Indian Journal of Engineering, Vol. 13, No. 34, October-December, 2016 ANALYSIS

ISSN 2319–7757 EISSN 2319–7765

Indian Journal of Engineering

Power Aware Multipath Routing Protocol for Mobile Ad hoc Networks

Nagaraj M. Lutimath[1☼], Suresh L[2], Chandrakant Naikodi[3]

1. Department of Computer Science and Engineering, Sri Venkateshwara College of Engineering, Bangalore-562157, India, email: nagarajlutimath@gmail.com
2. Department of Computer Science and Engineering, Cambridge Institute of Technology, Bangalore-560036, India, email: suriakls@gmail.com
3. Department of Computer Science and Engineering, Cambridge Institute of Technology, Bangalore-560036, India, email: nadhachandra@gmail.com

☼Corresponding author: Department of Computer Science and Engineering, Sri Venkateshwara College of Engineering, Bangalore-562157, India, email: nagarajlutimath@gmail.com

Publication History

Received: 29 August 2016

Accepted: 24 September 2016

Published: October-December 2016

Citation

Nagaraj M Lutimath, Suresh L, Chandrakant Naikodi. Power Aware Multipath Routing Protocol for Mobile Ad hoc Networks. *Indian Journal of Engineering*, 2016, 13(34), 672-679

ABSTRACT

Advances in wireless technology have made routing popular. Routing is vital research feature in the Mobile Ad hoc NETworks (MANETs). The role of the protocol is to increase overall throughput and the packet delivery ratio in MANETs. This paper proposes a Power Aware Multipath AODV Routing Protocol (PAMAODV) for MANETs. The main goal is to find a stable route by selecting power efficient path between source and destination. In addition it aims to reduce the control packets overhead. The Simulation is done using NS-2. The results show that PAMAODV has more packet delivery ratio and throughput compared with the traditional AODV protocol. The packet loss ratio of PAMAODV is also less than AODV, which shows that proposed protocol is efficient than AODV.

Keywords: AODV, Energy, Multipath, Power

Abbreviations: MANET – Mobile Ad hoc Network

1. INTRODUCTION

Mobile wireless Ad Hoc networks (MANETs) do not have preexisting infrastructure architecture. Each node operates as a host as well as router to route packets from source to destination. Routing in Ad Hoc networks has been an important challenging task due to mobility of nodes. Generally protocols are of two types reactive or on-demand protocols and proactive or table-driven protocols. Reactive routing protocols maintain routing information about current routes. Route discovery process is used for creation of routes. They are created when desired by the source node. Frequent change of topology may break current route and cause subsequent route search. In proactive routing protocol, the nodes continuously maintain complete routing information of the network. This is achieved by flooding network periodically with network status information to find out any feasible change in network. In proactive routing if any node needs to send any information to another node, the route is known and its latency is low. For optimal route many of them choose minimum hop count approach and this is shown by research that we cannot find stable path only by using minimum hop metrics. Because during the data transmission the hop count scheme does not minimize the route breakage, it takes some time in sensing link failure and then route recovery process is initiated. All these process consumes lot of network bandwidth and battery power. The topology of MANET network continuously changes because of node random mobility and this leads to frequent link disconnection between communicating nodes. The communicating distance can be predicted by using signal strength parameter during route discovery process. Power consumption is a crucial design concern in MANETs because nodes are basically battery limited. Power consumption can occur due to receiving the data, transmitting the data traffic, mobility etc. Power failure of mobile node not only affects the node itself but also its ability to forward packets on behalf of others and hence overall network lifetime. So in our proposed work we focus to add only those nodes in route which are close to each other that is where the received power greater than or equal to threshold values. Earlier an algorithm to put forward a novel routing protocol RSEA-AODV [1] that considers signal strength, remaining battery capacity, draining rate and delay during route discovery for reliable data transmission across the network was proposed. It increases the network life time by decreasing link failures by the sharing of traffic load. The paper is structured as follows. In section I Introduction is given. Section II, describes the Literature Survey, Section III Problem Definition, IV Proposed work in detail. Section V illustrates the PAMAODV Protocol, Section VI Simulation and Evaluation, lastly Conclusion and Future works for proposed work are discussed.

2. LITERATURE SURVEY

Many research works have been conducted in the field of power control in MANETs. A congestion-aware routing that uses a metric incorporating data-rate, Medium Access Control (MAC) overhead, and buffer delay to combat congestion was presented [2].These parameters are used to select maximum throughput paths, avoiding the most congested links. The CARP route discovery packet is similar to that in DSR [3] where every packet carries the entire route node sequence. A Shortest Multi-paths Source routing protocol [4] which is based on DSR and Split Multi-paths Routing (SMR) [5] was proposed. This proposed protocol increases the number of selected routes between the source and the destination by requiring. The selected routes have to be partially disjoint. However, these algorithms listed above may result in a rapid reduction of the battery energy in then nodes along the most heavily-used paths in the network. Indeed, routing of packets is a significant power consuming activity since it involves packets forwarding by many intermediate nodes. The general consensus is that routing protocols should optimize energy consumption for routing activity given the limited battery power available in wireless nodes. To minimize the energy consumption and increase the network's connectivity, an energy-efficient routing protocol [6] for Ad Hoc network was proposed. A new Stable and Delay Constraints Routing (SDCR)[7] protocol for MANET which provides QoS guarantees was proposed. The protocol significantly improves routing performance by finding stable paths and performing rerouting before the paths become unavailable. A QoS aware routing protocol (AQRL) [8] that includes the load balancing scheme and multi-constraint QoS mechanism containing bandwidth, delay and packet loss to search the satisfying path between the source node and destination node. A Weight-based Load Balanced Routing (WLBR) [9] protocol for MANETs that assigns weight to each route based on three factors: the aggregate interface queue length, the route energy and the hop count. The route with highest weight value is selected for data transmission. It helps to achieve load balancing and to extend the entire network life time. The network lifetime is always kept in consideration while designing a routing algorithm. Node mobility is another characteristic which causes in frequent link failure. In case of frequent link failure, more numbers of control packets are generated for route recovery which causes in more energy consumption. So in order to increase the network lifetime, node drain rate and their relative mobility is calculated of each path and then the path having least value is selected as optimal path for data forwarding. Energy efficient routing protocol [10] considers energy efficient performance metrics like node remaining energy and node draining rate during path selection. This approach minimizes the chance of selection of low energy node during route discovery. Link can be break either if this distance becomes large that is if the communication range or if node goes out of order because of energy depletion.

3. PROBLEM DEFINITION

The objective of the proposed protocol PAMAODV is to find efficient route between a given source and destination. PAMAODV uses received power using a time stamp with a threshold constraint during the route discovery process. Selection of the path for given source and destination assures increase in packet delivery ratio and throughput. This further reduces the latency and delay. We now explain the proposed work with the cost metric below.

4. PROPOSED WORK

We propose the working procedure of PAMAODV that has the rule for reliable route selection during the route discovery process. In MANET node mobility and fast energy depletion makes a challenging issue in obtaining a reliable stable route for data transfer between given source to destination. We propose the following metric.

A. *Receiving Power for a time stamp*

We define the Receiving Power cost metric based on the transmission energy and request time stamp of a given intermediate node. It is defined as the ratio of the receiving energy of the intermediate node to the request time stamp.

If P is the receiving power, R is the receiving energy and T is the time stamp, when the packet is received then, P is given by,

$$P = R/T \tag{1}$$

5. PAMAODV

A. *Route Discovery*

The route discovery process is initiated when the source node if source node finds no route to destination in its routing table. It then it broadcasts the RREQ message to his entire neighbors. After receiving RREQ message by source node or neighbor node, each intermediate node calculates received power cost metric of received RREQ. The calculated value is compared with defined threshold value, if it satisfy the condition then it process the RREQ message otherwise it discard the RREQ message. Using this approach we find the route from source to destination.

B. *Scheme*

The following steps are used for route selection,

- Receive the route request.
- The route is selected on the basis P using equation 1.
- If the value of P is greater than Thr1 then accept route request otherwise.
- Discard the route request.

In the above scheme Thr1 is the received power threshold, P is calculated from equation 1.

6. SIMULATION AND EVUALATION

To evaluate our proposed routing protocol (PAMAODV), an extensive simulation study is performed using the NS-2 simulator [11]. We compare this proposed protocol with traditional AODV protocol. The simulation is carried out for 60 seconds and using a topology size of 1000 meter * 1000 meter. We use the two Ray ground as a model of propagation and the Constant Bit Rate (CBR) as a traffic type. The main parameters of our simulation model are given in Table 1.

Table 1 Simulation Parameters

Parameter Type	Parameter Value
Simulation terrain (m x m)	1000m * 1000m
Routing Protocol	AODV
Number of nodes	30
Mobility model	Random Way point
Propagation model	Two Ray Ground
Antenna type	Omni directional
Transmission range (m)	250
Simulation Time (s)	60
Traffic Type	CBR
Channel Bandwidth (Mbps)	15
Packet Size (B)	512
Transport Protocol	UDP
Thr1	$4.21 * 10^4 *$RxThr
Date Rate of Control Frames (Mbps)	11,15
Initial energy (Joule)	20
Mobile Connections	45-60

A. Simulation Results

The simulation parameter metrics used for simulation are Packet Delivery Ratio, Throughput and Packet Loss Ratio.

Packet Delivery Ratio (PDR) is the ratio of the number of packets received successfully to the number of packets sent from source to destination.

Throughput is the number of packets received by the destination node per second.

Packet Loss Ratio (PLR) is the ratio of the number of packets sent from source to destination. Figure 1 shows the PDR for 30 Nodes at a data rate of 11Mbps.

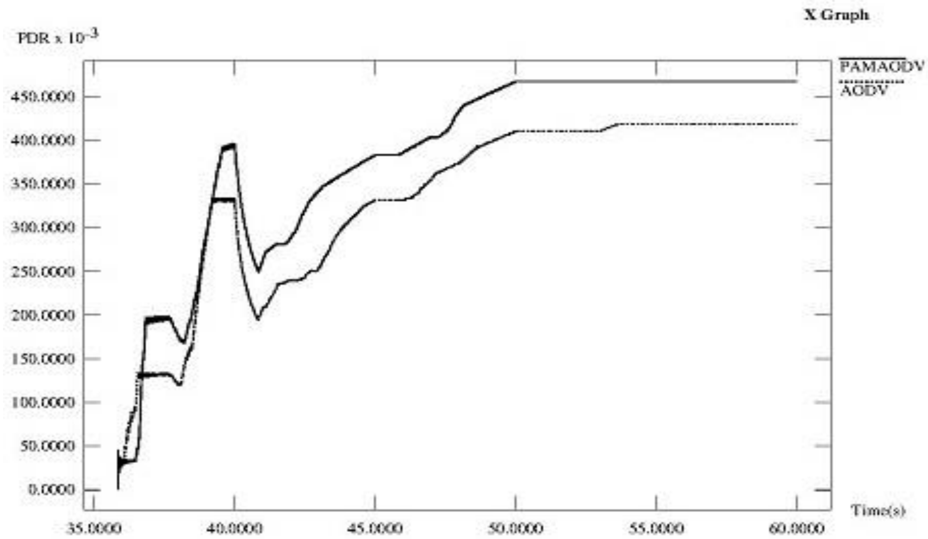

Figure 1 PDR Vs Time for data rate 11Mbps

In the Figure 1 the PDR for AODV is $325*10^{-3}$ at 40.0s . PAMAODV it is $350*10^{-3}$, which is 7 percent higher than AODV.Similarly PDR for AODV is $406*10^{-3}$at 50.0s . PAMAODV it is $475*10^{-3}$, which is 14.5 percent higher than AODV. This is because the more receiving power nodes are present in one of multipaths is taken for packet delivery in PAMAODV protocol. Figure 2 shows the PDR results for data rate of 15Mbps.

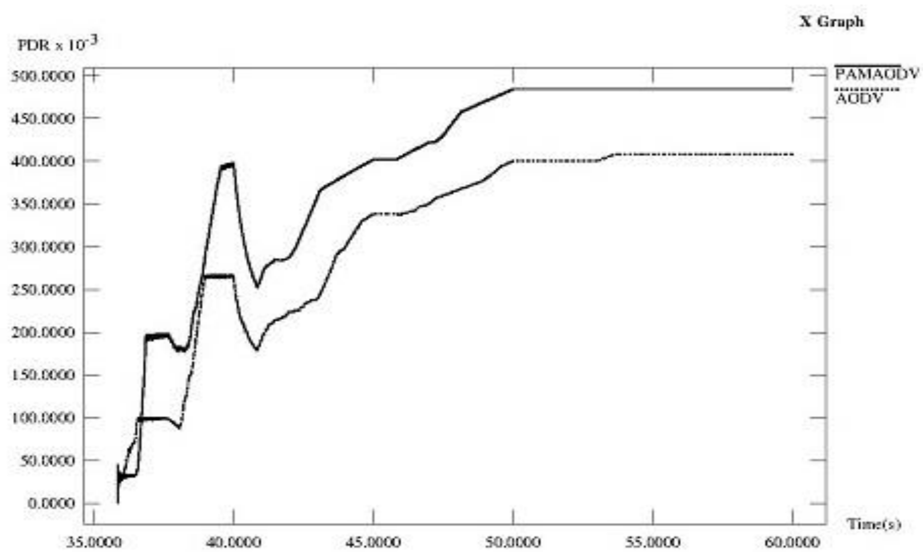

Figure 2 PDR Vs Time for data rate 15Mbps

In Figure 2 PDR for AODV is $270*10^{-3}$at 40.0s PAMAODV it is $395*10^{-3}$,it is 31.6 percent higher than AODV. Similarly PDR for AODV is $405*10^{-3}$ at 50.0s. PAMAODV it is $490*10^{-3}$,which is 17.3 percent higher than AODV. This is because the more receiving power nodes are present in one of multipaths is taken for packet delivery in PAMAODV protocol The PDR in PAMAODV is $255*10^{-3}$for 40.0s it has increased to $480*10^{-3}$ for 50.0 seconds.The reason behind this is more packets are received at 50.0s than 40.0s.. Figure 3 shows the Throughput results for 30 nodes date rate of 11Mbps.

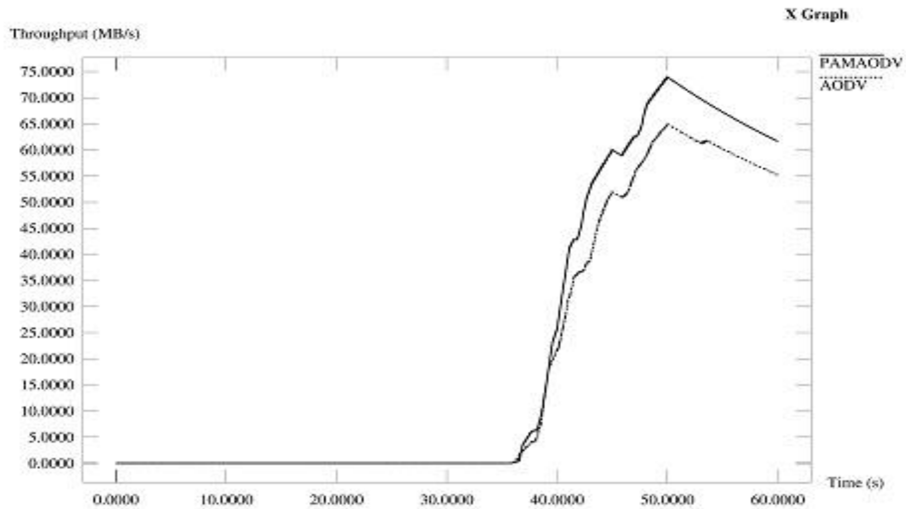

Figure 3 Throughput Vs Time for data rate of 11Mbps

In the Figure 3 Throughput for AODV is 22MB/s at 40.0s. PAMAODV it is 24MB/s which is 9.09 percent higher than AODV.This is because path formed by higher power nodes is taken for packet delivery in PAMAODV protocol. The Throughput in PAMAODV is 52MB/s at 45.0 seconds but it is 75MB/s at 50.0s. The reason behind this is communication traffic delay in receiving the packets at 45.0s than at 50.0s.We find Figure 3 than Throughput of PAMAODV is either more or equal to AODV.Figure 4 shows the Throughput results for data rate of 15Mbps for 30 nodes.

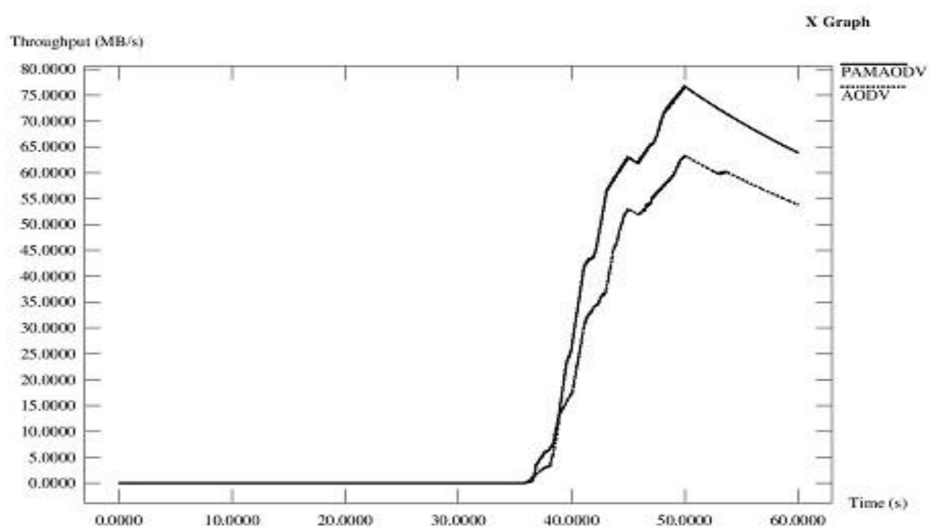

Figure 4 Throughput Vs Time for data rate of 15Mbps

In the Figure 4 Throughput for PAMAODV is 19.4 percent higher than AODV at 50.0s. Similarly Throughput for AODV is 23.4 percent lower than PAMAODV at 60.0s. This is because a efficient power path formed is taken for packet delivery in PAMAODV protocol. Further we observe that Throughput of PAMAODV is greater than or equal to AODV at each interval of time. Hence the PAMAODV is efficient than AODV in terms of throughput.

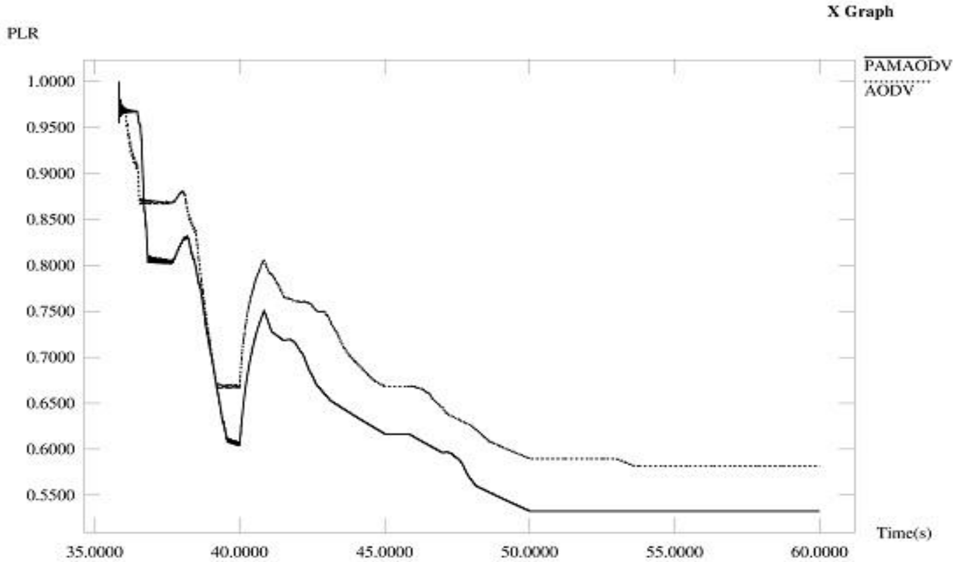

Figure 5 PLR Vs. Time for data rate of 11Mbps

In the Figure 5 the PLR for AODV is 0.66 but for PAMAODV it is 0.60 at 40.0s, which is 11.66 percent lower than AODV.Similarly PLRfor PAMAODV is 8.6 percent lower than AODV at 50.0s. This is because power a path formed by multipath is taken for packet delivery in PAMAODV protocol. In Fig 6 shows the packet loss results for data rate of 15Mbps for 30 nodes.

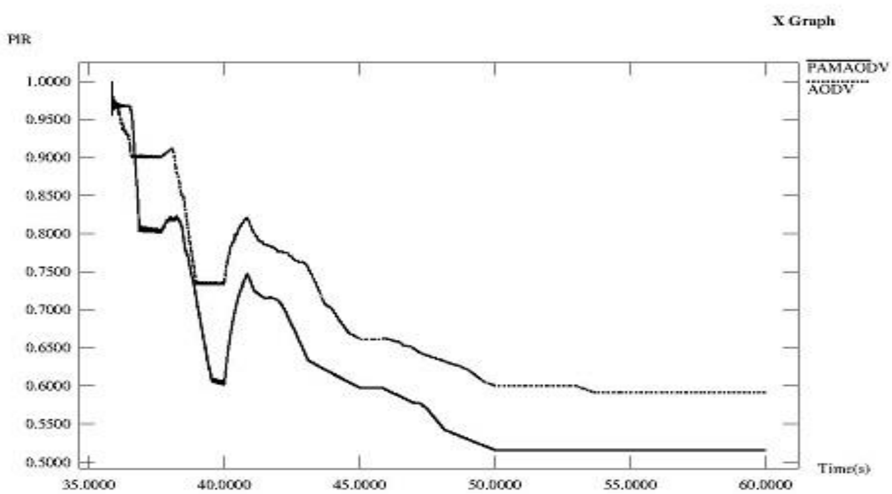

Figure 6 PLR Vs Time for data rate of 15Mbps

In the Figure 6 the PLR for PAMAODV 17.8 is percent lower than AODV at 40.0s.Similarly PLR for PAMAODV is 11.6 percent lower than AODV at 50.0s. This is because a path formed by power nodes multipath is taken for packet delivery in PAMAODV protocol. Thus our proposed protocol performs better in terms of packet delivery and throughput.

7. CONCLUSION

In this paper we have proposed a power aware multi-path routing protocol PAMAODV based on AODV for MANET using receiving energy of intermediate node. PAMAODV uses higher energy node path to increase the performance of data transmission between a source and destination. With simulation we have shown that PAMAODV is better than AODV in terms of Packet Delivery Ratio, Throughput and Packet Loss Ratio. In future to our protocol will be enhanced using the network performance.

REFERENCES

1. Ranjan Kumar, Mansi Gupta "Route Stability and Energy Aware based AODV in MANET" in IEEE High Performance Computing and Applications (ICHPCA), 2014 International Conference, Bhubaneshwar, India, 22-24 Dec. 2014, pp.1-5.
2. S.K.Dhurandher, S.Misra, M.S.Oubaidat, V.Bansal, P.R.Singh and V.Punia, "An energy-efficient ad hoc on-demand routing protocol for mobile ad hoc networks", International Journal of Communication System", 2009.
3. Johnson, Y. Hu, and D. Maltz, "The Dynamic Source Routing Protocol for Mobile Ad-hoc Networks for IPv4", RFC 4728, Feb. 2007.
4. H.Zafar, D.Harle, I.Andonovic, and Mahmood Ashraf, "Performance Evaluation of Shortest Multipath Source Routing Scheme",IET communications, Vol. 3, No.5, May 2009.
5. Johnson, Y. Hu and D. Maltz, "The Dynamic Source Routing Protocol for Mobile Ad-hoc Networks for IPv4", RFC 4728, Feb. 2007.
6. S.K.Dhurandher, S.Misra, M.S.Oubaidat, V.Bansal, P.R.Singh and V.Punia, "An energy-efficient ad hoc on-demand routing protocol for mobile ad hoc networks", International Journal of Communication System", 2009.
7. P. Yang and B. Huang, "QoS Routing Protocol Based on Link Stability with Dynamic Delay Prediction in MANET," iEEE Pacific Asia Workshop on Computational Intelligence and industrial Application, voU pp. 515-5IS, 2005.
8. C .Liu, K. Liu, and L. Li, "Research of QoS-aware routing protocol with load balancing for mobile ad hoc networks," 4th International Conference on Wireless Communications, Networking and Mobile Computing (WiCOM'08), Dalian, pp.I-5, October 2005.
9. Rani, M. Dave, "Weighted load balanced routing protocol for MANET," i6th IEEE International Conference on Networks (ICON), pp.I-6, 12-14 Dec 200S.
10. Perkins, E. Belding-Royer, "Ad Hoc On-demand Distance Vector (AODV) Routing, RFC, 2003.
11. Network Simulator, http://www.isi.edu/nsnam/ns