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San Jose State University
Department of Electrical Engineering

EE-286-01- WIRELESS AND MOBILE NETWORKING

PROJECT - 2

Group-3

Submitted to –

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Part - 1 - Counting Received Packets

➢ I have changed the value of field "SeedManager" from 12345 to 54321. I could visualize what is happening by using NetAnim.

```
std::string CSVfileName = "Proj
SeedManager::SetSeed (54321);
```

➢ I have received 4 different types of files by performing this command. They are as below-

1. ***.route file***: It is a specific type of computer file that contains all details about routing tables, hop count, source and destination IP addresses, which would ultimately help in improving the performance of the system.
2. ***.tr file***: This type of file has details about the traces of the packets in the network. It is used for the calculation of delays in the network.
3. ***.csv type***: It has details about receiving rate, number of packets received and is used to calculate the total number of packets received.
4. ***.pcap file***: It has wireshark capture for each transmitter and receivers.

Ques.1. How many transmitters are in the network?

Ans.1. We can get the knowledge of number of transmitters by viewing the C++ code given to us. We see that there are **25** transmitters in the network, which are transmitting the data.

```
uint32_t nWifis = 25;
```

Ques.2. How many receivers are in the network?

Ans.2. This can be checked from the code; and we have **5** receivers and those are the sink nodes. These are the nodes which collects all the data in the network.

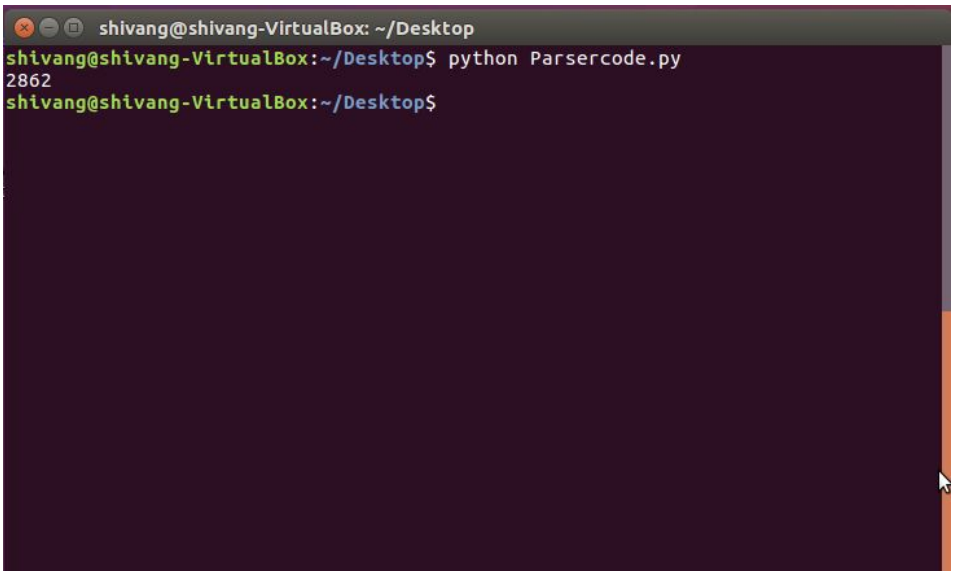
```
uint32_t nSinks = 5;
```

Ques.3. Who is transmitting to who?

Ans.3. All the sink nodes are the receiving nodes and all other nodes are transmitting. In our network, we have 25 transmitters and 5 receiver nodes (sink nodes). These are the nodes which receives the traffic. Here, the nodes from 10.1.1.1 to 10.1.1.5 are the receiver nodes and rest all the others are the transmitter nodes.

Ques.4. How many total packets were successfully received during the simulation?

Ans.4. Total number of packets which are successfully received during the simulation ation are 2862 packets. Since this is a DSDV routing so here everyone can listen to each other nodes.



Ques.5. Look at the *.route* file. What is the route with largest hop count? How many entries are there in table for each node?

Ans.5. For finding the route with highest number of hop count is calculated in the following method, by analysing each and every node. The following table shows my results -

Node Numbers	**Highest Hop Count Value**
Nodes - 0,5	Highest Hop Count is **3**
Nodes - 1,3,10,23	Highest Hop Count is **5**
Nodes - 2,12,21	***Highest Hop Count is 8***

Nodes - 4,7,8,9,14,15,18,20,24	Highest Hop Count is **4**
Node - 6,19,22	Highest Hop Count is **7**
Node - 11,13,16,17	Highest Hop Count is **6**

So we can see that among all nodes, the highest / largest HOP COUNT was ***8*** and for NODES # 2,12 and 21. So the nodes are ***2, 12*** and ***21***.

Ques.6. Look at the .pcap files? Describe different types of packets that are being sent.

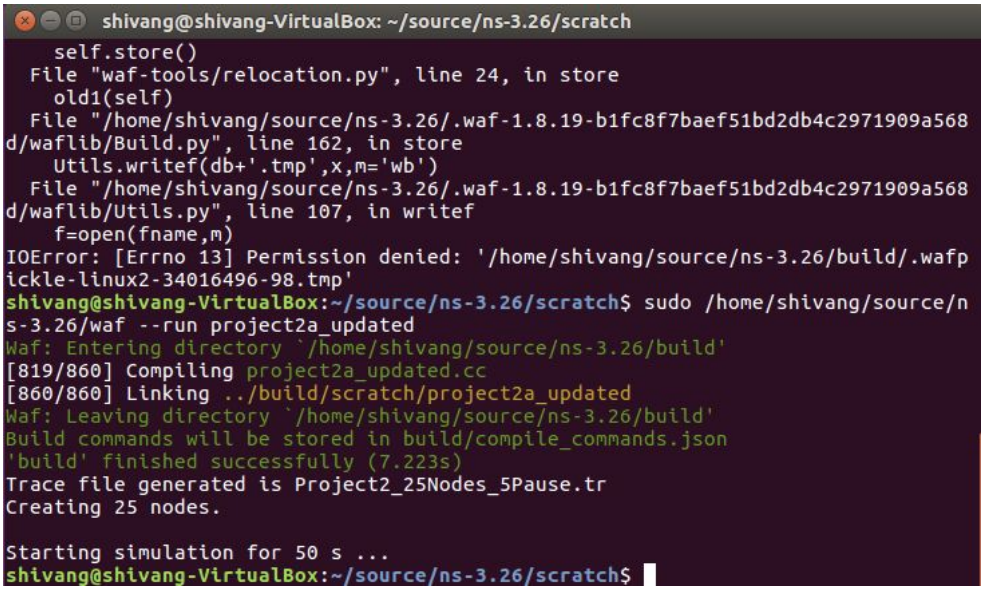
Ans.6. While looking at the .pcap file, I found out that there were 5 different types of packets which were being sent. They were as below -

1. ***Packetbb*** - Packetbb is a general multi-message packet format specification, which is designed for exchanging the information between Mobile Ad-Hoc Network Routers.
- The specification even allows to have zero or more messages inside it. If there are Zero messages inside it, then it will simply have the header information, else will include the message along with the header information.

2. ***ARP*** - This is a communication protocol and is used for finding the link layer address related to an IP address.
- It is used to map a network address to a physical address like MAC address.

3. ***UDP*** - User Datagram Protocol is one of the most core protocol of the Internet Protocol Suite.
- It is generally used for allowing applications to send messages to other hosts/clients.
- Prior/earlier communications are not required with UDP to set up communication channel.

4. ***ACK*** - Acknowledgement as we all know is a message which is passed between communication processes to signify acknowledgement, or as a receipt of the message, all as a part of communication protocol.



Part - 2 - Transmission Range

The lines in the code given to us has that change the range of transmission range of each node. Further, in those lines i have changed the values of the parameters - Energy Detection Threshold and CcaMode1 Threshold to respective values in the file.

Ques.1. What do the lines you changed do?

Ans.1. I changed the values of Energy Detection Threshold to -75 and CcaMode1Threshold Value to -76 in the following lines -

"wifiPhy.Set ("EnergyDetectionThreshold", DoubleValue(-75))" ; and
"wifiPhy.Set ("CcaMode1Threshold", DoubleValue(-76));.

- Energy Detection threshold, allows the Physical layer to detect the signal that the energy of the signal should be higher than the Threshold value. These lines are responsible for the threshold values of energy.
- CCA model threshold value : It is used for declaring the CCA Busy state, so the energy of the signal should be higher than the threshold value.

Ques.2. How many total packets were successfully received during the simulation?

Ans.2. Total number of packets that are received is increased to 3643. This is due to the fact that the distance has been increased and so the number of packets.

Ques.3. Look at the .routes files? What is the route with largest hop count? How many entries are in the table for each node?

Ans.3. The largest hop count in the .routes file came out to be 9. This means that every node is unable to reach another node and needs intermediate path (nodes) to get to the packet and this is due to the change in the range of nodes.

Part - 3 - Delay

- "***Delay***" is one of the most important which is to be considered in Ad-Hoc Routing. ***Delay*** is simply the time difference once the packet has been sent from transmitter to the time it has been received correctly at the destination.
- Here in our project, we receive this information from the .tr file.
- In this part, I read the .tr file to see whether the packet is being transmitted or received. Then I checked whether the last bit of the destination IPv4 and last bit of DA are same or not; to know if the transmission is direct or through any other node.
- If there is a mismatch, then it means that the packet went through some intermediate nodes with several hop counts. In such case I again checked whether intermediate node sent packet to the destination or not.
- Also checked the reception time when the actual destinal is receiving the packet, since the difference in transmitting time from source to the receiving time at destination is the actual delay if the packet. I then store all the values of delay in a table and add them and divide by the number of elements in the list, from which we get the average delay.
- The maximum value from the list will be the maximum delay.
- Then repeated the same procedure for DSDV, DSR and AODV.

Ques.1. What is the average delay of the packets for DSDV routing protocol?

Ans.1. For DSDV routing the average delay came to be 0.00097.

Ques.2. What is the maximum delay of the packets for DSDV routing protocol?

Ans.2. The maximum delay of the packets for DSDV routing protocol is 0.0165.

Ques.3. How do you determine when a packet is successfully received from the .tr file?

Ans.3. To understand how we can determine whether a packet is successfully received from the .tr file or not, we have following two cases for our consideration -

Case 1: When the Transmission is **DIRECT** -

- In this case, the IP address and the sequence number of the source and destination will be same. Source sends the packet to the destination with the destination address. The receiver looks for destination address field and if it matched then it will accept the data else not.

Case 2: When the transmission is **INDIRECT** (with MULTIPLE HOPS) -

- This is the case with multiple hops and the route is indirect.
- The packet from the source will have both intermediate and destination IPv4 address, which will be encapsulated in the MAC address of source and the destination, telling that the next destination is middle one.
- When packet reaches the middle node, then it updates the MAC address to that of the final destination and then the packet is transmitted to the actual destination.

Part - 4 - Other Routing Protocols

I have uncommented the function, which supports switching between the different routing protocols. Also, ahead of that I ran Python files and did the same process for AODV.

Following are some details of various protocols we are going to use them here in our project:

1. **DSDV** - Destination Sequenced Distance Vector Routing (DSDV) is a table driven routing protocol used in Ad-Hoc networks. It was developed in the year 1994.
- It is extremely useful in solving the LOOP PROBLEM.
- Each entry in the routing table contains a sequence number. This number is generated by the destination and transmitter has to send it out for each updates.

- The most basic ***advantage*** of this protocol is that all routes are present in the network, which shows ***less delay*** for the wait list for finding the routes in the network.
- The ***disadvantage*** is that it requires a regular updation for its tables, which in return need ***battery power*** and a ***small amount of bandwidth***, even when the network is free and idle.

2. **DSR** - Dynamic Source Routing (DSR) is a protocol which makes the tables only on-demand, just like AODV.
- It is used for ***wireless mesh networks***.
- Even though it makes tables only on demand, but it uses ***source routing*** instead of relying on routing table at each intermediate node.

3. **AODV** - Ad-Hoc On Demand Distance Vector (AODV) is the most latest Ad-Hoc routing protocols, developed in the year 2013 at UC Santa Barbara and University of Cincinnati.
- AODV is used in ***ZigBee*** - which is a low power and low data rate ad hoc wireless network.

Ques.1. What is the average delay of the packets for DSR routing protocol?

Ans.1. The average delay for the packets of DSR routing protocol is 6.675 seconds.

Ques.2. What is the maximum delay of the packets for DSR routing protocol?

Ans.2. The average delay for the packets of DSR routing protocol is 0.70 seconds.

Ques.3. What is the average delay of the packets for AODV routing protocol?

Ans.3. The average delay for the packets of AODV routing protocol is 0.02 seconds.

Ques.4. What is the maximum delay of the packets for AODV routing protocol?

Ans.4. The average delay for the packets of AODV routing protocol is 0.04 seconds.

Ques.5. Which protocol successfully transmits the most packets?

Ans.5. The routing protocol which successfully transmits the most packets is AODV. DSR comes next to AODV and then the last one is DSDV.

Ques.6. Which routing protocol has the largest average delay?

Ans.6. The routing protocol which has the largest average delay is DSR.

Ques.7. Which routing protocol has the largest maximum delay?

Ans.7. The routing protocol which has the largest average delay is DSR of 34.9012.

Ques.8. Look at the .pcap files. Describe how different types of packet being sent are different than when using the DSDV routing protocol.

Ans.8.

For DSDV -

- In the pcap file of DSDV we can see that before the actual data is being send, we are sending a chunk of broadcast packets and also receiving them. By the end of such exchanges, the routing table of that particular network is being created.
- Since we know that DSDV is a proactive algorithm. And also a table-driven routing protocol, whereas AODV and DSR are on-demand routing protocols, which means that the route is calculated when needed by the nodes for transmission of data. Due to this DSDV is a proactive protocol whereas AODV and DSR are reactive protocols.

For DSR -

DSR is a reactive algorithm and so the route is discovered before the first time when the data is needed to be send to the destination. Initially broadcast route discovery is done so that to find out the route needed and then a ***ROUTE REQUEST*** and ***ROUTE REPLY*** are obtained. In the pcap file we can see that a list of route request and corresponding route reply are sent. These requests are only for the route needed.

So, DSR and AODV have ***Route Request*** and ***Route Reply*** are the packets that are being sent other than DSDV protocol.

This is the reason for the difference in packet differences while using DSDV routing protocols.