Radio Virtual Machine for ETSI Standard Reconfigurable Radio System

Heungseop Ahn and Seungwon Choi
Department of Electrical and Computer Engineering
Hanyang University
Seoul, Korea
E-mail: {ahs90, choi}@dsplab.hanyang.ac.kr

Abstract: *This paper introduces Radio Virtual Machine (RVM) for a Reconfigurable Radio System (RRS) of which the configuration is determined by the downloaded radio application code. First, this paper introduces the architecture of reconfigurable Mobile Device (MD) as a standard of European Telecommunications Standards Institute (ETSI). Then the RVM, an engine for reconfiguring the MD, is introduced. In addition, a procedure of compiling the radio application code is also shown in this paper. Main contribution of this paper is to present the RVM functionality of resolving the problem of portability between the software and hardware of a reconfigurable MD.*

Keywords: SDR, Reconfigurable Radio System, Virtual Machine, Radio Programming Interface, ETSI Standardization.

1. Introduction

Software Defined Radio (SDR)-related researches have been developed and standarfor both developing new technologies and standardized since early 2,000[1, 2]. Although Software Communication Architecture (SCA) [2] is one of the main results of the SDR researches and provides many advantages in designing communication systems which has functionality of reconfigure-ability, it is still stuck to many inherent problems. The main issue of SCA is the portability problem between software and hardware. The key point that this paper addresses is the problem of portability between the software and hardware of SDR system. In order to develop a commercially feasible technology of decoupling the software and hardware, Working Group2 (WG2) of Technical Committee Reconfigurable Radio System (TC RRS) of ETSI has been performing the researches of RRS and Radio Virtual Machine which will be explained mainly in this paper.

2. Reconfigurable Radio System

ETSI's TC RRS has developed a standard architecture of a hardware platform for a SDR system since 2011. The main issue when develpoing the strandrad architecture is to resolve the problem of portability between a software and hardware. There are 4 fundamental componentst in a reconfigurable MD architeucre, i.e., Communication Services Layer (CSL), Radio Control Framework (RCF), Unified Radio Application (URA), and Radio Platform (RP) as illustrated in Fig. 1 [3]. These 4 components are interconnected through standard interfaces i.e., MUlti-Radio Interface (MURI) [4], Unified Radio Application Interface (URAI) [5], Reconfigurable Radio Frequency Interface (RRFI) [6].

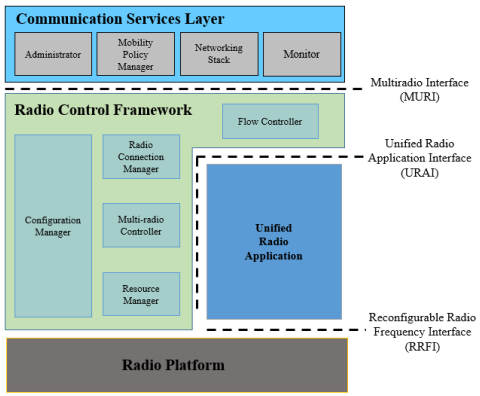

Figure 1 Reconfigurable Mobile Device Architecture Components for Radio Reconfiguration

If the hardware platform shall be compliant with the standard architecture and interfaces, the problem of portability can be overcome.

3. Radio Virtual Machine

As introduced in [3], the RVM is an Abstract Machine which is capable of executing radio application code and independent of the hardware platform. The RVM architecture is represented in Fig. 2. The block "Basic Operations" downloads

operations from the Radio Library and User Defined Functional Block (UDFB) Set. The block "Program memory" includes configuration codes which determines the RVM configuration. Control Unit generates Initialization and Set-up instructions for Abstract Processing Elements (APEs), Data Objects (DOs) and Abstract Switch Fabric (ASF) based on decoding configuration codes stored in the Program memory block.

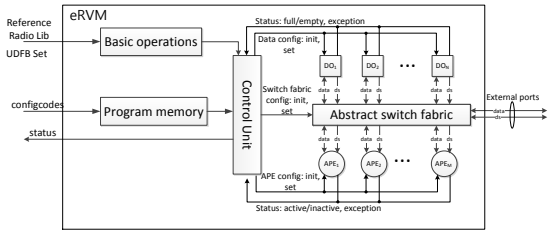

Figure 2 RVM Architecture

The RVM is scalable vertically and/or horizontally. As for vertical scaling, since each RVM contains exactly one particular data flow chart, i.e., specific algorithm, in order to build an RVM hierarchy, an APE can contain another RVM which executes another particular data flow chart. As for horizontal scaling, several RVMs can be arranged on the same level. These horizontally arranged RVMs need to be independent, meaning that fully independent processes are executed in parallel.

As mentioned in [3], RVM abstracts software development from target hardware platform. Independent software developers are able to create modem software or its separate components without considering particular modem hardware details. After radio application codes are generated, compilation procedure of the radio application codes can be broken into two steps as it is pointed out in Fig. 3.

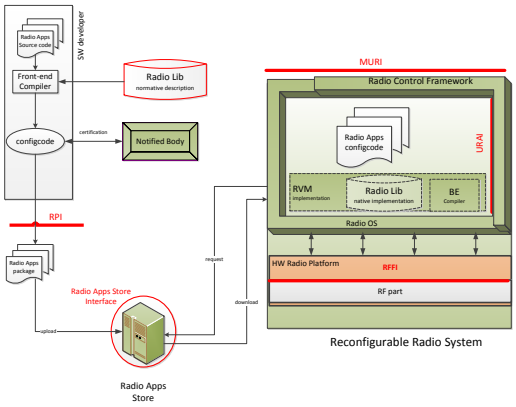

Figure 3 Reconfigurable Radio System architecture for in-device compilation

During the first step, a front-end compiler translates radio application source codes into RVM configurations (configcode). These configcodes can be executed by the RVM. The configcodes are uploaded to a Radio Application Store and can be downloaded into mobile devices by users according to their needs and radio access availability. During the second step, a back-end compiler compiles RVM configcodes. The result of the second step is executable codes, which can be run on particular target platform.

4. Conclusion

This paper present an RRS architecture with RVM to solve the portability problem of SDR system. One of the main contributions of the RVM concept provided by the standard architecture is that a new market of the radio application codes will appear, which will in turn bring about Radio Application Store, and it will be proliferated rapidly as the ETSI standard is deployed widely. Obviously, software reconfiguration features also require the introduction of novel mechanisms for equipment certification. Corresponding architecture and certification standards are currently under development in the ETSI TC RRS.

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