Wireless World Research Forum (WWRF)

Title of the research item

Proof of Concept Evolutionary Environment of End-to-End Reconfigurability

Authors: Karim El-Khazen, Motorola Labs, France
Dominique Nussbaum, Eurecom Institute, France
Nikos Houssos, University of Athens, Greece
Antoine Delautre, Thales Communications, France

Contact name:

Karim El-Khazen
Motorola Labs (CRM) – European Communications Research Lab
Parc des Algorithmes Saint-Aubin, 91193 Gif-sur-Yvette, France
Email: karim@motorola.com
Tel: + 33 1 69 35 48 25, Fax: + 33 1 69 35 77 01

Subject Area

WG6: Reconfigurability

(a) Objectives of the required research

Intense efforts within the wireless telecommunications sector have lead to the development of a wide range of systems such as Cellular, Wireless Local Area Networks and Broadcast as well as their associated equipments. In order to optimise resource usage, increase network/equipment capabilities and versatility, scalable and reconfigurable infrastructure and devices are foreseen.

Aiming at bringing the full benefits of the valuable diversity within this radio eco-space, the presented research targets the development of a flexible, modular and evolutionary prototyping environment in order to illustrate the vision of End-to-End Reconfigurability [1]. The first objective is to trial architectural design of reconfigurable devices and supporting systems functions to offer an expanded set of operational choices to the users, applications/service providers, operators, regulators in the context of heterogeneous mobile radio systems.

The proof of concept environment is also foreseen as a means to guide the core technology options selection and development work via feedback on critical issues with respect to integration of an overall End-to-End reconfigurable system.

(b) State of the art in the area

A very strong heritage in reconfigurability was gained through former European-funded research projects of the 5th Framework Programme like TRUST [2], SCOUT [3], MOBIVAS [4] and CAST [5], where expertise in the functions offered to the user terminals, applications and services was capitalized. Each of these projects concentrated on a variety of different technical aspects such as terminals, value-added service provision, enabling technologies, applications, reconfigurable devices, network provisions, security, proof of concept of reconfigurability.

The end-to-end reconfigurability wireless system vision is fairly new and the work carried out so far has not induced any significant breakthrough.

(c) Possible approach

A phased approach is considered in order to build the flexible, modular and evolutionary prototyping environment. Three phases of two years each are foreseen.

In the first phease, the proof of concept will consist in the integration of available platforms, capitalizing on the research and development projects of FP5 that demonstrated the feasibility of the reconfigurability advent. This environment will allow experiments in various topics such as the mode switching and the mobility of multi-RAT mobile terminal in a heterogeneous network and the software upgrade of terminal and network entities.

During the second phase, the prototyping environment will be further developed, integrating additional modules (hardware/software) and implementing new functionalities to support advanced scenarios. At the same time, specific adapter modules will be developed in order to fill the identified holes.

Finally, in the third phase, more sub-modules will be integrated within the overall proof of concept, forming an End-to-End Reconfigurability prototyping environment. The scheduling of this third phase will depend on the level of maturity of the sub-modules.

(d) Work Plan

The definition of the system architecture of the proof of concept is being addressed and it is believed that leveraging on the available platforms from FP5 projects such as MOBIVAS, MobyDick [6], or SCOUT will be substantially more efficient than starting from scratch. Thus, the architectural work will take into account the inputs coming from these former projects in terms of system requirements and design specifications. Moreover, the interfaces of the proof of concept environment will be specified in order to guarantee its evolutionary aspects. One of the challenges will be to plan the content of the overall proof of concept, evaluating the external dependencies and anticipating eventual recovery actions, and checking for new and/or reviewed features and their impact on the development and integration.

The prototyping of the modular, flexible and evolutionary environment will comprise the development of hardware and software modules in order to adapt the current platforms and integrate them. The integration will not be immediate and will depend on the openness of the different platforms. The identification of the adapter modules is required in order to ensure consistent integration. Different types of integration will be combined in the architectural design phase, in order to benefit from the functionalities offered by the various platforms. Several wireless access systems will interwork, such as UMTS-TDD, GPRS, WLAN and DVB-T. This experimental heterogeneous network platform will also include multi-RAT user equipments.

In this all-IP network architecture, new concepts will be demonstrated in a near real environment at reasonable cost, such as vertical and horizontal reconfigurability managed by new entities like the reconfiguration server dedicated for instance to software upgrade of network equipments and user handsets. Different identified scenarios will be validated using the prototyping environment. The foreseen immediate functionalities are the following: Flexible service deployment support,

such as flexible service creation, authentication and billing, Mode switching and mobility of a multi-RAT mobile terminal in a heterogeneous network, and Software upgrade of terminal and network entities.

(e) Expected results

The expected results are diversified, going from system architecture definition to validation of scenarios of End-to-End Reconfigurability, through development and integration of the environment.

The research work will provide a system architecture for the proof of concept for the three phases and will contribute to the definition of its interfaces. Logical and functional aspects of the interfaces between the different integrated platforms will be described.

Hardware and software modules will be developed in order to integrate the different platforms within one overall system. It will imply the identification and development of specific adapter modules to fill the identified holes, the modification of the existing platforms and integration of the various components, the development of new functionalities and tools, as well as tests and validation of the overall system. In the design phase of the proof of concept, two approaches are available for the integration type. Vertical and horizontal integrations will be combined in the architectural design. More specifically, the proposed environment will be based on the vertical and horizontal integrations of UMTS, GPRS, WLAN and DVB networks. This integration will provide an experimental heterogeneous network platform with several base stations/access points and multimode user equipments.

The flexible, scalable and evolutionary environment developed will allow the validation of scenarios and various experiments on topics such as mobility management, interoperability between different access techniques (e.g. UMTS TDD, 802.11…). More specifically, two scenarios will be validated in the first phase:

- Mode switching and mobility of a multi-RAT mobile terminal in a heterogeneous network (with QoS aspects),

- Software upgrade of terminal and network entities, as well as different layers in the protocol stack, including the physical layer.

Those tests and experiments will provide outputs for the researchers, and will enable the validation of the vision of End-to-End Reconfigurability.

The technical work is summarised and shown in Figure 1.

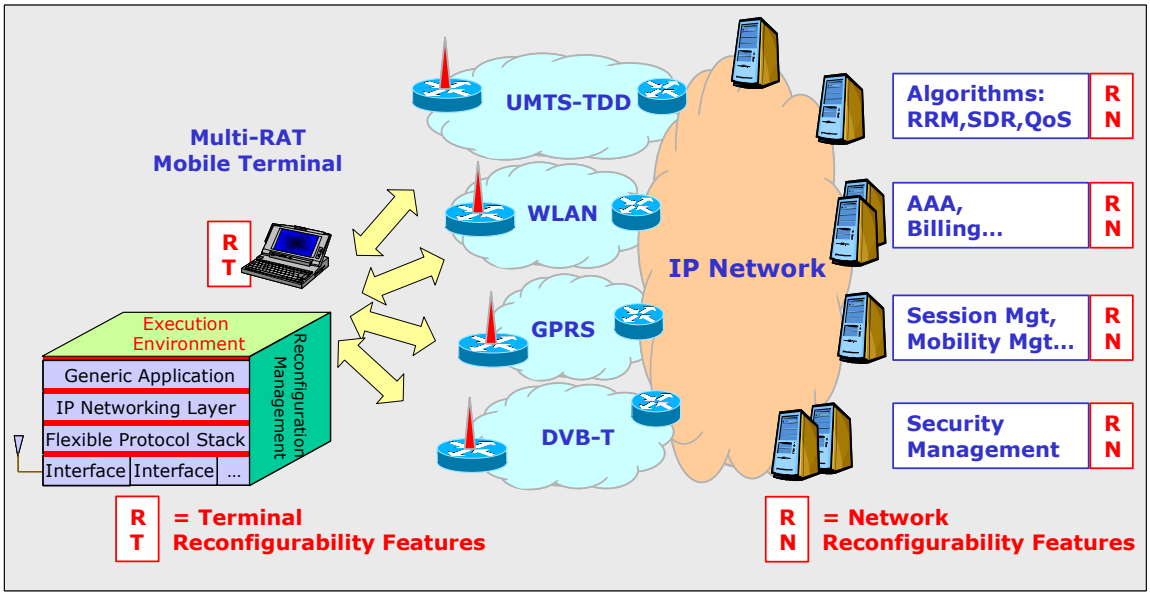

Figure 1: Technical Scope

(f) Time frame to get the expected results

As mentioned before, the final overall proof of concept of End-to-End Reconfigurability is targeted to be available at the end of the 6-year period, nevertheless, a first prototyping environment will be completed at the end of the first phase. Several demonstrations will be planned and organised.

(g) References

[1] FP6 End-to-End Reconfigurability (E^2R) Project Proposal, presented at the EU Concertation Meeting, Brussels, September 9th, 2003

[2] IST Project TRUST (Transparently Reconfigurable Ubiquitous Terminal)

[3] IST Project SCOUT (Smart user-Centric cOmmUnication environmenT), http://www.ist-scout.org/

[4] IST Project MOBIVAS (Downloadable MOBIle Value-Added Services through Software Radio & Switching Integrated Platforms), http://mobivas.cnl.di.uoa.gr/

[5] IST Project CAST (Configurable-radio with Advanced Software Technology)

[6] IST Project MobyDick (Mobility and Differentiated Services in a Future IP Network), http://www.ist-mobydick.org/