EE286 - Wireless and Mobile Networking

SJSU SAN JOSÉ STATE UNIVERSITY

Project 2

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1. **Counting Received Packets**

Description:

In this part, we ran the project2a.cc file using NS-3. We wrote a Python code "csvparser.py" to parse the CSV file generated and extracted the total packets received from it.

We changed the following line- SeedManager::SetSeed (12345); and set the number to 10000.

project2a.cc

```
bool printRoutingTable = true;
std::string CSVfileName = "Project2Results.csv";

SeedManager::SetSeed (10000);

Config::SetDefault ("ns3::OnOffApplication::PacketSize", StringValue ("1000"));
Config::SetDefault ("ns3::OnOffApplication::DataRate", StringValue (rate));
Config::SetDefault ("ns3::WifiRemoteStationManager::NonUnicastMode", StringValue (phyMode));
Config::SetDefault ("ns3::WifiRemoteStationManager::RtsCtsThreshold", StringValue ("2000"));
```

1. How many transmitters are in the network?
   There are **25 transmitters** in the network.

2. How many receivers are in the network?
   There are **5 receivers** in the network.

3. Who is transmitting to who?
   Every node can transmit to any of the 5 sink nodes (Receivers), but the receivers cannot transmit to themselves.
   Nodes 0, 1, 2, 3 and 4 are sink nodes that is they can transmit and receive. So, we can see IP addresses 10.1.1.1-10.1.1.5 in both the source and destination in Wireshark.
   So, all nodes 0-24 can transmit but nodes 0, 1, 2, 3, 4 will receive.

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

```
('TOTAL PACKETS RECEIVED:', 2548)
aishwaryas@ubuntu:~/source/ns-3.26$ date;
Tue Nov 28 13:02:47 PST 2017
aishwaryas@ubuntu:~/source/ns-3.26$
```

   The total number of packets received during the simulation is **2548.**

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

10.1.1.21	10.1.1.21	10.1.1.1	1	2	9.901s	6.000s
10.1.1.22	10.1.1.21	10.1.1.1	9	2	9.913s	6.000s
10.1.1.23	10.1.1.25	10.1.1.1	5	2	9.929s	0.000s

   The route with the maximum hop count of **9** is from Node 0 (10.1.1.1) to Node 21 (10.1.1.22). The route is as follows:

Node 0 (10.1.1.1) -> Node 20 (10.1.1.21) -> Node 24 (10.1.1.25) -> Node 19 (10.1.1.20) -> Node 17 (10.1.1.18) -> Node 9 (10.1.1.10) -> Node 3 (10.1.1.4) -> Node 16 (10.1.1.17) -> Node 15 (10.1.1.16) -> Node 21 (10.1.1.22).
There are 24 entries in the routing table for each node.

6. Look at the .pcap files. Describe the different types of packets that are being sent.
The different types of packets being sent are- **ARP packets, UDP packets, 802.11 packets (ACK) and packetbb packets.**

No.	Time	Source	Destination	Protocol	Length	Info
84	0.099451	10.1.1.12	10.1.1.255	packetbb	88	
85	0.099877	10.1.1.9	10.1.1.255	packetbb	88	
86	0.100287	10.1.1.2	10.1.1.255	packetbb	88	
87	6.065106	00:00:00_00:00:0c	00:00:00_00:00:05	ARP	64	10.1.1.12 is at 00:00:00:00:00:0c
88	6.066889		00:00:00_00:00:05 (RA)	802.11	14	Acknowledgement, Flags=o.......
89	6.076507	00:00:00_00:00:0c	Broadcast	ARP	64	Who has 10.1.1.2? Tell 10.1.1.12
90	6.077057	00:00:00_00:00:02	00:00:00_00:00:0c	ARP	64	10.1.1.2 is at 00:00:00:00:00:02
91	6.078786	00:00:00_00:00:02	00:00:00_00:00:0c	ARP	64	10.1.1.2 is at 00:00:00:00:00:02
92	6.079240		00:00:00_00:00:02 (RA)	802.11	14	Acknowledgement, Flags=o.......
93	6.080647	10.1.1.5	10.1.1.2	UDP	1064	Source port: 49153 Destination port: 9

First, ARP resolution will take place so every node sends ARP packets to figure out the MAC addresses of other nodes. UDP is used for data transmission between nodes.

2. Transmission Range

Description:
In this part, we changed the EnergyDetectionThreshold and the CCaMode1Threshold to -75 and -76 respectively and then ran the project2a.cc file. We used the same Python parser "csvparser.py" for the CSV file generated and extracted the total received packets from it.

1. What do the lines you changed do?

```
WifiMacHelper wifiMac;
wifiMac.SetType ("ns3::AdhocWifiMac");
YansWifiPhyHelper wifiPhy = YansWifiPhyHelper::Default ();
wifiPhy.Set ("EnergyDetectionThreshold", DoubleValue (-75) );
wifiPhy.Set ("CcaMode1Threshold", DoubleValue(-76));
YansWifiChannelHelper wifiChannel;
```

We changed the EnergyDetectionThreshold to -75 and the CcaMode1Threshold to -76. The EnergyDetectionThreshold is used to set the value of detection at the PHY layer. If the energy of received signal is greater than this threshold, the signal can be detected at the PHY layer. The CcaModel1Threshold allows the PHY layer to declare the Clear Channel Assessment (CCA) Busy State.

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

```
('TOTAL PACKETS RECEIVED:', 675)
aishwaryas@ubuntu:~/source/ns-3.26$
```

The total packets received during this simulation were **675.**

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

```
Node: 7, Time: +10.000s, Local time: +10.000s, DSDV Routing table

DSDV Routing table
Destination     Gateway     Interface     HopCount     SeqNum     LifeTime     SettlingTime
10.1.1.5        10.1.1.18     10.1.1.8        7          2        9.983s      6.000s
```

```
Node: 18, Time: +10.000s, Local time: +10.000s, DSDV Routing table

DSDV Routing table
Destination     Gateway     Interface     HopCount     SeqNum     LifeTime     SettlingTime
10.1.1.3        10.1.1.3      10.1.1.19       1          2        9.978s      0.000s
10.1.1.4        10.1.1.16     10.1.1.19       2          2        9.987s      0.000s
10.1.1.5        10.1.1.16     10.1.1.19       7          2        9.978s      6.000s
```

The route with the largest hop count of **7** is from node 18 (10.1.1.19) to node 4 (10.1.1.5) and from node 7 (10.1.1.8) to node 4 (10.1.1.5). The number of entries in the routing table for each node is different. Node 18 has 13 entries while Node 7 has 12 entries in its routing table. The route is as follows:
Node 7 (10.1.1.8) -> Node 17 (10.1.1.18) -> Node 9 (10.1.1.10) -> Node 13 (10.1.1.14) -> Node 10 (10.1.1.11) -> Node 6 (10.1.1.7) -> Node 4 (10.1.1.5)

3. Delay

Description:

In this part, we wrote a Python parser to parse the Trace file “IP_Trace.tr” generated after running the simulation. This Python file “delay.py” calculates the Maximum Delay and the Average Delay of packet transmission for each routing protocol. We extracted three fields- Source IP, Destination IP and id for every packet transmitted and compared it with the same fields of the receiving packets.

```
aishwaryas@ubuntu:~/source/ns-3.26$ python testpy.py
0.0755830392157
The average delay is 0.0755830392157
The maximum delay is 3.0079
The Total delay is 61.67576
aishwaryas@ubuntu:~/source/ns-3.26$
```

1. What is the average delay of packets for the DSDV routing protocol?
   The average delay of packets for the DSDV routing protocol is **0.075583**

2. What is the maximum delay of packets for the DSDV routing protocol?
   The maximum delay of packets for the DSDV routing protocol is **3.0079**

3. How do you determine when a packet is successfully received from the .tr file?
   We extract three fields namely the Source IP, Destination IP and id field of the transmitted packets from the trace file and match them with the same three fields of the received packets. If there is a match, we find the sending time and the receiving time of the packet and take the difference to find out the delay. This is done for all the packets. We know that a packet is successfully received because of the **Rx(1) field** in the trace file.

4. Other Routing Protocols

Description:

In this Part, we ran the two Python files “csvparser.py” and “delay.py” for DSR and AODV protocols and found out the Average Delay and the Maximum Delay for each protocol.

1. What is the average delay of packets for the DSR routing protocol?
   The average delay of packets for the DSR routing algorithm is **0.44844**

2. What is the maximum delay of packets for the DSR routing protocol?
   The maximum delay of packets for the DSR routing protocol is **36.85236**

3. What is the average delay of packets for the AODV routing protocol?
   The average delay of packets for the AODV routing protocol is **0.043955**

4. What is the maximum delay of packets for the AODV routing protocol?
   The maximum delay of packets for the AODV routing protocol is **2.0017**

5. Which routing protocol successfully transmits the most packets?
   As per the CSV file, the **AODV routing protocol** successfully transmits the most packets.

6. Which routing protocol has the largest average delay?
   The **DSR routing protocol** has the largest average delay.

7. Which routing protocol has the largest maximum delay?
   The **DSR routing protocol** has the largest maximum delay.

8. Look at the .pcap files. Describe how different types of packets being sent are different than when using the DSDV routing protocol.
   In **AODV**, we can **see AODV packets of the type Route Request (RREQ), Route Reply (RREP) and Route Error (RERR), 802.11 ACK Packets, UDP Packets and ARP Packets.**
   In **DSR**, we can see **IPv4 Packets, 802.11 ACK Packets and ARP Packets.**
   In **DSDV**, we can see **packetbb** packets, which are the routing update packets used to construct the routing tables as DSDV is proactive.

5. Number of Users

Description:

In this Part, we changed the number of nodes to 10, 25 and 50 for each protocol and ran the two Python files to find out the total packets received, the Average Delay and the Maximum Delay.

Number of users	Routing Protocols	Total Packets Received	Average Delay	Maximum Delay
10	DSDV	86	0.002763	0.0133
	DSR	218	0.02194	0.0581
	AODV	177	0.004119	0.0173
25	DSDV	675	0.075583	3.0079
	DSR	1136	0.44844	36.85236
	AODV	2212	0.043955	2.0017
50	DSDV	2555	0.2957	4.0268
	DSR	1354	0.7885	42.468
	AODV	2051	0.2518	3.985

6. Effects of Mobility

Description:

In this Part, we changed the Pause time to 1 second for each protocol and ran the two Python files to find out the total packets received, the Average Delay and the Maximum Delay.

Number of users	Routing Protocols	Total Packets Received	Average Delay	Maximum Delay
10	DSDV	112	0.041191	1.0138
	DSR	167	0.18478	15.92557
	AODV	259	0.0356	0.0356
25	DSDV	759	0.10703	2.806
	DSR	1313	0.71048	38.962
	AODV	2586	0.05321	2.7311
50	DSDV	2272	0.28016	3.9959
	DSR	1107	0.677325	42.9358
	AODV	1754	0.23156	3.619