openwincon: Open Source Wireless-Wired Network Controller

Software Defined Infrastructure (SDI) approach for Fixed-Mobile-Converged Enterprise Networks

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***Abstract*— Software Defined Networking/Network Function Virtualization (SDN/NFV) is considered as a key technology for future mobile networks, such as 5G mobile communications systems. By 2020, the market size for Centralized-Radio Access Networks (C-RAN) will reach $21B. At the same time, enterprise Software Defined Data Center (SDDC) and the mobility market will increase to $77B and $360B, respectively. However, research on mobile enterprise networking is not widely considered. Also, open source software and hardware for an enterprise network is not well developed. Thus, in this paper, we introduce the *openwincon* project. *openwincon* is an open source wireless-wired network controller, and it is based on Software Defined Infrastructure (SDI) technology. *openwincon* is sponsored by the Korean government and started in 2015. The source code will be available in early 2016.**

Keywords-component; SDI; SDN; NFV; Enterprise Network.

I. INTRODUCTION

Software Defined Networking/Network Function Virtualization (SDN/NFV) is considered as a key technology for future mobile networks, such as 5G. Its world market size is estimated at $19B. By the year 2018, telecom SDN/NFV will be $11B and enterprise SDN/NFV will be $8B. This number is larger than C-RAN's estimated $10B. By 2020, when the 5G mobile service will start, C-RAN's market size will reach $21B, but enterprise SDDC and mobility market will increase to an estimated $77B and $360B, respectively [1].

According to SDN/NFV for public networks, many open source efforts are under way, such as Open Daylight (ODL) [2], Open Networking Operating System (ONOS) [3], and Open Platform for Network Function Virtualization (OPNFV) [4]. Conventional researches are focused on the evolution of these platforms. However, research on mobile enterprise networks is just at the beginning [5] and it is not widely considered. Also, open source software and hardware for an enterprise network is not well developed in general.

Thus, in this paper, we introduce the *openwincon* project. *openwincon* is an open source wireless-wired network controller, and it is based on Software Defined Infrastructure (SDI) technology. In this project, we propose a new networking architecture that converges wireless and wired networks through SDN/NFV. It provides a control-bearer separated enterprise network through a single centralized controller. *openwincon* is sponsored by the Korean government and started in 2015 and will last until 2020. The open source software code opens in early 2016.

II. PREVIOUS WORKS

The conventional heterogeneous network architecture is depicted in Figure 1. In the figure, a wired network (Giga Internet) and four different wireless networks are considered. Among the wireless networks, WiFi, 2G, 3G and 4G are considered. Each network has its wireless links, access networks, and core networks.

For this reason, centralized and integrated control is not possible. In addition, integrated QoS/QoE (Quality of Service/Quality of Experience) for high-level services are practically impossible. Moreover, the network complexity is increased in terms of network manageability and controllability.

However, SDN/NFV provides a solution for this type of environment. For example, the bearer planes for most networks are similar, and can be integrated into a single device. Also, a difference between networks can be implemented as a single physical device with virtualized applications.

III. PROPOSED *OPENWINCON* ARCHITECTURE

The mobile network architecture based on *openwincon* is depicted in Figure 2. We support conventional wired and wireless networks and future networks such as 5G. For this, not only Single Radio Cells (SRCs) but also Multiple Radio Cells (MRCs) are considered. MRC supports multiple

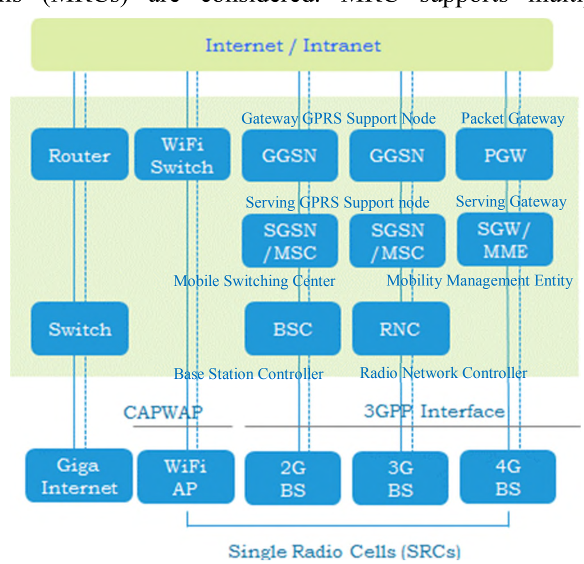

Figure 1. Conventional Heterogeneous Network Architecture

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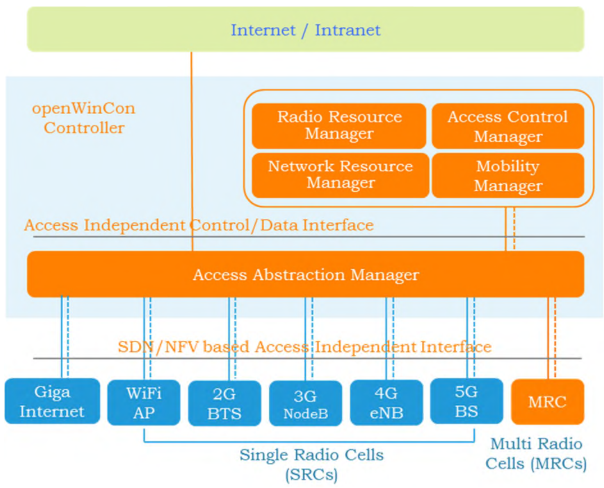

Figure 2. Proposed openwincon based Network Architecture

generation air interfaces simultaneously operating on the same physical device.

Five major features are considered. First, the Access Abstraction Manager (AAM) terminates air link dependent functionalities to abstract the multiple networks. This manager terminates protocols such as WiFi Control and Provisioning of Wireless Access Points (CAPWAP), and LTE S1. Second, the Radio Resource Manager (RRM) manages wireless resources such as frequency, bandwidth, and interference. Also, wireless scheduling is enabled to guarantee the QoS/QoE of services. Third, the Network Resource Manager (NRM) manages wireless resources. NRM includes OpenFlow-based network control and traditional traffic engineering. Fourth, the Access Control Manager (ACM) provides managements for subscribers, devices, and services. ACM includes control and management of authentication, authorization, accounting, security, and service policy. Fifth, the Mobility Manager (MM) provides mobility control for subscribers and devices. MM provides seamless and consistent handover scheme over heterogeneous wireless network environments.

We support carrier-grade reliability initially. As depicted in Figure 3, each controller supports reliability via a distributed multi-core architecture. Each manager operates over multiple distributed cores. It avoids service destruction when a single core fails. Also, inter-controller reliability is guaranteed through multi-site redundancy. Thus, a controller level failure is recovered via a peering controller.

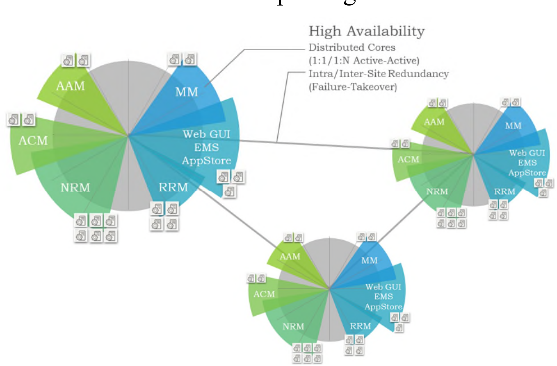

Figure 3. Redundancy and reliability support of openwincon

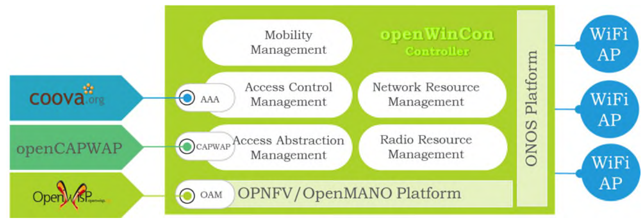

Figure 4. Proposed openwincon Internal Architecture for First Release

IV. CONCLUSIONS

Our project is sponsored by the Korean government for five years. Four universities participate: Kyung Hee University (KHU), Seoul National University (SNU), Pohang University of Science and Technology (POSTECH), and Sung Kyun Kwan University (SKKU). Also, SDN/NFV related companies and government offices participate in the project.

According to the development platform, we use ONOS SDN controller as a control plane platform and OPNFV as a bearer plane platform, as depicted in Figure 4. Figure 4 describes the goal of openwincon in the first year.

According to heterogeneous wireless technologies, we are going to re-use conventional open source solutions such as coova.org, openCapwap, OpenWISP, OpenWRT [6] for WiFi AP (Access Points), OpenBTS [7] for 2G/3G base stations, and Open-Air interface [8] for 4G.

The software source code will be released in early 2016. Apache 2.0 license will be applied. Also, the performance matrix will be announced with the source code.

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