Execution Evaluation Enhancement of Energy Utilization in Ad- Hoc Wireless Network

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Abstract— These days, ad-hoc wi-fi networks or mesh networks are receiving extraordinary studies hobby because of their wonderful ability in unique environments. This paper centered at the simulation of the overall performance and strength intake of ad-hoc network devices in one of a kind configurations. Ns-3 became used for this purpose due to the fact it's miles a modifiable cutting-edge software with open code. At the start, it changed into believed that this simulator is ideal for this purpose, but in a real experience, there are a few missing assets at the power module. Even though ns-3 become developed as an open-source software with the aid of a collection of volunteers, this venture might be useful to people who intend to start with ns3 programming or to take a look at strength intake in simulations. Having understood the program and its function, it will likely be evaluated for electricity consumption styles in ad-hoc networks and the probably troubles it can stumble upon. The capabilities of the ad-hoc throughput (packets) are captured in the analytical version as the strength demand for extraordinary advert hoc scenarios is a feature of the quantity of nodes. The results show amazing improvement in wireless community performance.

Keywords: Ad-hoc networks, Mesh networks, NS-3, wireless network, Energy consumption

I. Introduction

A Wi-Fi local region community (WLAN) is a network that gives connectivity to numerous devices inside a small location the usage of a Wi-Fi distribution method. Being a WI-FI mode of connection, the user can flow freely within the coverage vicinity and nevertheless preserve connectivity. The cutting-edge WLANS are normally known as wireless due to the fact they may be based on ieee 802.11 requirements [1][2]. This kind of network is most desired in homes and public homes as it presents the opportunity to connect to the community without the need for wires [3][4].

In a WLAN community, all the connecting devices are called stations or STAS, and each may be taken into consideration an get entry to point (AP) or a primary station (ST)[5]. Now not all WLANS have APs as they're usually wireless routers for packets forwarding to STS; they might additionally set up connectivity with every other community. Normally, STS are cell devices such as phones or laptops for site visitors data transmission from other STS or from an external network. Whilst a hard and fast of STAS speak with every other, they may be called a primary carrier set (BSS), and there are primary kinds of BSSS which are the infrastructure BSS and impartial BSS or ad hoc network (refer to parent 1). BSS differs from STS by no longer having aps and routing functionalities [6].

An extended provider set (ESS) refers to a hard and fast of connected BSSs while a Distribution System (DS) is a connection between APs in an ESS [7][8][9][10].

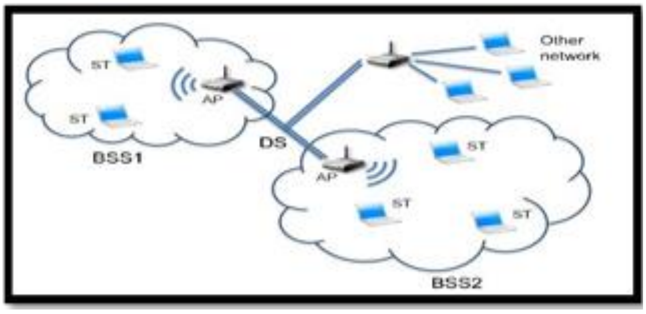

Fig. 1: ESS of Infrastructure WLANs

Networks are independent in ad-hoc mode, meaning that the STs have no control over an AP and establish communication with each other via routing functionalities (Fig. 2)[11]. Hence, it is a self-configuring and dynamic network as the STs can freely move and the routing functionalities are adaptive. Ad-hoc networks are easy to form, configure, and extend as they require minimal configuration;hence, they are ideal for several applications[17].However, STs are normally associated with high mobility which causes frequent establishment and breakage of network links; they are not only changing dynamically, but also rapidly, making them difficult to manage. As such, protocols will be required to manage them [13].

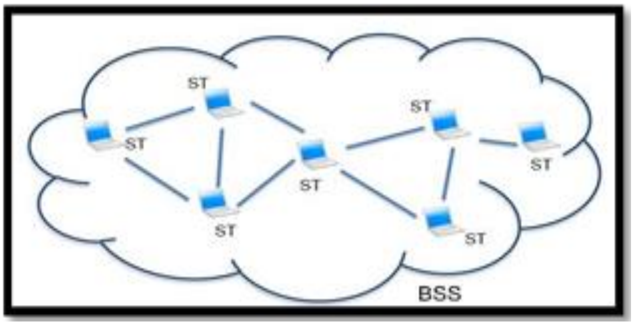

Fig. 2: BSS of an ad-hoc WLAN

Several protocols exist for ad-hoc WLAN control; however, in this study, the focus is on one of the protocols as described below:

A. *Proactive Routing*

Proactive protocols establish a list of possible destinations and their routes via a periodic distributionof the routing tables across the network; this allows multi-hop functionality as each station and the route to the next-hop and to every other node is known [13]. With this type of protocol, more data will be required to be continuously sent and this increases exponentially with the number of network nodes[14]. These protocols also respond to node failures and restructuring in a slow manner. In this study, the discussion will focus on the Optimized Link State Routing (OLSR) as depicted in Figure 3. The stations rely on this protocol to repeatedly send a HELLO frame to each neighbour node[15].

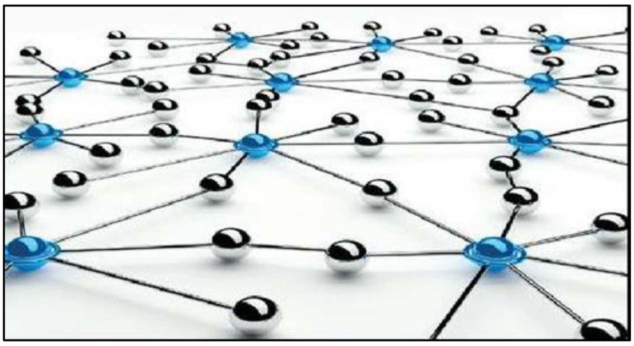

Fig. 3: OLSR multipoint relay point

These frames maintain a list of the source neighbours which allows the receiver to update its routing table in order to reachall two-hop-distance stations. Similarly, each node periodically transmits a Topology Control frame to inform about its nearby topology and give all the network nodes the chance to compute each routing entry in the table for the likely destinations[13]. As a Distance-Vector protocol, OLSRis based on the calculation of the distance and direction to any link in a network. Here, the direction is the next hop & interfaces to forward traffic, while distance reflects the cost of reaching the destination, normally the number of hops. The path with the minimum distance is considered the least cost route between two nodes; as such a vector or table of the minimum distance to each node is maintained at each node [16].

These protocols are having some advantages also like:

- Every node has its own routing table that makes aware of the path to be selected.
- Quick recovery of the route is possible by adopting an alternate path.
- Nodes can choose the best possible path from the available multiple paths between source and destination

B. Reactive Routing

Reactive protocols establish a route based on demand when a station intends to broadcast by flooding the network with Route Request packets. Again, a huge amount of data is required to be sent to the network when a station intends to transmit; this increases the latency time in finding routes [12]. Another way of using a reactive protocol is by sending a packet to each link before forwarding to each other link except the link that has just received it. This technique is referred to as flooding routing; it does not require information about any route but demands that every packet ought to be nearly broadcasted [17].

An example of the reactive protocols is the Ad hoc on Demand Distance Vector Routing Protocol (AODV) which is a reactive unicast routing protocol that works on the concept of all routes being maintained only on-demand. In an AODV protocol, not less than four control packets are required(HELLO messages, route requests (RREQs), route replies (RREPs), and route error messages (RERRs) [18][19]. Every node in AODV can maintain a routing table that stores all the active routes information such as the number of hops, sequence numbers for the destination, next-hop, active neighbors for a route, destination and the expiration time for a routing table entry (Figure 4).

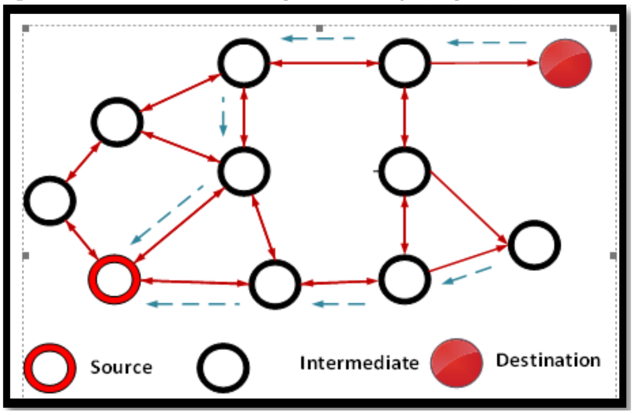

Fig. 4: AODV protocol

II. Related Works

WLANs are multi-hop dynamic, self-configured networks that require no infrastructure or centralized control. Routes availability can change in this type of network at an instant due to nodes mobility, and the network topology is not fixed; hence, it can frequently change [20]. There are other limitations of this type of networks, such as low bandwidth, power consumption, and limited channel &capacity. Due to the dynamic topology the routes are not fixed and get change with the movement of any node. So, as a result the route maintenance is required whenever routes are broken.[21, 22, 23].This entire process consumes the battery life;so, energy is an important attribute of WLANsas it has a direct relationship with the network service life [24, 25]. Nodes in WLANare battery-powered and as such, several studies have been dedicated to improving the performance of routing protocols in Ad hoc networks[26]. However, there is a need to emphasize the power consumption of routing protocols in different communication modes namely transmit, receive, and idle modes. Many researchers have conducted a simulation to evaluate the performance of routing protocols in different energy models with 50 nodes or less and suggested that the mica-motes energy radio model is the best energy model as compare to the other two energy models.[27,28].

The aim of this study is to investigate the performance of using ad-hoc protocols in mobile ad hoc networks in terms of their average throughput and power consumption using the NS-3 network simulator.

The remainder of this article is structured as follows: Section 2 evaluated wireless ad-hoc networks in terms of network performance metrics over a different number of nodeswhile Section 3analysed and discussed the results obtained from the simulation.

III. Methodology

NS3 simulator is a discrete-event network simulator for simulation of Internet systems;It is a publicly available tool mainly used for research and educational purposes. NS3 is built to solve the simulation needs of modern networking research and allows depth study of almost all kinds of networks using the C++ language. NS3 is built with a solid simulation core that is adaptable to network needs that users may have the interest to analyze. NS3 can be used as a real-time network emulator because the simulation models are sufficiently realistic. Areal-time scheduler that gives users the opportunity to send and receive packets generated from NS3on real network devices; it can also serve as a connecting link between virtual machines. The methodology of this works is aimed at studying the energy consumption pattern in ad-hoc WLANs within different scenarios. The first aspect of the methodology aims at increasing the traffic allocated to a single node that serves as a server while the rest of the nodes will serve as UDP clients. Figure 5 depicts the topology of the proposed system.

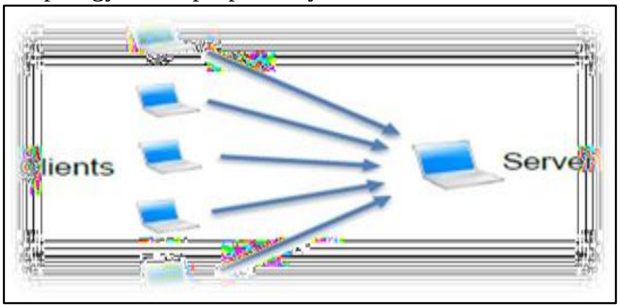

Fig. 5: The general proposed system

The simulations will be performed with 7 ad-hoc nodes while the energy model will still be the same just that it is now installed to the new nodes. Being that the server node is the last to be assigned, it will become the last of the network nodes. So, when installing the UDP application, it must be properly checked [29].

With the OLSR protocol, nodes are allowed to set tables of neighbours and next-hop destinations, but it must be ensured that it converges prior to traffic propagation; hence, the actual simulation will begin at 30 sec to allow convergence. The total simulation time will be set to 500 sec and see the result. Some traces will be connected after the entire configuration and compared for the total packets generated, transmitted, and received by the server. The energy consumption during the process will also be compared. The simulation has been configured in a manner that every node can send up to 10000 packets within 0.75 to 0.1 sec.

In this project, the first scenario is the easiest as only two nodes were serving as client and server and are transmitting the 10000 packets as depicted in Figure 6.

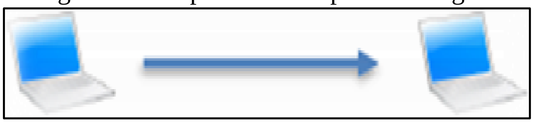

Fig. 6: The first scenario

The second scenario of this project is to use 4 nodes and sending the same number of packets as shown in Figure 7.

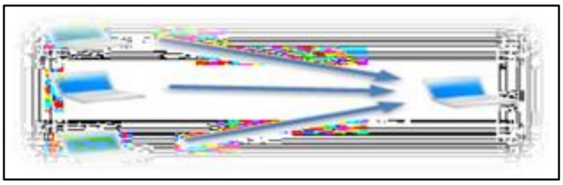

Fig. 7: The second scenario

The Third scenario of this project is to use 7 nodes and sending the same number of packets.

The simulation parameters of this project are as shown in Table 1.

Parameters	Values
Number of packets	10000
System type	Mobile ad-hoc
Number of nodes	2, 4, 7
Simulation metrics	#of packets, energy
Protocol	OLSR
Interval	0.1 s to 0.75 s

Table 1: Simulation parameters

The flow chart of the project is shown in Figure 8

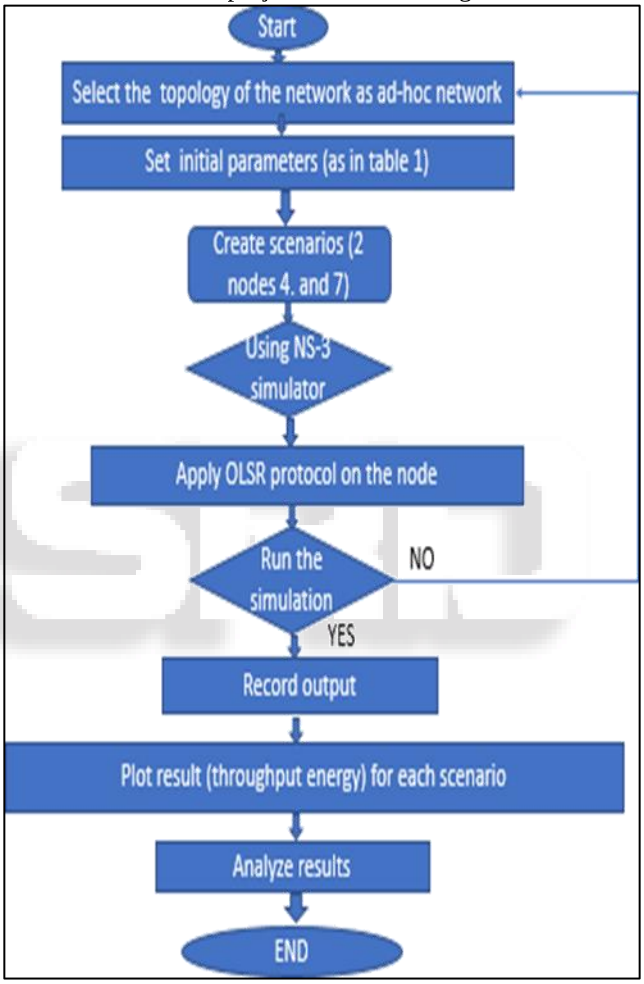

Fig. 8: Methodology flow chart

IV. Performance Metrics

The performance metrics are throughput and end-end delay and describe as:

A. Throughput

This reflects the total number of bytes at the destination sinks per second. Different scheduling frameworks utilize different total system capacities; hence, the throughput of a system is a significant parameter to consider when assessing resource utilization in a system, especially when deploying different frameworks. The throughput of a system can be computed thus:

$$\overline{Thr} = \frac{8 \times N_{rx}}{T_{Sim}} \quad (1)$$

Where $\overline{Thr}$ is the average throughput in bps, N_{rx} is the successfully received number of packets in bytes, and $T_{sim}$is the simulation time in s.

V. Results and Discussion

With increases in the number of generated or transmitted packets, the interval decreases accordingly and when the interval is less than 0.03 sec, the client can generate the 10000 packets within the 500 sec simulation time.

A. Analysis with 2 nodes

Results as shown in figure 9 and figure 20 respectively, the number of packets transmitted by a sender determines the consumed power. Note that in this study, we are only focusing on energy consumption during packets transmission. Here, the total energy consumed in the network is expected to be almost the same as energy consumed by a single node because the server sends only Acknowledgements.

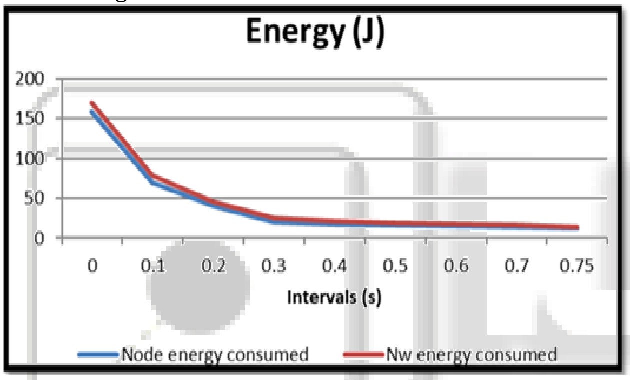

Fig. 9: Packets analyzed with 2 nodes

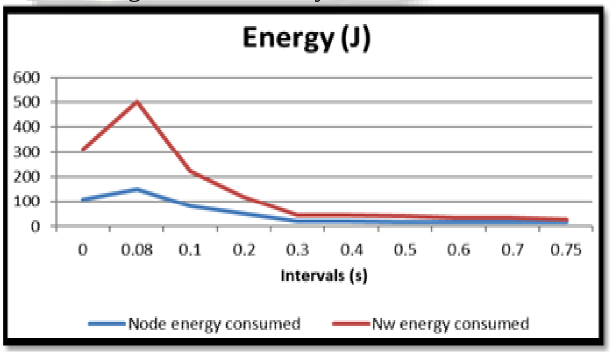

Fig. 10: energy results with 2 nodes

B. Analysis with 4 Nodes

The Mac Tx packets are more than the transmitted packets. The generated 10000 packets arrived at the physical layer but at low intervals while the transmitted packets reduced to almost 7000. This happened due to the CSMA/CA mechanism used in this network which served for not just collision detection but for collision avoidance. This implies that all the packets were being generated but before being transmitted, the nodes must wait until transmission can be allowed as illustrated in figures 11 and 12.

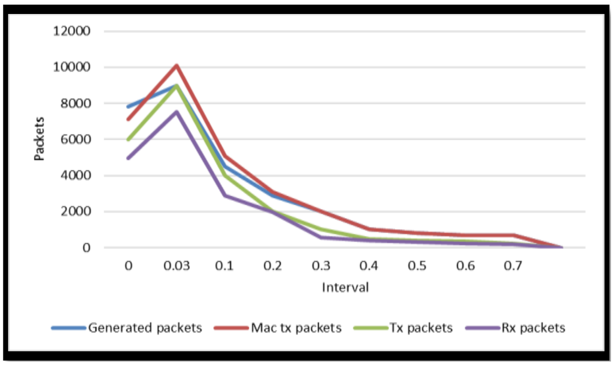

Fig. 11: Packets analyzed with 4 nodes

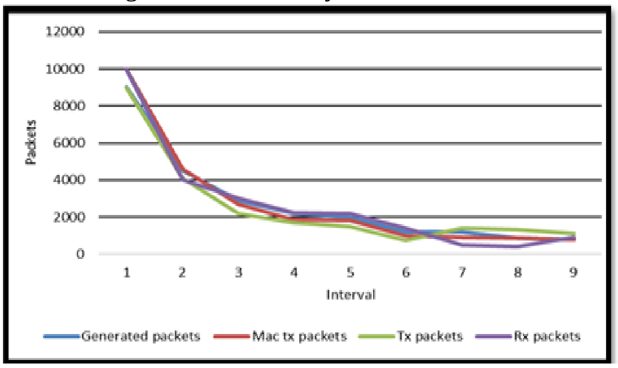

Fig. 12: Energy results with 4 nodes

C. Analysis with 7 nodes

Again, the consumed energy with 7 nodes is dependent on the number of transmitted packets. Being that we focus on energy consumption during packets transmission, the overall energy consumption was similar to the received packets by the server because the server receives all the packets from the neighboring nodes. Therefore, it is expected that there will be a relationship between the two measures. Flooding would worsen if the number of clients is increased to 6 nodes as shown in Figure 13.

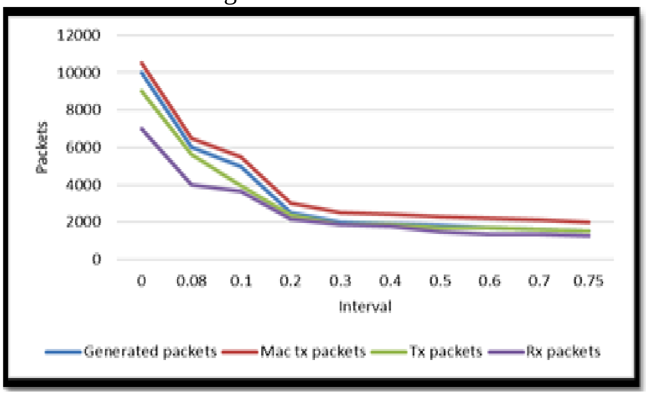

Fig. 13: Packets analyzed with 7 nodes

The rate of packets drop here is higher due to the number of nodes sending traffic which easily floods the network. In his case, the energy consumption was exactly like in the previous simulations as the same curve pattern is drawn between the transmitted and received packets. With this collision avoidance, the nodes are prevented from exponentially increasing the transmitted packets and the energy consumption by the packets.

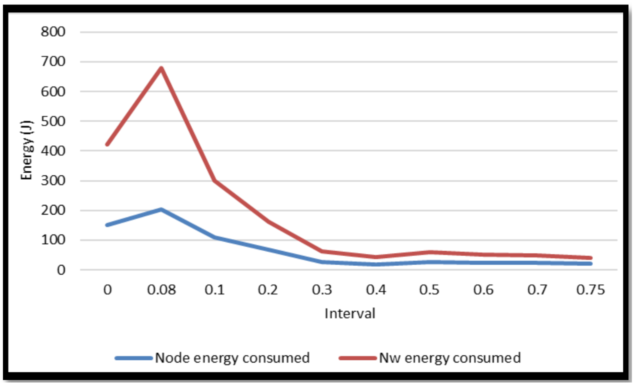

Fig. 14: Energy results with 7 nodes

This keeps the node from disconnection as the battery life is conserved as shown in figure 14;however, in high traffic, the high number of collisions experienced by a node can make it seem disconnected and not able to send any packets when the network is experiencing a persistent collision.

VI. Conclusion

In this paper, we've mentioned strength intake in advert-hoc community gadgets in exceptional situations. Based totally on the outcome of this examine, it's miles believed that energy consumption in an ad hoc community is a right away mirrored image of the wide variety of packets transmitted thru the community, if the wide variety of packets transmitted via a network may be managed, we can also manage the energy intake in the community. Also, the range of nodes within the network is also observed to have an effect on the community visitors even if the equal packet fee is maintained. The variety of packets transmitted in this case will increase with the whole number of network nodes; as a result, a larger network will revel in more flooding. It is also concluded that the range of collisions in step with node is better in small networks because increases within the length of an advert-hoc network also growth the feasible routes between a sender and a receiver.

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