Proposal of a Hierarchical and Distributed Method for Selecting a Radio Network and a Transmission Mode

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ABSTRACT

The deployment of heterogeneous radio networks and the deployment of Unicast Internet Protocol (IP)/Multicast IP architectures can impact the quality of services received by the users. The authors think that they will accept these quality variations if they have the possibility to choose the radio network and the transmission mode, multicast versus unicast. But, when choosing a radio network or a transmission mode, the choices of the users can be opposed to the choices of the operators managing the networks. To overcome this drawback, the authors defined a method allowing the users, the operators managing the networks and the service providers to cooperate in the selection process.

Keywords: 3GPP Architectures, Half-Duplex Transmission Module (HDTM), Heterogeneous Radio Network, Hierarchical and Distributed Handover (HDHO), Multicast Internet Protocol (IP), Transmission Mode, Unicast Internet Protocol (IP)

INTRODUCTION

The Third Generation Partnership Project (3GPP) defines architectures capable of transmitting Unicast IP packets, such as the Universal Mobile Telecommunications System (UMTS) architecture (KREHER, 2007), or Multicast IP packets, such as the Multimedia Broadcast Multicast Service (MBMS) architecture (RUM-MLER, 2009). The deployment of such architectures can impact the quality of a service received by a user because of the different mechanisms.
of Quality of Service (QoS) implemented in the unicast and multicast transmissions. For example, an UMTS architecture has four classes of service (3GPP TS 23.107, 2011), namely the “Conversational”, “Streaming”, “Interactive”, and “Background” classes. Whereas a MBMS architecture has only two classes of service (3GPP TS 23.246, 2011), namely the “Streaming” and “Background” classes.

Besides, as the users are mobile, the quality of the services they receive depends on the radio networks on which they connect because of differences between the bandwidth of the radio networks, differences between the mechanisms of QoS implemented in the radio networks, and differences between the mechanisms of Security. For example, when a user’s terminal performs a mobility from a UMTS network to a Wi-Fi network, the quality of a service received by the user can be degraded if the Wi-Fi network does not implement a QoS mechanism (ZHU, 2004) or if there is no correlation between the QoS mechanism implemented in the UMTS network and the QoS mechanism implemented in the Wi-Fi network (XIAO, 2005).

Can users accept the variations of the quality of services they receive during a mobility or when the transmission mode varies? We think they will accept these variations if they have the opportunity to choose the radio network and the transmission mode. An issue arises: the users’ objectives may conflict with the objectives of the operators managing the networks. For example, during a mobility, a user can choose a Wi-Fi network transmitting Unicast IP packets due to the free data transmission on this network, whereas the operator managing this network will not want that the user connects on his network because of the overload of this one. As conflicts can appear between the operators managing the networks and the users using them, it is necessary to define a process allowing them to make converge their point of view.

In the first section of the paper, we present the conclusions of our analysis of the process implemented in the architectures defined by the 3GPP for managing the mobility between heterogeneous radio networks, and of our analysis of the process managing the transmission mode in the MBMS architecture. As the users and the service providers are not involved in these two processes, we propose, in the second section, a method in which they can participate in these two processes. In the third section, we present a scenario implementing our method; then, in the fourth section, we present the results of a modelling of our method.

PRESENTATION OF THE CONCLUSIONS OF OUR ANALYSIS OF THE MOBILITY MANAGEMENT PROCESS AND THE TRANSMISSION MODE MANAGEMENT PROCESS IMPLEMENTED IN THE 3GPP ARCHITECTURES

In 2011, we studied the process implemented to manage the mobility between heterogeneous radio networks in the architectures defined by the 3GPP and we showed that it is not completely defined and does not allow users and service providers to participate in the process of selection of the radio network during a mobility. Then, we analyzed the MBMS architecture and showed that the users and the service providers do not participate in the process of selection of the transmission mode, multicast unicast versus. It is still the operator managing these architectures who chooses the transmission mode.

PROPOSAL OF A PROCESS OF SELECTION OF A RADIO NETWORK AND A TRANSMISSION MODE

As the choice of a radio network and a transmission mode can impact the quality of services received by a user, we specified a selection process of a radio network and a transmission mode in which the users, the service providers and the operators managing the networks,
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