Simulation and Investigation of S-MAC Using the Network Simulator NS2

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Abstract

Wireless Sensor Networks (WSN) shares one wireless medium for transmitting data packets, and it has a limited resource when it comes to the energy. Therefore, there is a necessity for energy-efficient protocol for accessing the medium. Sensor- Medium Access Control (S-MAC) is considered energy-efficient protocol because it reduces the energy consumptions of the sensors nodes. Therefore, in this paper, S-MAC is investigated and analyzed by using Network Simulator NS2.

Introduction

Wireless Sensor Networks (WSN) shares a wireless communication medium for sending and receiving data packets. Thus, there are varieties of protocols that mange accessing the medium such as Traffic-Adaptive Medium Access (TRAMA), Sensor-Medium Access Control (S-MAC), and Power Aware Multi-Access with Signaling (PAMAS). In this paper, the S-MAC is simulated and investigated by using the Network Simulator NS2.S-MAC protocol is considered one of contention-based protocols. The main the goal of S-MAC is to reduce energy consumptions. The protocol employs a duty-cycle approach, which means, nodes switch between a listen state and s sleep state periodically (Dargie & Poellabauer, 2010).

Description of Implementation

The network simulator NS2 is used to implement and simulate the S-MAC. In this implementation, two nodes were created, called n0 and n1. One is a sender (n0) and the other one is a receiver (n1). The traffic application is CBR, the transport service is UDP, and the routing protocol is DSR. For the simulation result analysis, AWK language is also used such that a scripting file it is wrote to take the task of analyzing the trace file.

Performance Analysis

After simulating the Sensor Medium Access Control Protocol (S-MAC) by using the Network Simulator NS2, the following Fig 1is built based on the simulation results. And based on that, graphs are created.

Packet rate	Sent packets	Received packet	Dropped packet	Through put	Number of RTS and CTS	RTS and CTS Utilization	NAK	ACK
2	39	39	0	100	6	16	3	39
4	78	78	0	100	12	16	6	78
6	123	109	14	89	20	16	10	109
8	156	121	35	78	25	16	12	121
10	195	146	49	75	31	16	16	146
20	390	160	230	41	62	16	31	160

Fig 1: The Simulation Results

The following graph (fig 2) represents and compares between the packet rate and the throughput.

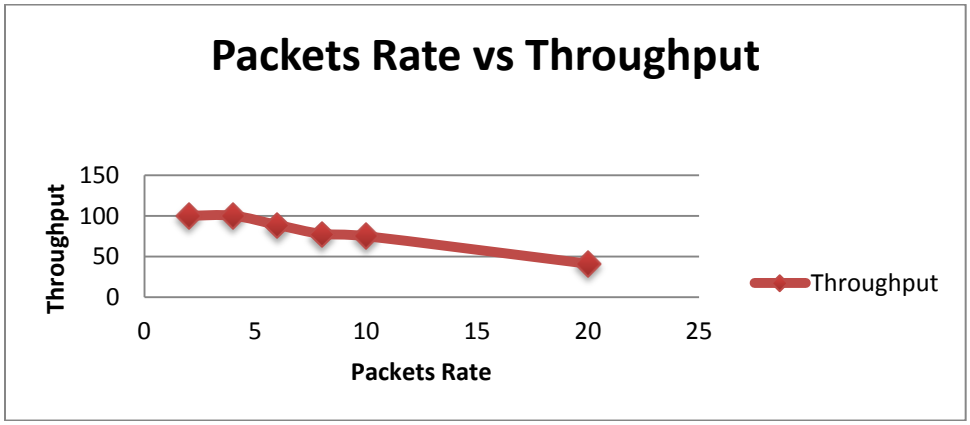

Fig 2: Packet Rate and the Throughput

The following graph (fig 3) represents and compares between the packet size and the throughput.

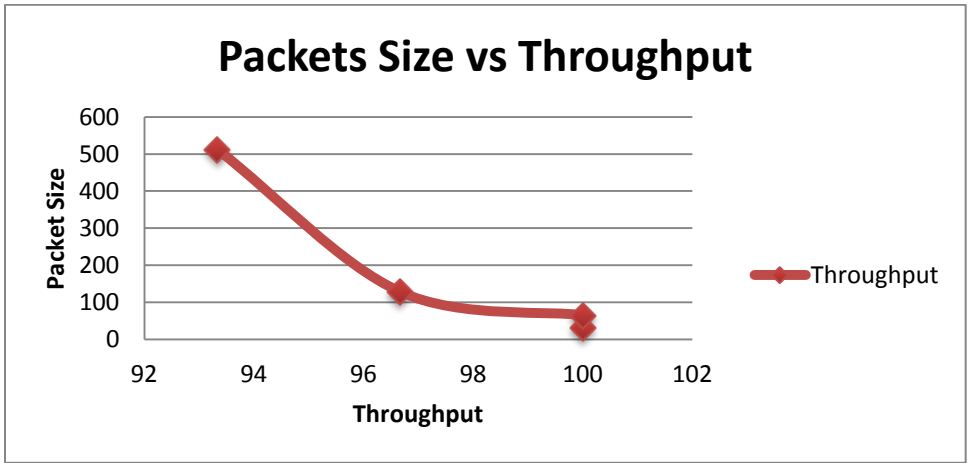

Fig 3: Packet Size and the Throughput

The following graph (fig 4) represents and compares between the number of packet and RTS and CTS.

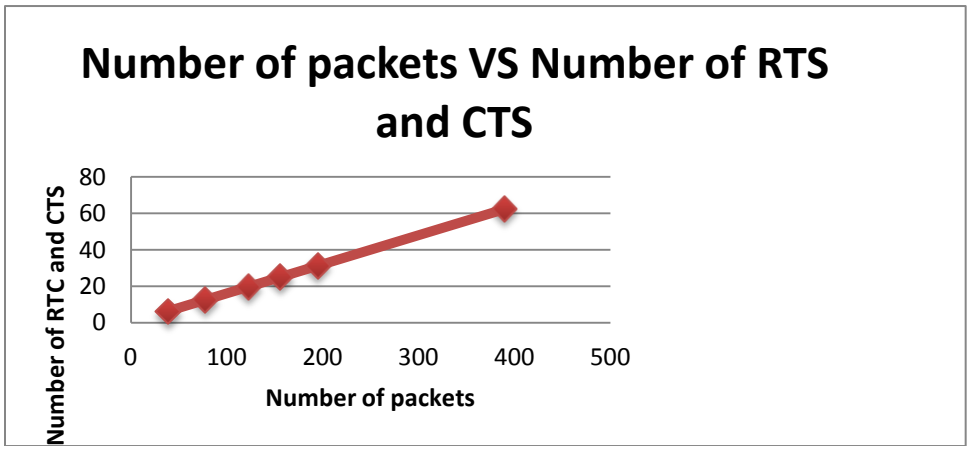

Fig 4: The Number of Packet, and RTS and CTS

The following graph (fig 5) represents and compares between packets number and NAK.

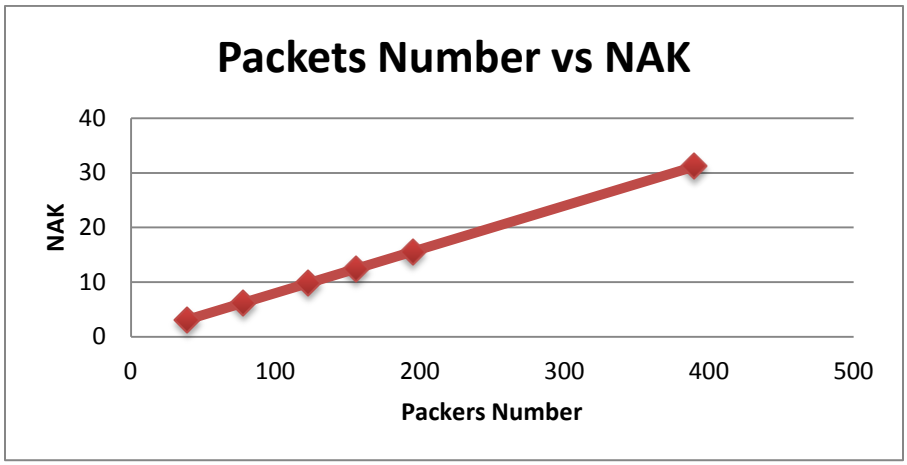

Fig 5: The Number of Packets and NAK

The following graph (fig 6) represents and compares between the sent packets and ACK.

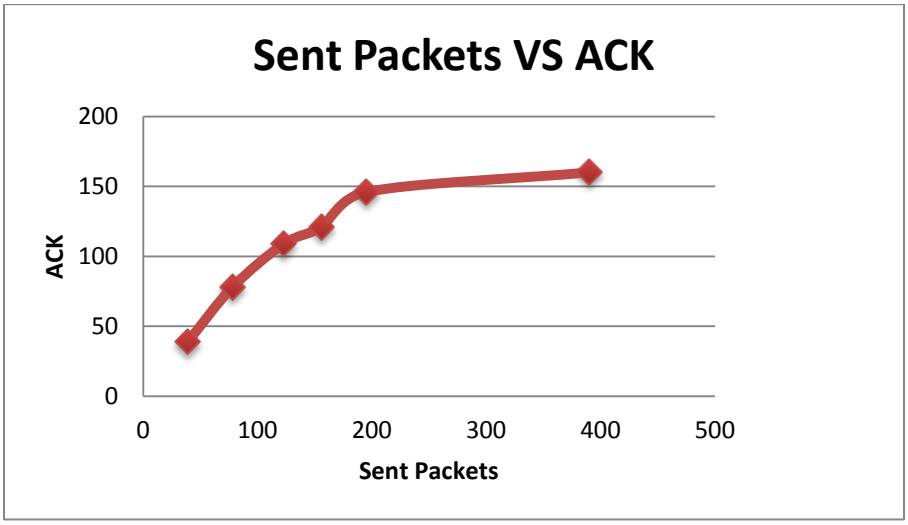

Fig 6: The Sent Packets and ACK

Analysis of Results

The second figure (Fig 2:) the throughput decreases as the packet rate is increased. For example, when the packet rate is 4, the throughput is 100, but when packet rate is 20, the throughput becomes 41. In the third figure (Fig 3:)the throughput decreases as the packet size is increased. In the forth figure (fig 4) the RTS and CTS are formulated almost 0.16 of generated packets. For example, when number of the generated packets equal 195, then the RTS and CTS is 31. The fifth figure (Fig 5:) represents and compares between packets number and NAK. NAK is used by nodes to save their energy, for example, when a node receive CTS and RTS both include on packet size so the receiving nodes do not need to keep listening on the medium. The sixth figure (fig 6) represents and compares between the sent packets and ACK. ACK can be calculated as the number of the received packets, for example, received packets = ACK (since the node must ACK the received packets).

Conclusion

In this paper, S-MAC is simulated and investigated by using Network Simulator NS2. The simulation of S-MAC is conducted on throughput, packet rate, packet size, number of sending packets, and number of NAC and ACK. As a result, there are five graphs that represent the simulation results.

Reference

Dargie, W., & Poellabauer, C. (2010). *Fundamentals of wireless sensor networks: theory and practice*: John Wiley & Sons.