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AN ENERGY EFFICIENCY ROUTING PROTOCOLS FOR IOT ENABLED WSNs

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ABSTRACT: The Internet of Things (IoT) has become increasingly significant in modern society. Any IoT -based system uses Wireless Sensor Networks (WSNs), a subset of IoT, as a data collection component. IoT-enabled WSNs need routing protocols that use less energy to increase network performance and longevity. In wireless sensor networks, various routing algorithms are used to improve network performance. So, in this specific study, we are analyzing performance metrics like Average throughput, Average end-to-end delays, packet delivery ratios (PDR), and energy efficiency while considering Routing protocols such as DSDV, DSR, and AODV. This analysis was performed using the NS-2 simulator.

Keywords: WSNs, Energy efficiency, AODV, DSDV, DSR, NS-2, IoT

1. INTRODUCTION

IoT provides sensing capabilities, which enable any physical thing to become smarter. For the Internet of Things, WSNs are necessary. It is useful in a wide range of areas, including the medical profession, the military, and industries, as well as being used in harsh environment applications. In many real-time applications, such as commercial and industrial automation, the IoT -enabled WSNs to play a significant role. This is composed of a variety of tiny sensors that use minimal energy to transmit the data. WSNs are a group of dispersed nodes. These nodes collect data from various nodes and transmit it to the hub over the wireless network [6]. Once the processing is complete, the user will receive the data. WSNs can be either structured or unstructured. The placement of the sensors is the primary distinction between these two types. In contrast to the latter, where sensor nodes are spread ad hoc, structured wireless networks offer an ideal architecture for the expansion of sensor nodes. Routing becomes a significant issue when the network has multiple sensor nodes since an unstructured WSN lacks a specified architecture for communication among the sensors. We, therefore, evaluate a few routing techniques and determine their operational usefulness to address this issue.

2. RELATED WORK

The reactive routing technique known as Ad hoc On-Demand Distance Vector (AODV) finds routes only when they are necessary by using a hop-by-hop approach. It was developed by C. Perkins and E. Royer and first published in their work in IEEE Transactions on Mobile Computing in 1999 [1]. This protocol is designed for usage in ad hoc wireless as a result of the potential for frequent topology changes brought on by node mobility, connection failures, or network partitioning.

An experimentally based comparative Routing protocol analysis in multi-hop ad hoc networks is presented by Marina K. and Suman R. in the paper “A Review of Multi-Hop Ad Hoc Network Routing Protocols [2]”, which was partly published as networking research series. The 2002 Third ACM International Conference on Mobile Ad Hoc Networking and Computing (MobiHoc) featured its presentation. The authors conducted tests on the simulation tool NS-2 and reviewed its outcomes to identify the benefits and drawbacks of each routing system.

The paper " Routeing with a DSDV for mobile devices, a very dynamic destination sequence [3]" by Perkins, C. E., and Bhagwat, provides the DSDV protocol, a proactive distance-vector routing protocol. DSDV was created for ad hoc mobile networks. To allow quicker recovery from link failures and better load balancing, the protocol has a system for

maintaining numerous pathways to the same destination in addition to its usual distance-vector routing foundation.

The study by Y. Xiao and Y. Liu, titled " Wireless Ad Hoc Networks with Energy-Aware Routing," [4] offers a comprehensive examination of wireless ad hoc network resource routing methods. DSDV, DSR, and AODV are among the protocols surveyed, along with other protocols that have been put out for energy-aware routing. Additionally, it includes reactive and proactive routing strategies.

The article " A Comparison of Wireless Sensor Networks Routing Protocols that Save Energy"[5] by S. Kumar, S. Jain, and R. Jain compares the four energy-efficient routing protocols, including AODV, DSDV, and DSR, in WSNs. The effectiveness of these techniques is evaluated by authors using criteria like energy usage, network lifetime, and packet delivery ratio. To compare the protocols, the study runs simulations with various network topologies and traffic patterns. The study's results demonstrated that the performance of the protocols varies according to the network structure and traffic pattern.

3. ROUTING PROTOCOLS

Now, we are going to talk about several proactive and reactive routing techniques in this study.

PROACTIVE ROUTING PROTOCOL (PRP): Table-driven routing protocols are another name for proactive routing systems. Even when there is no data to send, they construct and maintain routes beforehand. In a proactive routing system, Each node keeps a routing table that includes the paths to every node in the network as well as details on its topology. This data is periodically updated, regardless of if there is data to transfer. Proactive routing protocols include such as DSDV and OSLR.

REACTIVE ROUTING PROTOCOL (RRP): On-demand routing systems, also referred to as reactive routing protocols, only create routes when data must be transferred. Each node in a reactive routing protocol only builds a path to the target node, when necessary, instead of maintaining an exhaustive routing table. Due to the constantly shifting network topology, reactive routing methods may now operate more effectively in highly dynamic and mobile situations. Reactive routing protocols include such as AODV and DSR.

The AODV, DSDV, and DSR protocols are now specifically studied in this work by computing various performance characteristics.

A) AODV routing protocol: The term "AODV" refers to the RRP category of technologies and stands for Ad hoc on Demand Distance Vector, which indicates that only routes are found when a node requests the transfer of data. [1] There are no loops in it. The AODV protocol, which is

based on a series of two messages called PREQ and RREP, finds the route. Rather than upgrading every network node, the AODV protocol just updates the relevant surrounding nodes.

B) DSDV routing protocol: Destination Sequence Distance Vector is referred to as DSDV. It falls under the genre of PRP, where each node in the network maintains one or more tables with data pertaining to the network's overall topology [3]. The tables are updated often to retain the most latest routing information from every one node to another node.

C) DSR routing protocol: The reactive routing technology known as Dynamic Source Routing (DSR) is used in Wireless sensor networks as well as ad hoc wireless networks. DSR only creates routes when they are necessary, allowing for effective use of network resources and flexibility in response to shifting network topology. Every adjacent node in DSR keeps track of the whole network path from the source node to the destination node, which is how DSR keeps track of the source's journey [7].

4. SIMULATION PLATFORM

An open-source, event-driven network simulation tool used for networking research is called Network Simulator Version 2 (NS2). It was initially proposed between 1995 and 1996. For instance, NS-1 had its first alteration in 1995. A second version followed in 1996. To simulate the operation of complex networks, such as wired and wireless networks, protocols, and applications, NS2 offers a simulation environment. In this specific study, all the simulations were done using an intel core i5 with 8GB of RAM and an x64 processor running Ubuntu 22.04 with NS-2.

5. SIMULATION ENVIRONMENT

In the table below, the parameter kinds and values taken into account for the simulation are listed.

TABLE 1 simulation parameters

Parameter type	Parameter
Routing protocols	DSDV, AODV, and DSR
Number of Nodes	25, 50, 75, 100
Channel	Wireless channel
Propagation	Two-way ground
Type of Network interface	WirelessPhy
Type of MAC	802_11
Type of Link layer	LL
Model of Antenna	Omni Antenna
Simulation time	150ms
Type of queue	Priority queue
Simulator used	NS-2
Platform used	Ubuntu 22.04

6. RESULTS

To assess the effectiveness of the routing algorithms, we consider variables like averages for energy usage, throughput, packet delivery ratio, and end-to-end delay.

A) Average throughput: Throughput is a performance parameter that indicates how much data can be transmitted over a network or communication channel in a given period of time. It shows how quickly data is successfully transmitted between a source and a destination. Bits per second (bps) or bytes per second (Bps) are commonly used to measure throughput. The average throughput calculations were done for 25, 50, 75, and 100 nodes for AODV, DSDV, and DSR, respectively. The plotted graph shows the outcome. Based on the below graph, with regards to the average throughput, we can see that AODV outperforms DSDV and DSR.

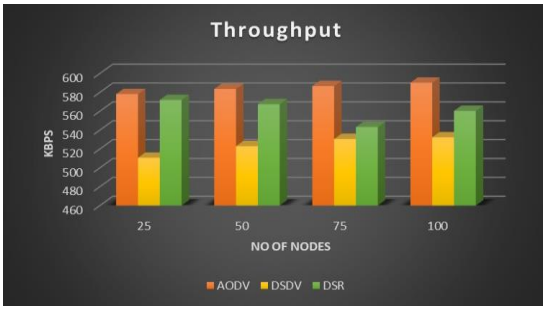

Figure 1 average throughput

B) Packet Delivery Ration (PDR): A performance metric called Packet Delivery Ratio (PDR) is used to analyze how well routing systems deliver packets in wireless networks. Concerning the number of packets transmitted, It shows the proportion of packets that made it from the source to the destination node successfully. A higher PDR denotes improved network functionality and more effective use of network capacity. The PDR calculations were done for 25, 50, 75, and 100 nodes for AODV, DSDV, and DSR respectively. The plotted graph shows the outcome. We can see from the graph below that, with regards to the packet delivery ratio, AODV outperforms DSDV and DSR.

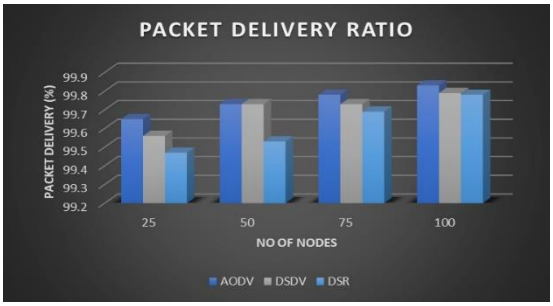

Figure 2 packet delivery ratio

C) Average End to End Delay: End-to-end delay simply specifies the amount of time needed for a packet to travel through the network from its source to its destination. The duration of time it takes for a packet to move from its source node to its destination across the network. The average end-to-end delay for the AODV, DSDV, and DSR routing protocols was calculated for 25, 50, 75, and 100 nodes, respectively. Plotting was done on the related graphs. A protocol that functions well typically has a lower end-to-end latency number. We can see from the graph

below that, with regard to the average end-to-end delay, AODV outperforms DSDV and DSR.

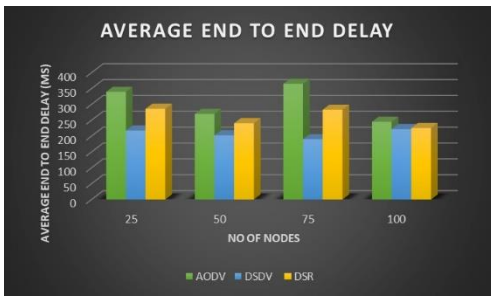

Figure 3 average end-to-end delay.

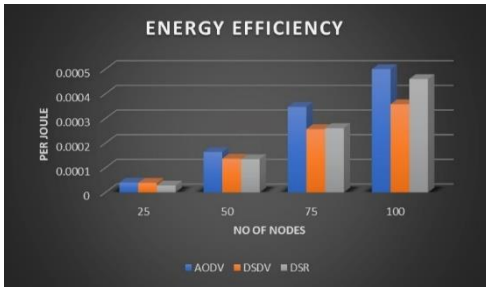

Figure 4 energy efficiency

D) Energy Efficiency: In wireless ad hoc networks, where nodes are frequently battery-powered and subject to energy constraints, energy efficiency is a key statistic used to assess the effectiveness of routing algorithms. Energy efficiency refers to a routing protocol's capacity to reduce network energy usage while providing effective and dependable data delivery. The energy efficiency calculations were done for 25, 50, 75, and 100 nodes for AODV, DSDV, and DSR respectively. The plotted graph shows the outcome. Figure 4 shows how AODV performs in regard to energy efficiency more than DSDV and DSR.

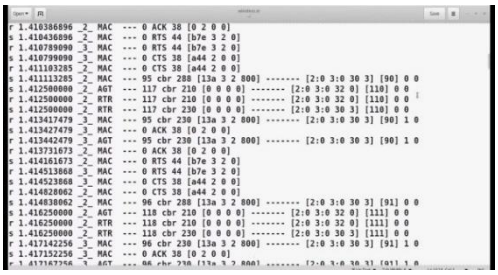

Figure 5 trace file

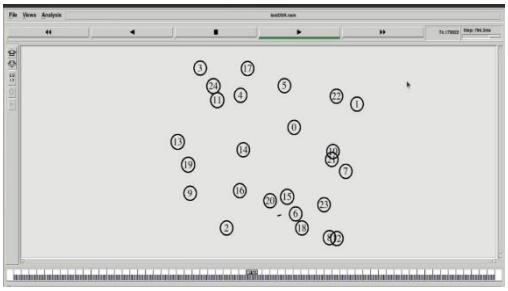

Figure 6 nam file

7. CONCLUSION

This study compared the AODV, DSDV, and DSR protocols. By analyzing several characteristics like average throughput, packet delivery ratio, average end-to-end delay, and energy efficiency, the effectiveness of these diverse protocols was evaluated. Overall, it was discovered that reactive routing methods outperformed proactive routing protocols.

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