

Abstract

Implementation of Base Station Receiver in WCDMA System

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Wideband Code-Division Multiple-Access (WCDMA) is one of the main technologies for the implementation of third-generation (3G) cellular systems. It is based on radio access technique proposed by ETSI Alpha group and the specification finalized in 1999.

The implementation of WCDMA will be a technical challenge because of its complexity and versatility. The complexity of WCDMA systems can be viewed from different angles: the complexity of each single algorithm, the complexity of overall system and the computational complexity of receiver. WCDMA link-level simulations are over 10 times more computational-intensive than current second-generation simulations. UMTS networks need to support the current second generation (2G) services and numerous new applications and services, including the delay issue.

WCDMA is a technology for wideband digital radio communications of Internet, multimedia, video and other capacity-demanding applications. It is the main 3G technologies, providing higher capacity for voice and data. It uses a spectrum of 5 MHz bandwidth, providing 50 times higher data rate than the present GSM networks (and 10 times higher data rate than the GPRS networks). It can support up to 2 Mbps for local area access or 384 kbps for wide area access. An upcoming release will include the enhancement of throughput up to more than 10 Mbps. WCDMA is also known as UMTS and has been adopted as a standard by the International Telecommunication Union (ITU) under the name of IMT-2000 direct spread. Gradual evolution from today's systems is driven by the demand for capacity, which is required by new and faster data based mobile services. WCDMA enables better use of available spectrum and more cost-efficient network solutions. The operator can gradually evolve from GSM to WCDMA, saving investments by re-using the GSM core networks. The benefits of WCDMA are faster, more efficient and more flexible service for data transmission, designed to support simultaneous services with different service quality requirements in terms of throughput, transfer delay, and bit error rate, and a global technology with nearly universal adoption.

Since the quality of the mobile communication system is mainly depended on the base station, therefore the information or related references are hardly found in public due to its

high commercial value.

In this thesis, multipath searcher and rake receiver hardware prototype for base station in WCDMA system are proposed by using practical and simple algorithms. This thesis is aimed to stimulate the research and development of 3G mobile technology in Thailand. Each base station receiver prototype employs the FPGA hardware model XC4VLX60 (Virtex4) which consists of one multipath searcher and three rake fingers. The receiver prototype consists of three fingers to receive multipath signals and each utilize 46% of resources on the FPGA chip. The performance of the receiver algorithms, which has 2 users, is simulated in the multipath and AWGN channel, which is composed of the case 2 propagation condition of 3GPP, 222 Hz maximum Doppler frequency (120 km/hr), and SNR -3 dB. The simulation results show that bit error rate of received signal is less than 3% at the information bit rate of 12.2 kbps, 6% at the information bit rate of 64 kbps, 10% at the information bit rate of 144 kbps, and 14% at the information bit rate of 384 kbps for I channel while bit error rate for Q channel is less than 3% for all information bit rate.

