A RAN/SDN Controller Based Connectivity Management Platform for Mobile Service Providers

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***Abstract*—In this demo, we demonstrate the integration of radio access network (RAN)/Software-Defined Networking (SDN) controller with a connectivity management platform designed for mobile wireless networks. This is an architecture designed throughout the EU Celtic-Plus project SIGMONA[1]. OpenDaylight based RAN/SDN controller and the application server are capable of collecting infrastructure and client related parameters from OpenFlow enabled switches and Android based phones respectively. The decision on the best access network selection is computed at the application server using a Multiple Attribute Decision Making (MADM) algorithm and instructed back to Android-based mobile client for execution of access network selection.**

***Index Terms*—SDN, OpenDaylight, connectivity management, MADM, MSPs.**

I. Introduction

SDN can provide extensive opportunities for RAN optimization of Mobile Service Provider (MSP) [1]. Similarly, exploiting the advantages of MADM methods can provide intelligent access network selection for users of MSPs [2]. The objectives of this demonstration are to show how connectivity management using MADM methods integrated with SDN/RAN based controller allows: (i) establishing the Internet connection of each client by pushing appropriate rules into OpenFlow enabled switch, (ii) sending client related parameters into application server via Representational State Transfer (REST)-Application Programming Interface (API), (iii) extracting infrastructure related parameters from OpenFlow enabled switches using OpenDaylight controller's REST-APIs, (iv) selecting the the most appropriate Access Point (AP) based on the collected client and infrastructure related parameters at the application server, (v) instructing the users of MSPs for appropriate AP selection.

II. Demonstration

Five main components of the demo architecture are shown in Fig. 1: SIGMONA client, Wireless Local Area Network (WLAN) infrasturcture, OpenFlow enabled switch, OpenDaylight based RAN/SDN Controller and Application Server. SIGMONA client, which is implemented as an Android application, is used to perform both client related parameter (Basic Service Set Identification (BSSID), SecurityCapabilities, Frequency, Received Signal Strength Indicator (RSSI), Service Set Identification (SSID), Password, ConnectionType, RoamingStatus, PhoneModel, International Mobile Station Equipment Identity (IMEI), International Mobile Subscriber Identity (IMSI), BatteryLevel, Mobile Station International Subscriber Directory Number (MSISDN)) transmission to application server as well as the necessary connection change parameters (BSSID, ConnectionType, SSID, Password) instructed by application server. WLAN infrastructure consists of two IEEE 802.11 network APs with SSIDs *A* and *B*, SDN/RAN controller based on OpenDaylight-Helium version [3] that collects infrastructure related parameters (including NumberOfConnectedUsers/AP, TotalPackets/sec/AP, TotalBytes/sec/AP, BackhaulStatus (on/off)) and sends via Northbound API, OpenFlow [1] capable 48-port HP 3800-48G-4XG switch and application server that runs a MADM algorithm called Total Order Preference By Similarity to the Ideal Solution (TOPSIS) in order to select the best AP selection based on weights associated to each parameters [2]. The REST-API, which handles measurements and commands, is used as the northbound API for communication between the RAN/SDN controller and application server. Inside the application server, for the management console and decision making input for MADM algorithm, there exists a Not Only SQL (NoSQL) database where all the infrastructure and client related information are stored. In addition to those five main components, three Mini-Personal Computers (PCs) (e.g. Intel NUC Kit NUC5i7RYH [4]) are used for generating multimedia traffic on APs connected to different ports as well as one commodity PC for running OpenDaylight controller.

A. Demonstration WorkFlow

During the experiment, we demonstrate how Android based SIGMONA client's AP decision is based on the network and client related parameters flowing through OpenFlow enabled switches with steps (1)–(5) given in Fig. 1. The general workflow is as follows: First, the existing three Min-PC clients and SIGMONA client are allowed to access the Internet by RAN/SDN controller via pushing appropriate rules specific to each client into OpenFlow enabled switch via Southbound OpenFlow protocol as illustrated in step (1). Then, SIGMONA Client collects all client and APs related information and sends them application server through previously established Inter-

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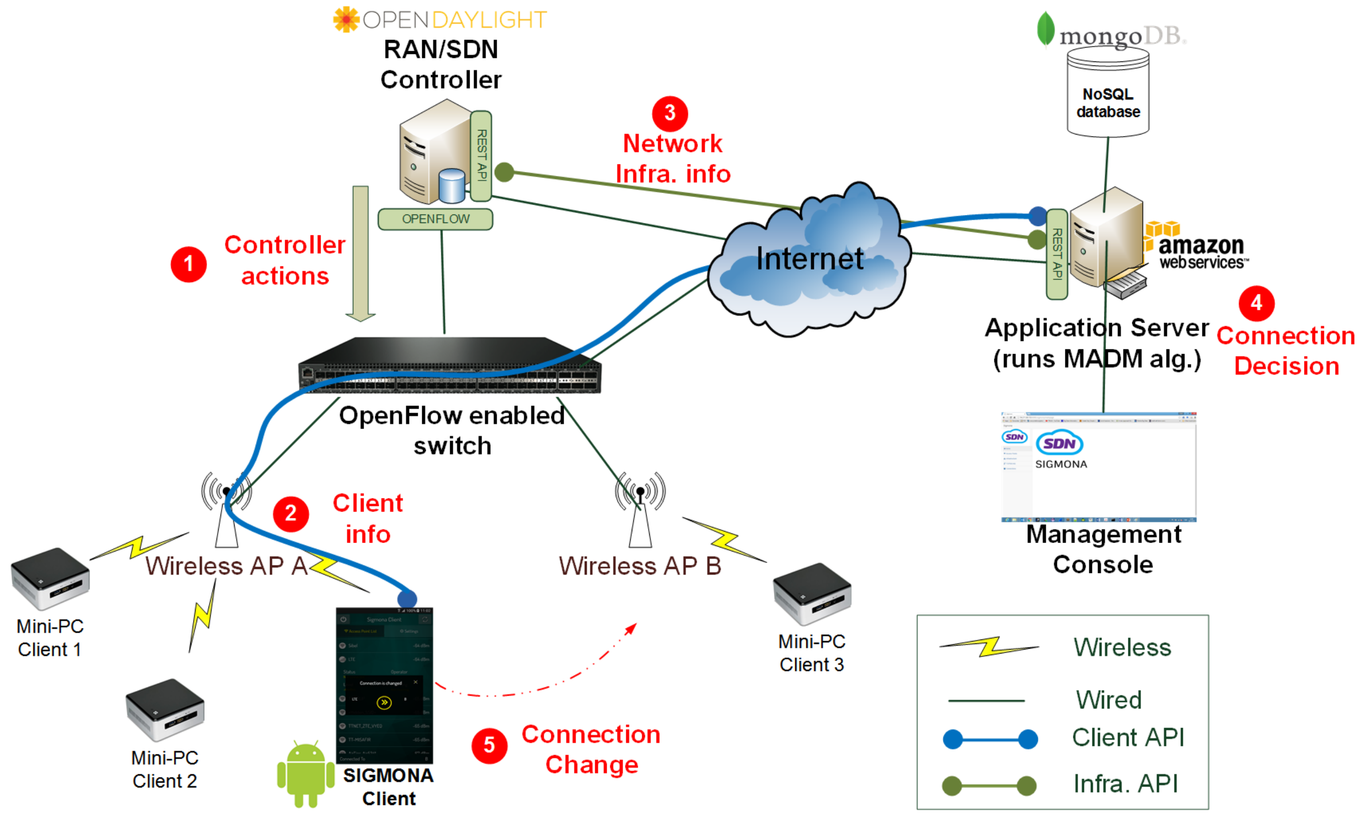

Fig. 1: Demonstration Setup

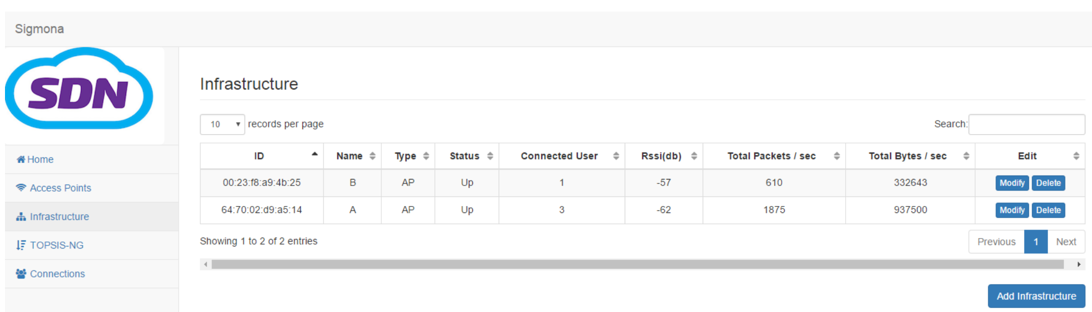

Fig. 2: Infrastructure and Client Related Info on Management Console Monitored in Real-Time

net connection in step (2). OpenDaylight based RAN/SDN controller also collects network related information from OpenFlow enabled switch provided by OpenDaylight's REST-APIs and sends them to application server via Northbound REST-API as in step (3). Based on the received information from both client and network infrastructure, the application server calculates the optimum AP for SIGMONA client using TOPSIS algorithm as in step (4). After connection decision is made, the result is instructed back into SIGMONA client and handover is performed when necessary as in step (5). For communication with SIGMONA client, REST-API is again used and for database Mongo DB [5] is used for storing tables of infrastructure and client related parameters. Compared to a classic Ethernet switch with controller and OpenFlow-enabled switches, the flexibility in establishing access strategies via controller actions and extracting the packet information of each device that is connected to APs is possible.

References

[1] "Open Networking Foundation (ONF)." https://www.opennetworking.org/, 2016. [Online; accessed 10-Jan.-2017].

[2] E. Zeydan, A. S. Tan, I. A. Karatepe, A. S. Er, and G. Ozcan, "Connectivity management using multiple attribute decision making in heterogeneous networks," in *2015 International Symposium on Wireless Communication Systems (ISWCS)*, pp. 461–465, Aug 2015.

[3] "OpenDaylight Project." https://www.opendaylight.org/, 2016. [Online; accessed 10-Jan.-2017].

[4] "Intel NUC Kit." http://www.intel.com/content/www/us/en/nuc/nuc-kit-nuc5i7ryh.html, 2016. [Online; accessed 10-Jan.-2017].

[5] "Mongo DB." https://www.mongodb.com/, 2016. [Online; accessed 10-Jan.-2017].