after schema update
Service level LCM operation on PNF example (with the same resource name - Guilin)

Vendor

Operator

SDC
CDS

SDC catalog

Design Time

Run Time

VID
SO
AAI
SDNC
PNF
SFTP

Pre-condition

Step 1: provide new image and new package to the operator

PNF Package X
Descriptor
Artifacts

Onboard package & Create resource A

Upload blueprint scripts and parameters

Associate additional artifacts (e.g. CBA) with the resource A

Create Service A with one resource instance Add additional service artifacts (e.g. wf)

Resource Instance name M
Resource Name A invariantUUID 1 UUID 1 swVersion 1.0
Artifacts

Service template
Name A invariantUUID 1 UUID 1 Revision 1.0

Distribution

Service Instantiation (PNP)

PNF instance-id 1 model-invariant-id 1 model-version-id 1 software-version 1.0

Service instance object A service-instance-id 1 model-invariant-id 1 model-version-id 1

Step 5: execute the workflow on the service instance

SO workflow execution on service instance

Instance ID & actionIdentifier

Netconf/Yang

Updates

Retrieve image

Distribution

PNF instance-id 1 model-invariant-id 1 model-version-id 1 software-version 2.0

Service instance object A service-instance-id 1 model-invariant-id 1 model-version-id 1

Step 6: update the management service instance object

SDN catalog

PNF

AAI

SDNC

Step 2: Update the resource template using the new onboarding package

PNF Package Y
Descriptor
Artifacts

Onboard package & update resource A

Upload/update blueprint scripts and parameters

Update additional artifacts (e.g. CBA) with the resource A

Update Service template by replacing the existing resource A with a new revision Update additional service artifacts (e.g. wf)

Resource Instance name M
Resource Name A invariantUUID 1 UUID 1 swVersion 2.0
Artifacts

Service template
Name A invariantUUID 1 UUID 2 Revision 2.0

Step 3: update service template with the new revision of the same resource template

New schema with updated software version and artifacts

Step 4: select an existing service instance, a target service template revision and a service level upgrade workflow

Step 6: update the management service instance object

Software Image

PNF Package Y
Descriptor
Artifacts

Software Image

PNF Package X
Descriptor
Artifacts

Software Image
Service level workflow on PNF Example

- **Design time**
  - indicates which resource instance shall be upgraded
  - indicates which sub-workflow / building blocks shall be used at resource level

- **Run time**
  - After service level upgrade, all resource instances must be upgraded to the revision defined in the service template

---

Upgrade Workflow example of one service instance

**Workflow pre-load**
- Creating resource instance upgrade list by comparing the service templates

**Service level preparation**
- Service level health check on all resource instances within the service
- Resource level preparation workflow on each upgrading resource instances

**Service level Upgrade**
- resource level activateNESw workflow on each upgrading resource instances
- Service level update AAI

**Service level post-check**
- Resource level post-check workflow on each upgraded resource instances

**Manual process**
- May trigger a separated service level rollback procedure if an error is found during the execution of a service upgrade flow

---

**PNF resource level preparation workflow**
- preCheck
- downloadNESw

**PNF resource level activateNESw workflow**
- activateNESw
- updateAAI

**Update**
- Update the software version, model-invariant-id and the model-version-id of the resource template in the A&AI entry
- Update the model-invariant-id and the model-version-id of the service template in the A&AI entry
Change Management Scheduling in ONAP and extensions

• As of Frankfurt
  - Automated schedule discovery with conflict avoidance
  - OOF for schedule discovery/optimization algorithms
    • use of MiniZinc / model-driven approach
    • static composition of constraints
  - Constraints supported: conflict, concurrency

• Guilin and beyond
  - Support wide variety of constraints – service impact, timezone, grouping based on attributes
  - Policy-enabled discovery – store constraints in policy engine
  - Enable modular and dynamic composition of constraints – i.e., user specified selection of constraints for each schedule discovery
  - Scale up schedule discovery to large number of network elements (especially for network edge – hundreds of thousands of nodes)
Integration of CNFs as enabler for Change Management

• CNFs/k8s have clear advantage over VNFs
  - Faster Instantiation
  - Scaling enabled
  - Distribution of Traffic
  - Upgrading and Release Management

• MultiCloud-K8s Project
  - Introduces CNF Deployment & Configuration Capabilities into ONAP
  - CNF/K8s Management Integrated with ONAP MultiCloud
  - Tested for deployment of vFW CNFs/VNFs with VNF API

• vFW CNF Upgrade Use Case
  - Available Scaling and Upgrade mechanisms in K8s
  - Platform provided Traffic Distribution mechanisms
  - Easier implementation of Build & Replace Upgrade Scenario for CNFs but could work also for VNFs (thanks to virtlet in K8s)
  - Acceleration of change management operations
  - Needed integration with CDS to improve service instantiation and its upgrade
Use of CDS for CNF Instantiation with K8S Plugin (Frankfurt)

- Utilization of SO Macro workflow
- CDS used for provisioning of input parameters for instantiation
- CDS uploads RB profile as a part of resource assignment workflow
- Service Design: Many Helm Charts in one CSAR
  - Decomposition into many VF-modules under one VNF
- MultiCloud-K8s Enhancements
  - Change of identifiers used to mapping between Helm Chart and vf-module
  - Simplified creation of vf-module with helm chart
    - Parameters from User Directives moved to SDNC Directives
    - Implemented default RB Profile so it is no longer mandatory resource for RB instantiation
    - K8splugin accepts input time parameters in time of instantiation

More about integration of CDS with MultiCloudK8s: Today at 2 PM -> Terrace 2A