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Energy Efficiency in IEEE 802.11 standard WLAN through MWTPP

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Abstract**:** *The main goal of this work is to achieve the energy efficiency in 802.11 WLAN through minimizing the energy consumption in the network. In this proposed study, we introduced a modification in PCF for enhancing the performance of WLAN and it is achieved by giving a new definition for the PCF function of transmission. Generally, in PCF the way AP transmits for the various nodes is one-way during the process of polling. The proposed function modification for PCF enhances the IEEE 802.11 standard PCF Multi-Way Transmission PCF Protocol (MWTPP) with an improved version MWTPP it gives a low-complexity mechanism by which the active and non-active stations in the BSS save energy during the process of polling. With the inception of MWTPP transmissions are taken place in multi-way the access to the WLAN channel for mobile nodes in the list generated for polling with the SIFS interval whenever the transmission in receiving data packet from AP.*

Keywords: MWTPP (Multi-Way transmission PCF Protocol), WLAN(Wireless LAN), PCF(Point Coordination Function),

I. INTRODUCTION

The main goal of this work is to achieve the energy efficiency in 802.11 WLAN through minimizing the energy consumption in the network. In this proposed study, we introduced a modification in PCF for enhancing the performance of WLAN and it is achieved by giving a new definition for the PCF function of transmission. Generally, in PCF the way AP transmits for the various nodes is one-way during the process of polling. The proposed function modification for PCF enhances the IEEE 802.11 standard PCF **M**ulti-**W**ay **T**ransmission **P**CF **P**rotocol (MWTPP) with an improved version MWTPP it gives a low-complexity mechanism by which the active and non-active stations in the BSS save energy during the process of polling. With the inception of MWTPP transmissions are taken place in multi-way the access to the WLAN channel for mobile nodes in the list generated for polling with the SIFS interval whenever the transmission in receiving data packet from AP.

II. METHODOLOGY

The proposed function modification for PCF enhances the IEEE 802.11 standard PCF **M**ulti-**W**ay **T**ransmission **P**CF **P**rotocol (MWTPP) with an improved version MWTPP it gives a low-complexity mechanism by which the active and non-active stations in the BSS save energy during the process of polling. With the inception of MWTPP transmissions are taken place in multi-way the access to the WLAN channel for mobile nodes in the list generated for polling with the SIFS interval whenever the transmission in receiving data packet from AP. The polled mobile nodes or stations can send ACK after the receiving the data packet, by sending a data packet of equal duration of the downlink data packet to the AP. When the mobile nodes listed in the poll do not have data to transmit, it sends only ACK for the data packet or replies with NULL packet irrespective of the AP sends a polled packet because there is no data for the nodes or station. Therefore, the polling operating cost can be minimized when the AP has downlink data for the mobile nodes in the polling list, thus enhancing the utilization of channel. Since the interval of uplink transmissions is fixed by the interval of downlink transmissions, the transmission time of stations in the polling list can be known in advance, from the data packets buffered for these stations at the AP. Thus, the AP can appropriately resolve the interval of a CFP interval to allow an uplink transmission for each station in the polling list. However, not all the mobile nodes in the polling list might have a data packet to transmit. The mobile nodes proposing to leave the polling list because of no more data to send might fail to re-associate with CP. Since DCF is a contention-based protocol, the stations have to compete with all other mobile stations in the same confined area for channel access, and might need several CPs to send the frames of all the nodes caused by the re-association. This phase might degrade the performance of the modified PCF incorporating MWTPP. As a solution to this problem, one bit can be taken from the MAC header of the data frame used in CFP, to inform about having more data to transmit. Once an admitted station has no more data to send, it should set the more data bit to 0 in the MAC header of the last data packet. With this information, the AP will remove that station from the polling list, in an easy and quick manner, without performing a reassociation in CP. When the AP has no data to transmit to a given station in the polling list, it sends a poll packet to which the station can reply with a data packet of an arbitrary length (up to a maximum of 2312 bytes). This might have a negative effect on the performance of other stations in the polling list. To solve this limitation, the AP can maintain the information related to the duration of the last downlink data packet sent to each station in the polling list, with a record. Likewise, each station can have knowledge of the duration of the last uplink data packet transmitted to the AP. When a station receives a poll packet without a data packet, it will send an uplink data packet of equal duration of the last uplink data packet. Hence, the AP can estimate a proper duration of a CFP interval, based on own information on downlink packets and the polling list. Some underperformance of modified PCF with multi-way transmissions might also occur if a station has an uplink packet of shorter duration of the downlink packet, since the duration of the uplink packet must be fixed by the downlink packet to determine a proper CFP duration. This issue can be faced by adding a sequence of zero bits (fill bits) at the end of the uplink packet to match the size of the downlink packet. Although the channel utilization can be minimally affected with the fill bits, all the previous modifications of PCF can provide a precise estimation of the next CFP, which can be used by the AP to enable energy saving for admitted stations in the polling list. After estimating the CFP interval, the AP updates the CFP- Max-Duration field. All stations update their NAVs with CFP-Max-Duration when the beacon is transmitted. During the polling process, each pollable station then monitors the time elapsed from the transmission of the beacon until receiving the ACK of its uplink data packet and immediately after returns to the doze state until the end of the CFP interval. With the CFP-Max-Duration and the time elapsed to receive ACK, the station can calculate the sleep period and set its wake-up timer to the beginning of CP. In the presence of channel errors or collisions, the AP will wait for PIFS and send a data packet to the next station in the polling list. Under this scenario, the stations with bad channel conditions might stay awake for the entire CFP, hence consuming extra energy. In addition, the duration of the CFP interval will be changed. Thus, PS stations will remain longer in the doze state, and awake when CP is already initiated. To prevent potential instability issues, the AP will not announce a new CFP interval until the CFP-Max-Duration has expired, thus allowing PS station to wake up and follow the next CFP repetition interval. In addition, station-to-station communications (via the AP) involving PS stations will be frozen during that CP interval, and the data packets will be buffered at the AP until CFP-Max-Duration expires.n easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

III. ANALYSIS

TABLE1: END-TO-END DELAY

Time	E2E Delay in CLP(with 100 nodes)	E2E Delay in NBEP(with 100 nodes)
0.0	0	0
0.5	0.02	0.01
0.8	0.06	0.03
0.85	0.09	0.04
0.9	0.16	0.07
1.0	0.25	0.08
1.2	0.29	0.099
1.4	0.33	0.109
1.6	0.38	0.12
1.8	0.41	0.13
2.0	0.46	0.15

TABLE 2: PACKET DELIVERY RATIO

Time	PDR in CLP(with 100 nodes)	PDR in NBEP(with 100 nodes)
0.0	0	0
0.5	27	45
0.8	58	84
0.85	79	105
0.9	96	135
1.0	155	175
1.2	160	210
1.6	178	230
1.9	188	244
2.2	202	261

Figure-1:Graph of End-to-End Delay

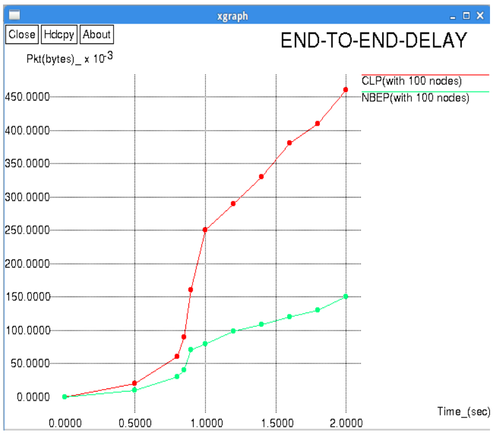


Figure-2:Graph of Packet Delivery Ratio

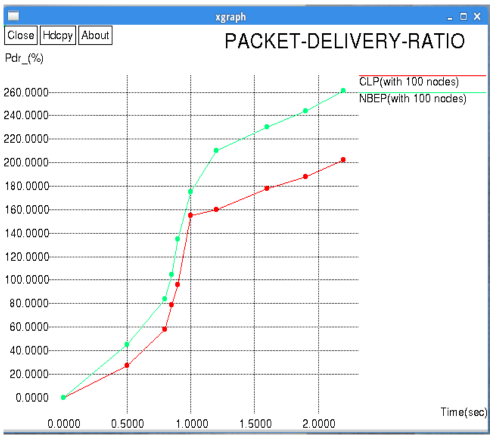


TABLE 3: PACKET LOST

Time	Packet lost in CLP (with 100 nodes)	Packet lost in NBEP (with 100 nodes)
0	0	0
5	1	1
10	1.16	1.01
15	1.6	1.3
20	1.9	1.5
25	2.2	1.7
30	2.8	1.91
35	3.1	2.01
40	3.3	2.03
45	3.7	2.2
50	4.0	2.33

TABLE4: ENERGY SPENDIN/CONSERVATIO

Time	Energy Spent in CLP (with 100 nodes)	Energy Spent in NBEP (with 100 nodes)
0	1000	1000
25	952	992
50	895	923
75	812	876
100	715	815
150	612	762
200	512	727
250	490	687
300	471	652
350	458	618
400	431	578

Figure-3:Graph of Packet lost

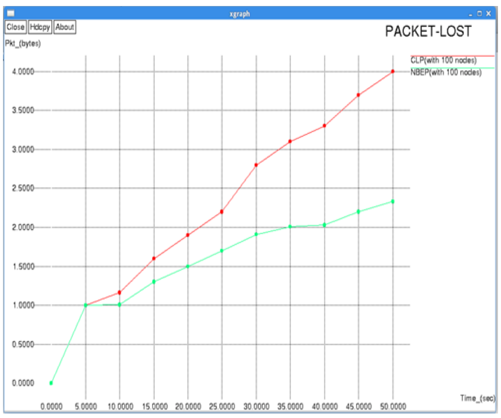


Figure-4:Graph of Energy Consumption

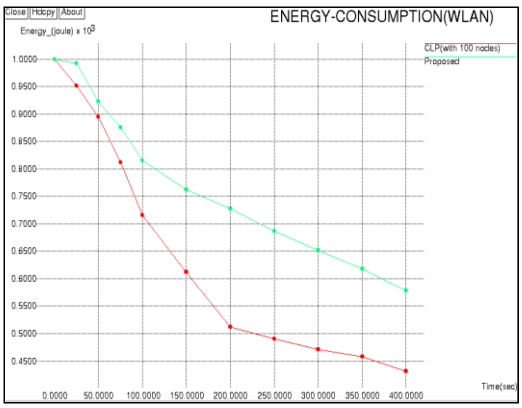
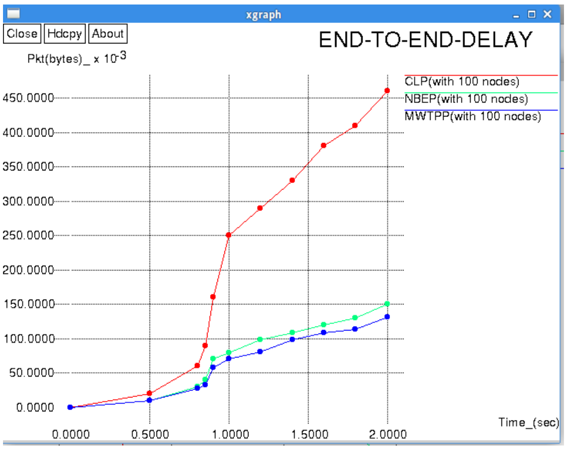


TABLE-5
SUMMARY OF ENERGY CONSERVATION & ENERGY SPENDING (WITH 100 NODES)

Time	Energy Conserved (Existing System)	Energy Conserved (Proposed System)	Energy Spent in Existing system	Energy spent in proposed system	Energy spending (in %) Proposed	Energy spending (in %) Existing
0	1000	1000	0	0	0	0
25	952	992	48	8	0.8	4.8
50	895	923	105	77	7.7	10.5
75	812	876	188	124	12.4	18.8
100	715	815	285	185	18.5	28.5
150	612	762	388	238	23.8	38.8
200	512	727	488	273	27.3	48.8
250	490	687	510	313	31.3	51.0
300	471	652	529	348	34.8	52.9
350	458	618	542	392	39.2	54.2
400	431	578	569	422	42.2	56.9

When the MWTPP is again tested with the same test bed the results we got to evaluate the performance of the WLAN are shown in the following graphical results. All the performance metrics are shown satisfactory improvement over the CLP and also our earlier NBEP-model[1].

FIGURE-5
GRAPHICAL ANALYSIS OF MWTPP WITH CLP & NBEP



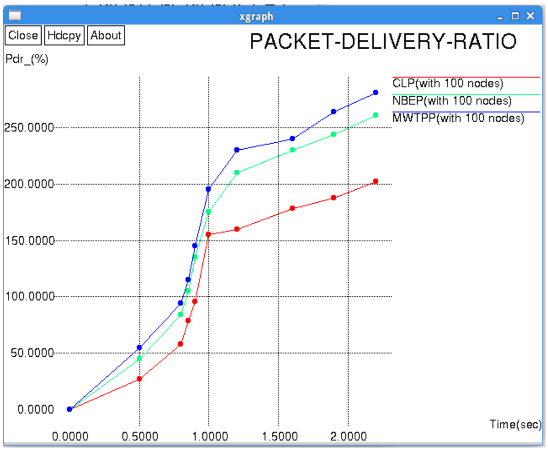
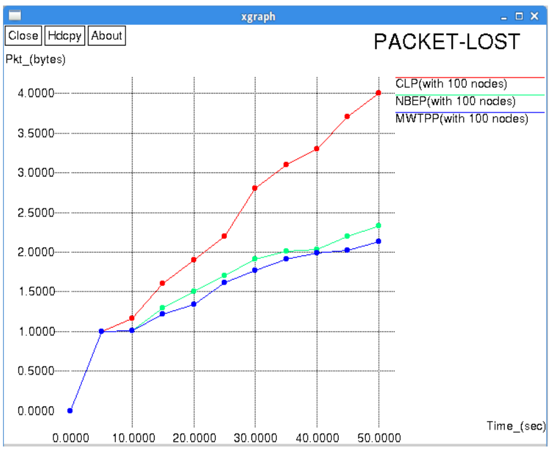


Figure-5: End-to-End Delay **Figure-6 Packet Delivery Ratio**



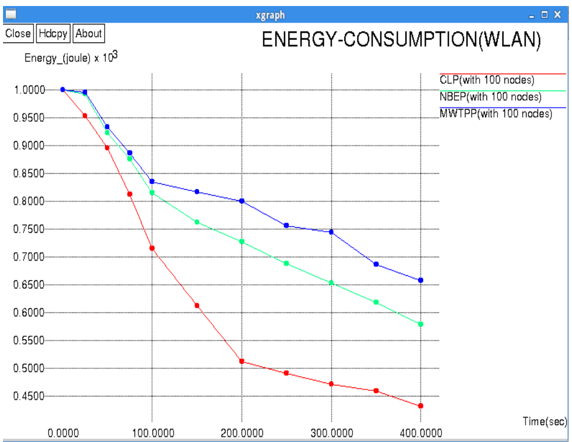


Figure-7: Packet Lost **Figure-8:Energy Consumption**

IV. CONCLUSION

In the above discussion, Energy Conservation has been analyzed with the help of the graph generated by the ns2 and thus get conclusive figures of energy spending in percentage. In the graph it is seen at the very outset of the time interval the energy in both the systems, i.e. in the existing and proposed is considered as 1000 joule. The result indicates the betterment of the system with the help of the proposed model over the existing system. After 25 sec the energy conserved in existing system is 992 joule as compared to 952 joule in the existing system. In percentage the 0.8% energy spending is in the proposed system and 4.8% energy spending in the existing system. Hence very less amount of energy is spent in the proposed system as compared to the existing system. After 50 sec the energy conserved in existing system is 923 joule as compared to 895 joule in the existing system. In percentage the 7.7% energy spending is in the proposed system and 10.5% energy spending in the existing system. Hence very less amount of energy is spent in the proposed system as compared to the existing system. After 75 sec the energy conserved in existing system is 876 joule as compared to 812 joule in the existing system. In percentage the 12.4% energy spending is in the proposed system and 18.8% energy spending in the existing system. Here is also a significant less amount of energy is spent in the proposed system as compared to the existing system. After 100 sec the energy conserved in existing system is 815 joule as compared to 715 joule in the existing system. In percentage the 18.5% energy spending is in the proposed system and 28.5% energy spending in the existing system. At this stage also a less amount of energy is spent in the proposed system as compared to the existing system. After 150 sec the energy conserved in existing system is 762 joule as compared to 612 joule in the existing system. In percentage the 23.8% energy spending is in the proposed system and 38.8% energy spending in the existing system. Hence very less amount of energy is spent in the proposed system as compared to the existing system. Finally, after time period, 200 seconds, the energy conserved in existing system is 727 joule as compared to 512 joule in the existing system. In percentage the 27.3% energy spending is in the proposed system and 48.8% energy spending in the existing system. Hence very less amount of energy is spent in the proposed system as compared to the existing system.

After increasing the network size, i.e. instead of 50 nodes we used 100 nodes and again analysed the graphs generated by NS2. It is significantly shown the better results in NBEP with MWTPP model as compared to CLP.

We further implemented the NBEP with a new approach and named the model as MWTPP and the results we got are fairly improved. The analytical graphs are shown in figures-5 to figure-8. In all the graphs the QoS performance metrics of WLAN are shown better results as compared to CLP and as well as our earlier model NBEP.

ACKNOWLEDGMENT

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