Chapter XIII
High Speed Packet Access

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ABSTRACT

Data services and multimedia are expected to have significant growth over the next few years and will likely become the dominant source of 3G traffic. High Speed Downlink Packet Access (HSDPA) provides large enhancements over Wideband Code Division Multiple Access (WCDMA) for the downlink. HSDPA was standardized as part of Third Generation Partnership Project (3GPP) Release 5 and Release 6. The HSDPA peak date rate available in the terminals is initially 1.8 Mbps, and it is increasing to 3.6 and 7.2 Mbps with potential beyond 10 Mbps. HSDPA has been designed to increase downlink packet data throughput by means of fast physical layer retransmission and transmission combining as well fast link adaptation controlled by the Node B—that is, a base transmission station (BTS). High Speed Uplink Packet Access (HSUPA) was part of 3GPP Release 6 with the first specification version in December 2004. The HSUPA peak data rate in the initial phase is expected to be 1–2 Mbps with the second phase pushing the data rate to 3–4Mbps. HSDPA and HSUPA together are called High Speed Packet Access (HSPA). The section covers HSPA principles for WCDMA—the key new feature included in Release 5 and enhanced further in Release 6 specification.

INTRODUCTION

Since the first cell networks, from the 1980s of the last century, wireless communications were directed for speech transport.

At the beginnings of wireless telephony, first generation (1G) networks were based on analog technology—Nordic Mobile Telephony (NMT), which used frequency modulation (FM) for speech transfer and frequency shift keying (FSK) for

signalization. This system had a lot of imperfections: international systems were incompatible, user equipment was too big, and battery life was too short.

In the 1990s, the second generation (2G) wireless mobile system called Global System for Mobile Communication (GSM) came into life. GSM had fixed the main imperfection of 1G and it was a completely digital system with international conciliate and very good coverage with high-density transmitters. A big disadvantage of this technology was very low data rate (9.6 Kbps), which is deficient for most services. There was no intention for GSM to be used as a local area network (LAN)—it was based on circuit switched technology (CS).

Thus, the next generations of wireless mobile systems tended to integrate the speech transport and advanced data transfer. That resulted in GSM enhancements and new technologies. High Speed Circuit Switched Data (HSCSD) is one of them. It provides 57.6 Kbps transmission rate. General Packet Radio Service (GPRS) played an important role in transition to the third generation (3G) wireless mobile system. GPRS implementation required the integration of the two new nodes: Serving GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN). The downlink packets transfer rate is 115 Kbps. It is also possible to define the desired profile quality of service (QoS). Enhanced Data-rates for Global Evolution (EDGE) was the last 2G system improvement. The purpose of EDGE was to provide high-speed data transport using the existing resource of GSM network. For that purpose another modulation method was applied, 8 Phase Shift Keying (8 PSK), and transfer rates up to 230 Kbps may be reached (Medvid, 2006).

A new trend in technology and user requirements put higher criteria on data rate and mobility.

The first 3G Wideband Code Division Multiple Access (WCDMA) networks were lunched during 2002. WCDMA enables peak data rates of 384 Kbps with latency 100–200 ms, which makes Internet access close to low-end Digital Subscriber Line (DSL) connections and provides good performance for most low-delay Internet Protocol (IP) applications as well. By the end of 2005 there were 100 WCDMA networks and over 150 operators having frequency licenses for WCDMA operation. By December 2007 there were over 170 million WCDMA subscribers. As WCDMA mobile penetration increases, it allows WCDMA networks to carry larger share of voice and data traffic. WCDMA makes it possible to offer customers substantially more voice minutes with better quality and provides even more dramatic evolution in terms of base station capacity and hardware efficiency (Holma & Toskala, 2004).

In just a few years the Internet has transformed the way we access information, communication, and entertainment services at home and at work. Broadband connections have made the Internet experience richer for millions of people and in the coming years, millions more will turn to wireless technology to deliver their broadband experience. To increase data transfer rates, new standards (improvement of WCDMA) were carried out. Third Generation Partnership Project (3GPP) standardized High-Speed Downlink Packet Access (HSDPA) technology in Release 5, and High-Speed Uplink Packet Access (HSUPA) in Release 6. HSDPA and HSUPA together are called High-Speed Packet Access (HSPA) or 3.5G.

HSPA is the undisputed leader in mobile broadband services, as it provides:

- an ecosystem of unrivalled breadth and depth, covering both traditional mobile terminals and personal consumer devices such as notebooks, ultra mobile PCs, cameras, portable game consoles, and music players,
- unmatched economies of scale that benefit all players in the ecosystem, which are uniquely available to a technology that is part of the 3GPP family of standards, currently serving over two billion subscribers,