International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

A Comparative Analysis MAC Protocols for Optimization of UWB Channels in the Presence of Fast Fading & Shadowing

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Abstract: ***In the existence of UWB channels that provide large bandwidth and potential promise for high quality services and applications in wireless networks MAC protocol acting a crucial role in utilizing the channels efficiently. Recently Cai et al. explored the view of Exclusive region for building Distributed Exclusive Region (DEX) Based MAC Protocol. DEX MAC improved performance of wireless network for using UWB channels effectively in distributed and asynchronous fashion. Their protocol was not evaluated in the presence of fast fading and shadowing conditions of UWB channels, these can be evaluated in the presence of fast fading and shadowing conditions of UWB channels previous article. In this we compare different DEX MAC protocols by using different parameters like PDR, Delay, throughput, overhead, energy consumption, packet drop. With mathematical analysis. The simulation results give better performance with existing one.***

Keywords: fast fading, shadowing, DEX MAC, UWB

1. Introduction

Ultra-Wide-Band (UWB) communication technology holds great assure for revolutionizing wireless communications.[1, 2,3] The UWB systems are mostly based on the impulse Radio (IR) technology extremely uses short pulses (e.g. picoseconds duration) giving rise to a broad spectral job in the frequency domain (bandwidth from near DC to a few GegaHz).

UWB Advantages:
1) Low-power operation.
2) Low probability of detection (LPD) and low probability of jamming (LPJ) capability due to the low energy per frequency band.
3) Ability to penetrate walls, flowers, etc. due to the lower frequencies use.
4) Higher immunity to multi-path fading effects due to increased signal multiplicity.
5) Accessibility of precise location information, given that UWB uses precise pico-second pulses for transmission.

UWB technology can continue to exist for a wide range of application including ground-penetrating radars, imaging systems, vehicular radars, wireless offices and homes, identification tags, location tracking, in-container inventory systems, security systems, short range voice, data and video, etc.Due to the pico-second precision pulses used in UWB and impulse radio, channel acquisition time, i.e. time for a transmitter and receiver to achieve bit synchronization can be quite high, of the order of a few milli-seconds. In a broadcast multiple access environment, this will significantly impact medium access control (MAC) protocol performance.

The design necessities for UWB based network are:

1) Providing a method to permit a user to work out a particular data stream
2) Allow all the users to forcefully share the media spectrum range
3) Techniques to build the system with sufficient presentation or cost advantage over existing
4) Approach to justify the effort and savings.

1.1 UWB Applications

The idea for discussing UWB technology comes from its applications and the advantages it offer over narrowband technologies. Some of the current and future applications of UWB technology are [3][4]:

1.1.1 Applications in Wireless Communication Systems:
1) High bandwidth wireless network used for homes and offices.
2) Roadside Information stations that can be deploy wherever the messages may contain Weather reports, road conditions, construction information and emergency assistance Communication.
3) Automotive in-car services like real time video for directions and passenger entertainment or download driving directions from PDA for use by onboard navigation system
4) Short range voice, data and video application
5) Military communications on board helicopters and aircrafts which would otherwise have too many interfering multipath mechanism.

1.1.2 Applications for Radar and Sensing
1) Ground penetrating radar
2) Vehicular Radars use for collision avoidance/detection and sensing road conditions

3) Through wall imaging used for accumulate, security and medical applications
4) Identification tags
5) Radar security fence
6) Multi-sensor robots for reconnaissance

1.1.3 Applications in Precision Location Tracking

1) In container inventory systems: RFID
2) Aiding GPS for localization.
3) Localization in search and rescue efforts

1.1.4 Some implementations of these applications :

1) **VETAS:** Vehicular Electronic Tagging and Alert System initiated by the US Department of Transportation to provide a means of keeping repeatedly convicted drivers off the road.
2) **WICS:** UWB Wireless Intercom Communications System for US Navy aircraft. The Transceiver provides multi channel, full duplex 32kbs digital voice across a range of ~100m.
3) **MANET:** Development of highly mobile, multi-node, ad-hoc wireless communications. Network funded by the Office of Naval Research. The system is intended to provide a Connectionless, multi-hop, packet switching solution pro survivable communications in a high link failure environment.

One recent contribution is from Cai et al. [17] where a MAC protocol is designed and optimized for exploring exclusive region in UWB channels in order to have fair and efficient sharing of resources. This could improve the performance of network so as to improve the communications between two parties through the exclusive region. In other words scheduling and synchronizations were achieved. The MAC protocol designed by Cai et al. is improved further in EEDRP [18], RAMM [20], DEXRSSMAC [21] and EDEXMAC [22]. In [19] also there is work on the improvement of Cai et al.'s work with respect to finding exclusive region using directional antenna.

Our protocol performs better in the fast fading and shadowing conditions of UWB channels and ensures fair and efficient sharing of resources to facilitate enhanced performance. The protocol is evaluated with NS2 simulations. It is compared with other existing protocols such as DLBOP, EEDRP, DEXRSSMAC, EDEXMAC. The empirical results revealed that the Enhanced EDEXMAC outperforms other protocols. The remainder of the paper is structured as follows. Section 2 provides review of literature. Section 3 presents proposed work. Section 4 presents mathematical Analysis. Section5 shows simulation and results while section 6 concludes the paper besides providing directions for future work.

2. Related Work

A Mobile Ad-hoc Network (MANETs) [6] is a collection of nodes or terminals that communicate together by forming a multi-hop radio network. The nodes can move and their network topology may be dynamic.

In recent work [7] we presented an efficient routing method using energy efficiency parameters. With the exchange of considerable number of control messages to establishment of routes, or a data messages, this exhaust resources and aggravates performances. One of major causes of exchange of these message is the lost of paths, result of the exhausting of a node battery. To overcome this problem, we suppose that all nodes composed the networks have information about the energy stored in the batteries of its neighborhood. It avoid the routing using a node that it battery will be exhausted.

In paper[8]Efficient energy management is a key requirement in WSN, and many of the strategies assume that the data acquisition consumes significantly less energy than data transmission .

In [9], the authors take advantage of the positioning capabilities of UWB to propose an energy efficient routing algorithm. This algorithm is developed to search for energy efficient routes with respect to the Quality of Service (QoS) of the system.
In papers [10,11,12]There are some studies presented in the open literature where the benefits of diversity techniques for on-body communications in narrow-band systems have been investigated. Introductory studies for on-body diversity measurements at 2.45 GHz were presented in [11].

The diversity performances were evaluated in terms of DG, power imbalance and envelope correlation coextends between the two receiving channels. A comprehensive study of diversity for an on-body channel at 2.45 GHz was presented in [10].
Using different antennas and diversity types. Current literature on ranging in UWB systems is rather limited. Published materials either focus on simulation and measurements of UWB ranging and positioning [13], [14] or on theoretical accuracy of UWB synchronization and ranging for time hopping (TH)-IR UWB signals [15], [16] with no specific application IEEE 802.15.3a/4a signal formats.

In paper [23] a novel RTT-based ranging method is proposed over a PCB that performs RTT measurements. The effect of hardware errors has been minimized by choosing the scale-W parameter as RTT estimator. A coefficient of determination value of 0.96 achieved with this estimator in LOS justified the simple linear regression function as the model that relates distance estimates to RTT measurements in LOS

3. Proposed Work

We proposed a new protocol in this paper. It is named Enhanced EDEXMAC (Enhanced Distributed Exclusive Region Based MAC). It is an extension to the original Distributed Exclusive Region (DEX) MAC protocol which optimizes communications in UWB channels[17]. Since UWB channels provide higher bandwidth and suitable for data intensive applications, finding exclusive region for supporting fair and efficient sharing of resources can further optimize performance of such networks. For this reason, in our previous paper, we proposed Distributed Exclusive Region Based Received signal strength MAC Protocol (DEXRSSMAC)[18,19,20,21]. In this paper we focused on understanding two conditions in UWB channels namely fast fading and shadowing. These two contingencies are addressed by optimizing the proposed protocol named Enhanced EDEXMAC. The improvements in MAC could help finding exclusive region for efficient communication besides handling fast fading and shadowing conditions.

As shown in Figure 1, it is evident that the proposed protocol enhances the DEX protocol proposed in [1] by proposing optimization by analyzing fast fading and shadowing conditions in UWB channels. The proposed Enhanced EDEXMAC protocol is aware of the fast fading and shadowing conditions. The two channel conditions are described with mathematical analysis. This knows how the basis for our optimization mechanism is. After adapting to the channel fast fading and shadowing conditions, the protocol is aware of such conditions and the optimization comes into picture. Thus the proposed protocol starts working with considerable performance improvement.

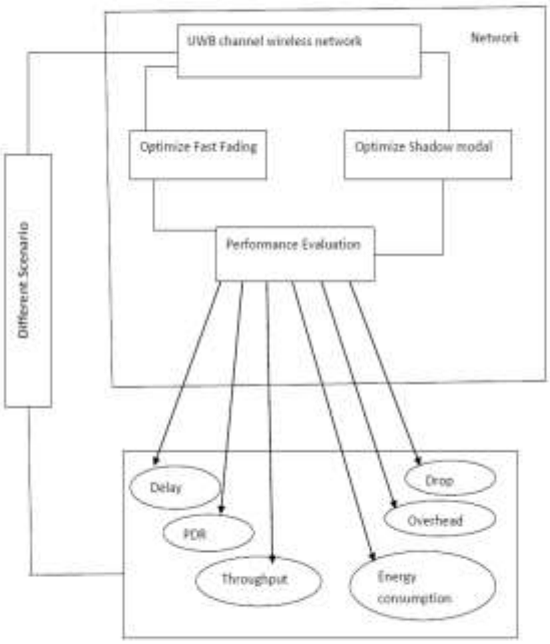

Figure 1: Overview of the Proposed Architecture

4. Mathematical Analysis

4.1 Delay Formula

The time difference between packets received and packet sent.

$$\boxed{\text{Delay} = \sum_{p=1}^{n} (DN_{rt} - SN_{st})}$$

Here p=1 to n Gives the Number of packets in the Simulation
DN Destination Node
rt Received time
SN Source Node
st Sent Time
s 1.523852013 _10_ RTR --- 1 cbr 532 [0 0 0 0] ------- [10:0 8:0 30 4] [1] 0 0
r 1.526374674 _4_ RTR --- 1 cbr 532 [13a 4 a 800] ------- [10:0 8:0 30 4] [1] 1 0
the above simulation pattern shows
First row "s" means sent packet, "r" means received packet
Second Row represents Sent Time at Source Node and Received Time at Destination Node.
Delay = Received Time at Destination Node – Sent Time at Source Node
= 1.526374674-1.523852013
Delay = 0.002522661

4.2 Throughput

No. Of packets received in given amount of time at destination node is called Throughput.
We can calculate it by Bytes or Kilo Bytes or Mega Bytes.

Time we can take in seconds.

$$\boxed{\textbf{Throughput} = \textbf{No. of Packets Received / Time}}$$

$$\boxed{\textbf{Throughput}=(DN_1 \sum_{i=0}^{n} P_i.Size \; + \; DN_2 \sum_{i=0}^{n} P_i.Size + - - - - + DN_n \sum_{i=0}^{n} P_i.Size)/Time}$$

DN: Represents Destination Node
P: Represents Packet Count
Size: Packet Size in Bytes
The simulation Data flow for the above is at node 4 the packet size is 532 received number of packets is 3 and at node 10 the packet size is 512received number of packets is 3
Received Packets at Node 4 : 3 and Size 532
Received Packets at Node 10 3 and Size 512
Throughput = (3x532 + 3x512) = 3132 bytes per 0.03 millisecond

4.3 Packet Delivery Ratio:

The Packet Delivery Ratio we can calculate by the ratio between no. of received packets and no. of sent packets. PDR can represent in percentage

PDR =(TNRP/TNSP)x100 i.e
PDR = (No. of Received Packets/No. of Sent Packets) x100

TNRP : Total No. of Received Packets
TNSP : Total No. of Sent Packets
If suppose the Total No. of Received Packets is 3 and Total No. of Sent Packets 3 therefore the packet delivery ratio is 100%.i.e
TNRP : 3

TNSP : 3
PDR = (3/3)100= 100%

4.4 Packet Drop:

The total no. of drop packet gives Packet Drop count in the network.
The no. of drop packets we can calculate with respect to time.

$$\boxed{\textbf{Packet Drop} = \textbf{TNDP}}$$

TNDP : Total No. of Drop Packets
As for the simulation our simulation results shows .
No. of Drop Packets = 2 packets per 0.03 millisecond

4.5 Energy Consumption:

The amount of energy consumed at each node gives total consumed energy in the network.

$$\boxed{\textbf{Energy Consumption} = \sum_{i=0}^{n} N_i E_{UJ}}$$

N : Represents a Node in the Network
E_{UJ} : Utilized Energy in Joules
Simulation at run time
Node 1 used 20 Joules
Node 2 used 10 Joules
Node 6 Used 15 joules
Total Energy Consumption = 20+10+15 = 45 Joules

4.6Overhead

The Network Overhead we can define as the amount of processing time to send a packet from source to destination. If processing time is less the network overhead also less.

$$\boxed{\textbf{Overhead} = \sum_{i=0}^{n} PR_{it}}$$

PR_{it} Processing Time for i^{th} packet (i=0, 1, 2, 3.........................n)
the simulation at runtime for communication overhead Processing Time of 31^{St} packet is 1.810000000(Processing Start Time) 1.815957134 (Processing End Time)
Overhead = 0.005957134

5. Simulation at run time

```
s 1.800000000 _10_ RTR --- 30 cbr 532 [0 0 0 0] ------- [10:0 8:0 30 4] [30] 0 0
r 1.803056396 _4_ RTR --- 30 cbr 532 [13a 4 a 800] ------- [10:0 8:0 30 4] [30] 1 0
f 1.803056396 _4_ RTR --- 30 cbr 532 [13a 4 a 800] ------- [10:0 8:0 29 8] [30] 1 0
r 1.806477134 _8_ AGT --- 30 cbr 532 [13a 8 4 800] ------- [10:0 8:0 29 8] [30] 2 0
s 1.810000000 _10_ AGT --- 31 cbr 512 [0 0 0 0] ------- [10:0 8:0 32 0] [31] 0 0
r 1.810000000 _10_ RTR --- 31 cbr 512 [0 0 0 0] ------- [10:0 8:0 32 0] [31] 0 0
s 1.810000000 _10_ RTR --- 31 cbr 532 [0 0 0 0] ------- [10:0 8:0 30 4] [31] 0 0
r 1.813096396 _4_ RTR --- 31 cbr 532 [13a 4 a 800] ------- [10:0 8:0 30 4] [31] 1 0
D 1.813096396 _4_ RTR --- 31 cbr 532 [13a 4 a 800] ------- [10:0 8:0 29 8] [31] 1 0
r 1.815957134 _8_ AGT --- 31 cbr 532 [13a 8 4 800] ------- [10:0 8:0 29 8] [31] 2 0
s 1.820000000 _10_ AGT --- 32 cbr 512 [0 0 0 0] ------- [10:0 8:0 32 0] [32] 0 0
r 1.820000000 _10_ RTR --- 32 cbr 512 [0 0 0 0] ------- [10:0 8:0 32 0] [32] 0 0
s 1.820000000 _10_ RTR --- 32 cbr 532 [0 0 0 0] ------- [10:0 8:0 30 4] [32] 0 0
r 1.822556396 _4_ RTR --- 32 cbr 532 [13a 4 a 800] ------- [10:0 8:0 30 4] [32] 1 0
D 1.822556396 _4_ RTR --- 32 cbr 532 [13a 4 a 800] ------- [10:0 8:0 29 8] [32] 1 0
r 1.825457134 _8_ AGT --- 32 cbr 532 [13a 8 4 800] ------- [10:0 8:0 29 8] [32] 2 0
s 1.830000000 _10_ AGT --- 33 cbr 512 [0 0 0 0] ------- [10:0 8:0 32 0] [33] 0 0
r 1.830000000 _10_ RTR --- 33 cbr 512 [0 0 0 0] ------- [10:0 8:0 32 0] [33] 0 0
```

6. Results and Simulation

We implemented the proposed Enhanced EDEXMAC (Enhanced Distributed Exclusive Region Based MAC) protocol using NS2 simulations. The protocol supports exclusive region based optimization of communication to provide fair and efficient sharing of resources of UWB channels in the presence of fast fading and shadowing conditions. The environment used for the empirical study is shown in Table 1 and Table 2 shows performance metrics used to evaluate the results of our work.

Table 1: Simulation Environment

S.No	Parameter Type	Parameter Value
1	Channel type	Channel/Wireless Channel
2	Radio-propagation model	Propagation/Shadowing
3	Antenna type	Antenna/Omni Antenna
4	Link layer type	LL
5	Interface queue type	Drop Tail
6	Network interface type	Phy/WirelessPhy
7	MAC type	Mac/802_11
8	Routing Protocol	EDEXMAC
9	Number of Mobile Nodes	30
10	Network Area	600 x 600
11	Interface Queue Size	50
12	Shadow Model Range	150

As shown in Table 1, the environment used for empirical study through NS2 simulations is presented.

7. Performance Metrics

Table 2: Performance Metrics

Metric	Description
Packet Delivery Ratio (PDR)	It is the performance measure used to know the ratio between number of packets received and the number of packets sent.
Throughput	The rate of messages transferred successfully in network.
Average Delay	The time difference between packets received

	and packet sent.
Energy Consumption	It is the measure used to know how much energy is consumed by the network in data transmission, sensing, data processing and idle sleep state.
Packet Drop	It is the number of packets dropped by the protocol for any reason
Communication Overhead	It is the cost of communication while the proposed scheme is operating.

The performance metrics presented in Table2 are used to evaluate our work. The results are observed in terms of these measures with mathematical Analysis.

Table 3: Delay Performance Comparison

Sim Time	DELAY TIME		
	Enhanced EDEXMAC	EDEXMAC	DEXRSSMAC
0	0	0	0
2.5	0	0	0
5	0.005706327	0.03	0.047
7.5	0.004281541	0.03	0.047
10	0.003806917	0.03	0.047
12.5	0.003569308	0.03	0.047
15	0.003426943	0.02	0.047
17.5	0.00333195	0.02	0.047
20	0.003264172	0.018	0.026
22.5	0.003213291	0.017	0.022

The above Table.3 refers to it obvious that the delay performance of Enhanced DEXRSSMAC is compared with EDEXMAC and DEXRSSMAC protocols. The proposed Enhanced DEXRSSMAC protocol shows less delay as it is optimized with exclusive region in the presence of fast fading and shadowing in UWB channels the experimental search in the above Received Time at Destination Node is 1.526374674 and Sent Time at Source Node 1.523852013therefore the Delay time is 0.002522661.

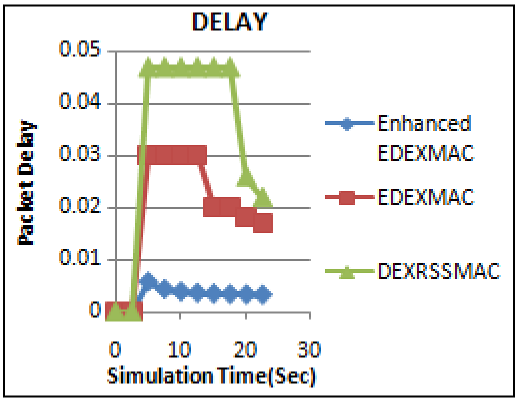

Figure 2: Delay Performance Comparison

As shown in Figure2, it is evident that the proposed protocol shows reduction in delay as simulation time increases. Its performance is better than that of EDEXMAC but DEXRSSMAC is not optimized in the presence of fast fading and shadowing with respect to UWB channels. This can be proved experimentally and theoretically. Table.4: PDR Performance Comparison

Table 4: Packet delivery ratio Comparison

Sim Time	Enhanced EDEXMAC	EDEXMAC	DLBOP	EEDRP	DEXRSSMAC
0	0	0	0	0	0
2.5	0	0	0	0	0
5	0.62	0	0	0	0
7.5	1.25	0.25	0	0	0
10	1.87	0.35	0.18	0.25	0.3
12.5	2.5	0.35	0.19	0.23	0.29
15	3.12	0.35	0.2	0.2	0.28
17.5	3.75	0.36	0.15	0.25	0.32
20	4.37	0.39	0.12	0.27	0.37
22.5	5	0.42	0.12	0.27	0.38

The above Table.4 refers to Packet delivery ratio. The results are experiential at different simulation times. The results of our protocol named Enhanced EDEXMAC are comparing with existing protocols such as DLBOP, EEDRP, DEXRSSMAC, and EDEXMAC. The results discovered that PDR is increased as simulation time increased. When compared with other protocols, Enhanced EDEXMAC showed higher packet delivery ratio. The justification behind this is that it exploits exclusive region in UWB channels for fair and efficient sharing of resources in the presence of fast fading and shadowing. From the above said experimental search total no. Of packet send at Node 4 is 3and total no. Of packets received at node 10 is 3 therefore the packet delivery ratio is 100%.

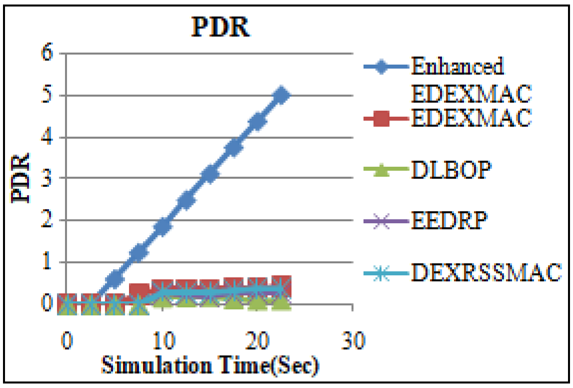

Figure 3: PDR Performance Comparison

The packet delivery ratio, as shown in Figure3, is more with Enhanced EDEXMAC which is the protocol proposed and implemented in this paper. Its performance is better than all other protocols Enhanced EDEXMAC performs better than EDEXMAC, DEXRSSMAC, EEDRP and DLBOP. EDEXMAC, DEXRSSMAC, EEDRP is better than DLBOP in terms of packet delivery ratio. The trend in the results observed is that PDR increases as simulation time increases.

Table 5: Packet Drop Comparison

Sim Time	Enhanced EDEXMAC	EDEXMAC	DLBOP	EEDRP	DEXRSSMAC
0	0	0	0	0	0
2.5	0	0	0	0	0
5	0	0	0	0	0
7.5	100	0	1500	350	270
10	160	100	2000	500	300
12.5	145	750	2700	1200	800
15	140	1000	3800	1500	1300
17.5	135	1200	4100	1700	1450
20	140	1500	5800	2000	1700
22.5	126	1600	5800	2100	1700

Packet drop is observed in the simulations and presented in Table 5. The results revealed that the packet drop is more as simulation time increases. Another observation is that Enhanced EDEXMAC shows less packet drop issue when compared with all other protocols. After this, Enhanced DEXMAC shows better performance when compared with EDEXMAC, DEXRSSMAC, DLBOP and EEDRP. The simulation results compared with theoretical is that with 0.03 milliseconds 2 packets were dropped.

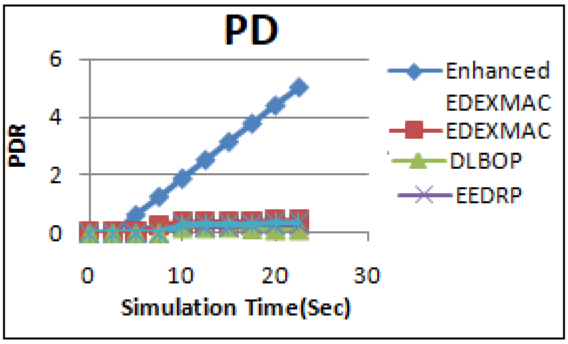

Figure 4: Packet Drop Comparison

Packet drop, as shown in Figure4, is least when proposed protocol Enhanced EDEXMAC is used. Its performance is comparable with other protocols such as EDEXMAC, DEXRSSMAC, EEDRP and DLBOP. The other protocols show increase in packet drop. DLBOP exhibits highest packet drop behavior. Therefore the proposed protocol is performing better in terms of packet drop.

Table 6: Energy Consumption

Sim Time	Enhanced EDEXMAC	EDEXMAC	DLBOP	EEDRP	DEXRSSMAC
0	100	100	100	100	100
2.5	95.72	97.58	95.54	92.85	90.12
5	92.24	96.45	95.45	92.52	90.85
7.5	80.86	90.47	95.87	92.45	90.89
10	76.57	85.89	92.65	92.74	90.47
12.5	72.96	80.57	90.45	90.65	86.25
15	59.34	71.58	89.58	90.12	85.78
17.5	55.79	69.15	88.63	90.21	83.5
20	52.46	68.89	88.87	89.25	80.6
22.5	45.48	65.87	86.81	89.54	75.36

Energy Consumption shown in Table.6 of different protocols is presented. The proposed protocol Enhanced EDEXMAC shows highest performance. It consumes less energy source when compared with other protocols such as EDEXMAC, DEXRSSMAC, EEDRP and DLBOP. As the simulation time increases the residual energy is reduced. However, the proposed protocol outperforms other protocols. The simulation results compared with mathematical analysis Node 1 used 20 Joules, Node 2 used 10 Joules, Node 6 Used 15 joules therefore Total Energy Consumption is 45 Joules.

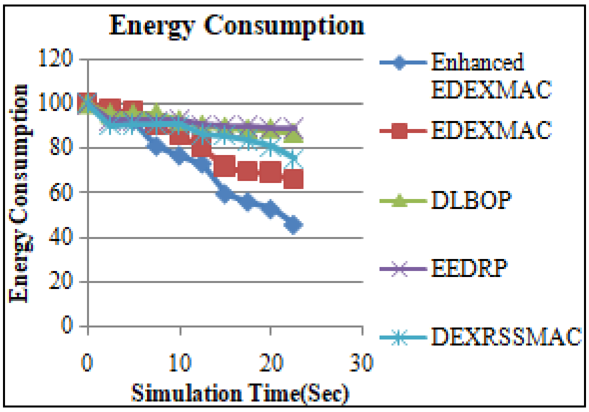

Figure 5: Energy Consumption

As shown in Figure5 , it is evident that the Enhanced EDEXMAC shows highest performance. The least performance is exhibited by DLBOP. The other protocols such as EDEXMAC, EEDRP and DEXRSSMAC show more energy consumption when compared with Enhanced EDEXMAC. The energy is measured in joules and presented in vertical axis while the simulation time in seconds is presented in horizontal axis.

Table 7: Throughput Performance Comparison

Sim Time	Throughput		
	Enhanced EDEXMAC	EDXMAC	DEXRSSMAC
0	0	0	0
2.5	0	0	0
5	212800	0	42560
7.5	212800	0	42560
10	212800	55328	42560
12.5	212800	55328	42560
15	212800	52560	42560
17.5	212800	52561	42560
20	212800	54048	42560
22.5	212800	54048	42560

The throughput performance, as shown in Table7, is observed. The results revealed that the performance of Enhanced EDEXMAC is significantly better than that of EDEXMAC, these can be as counterpart that is optimized for fast fading and shadowing conditions in UWB channels .where as for the same reason the proposed protocol shows better performance over DEXRSSMAC. The simulation results might be finalize that Received Packets at Node 4 is 3 and its packet Size 532 where as at Received Packets at Node 10 is 3 its packet Size512 their throughput is 3132 bytes per 0.03 millisecond.

As shown in Figure6, the number of bytes of data transmitted is presented in vertical axis while the horizontal axis shows simulation time in seconds. The results discovered that the throughput of the proposed protocol is significantly better than that of the existing ones named DEXRSSMAC and EDEXMAC.

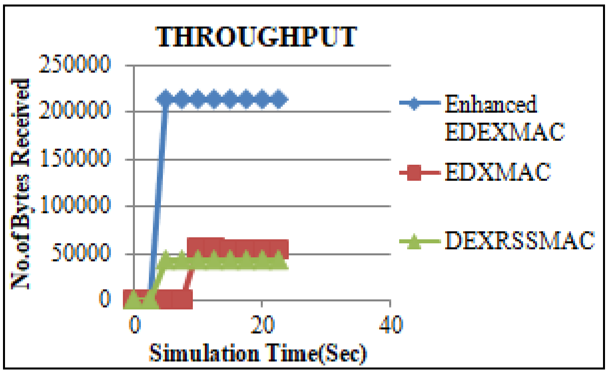

Figure 6: Throughput Performance Comparison

Table 8: Communication Overhead Comparison

Sim Time	Enhanced EDEXMAC	EDEXMAC	DLBOP	EEDRP	DEXRSSMAC
0	0	0	0	0	0
2.5	0	0	0	0	0
5	0	0	0	0	0
7.5	0	0	100	200	100
10	50	50	1200	200	100
12.5	120	220	1350	360	350
15	170	300	1500	500	400
17.5	200	445	1750	750	505
20	210	500	2200	800	600
22.5	210	600	2800	800	700

From the above Table.8, it is evident that the proposed protocol is able to decrease communication overhead notably as there is exclusive region that can get optimized in the presence of fast fading and shadowing with respect to UWB channels. The Enhanced EDEXMAC protocol outperforms other protocols with respect to communication overhead. The smallest amount performance is shown by DLBOP while the EDEXMAC shows superior performance when compared with its predecessors such as DEXRSSMAC, EEDRP and DLBOP. The simulation results conclude that Processing Time of 31St packet is 1.810000000(Processing Start Time) and 1.815957134 (Processing End Time) therefore the communication Overhead conclude that 0.005957134

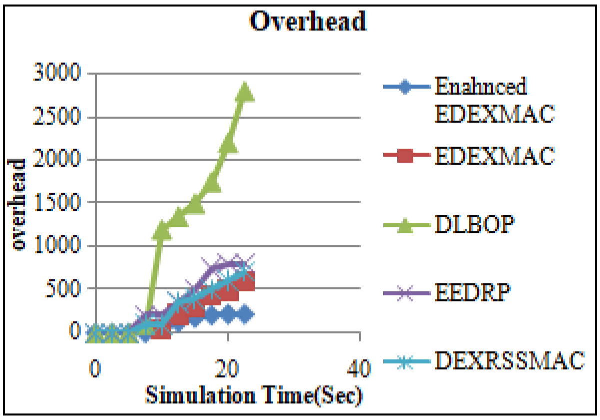

Figure 7: Communication Overhead Comparison

As shown in Figure 7, the communication overhead of different protocols is presented. The results reveal that the proposed scheme named Enhanced EDEXMAC shows better performance than EDEXMAC and DEXRSSMAC Protocols where as outer performance than EEDRP and DLBOP protocols.

8. Conclusions and Future Work

In this paper we studied UWB channels for finding exclusive region for improving performance with fair and efficient communication between two parties in the presence of conditions such as fast fading and shadowing. We enhanced the recent protocol named Distributed Exclusive Region (DEX) Based MAC Protocol proposed by Cai et al. Our protocol is named as Enhanced EDEXMAC protocol. This protocol has emergency plans for overcoming issues of fast fading and shadowing. It has got optimizations to handle UWB channel conditions such as fast fading and shadowing. We implemented the proposed Enhanced EDEXMAC using NS2. Our simulation results are compared with other existing DEX based MAC protocols. The results revealed that Enhanced EDEXMAC shows significant performance improvement with other protocols such as EDEXMAC, DEXRSSMAC, EEDRP, and DLBOP. This research can be extended further to investigate DEX optimizations in the real world UWB channels to evaluate their efficiency.

References

[1] M. Z.Win and R. A. Scholtz, “Impulse radio: How it works,” *IEEE Communication Letters* **2**, pp. 10–12, Jan. 1998.

[2] J. Foerster, E. Green, S. Somayazulu, and D. Leeper, “Ultra-wideband technology for short- and medium-rangewireless communications,” *Intel Technical Journal* , May 2001. http://developer.intel.com/technology/itj/.

[3] J. Reed, R. M. Buerhrer and D. Mckinstry. Introduction to UWB: Impulse Radio for Radar andWireless Communications. GM Briefing, August 2002.

[4] Y. M. Kim. Ultra Wide Band Technology and Applications. Nest Group , July 2003

[5] Robert J. Fontana. Recent Applications of Ultra Wide Band Radar and Communication systems. In*EuroEM*, May 2000.

[6] T. Murata,(1989), “Petri nets properties analysis and applications”, proceeding of ieee vol 77.

[7] M.Heni, R. Bouallegue, (2012),“Power Control in reactive routing protocol for mobile ad hoc network”, International Journal of Wireless & Mobile Networks (IJWMN).

[8] C. Alippi, G. Anastasi, M. Di Francesco, and M. Roveri, “Energy management in wireless sensor networks with energy-hungry sensors,” *IEEE Instrumentation and Measurement Magazine*, vol. 12, no. 2, pp. 16–23, 2009.

[9] X. An and K. Kwak, \An energy-efficient routing scheme for UWB sensor networks", in *Proc. Asia-Paci_c Conf. Commun. APCC 2006*,Busan, South Korea, 2006, pp. 1{5.

[10] Khan, I., P. S. Hall, A. A. Serra, A. R. Guraliuc, and P. Nepa, Diversity performance analysis for on-body communication channels at 2.45 GHz," *IEEE Transactions on Antennas and Propagation*, Vol. 57, No. 4, 956{963, Apr. 2009.

[11] Serra, A. A., P. Nepa, G. Manara, and P. Hall, \Diversity measurements for on-body communication systems," *IEEE Antennas and Wireless Propagation Letters*, Vol. 6, No. 1, 361{363, Jan. 2007.

[12] Cotton, L. and G. Scanlon, \Characterization and modeling of on body spatial diversity within indoor environments at 868 MHz," *IEEE Transactions on Wireless Communications*, Vol. 8, No. 1, 176-185, Jan. 2009.

[13] J. Keignart, N. Daniele, and B. Denis, "Impact of NLOS propagation upon ranging precision in UWB systems," in *Proc. IEEE Conf. Ultra Wideband Syst. Technol.*, Nov. 2003, pp. 379–383.

[14] J.-Y. Lee and R. A. Scholtz, "Ranging in a dense multipath environment using an UWB radio link," *IEEE J. Sel. Areas Commun.*, vol. 20,no. 9, pp. 1677–1683, Dec, 2002.

[15] J. Zhang, R. A. Kennedy, and T. D. Abhayapala, "Cramér–Rao lower bounds for the synchronization of UWB signals," *Eurasip J. Appl.Signal Process.*, vol. 2005, no. 3, pp. 426–438, Mar. 2005.

[16] S. Gezici, Z. Tian, G. V. Giannakis, H. Kobaysahi, A. F. Molisch, H. V. Poor, and Z. Sahinoglu, "Localization via ultra-wideband radios,"*IEEE Signal Process. Mag.*, vol. 22, no. 4, pp. 70–84, Jul. 2005.

[17] Lin X. Cai, Lin Cai, Member, IEEE, Xuemin (Sherman) Shen, Fellow, IEEE, Jon W. Mark, Life Fellow, IEEE, and Qian Zhang, Senior Member, IEEE, "MAC Protocol Design and Optimization for Multi-Hop Ultra-Wideband Networks," IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS. 8 (8), p1-10, 2009.

[18] Y V Adi Satyanarayana,K Padma Raju and P V Naganjaneyulu, "Energy Efficient Directional Routing Protocol for UWB MANET," International Journal of Computer Networks And Security. 25 p1-8, 2015.

[19] Y V ADISATYANARAYANA , K PADMARAJU & P V NAGANJANEYULU, "A MAC PROTOCOL FOR UWB HETEROGENEOUS MOBILE AD HOC NETWORKS BASED ON ER BY USING DIRECTIONAL ANTENNA," International Journal of Computer Networking, Wireless and Mobile Communications. 4 (4), p1-16, 2014.

[20] Y.V. Adi Satyanarayana, K.Padma Raju and P.V.Naganjaneyulu, "Resource Allocation for Multi-user Multi-Traffic Class in UWB MANET," International Journal of Computer Science and Engineering, 4(9), p1-6, 2016.

[21] Y.V. Adi Satyanarayana,K.Padma Raju and P.V.Naganjaneyulu, "DEXRSSMAC: Received Signal Strength for Optimization of Distributed Exclusive Region Based MAC Protocol," International Journal of Advances in Electronics, Computers and Information Technology (IJAECIT). Vol 1, Issue 1, February 2017

[22] Y.V. Adi Satyanarayana,K.Padma Raju and P.V.Naganjaneyulu, " Enhanced Distributed Exclusive Region Based MAC Protocol for UWB Channels with Fast Fading and Shadowing" Communicated to Asian journal of information Technology.

[23] Alfonso Bahillo, Patricia Fernández, Javier Prieto, Santiago Mazuelas, Rubén M. Lorenzo and Evaristo J. Abril *University of ValladolidSpain* "Distance Estimation based on 802.11 RTS/CTS Mechanism for Indoor Localization'' Advances in Vehicular Networking Technologies