M.A.N.E.T

Mobile Ad Hoc Network

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AUT

Research

M.A.N.E.T

A Mobile Ad Hoc Network (MANET) is a collection of nodes that can form a decentralized network between the nodes using moveable and wireless devices such as phones and laptops.

Objectives

A The main objectivce/motivation of this project was so that this project could potentialy be implemened into a wider scale such as a farm or a proper working enviroment. Learning about how MANETs work and how protocols function.

Protocols

B.A.T.M.A.N

Better approach to mobile ad hoc networking (BATMAN), is a proactive routing protocol for multi-hop ad hoc mesh networks. It was developed as a replacement for Optimized link-state routing (OLSR). A BATMAN node learns which of its neighbors are closest to the destination and routes traffic accordingly (B.A.T.M.A.N. protocol concept 2020) .

BABEL

Babel is a protocol is a 'loop-avoiding distance-vector' routing protocol that is designed to be robust and efficient. The protocol shares the same characteristics as HSDV and AODV. Babel is suitable for unstable networks; it limits the frequency and duration of faults such as routing loops and black holes (Chroboczek, 2011).

OLSR

Optimized Link State Routing Protocol (OLSR) is a proactive routing protocol that is used for mobile ad hoc networks (MANETS). This is achieved by OLSR utilizing multipoint relays (MPR) that is a one hop neighbor for the nodes to forward packets (Sivabalan, N.D.).

References

B.A.T.M.A.N. *protocol concept*. Open-Mesh. (2020). https://www.open-mesh.org/projects/open-mesh/wiki/BATMANConcept.

Chroboczek, J. (2011, April). *The Babel Routing Protocol*. https://www.hjp.at/{en}/doc/rfc/rfc6126.html.

Sivabalan, V. *Mobile Ad-Hoc Networks: Applications, Advantages & Disadvantages*. Study.com. https://study.com/academy/lesson/mobile-ad-hoc-networks-applications-advantages-disadvantages.html.

Testing

Typology

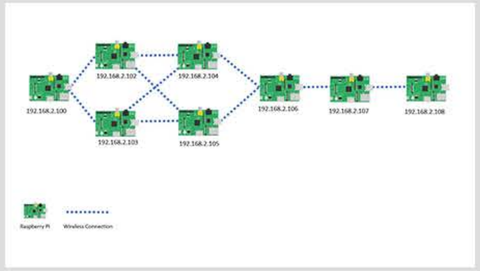

Figure 1: Network Typology

Procedure

Our MANET network was designed in this format so we could test the different protocols. We set the Raspberry Pi's so that the route the packet took was from the start of the network (Pi 100, refer to Figure 1) to the end of the network (Pi 107) hopping through nodes before reaching the end.

The packet then finds a route which then hops to nodes that are between the source and destination. When a packet was sent from the source node with the address of the destination node. It was forced to use its routing table created from the protocols that were tested to find a suitable route.

Barriers & Difficulties

We experienced testing limitations for the protocols where external factors cause test results to differ due to frequencies and objects interfering.
We did not have a big enough area to test the Pi's capabillities to the fullest. A large area such as a farm where we are able to conduct wide spread testing
Hardware was a problem where the Pi's were very old and caused them to function very slow which also caused connectivity problems

Results

Throughput

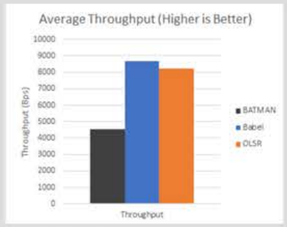

Figure 2: Throughput

Throughput can be calculated approximately as:

$$\frac{Packet\ Size}{Time}$$

Throughput is the rate of successful message delivery across a network. It indicates how much data is transferred in an amount of time. This is an important factor of overall network performance.

Latency

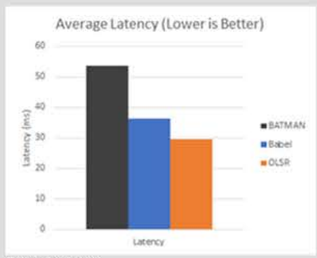

Figure 3: Latency

One-way trip time can be approximated as:

$$\frac{1}{2} Round\ Trip\ Time$$

Latency is "the time from the source sending a packet to the destination receiving it". It can be measured as round-trip time or one-way trip time. Round trip time is given as raw data from our tests.

Packet Loss

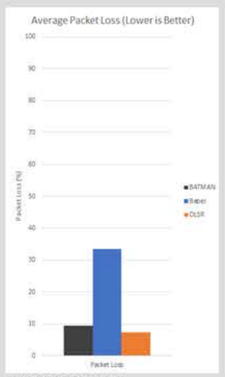

Figure 4: Packet Loss

Packet loss is the number of packets sent from the source but not successfully delivered to the destination. It is given as raw data from our tests but can be calculated as:

$$\frac{(Packets\ Sent - Packets\ Received)}{Packets\ Sent} \times 100$$

Conclusion

Findings

B.A.T.M.A.N

Batman has high latency, low throughput, and moderate packet loss. BATMAN works okay overall,but to run it on the Raspberry Pi requires special commands that require root access, which sometimes requires having to enter a password every time you run the command. This makes it less suitable for real world applications than the other two protocols.

BABEL

Looking at the raw data during testing, it appeared as though Babel would be the worst protocol due to higher packet loss in every test, and in some cases (deemed outliers) substantially higher packet loss than the other protocols. However, after analysis of the data it appears that Babel has the highest throughput and the similar latency to OLSR.

OLSR

Based on the results of testing prior to analysis, OLSR appeared to be the best protocol as it had the lowest packet loss compared to other protocols and was significantly lower than Babel. After comparing the results, we can conclude that OLSR has the most reliable packet delivery (lowest packet loss),lowest latency and similar throughput to Babel.

Conclusion

The network layout and the physical location of each Pi was the same for each test, the only variable was which routing protocol was used. Therefore, the difference in performance must be due to the routing protocol that was used. From the quantitative results of testing and the qualitative experience setting up and using the protocols, we conclude that OLSR is the protocol that would be best suited to use in the implementation of a MANET.

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