



# Performance Enhancement in AODV with Accessibility Prediction

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## × In MANETs

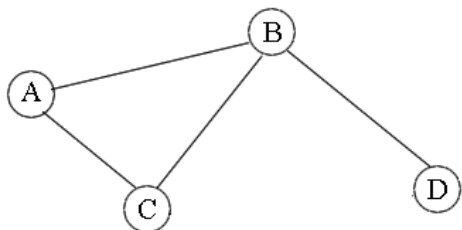
- ▶ Limited resources of all kind
- ▶ Ever changing topology
  - Cause route errors, require new route discoveries
  - Major cause of MAC and routing overhead

## × Protocols for Ad hoc networks should

- ▶ Effectively use resources
- ▶ Try to maximize the benefits

## × Routing protocols should try to maximize the utility of routing operations without causing unnecessary overhead..... **Learn more in the same price**

- ✗ **Nodes have opportunity to collect information about the relative accessibility and mobility**
- ✗ **Possible in almost all ad hoc routing protocols**
- ✗ **Future routing operations could be enhanced**



Accessible pairs at Step 1

(A,B), (A,C), (A,D), (A,E), (B,D), (B,D), (B,B), (C,D), (C,E), (D,E)

Node pairs which can observe relative mobility

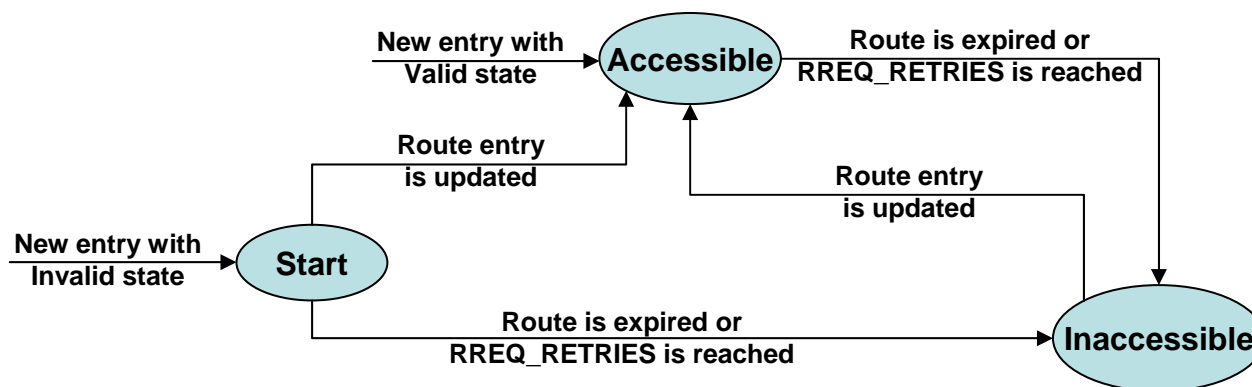
(A,E), (B,E), (C,D), (C,E), (D,E)

## × Particularly in AODV

- ▶ Repeated RREQs are discarded
  - After performing all resource hungry steps
  - Routing information about sender/originator can be updated
  
- ▶ RREQ\_RETRIES is reached
  - Destination might be unreachable
  
- ▶ No new RREQ after PATH\_DISCOVERY\_TIME
  - Route between source and destination might be successfully established

## × In AODV-AP

- ▶ A new field “Accessible” is added to each routing table entry
  - Depicts the predicted accessibility information
  - Possible values
    - ◆ Start = No information
    - ◆ Accessible = A valid route to node exists or would be possible
    - ◆ Inaccessible = A valid route to node would not be possible
- ▶ Routing entries will never be deleted



## × Cost

- ▶ No extra messaging
- ▶ Additional computation due to “Accessibility” field-negligible
- ▶ Computation cost of using repeated RREQs-negligible
- ▶ Routing table entries are never deleted
  - Size of routing table
    - ◆ Might not be a problem in a reasonable size network

## × Wrong accessibility prediction

- Depends on the use

## × Modified route discovery method

- ▶ No route discovery for “Inaccessible” nodes
- ▶ Reduces overhead
- ▶ Wrong prediction
  - Considering an “Inaccessible” node “Accessible”
    - ◆ Behaves like usual AODV
  - Considering an “Accessible” node “Inaccessible”
    - ◆ Limited connectivity

## × Mobility as a route cost metric

- ▶ Relatively stationary nodes: good candidates to be included in a route

## × Simulation based comparison

- ▶ AODV vs. AODV-AP with modified route discovery
- ▶ NS-2 (2.28) with AODVUU
- ▶ Simulation parameters
  - Simulation run length: 1800 seconds
  - CBR sources generating UDP traffic
  - Data packet size: 512 Bytes
  - Mobility (Random way point) scenarios and Data traffic scenarios are generated with CMU's utilities using following parameters

**Table 1. Simulation space**

Number of Nodes	Number of Connections attempted	Area of Topology (m <sup>2</sup> )	Pause Time (seconds)	Maximum Speed of nodes	Data Packet Rate (packets/second)
50	20, 40	1500 x 300	60, 120, 300,	5, 10, 15 and	1, 2, 5, 10
100	25, 50, 75	2200 x 600	600 and 900	20 m/sec	

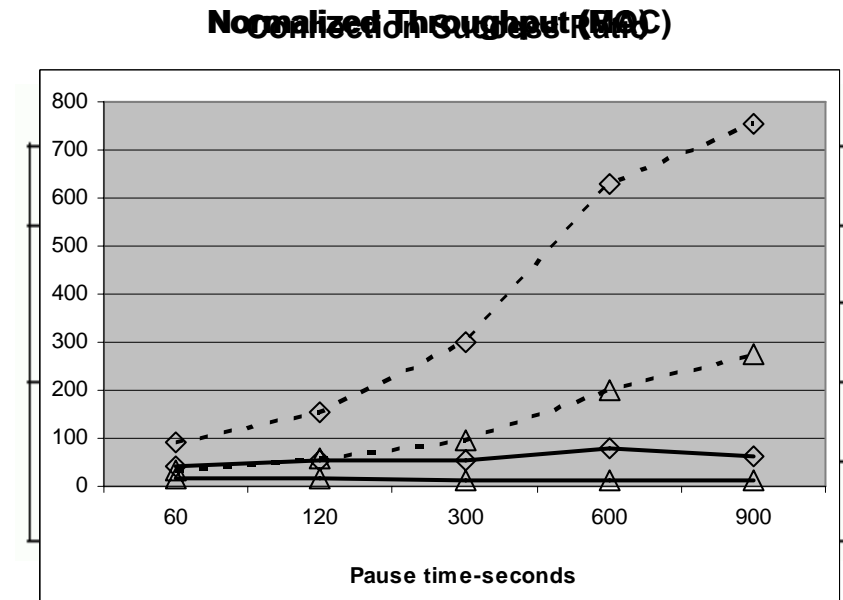


## × Simulation targets

- ▶ MAC overhead
- ▶ Routing overhead
- ▶ Packet delivery ratio
- ▶ Connection Success Ratio
  - To observe the effect on connectivity
- ▶ Effective Throughput
- ▶ Normalized Effective Throughput
  - Effective Throughput normalized with respect to MAC and routing overhead
  - To observe how effectively the network resources are used

## ✘ Simulation Results

- ▶ AODV-AP has higher contribution of data traffic
- ▶ Connection Success Ratio
  - Slightly less than AODV for 50 nodes
  - Higher than AODV for 100 nodes : AODV more vulnerable to congestion
- ▶ Normalized Throughput
  - More than double w.r.t. MAC overhead
  - 10-20 times higher w.r.t routing overhead



## × AODV-AP

- ▶ Enables the nodes to predict relative accessibility of other nodes
- ▶ With almost negligible cost
- ▶ Modified route discovery method uses network resources more economically and effectively

## × In future

- ▶ Could be more successful at layer 2 as in 802.11s
- ▶ Relative mobility prediction and use it as route cost metric
- ▶ Analyze other routing protocols like DSR, OLSR



**Thank you for you attention**

**Any Questions**

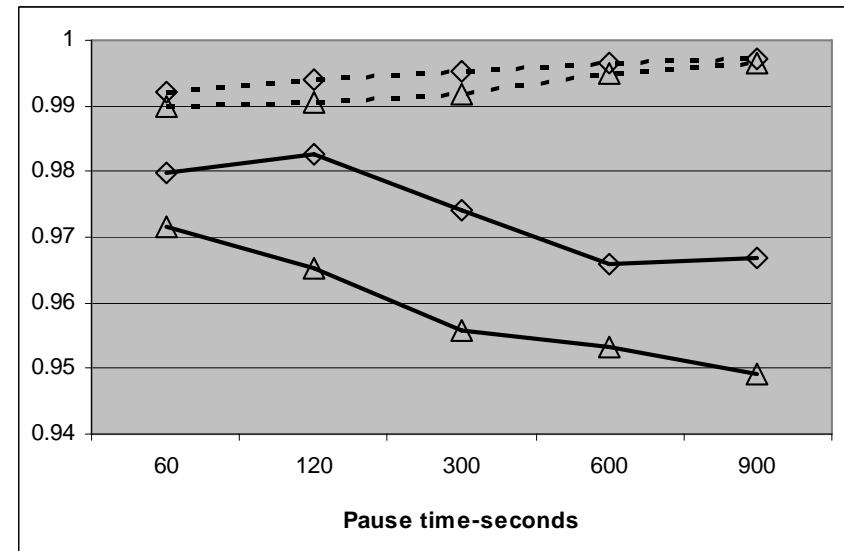
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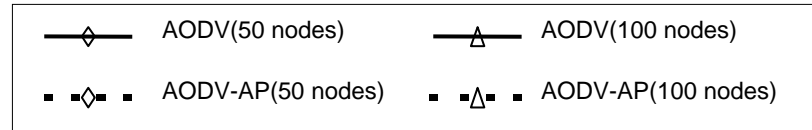
## × Simulation Results vs. Pause Time (rest)

- ▶ MAC overhead
  - Reduced to 25%
- ▶ Routing overhead
  - Reduced to 1%
- ▶ Packet delivery ratio
  - Always above 99%

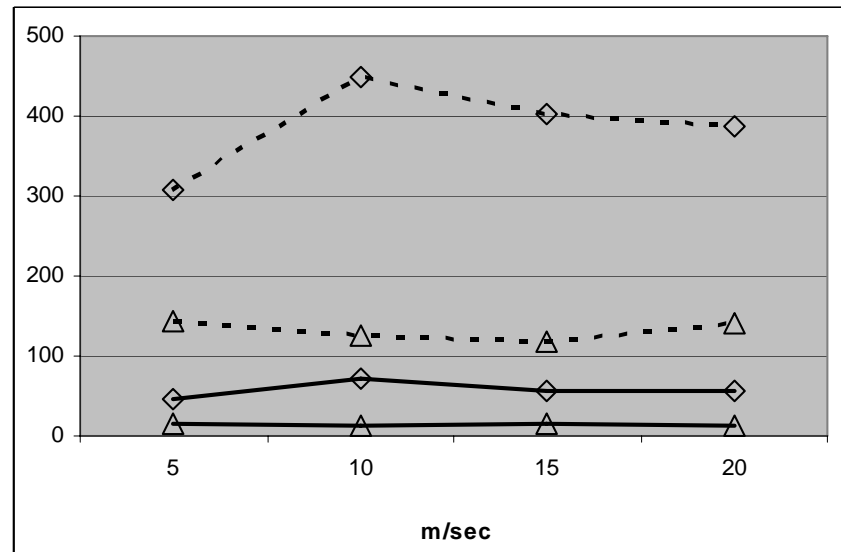


## ✘ Simulation Results vs. average node speed

- ▶ MAC overhead
- ▶ Routing overhead
- ▶ Packet delivery ratio
- ▶ Connection Success Ratio
- ▶ Normalized Throughput
  - w.r.t. MAC overhead
  - w.r.t routing overhead

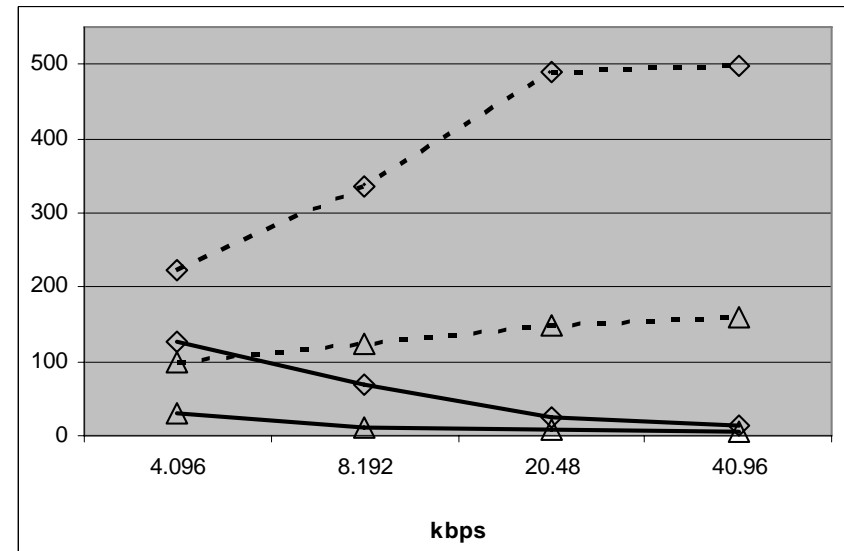


**No significant change with node speed**



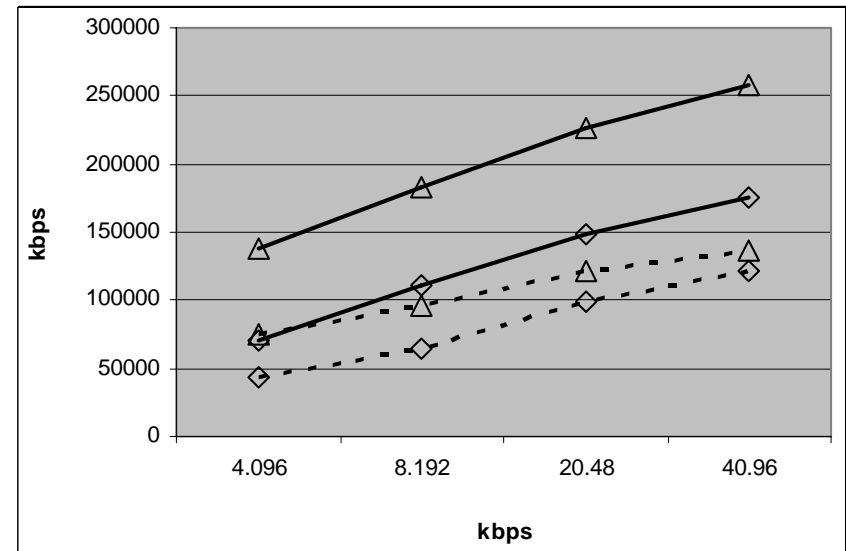
## ✘ Simulation Results vs. offered data load

- ▶ MAC overhead
- ▶ Routing overhead
- ▶ Packet delivery ratio
- ▶ Connection Success Ratio
- ▶ Normalized Throughput
  - w.r.t. MAC overhead
  - w.r.t routing overhead



## × Simulation Results Throughput

- ▶ Vs. Pause time
- ▶ Vs. Average node speed
- ▶ Vs. Offered data load





## × Simulation parameters

- ▶ SMP machine with 2 Intel Xeon 3.2 GHz processors
- ▶ 2 GB RAM
- ▶ Linux 2.6.12.1

## × NS-2

- ▶ Lucent WaveLAN DSSS radio interface at 2Mbps
- ▶ Omni-directional antenna with unity gain
- ▶ Radio propagation model uses Friss-space attenuation at near distances and Two ray Ground at far distances