Integration of Broadcast Technologies with Heterogeneous Networks – An IEEE 802.21 Centric Approach

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Abstract—**In order to integrate broadcast communication technologies like DVB-H and MBMS in a heterogeneous system, different mechanisms have to be developed, both on the mobile user terminal and on the network infrastructure. This paper presents the framework developed in the Daidalos-II (FP6) project for supporting broadcast integration with heterogeneous wireless networks with a focus on the development of a hybrid terminal.**

I. MOTIVATION

Nowadays, in the drive to support access to services in a seamless and heterogeneous way, more and more communication technologies are integrated into the End-User Mobile Terminal. Among them are the new technologies for mobile broadcast like DVB-H, a standard developed by the DVB Project [1], and MBMS, a standard developed by the 3GPP [2] consortium. Both of them are broadcast technologies being, by nature, unidirectional. This makes the usual mobility management and Quality of Service provisioning mechanisms partially useless. That is why different mobility frameworks developed for bidirectional communications, like Media Independent Handover Services developed by the IEEE 802.21 [3] group, have to be enhanced in order to support these broadcast technologies on such hybrid networks. Another challenge is the seamless integration of these technologies in a single terminal, so that for the upper layers they behave like a "normal", bidirectional one. Different aspects, like unicast and multicast management, have to be addressed together with address resolution, handover preparation and handover execution.

This paper presents the mobile terminal architecture envisioned in the IST Daidalos project [4] for supporting heterogeneous wireless networks and seamless integrating broadcast technologies like DVB-H and MBMS in hybrid mobile terminals. Related work is presented in section 2, followed in section 3 by short presentations of the broadcast technologies, the IEEE 802.21 framework and the enhancements it needs in order to allow the seamless integration of all communication technologies. In section 4 an overview of the envisioned architecture is given and in section 5 a conclusion is drawn and future work is presented.

II. RELATED WORK

IP Datacast [5] is a new system approach which has recently been standardized. It was developed by the DVB Project [1] in order to specify the higher layer protocols for Digital Video Broadcast - Handheld as well as to include an access to cellular communications systems to build a hybrid network. Regarding terminal mobility support, IP Datacast specifies independent mechanisms for DVB-H horizontal handovers, and service enhancements. The IP Datacast support for mobility is relies on the DVB-H "passive" handover mechanism which is based on the information from the Program Service Information /System Information tables (used for low-level signalling) and the IP Datacast Electronic Service Guide (used for high-level service signalling). However, the actual control of the handover process itself and the support for vertical handovers is out of IP Datacast's scope.

In order to optimize the handover process and allow, eventually, for vertical handovers, the return channel has to be integrated in a seamless way. The IETF developed a mechanism called Uni-Directional Link Routing [6], mechanism which uses a link-layer tunneling over an additional bidirectional link to connect nodes back to the DVB router. This will allow the terminal to create a virtual, "tap", communication interface.

On the IST Daidalos project [4] a mobility architecture was developed for the interaction of different communication technologies. The Terminal Mobility architecture was based on an Interface Abstraction Layer model which allows the other functional entities in the control plane to execute their process independently of the heterogeneous access technologies supported in the network, the broadcast technologies not being seamlessly integrated for bidirectional communications. In order to simplify and optimize the information flow between the mobile terminal and the network, a new architecture is needed. Also the signalling has to be covered in a heterogeneous way, both for bi-directional and uni-directional technologies.

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III. THE IEEE 802.21 BASED MOBILITY ARCHITECTURE

A. DVB-H and MBMS

The DVB-H is the standard developed by the DVB Project for handhelds devices. It is based on the DVB-T standard for terrestrial reception but with optimizations for energy consumption, smaller display sizes and more reliable reception in a mobile environment.

MBMS is a standard developed by the 3GPP group. The MBMS is an enhancement feature of the UMTS standard aiming at providing the capability for Broadcast and Multicast services in a cellular network.

B. IEEE.802.21 Framework

The IEEE 802.21 framework is intended to provide methods and procedures that enable transparent service continuity across heterogeneous networks and facilitate handovers between them. These procedures are based on the information gathered from both the mobile terminal and the network infrastructure and coordinated with different user requirements and preferences.

The 802.21 framework facilitates the network discovery and selection by providing network specific information to the terminal that helps to determine the surrounding network environment and to select an appropriate connection point.

The main component of the 802.21 framework is the Media Independent Handover Function (MIHF) which provides a unified interface available to the upper layers, independent of the underlying access technologies. In order to achieve this, MIHF defines three different services: Media Independent Event Service, Media Independent Command Service and Media Independent Information Service.

C. Extensions needed for broadcast integration

One of the limitations of the IEEE 802.21 framework is the fact that the framework was developed only for bi-directional communication networks and with limited QoS provisioning support. In order to satisfy the Daidalos-II requirements, this framework has to be extended so that the broadcast technologies, like DVB-H and MBMS can be supported and seamlessly integrated in the overall mobility architecture.
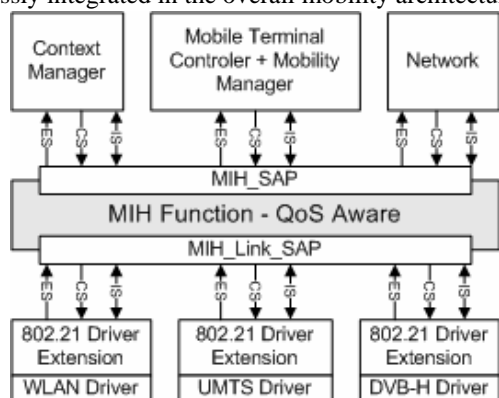

Figure 1. Daidalos Mobility and QoS Architecture

The mobile terminal architecture, envisioning an IEEE 802.21 centric structure, needs therefore extensions and enhancements. In addition to this, new challenges arise with the management of unicast and multicast addresses. In the case of a handover over the broadcast channel, the new Access Router has to re-build the multicast tree, this resulting in additional delay for the terminal. A mechanism based on Context Transfer [7] is used for signaling and transfer information between the two Access Routers.

IV. INTEGRATION OF UNIDIRECTIONAL TECHNOLOGIES

Integration of unidirectional technologies forms a particular challenge to the 802.21 framework because many of the functionalities require a bi-directional communication. For that reason, 802.21 was analyzed in order to evaluate which functionalities actually need a bi-directional channel in order to work and which do not necessarily need one. For the necessary bidirectional functions, specific solutions for the different unidirectional technologies were developed in order to emulate the bidirectional communication. A special scenario is the one where no return channel is available. In this case, the network will not be able to issue commands, for example, and the terminal will support only Local Commands for this case.

In order to have a seamless integration of the broadcast technologies, the UDLR [6] mechanism has to be integrated together with the IEEE 802.21 Media Independent Handover Function to support a seamless interface to the upper layers. This allows for unified mobility and QoS signalling enhancing the communication between the terminal and the network.

V. CONCLUSION AND FUTURE WORK

The final paper will explain the enhancements necessary to enable the IEEE 802.21 framework handling unidirectional DVB-H interfaces via UDLR technology. Extensions will be presented as well as a novel terminal architecture, enabling bidirectional communications, even over naturally unidirectional technologies, and opening new business models for future mobile operators and broadcasters.

VI. REFERENCES

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