

Beacon Initiated Reconfigurable SDR Controller on FPGA for High Speed Communication System

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ABSTRACT: Service providers make use of cost-effective wireless resolutions to recognize, concentrate, and perhaps track users by means of their approved MDs to sustenance added services, such as geo-advertisement, safety, and administration. Indoor and outdoor hotspot area plays an important role for such facilities. Nevertheless, GPS doesn't work in several areas. To resolve these issues, service providers inspire available indoor radio technologies, such as Wi-Fi, LTE, and GSM, to recognize and localize users.

We concentrate our study on adaptively modifying beacon time of the receiver and it calendars the sender listening time as per the scheduled period. Numerous energy proficient Receiver Initiated Asynchronous Duty-Cycle MAC protocol was introduced for wireless sensor networks (WSNs). Maximum nodes suffer from important performance Deprivation for burst traffic, due to arbitrarily waking up to communicate within them. The projected protocol is fresh receiver initiated asynchronous duty-cycle MAC protocol aimed at burst traffic. Through this high energy proficiency and low end-to-end packet delivery latency for burst traffic is accomplished. We have estimated the performance of MAC through comprehensive ns-2 simulation. The simulation results indicate that the projected protocol reduces end-to-end packet delivery latency and power consumption under several data rates in diverse topologies compared with RI-MAC.

KEYWORDS: Software Define Radio (SDR), Wireless Sensor Network (WSN), Filed Programmable Gate Array (FPGA), Multiple Access Control (MAC).

I. INTRODUCTION

In wireless sensor networks (WSN), energy consumption is one of the most important factors because it is difficult to recharge or replace the battery of each sensor node frequently. For that reason, in wireless sensor network maximum MAC protocols employ the duty cycling method, to save energy the sensor nodes turn their radio on and off continually.

There are mainly two kinds of duty cycle MAC protocols, first is synchronous and other is asynchronous. In synchronous duty cycle MAC protocols for example T-MAC and S-MAC sensor nodes continually wake up and sleep simultaneously. Thus time synchronization leads to regulate message overhead and makes sensor nodes costly and multifaceted. While in case of, asynchronous duty cycle MAC protocols, every sensor node wakes up and sleeps individually. Thus, time synchronization is not compulsory. Most asynchronous duty cycle MAC protocols implement a random wake up interval in order to avoid repetitive collisions.

Idle listening is one of the major energy surplus sources in WSNs. duty cycle mechanisms used to decrease energy consumption in idle listening. Nevertheless, it suffers by sleep latency problem since the subsequent hop node may be in sleeping state while data arrival. Sleep latency outcomes in high end-to-end packet delivery latency with packet

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

delivery hops growing. It can't be charitable for some real time applications. Event recognition is one of the major applications in WSNs. The node generally transmits the data packets with burst once spotting the event. The surviving receiver initiated asynchronous duty cycle MAC protocol suffers by serious performance degradation under burst traffic.

The contributions of the proposed paper are as follows:

- Each receiver adaptively regulates its beacon time; with the purpose that packet can be accelerated as soon as possible and thus how the low end-to-end packet delivery latency is accomplished.
- End-to-end packet delivery latency is disintegrated into how to regulate single hop latency.
- In order to decrease idle listening and save power consumption, the sender calendars its listening time as per its receiver beacon time.

II. RELATED WORKS

Background and Related Works

In zones where the satellite technologies like GPS fail to deliver a practical level of positioning accuracy, there is a definite interest between network operators, service suppliers, and regulatory groups in serving these environments with positioning resolutions that are accurate, mountable and also the cost effective. To sustain indoor localization, various clarifications leverage is available for indoor radio signals, for example Wi-Fi, LTE, and GSM. However, service providers for such types of technologies function on a large scale. To keep system resources enhanced and reduce upgrade and maintenance costs, network operators have a clear tendency to exploit these radio access tools on the cloud. The RAN operation on the cloud needs two main components such as SDR hardware responsible for swapping information with end users and a SDR employment put on the radio system in software. Our eventual goal is indoor localization. Henceforward, we focus on radio constraint transferred from indoor SDR systems for localization. These parameters will be fed later to a localization algorithm to evaluate locations of target objects. However, due to the stimulating characteristic of the indoor environment, we need first, the removal of polluted signals from radio measurements earlier than they can be served to the localization algorithm and other is, a robust algorithm to model the target atmosphere immediately is required

GPS TECHNOLOGY AND INDOOR CHALLENGES

A satellite navigation structure, such as GPS, comprises of multiple satellites that send radio signals from space to skilled devices (GPS receivers) on the earth. At first, GPS receivers execute time synchronization with satellites' clocks. Later, the distance among a satellite and a GPS device is calculated seeing the time it takes the radio signal to mobile from a satellite to the device 4 times multiplied by the speed of light. GPS devices have to lock onto at best four or more satellites to guesstimate their location (longitude, altitude, and latitude). GPS is an outstanding example that deal the high accuracy, scalability, and confidentiality (devices only recognize their personal locations) for a wide range of outdoor applications. Higher correctness signals of GPS satellites are constrained to military and governmental agencies. Other Satellite based clarifications, such as Galileo, assurance to offer higher accuracy than the GPS publicly for each user. However, such explanations are still in the improvement phase. Since the GPS signal is fragile, about 1×10^{-16} watts dignified at the surface of the earth, devices can only attain lock when they have a clear line of vision with satellites. GPS signals travel through transparent objects, such as tinny clouds, glass, and so on. Nevertheless, the GPS signal doesn't pass by solid objects, for example buildings. Hence, GPS cannot concentrate capable devices indoors, in dense urban zones, or similar surroundings. Moreover, GPS devices might need a long time to lock onto satellites, from 30 seconds to certain minutes. Thus, GPS devices are comparatively power constrained, making their intensive

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

use unproductive on battery based devices, for example smartphones. In terms of safety, GPS signal modulation and frequency spectrum is publically accessible. Thus, GPS is defenseless to blocking, jamming or spoofing spasms. Because conservativeGPS has the difficulty of providing consistent performance when signal conditions are humble, numerous solutions have been proposed to recover the situation. Indoor GPS is a resolution based on devices that act as a simulated satellite with signal correction abilities. Assisted GPS (A-GPS) or Differential GPS (D-GPS) are two other solutions directing areas discovered by typical GPS signal. AGPS pronounces a system where outdoor sources, such as a support server and ground stations, help a GPS receiver to perform its task to make range measurements and position resolutions. The ground stations or support servers communicate with the GPS receiver through a wireless linkage. The ground station may also transferGPSlike signals; this method is called Pseudolites navigation system. Henceforth, the Pseudolites approach bids an extra source to GPS receivers. If theground stations are transmitting the alteration between their position indicated by the GPS and their exact known fixed location, this methodology is called Differential GPS (D-GPS). A and D-GPS improve the place accuracy from 15m down to 10cm. However, the cost of deployment and maintenance, together with high battery consumption remains an obstacle from adopting these solutions to a broad range of applications. DisparateGPS transmitter, BTSs of cellular networks, such as GSM and LTE, are located in comparatively close distance to end users. Each BTS covers a specificgeographical area called a cell. Moreover, the comparatively high transmitted power of cellular BTSs (compared to GPS) makes cellular radio signals accessible outdoor and in most indoor areas. Hence, several results for indoor localization solutions take benefit of available cellular signals indoors to localize and track MDs. These solutions are attractive due to the widespread adoption of users to cellular MDs [50]. However, these solutions can be extended to all available indoor radio. A Large number of papers argue that UWB radio offers excellent means to determine a device's location with high precision. Unfortunately, at the time of this work, UWB-based solutions have a longer time for deployment and are expensive.

About MAC Related Work

The idea of receiver-initiated transmission in a MAC protocol is not new, but we make the first attempt to combine this idea together with duty cycling in the context of MAC protocols. Contention-based duty-cycle MAC protocols in WSNs can be classified into two categories: synchronous and asynchronous. Synchronous duty-cycle MAC protocols, such as SMAC, T-MAC, RMAC, DWMAC and PRMAC, need the neighbor nodes to synchronize for communicating with each other. In contrast, asynchronous duty-cycle MAC protocols, such as BMAC, Wise MAC, XMAC, RI-MAC and PW-MAC, do not require any synchronization between the neighbor nodes. The proposed MAC is an asynchronous duty-cycle MAC protocol, so we focus on asynchronous MAC protocols in this section. In these existing asynchronous duty-cycle MAC protocols, each node always wakes up randomly. This random wakeup introduces extra packet delivery latency. Especially for burst traffic, they suffer from serious performance degradation. Furthermore, because the sender does not know when the receiver wakes up in some MAC protocols (e.g. BMAC, XMAC and RI-MAC), it has to immediately wake up when it wants to transmit data packets, which wastes a great deal of energy.

In RI-MAC, as shown in Fig. 1, when a packet arrives at a sender, it wakes up and simply waits for a base beacon from its intended receiver. When the receiver wakes up, it sends a base beacon as an invitation for data transmission. Once the sender receives the beacon message then the data transmission will start when the data is successfully received, the receiver sends a beacon as an acknowledgement (also used as an invitation for new data transmission). If a collision occurs, the receiver sends a beacon which includes the back off window size.

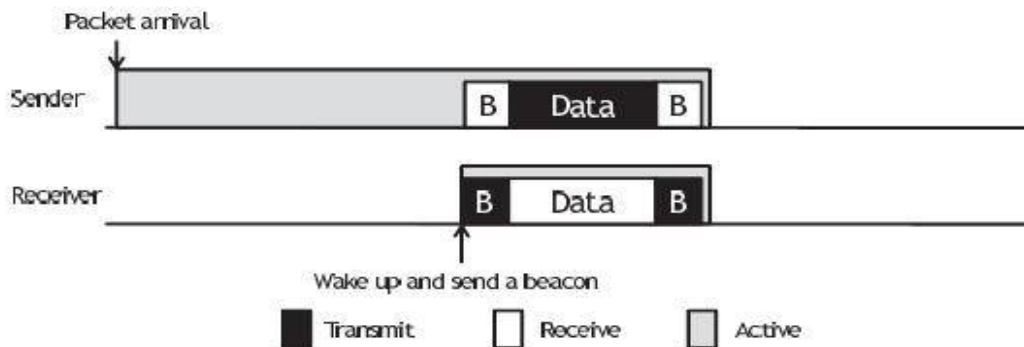


Fig. 1 Operation of RI-MAC

III. PROPOSED WORK

The idea of beacon Initiated reconfigurable SDR controller on FPGA for high speed communication system is not new but we add duty cycle technique here which helps us to reduce the power consumption and increases the efficiency of that protocol. When the data packets arrives at the sender it wakes and wait for beacon signal from its receiver i.e in other word we can say it invites receiver for data transmission. When beacon signal is received by sender the data transmission actually start and when all data will successfully sent receiver also send the beacon signal as an acknowledgement which we can say new invitation for transmission of data. In this way each node wakes up randomly for continuously supervising the beacon signal which tells us that it is always ready to receive the data. when the sensor node has so many data packets waiting in a queue then sensor node transmit the data one by one immediately but if no any data packet is received then the sensor node will go to sleep mode and save the power consumption.

In this proposed work, it is shown that design of transmitter and receiver for software defined radio. The main controller combines all signals of transmitter and receiver. The input signals for transmitter are clock, power gating, base beacon and data which we have to send. On the other hand the output signals are received data, radio status, and CRC. CRC is nothing but checksum which we have to add in the input data to crosscheck whether whatever data send by sender exactly we got at receiver or not! Acknowledgement is given by both sender as well as receiver. Similarly the input signals to receiver are clock, power gating and input data and at the output side beacon from transmitter memory to save the status of device. Device status tells us our device is on or off. Main controller combines input signals of transmitter to the receiver. There is one multiplier which filters out the output data. When supply is zero system is in ideal mode. When data arrives base beacon is send by sender to receiver and data transmission takes place. When data successfully received receiver also send the beacon signal.

IV. HARDWARE AND SOFTWARE DESIGN

Both of these hardware and software are much precisely designed. Whenever the power supply is off the fsm is in idle state. When it becomes 1 sender sends the base beacon to receiver as invitation for transmission of data. There are lot many things like device status, radio status. Power gating, Checksum i.e. CRC, multiplier unit for filtering out the data are there in this system. When power gating is on data transmission is successfully done while on the other hand when it is zero senders will not send any acknowledgement that is base beacon to receiver and transmission of data stops.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

V. DESIGN

A. Overview

Like RI-MAC, proposed MAC is an asynchronous duty-cycle receiver-initiated MAC protocol. Each node wakes up randomly to broadcast a beacon to notify that it is ready to receive data. When a node has queuing data packets receives the beacon from its intended receiver, it transmits data packets immediately. If no packet is received after broadcasting its beacon, the node will go to sleep to save energy. Time is divided into random period (RP) and scheduled period (SP) as in figure 2. During RP, each node randomly wakes-up to broadcast its beacon like RI-MAC

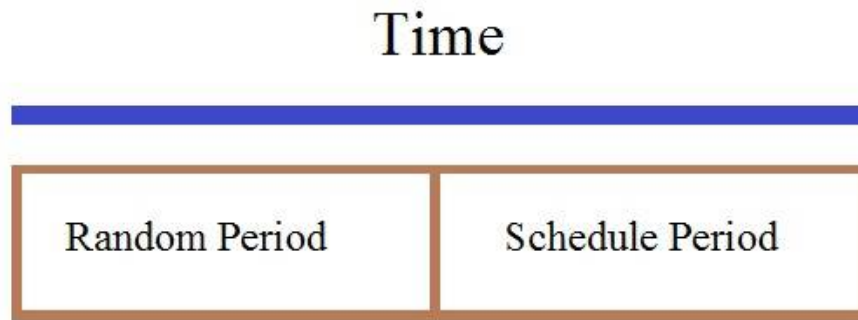


Figure 2:Timing Diagram

B. Latency Problem Description

We describe end-to-end packet delivery latency problem. Figure 3 represents the deployment of nodes. The network is composed of N nodes, including one or more than one source nodes, some relay nodes and one sink node. When any node detects the event, it generates data packets that are transmitted to the sink node through multiple relay nodes with burst. The interval between when the source node generates the data packet and when the sink node receives it is defined as end-to-end packet delivery latency D .

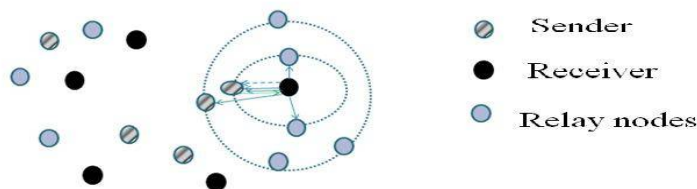


Figure 3: Network Model

Figure 4 illustrates single hop latency in Receiver Initiated Asynchronous Duty-Cycle MAC protocol. Node S transmits its beacon at t_1 and receives the data packets. Then S keeps listening to the channel for the beacon from receiver R. Once S receives R's beacon successfully at t_2 , R receives the queued data packets from S. Thus the sender S needs to wait till the receiver wake-up, it's just a waste of time. If we ignore the packet propagation delay, single hop latency from S to R can be presented as

$$d_{S,R} = t_2 - t_1$$

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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If the duration of operational cycle is T_{cycle} and each node randomly wakes up, average single hop latency is $T_{cycle}/2$, thus we find that single hop latency can be reduced significantly if R wakes up just after S wakes up, but not randomly chooses its beacon time

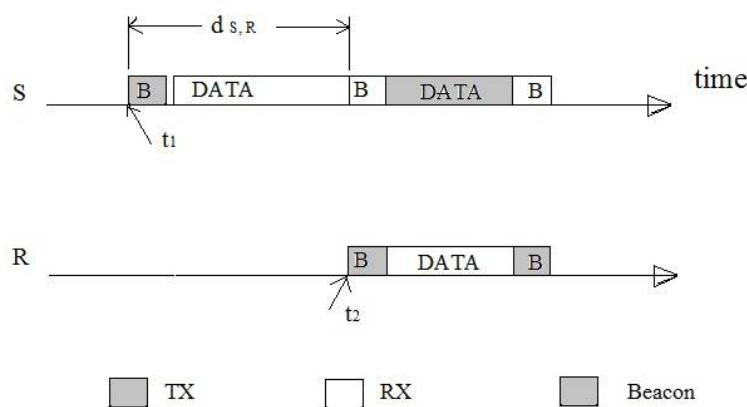


Figure 4: Single hop latency

C. Adaptive Beacon Time of Receiver

Adaptive beacon time mechanism of receiver is proposed to control single hop latency, by reducing this end-to end packet delivery latency also can be reduced significantly. When the sender transmits the data packet, it piggybacks its next beacon time in the data packet. Once the data packet is received successfully by the receiver, the receiver adaptively adjusts its next beacon time based on the information piggybacked.

Initially, each node i is in Random period and chooses its beacon time T_{beacon} randomly. Each node randomly wakes up at its beacon time to notify that it is ready to receive the data packets by broadcasting a beacon. Once the nodes detect the event it transmits the data packets to the sink node through multi-hop relaying. When sender S transmits the data packets to its receiver, S 's next beacon time $T_{beacon,S}$ is piggybacked in the data packet. Upon receiver R receives the data packets, R updates its next beacon time corresponding to S based on, $T_{beacon,S}$:

$$T^R_{beacon,S} = T_{beacon,S} + T_{guard}$$

Where T_{guard} can ensure that S receives all queued packets from its previous hop.

Especially, because R may have multiple senders, R should choose minimum next beacon time as its scheduled next beacon time.

$$T^R_{beacon} = \min_i (T^R_{beacon,i} \geq \text{TIME_NOW})$$

International Journal of Innovative Research in Science, Engineering and Technology

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Variable	Definition
$T_{beacon,i}$	next beacon time of sender i piggybacked in the data packet
T_{guard}	the interval between sender's beacon time and receiver's beacon time
$T_{beacon,i}^j$	next beacon time of receiver j based on next beacon time of sender i
T_{beacon}^j	receiver j 's scheduled next beacon time based on each sender i
$T_{listen,i}$	sender's scheduled listening time for receiver i
T_{thre}	the duration of scheduled period in each node

Table I: VARIABLES DEFINITION

D. Scheduled Listening Mechanism of Sender

In MAC, the sender plays a very important role. Firstly, the receiver schedules its next beacon time based on the sender's beacon time information piggybacked in the data packet. On the other hand, in order to reduce energy waste of idle listening, the sender schedules its listening time based on the receiver's beacon time. The most important difference between MAC and RIMAC for a sender is how the sender wakes up to listen to the channel when it wants to transmit the data packet. In RI-MAC, the sender immediately wakes up to listen to the channel when it has queued data packets.

In MAC, according to adaptive beacon time of receiver, the sender schedules its listening time during Schedule period to reduce idle listening and save energy. Because the node always immediately wakes up to listen to the channel when it wants to transmit the data packet during Random period, the sender doesn't miss its receiver. However, the sender starts to listen to the channel only just before its receiver wakes up during SP.

VI. RESULT

Following simulation result are observed in the software tools, and achieved the target.

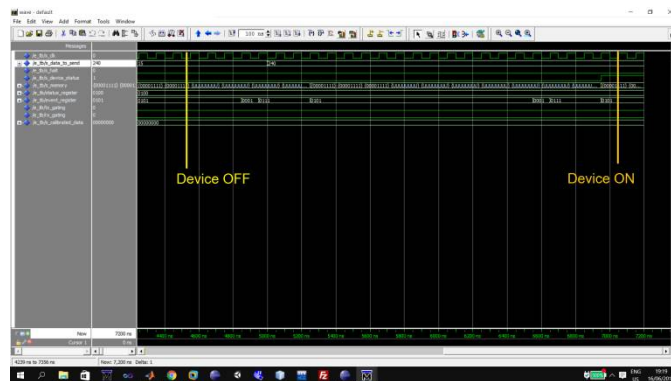


Fig. Simulation Result

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

VII. CONCLUSIONS

In this paper we have proposed a new Receiver Initiated Asynchronous Duty-Cycle MAC protocol For Burst Traffic. The proposed MAC protocol will guarantee that it will Increase performance and this can be achieved by reducing end-to-end packet delivery latency, Increases the life time of sensor network and Saves energy.

The enhancement can be done to the burst traffic based on the priority concept. There are two advantages of platform combining DSP and FPGA. DSP accelerates hardware for FPGA. On the hand other as we know that FPGA already have partial reconfiguration capability because of which we can easily reduce the size of software which is downloaded. In this we have proposed a new Receiver Initiated Asynchronous MAC protocol having duty cycle technique for Burst Traffic.

This system improves the performance by reducing the end to end packet delivery which saves energy and also increases the life time of sensor nodes. In this E-controller can also added which can combines signals of both transmitter and receiver in software defined radio. So that power consumption can also be reduced on large scale because whenever the acknowledgement is not send or received by device data transmission stops and energy can be saved

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