REVIEW ON DS SS-CDMA TRANSMITTER AND RECEIVER FOR AD HOC NETWORK USING VHDL IMPLEMENTATION

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ABSTRACT

In telecommunications, direct-sequence spread spectrum (DSSS) is a modulation technique. As with other spread spectrum technologies, the transmitted signal takes up more bandwidth than the information signal that modulates the carrier or broadcast frequency. DS-CDMA is advantageous for ad hoc networks because it eliminates the need for any frequency or time-slot coordination, directly benefits from inactive terminals in the network. Ad-hoc network is a decentralized type of wireless network. The network is ad hoc because it does not rely on a pre-existing infrastructure, such as routers in wired networks or access points in managed wireless network. This paper investigates the benefit of Medium access Protocol based on direct-sequence code-division multiple-access (DS/CDMA) Ad-hoc network. This article give a review of MAC protocol that have been proposed for Direct sequence spread spectrum code Division Multiple Access(DS-SS CDMA) for ad-hoc network using VHDL implementation. We first describe the problem of DS CDMA used for ad-hoc network, and then describe the How to remove problem of DS CDMA using our proposed protocol.The main issue in DS-CDMA ad hoc networks is the prevention of a near-far problem in packet communication and low throughput, collision & cross correlation. We know that the two solutions to reduce the near far effect are power control and medium access. So we are focusing the medium access problem and we are designing multiple access interference (MAI) at the protocol level using VHDL implementation. Our Goal is to Using VHDL Implementation for design a DS SS CDMA-based Transmitter with MAC protocol & receiver for ad-hoc network that increases the throughput and avoided the collision & cross correlation, and improve overall performance in ad- hoc network.

KEYWORDS: VHDL, MAC protocol, DBPSK modulator & demodulator, DDFS, Direct Sequence Spread Spectrum.

I.   INTRODUCTION

Code division multiple access (CDMA) is a channel access method used by various radio communication technologies. One of the concepts in data communication is the idea of allowing several transmitters to send information simultaneously over a single communication channel. This allows several users to share a band of frequencies. This concept is called multiple accesses [1-2].

In telecommunications, a direct sequence spread spectrum system achieves its spreading capability by modulating a narrow bandwidth data signal with a wide bandwidth spreading signal [6]. In DS SS Each bit in the original signal is represented by multiple bits in the transmitted signal, using a spreading code .The spreading code spreads the signal across a wider frequency band in direct proportion to the number of bits used[9-13].DS-CDMA is advantageous for ad-hoc networks because it eliminates the need for any frequency or time-slot coordination, imposes no sharp upper bound on the number of mobiles, directly benefits from inactive terminals in the network, and is capable of exploiting bur sty data traffic, intermittent voice signals, multi beamed arrays, and reassignments to accommodate variable data rates[3].

In below Figure 1 Shown the Principal of Direct sequence spread Spectrum system. In DS-CDMA transmitter, the binary data signal using DBPSK modulator and modulates a RF carrier [14]. In DBPSK system, the input binary sequence is first differentially encoded and then modulated using a BPSK modulator. Differential binary phase shift keying is a no coherent form of phase shift keying which avoids the need for a coherent reference signal at the receiver [22]. The modulated carrier is then modulated by the code signal. This code signal consists of a number of code bits called "chips" that can be either +1 or −1. To obtain the desired spreading of the signal using PN sequence generator, The PN Sequence Generator block generates a sequence of pseudo random binary numbers using a linear-feedback shift register (LFSR) [15]. This block implements LFSR using a simple shift register generator (SSRG, or Fibonacci) configuration. A pseudo noise sequence can be used in a pseudo random scrambler and describable, the chip rate of the code signal must be much higher than the chip rate of the information signal [5].

Signal transmission consists of the following steps [6]:
1. A pseudo-random code is generated, different for each channel and each successive connection.
2. The Information data modulates the pseudo-random code (the Information data is "spread").
3. The resulting signal modulates a carrier.
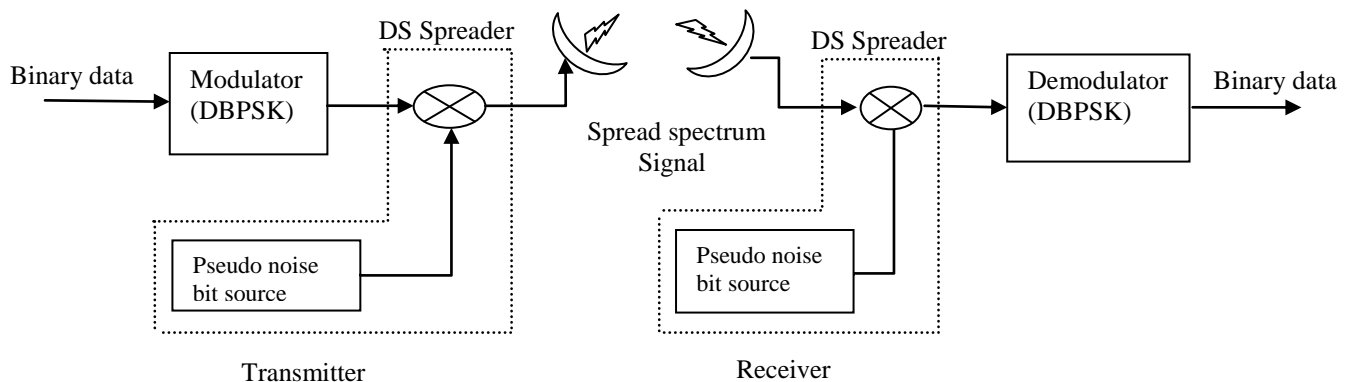4. The modulated carrier is amplified and broadcast.

Figure 1. Principal of Direct sequence spread Spectrum system

After transmission of the signal, the receiver uses coherent demodulation to de spread the SS signal, using a locally generated code sequence [4]. To be able to perform the de spreading operation, the receiver must not only know the code sequence used to spread the signal, but the codes of the received signal and the locally generated code must also be synchronized. This synchronization must be accomplished at the beginning of the reception and maintained until the whole signal has been received. The code synchronization/tracking block performs this operation. After de spreading a data modulated signal results, and after demodulation the original data can be recovered [3].
Signal reception consists of the following steps [6]:
1. The carrier is received and amplified.
2. The received signal is mixed with a local carrier to recover the spread digital signal.
3. A pseudo-random code is generated, matching the anticipated signal.
4. The receiver acquires the received code and phase locks its own code to it.
5. The received signal is correlated with the generated code, extracting the Information data.

II.   PROBLEM DESCRIPTION

Our main problem with applying DS SS is the so called Near –Far effect. This is describing by below example [1]. In below figure this effect is present when an interfering transmitter is much closer to the receiver than the intended and B is low, the correlation between the received signal from the interfering transmitter and code A can be higher than the correlation between the received signal from the intended transmitter and code A. The result is that proper data detection is not possible [1].
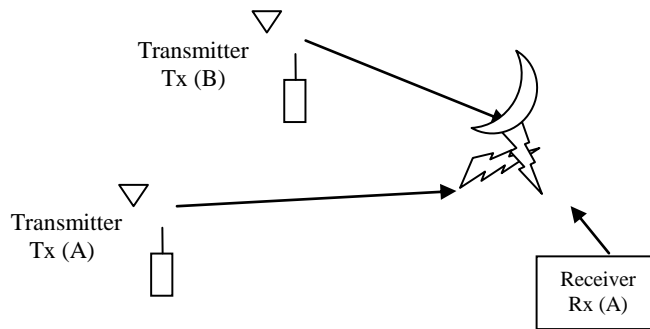
Figure 2. Near far effect

Another one problem is hidden and exposed terminal in wireless Ad-hoc network. The hidden terminal problem refers to the collision of packet at the receiving node due to the simultaneous transmission of those nodes that are not within the direct transmission range of the sender and Exposed terminal problem refers to the inability of a node which is blocked due to nearby transmitting node, to transmit another node [19].

For Example if both node S1 and S2 transmit to node R1 at same time their packets collide at node R1.This is because both nodes S1 and S2 are hidden from each other as they are not within the direct transmission range of each other. This is called hidden terminal problem. On the other and If a transmission from node S1 to another node R1 is already in progress, node S3 cannot transmit to node R2,as it concludes that its neighbour node S1 is in transmitting node and hence it should not interface with the ongoing transmission. In this problem reduce the throughput of network when traffic load is high [21].
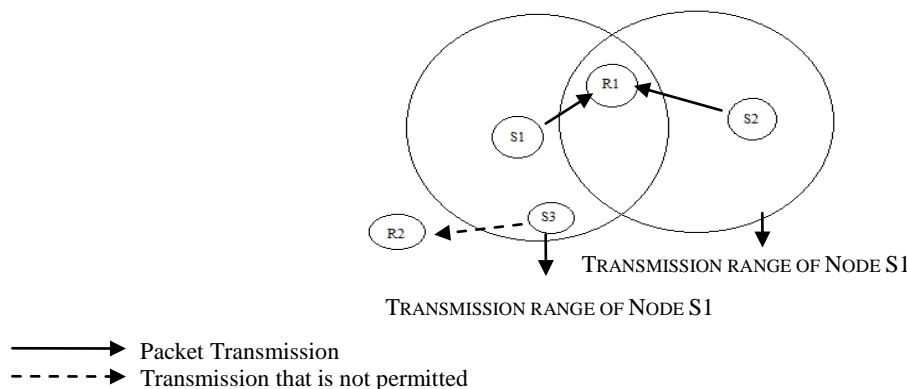

→ Packet Transmission
- - - → Transmission that is not permitted

Figure 3. Hidden and exposed terminal problems

III.   PROPOSED WORK

A CDMA communication system requires an efficient design and testing of its subsystems of PN-sequence generator, spectrum spreading and de-spreading digital circuits and digital modulator and demodulator modules which give high throughput. Another one issue is near far effect & avoidance of collision and cross relation.

3.1. REASON FOR USES PROPOSED PROTOCOL

The Near far effect is created in the uplink of DS SS CDMA When a combination of open- and closed-loop power control which ensures that each terminal generates the same signal power at the base station. The base station monitors the received signal power from each terminal and instructs distant terminals to increase their signal powers and nearby terminals to decrease theirs [6]. A below example shown the power control alone is not enough to reduce the near–far problem in DS SS CDMA Ad-hoc Network [11].

Example:-

Let d_{ij} denote the distance between nodes i and j. suppose that A wants to communicate with B using a given code and C wants to communicate with D using a different code. Suppose that $d_{AB} \approx d_{CD}$,

dCB<< dAB, and dAD << dCD. Then, the MAI caused by C makes it impossible for B to receive A transmission. Similarly, the MAI caused by A makes it impossible for D to receive C transmission. It is important to note that the two transmissions cannot take place simultaneously, irrespective of what transmission powers are selected if an increase its power to combat the MAI at B, then this increased power will destroy the reception at D.
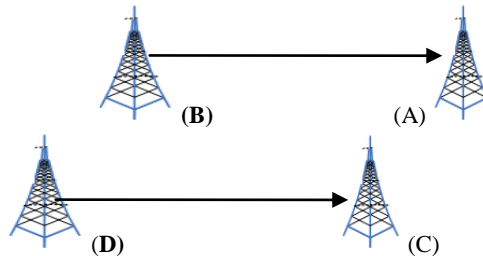

Figure 4. Example shown the power control alone is not enough to reduce the near–far problem in DS SS CDMA Ad-hoc Network

The above Fig. unveils two types of problems [16].
1. Medium access problem: - The use of two different spreading codes to occur at the same time is not possible for two transmissions, this problem is called medium access problem.
2. Power control problem: - if the terminals adjust their signal powers then two transmissions can take place at the same time so that the interference caused by one transmission is not large enough to demolish packet reception at other terminals. This is a power control problem.

So the solution to the near–far problem has to have both elements: power control and medium access. It is important here to differentiate between the spreading code protocol and the MAC protocol. The former decides which PN code is used to spread the signal, but does not solve the contention on the medium [7]. On the other hand, the MAC protocol is responsible for minimizing or eliminating collisions, thereby achieving good utilization of the available bandwidth. And this protocol also free form hidden and exposed terminal problem [20].

3.2. DESIGN GOAL FOR PROTOCOL

The Following are the important goal to be met while designing a design our MAC protocol for Ad-hoc network[21]:
- The operation of the protocol should be distributed and provide quality of service for real time traffic.
- The protocol must be asynchronous, distributed operation, and scalable for large networks. It must also involve minimal exchange of information and must be suitable for real-time implementation.
- The protocol must be scalable to large network. in this protocol should be minimize the effect of hidden and exposed terminal problem.
- The protocol should have mechanism for adaptive data rate control and it should have power control mechanisms in order to efficiently manage the energy consumption of node.
- The receiver circuitry should not be overly complex in the sense that it should not be required to monitor the whole code set.
- The protocol should adapt to channel changes and mobility patterns.

So we design the DS SS CDMA transmitter with MAC protocol & Receiver using VHDL Implement

IV.   PROPOSED SIMULATION TECHNIQUE

VHDL (VHSIC hardware description language) is a hardware description language used in electronic design automation to describe digital and mixed-signal systems such as field-programmable gate arrays and integrated circuits.

VHDL is frequently used for two different goals: simulation of electronic designs and synthesis of such designs. Synthesis is a process where a VHDL is compiled and mapped into an implementation technology such as an FPGA or an ASIC [20].

We can design hardware in a VHDL for FPGA implementation to produce the RTL schematic of the desired circuit. After that, the generated schematic can be verified using simulation software which shows the waveforms of inputs and outputs of the circuit after generating the appropriate test bench.

A VHDL specification can be executed in order to achieve high level of confidence in its correctness before commencing design and may simulate one to two orders of magnitude faster than a gate level description the transmitter and receiver were implemented on FPGA. In this project we uses the VHDL Implementation on Xilinx 14.1 and Model sim Xilinx Edition 10.1C (MXE) tool will be used for functional simulation and logic verification at each block level and system level. The Xilinx Synthesis Technology (XST) of Xilinx ISE tool will be used for synthesis of transmitter and receiver on FPGAs [9].

V.   CONCLUSIONS

In this project we proposed a DS SS CDMA-based medium access protocol with transmitter & receiver for ad- hoc networks. Our protocol reduction in the energy consumed to successfully deliver a packet from the source to the destination. In this protocol is providing a solution to the near-far problem in CDMA ad hoc systems at the protocol level & it's also increases the throughput of network and reduce the hidden and exposed terminal problem.

In this Implementation of a CDMA communication system with DSSS technique in VHDL has the following advantages

- The design is fully reconfigurable. Solve the near far problem in packet communication.
- Avoidance of Collision & Cross correlation
- Increase network throughput & free from hidden and exposed terminal problem.

Applications:-

- Used in Military communication.
- Useful in emergency operation such as search and reduce, crowed control and commando operation.
- Standard CDMA systems designs such as used for mobiles and GPS

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