Adaptive Gateway Discovery in Hybrid MANETs

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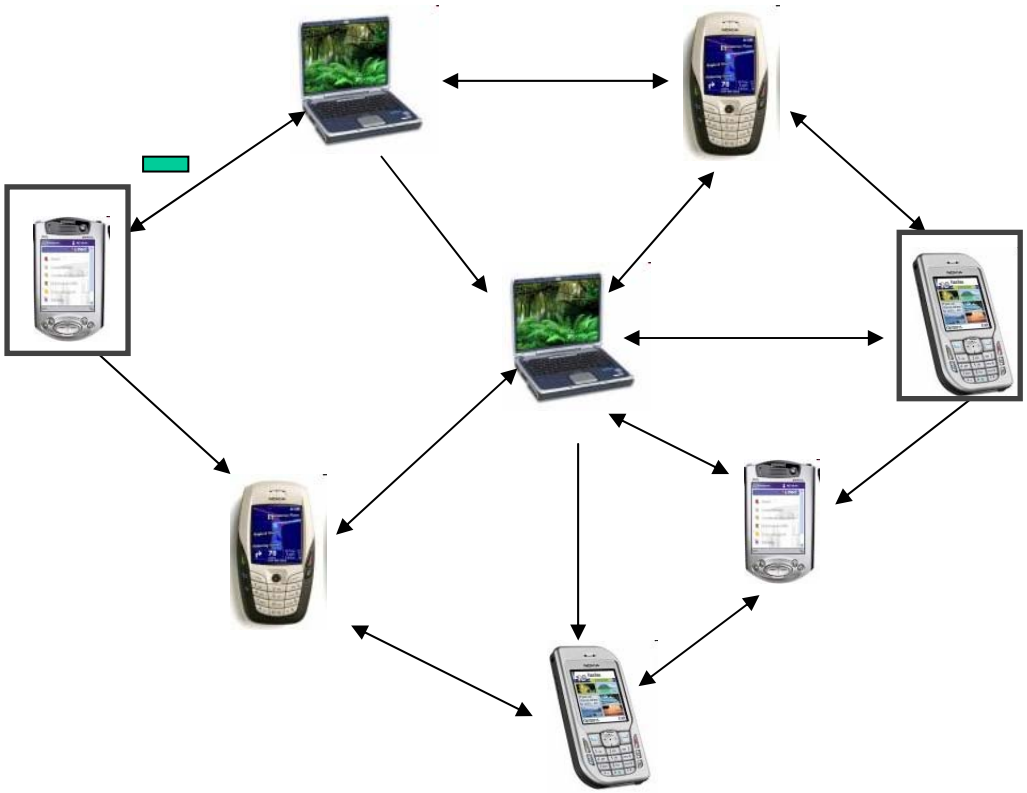
Outline

1. Motivation
2. Global Connectivity Mechanism
3. Adaptive Proposal
4. Simulations and Results
5. Conclusions

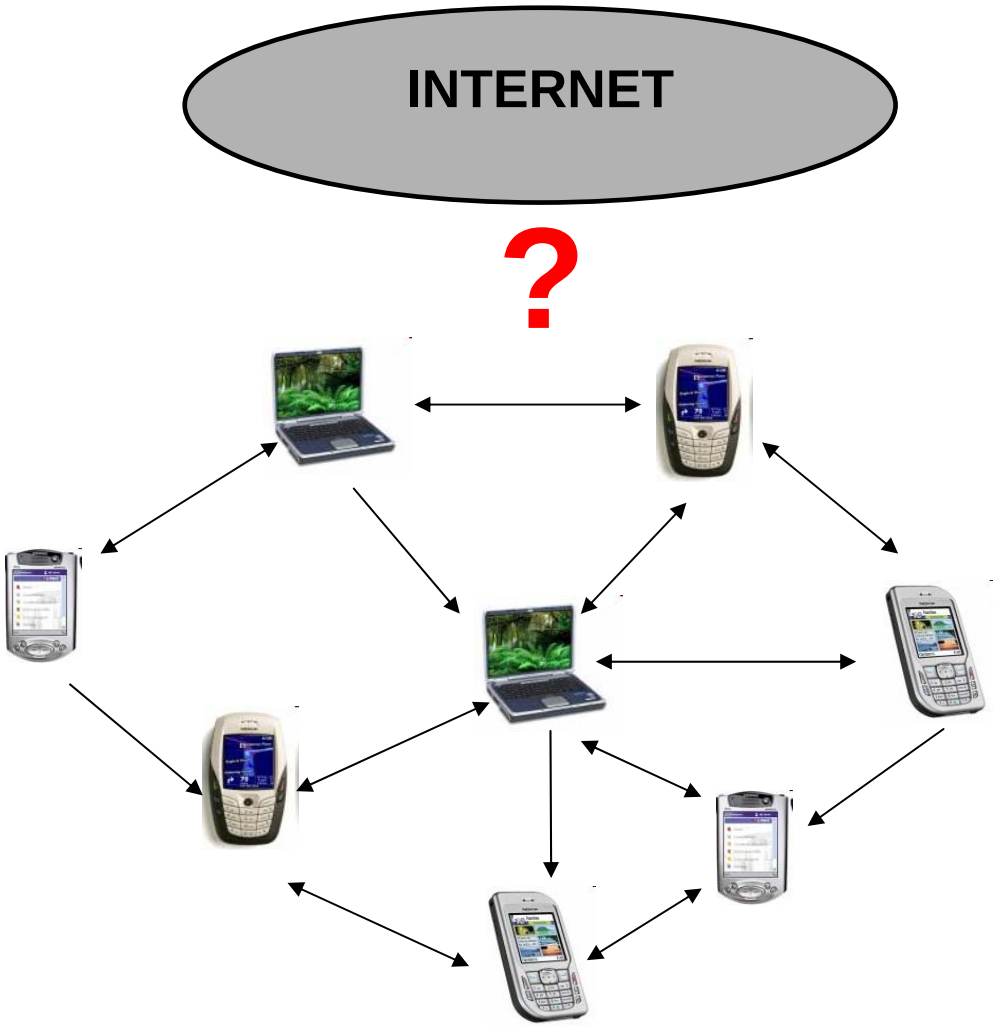
Introduction: Ad Hoc Networks (MANET)



- There is no infrastructure
- Mobile devices

- Dynamic paths
- Multihop communication

Introduction: Internet connection in MANETs (I)

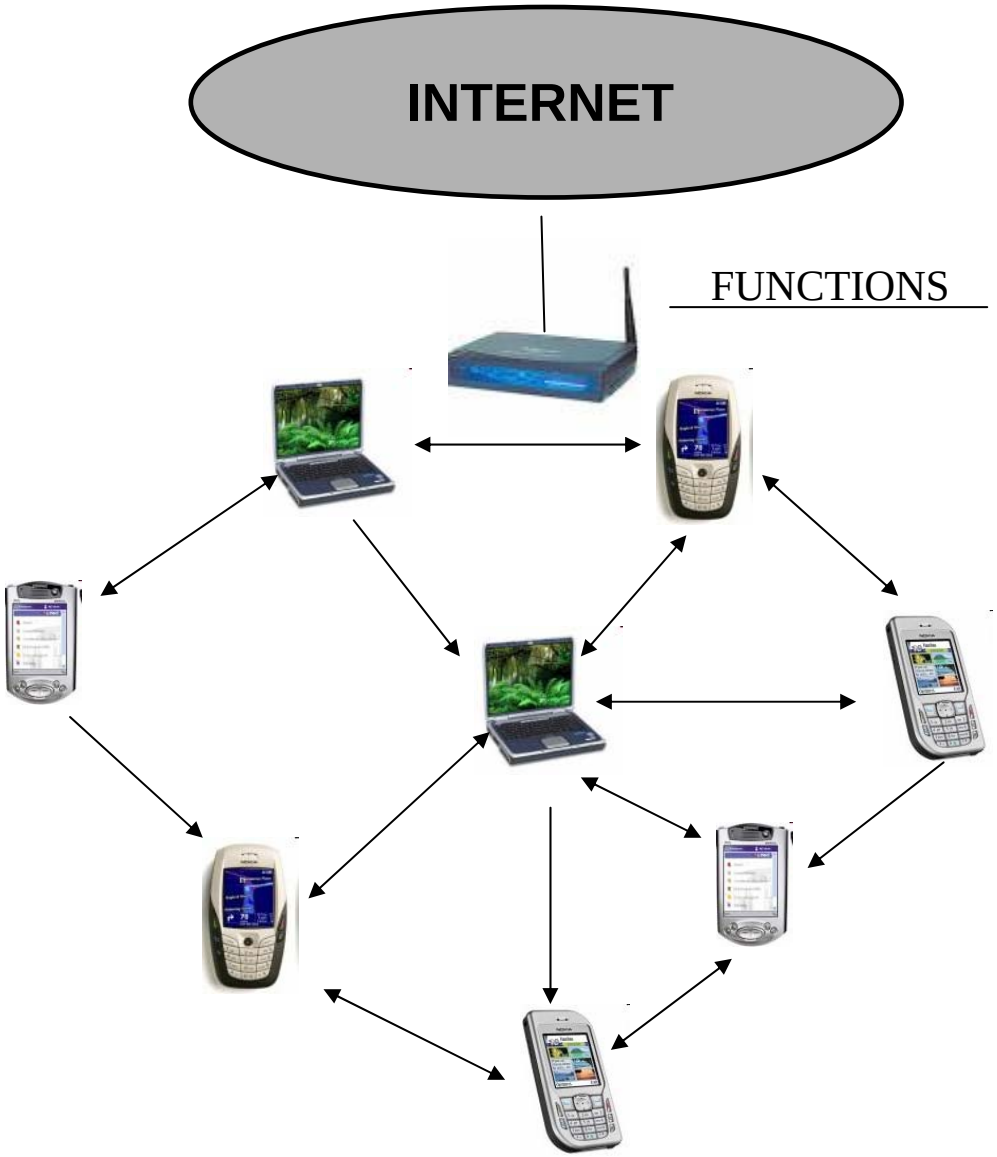


Global IPv6 address

Technologies:

- IPv6 address autoconfiguration
- Duplicated Address Detection (DAD)
- Mobile IPv6

Introduction: Internet connection in MANETs (II)



Access Router

+

GATEWAY

Prefix Information in Multihop	Ad Hoc Routing Capabilities

Mechanisms:

- Global connectivity (Wakikawa)
- Prefix continuity (Jelger)

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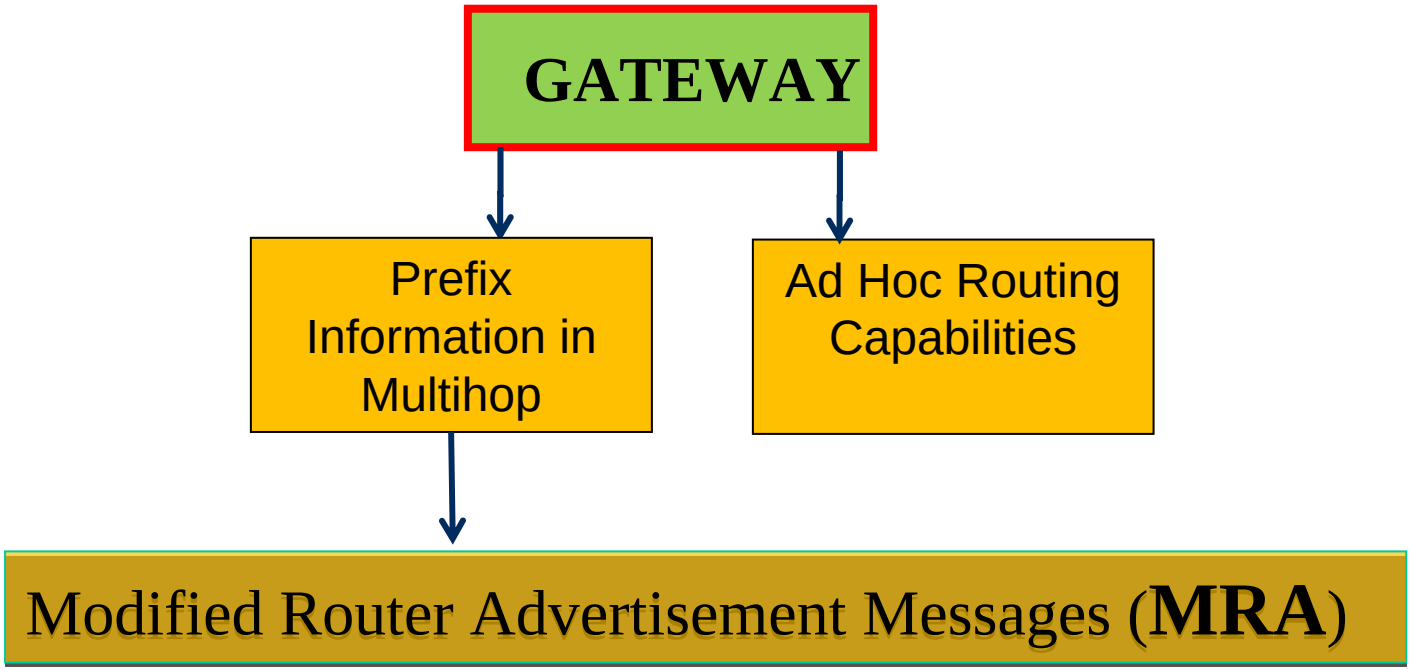
Global Connectivity



Global Connectivity

Gateway

MRA

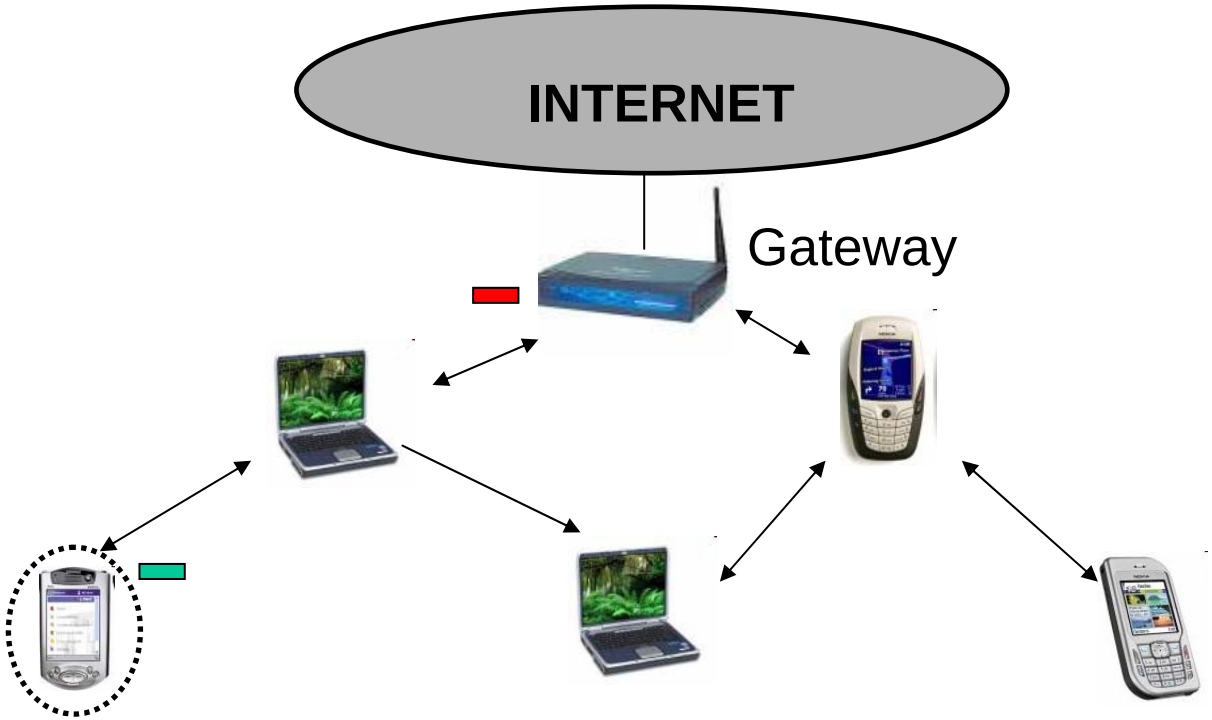
When a nodes receives the MRA:

- ❑ It employs the prefix information (when necessary)
- ❑ It updates the route to the Internet

When should MRA messages be generated?

- ❑ Proactively
- ❑ Reactively
- ❑ Hybrid

Global Connectivity : Reactive



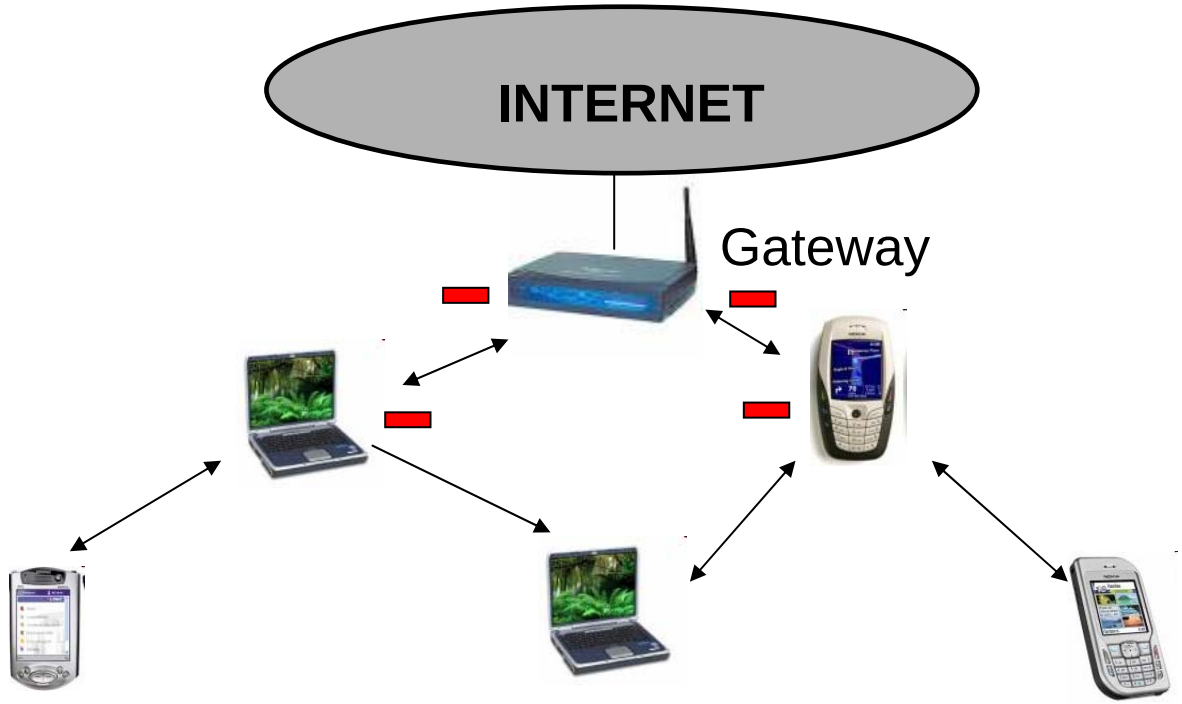
No Route to the Internet

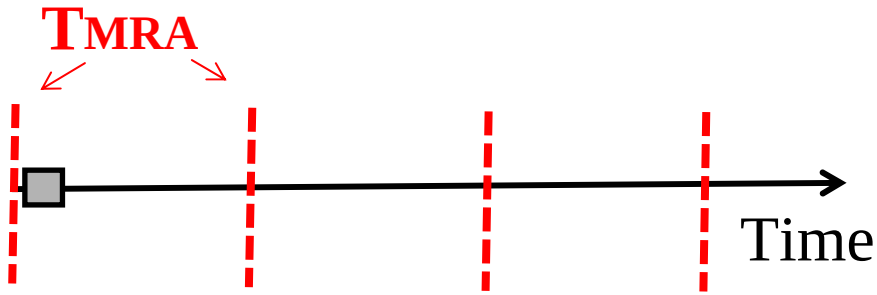
Updated Route to the Internet

MRS: *Modified Router Solicitation*

MRA: *Modified Router Advertisement*

Global Connectivity : Proactive





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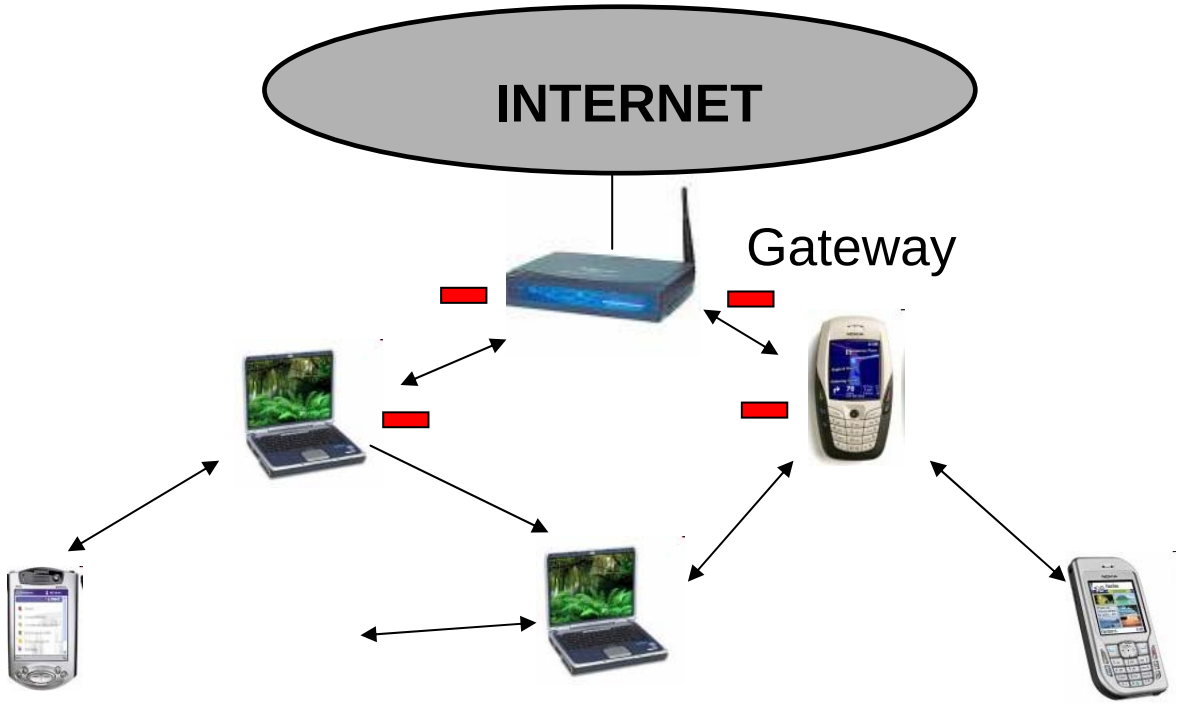
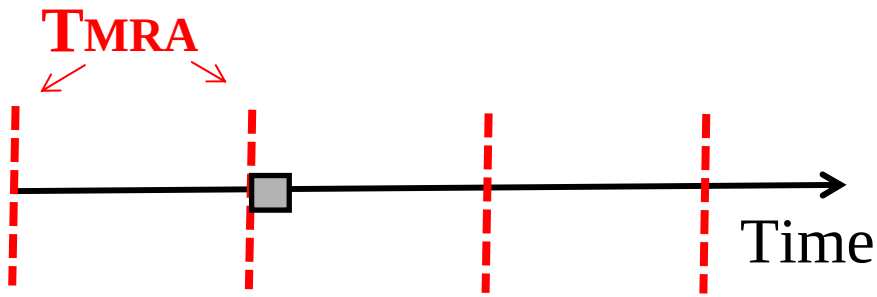
Global Connectivity : Proactive



Invalid Route to the Internet



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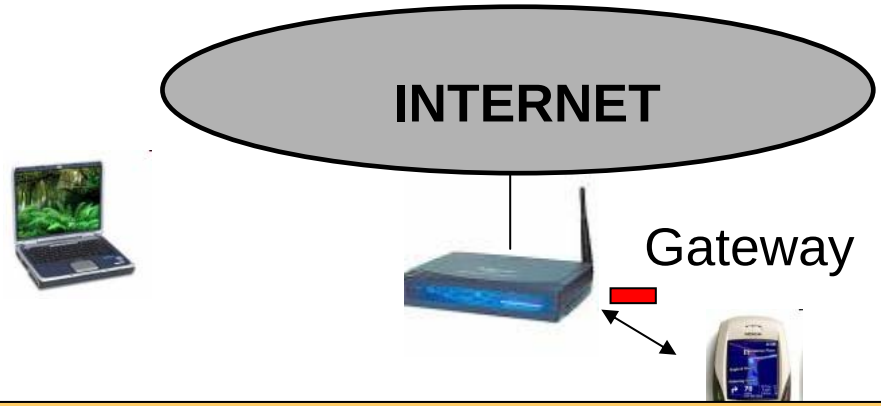
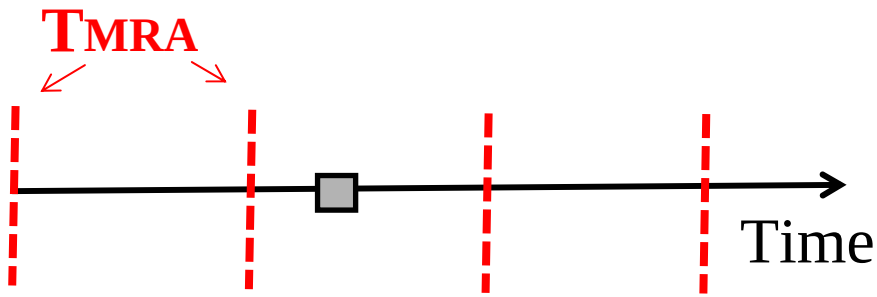
Global Connectivity : Reactive



WHICH TMRA SHOULD BE CONFIGURED?

Invalid Route to the Internet

Valid Route



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Adaptive Proposal

Which TMRA should be configured?

- Low TMRA ⇒ Unnecessary Overhead
- High TMRA ⇒ On Demand

The optimum TMRA depends on the network conditions

Solution:

ADAPTIVE PROACTIVE GATEWAY DISCOVERY

Adaptive Proposal

Assumption:

MRS messages received by the Gateway indicate that the routes to external hosts are invalid

Implementation:

The Gateway estimates the number of MRS messages that are expected to be received

Adaptive Proposal : Implementation

Auto-Regresive Process:

$$\hat{s}[n] = -a_1 s[n-1] + q[n]$$

Expected MRS messages

Number of MRS received in the previous interval

$$a_1 = -\frac{Rs\ (1)}{Rs\ (0)} = -\frac{\frac{1}{N-1}\sum_{n=0}^{N-2} s[n] * s[n+1]}{\frac{1}{N}\sum_{n=0}^{N-1} s[n] * s[n]}$$

Yule Walker Equations

Insesgated Estimator

Adaptive Proposal: Implementation

When the number of Expected MRS messages is estimated, we define four **levels**:

- CRITICAL LEVEL → T_{MRA} = 2 s
- MEAN LEVEL → T_{MRA} = [2,4] s
- LOW LEVEL → T_{MRA} = [4,8] s
- OTHER → T_{MRA} = [8,18] s

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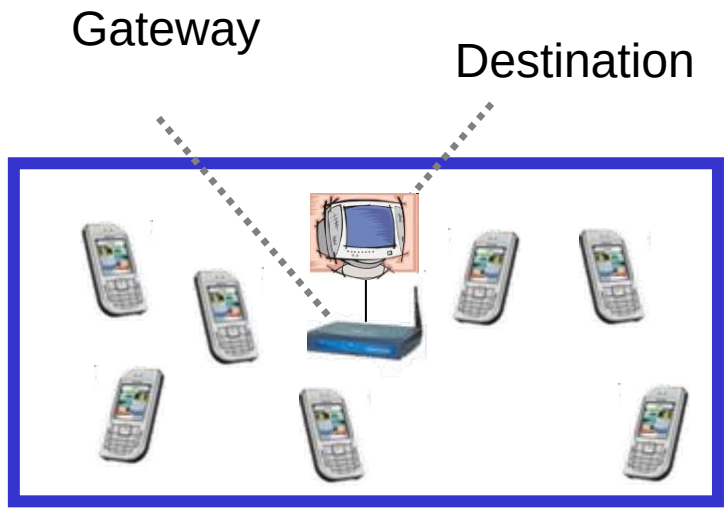
Simulations. Parameters

Simulation tool = *Network Simulator*, ns2

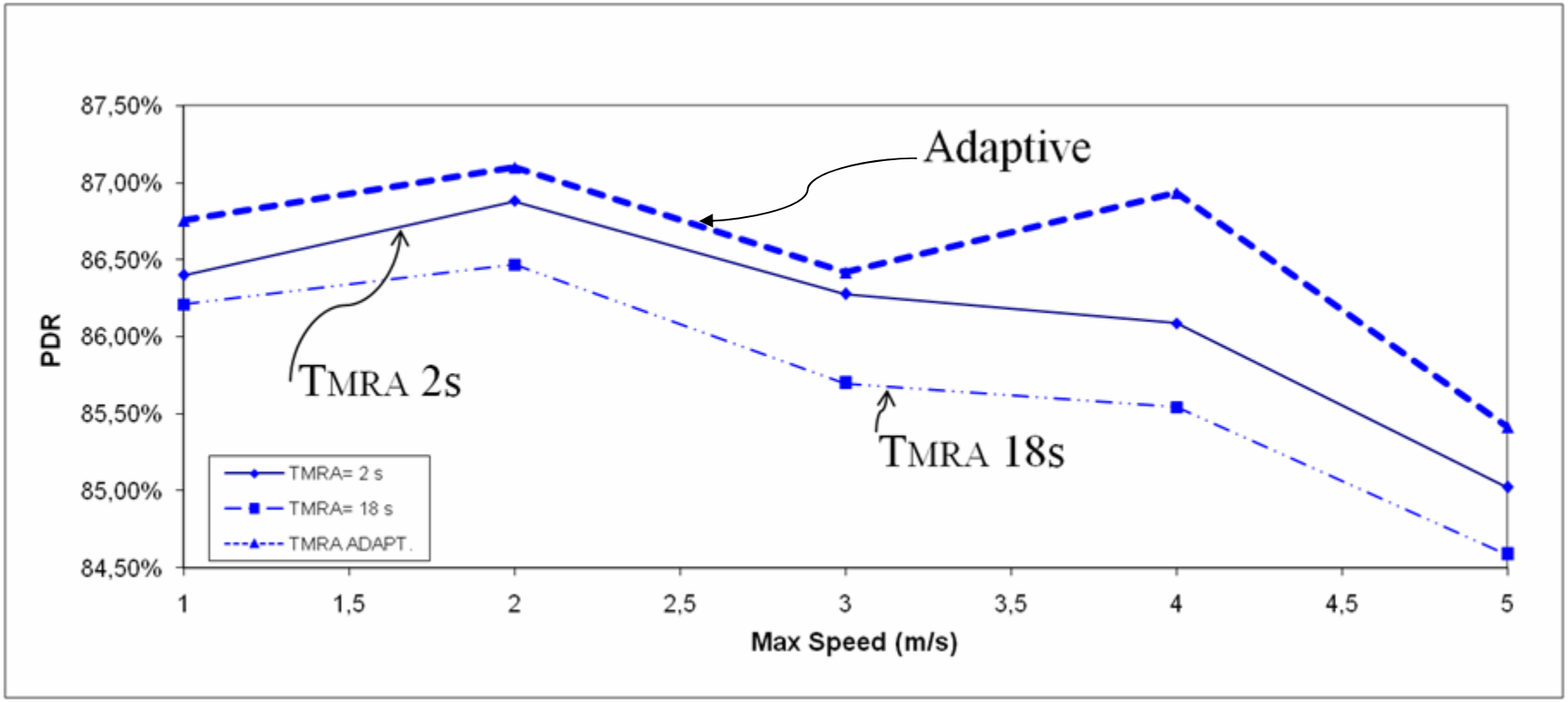
Simulation Area	1500 m x 300m
Mobile nodes	50
Mobility pattern	Max. speed = [1,2,3,4,5] m/s Min. speed = 1 m/s
Traffic pattern	10 CBR sources Rate= 9 packets/s Packet size = 512 B
Simulation time	1000 s
Transmission range	250 m
Number of runs per point	20
Ad Hoc protocol	AODV
Link layer	802.11b RTS/CTS Enabled
Internal node Queue	64 packets
Adaptive Technique	CRITICAL LEVEL = 200 MRS MEAN LEVEL = 100 MRS LOW LEVEL = 30 MRS



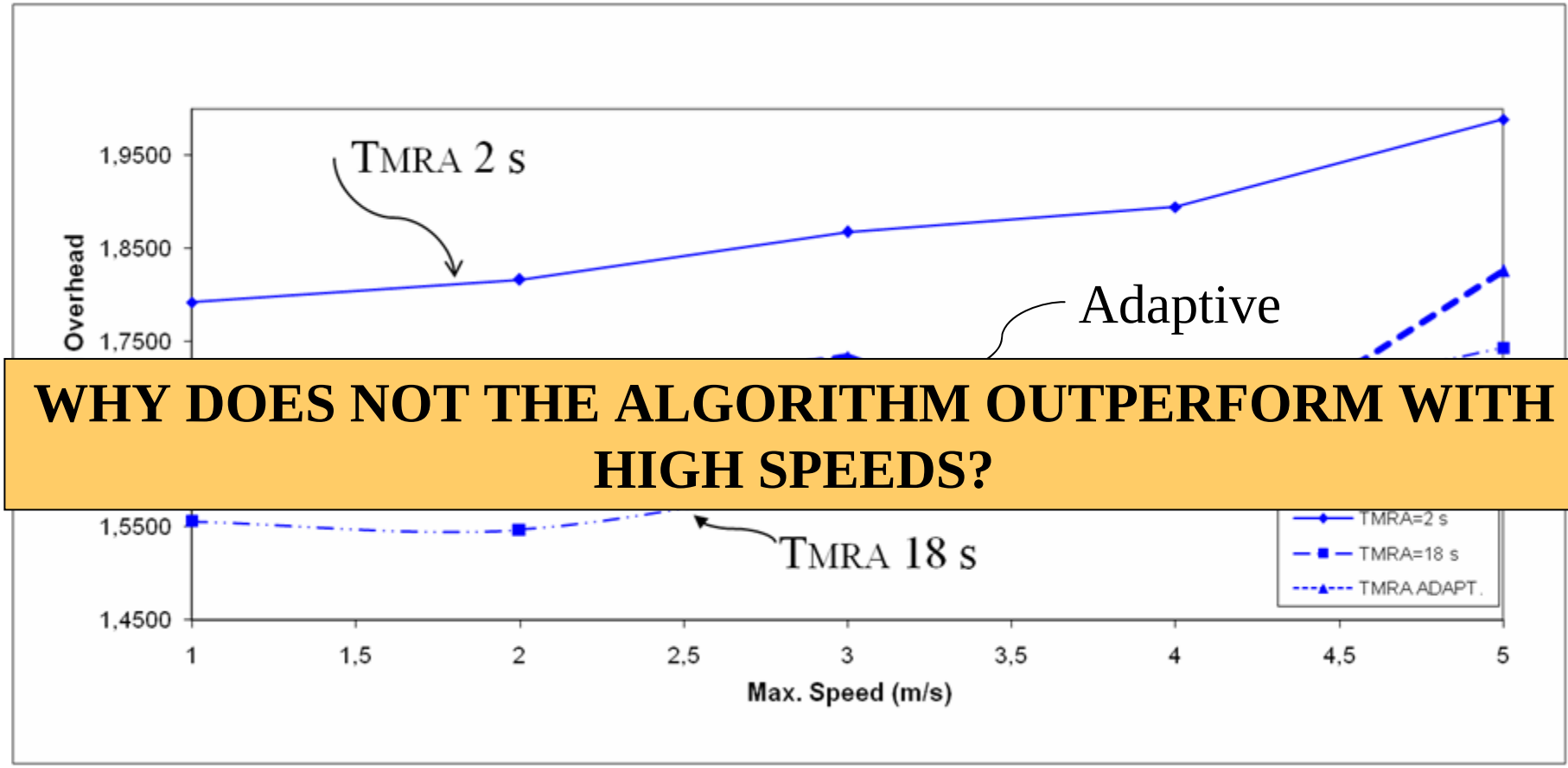
Packet Delivery Ratio?

Normalized Overhead?

Results. Packet Delivery Ratio



Results. Normalized Overhead



WHY DOES NOT THE ALGORITHM OUTPERFORM WITH HIGH SPEEDS?

Results: Comments

Assumption:

MRS messages received by the Gateway indicate that the routes to external hosts are invalid

but

COLLISIONS may lead to the generation of MRS messages

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Conclusions

- A new strategy for proactive gateway discovery has been presented
- This strategy reduces Packet Losses while maintaining or reducing Overhead
- This strategy outperforms in scenarios characterized by low mobility conditions
- However, it does not improve network performance in scenarios with a high velocity because:

  MRS messages can be generated by:

  - Error in transmission (Collisions)
  - Invalid Routes . We assume this reason

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