# A Schema Based Approach to Access Network Discovery and Selection in EPS

Ivaylo Atanasov[1]

***Abstract* – Access Network Discovery and Selection Function (ANDSF) defined in the architecture of the Evolved Packet System (EPS) allows the operator to control the user choice of access technology if several non-3GPP access networks are available. The 3GPP specifications define the management objects that can be used by ANDSF and the user equipment (UE), but do not define the structure and format of user capabilities that the UE may provide in order to support the rules generation by the ANDSF. The paper provides a structural approach to definition of the information that the UE may send to the ANDSF. The information is defined using XML schemes.**

***Keywords* – Evolved Packet System, Access Network Discovery and Selection, User equipment capabilities.**

## I. INTRODUCTION

Evolved Packet System (EPS) is the name for the evolution of mobile networks [1]. EPS covers the radio access, the core network and the user equipments that comprise the overall mobile system. Along with the high-speed 3GPP radio access networks, EPS supports also non-3GPP accesses such as WLAN, WiMAX and wired access.

When a user equipment (UE) is registered in the home network and when both 3GPP and non-3GPP accesses are available, or when multiple non-3GPP accesses are available, the EPS network may provide the UE with assistance data/policies about available accesses. The EPS network allows the operator to influence the access that the UE shall handover to (when in active mode) or re-select (when in idle mode). The architecture that may be used for access network discovery and selection is based on a new network element called Access Network Discovery and Selection Function (ANDSF). The ANDSF contains data management and control functionality necessary to provide network discovery and selection assistance data as per operators' policy [2].

ANDSF is in an initial stage of standardization. Only the minimal interface to the mobile equipment is defined [3]. The definition on how the ANDSF should work is limited and there are no connections between ANDSF and other entities. Further, the ANDSF relies only on its own information for decisions. The following extensions are proposed in [4]. First, the ANDSF decisions should be based on subscription. Second, the ANDSF decisions should use dynamic access network information and the ANDSF should support from the always-best-connected enabler towards the services. Third, the ANDSF should provide the means to integrate femto-accesses for network discovery and selection.

The idea of using dynamic access network information is developed in [5], [6] and [7]. In [5], the authors propose a solution that combines ANDSF and MIH (Media Independent Handover (MIH) Service standard 802.21 from IEEE) for improving the inter-system handover behavior. In [6], the authors propose novel access reselection procedures which enable a network provider to optimize the allocation of the users on the different access networks available using as central concept that handovers can and should be triggered by the modifications on the resources required by the mobile devices in order to optimize the overall usage of the wireless environment. A multilink architecture with evolved ANDSF and Policy and Charging Rule Function is suggested in [7].

3GPP defines management objects that can be used by the ANDSF and the UE [3]. The Management Object (MO) is compatible with the OMA Device Management (DM) protocol specifications, version 1.2 and upwards. It is defined using the OMA DM Device Description Framework (DDF) as described in the Enabler Release Definition OMA-ERELD-DM-V1_2 [8]. The MO consists of relevant parameters for inter-system mobility policy and access network discovery information that can be managed by the ANDSF.

In this paper, we propose a structural approach to definition of information that the UE may send to the ANDSF in order to support the ANDSF decisions. The proposed information structure is based on the MO information for UE location as defined in [3] and on UE capabilities. The definitions are presented using XML schemes.

The paper is structured as follows. Section II provides an analysis on required information about UE capabilities and defines the respective XML schemes. In Section III, XML schemes are defined for the information related to UE location. Section IV presents an example of the content of a client initiated session alert message of code "Generic Alert" which UE may use to initiate the information provision by the ANDSF.

## II. UE CAPABILITIES INFORMATION STRUCTURE

The UE needs to provide to the ANDSF information about its capabilities and its location. The UE capabilities describe the supported access technologies and the routing capabilities. The related XML scheme is shown in Fig.1.

The UE may obtain IP connectivity by attaching to 3GPP access technologies, 3GPP2 access technologies and non-3GPP access technologies. The UE may support more than one access technologies.

Each access technology is designed to operate in particular frequency bands. The UE routing capabilities define the mechanism for routing of different IP flows. The UE is classified in a given category depending on the supported

[1]Ivaylo Atanasov is with the Faculty of Telecommunications, Technical University of Sofia, Kl. Ohridski 8, 1000 Sofia, Bulgaria, E-mail: iia@tu-sofia.bg

## IV. Example of User Data Provided to ANDSF

The UE may initiate information provisioning from the ANDSF, using a client initiated session alert message of code "Generic Alert". The "Type" element of the OMA DM generic alert message shall be set to "urn:oma:at:ext-3gpp-andsf:1.0:provision-multiple-if" as we assume that the UE is configured for IFOM. In our example, the UE supports both LTE and WiMAX access network technology. For LTE, the UE supports operating bands of 1447.8 MHz -1462.9 MHz for uplink and 1495.9 MHz -1510.9 MHz for downlink and FDD mode. For WiMAX the UE supports operating bands of 3527.5MHz -3562.5 MHz and TDD mode. The UE category in LTE is 5, that means that UE supports 4x4 MIMO, data rates of 300 Mbps for downlink and 75 Mbps for uplink, and the supported modulation format is 64QAM. The UE location in LTE access network is identified by PLMN-id of 28402, tracking area code of 0xD34F and E-UTRA cell identity of 0xAF52D10<EUTRA. In WiMAX, the UE location is identified by NAD-ID of 0xF4700A and BS-ID of 0xCA9912.

Fig.10 shows the XML description of information about UE capabilities and location used in the example for access network discovery and selection.

## V. Conclusion

The paper provides a structural approach to definition of information that an UE may send to the ANDSF in order to support the decision for access network discovery and selection. The suggested information contains both UE capabilities and location. The UE capabilities include information about supported access network technologies and routing capabilities. The XML schemes defining this information can be used to express a set of rules to which the UE provided information must conform in order to be considered 'valid' according to that schema. The suggested XML schemes are designed with the intent that determination of the UE provided information validity would produce a collection of information adhering to specific data types.

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## References

[1] 3GPP TS 23.002, Network Architecture, v11.1.0, 2011.
[2] 3GPP TS 23.402, Architecture enhancements for non-3GPP accesses, v11.1.0, 2011-12.
[3] 3GPP TS 24.312, Access Network Discovery and Selection Function (ANDSF) Management Object (MO), v11.1.0, 2011.
[4] M. Corici, J. Fiedler, T. Magedanz, D. Vingarzan. "Access Network Discovery and Selection in the Future Broadband Wireless Environment", Retrieved from http://www.slideshare.net/zahidtg/access-network-discovery-and-selection-in-the-future-broadband-wireless-environment, Accessed 2012.
[5] S. Frei, W. Fuhrmann, A. Rinkel, B. V. Ghita. "Improvements to Inter-system Handover in the EPC Environment", 4th IFIP International Conference on New Technologies, Mobility and Security (NTMS), Paris, France, Conference proceedings pp 1-5, 2011.
[6] M. Corici, T. Magedanz, D. Vingarzan, C. Pampu, Q. Zhou, "Access Network Reselection based on Momentary Resources in a Converged Wireless Environment", IEEE Globecom'2010 - Next Generation Networking Symposium, Miami, USA, Conference proceedings, 2010.
[7] H. Lonsethagen et al. Multilink network architecture, Report, Celtic project CP5-013, MARCH – Multilink architecture for multiplay services, http://projects.celtic-initiative.org/march/march/UserFiles/file/CP5-013-MARCH-D5_2-final.pdf Accessed 2012.
[8] OMA-ERELD-DM-V1_3: "Enabler Release Definition for OMA Device Management", 2009.

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     <band>
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</UE>
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Fig.10 An example of UE capabilities and location required for access network discovery and selection