Reliable Data Transmission Using Improved Packet Retransmission Timeout Calculation For Wireless Sensor Network

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***Abstract*— Congestion in network due to heavy traffic of data is major problem in wireless sensor networks now days. Large are wireless sensor networks, which consists of more than 1000 nodes in network should be reliable, because missing a single packet of information can cause a big event. On the other hand time saving is other issue. Sender can't transmit other important information until it gets acknowledgement of previous packet. In this time gap, receiver will be unaware if any event occurs. This paper presents a mechanism to save time and utilize the time gap, so that it can't miss any event information. The improved mechanism has been included in TCP NewReno. The implementation of proposed technique is done in Qualnet 5.0. Results are described in result section.**

***Keywords*— wireless network; TCP timeout; TCP NewReno TCP variants.**

I. INTRODUCTION

Wireless sensor networks [1] can be described in terms of thousands of small devices responsible of computation, communication and sensing. These small devices are called MOTE [2]. The MOTEs are deployable in real time application to protect large area. Figure 1 shows a wireless sensor network, dashed lines shows wireless links between nodes. The sensor attached with the MOTE senses the environmental signals, processor/microcontroller perform computing to identify the events. The communication devices are transceivers which receive and transmit event information to the base station through multihoping [3].

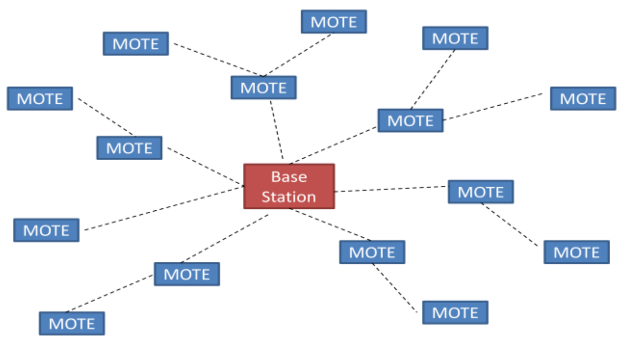


Figure 1: Wireless Sensor Network Architecture

The packets of event information transmitted in network required certain protocols to reach the destination. There are several routing protocols exists for WSN. Static routing [4] is preferable in the case of multihop transmission.

The other required protocol is MAC [5] protocol. Energy of MOTE to sense and transmit the information in WSN is a major issue. Various protocols are exists for MAC, but till now not any MAC protocol is suitable for WSN. Still development and research are going on. Other than energy saving protocol, few media access protocol with collision detection and avoidance are used for WSN.

After MAC protocol, the most important protocol is TCP [6], which is required for reliable packet transmission. The successful packet transmission to the base station is very essential. Any serious event can take place, if packet transmission fails. In WSN packet loss occurs due to weather conditions, obstacles, multipath interferences, signal attenuation and fading. There are many nodes which can transmit event information at the same time. It may cause congestion in network. There are various variants have been proposed to reduce congestion effects, TCP Tahoe [7,8,9], TCP Reno [8], TCP Reno with Selective Acknowledgement (SACK) [7,8], TCP NewReno [10, 11], TCP Westwood [11] TCP Vegas [12], and TCP FACK [13] are examples of proposed end-to-end solutions. They are all proposed to improve network performance.

This paper presents an improved retransmission time out condition in TCP New Reno. The mechanism adapts the value of retransmission time to retransmit the unacknowledged packet and calculate new retransmission time-Out value. The detail descriptions are given in the following sections.

There are various researches going on to reduce effect of congestion and to make reliable communication by implementing transmission control protocol. Few of the research are as follows.

H. Kumar et. al. [14] has proposed a congestion control mechanism for MANET. In proposed technique the particular channel, queue length of packet, traffic rate based overall congestion standard, packet loss rate and packet dropping ratio are calculated to monitor the congestion status in network. According to congestion status, a routing protocol has been developed. The proposed routing protocol with conventional TCP has been implemented and compared by author. As results shows proposed technique is better.

N Sharma et. al. [15] has implemented various parameters to identify the non-congestion losses of TCP in MANET. Author has implemented parameters in NS-3 simulator, simulate the communication and then observe the performance of MANET in different scenarios.

Yuwono et. al. [16] compared two TCP congestion control algorithms. The algorithms are Cubic TCP and Yeah TCP by using BATMAND in several static and mobile node scenarios. Author has investigated the performance of both TCP variants by changing in slow start window. According to the results Yeah TCP has better performance due to its capability to anticipate loss events on MANET.

Chien-Chia Chen et.al. [17] has proposed a network coded multipath scheme based on random linear coding scheme with adjustable redundancy, multipath routing, and ACK Piggy coding. Simulation result shows the proposed method is efficient in 3-hop static scenario.

Above literatures shows new path to develop new mechanism to reduce congestion effects in network. The following sections will present the implementation of proposed mechanism.

Organization of paper: section II presents the proposed mechanism, section III describes the simulation of network, and section IV presents results of simulation.

II. Proposed Mechanism

The data transmission in network uses TCP protocol for reliable transmission, because receiver sends acknowledgement for each packet. But in this case sender has to wait until it gets acknowledgement. Sender has no option to send packet even it has to send any important information.

TCP start a timeout timer when it transmit a packet, and wait for acknowledgement. If acknowledgement of packet lost in the network, TCP retransmits the packet and double the timeout timer. Reliability of packet transmission, costing enough time waste during communication. The enhance mechanism for data transmission calculates retransmission timeout, so that it can reduce time wastage during retransmission of packets.

The enhanced mechanism for data transmission is as follows.

A. Initial Window

The initial sending window is calculated by following formula:

*Iw= min (4 * SMSS , Max (2 * SMSS , 4380 byte));*

B. Slow-Start Algorithm

The slow start algorithm is used to start a connection and the periods after the value of retransmission timer exceed the RTO (retransmission timeout). The size of cwnd will be initialized to 1.

The slow start algorithm describes as below:

if (Receive ACKs && cwnd < ssthresh)

{

cwnd = cwnd++;

}

C. Congestion Avoidance Algorithm

The congestion avoidance algorithm describes as below:

if (Receive ACKs || (Receive Explicit Packet Loss

Notification))

{

if (cwnd > ssthresh)

cwnd = 1+1/cwnd

else

cwnd++;

}

D. Fast Retransmission and fast Recovery

if (Congestion || Heavy Packet)

{

if (Receive Same ACK 3 Times || Retransmission

Timer Overtime) / Congestion */*

{

*Ssthresh = max(flightsize/2 , 2*SMSS);*

// Flightsize are those data which have no acknowledged.

if (Retransmission Timer Overtime)

{

cwnd = 1; Exit and call slow-start;}

else / Receive Same ACK 3 Time */*

$RTT_{new} = (1- t1)\, RTT_{old} + t1.\, RTT$

Where, $t1 = 1/8$

$RTO = RTT + 6.\, RTT_{new}$

$Re\_trans_{new} = 1 + (rtt - min\ rtt) / (max\_ rtt - min\_ rtt)$

$Reset\_RTO = Retrans_{new} * RTO_{old}$

cwnd = ssthresh;

}

}

III. Computer Simulation

The implementation and simulation has been done in QualNet 5.0 [18] network simulator. The scenario for experimentation is as follows:

- *Mobility model Random Way Point*

  Speed of nodes 30 mps

  Pause time 5s, 10s, 15s, 20s, 25s, 30s.

  Simulation Time 200s

- *Terrain:* Coordination 1500 * 1500 m
- *Connection:* FTP (File transfer protocol): client to server

  Item size 512(byte)
- *Radio/physical layer parameters:*

  Radio type: 802.11b Radio

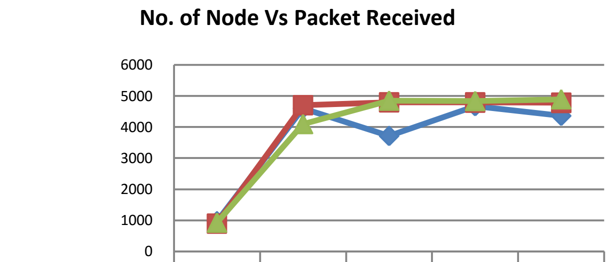
  Data rate: 2Mbps

  Packet reception model: Bit error rate (bpsk.ber)
- *MAC Protocol:* 802.11
- *Routing Protocol:* DSR
- *Transport Protocol:* TCP Variants
- *No. of Node:* 10, 20, 30, 40, 50
- *Node Placement:* Random

Performance metrics used for this work are throughput, signal received with error, bytes received and packet loss.

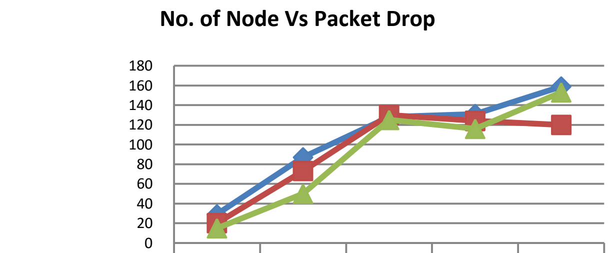
IV. RESULTS

Following graphs shows the output of simulation after implementation of proposed protocol. The result of ATTCP (Adaptive Timer TCP) is compared with result of TCP New RENO and TCP TAHOE.



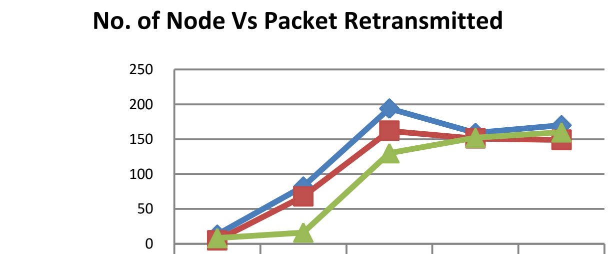
	10	20	30	40	50
TCP Tahoe	965	4606	3715	4676	4365
TCP New Reno	900	4703	4794	4790	4780
ATTCP	925	4098	4851	4839	4895

Figure 2: Simulation result 1



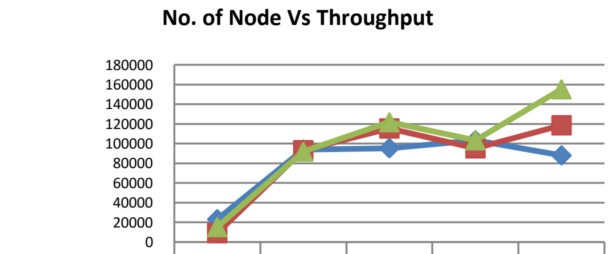
	10	20	30	40	50
TCP Tahoe	29	87	128	131	159
TCP New Reno	20	73	130	124	120
ATTCP	15	50	125	116	153

Figure 3: Simulation result 2



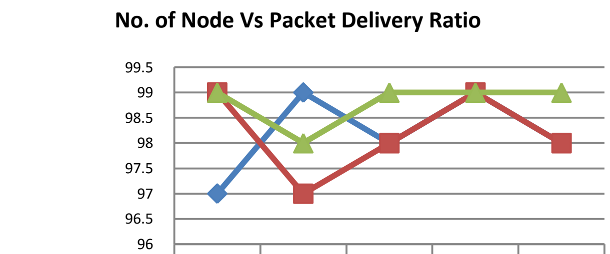
	10	20	30	40	50
TCP Tahoe	13	82	194	159	170
TCP New Reno	5	68	162	151	149
ATTCP	8	16	130	152	160

Figure 4: Simulation result 3



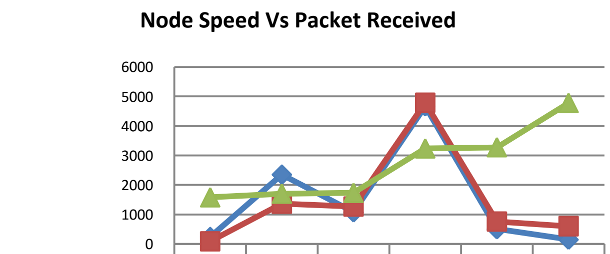
	10	20	30	40	50
TCP Tahoe	23031	93641	95218	103176	87851
TCP New Reno	9118	93282	115403	95370	118629
ATTCP	15156	91947	121890	103483	155409

Figure 5: Simulation result 4



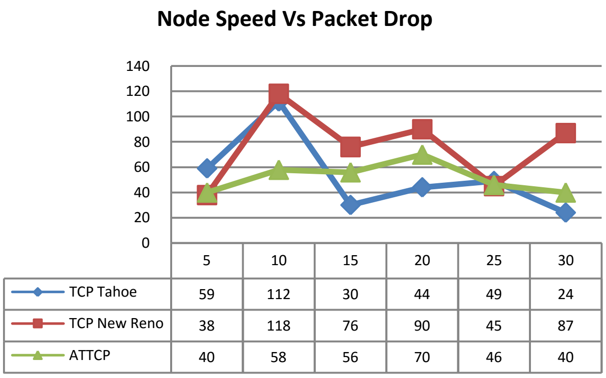
	10	20	30	40	50
TCP Tahoe	97	99	98	99	98
TCP New Reno	99	97	98	99	98
ATTCP	99	98	99	99	99

Figure 6: Simulation result 5



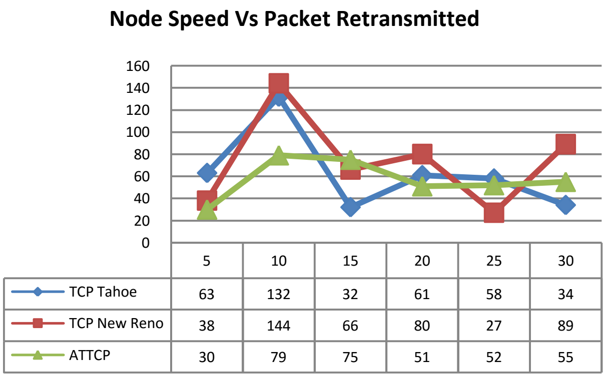
	5	10	15	20	25	30
TCP Tahoe	234	2348	1072	4666	498	144
TCP New Reno	80	1365	1263	4788	749	595
ATTCP	1583	1706	1733	3239	3279	4781

Figure 7: Simulation result 6



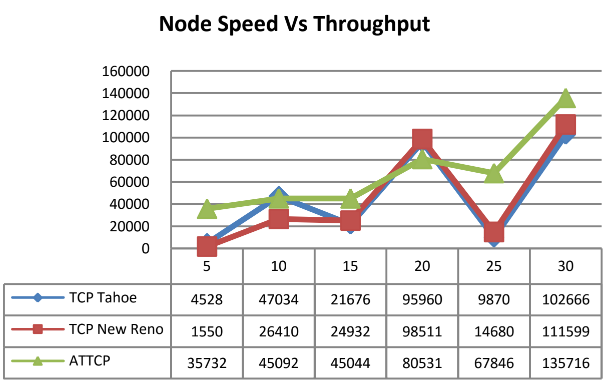
	5	10	15	20	25	30
TCP Tahoe	59	112	30	44	49	24
TCP New Reno	38	118	76	90	45	87
ATTCP	40	58	56	70	46	40

Figure 8: Simulation result 7



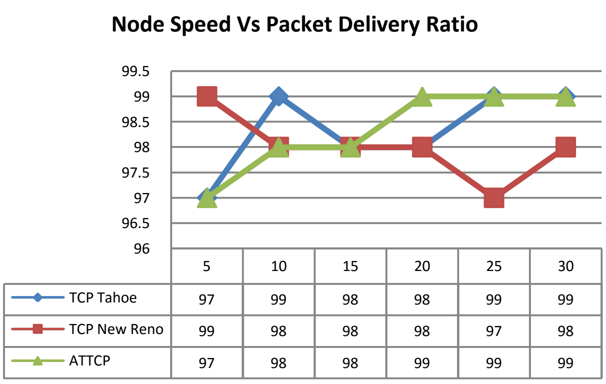
	5	10	15	20	25	30
TCP Tahoe	63	132	32	61	58	34
TCP New Reno	38	144	66	80	27	89
ATTCP	30	79	75	51	52	55

Figure 9: Simulation result 8



	5	10	15	20	25	30
TCP Tahoe	4528	47034	21676	95960	9870	102666
TCP New Reno	1550	26410	24932	98511	14680	111599
ATTCP	35732	45092	45044	80531	67846	135716

Figure 10: Simulation result 9



	5	10	15	20	25	30
TCP Tahoe	97	99	98	98	99	99
TCP New Reno	99	98	98	98	97	98
ATTCP	97	98	98	99	99	99

Figure 11: Simulation result 10

Figure no 2-6 shows the effect of increasing traffic in network. X-axis shows number of nodes and Y-axis shows the corresponding values of parameters. Figure no 7-10 shows the effect of increasing speed of nodes in network. X-axis shows speed of nodes (m/s) and Y-axis shows the corresponding values of parameters.

It can be observed that in most of the cases either in dense network or variation in pause time, the performance of ATTCP is better than other TCP variants. The simulation result shows that ATTCP is more reliable and less time consuming. The packet retransmission rate is more than other variants. It can be used in sensitive networks

V. Conclusion

This paper presents a mechanism to make TCP more reliable and time saving protocol. The new mechanism uses a calculation of retransmission timeout by which sender has to wait for minimum duration to send a new packet or retransmit old packet. The variant of TCP is implemented on QualNet 5.0. According to the simulation results new variant of TCP, ATTCP is working better than other TCP variants. ATTCP is more reliable, so it can be used in most sensitive places, where real time event monitoring is required in limited time constraints.

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