Chapter 4.11
Use of Traffic Separation Techniques for the Transport of HSPA and R99 Traffic in the Radio Access Network with Differentiated Quality of Service

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ABSTRACT

This article presents various traffic separation approaches to transmit HSPA (HSDPA/HSUPA) traffic in the existing ATM-based UMTS Radio Access Network, together with Release 99 (R99) traffic. The traffic separation technique enables QoS differentiations of HSPA and R99 traffic, while aiming to achieve a maximum utilization of the transport resources in the radio access network. The potential benefit of applying traffic separation and its impact on the performance of the transport network as well as the end users are explored in this article. The quantitative evaluations are provided by simulations. The results presented are obtained from a UMTS simulation model developed in this work which can transmit HSDPA and HSUPA traffic as well as R99 traffic simultaneously. The presented results demonstrate that applying traffic separation between HSPA and R99 traffic can considerably improve the performance of both HSPA and R99 traffic, and as well bring significant gain on efficient bandwidth utilization.
INTRODUCTION

Universal Mobile Telecommunication Systems (UMTS) is a key standard of the third-generation (3G) WCDMA-based cellular network. With the development and expansion of 3G cellular networks, UMTS evolution continues to unfold, with the range of the offered services rapidly extending from primarily voice telephony to a variety of appealing data and multimedia-based applications. It is expected that data services like Internet access, email, FTP upload/download, will constitute a dominant traffic share in UMTS networks. In order to significantly improve the support of such delay-tolerant data services with enhanced resource efficiency and service quality, High Speed Downlink Packet Access (HSDPA) (3GPP TR 25.855, 2001) and High Speed Uplink Packet Access (HSUPA) also named as Enhance Uplink (3GPP TS 25.309, 2006) are introduced by 3GPP Release 5 and Release 6 individually, as the evolution of UMTS to enhance the transmission of data packet traffic on the downlink and uplink separately. They offer a much higher data rate (up to 14.4 Mbps in the downlink with HSDPA and 5.76 Mbps in the uplink with HSUPA), lower latency, increased system capacity and thus facilitate improved data services. HSDPA and HSUPA are jointly referred to as High Speed Packet Access (HSPA) (Dahlman, Parkvall, Sköld, & Beming, 2007). So far, HSPA services have been already supported in the existing ATM-based UMTS networks to enhance data transmissions. Besides, the UMTS system still accommodates a significant amount of Release 99 (R99) traffic such as voice telephony. In R99, user traffic is transported via Dedicated Channels (DCHs) over the radio interface. For HSPA traffic, in order to support their new features like fast Hybrid Automatic Repeat Request (HARQ), fast Node B scheduling, and using a shorter 2ms Transmission Time Interval (TTI) (mainly for HSDPA and optionally for HSUPA), HSDPA establishes a new downlink transport channel called High-Speed Downlink Shared Channel (HS-DSCH) that is shared by all HSDPA UEs in the cell. In HSUPA, for each UE a new uplink transport channel called E-DCH (Enhanced Dedicated Channel) is used to provide high-speed uplink traffic transmission. HSPA traffic is characterized by high peak data rates and high burstiness. To support such HSDPA traffic on the downlink and HSUPA traffic on the uplink, not only the UMTS air interface but also the backhaul of the UMTS access network, namely UMTS Terrestrial Radio Access Network (UTRAN), will require considerably high transport capacity for the provisioning of high-speed transmission of packet data. In addition, R99 and HSPA services have rather different QoS requirements: R99 mainly carries delay sensitive traffic like voice or streaming services; whereas HSPA traffic is primarily interactive and background traffic which is insensitive to the delay. Thus, how to efficiently transport R99 and HSPA traffic in the same radio access network while guarantying their individual QoS requirements is a big challenge for designing the evolved UMTS network.

This article presents various traffic separation approaches to transmit both HSPA and R99 traffic in the existing ATM-based UMTS networks, providing a differentiated QoS support for each type of traffic according to its individual QoS requirements. The traffic separation technique is based on using separate ATM Virtual Paths (VPs) or Virtual Circuits (VCs) for transmitting different types of traffic each with a different ATM QoS class. The contribution of this article is twofold: (1) To investigate how much performance gain can be achieved by applying traffic separation in the transport network on the user throughput, packet losses, and link layer transport efficiency, and in addition what will be the impact on the dimensioning of the transport network, especially the Iub interface that is between the RNC and the Node B. The presented results demonstrate that applying traffic separation between HSPA and
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