# ENHANCING THE PERFORMANCE OF MOBILE AD HOC NETWORKS WITH THE AID OF TRANSPARENT AD HOC NETWORK GATEWAYS

SHIV MEHRA

Master Thesis Presentation

Advisor: Dr. Chansu Yu

## Outline

- Wireless Mobile Networks
- Motivation
- MANET Routing
- Scalability of MANET Routing
- Our Proposed Scheme
- Simulation setup and results
- Observations and Conclusions

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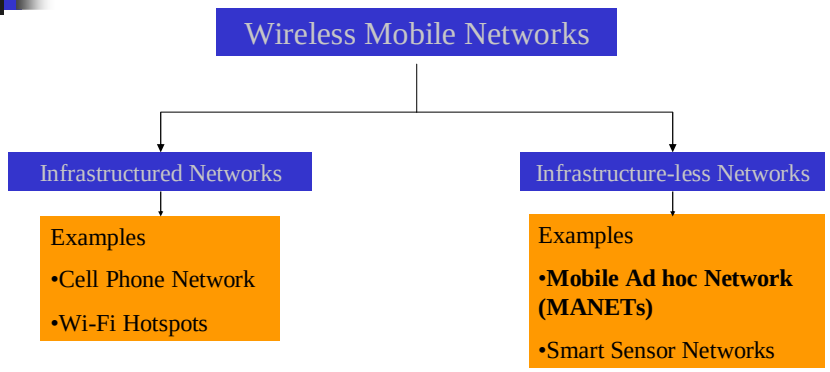
# Wireless Mobile Networks

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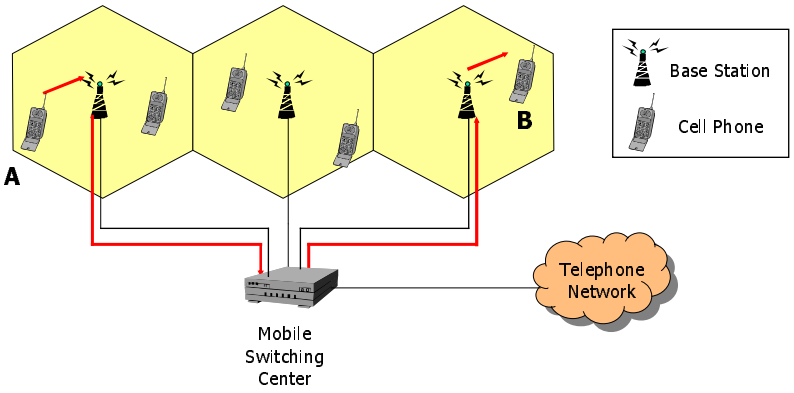
# Infrastructured Cellular Networks

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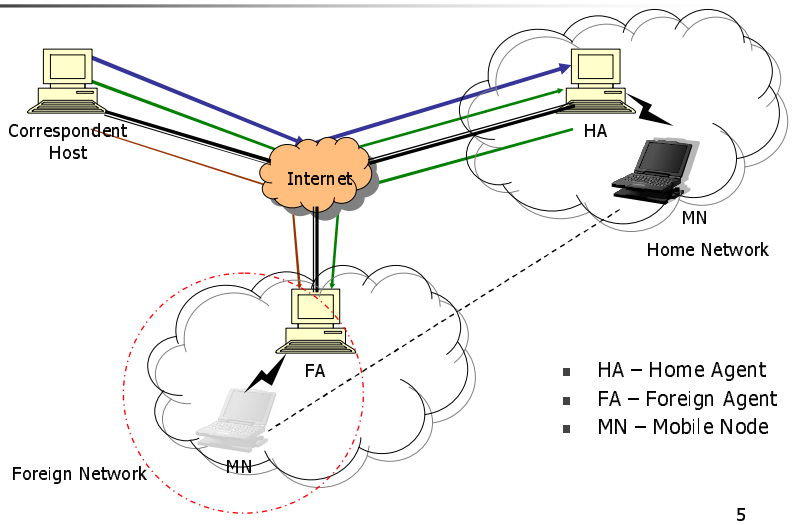
# Infrastructured Networks – Mobile IP




- HA – Home Agent
- FA – Foreign Agent
- MN – Mobile Node

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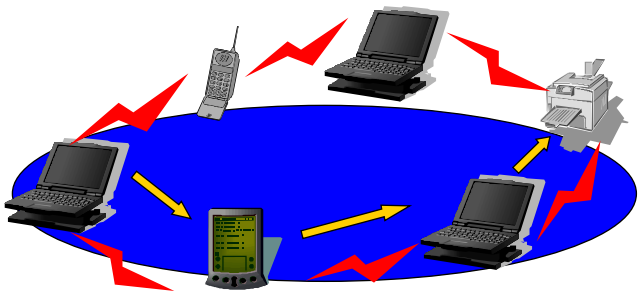
# Infrastructure-less Networks

- Networks formed on the fly.
- No centralized base stations.
- Special routing protocols



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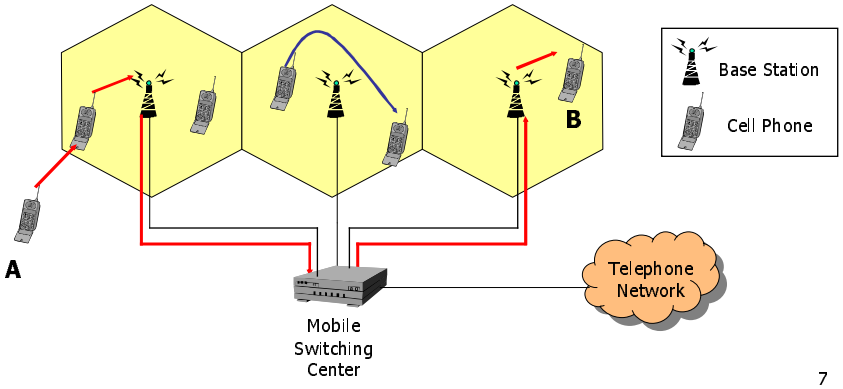
# Hybrid Networks

- Extending base station services

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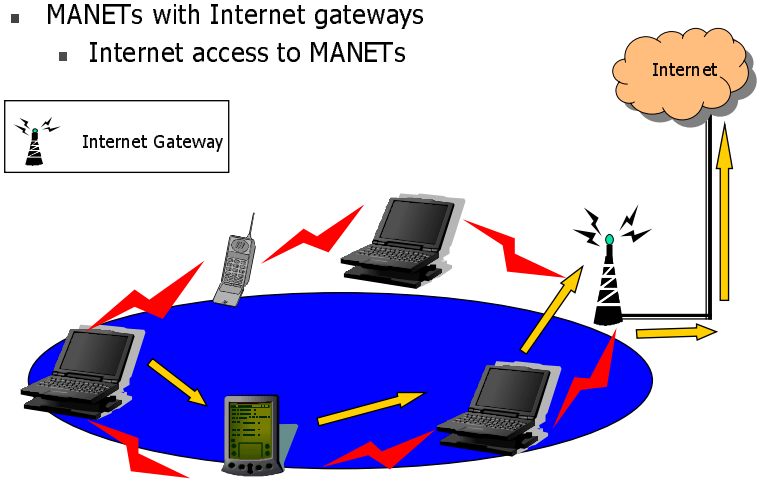
# Hybrid Networks

- MANETs with Internet gateways
  - Internet access to MANETs

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# Infrastructured MANETs

- Utilize Internet based gateways – Infrastructured MANETs

| Mobile IP Foreign Agent as Gateway Router (Seamless Roaming Supported) (Nodes running both, the Mobile IP software as well as the MANET routing protocol gain Internet access) | | |
|---|---|---|
| **Implementation** | **Special Features** | **Routing Protocol** |
| Simulation/Real | Special FA RREP packet is introduced. | Ad Hoc On-Demand Routing Protocol |
| Simulation in Network Simulator-2 | MIPMANET Cell Switching Algorithm: | Ad Hoc On-Demand Routing Protocol |
| Simulation in Network Simulator-2 | Duplicate Address Detection: | Ad Hoc On-Demand Routing Protocol |
| Real implementation on OS/2 and AIX | Implementation of the Route Manager Program: | Modified Version of Routing Information Protocol |

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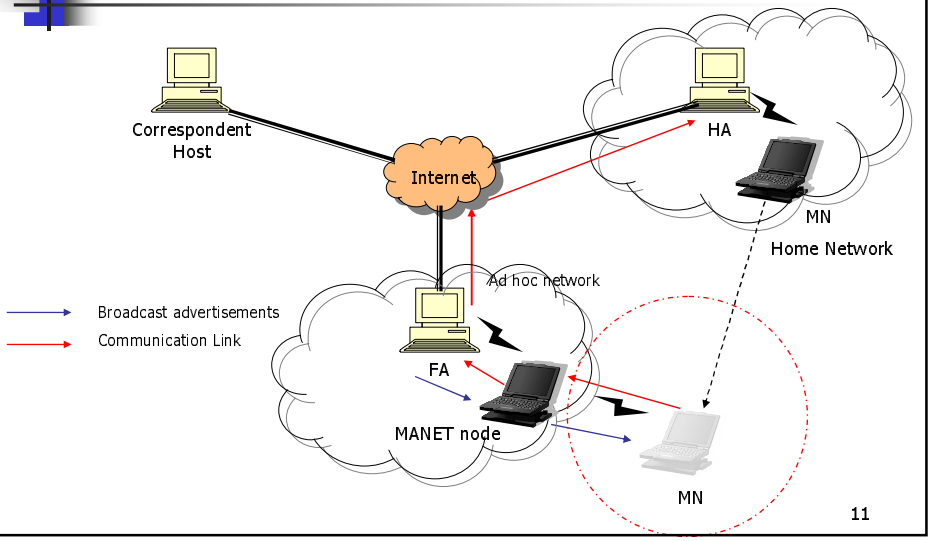
# Infrastructured MANETs – Mobile IP

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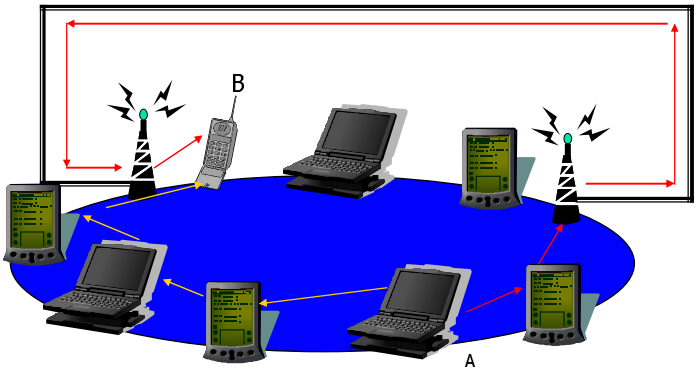
# Infrastructured MANETs

- Exploit Infrastructured MANETs
  - Aim to facilitate communication between MANET nodes.

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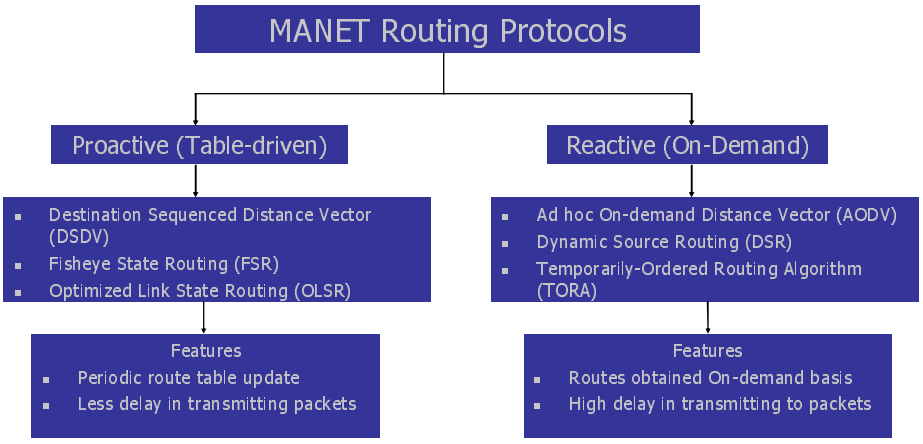
# Types of Routing Protocols

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# Ad hoc On-Demand Distance Vector (AODV)

- Uses two mechanisms for routing viz.
  - **Route Discovery** – This mechanism is invoked when a source node has data to send
    - Route request (RREQ) – Broadcasts in search for a destination
    - Route reply (RREP) – Unicast packet by the destination/intermediate node
  - **Route Maintenance** – This mechanism responds to link failures
    - Route error (RERR) – Broadcast packet when a link fails

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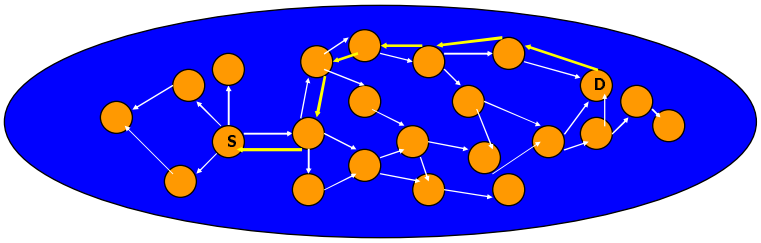
# AODV

Source node broadcasts an RREQ in search destination for a destination

Destination node replies with an RREP

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# Scalability of MANET Routing

- Increase in network size (number of nodes) drastically affects the performance of MANETs because of
  - Increased path length (high delay)
  - Burden on intermediate nodes (reduced throughput)
  - Increased collisions (large packet drop)

To overcome the above drawbacks we propose the Transparent Ad hoc Network Gateway or TANGs

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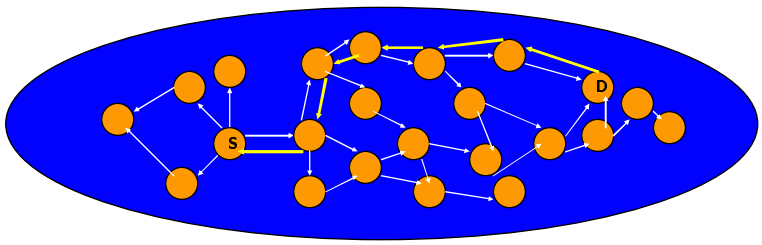
# Our Proposed Scheme

- Exploit the existing infrastructure

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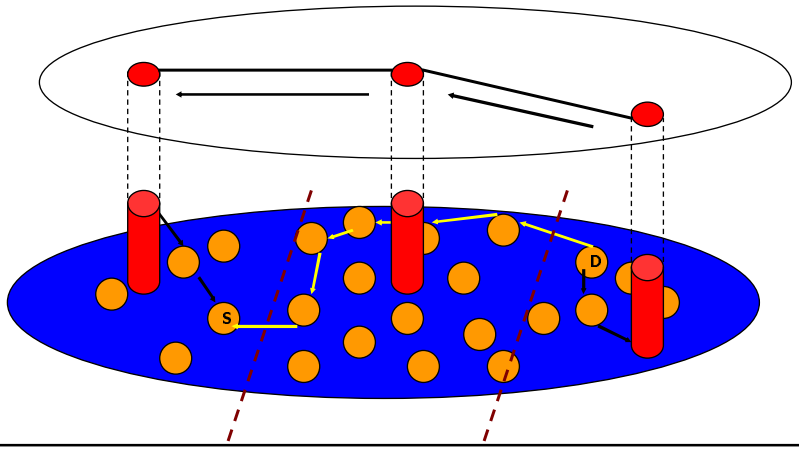
# Our Proposed Scheme

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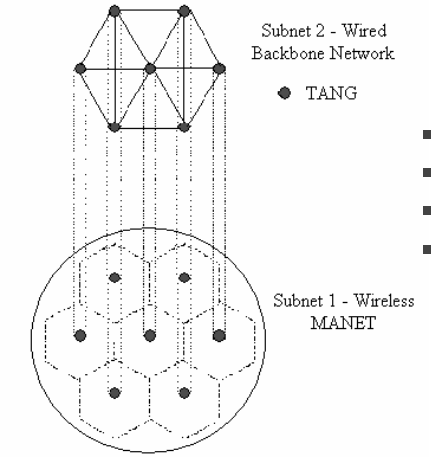
# Concept of TANG in a MANET




- Virtual cells.
- Two interfaces (AODV)
- Broadcast on both interfaces
- No modification to routing protocol

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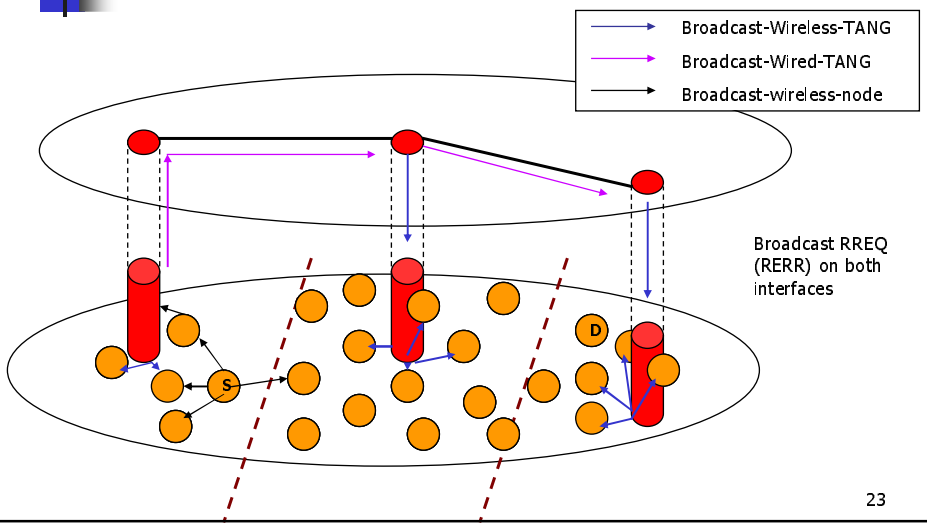
# TANG Operation

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# Advantage of TANGs

- MANET nodes are
  - not aware of TANGs
  - not aware of the logical partitions in the MANET

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# Simulation Emphasis

- Impact of number of TANGs
- Scalability

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# Performance Metrics

- Throughput: Number of packets delivered
- End-to-End delay
- Packet delivery ratio: # of packets delivered/# of packets originated
- Routing overhead: RREQ and RERR packets

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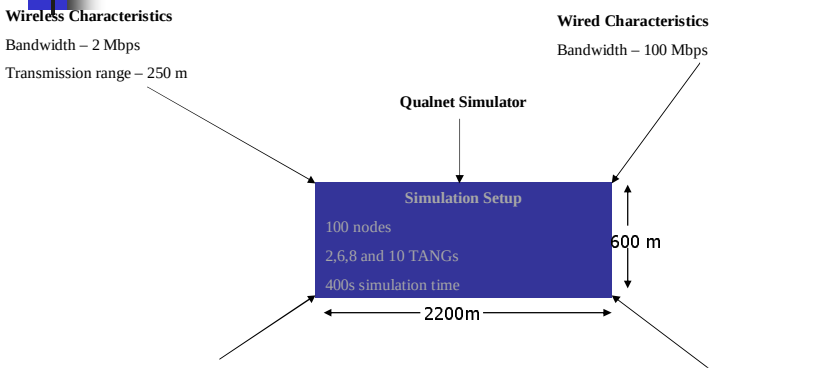
# Simulation – Impact of number of TANGs

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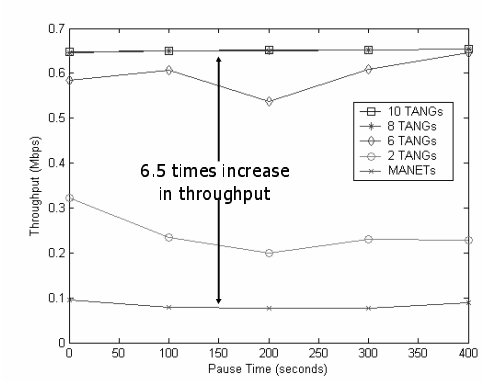
# Throughput Graph




- Intermediate nodes burdened
- Increases in congestion: A lot of spurious link failures
- Backbone network exploited

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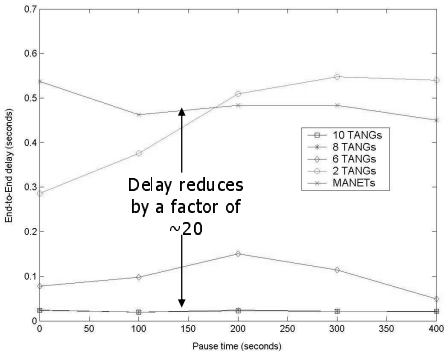
# Delay Graph




- Time required for network-wide search reduces
- Reduced hop count – less delay

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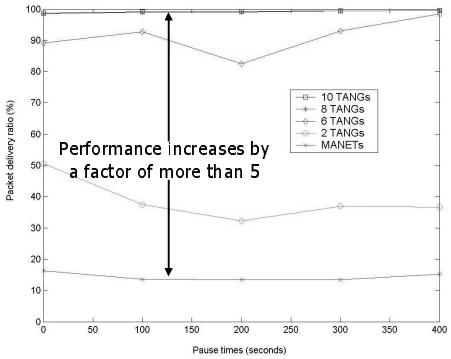
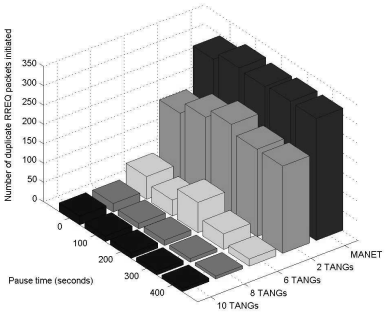
# Packet Delivery Ratio



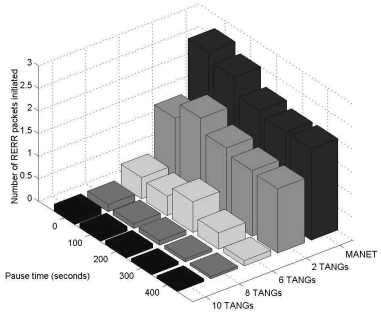

- High network Congestion - Number of collisions increases



# AODV Routing Overhead




Number of duplicate RREQ packets initiated




Number of RERR packets initiated

- Additional overhead causes overall degradation in MANETs.

# Simulation - Scalability

**Wireless Characteristics**

Bandwidth – 2 Mbps

Transmission range – 250 m

**Wired Characteristics**

Bandwidth – 100 Mbps

**Qualnet Simulator**

**Simulation Setup**

Nodes – 100,200 and 500 nodes

# of TANGs – 10, 14 and 22 for 100,200 and 500 respectively.

Area – 2200m x 600m , 3200m x 900m and 5000m x 1000m for 100,200 and 500 nodes respectively

400s simulation time

**Communication Model**

Number of sources – 20 sources

Packet Size – 512 bytes

Packet rate – 4 packets/sec

Traffic type – Constant bit rate

**Mobility Pattern**

Model – Random Waypoint Model

Speed - 0 m/s – 15 m/s

Pause time – 0s, 100s, 200s, 300s, 400s

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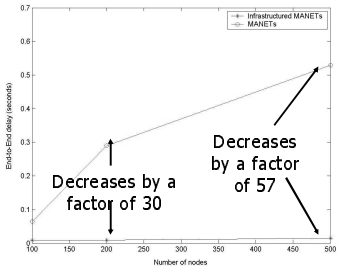
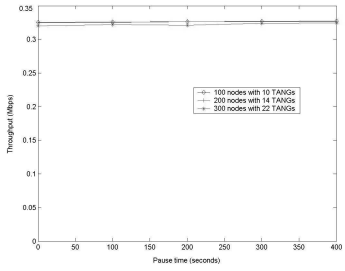
# Scalability




Delay graph – no mobility




Throughput graph – with mobility

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# Observation

- Increase in number TANGs: Improves performance but after a threshold value does not significantly impact the performance
- Under high network congestion an infrastructured MANET performs significantly better than a pure MANET.
- TANGs are not bottlenecks
- An infrastructured MANET with TANG scales much better than a pure MANET.

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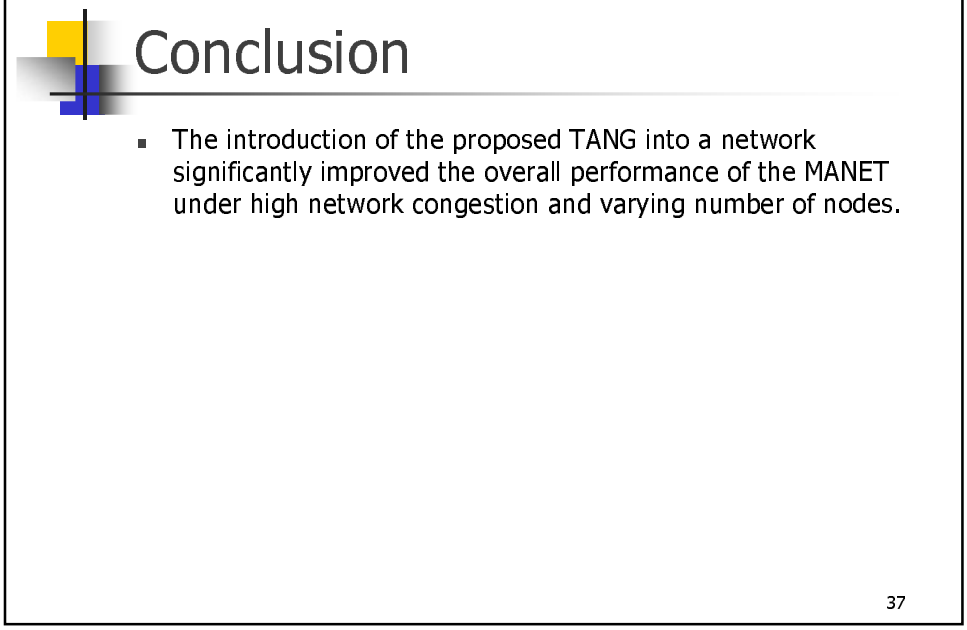
Conclusion
The introduction of the proposed TANG into a network significantly improved the overall performance of the MANET under high network congestion and varying number of nodes.
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