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INTRODUCTION OF A LEO MOBILE COMMUNICATION SATELLITE CONSTELLATION AND KEY TECHNIQUES RESEARCH OF USER LINK

Abstract

This paper introduces a Low Earth Orbit (LEO) constellation mobile satellite communication system. The system operates 48 active satellites to complete its constellation. The system could provide global coverage, therefore has more capacity and support real time communication. The network, which is composed of satellite constellation and earth radio facilities, supports the transmission of voice, data, FAX and messaging traffic among the various system subscribers, or between subscribers and PSTN users across the world all time. The system radio link consists of user link, feeder link and inter-satellite link. User link, which is used by ground terminals and satellites, works on S-band. Feeder link works on C-band providing communication between satellites and gateway stations. Inter-satellite link supports inter-satellite data transmission via Ka-band, combined with onboard switching, which realize global roaming. User link is the focus of program implementation. Each satellite provides 10 independent beams at both receiver and transmitter and 16 CDMA channels per beam. The user link air interface of user link is similar to IS-95. The onboard digital transceiver is researched in this paper, which is composed of receiver, access control and switching unit and transmitter. The acquisition, tracking, de-spread, demodulation and decoding of uplink signal are implemented in uplink receiver while coding, spreading and modulation of downlink signal in downlink transmitter. The access control and switching unit perform data exchange between receiver and transmitter. The receiver works in the severe environment of low signal-to-noise (SNR) rate, large Doppler shift and large Doppler Rate-of-Change.The carrier Doppler shift of uplink signal is up to 45kHz. Doppler Rate-of-Change exceeds 200Hz/s. PN code phase uncertainty is approximately 64chip. The acquisition should be finished within 20ms and the detection probability is no less than 95% assisting with full zeros frame when Eb/N0 is 7dB. The access channel synchronization scheme is developed, which is composed of synchronizations of the carrier frequency and PN code phase. Parallel frequency search method based on FFT and the multiple PN code phase search technology are employed. The PN code acquisition strategy and adaptive method of calculating threshold are analyzed. Acquisition, tracking, de-spread, demodulation and decoding of access channel are implemented in one XC4VSX55 FPGA of Xilinx. The synchronization is validated in electrical qualification mode (EQM) hardware platform. Testing results indicate that the detection probability, false alarm probability, mean acquisition time and the Bit Error Rate (BER) meet the application requirements.