EE 286 Project 2

SAN JOSÉ STATE
UNIVERSITY

Comparison of Routing Algorithms (DSDV, DSR, AODV) using NS3 Simulation

Prepared by

Shiva Gopalkrishnan (012353237)

Karthikeya Remilla (012428546)

Parvathi Chandrasekhar (012474995)

PART 1. COUNTING RECEIVED PACKETS

DSDV:

1. How many transmitters are in the network?

There are 25 Transmitters in the network.

2. How many receivers are in the network?

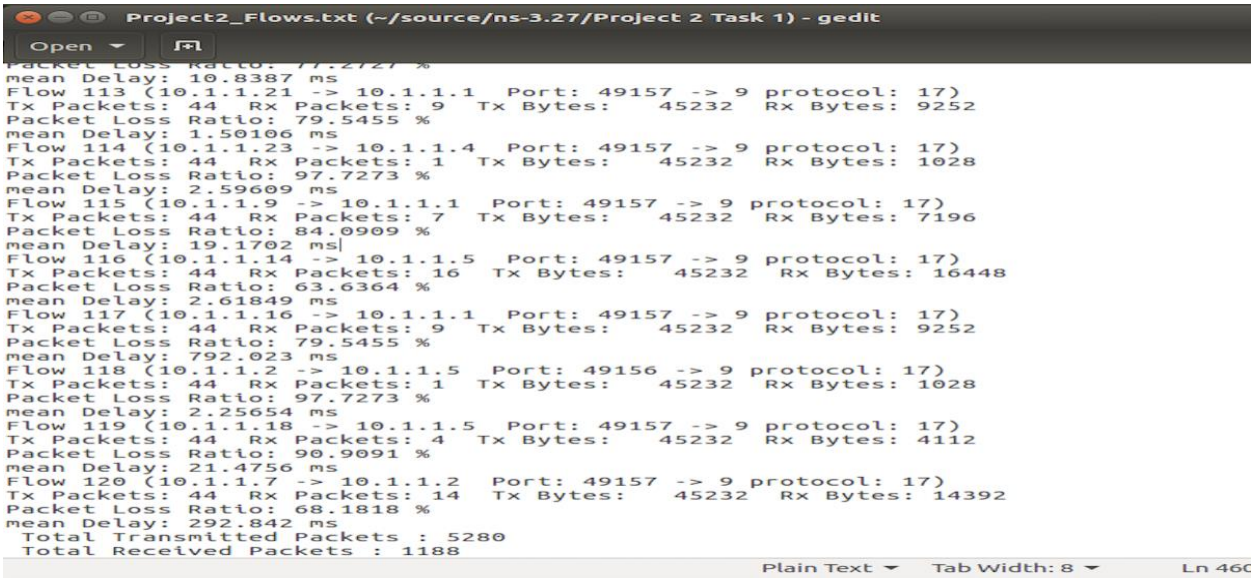
There are 5 Receivers in the network.

3. Who are the sources in the network, who are the destinations?

```
void  ProjectTwoSimulation::InstallApplications ()
{
    for (uint32_t i = 0; i <= m_nSinks - 1; i++ )
        {
            Ptr<Node> node = NodeList::GetNode (i);
            Ipv4Address nodeAddress = node->GetObject<Ipv4> ()->GetAddress (1, 0).GetLocal ();
            Ptr<Socket> sink = SetupPacketReceive (nodeAddress, node);
            }
```

As per the code, Nodes 0,1,2,3,4 are the destinations and remaining are the sources in the network.

4. How many total packets were transmitted during the simulation and how many were successfully received? What was the delivery ratio?

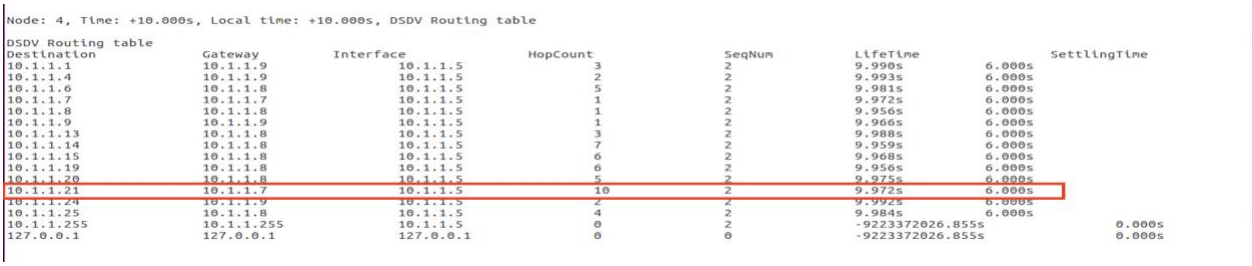


Total Transmitted Packets = 5280
Total Received Packets = 1188

Delivery Ratio = 1188/5280 = 0.225 = 22.5%

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?

There are 2 entries with largest Hop Count of 10 at Node 4 and Node 8.



Node: 4, Time: +10.000s, Local time: +10.000s, DSDV Routing table

DSDV Routing table

Destination	Gateway	Interface	HopCount	SeqNum	LifeTime	SettlingTime
10.1.1.1	10.1.1.9	10.1.1.5	3	2	9.990s	6.000s
10.1.1.4	10.1.1.9	10.1.1.5	2	2	9.993s	6.000s
10.1.1.6	10.1.1.8	10.1.1.5	5	2	9.981s	6.000s
10.1.1.7	10.1.1.7	10.1.1.5	1	2	9.972s	6.000s
10.1.1.8	10.1.1.8	10.1.1.5	1	2	9.956s	6.000s
10.1.1.9	10.1.1.9	10.1.1.5	1	2	9.966s	6.000s
10.1.1.13	10.1.1.8	10.1.1.5	3	2	9.988s	6.000s
10.1.1.14	10.1.1.8	10.1.1.5	7	2	9.959s	6.000s
10.1.1.15	10.1.1.8	10.1.1.5	6	2	9.968s	6.000s
10.1.1.19	10.1.1.8	10.1.1.5	6	2	9.956s	6.000s
10.1.1.20	10.1.1.8	10.1.1.5	5	2	9.975s	6.000s
10.1.1.21	10.1.1.7	10.1.1.5	10	2	9.972s	6.000s
10.1.1.24	10.1.1.9	10.1.1.5	2	2	9.992s	6.000s
10.1.1.25	10.1.1.8	10.1.1.5	4	2	9.984s	6.000s
10.1.1.255	10.1.1.255	10.1.1.5	0	2	-9223372026.855s	0.000s
127.0.0.1	127.0.0.1	127.0.0.1	0	0	-9223372026.855s	0.000s

Node: 8, Time: +10.000s, Local time: +10.000s, DSDV Routing table

DSDV Routing table

Destination	Gateway	Interface	HopCount	SeqNum	LifeTime	SettlingTime
10.1.1.1	10.1.1.24	10.1.1.9	2	2	9.991s	6.000s
10.1.1.4	10.1.1.4	10.1.1.9	1	2	9.958s	6.000s
10.1.1.5	10.1.1.5	10.1.1.9	1	2	9.955s	6.000s
10.1.1.6	10.1.1.4	10.1.1.9	6	2	9.980s	6.000s
10.1.1.7	10.1.1.7	10.1.1.9	1	2	9.955s	6.000s
10.1.1.8	10.1.1.5	10.1.1.9	2	2	9.987s	6.000s
10.1.1.13	10.1.1.5	10.1.1.9	4	2	9.987s	6.000s
10.1.1.14	10.1.1.4	10.1.1.9	8	2	9.958s	6.000s
10.1.1.15	10.1.1.5	10.1.1.9	7	2	9.967s	6.000s
10.1.1.19	10.1.1.5	10.1.1.9	7	2	9.955s	6.000s
10.1.1.20	10.1.1.5	10.1.1.9	6	2	9.974s	6.000s
10.1.1.21	10.1.1.7	10.1.1.9	10	2	9.972s	6.000s
10.1.1.24	10.1.1.24	10.1.1.9	1	2	9.965s	0.000s
10.1.1.25	10.1.1.5	10.1.1.9	5	2	9.983s	6.000s
10.1.1.255	10.1.1.255	10.1.1.9	0	2	-9223372026.855s	0.000s
127.0.0.1	127.0.0.1	127.0.0.1	0	0	-9223372026.855s	0.000s

NODE 0	15
NODE 1	3
NODE 2	16
NODE 3	15
NODE 4	16
NODE 5	16
NODE 6	15
NODE 7	18
NODE 8	16
NODE 9	3
NODE 10	15
NODE 11	15
NODE 12	20
NODE 13	17
NODE 14	15
NODE 15	16
NODE 16	15
NODE 17	18
NODE 18	15
NODE 19	15
NODE 20	18
NODE 21	18
NODE 22	15
NODE 23	15
NODE 24	21

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

PacketBB: It is a general purpose multi-message packet format specification designed for information exchange between MANET nodes.
ARP: It is a protocol used by the Internet Protocol to map IP network addresses to the hardware addresses used by a data link protocol.
UDP: It is a datagram-oriented transport layer protocol.

PART 2. Transmission Range

1. What do the lines you changed do?

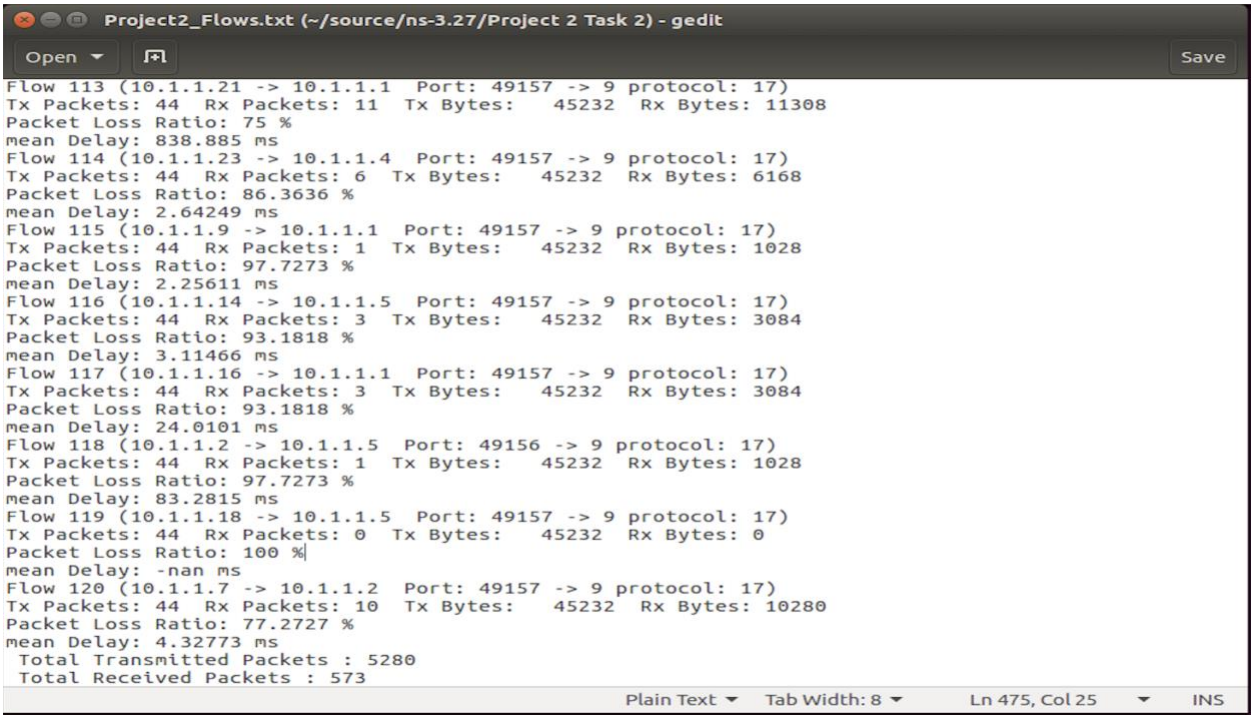
```
void  ProjectTwoSimulation::CreateDevices (std::string tr_name)
{
        WifiMacHelper wifiMac;
        wifiMac.SetType ("ns3::AdhocWifiMac");
        YansWifiPhyHelper wifiPhy = YansWifiPhyHelper::Default ();
        wifiPhy.Set ("EnergyDetectionThreshold", DoubleValue (-77) );
        wifiPhy.Set ("CcaMode1Threshold", DoubleValue(-78));
        YansWifiChannelHelper wifiChannel;
        wifiChannel.SetPropagationDelay ("ns3::ConstantSpeedPropagationDelayModel");
        wifiChannel.AddPropagationLoss ("ns3::FriisPropagationLossModel");
        wifiPhy.SetChannel (wifiChannel.Create ());
        WifiHelper wifi;
        wifi.SetStandard (WIFI_PHY_STANDARD_80211b);
        wifi.SetRemoteStationManager ("ns3::ConstantRateWifiManager", "DataMode", StringValue (m_phyMode), "ControlMode",
                                      StringValue (m_phyMode));
        devices = wifi.Install (wifiPhy, wifiMac, nodes);


        //PCAP FILE CODE
        wifiPhy.EnablePcapAll (tr_name);


}
```

By reducing the threshold value, the number of packets received are reduced from 1188 to 573. Receivers will accept only those packets which have energy/power more than the threshold.

2. How many total packets were successfully received during the simulation? What was the packet delivery ratio?

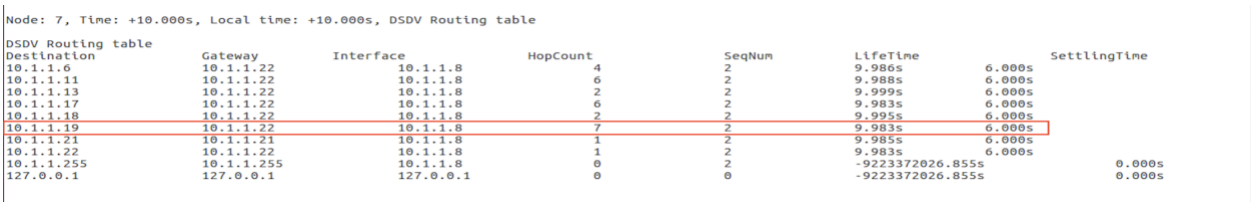


Total Number of Received packets = 573 Packets
Total Number of Transmitted packets = 5280 Packets

Packet Delivery ratio = 573/5280 = 0.1085 = 10.85%

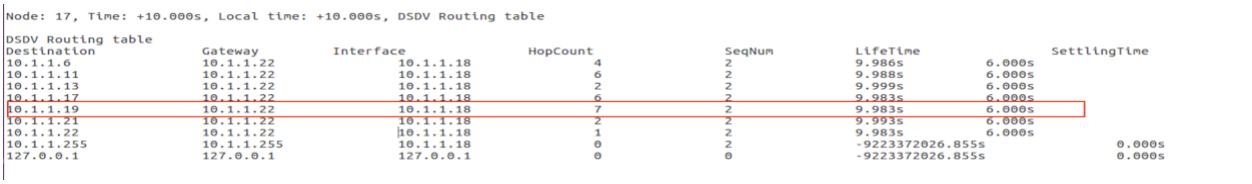
3. Look at the .routes file. What is the route with the largest hop count? How many entries are in the table for each node?

There are 4 entries with largest Hop Count of 7 at Node 7, Node 17, Node 20 and Node 22.



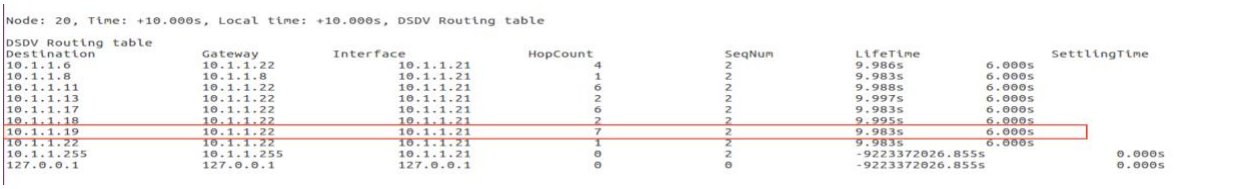
```
Node: 7, Time: +10.000s, Local time: +10.000s, DSDV Routing table

DSDV Routing table
Destination         Gateway         Interface         HopCount         SeqNum         LifeTime         SettlingTime
10.1.1.6            10.1.1.22         10.1.1.8                4               2          9.986s            6.000s
10.1.1.11           10.1.1.22         10.1.1.8                6               2          9.988s            6.000s
10.1.1.13           10.1.1.22         10.1.1.8                2               2          9.999s            6.000s
10.1.1.17           10.1.1.22         10.1.1.8                6               2          9.983s            6.000s
10.1.1.18           10.1.1.22         10.1.1.8                2               2          9.995s            6.000s
10.1.1.19           10.1.1.22         10.1.1.8                7               2          9.983s            6.000s
10.1.1.21           10.1.1.21         10.1.1.8                1               2          9.985s            6.000s
10.1.1.22           10.1.1.22         10.1.1.8                1               2          9.983s            6.000s
10.1.1.255          10.1.1.255        10.1.1.8                0               2          -9223372026.855s                  0.000s
127.0.0.1           127.0.0.1         127.0.0.1               0               0          -9223372026.855s                  0.000s
```



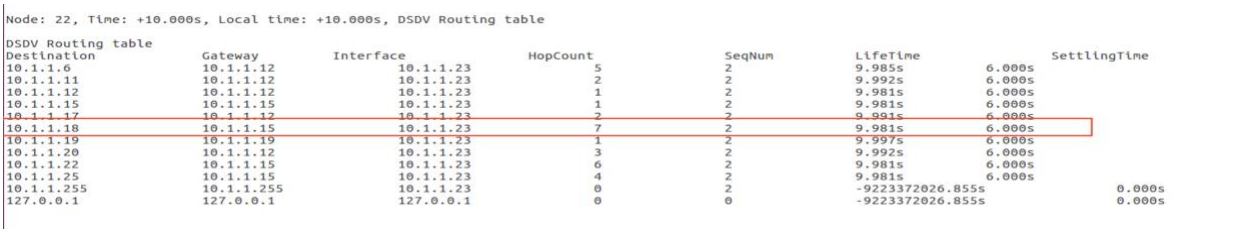
```
Node: 17, Time: +10.000s, Local time: +10.000s, DSDV Routing table

DSDV Routing table
Destination         Gateway         Interface         HopCount         SeqNum         LifeTime         SettlingTime
10.1.1.6            10.1.1.22         10.1.1.18               4               2          9.986s            6.000s
10.1.1.11           10.1.1.22         10.1.1.18               6               2          9.988s            6.000s
10.1.1.13           10.1.1.22         10.1.1.18               2               2          9.999s            6.000s
10.1.1.17           10.1.1.22         10.1.1.18               6               2          9.983s            6.000s
10.1.1.19           10.1.1.22         10.1.1.18               7               2          9.983s            6.000s
10.1.1.21           10.1.1.22         10.1.1.18               2               2          9.993s            6.000s
10.1.1.22           10.1.1.22         10.1.1.18               1               2          9.983s            6.000s
10.1.1.255          10.1.1.255        10.1.1.18               0               2          -9223372026.855s                  0.000s
127.0.0.1           127.0.0.1         127.0.0.1               0               0          -9223372026.855s                  0.000s
```



```
Node: 20, Time: +10.000s, Local time: +10.000s, DSDV Routing table

DSDV Routing table
Destination         Gateway         Interface         HopCount         SeqNum         LifeTime         SettlingTime
10.1.1.6            10.1.1.22         10.1.1.21               4               2          9.986s            6.000s
10.1.1.8            10.1.1.8          10.1.1.21               1               2          9.983s            6.000s
10.1.1.11           10.1.1.22         10.1.1.21               6               2          9.988s            6.000s
10.1.1.13           10.1.1.22         10.1.1.21               2               2          9.997s            6.000s
10.1.1.17           10.1.1.22         10.1.1.21               6               2          9.983s            6.000s
10.1.1.18           10.1.1.22         10.1.1.21               2               2          9.995s            6.000s
10.1.1.19           10.1.1.22         10.1.1.21               7               2          9.983s            6.000s
10.1.1.22           10.1.1.22         10.1.1.21               1               2          9.983s            6.000s
10.1.1.255          10.1.1.255        10.1.1.21               0               2          -9223372026.855s                  0.000s
127.0.0.1           127.0.0.1         127.0.0.1               0               0          -9223372026.855s                  0.000s
```



```
Node: 22, Time: +10.000s, Local time: +10.000s, DSDV Routing table

DSDV Routing table
Destination         Gateway         Interface         HopCount         SeqNum         LifeTime         SettlingTime
10.1.1.6            10.1.1.12         10.1.1.23               5               2          9.985s            6.000s
10.1.1.11           10.1.1.12         10.1.1.23               2               2          9.992s            6.000s
10.1.1.12           10.1.1.12         10.1.1.23               1               2          9.981s            6.000s
10.1.1.15           10.1.1.15         10.1.1.23               1               2          9.981s            6.000s
10.1.1.17           10.1.1.12         10.1.1.23               2               2          9.991s            6.000s
10.1.1.18           10.1.1.15         10.1.1.23               7               2          9.981s            6.000s
10.1.1.19           10.1.1.19         10.1.1.23               1               2          9.997s            6.000s
10.1.1.20           10.1.1.12         10.1.1.23               3               2          9.992s            6.000s
10.1.1.22           10.1.1.15         10.1.1.23               6               2          9.981s            6.000s
10.1.1.25           10.1.1.15         10.1.1.23               4               2          9.981s            6.000s
10.1.1.255          10.1.1.255        10.1.1.23               0               2          -9223372026.855s                  0.000s
127.0.0.1           127.0.0.1         127.0.0.1               0               0          -9223372026.855s                  0.000s
```

NODE 0	3
NODE 1	3
NODE 2	2
NODE 3	2
NODE 4	4
NODE 5	14
NODE 6	4
NODE 7	10
NODE 8	4
NODE 9	3
NODE 10	12
NODE 11	12
NODE 12	9
NODE 13	2
NODE 14	12
NODE 15	14
NODE 16	12
NODE 17	9
NODE 18	12
NODE 19	13
NODE 20	10
NODE 21	10
NODE 22	12
NODE 23	2
NODE 24	14

PART 3. Delay

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

Average Delay = 0.07929

2. How did you determined the total average delay from the average delays of each flow?

In .txt file, we used the formula,
total average delay = $\sum$ ((mean delay(i) x received packets(i)))/total received packets for all flows
$\sum$ -> summation from i = 1 to No. of Flows

PART 4. Other Routing Protocols

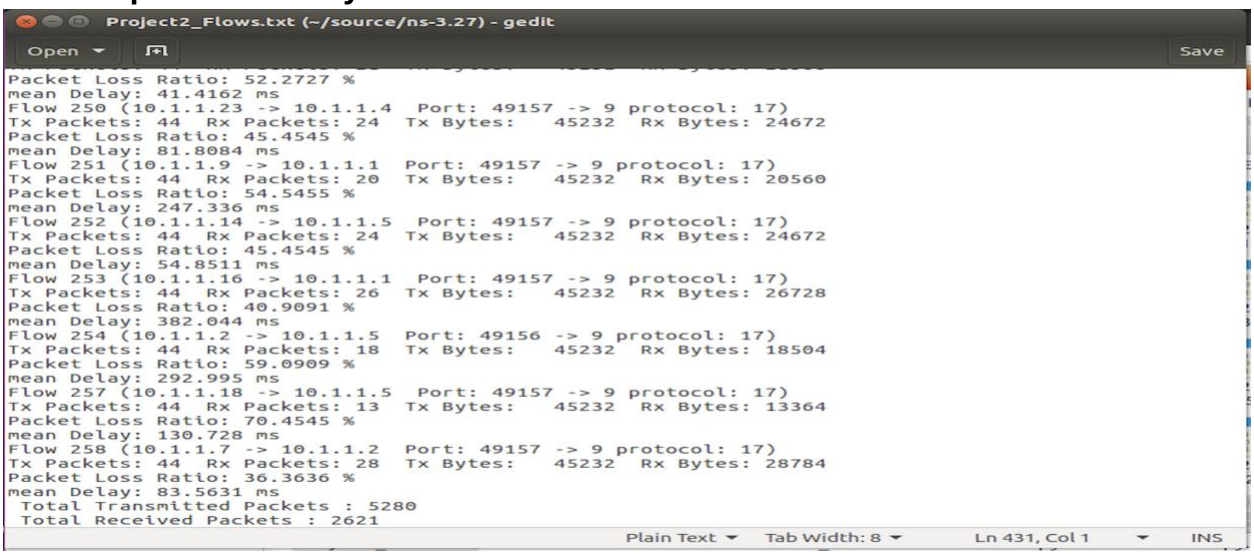
AODV:

AODV is an on–Demand routing protocol which is a combination of both DSDV and j8. Route is calculated on demand, just as it is in DSR via route discovery process. On the other hand, AODV also maintains a routing table where it maintains one entry per destination unlike the DSR that maintains multiple route cache entries for each target.

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

Average Delay = 0.18216

2. How many total packets were successfully received during the simulation? What was the packet delivery ratio?



Total Transmitted Packets = 5280 Packets
Total Received Packets = 2621 Packets

Delivery Ratio = 2621/5280 = 0.496 = 49.6%

3. Look at the .pcap files. Describe how different types of packets being sent are different than when using the DSDV routing protocol?

AODV, UDP, ARP

DSR:

DSR is an On-Demand routing protocol, where the route is calculated only when it is necessary. It does not use any periodic routing messages like AODV, thus reduces bandwidth overhead and conserved battery power and huge routing updates.

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

Average Delay = 2.213

2. How many total packets were successfully received during the simulation? What was the packet delivery ratio?

Total Transmitted Packets = 5280
Total Received Packets = 1074

Delivery Ratio = 1074/5280 = 0.203 = 20.3%

3. Look at the .pcap files. Describe how different types of packets being sent are different than when using the DSDV routing protocol?

DSR: The routing information is inserted in the header of the actual data packet. From the Wireshark analysis, we can see that there is an options field in the DSR protocol packets, which indicated that DSR inserts routing information in the options field of the header.
ARP: It is a protocol used by the Internet Protocol to map IP network addresses to the hardware addresses used by a data link protocol.
UDP: It is a datagram-oriented transport layer protocol.

Summarization:

1. Which routing protocol successfully transmits the most packets?

AODV Routing Protocol successfully transmits the most packets with 2621 packets.

2. Which routing protocol has the largest average delay?

DSR has the largest average delay.

3. Which routing protocol has the largest maximum delay?

DSR has the largest maximum delay.

4. Look at the .pcap files. Describe how different types of packets being sent are different than when using the DSDV routing protocol?

In DSDV, PacketBB packets are used. These packets are general purpose multi-message packet format specification designed for information exchange between MANET nodes. In DSR, the routing information is inserted in the header of the actual data packet. From the Wireshark analysis, we can see that there is an options field in the DSR protocol packets, which indicated that DSR inserts routing information in the options field of the header.

PART 5. Number of Users

Number of Users	Routing Protocol	Total Packets Rec.	Packet Delivery Ratio	Avg. Delay
10	DSDV	183	0.231	0.00404
	DSR	455	0.574	0.960
	AODV	408	0.515	0.5219
25	DSDV	1188	0.225	0.07929
	DSR	1974	0.373	2.213
	AODV	2621	0.496	0.18216

PART 6. Effects of Mobility

Pause = 1s

Number of Users	Routing Protocol	Total Packets Rec.	Packet Delivery Ratio	Avg. Delay
10	DSDV	192	0.242	0.004
	DSR	403	0.508	1.225
	AODV	356	0.449	0.759
25	DSDV	1421	0.269	0.1477
	DSR	1962	0.371	1.425
	AODV	2697	0.510	0.205