

# Reconfigurable Base-station Platform Based on ETSI-Standard Radio Virtual Machine for Supporting Various 5G Network Services

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**Abstract** This paper presents a reconfigurable base-station platform that supports the wide variety of evolution of network services required for 5G mobile communications. The new technology is based on Radio Virtual Machine concept which resolves the problem of portability between the various network service software and base-station platform hardware. Using the proposed method, base-station is capable of adopting the various network services required for the 5G mobile systems.

**Keywords:** 5G, Reconfigurable Base-station, Network Services Evolution, Radio Virtual Machine.

## 1. Introduction

As shown in Figure 1, as the mobile communications evolve from the 3<sup>rd</sup> Generation (3G) to the 4<sup>th</sup> Generation (4G) and from the 4G to the 5<sup>th</sup> Generation (5G), modern base station systems should support various network service technologies such as Mobile Edge Computing (MEC) [1], Network Slicing [2], Multiple Radio Access Technology (Multi-RAT) [3], etc in order to fulfill the additional requirements of the new generation such as massive connectivity as well as low latency and high data rate. As the network services evolve much faster than the life time period of the base-station hardware, it will be extremely inefficient and costly for the network operators to add/exchange/modify the base station hardware in accordance with the new requirements of the new network services.

Borrowing the software reconfiguration technology based on the concept of Radio Virtual Machine (RVM) [4, 5], which has been standardized in the Technical Committee of Reconfigurable Radio System (TC-RRS) in European Telecom. Standard Ins. (ETSI), this paper presents an efficient and practical method of updating the capability of base station systems through the software download corresponding to any desired network services

mentioned above. With the proposed idea introduced in this paper, the base station will be capable of supporting any network services, which might keep evolving constantly, without changing any hardware of the base station systems.

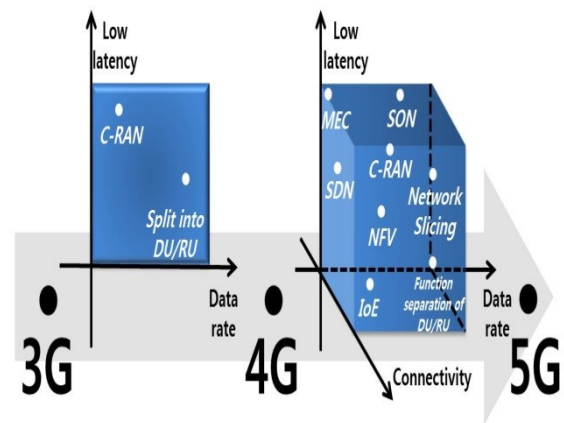


Figure 1. Network services required to the base-station systems according to the evolution of mobile communications

## 2. Radio Virtual Machine

RVM is an abstract machine which enables a desired software to be ported on an arbitrary platform hardware [5]. Figure 2 illustrates a generic structure of RVM consisting of Data Object (DO) and Abstract Processing Element (APE), which are for abstracting the memory and computational resources of the target platform, respectively. The DO and APE are interconnected through the Abstract Switch Fabric (ASF). The operators to be executed in the APEs are fetched from the Basic Operations of which the contents are determined by the Radio Library of the given platform hardware. Meanwhile the ASF is controlled by the Control Unit (CU) in accordance with the Program Memory of which the contents are determined by the software, i.e., *configcodes* shown in Figure 2, to be ported on the platform hardware [4].

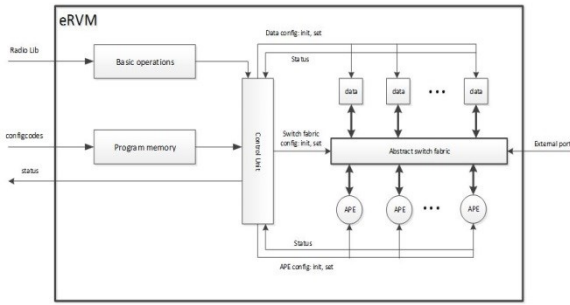


Figure 2. RVM Structure

### 3. Reconfigurable Base-station Platform Based on RVM

Though the RVM has been developed for porting the Radio Application (RA) code onto the platform hardware for the Radio reconfiguration [5], since the RVM is generic, i.e., platform-independent, it can be used for the various Network services software such as MEC, NW Slicing, etc as well as the RA code to be ported on an arbitrary platform hardware. Note that the software description of the network services to be considered in 5G base-station systems is for restructuring of logical nodes of a given base-station system whereas the software reconfiguration with the RA code is for setting up the radio characteristics in accordance with a desired RAT.

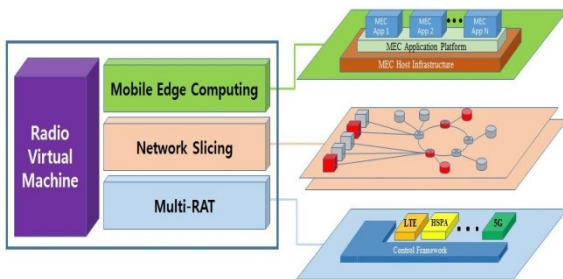


Figure 3. Conceptual Diagram of RVM-based base-station system

Figure 3 illustrates a conceptual diagram of the RVM-based base-station system of which the logical structure of the base-station is determined according to the given software which describes the desired network services mentioned above, i.e., MEC, NW Slicing, RAT reconfiguration, etc. Using the RVM as a translator of the desired software, the software of any above-mentioned network services can be developed by the 3<sup>rd</sup> party software vendors independently of platform hardware. As shown in Figure 4, the network services software can be provided from the cloud service, i.e., App Store, which means any state-of-the-art network service technologies in 5G can be distributed by network operators over-the-air for the 5G base-station platform to be reconfigured according to the downloaded software.

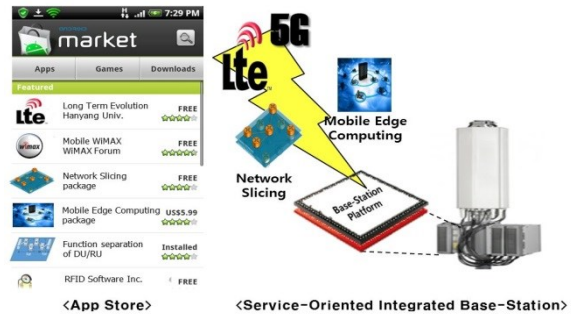


Figure 4. Reconfigurable Base-station

### 4. Conclusion

This paper presents a reconfigurable base-station of which its configuration can be determined by the software describing various network services required for the 5G mobile communications. In order for the software to be efficiently ported on the target platform, this paper suggests the concept of the RVM as an enabler for restructuring of logical nodes and/or radio characteristics of the base-station system. The base-station platform adopting the RVM enables the base-station system to cope with the evolution of various network services through a simple software download without any hardware changes.

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### References

- [1] ETSI, "Mobile-Edge Computing(MEC); Service Scenarios," ETSI GS-IEG 004 V1.1.1, Nov. 2015.
- [2] 3GPP TR 38.801, "Study on new radio access technology: Radio access architecture and interfaces," V14.0.0, Mar. 2017.
- [3] 3GPP TR 37.900, "Radio Frequency(RF) requirements for Multicarrier and Multiple Radio Access Technology(Multi-RAT)Base Station(BS)," V14.0.0, Mar. 2017.
- [4] ETSI EN 303 146-4 V1.1.2 (2017-04), Reconfigurable Radio Systems (RRS); Mobile Device (MD) information models and protocols; Part 4: Radio Programming Interface (RPI)
- [5] ETSI EN 303 095 V1.2.1 (2015-06), Reconfigurable Radio Systems (RRS); Radio Reconfiguration related Architecture for Mobile Devices