Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Ethan Ridd
School of Applied Computing, Faculty of Architecture, Computing and Engineering,
University of Wales Trinity St David, Mount Pleasant, Swansea, SA1 6ED,
BSc Computer Networks and Cybersecurity.
Email: eridd.144898@student.uwtsd.ac.uk

School of
Applied Computing

Comparing the Performance of Routing Protocols on Mobile Ad Hoc Networks (MANET)

Introduction: Mobile Ad Hoc Network or MANETs are a form of wireless networks that require no centralised infrastructure such as a route or hub[1]. The nodes within the network perform routing for themselves and their neighbours. MANETs use 3 types of routing protocols, Reactive which only creates routes when they are needed such as DSR or AODV, Proactive which maintains routes constantly an example being OLSR and DSDV. A third type of routing protocols being Hybrid routing protocols such as ZRP which has characteristics of the other 2 types. For this project the author knew he couldn't compare all the different types of routing protocols against one another as they all work so differently so he decided to focus on reactive protocols, specifically AODV and DSR[2].

Implementation: The author created several simulations within Netsim[3] each with a different node density(15, 30, 45) as seen in figure 1. The simulations would run both AODV and DSR routing protocols. The author ran the simulations without interference then ran them again with interference to understand how the protocols work under the interference naturally found affecting wireless networks. To simulate traffic within the network the author created 5 constant bit rate applications with a packet size of 1460 bytes. The author then calculated the mean average of the 5 applications and used the Delay and Throughput as metrics.

Testing: The author also ran a Wireshark program between the nodes 12 and 1 to monitor the packets being sent through these 2 node as can be seen in figure 2. We can see the numerous packets associated with DSR, such as the route request and route reply packets used in route creation. We can also see the UDP packets that are used to sent the CBR packets. At the bottom of figure 2, in the data section we can see the English alphabet used as test data and we can see that the data size is at 1460 bytes which the author had configured. Wireshark was very helpful in understanding how the network performed.

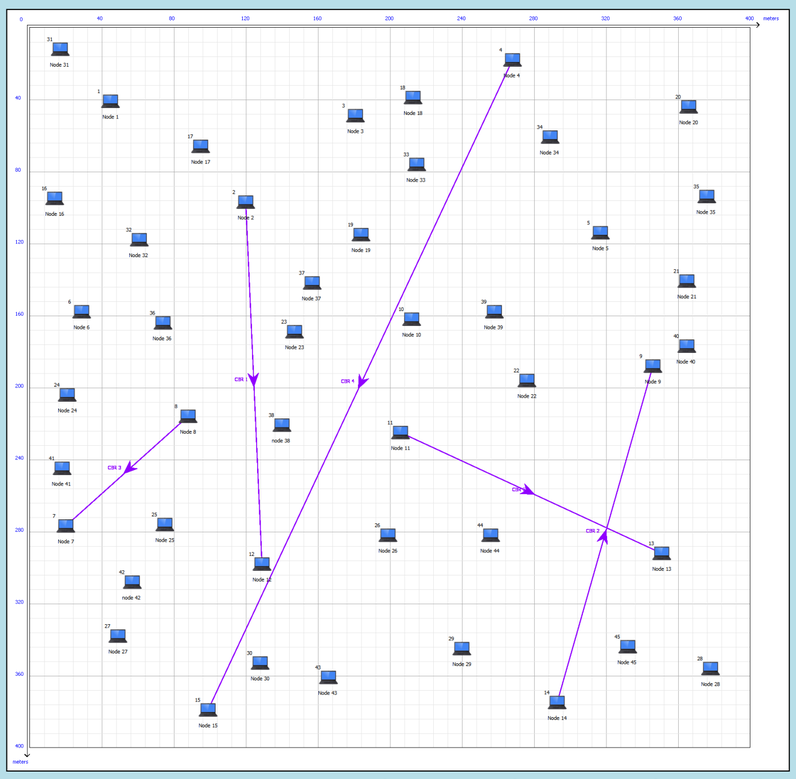
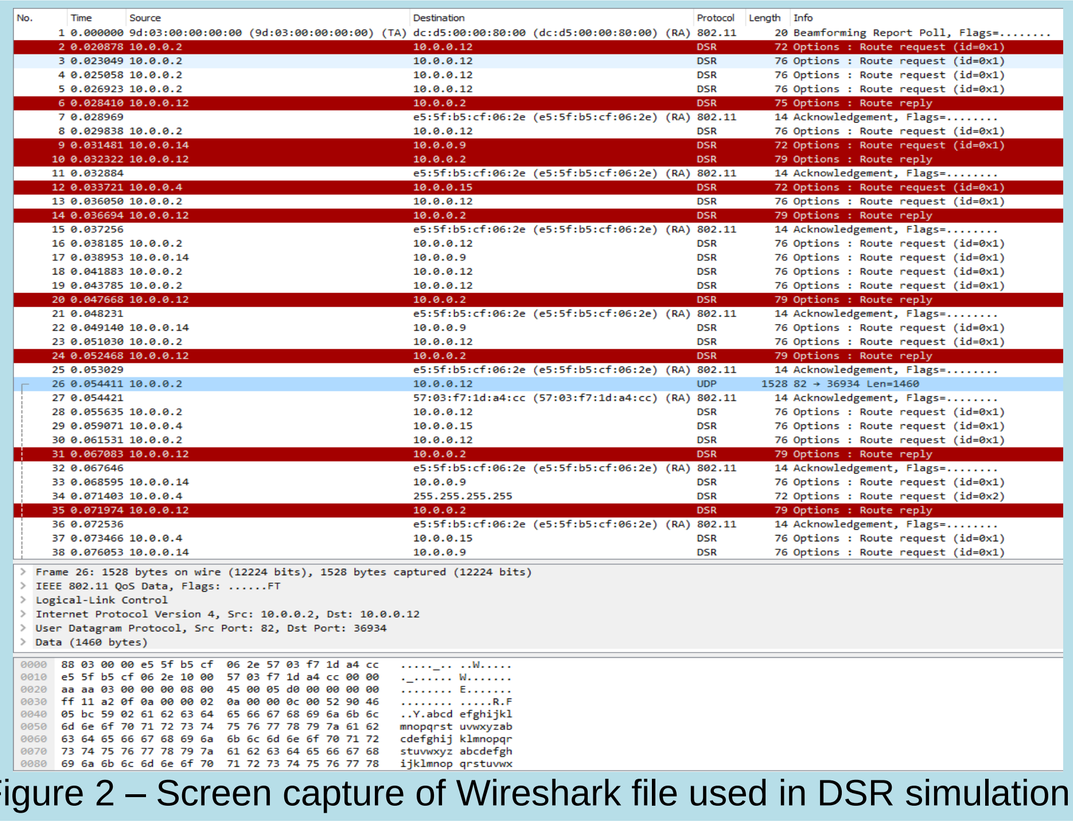


Figure 1 – Screen captures showing the 45 node topology



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	9d:03:00:00:00:00 (9d:03:00:00:00:00) (TA)	dc:d5:00:00:80:00 (dc:d5:00:00:80:00) (RA)	802.11	20	Beamforming Report Poll, Flags=.....
2	0.020878	10.0.0.2	10.0.0.12	DSR	72	Options : Route request (id=0x1)
3	0.023049	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
4	0.025058	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
5	0.026923	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
6	0.028410	10.0.0.12	10.0.0.2	DSR	75	Options : Route reply
7	0.028969		e5:5f:b5:cf:06:2e (e5:5f:b5:cf:06:2e) (RA)	802.11	14	Acknowledgement, Flags=.....
8	0.029838	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
9	0.031481	10.0.0.14	10.0.0.9	DSR	72	Options : Route request (id=0x1)
10	0.032322	10.0.0.12	10.0.0.2	DSR	79	Options : Route reply
11	0.032884		e5:5f:b5:cf:06:2e (e5:5f:b5:cf:06:2e) (RA)	802.11	14	Acknowledgement, Flags=.....
12	0.033721	10.0.0.4	10.0.0.15	DSR	72	Options : Route request (id=0x1)
13	0.036050	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
14	0.036694	10.0.0.12	10.0.0.2	DSR	79	Options : Route reply
15	0.037256		e5:5f:b5:cf:06:2e (e5:5f:b5:cf:06:2e) (RA)	802.11	14	Acknowledgement, Flags=.....
16	0.038185	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
17	0.038953	10.0.0.14	10.0.0.9	DSR	76	Options : Route request (id=0x1)
18	0.041883	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
19	0.043785	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
20	0.047668	10.0.0.12	10.0.0.2	DSR	79	Options : Route reply
21	0.048231		e5:5f:b5:cf:06:2e (e5:5f:b5:cf:06:2e) (RA)	802.11	14	Acknowledgement, Flags=.....
22	0.049140	10.0.0.14	10.0.0.9	DSR	76	Options : Route request (id=0x1)
23	0.051030	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
24	0.052468	10.0.0.12	10.0.0.2	DSR	79	Options : Route reply
25	0.053029		e5:5f:b5:cf:06:2e (e5:5f:b5:cf:06:2e) (RA)	802.11	14	Acknowledgement, Flags=.....
26	0.054411	10.0.0.2	10.0.0.12	UDP	1528	82 → 36934 Len=1460
27	0.054421		57:03:f7:1d:a4:cc (57:03:f7:1d:a4:cc) (RA)	802.11	14	Acknowledgement, Flags=.....
28	0.055635	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
29	0.059071	10.0.0.4	10.0.0.15	DSR	76	Options : Route request (id=0x1)
30	0.061531	10.0.0.2	10.0.0.12	DSR	76	Options : Route request (id=0x1)
31	0.067083	10.0.0.12	10.0.0.2	DSR	79	Options : Route reply
32	0.067646		e5:5f:b5:cf:06:2e (e5:5f:b5:cf:06:2e) (RA)	802.11	14	Acknowledgement, Flags=.....
33	0.068595	10.0.0.14	10.0.0.9	DSR	76	Options : Route request (id=0x1)
34	0.071403	10.0.0.4	255.255.255.255	DSR	72	Options : Route request (id=0x2)
35	0.071974	10.0.0.12	10.0.0.2	DSR	79	Options : Route reply
36	0.072536		e5:5f:b5:cf:06:2e (e5:5f:b5:cf:06:2e) (RA)	802.11	14	Acknowledgement, Flags=.....
37	0.073466	10.0.0.4	10.0.0.15	DSR	76	Options : Route request (id=0x1)
38	0.076053	10.0.0.14	10.0.0.9	DSR	76	Options : Route request (id=0x1)

```
> Frame 26: 1528 bytes on wire (12224 bits), 1528 bytes captured (12224 bits)
> IEEE 802.11 QoS Data, Flags: ......FT
> Logical-Link Control
> Internet Protocol Version 4, Src: 10.0.0.2, Dst: 10.0.0.12
> User Datagram Protocol, Src Port: 82, Dst Port: 36934
> Data (1460 bytes)

0000  88 03 00 00 e5 5f b5 cf  06 2e 57 03 f7 1d a4 cc   ......_. ..W.....
0010  e5 5f b5 cf 06 2e 10 00  57 03 f7 1d a4 cc 00 00   ._...... W.......
0020  aa aa 03 00 00 00 08 00  45 00 05 d0 00 00 00 00   ........ E.......
0030  ff 11 a2 0f 0a 00 00 02  0a 00 00 0c 00 52 90 46   ........ .....R.F
0040  05 bc 59 02 61 62 63 64  65 66 67 68 69 6a 6b 6c   ..Y.abcd efghijkl
0050  6d 6e 6f 70 71 72 73 74  75 76 77 78 79 7a 61 62   mnopqrst uvwxyzab
0060  63 64 65 66 67 68 69 6a  6b 6c 6d 6e 6f 70 71 72   cdefghij klmnopqr
0070  73 74 75 76 77 78 79 7a  61 62 63 64 65 66 67 68   stuvwxyz abcdefgh
0080  69 6a 6b 6c 6d 6e 6f 70  71 72 73 74 75 76 77 78   ijklmnop qrstuvwx
```

Figure 2 – Screen capture of Wireshark file used in DSR simulation

Results: The results gathered from the simulations show some interesting trends, as can be seen in figure 3 the delay of the all 4 scenarios show that the CBR average of DSR both with and without interference increases drastically during the 30 node simulations, even though on the 15 and 45 node simulations the delay was much closer to AODV. AODV remained on an clear trend through all of the simulations both with and without interference. When it came to the data relating to the average throughput of the CBR, the AODV remain a constant with on a small decrease in throughput on the 45 node simulation. When it came to the DSR simulations the throughout remained almost equal the AODV on the 15 and 45 node scenarios, but again at 30 nodes the throughput experience a substantial drop decreasing by roughly 50% as seen in figure 4. What is interesting is that DSR with interference had better through put on average that DSR without interference.

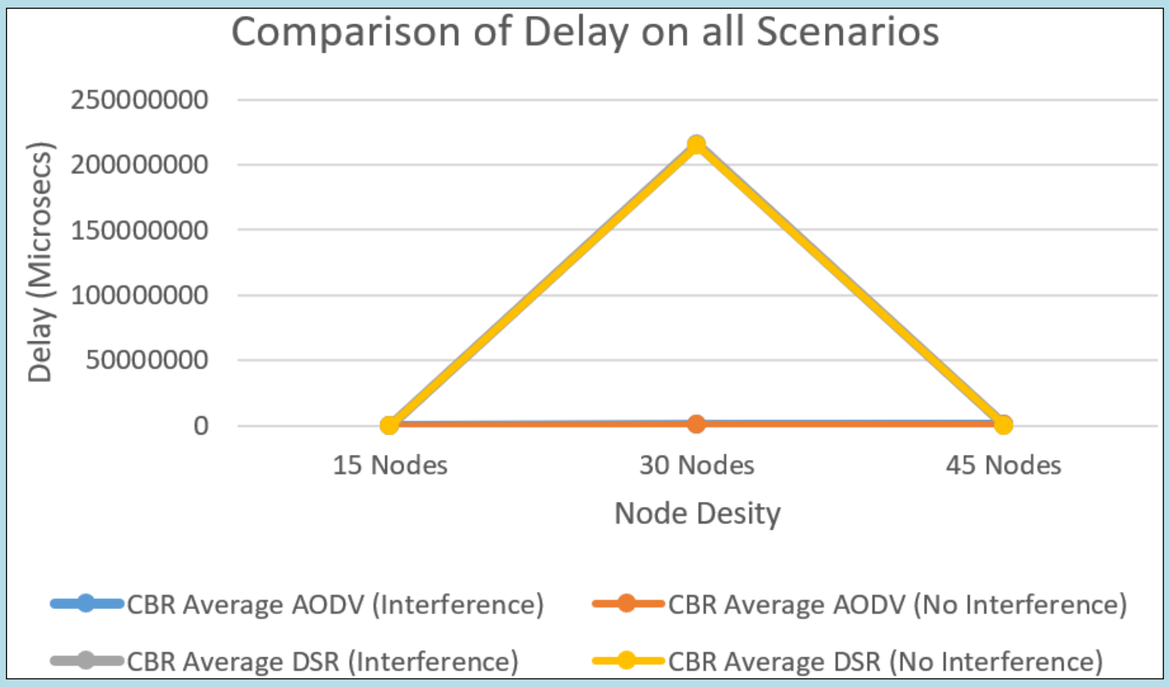


Figure 3 – Graph showing Delay Results

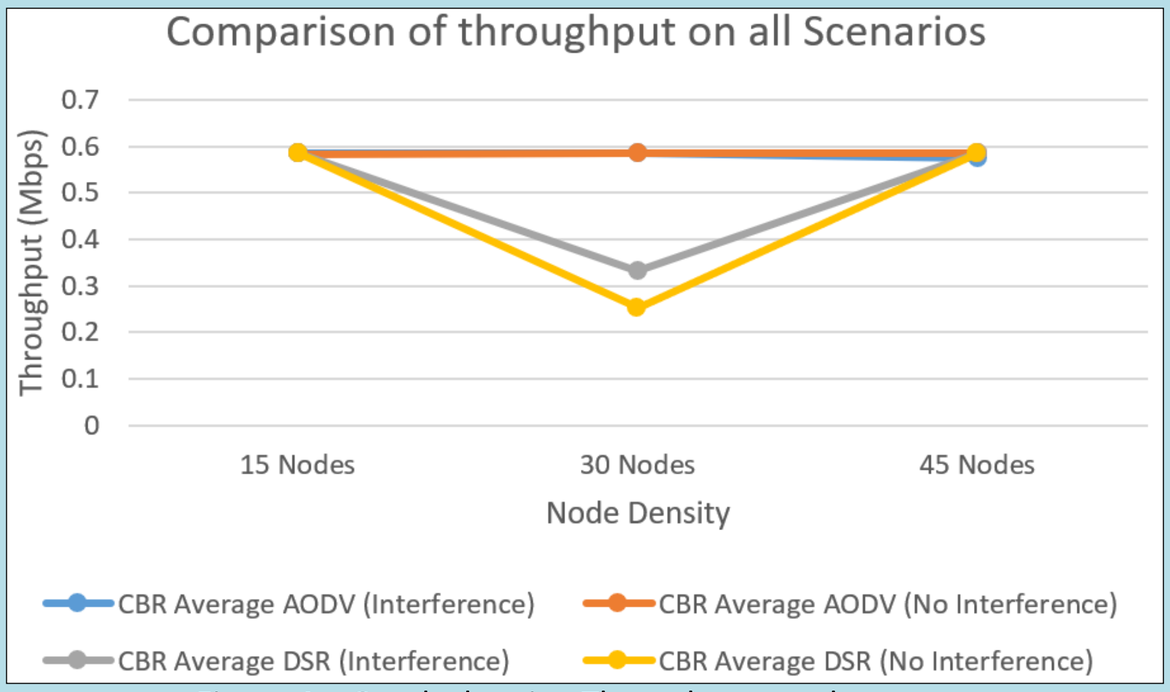


Figure 4 – Graph showing Throughput results

Conclusion / Future Work: To conclude, the data gathered from the simulations show that AODV is superior to DSR as the throughput tested higher in the AODV simulation than DSR and the Delay was lower with AODV than it was with DSR. These result have also been found in research conducted by others such as a paper from California state university by Dr Nan Wang et al [4] which states that AODV was better the 4 other routing protocols compared. The disparity found in the DSR simulations with a 30 node density could be caused by numerous factors such as the way DSR works and handles constant streams of data or the way the author configure the simulations. In the future the author would like to simulate the networks and the routing protocols in more physical medium using Raspberry Pi's, this would allow him to simulate and test TORA against the other 2 routing protocols, which Netsim does not currently support. The author would also like to repeat these simulations a few more times to gather more reliable data.

[1] M. A. Phillip, "A WHITE PAPER ON THE MOBILE AD-HOC NETWORKS FOR THE EXISTING PROTOCOLS AND APPLICATIONS," vol. 1, no. 2, pp. 19–29, 2014.
[2] D. N. Patel, S. B. Patel, H. R. Kothadiya, P. D. Jethwa, and R. H. Jhaveri, "A survey of reactive routing protocols in MANET," in *International Conference on Information Communication and Embedded Systems (ICICES2014)*, 2014, pp. 1–6.
[3] "NetSim-Network Simulator & Emulator | Home." [Online]. Available: http://www.tetcos.com/. [Accessed: 04-Oct-2017].
[4] Y. Bai, Y. Mai, and N. Wang, "Performance comparison and evaluation of the proactive and reactive routing protocols for MANETs," in *2017 Wireless Telecommunications Symposium (WTS)*, 2017, pp. 1–5.