



layer or interlayer networking is proposed. Inter-layer communication between layers is called the cross-layer. The cross-layer design provides the facility of information sharing.

In our propose cross-layer design, the PHY/MAC and Network layers are used. The physical layer propagates the electric or electromagnetic signal. The MAC Layer provides the means for data access mechanism and communication between mobile nodes. Currently Ad hoc routing protocols work mainly on the network layer. So to optimize the route discovery we have used the network layer with Destination-Sequenced Distance Vector (DSDV) Ad hoc routing protocol. There are a lot of research investigations being carried out in performance optimization of ad hoc networks concerning these issues.

## II. METHODS AND MATERIAL

Here we describe our Rate Adaptation Scheme and Congestion Control Scheme for controlling the congestion. It consists of two schemes:

- (1) The Rate Adaptation Scheme adapts data rate in the MAC layer based on the channel estimation Information from physical layer and congestion information from network layer.
- (2) Congestion Control Scheme congestion exploits congestion information in network layer from MAC layer.

### (1) Rate Adaptation Scheme (RAS)

Rate adaptation is the determination of the optimal data transmission rate most appropriate for current wireless channel conditions [28]. It consists of assessing channel conditions and accordingly adjusting the rate. The rate adaptation scheme is implemented with a minor modification to the IEEE 802.11 MAC protocol. In this scheme, a source node sends a RTS packet before it transmits any data. When the destination node receives this RTS, it estimates the signal strength of the transmission channel. Our goal is to design a Rate Adaptation Scheme that provides high network performance in both congested networks and lightly-loaded networks. For the Rate Adaptation algorithm, we used a simple threshold based technique. In this scheme, the rate is chosen by comparing the channel quality estimation against a series of thresholds.

For rate adaptation scheme [13] based on congestion information, we use the queue length as the congestion metric. At the sender (who sends RTS) side, when congestion happens, MAC layer try to quickly send out the packets, so it prefers to select high data rate. But the receiver (who receives RTS) side is prone to reduce the data rate to avoid more incoming packets waiting in its already congested queue.

### (2) Congestion Control Scheme (CCS)

We measure the congestion information at a node by two congestion control metrics. One is average MAC layer utilization. The instantaneous MAC layer utilization is considered as 0 only when the medium around the node is available for beginning a transmission. We consider instantaneous MAC layer utilization at a node is 1 when the node is busy. To use congestion information in routing protocol DSDV [21], we modified the Routing Discovery mechanism. When an intermediate node receives a Route Request packet that is not directed to it, it then checks the congestion metrics. If the congestion metrics are higher than some thresholds, that indicates high level congestion around the node [19].

## SIMULATION PROCESS

### A. Simulation Process

Simulation is “the process of designing a model of a real system and conducting experiments with this model for the purpose of understanding the behavior of the network.

In a computer network simulation, a packet arrival process, waiting process, and service process are usually modelled as random processes. A random process is expressed by sequences of random variables. These random processes are usually implemented with the aids of a Random Number Generation (RNG).

### B. Simulation Parameters

TABLE I  
SIMULATION PARAMETERS

Sr.No	Name of Parameter	Value
1	Type of Channel	Wireless Channel
2	Channel Model	Rician Model
3	MAC Protocol	IEEE 802.11
4	Routing Protocol Studied	DSR
5	Routing Protocol Implemented	DSDV
6	Interface Queue Type	CMUPriQueue
7	Antenna Type	Omni Antenna
8	Simulation Time	200 Sec.
9	Simulation Area	500 m X 500 m

10	Transmission Range	250 m
11	Node Movement Model	Random Way Point
12	Traffic Type	CBR
13	Packet Size	512 Bytes/Packet
14	No. of Nodes	20, 30, 40, 50, 60
15	Interface Query Length	50
16	Node Mobility	20, 30, 40, 50, 60 (metre/s)

### C. Traffic Scenarios

We can also define the traffic and movement pattern in separate files called CBR traffic file and **mobility file** respectively. **CBR file** can be created by using a tcl program called CBRgen.tcl.

Manually giving traffic connections for a large number of nodes would be cumbersome. So random traffic connections of CBR can be setup between mobile nodes using a traffic scenario generator script. Using this script we can generate random traffic connections between any numbers of nodes. We need to define the following to generate random traffic connections:

```
ns cbrgen.tcl [-type ##] [-nn ##] [-seed ##] [-mc ##][-rate ##]
```

### D. Mobility Scenarios

The movement files are generated by using the following commands in the appropriate directory respectively.

```
./setdest -n <num_of_nodes> -p pausetime -s <maxspeed> -t <simtime> <maxx> -y <maxy>
```

The mobile nodes move according to the random waypoint model. Each mobile node begins the simulation by remaining stationary for pause time seconds. It then selects a random destination in the defined topology area and moves to that destination at a random speed. The random speed is distributed uniformly between zero (zero not included) and some maximum speed. Upon reaching the destination, the mobile node pauses again for pause time seconds, selects another destination, and proceeds there as previously described. This movement pattern is repeated for the duration of the simulation.

### E. NAM file and TRACE file

After simulating the program using CBR and scenario files we can get the output in form of two files. One is called as the network animator file (NAM) and the other is called the trace file. These two files are created in the due course of running the program. Basically the two files stores the same things but in different format. NAM

file stores the output in such a way that it can be used by the animator to show an animated result, and the trace file stores the output so that it can be analysed [22]

### F. Simulation Results

The simulation results under various offered load of different Rate Adaptation Scheme and Congestion Control schemes

## III. RESULT AND DISCUSSION

### G. Performance Metrics

The second goal of this thesis is to compare the performance of the two protocols under different scenario. Comparing the different methods is done by simulating them and examining their behaviour.

The evaluation could be done in the following three metrics:

1. **Throughput** represents the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.
2. **Packet Delivery Ratio** defined as the number of received data packets divided by the number of generated data packets
3. **End- to- End Delay** is defined as the time a data packet is received by the destination minus the time the data packet is generated by the source.
4. **Packet Loss** is defined as dropping of packets due to congestion

### H. Performance Evaluation

Performance Evaluation of DSR, DSDV Mobile Ad-Hoc Protocols on Different Scenarios: An Analytical Review [29]

#### 1. Packet Loss Vs. No. of Nodes

No. of Nodes	Packet Loss	
	RA_DSR	RA_DSDV
20	155	137
30	225	199
40	275	223
50	299	275
60	312	289

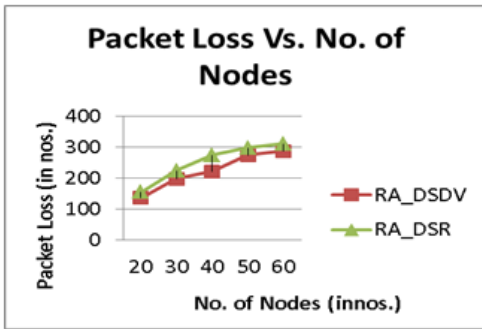


Figure1: Data Packet Loss (Dropped Packets) for DSR and DSDV

## 2. Throughput, Packet Delivery Ratio, End-to-End Delay vs. No. of Nodes

### Throughput

Throughput		
No. of Nodes	RA_DSR	RA_DSDV
20	134.44	160.21
30	156.43	178.34
40	168.89	190.16
50	189.12	212.23
60	201.32	218.56

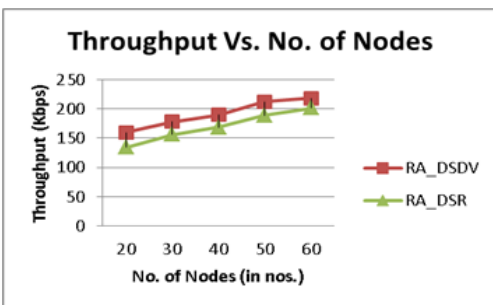


Figure2: Throughput for DSR and DSDV

### Packet Delivery Ratio

Packet Delivery Ratio		
No. of Nodes	RA_DSR	RA_DSDV
20	96.43	93.77
30	92.37	89.15
40	89.23	80.47
50	85.21	79.65
60	80.33	72.18

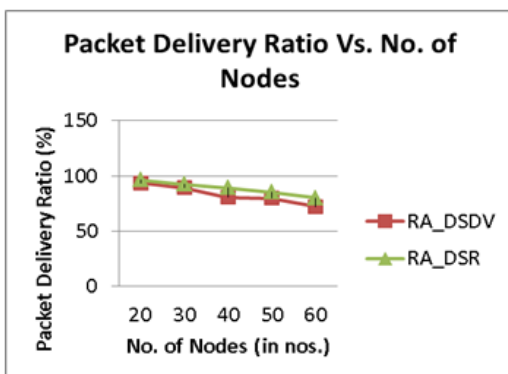


Figure 3: Packet Delivery Ratio for DSR and DSDV

### End-to-End Delay

End-to-End Delay		
No. of Nodes	RA_DSR	RA_DSDV
20	171.67	174.70
30	127.75	146.895
40	173.34	193.11
50	206.10	140.519
60	233.40	142.523

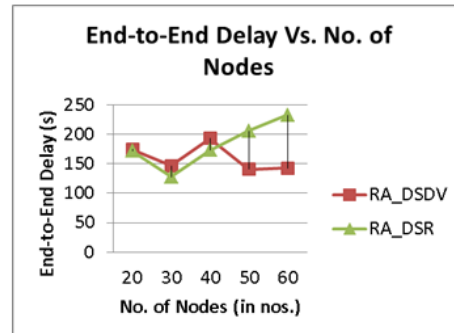


Figure 4: Average End-to-End Delay for DSR and DSDV

## IV. CONCLUSION

The proposed schemes in our work is an innovative way to deal with performance optimization design challenges of Ad hoc networks and how network performance can be improved by using Rate Adaptation Scheme and Congestion Control Scheme. Using congestion information in both sender and receiver sides along with signal strength helps maximizing network capacity at MAC layer. The results show that the Rate adaptation in MAC layer improves the network performance. Using congestion information from network layer provides up-to-date path which improves the performance of the overall network. We implemented a cross-layer congestion control in NS-2 which is a packet level simulator. We evaluated the performance comparison of DSDV and DSR Ad hoc routing protocols in terms of Throughput, Packet Delivery Ratio and End-to-End Delay performance criteria. Also we conclude that DSDV Ad hoc routing protocol provides optimized result in small area wireless Ad hoc network. At the same time, it is also true that any of the single protocol does not supersede the other one, their performance depends upon the different scenarios.

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