Simulation and analysis on different Mobile Wireless Ad Hoc Networks (MANET) routing protocols

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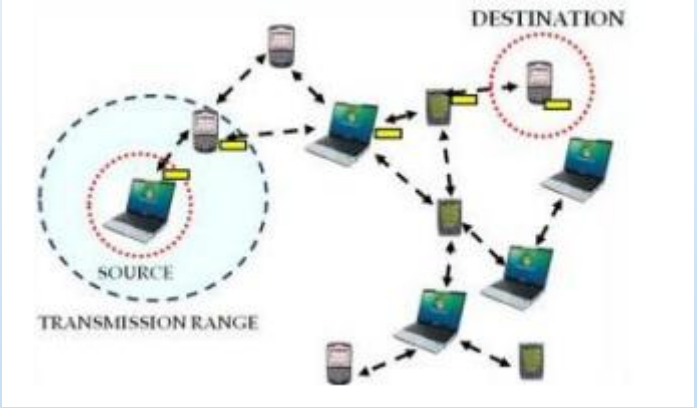
Outlines

- Motivation
- DSR Protocol
- AODV Protocol
- TORA Protocol
- Related Works
- Scenarios and Result
- Conclusion
- References

Motivation

- Evaluate the performance based on:
  - Number of Nodes
  - Transmission Power
  - Source Data Rate
  - Environment Size



- Compare the performance of three different routing protocols

García Villalba, L.J.; García Matesanz, J.; Sandoval Orozco, A.L.; Márquez Díaz, J.D. Auto-Configuration Protocols in Mobile Ad Hoc Networks. Sensors 2011, 11, 3652-3666.

DSR Protocol

- Dynamic Source Routing is a protocol for wireless mesh networks
- An on-demand protocol designed to restrict bandwidth consumed
- Based on source routing

Advantages	Disadvantages
Eliminates the need to periodically flood the network with table update messages	The route maintenance mechanism does not locally repair a broken link
Eliminates the need to find routes to all other nodes in the network	Might result in inconsistencies during the route reconstruction
Reduces the control overhead by utilizing the route cache information	The performance degrades rapidly with increasing mobility

AODV Protocol

- Ad hoc On-Demand Distance Vector Routing is a routing protocol for mobile ad hoc networks and other wireless ad hoc networks
- Used in ZigBee

Advantages	Disadvantages
Can respond very quickly to the topological changes that affect the active routers	Has a high processing demand
Support both unicast and multicast packet transmission	Consumes a large share of the bandwidth
Lower setup delay for connections and detection of the latest route to the destination	Take a long time to build the routing table

TORA Protocol

- The Temporally Ordered Routing Algorithm is an algorithm for routing data across Wireless Mesh Networks or Mobile ad hoc networks
- Limit control message propagation in the highly dynamic mobile computing environment

Advantages	Disadvantages
Create a DAG only when necessary	Periodic beaconing leads to unnecessary bandwidth consumption
Multiple paths created	Not scalable by any means
Good in dense networks	High processing demand

Related Works

- Dr. R. Shanmugavadivu1, B. Chitra2, “A COMPARISON OF REACTIVE ROUTING PROTOCOLS DSR, AODV AND TORA IN MANET”

  This paper compared three reactive routing protocols DSR,AODV and TORA and analysed the advantages and disadvantages of these protocols

- N. Adam, “Effect of node density on performances of three MANET routing protocols - IEEE Conference Publication"

  This paper analysed the performance using the following metrics:packet delivery ratio, end-to-end delay, packet dropped, routing load and end-to-end throughput

- Dr. R. Shanmugavadivu and B. Chitra, "A COMPARISON OF REACTIVE ROUTING PROTOCOLS DSR, AODV AND TORA IN MANET," 2016. [online] Ijarcet.org. Available at: <http://ijarcet.org/wp-content/uploads/IJARCET-VOL-5-ISSUE-2-296-300.pdf> [Accessed 7 April 2020].
- N. Adam, "Effect of node density on performances of three MANET routing protocols - IEEE Conference Publication", Ieeexplore.ieee.org, 2020. [Online]. Available: https://ieeexplore.ieee.org/document/5503051/. [Accessed: 06- Feb- 2020]

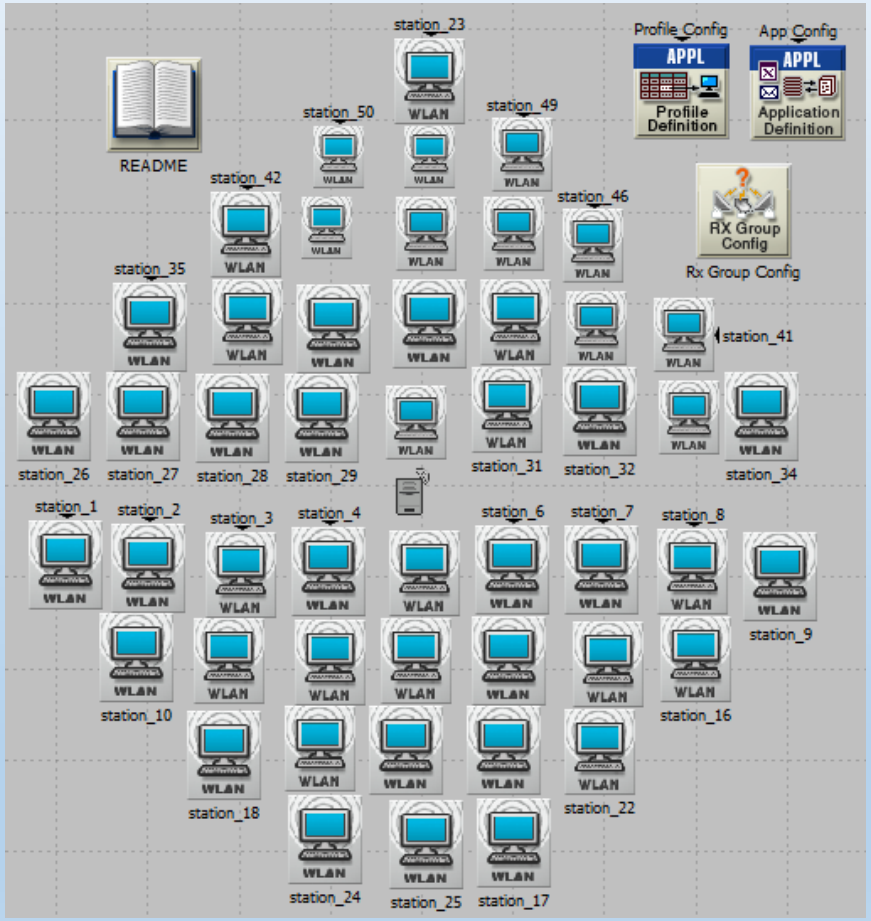
Scenarios Setup

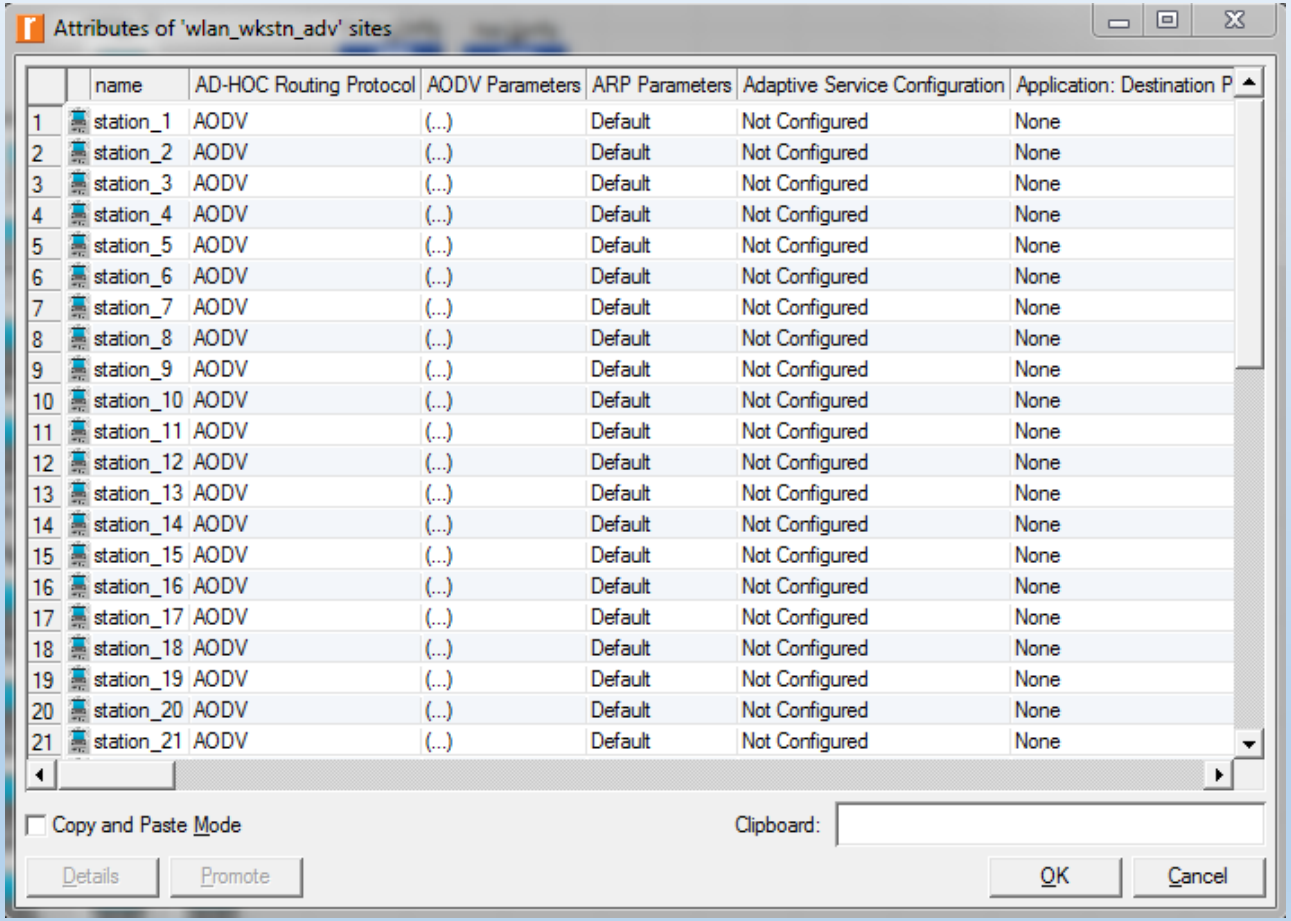
- Comparison of the performance of the three routing protocols based on varying parameters using Riverbed Modeler.

Simulation time	1 Hour
Bandwidth	2 Mb
Traffic type	FTP
Packet size	512
Number of nodes	10, 25 and 50 nodes
Transmission power	0.005 W, 0.03 W, and 0.05 W
Source data rate	1 Mbps, 2 Mbps and 5.5 Mbps
Environment size	10×10, 10×15 and 10×20

- Scenarios are:
  1. Performance (Throughput) based on number of nodes
  2. Performance (Throughput) based on transmission power
  3. Performance (Throughput) based on source data rate
  4. Performance (Throughput) based on environment size

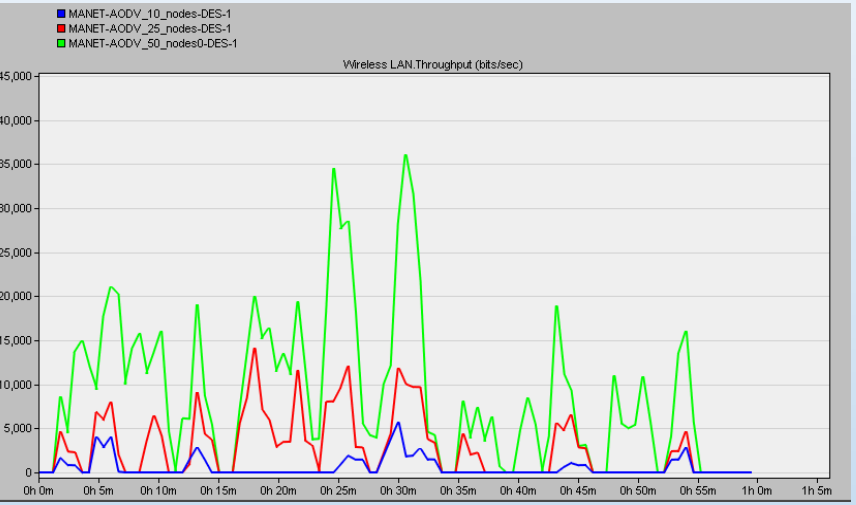
50-node AODV Network Example



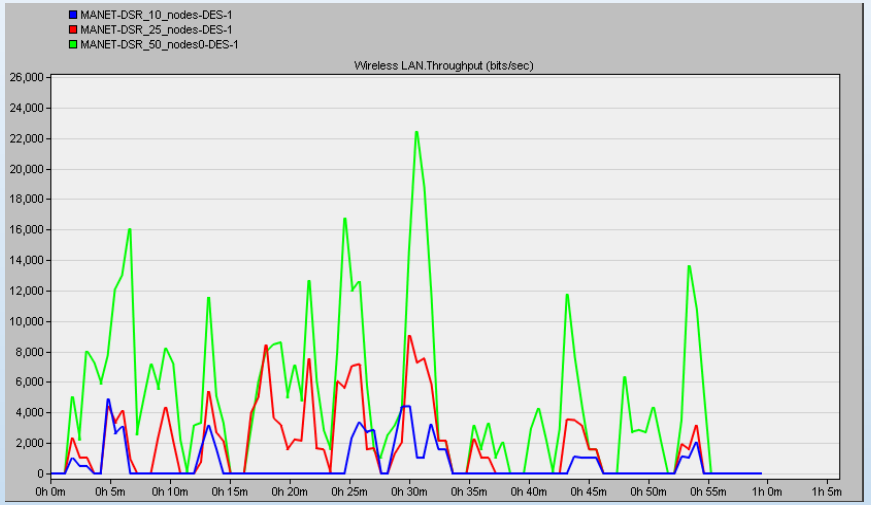


Scenario 1: Performance (Throughput) based on Number of Nodes

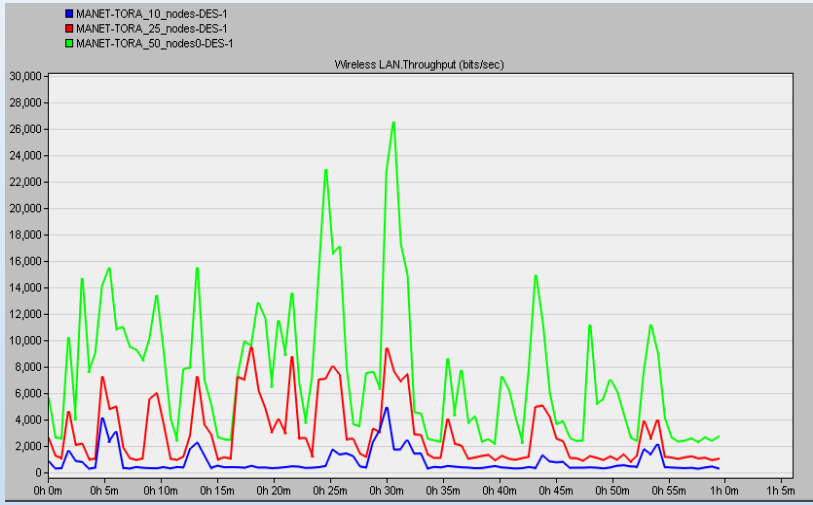
AODV: 10 vs 25 vs 50 nodes

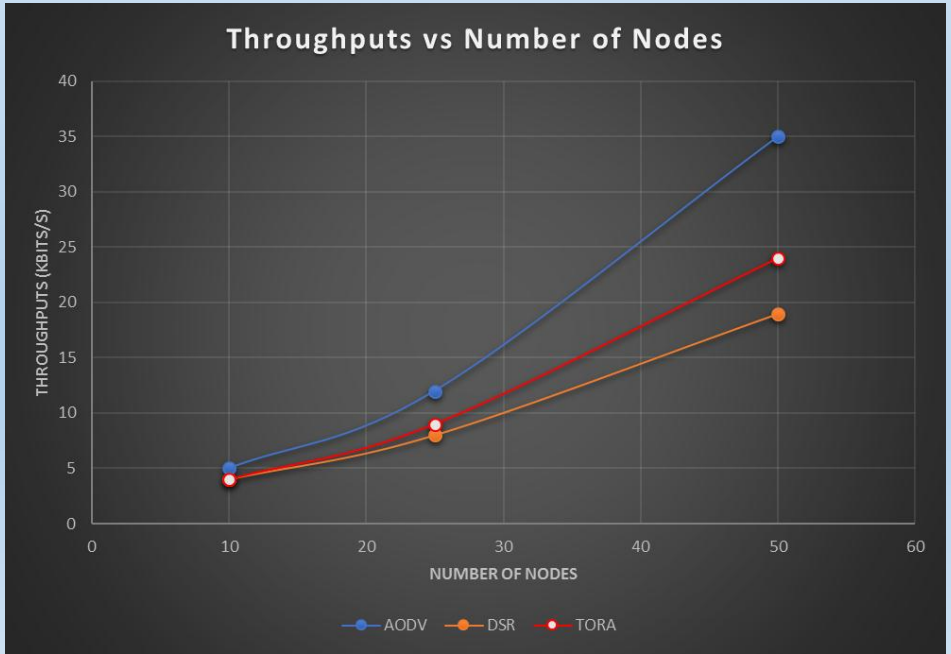


DSR: 10 vs 25 vs 50 nodes



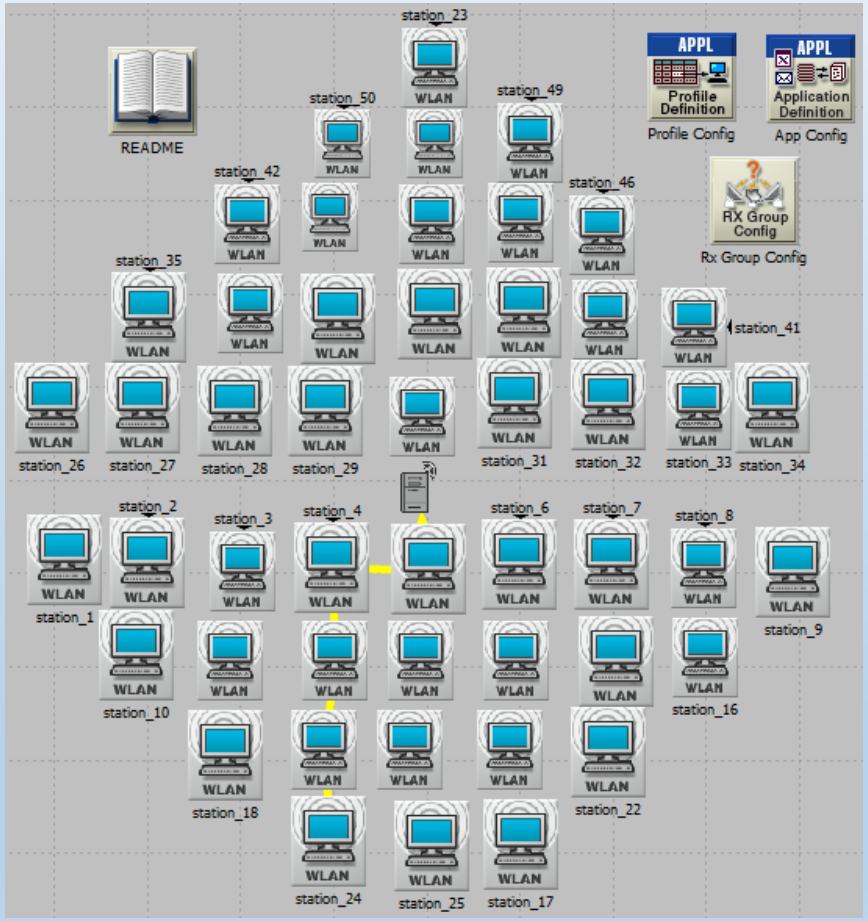
TORA: 10 vs 25 vs 50 nodes

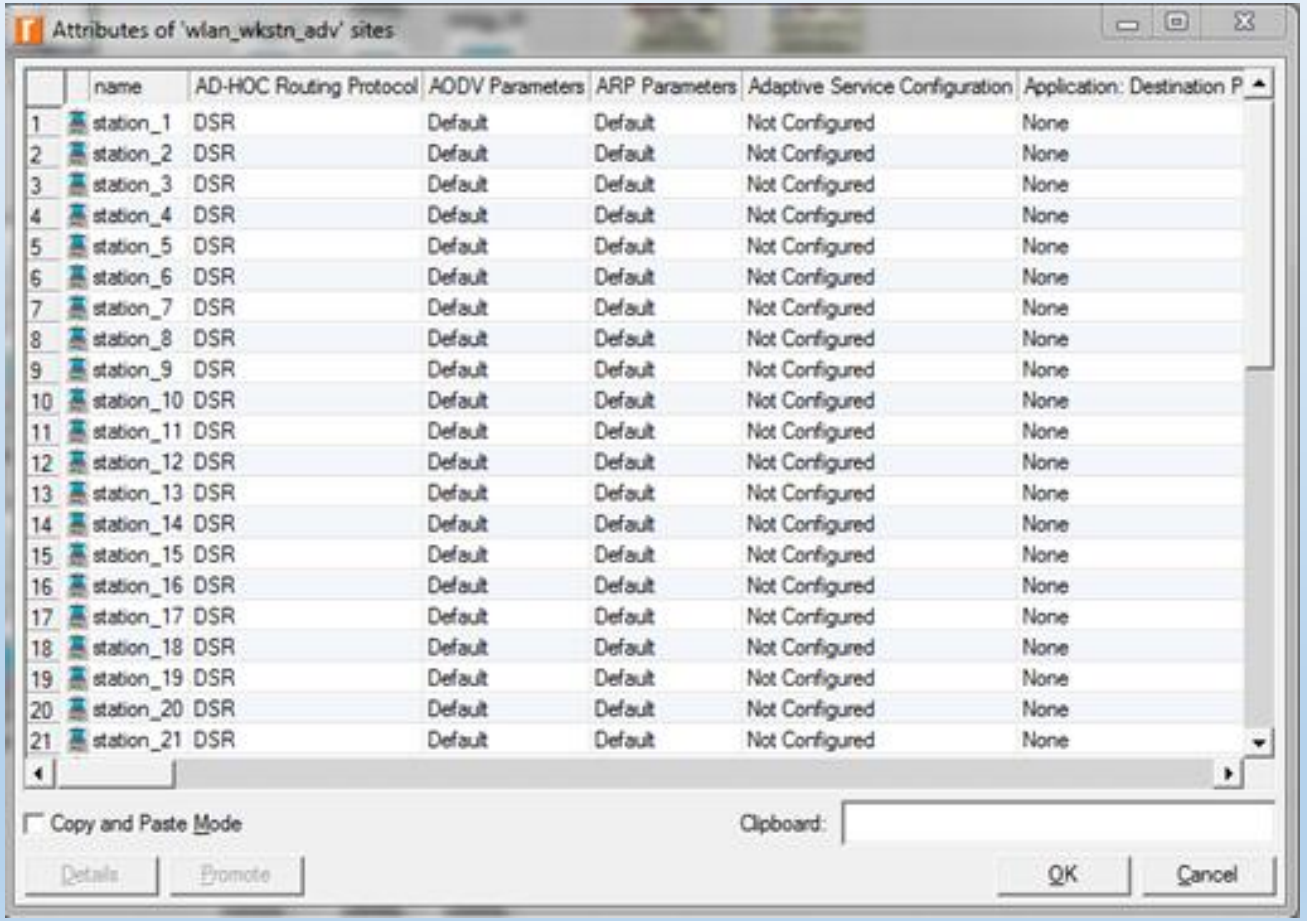




Result: Throughput is increasing as the number of nodes increases for all protocols. AODV has the largest throughput for any number of nodes situations. Both DSR and TORA performs quite similar increase trend in this scenario

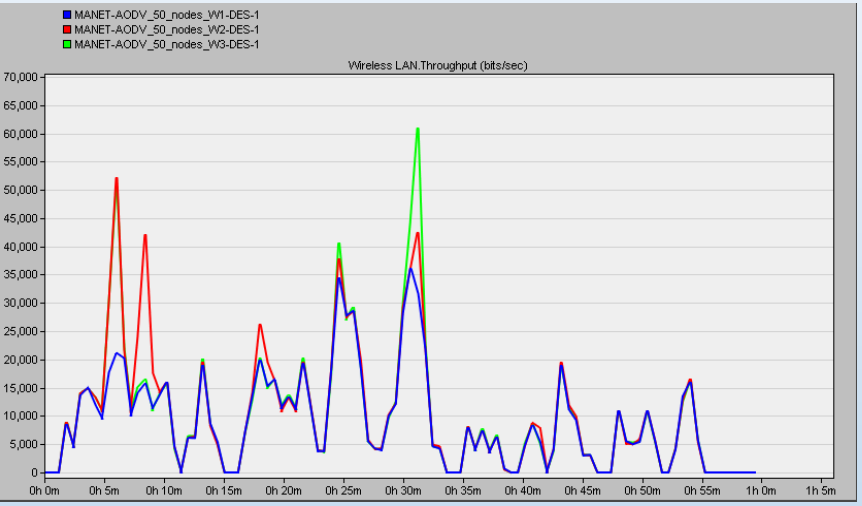
50-node DSR network with 0.005 W Example



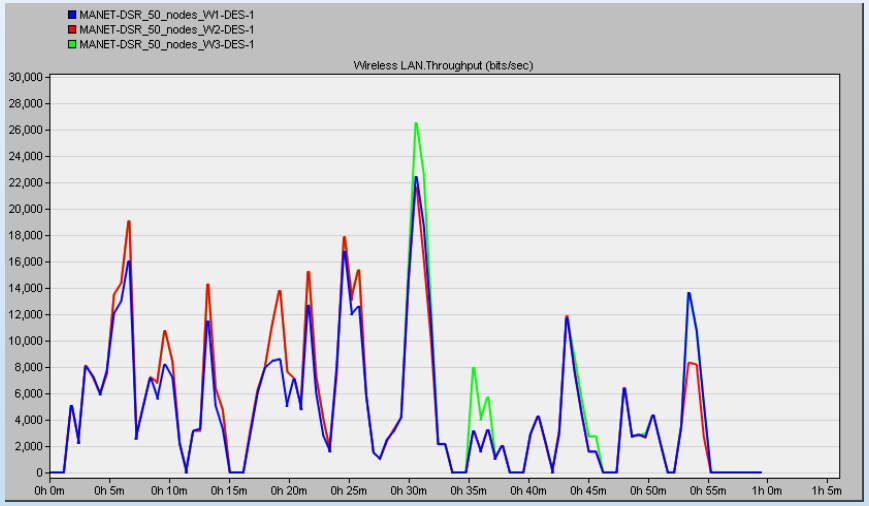


Scenario 2: Performance (Throughput) based on Transmission Power

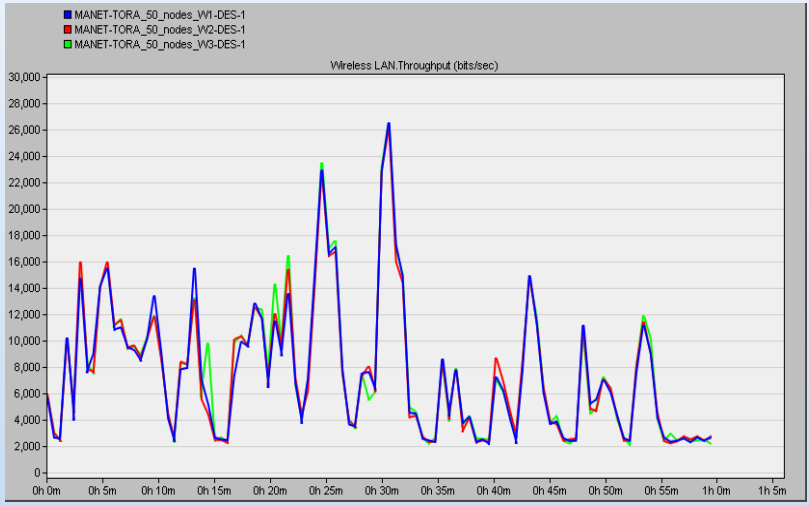
AODV: 0.005 vs 0.03 vs 0.05 W

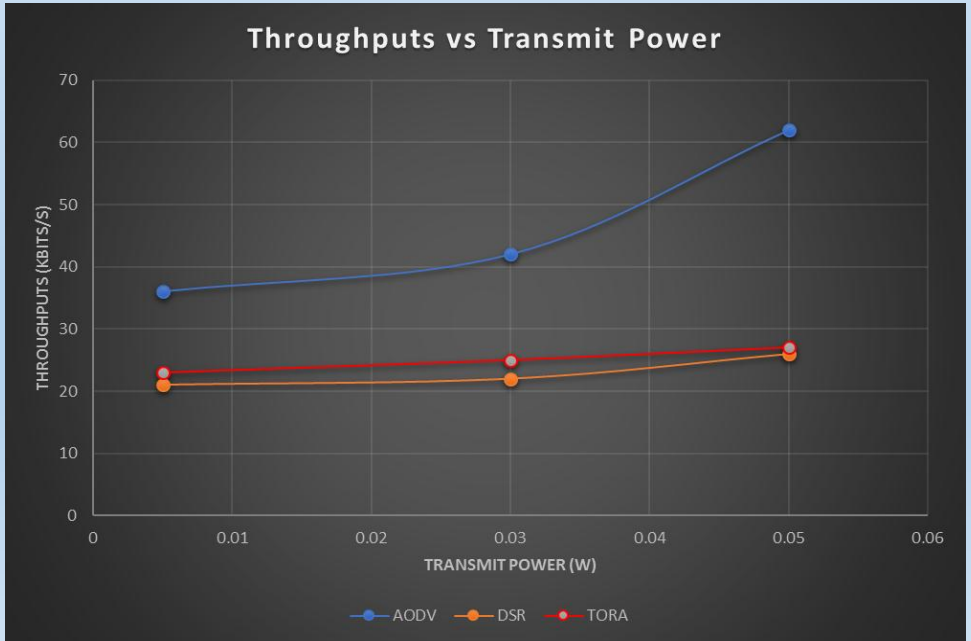


DSR: 0.005 vs 0.03 vs 0.05 W



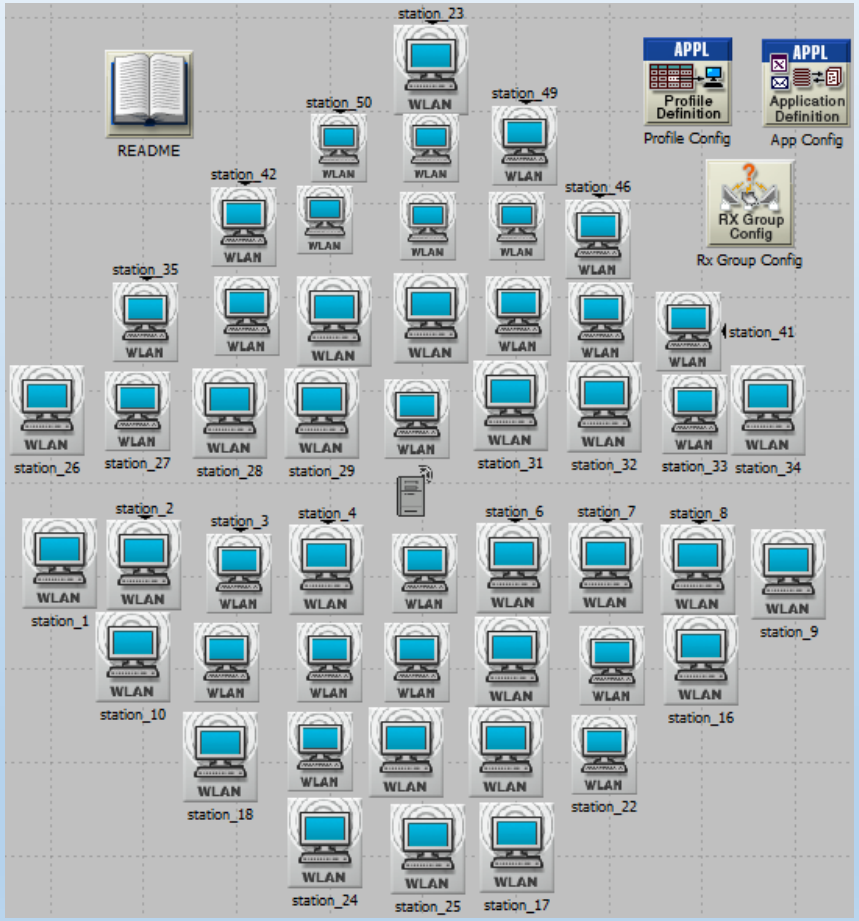
TORA: 0.005 vs 0.03 vs 0.05 W

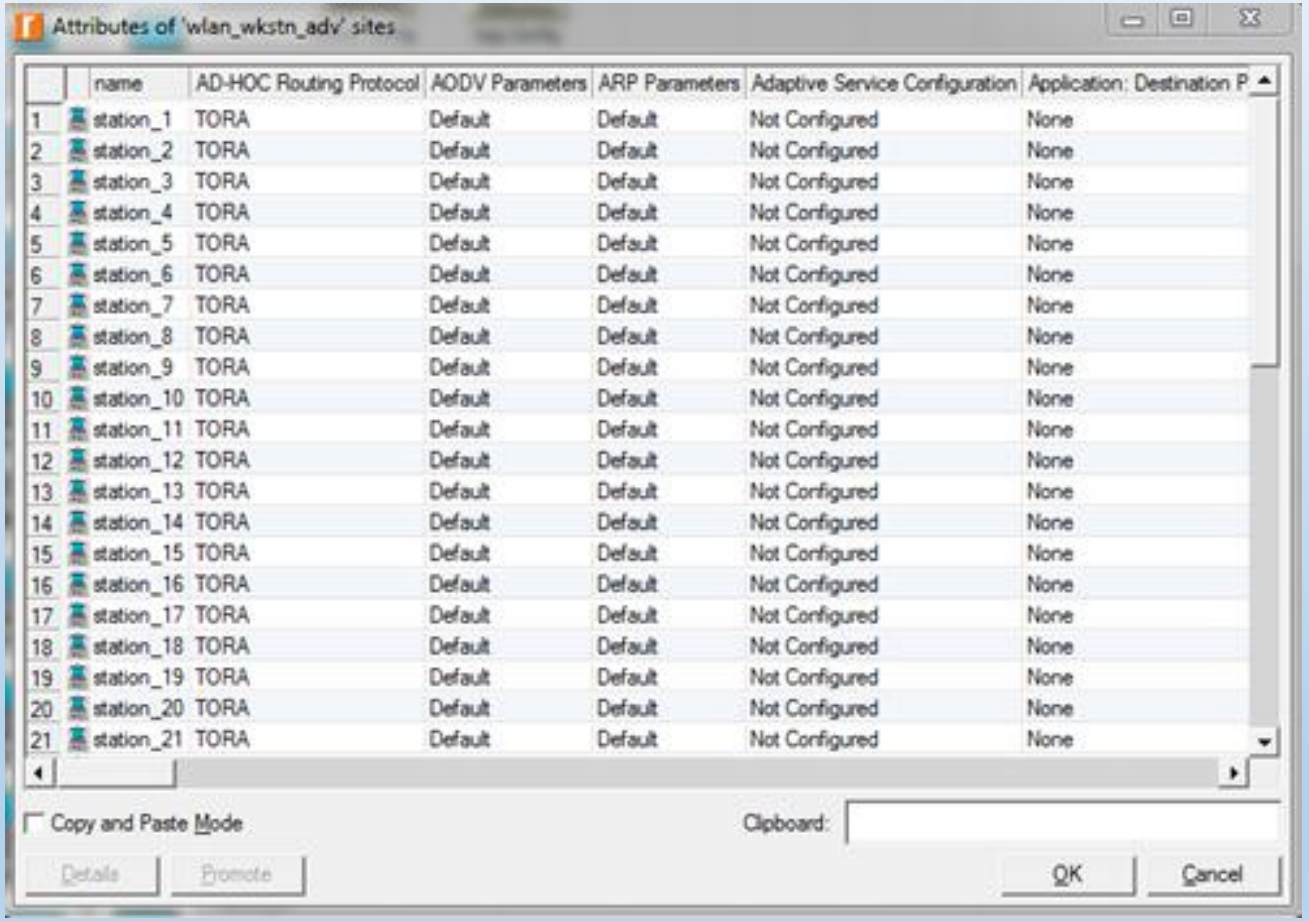




Result: Throughput is slightly increasing as the transmission power increases for all protocols. AODV performs the largest rise in throughput with the increase of transmission power. But, DSR and TORA don't show significant growth.

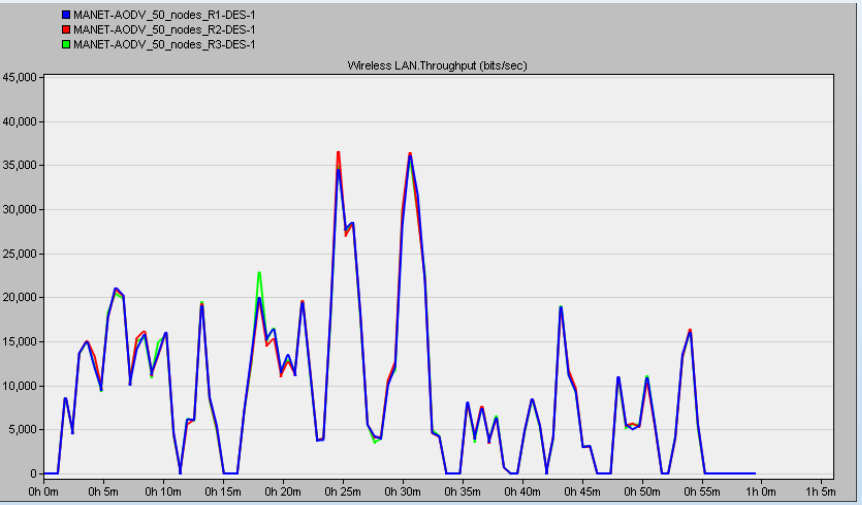
50-node TORA network with 1 Mbps Example



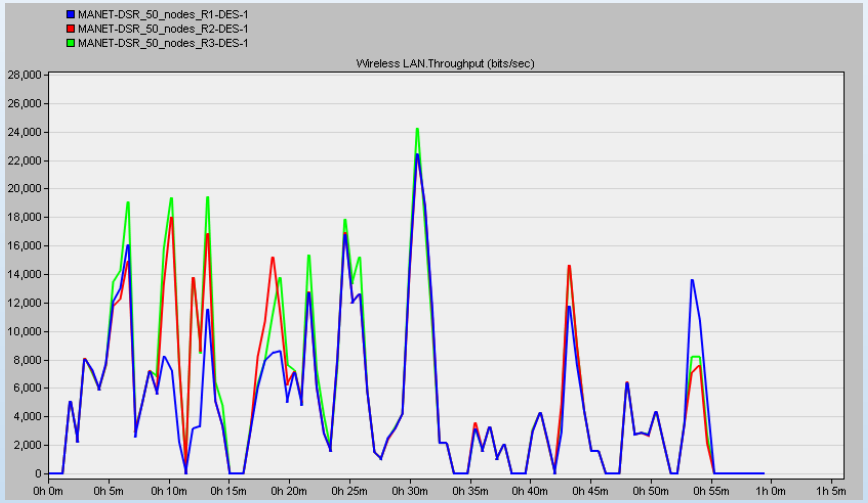


Scenario 3: Performance (Throughput) based on Source Data Rate

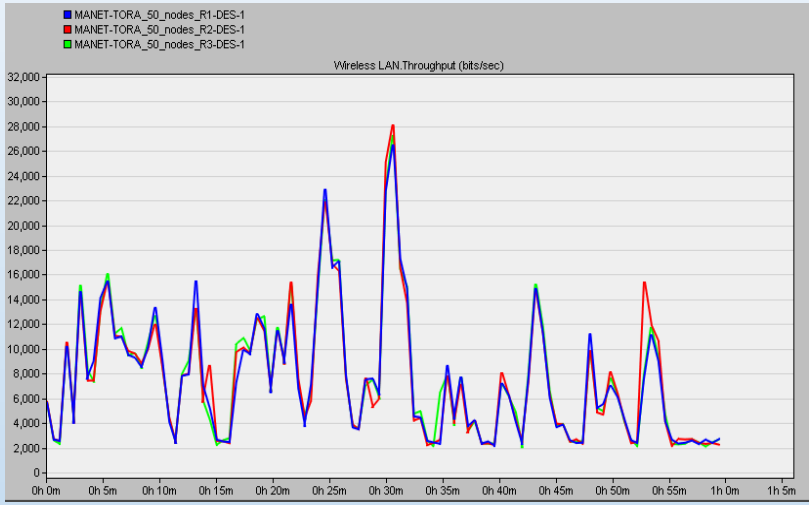
AODV: 1 vs 2 vs 5.5 Mbps

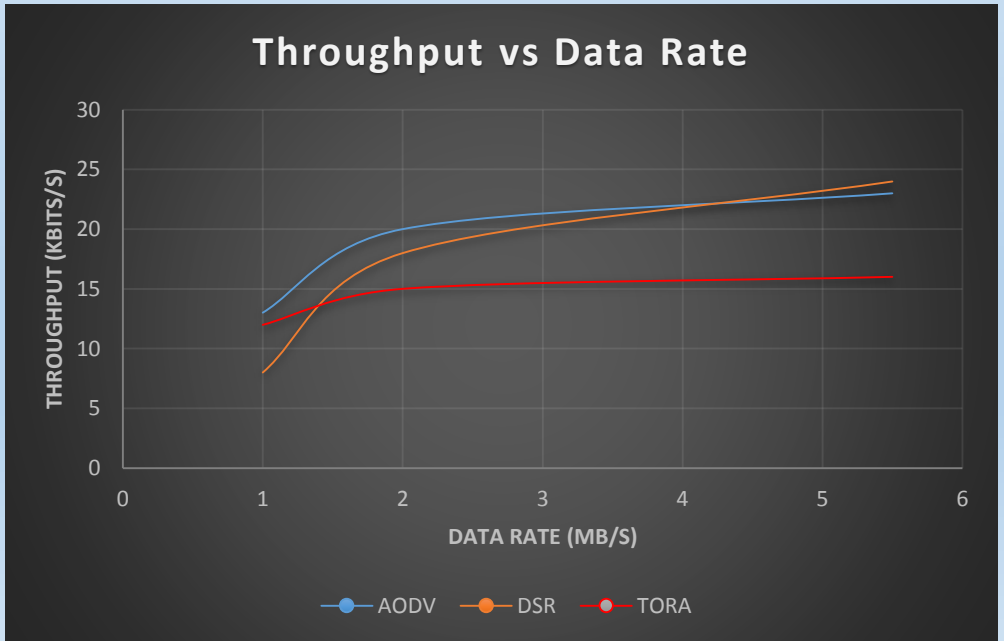


DSR: 1 vs 2 vs 5.5 Mbps



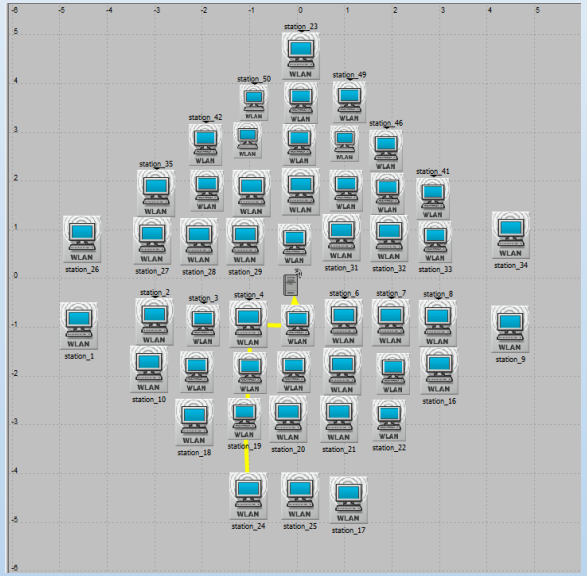
TORA: 1 vs 2 vs 5.5 Mbps

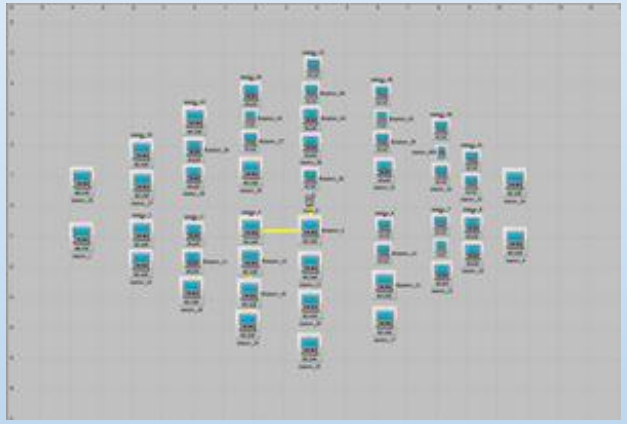




Result: Increase in the source data rate causes an increase in throughput for all protocols. DSR shows the maximum growth in throughput with the increase of source data rate. But, TORA doesn't perform significant increase.

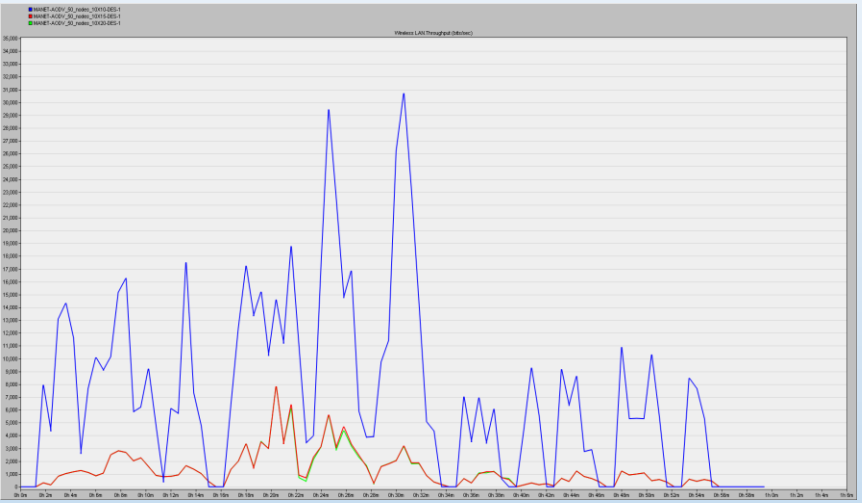
50-node DSR network with different environment sizes



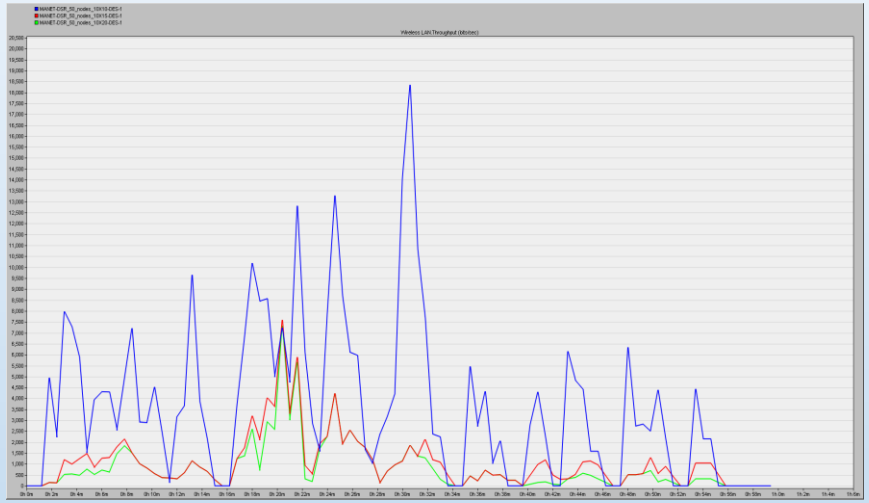


Scenario 4: Performance (Throughput) based on Environment Size

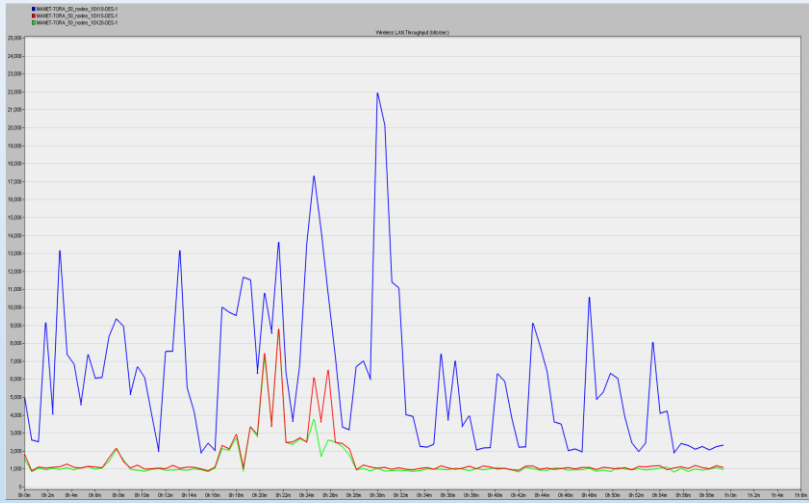
AODV: 10 × 10 vs 10 × 15 vs 10 × 20

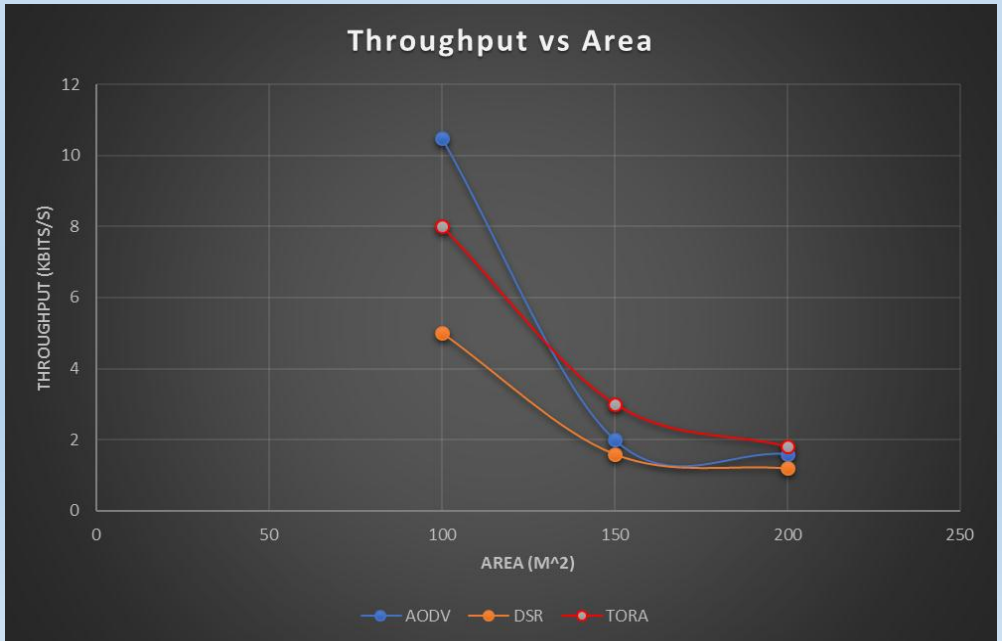


DSR: 10 × 10 vs 10 × 15 vs 10 × 20



TORA: 10 × 10 vs 10 × 15 vs 10 × 20





Result: Increasing environment size results in a decrease in throughput. But, AODV has the maximum decline in throughput with the increase of environment size. Besides, both DSR and TORA perform similar downtrend.

Conclusion

- In general, these three protocols perform quite similar behaviors with the four scenarios.
- Among three protocols, AODV shows the best performance especially in varying number of nodes and transmission power scenarios.

Scenarios	Protocols		
	AODV	DSR	TORA
Number of nodes	1	3	2
Transmission power	1	3	2
Data rate	1	2	3
Environmental size	1	3	2

Future Work

- Further investigation in adding more dynamic scenarios such as varying the source data rate with time and varying the speed of mobile nodes.
- Further investigation in adding more performance metrics such as packet delivery ratio and end-to-end delay.
- Further investigation in optimization of one of the three protocols like AODV by controlling the broadcasting of RREQ information.

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Thank You!

Any Questions?