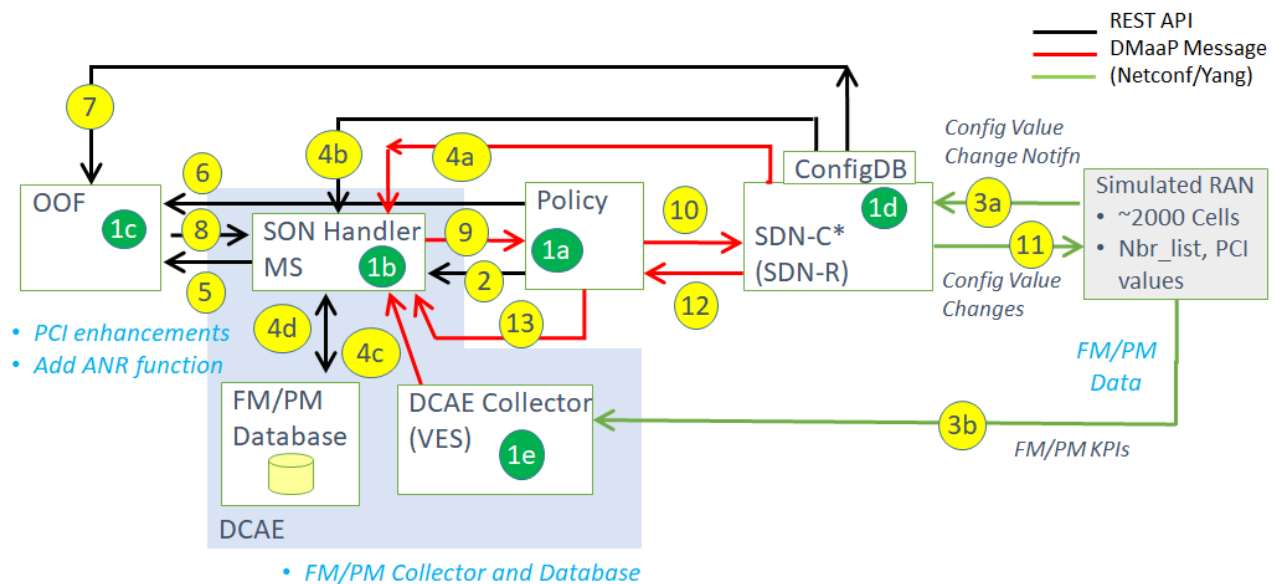# OOF-PCI Use Case - Dublin Release - ONAP based SON for PCI and ANR

N.K. ShankaranarayananSwaminathan Seetharaman5G - OOF (ONAP Optimization Framework) and PCI (Physical Cell ID) Optimization

Showcase VNF	Test Environment	Integration Team Liaison
	Rutgers Winlab ONAP Wireless Lab: Use case testing, use case PoC demo setup, Minor part of Integration Testing Windriver Lab: Major part of Integration Testing	krishna moorthy

Component/Activity	Responsible(s)
Overall Point of Contact, Use case scope and content	N.K. Shankaranarayanan (AT&T), Swaminathan Seetharaman (Wipro)
ConfigDB	Sandeep Shah, Devendra Chauhan
DCAE	ramya ravichandran, Reshmasree c
OOF	Vikas Varma, Avteet Chayal , Shankaranarayanan Puzhavakath Narayanan
Policy	mehreen kaleem, Saravanan Ayyadurai
SDN-R	Sandeep Shah
RAN-Simulator	Saravanan Ayyadurai
Winlab Setup	George Clapp
E2E Use case/demo setup/config	krishna moorthy, George Clapp
Integration Testing	krishna moorthy

(*Note: Team has renamed Casablanca PCI-Handler MS as SON-Handler-MS to reflect broader role of MS)

Step	Functionality
1a-1e	All modules loaded to support CL (manual set up)
2	SON-Handler MS* fetches configuration policies from Policy
3a	Config change notification from RAN to SDN-C (e.g. Neighbor List change)
3b	FM/PM data sent from RAN (PNFs) to VES Collector
4a	SDN-C publishes config data change on DMaaP to SON-Handler-MS. SDN-C also updates Config DB.
4b	SON-Handler MS reads relevant info from ConfigDB
4c	SON-Handler MS receives FM/PM trigger (e.g. PCI Confusion alarm)
4d	SON-Handler MS writes/reads FM/PM database
5	SON-Handler MS invokes OOF for PCI / ANR Optimization
6	OOF gets PCI / ANR optimization policies from Policy
7	OOF queries ConfigDB database to fetch data for cells in the region
8	OOF provides PCI / ANR Optimization result to SON Handler MS
9	SON-Handler-MS provides PCI / ANR recommendation to Policy
10	Policy sends instruction for configuration changes to SDN-C
11	SDN-C applies config changes in RAN via Netconf and also updates Config DB.
12	SDN-C sends an acknowledge to Policy after applying config change in RAN
13	Policy sends an acknowledge to SON-Handler MS upon receiving an acknowledge from SDN-C

Blue - New/updated step for ONAP Dublin.

Trigger for PCI optimization

1. Neighbor list change notification from RAN with PCI confusion and/or collision (Step 4a). The minimum number of collisions/confusions to trigger optimization are configurable in SON-Handler MS.
2. FM alarms for PCI confusion and/or collision from RAN (Step 4c with FM data). The minimum number of collisions/confusions to trigger optimization are configurable in SON-Handler MS.

Trigger for Centralized ANR updates

PM data with Handover success rate (PM KPI) is reported by RAN (Step 4c with PM data), <u>and</u> Handover success rate is consistently below HO_bad threshold (e.g., 25%). HO_bad threshold value and the number of consecutive values (reported after each successive observation time window) of Handover success rate that should be checked for consistency are configurable (in SON-Handler MS).

Trigger for Joint PCI-ANR optimization

When PCI optimization is being triggered 'too often', i.e., > threshold_number within a given time window (say, 30 mins), then joint PCI-ANR optimization is triggered. Reason: Such frequent triggering is seen as an indication of difficulty in achieving convergence of PCI values. When triggering joint PCI-ANR optimization, details of the cell-pairs for which the Handover success rate (PM KPI) is consistently below HO_poor threshold (e.g., 50%) (but greater than HO_bad threshold) are also provided as input as "removable neighbors". HO_poor threshold value and the number of consecutive values (reported after each successive observation time window) of Handover success rate that should be checked for consistency are configurable (in SON-Handler MS).

Development Status & High-Level Requirements

Project	PTL	JIRA Epic / User Story*	Requirements
AAI	James Forsyth		1. No impact. ConfigDB objects for pnf shall be aligned with with A&AI (e.g. use the same primary key for pnf, which is expecte to be pnf-id)
DCAE	Vijay Venkatesh Kumar	• Epic: DCAEGEN2-1108: DCAE Support for OOF-PCI solution • US DCAEGEN2-1109: Onboard SON Handler microservice to DCAE • US DCAEGEN2-1110: VES Collector for FM/PM data from RAN-SIM PNFs • US DCAEGEN2-1111: FM/PM Database for SON solution • US DCAEGEN2-1116: Preparation steps for onboarding of SON Handler MS • US DCAEGEN2-1219: Seed code check-in of SON Handler MS	1. SON Handler Microservice shall be onboarded onto DCAE (DCAEGEN2-1109) 2. A VES Collector shall accept FM/PM VES messages from RAN Simulator and publish to DMaaP - DCAEGEN2-1110 3. SON Handler microservice shall filter for specific alarms (e.g. PCI Confusion) and trigger OOF Optimization as needed - DCAEGEN2-1109 4. Implement PostgreSQL database to store FM/PM data and any other data needed by the SON Handler Microservice. This database provide a query interface so that the SON Handler MS can read and write data. - DCAEGEN2-1111 5. The SON Handler microservice shall filter specific FM/PM messages published by the VES Collector and write to the FM/PM database. DCAEGEN2-1109 6. The SON Handler MS interfaces to Policy, OOF, SDN-C, ConfigDB shall be modified as needed by DCAE onboarding. e.g. MS shall receive configuration policy via DCAE Controller - DCAEGEN2-1109 7. Microservice shall support centralized ANR SON functionality to modify neighbor cell relations based on handover KPIs. DCAEGEN2-1109
OOF	Shankaranarayanan Puzhavakath Narayanan	1. US - OPTFRA-416	1. OOF PCI Solver and interface shall support at least two optimization objectives (e.g. minimize changes, minimize PCI confusion) 2. OOF PCI Solver policy shall use a PCI range specified in the configuration policy 3. OOF shall provide a joint PCI/ANR solver which will optimize PCI and also recommend a removal of a neighbor relation if there PCI allocation is difficult for a cell which also has a neighbor link for which the successful_handover KPI is below a pre-specified threshold
Policy	Pamela Dragosh	EPIC POLICY-1438 US POLICY-1463: US POLICY-1464:	EPIC POLICY-1438 1. US POLICY-1463: a. Policy module shall support handling of partial success where only some of the PCI change actions from a set of changes are successful (e.g. allow partial changes, revert to previous state) b. Policy CLC shall co-ordinate between PCI SON Control Loop (CL) and some other control loops (CL) which are acting on the same cells. 2. US POLICY-1464: Covers all additional/changed configuration related aspects, for e.g., algorithm names/constraints for optimization (e.g., minimize number of PCI values used, minimize number of changes), thresholds, etc. Note: Including CLAMP for Dublin is not recommended based on guidance from Policy and DCAE PTLs.
SDC	Michael Lando		1. SON Handler Microservice shall be onboarded manually and not via SDC (as agreed with DCAE PTL)

| SDNC | Dan Timoney | (Carryover items from Dublin)

-SDNC-430: Modify RAN informational model and yang model for RAN
-SDNC-431: Implement config DB and REST API (SDN-R / OOF interface)
-SDNC-432: Interfacing SDN-R with Policy
•Receive DMaaP message in CL format from Policy (Modify Config message using existing LCM API), send netconf message changing PCI value to cellID as specified, update config DB, and publish change on DMaaP (DMaaP client is available and can be called)
-SDNC-433: Receive netconf notification from RAN, update configDB, and publish change on DMaaP | 1. SDNC-430: Modify RAN informational model and yang model for RAN
2. SDNC-431: Implement config DB and REST API which can be used by ONAP component. API shall support all CRUD operations. Schema and data model shall be aligned with A&AI.
3. SDNC-432: Interfacing SDN-R with Policy - Receive DMaaP message in CL format from Policy (Modify Config message using existing LCM API), send netconf message changing PCI value to cellID as specified, update config DB, and publish change on DMaaP (DMaaP client is available and can be called)
4. SDNC-433: Receive netconf notification from RAN, update configDB, and publish change on DMaaP |
| (RANSim) | | | 1. RANSim shall send FM/PM data (e.g. PCI confusion alarm, Handover KPI) to VES Collector
2. Provide UI support to ANR updates @sa |

*Each Requirement should be tracked by its own User Story in JIRA

APIs

There are two inter-module API specifications in this use case. Both were defined for Casablanca and there will be enhancements done for Dublin release.
(Note: The API from the SON Handler MS to the FM/PM Database is internal to DCAE and the API is not exposed.)

(a) OOF API for PCI:
Link to API spec on OOF page: PCI Optimization API
Link to OOF Impacts page for Dublin enhancments: OOF Impacts

(b) Config DB API:
Link to Config DB spec: https://wiki.onap.org/download/attachments/28382769 /SDNC_ConfigDB_API_Ver2.json?api=v2 (Nov 2018)

Link to Config DB page for Dublin enhancements: Config DB Impacts

Integration Testing

Note: The OOF-PCI Integration testing is being carried out at Windriver lab.
Please see this page for further test case details and up-to date status: Integration Testing

Note: DMaaP should be setup for most of the test cases below.

#	Component(s)	Test Case	Status	Remarks
IT#0 01	DCAE (SON Handler MS)	SON Handler Micro-service successfully on-boarded on to DCAE	COMPLETE	
IT#0 02	DCAE (SON Handler MS)	SON Handler Micro-service's DB is up and the Micro-service is able to read/write data.	COMPLETE	
IT#0 03	DCAE (SON Handler MS)	SON Handler Micro-service is able to successfully fetch config policies from Consul.	NOT YET TESTED	
IT#00 4	OOF and Policy	OOF is able to successfully fetch config policy from Policy	NOT YET TESTED	
IT#00 5	DCAE (SON Handler MS)	SON Handler Micro-service is able to successfully receive a message over DMaaP containing PM/FM data (from VES Collector)	COMPLETE	
IT#00 6	DCAE (SON Handler MS) and DMaaP	SON Handler Micro-service is able to successfully receive a message over DMaaP containing neighbor list update	COMPLETE	
IT#00 7	DCAE (SON Handler MS) REST interface	SON Handler Micro-service is able to successfully fetch neighbor list details using REST interface (Config DB APIs)	COMPLETE	

| IT#008	DCAE (SON Handler MS) and OOF	SON Handler Micro-service invokes REST API of OOF for PCI optimization	NOT YET TESTED	
IT#009	OOF and Config DB (REST API)	OOF is able to obtain relevant neighbor list information for optimization algorithm from ConfigDB (REST API)	NOT YET TESTED	
IT#010	DCAE (SON Handler MS) and OOF	SON Handler Micro-service receives optimization result from OOF (via callback URL) and sends response	NOT YET TESTED	
IT#011	DCAE (SON Handler MS) and Config DB (REST API)	SON Handler Micro-service is able to successfully fetch PNF details from Config DB (using REST API call)	COMPLETE	
IT#012	DCAE (SON Handler MS) and Policy	SON Handler Micro-service is able to send PCI/neighbor list updates via DMaaP to Policy	NOT YET TESTED	
IT#013	Policy and SDN-R	Policy is able to successfully send a DMaaP message (to SDN-R) with PCI/neighbor list updates.	NOT YET TESTED	
IT#014	Policy and DMaaP	Policy is able to successfully receive a DMaaP message with PCI/neighbor list update response	NOT YET TESTED	
IT#015	DCAE (SON Handler MS) and Policy	SON Handler Micro-service is able to receive PCI/neighbor list update response via DMaaP from Policy, process it and logs the results.	NOT YET TESTED	
IT#016	DCAE (SON Handler MS)	SON Handler Micro-service is able to process PM KPI data, store as needed, and apply rules to recommend removal of a neighbor relationship.	COMPLETE	
IT#017	SDN-R	Upon receiving message from Policy, SDN-R sends netconf message to RAN-Sim.	NOT YET TESTED	
IT#018	DCAE (VES Collector)	VES Collector receives VES messages from RAN-Simulator	COMPLETE	

Use Case Testing - End to End flow to be Tested

Note: The OOF-PCI use case implementation and testing will be done at the Rutgers University Winlab ONAP Wireless Lab. Access is available to interested ONAP members.

Please see this page for details: Open Wireless Laboratory (OWL) at Wireless Information Network Laboratory (WINLAB)

This should be a summary level Sequence diagram done in Gliffy

PCI Optimization for trigger from RAN Config Change
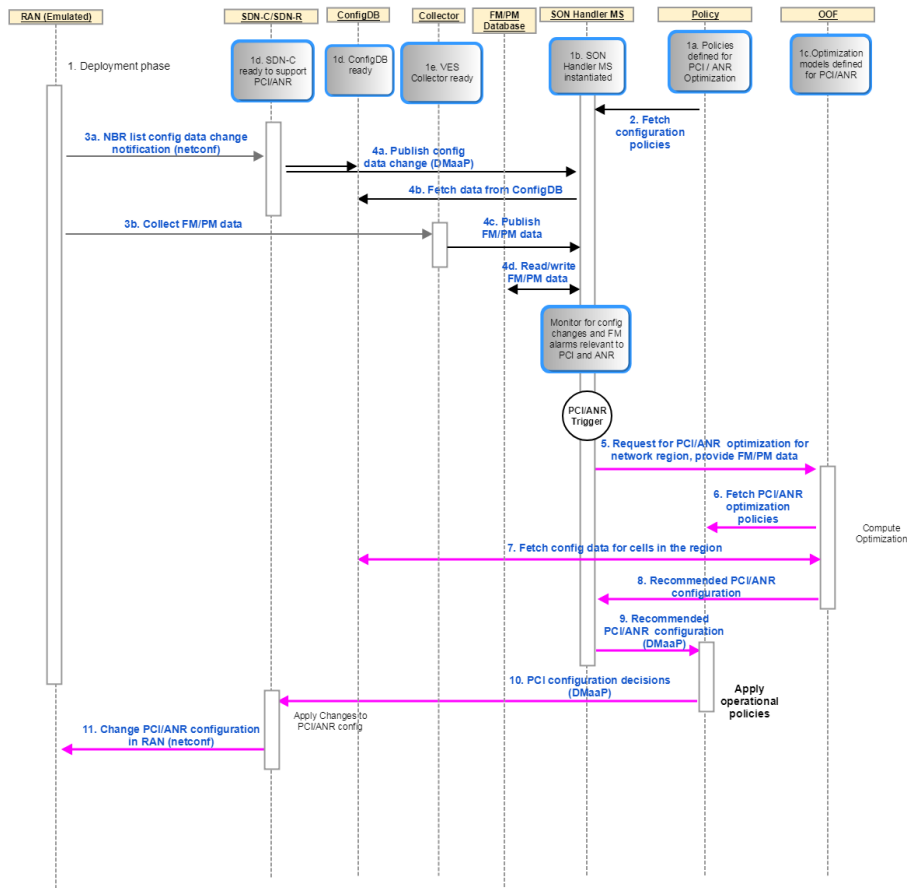
Test Cases and Status

#	Test Case	Status
1	There should be a test case for each item in the sequence diagram	NOT YET TESTED
2	create additional requirements as needed for each discreet step	COMPLETE
3	Test cases should cover entire Use Case	PARTIALLY COMPLETE
4	Test Cases should include enough detail for testing team to implement the test	FAILED