Percolation of Localization in Wireless Sensor Networks (WSNs)

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Atelier en Evaluation de Performances
1-4 June 2008

Drakkar Group

Plan

- Introduction
- Our focus
- Protocol Implementation
- Scope of our study
- Simulation Model / Assumptions
- Simulation Results
- Observations/Open questions

Introduction

WSNs

- Communicate wirelessly
- Numerous
- Spatially distributed
- Autonomous
- Tiny & cheap nodes
- Power constrained

Need for Localization in WSNs

-Application needs

-Better interpretation of sensed data

-Quality of network coverage

-Geographic Routing

-Target movement Monitoring

Coordinate System

-Relative

-Absolute

Our focus: localization with iterative trilateration

-Coarse Grained Localization

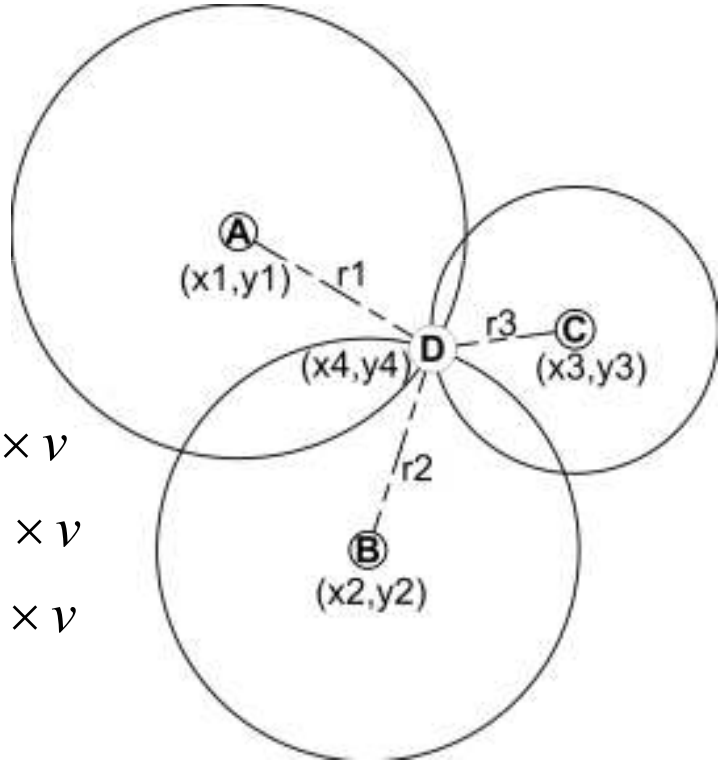
-Fine Grained Localization

$$\begin{cases} (x-x_1)^2+(y-y_1)^2=r_1^2 \\ (x-x_2)^2+(y-y_2)^2=r_2^2 \\ (x-x_3)^2+(y-y_3)^2=r_3^2 \end{cases}$$

$$r_1 = t_1 \times v$$

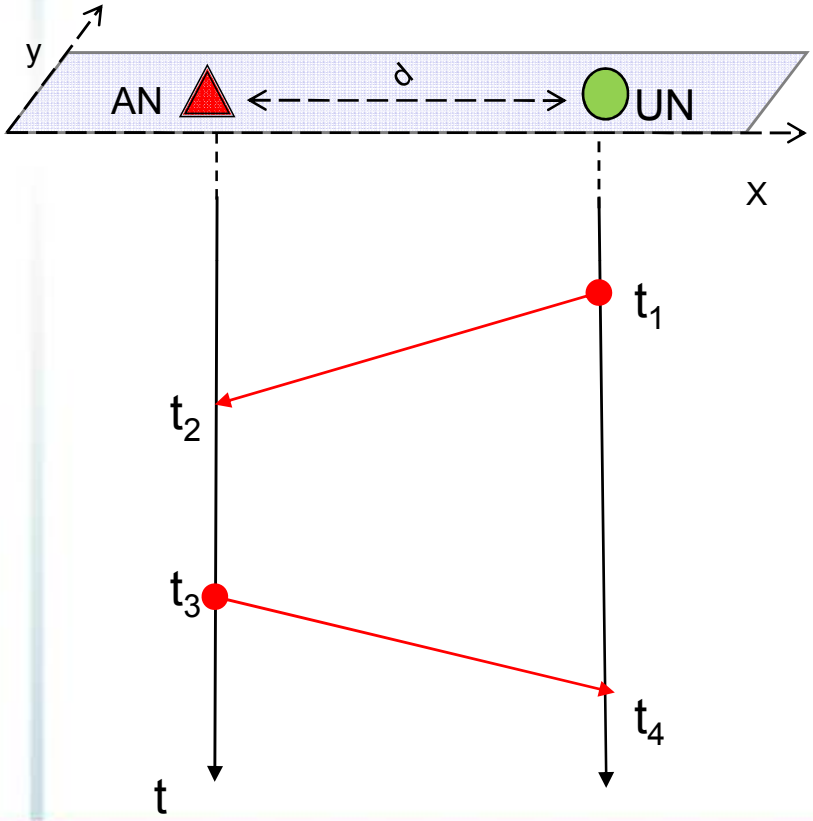
$$r_2 = t_2 \times v$$

$$r_3 = t_3 \times v$$



Protocol Implementation

Basic Lateration

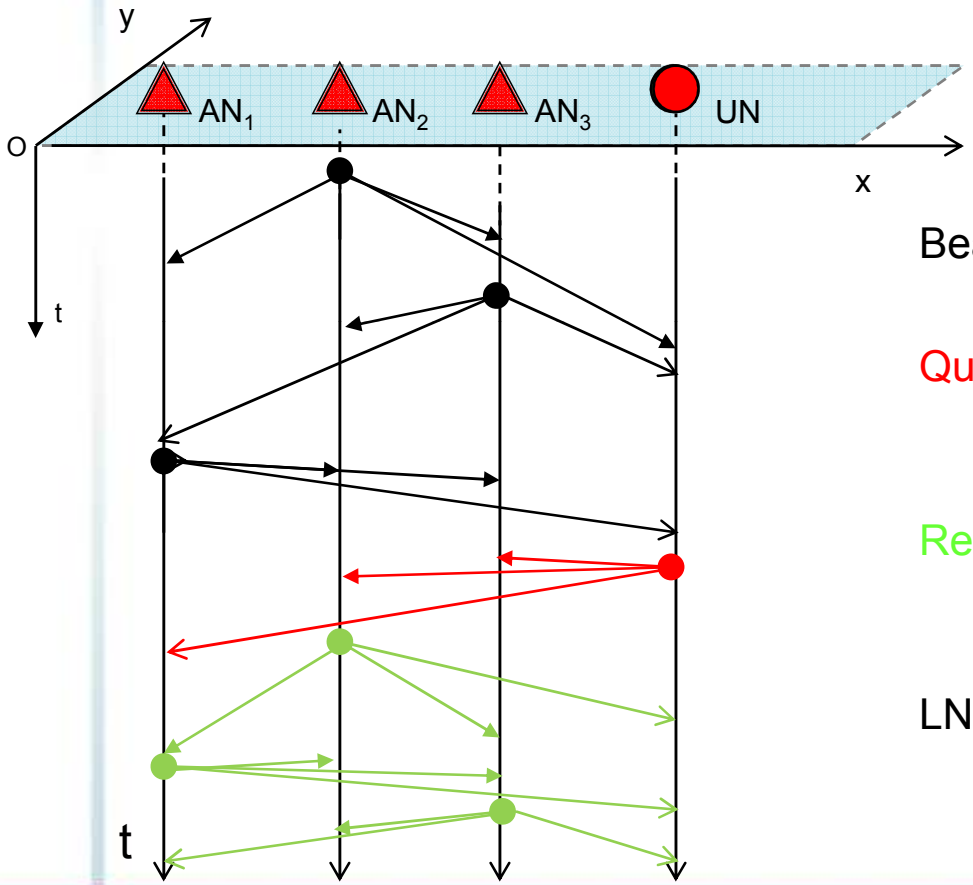


- t_1 et t_4 measured by node UN
- t_2 et t_3 measured by node AN
- t_3-t_2 : response time

$$d = \frac{v \cdot \left((t_4 - t_1) - (t_3 - t_2) \right)}{2}$$

Ref : L. de Nardis, M. Gabriella Di Benedetto (Univ. Rome), 2005

Tri-lateration and MAC Implementation



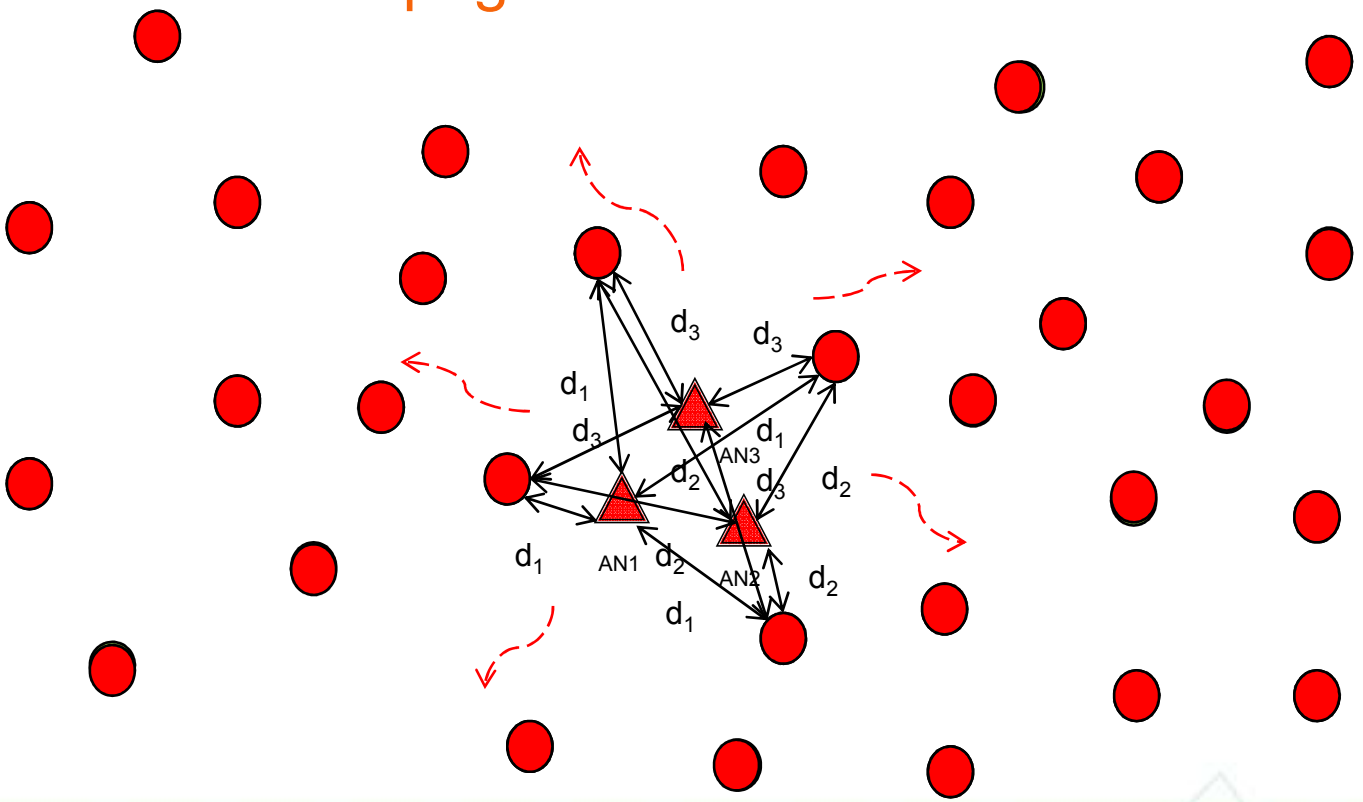
Beacon : sent by ANs

Query : sent by UNs (1st step of two-way ranging)

Response : sent by ANs (2nd step of two-way ranging)

LN transmits beacon msg

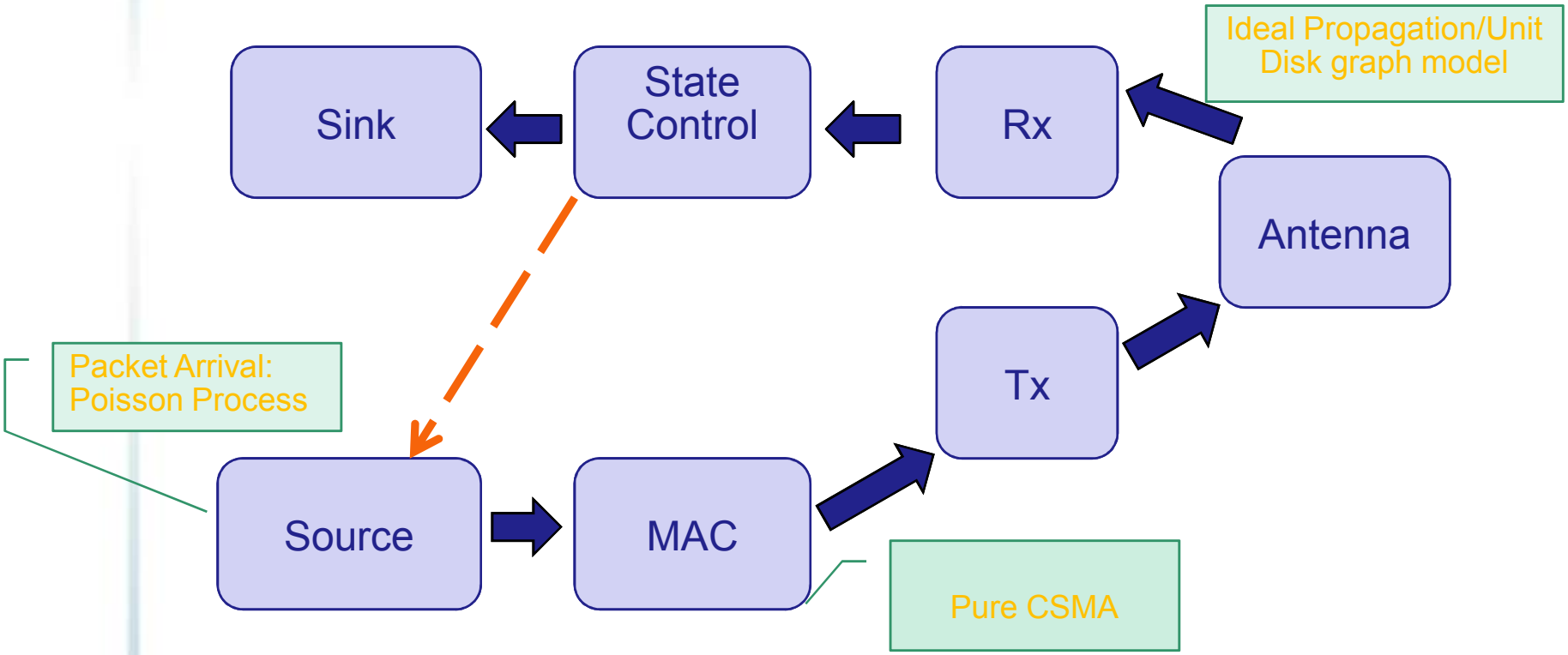
Propagation of localization wave



Scope of our study

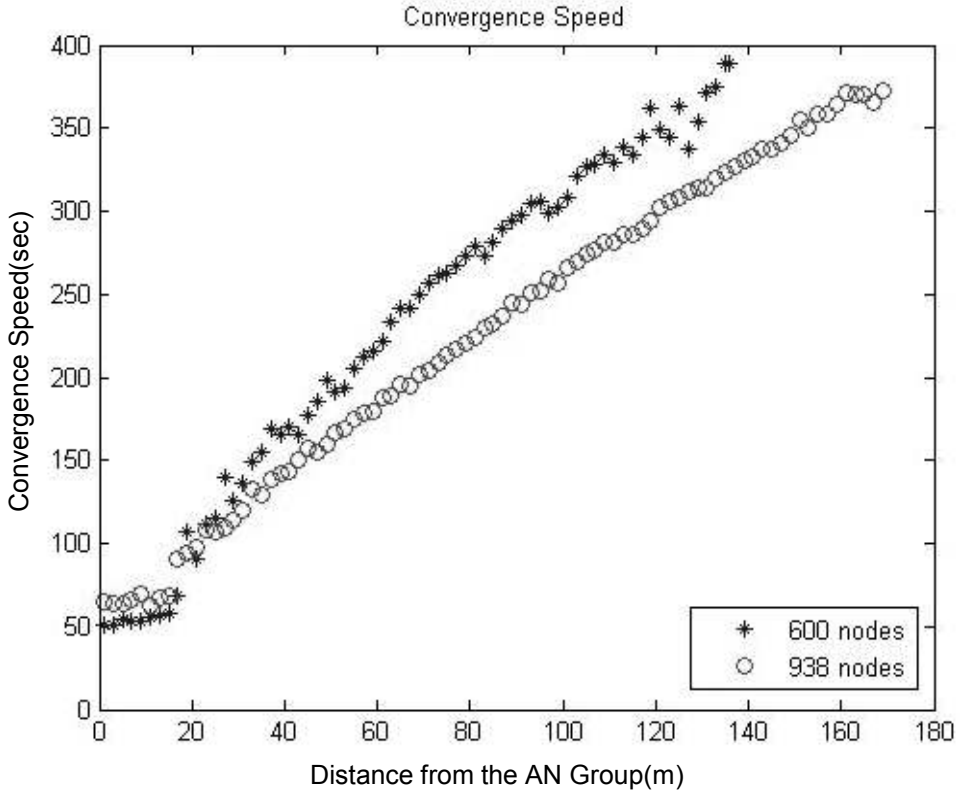
- Behavior of Location Propagation?
- Convergence Condition?
- Nature of Convergence Speed of this Process?
- Convergence Speed vs. Average Node Degree, Packet Interarrival Time?
- Predict Time for Full Network Localization?

Simulation Model/Assumptions

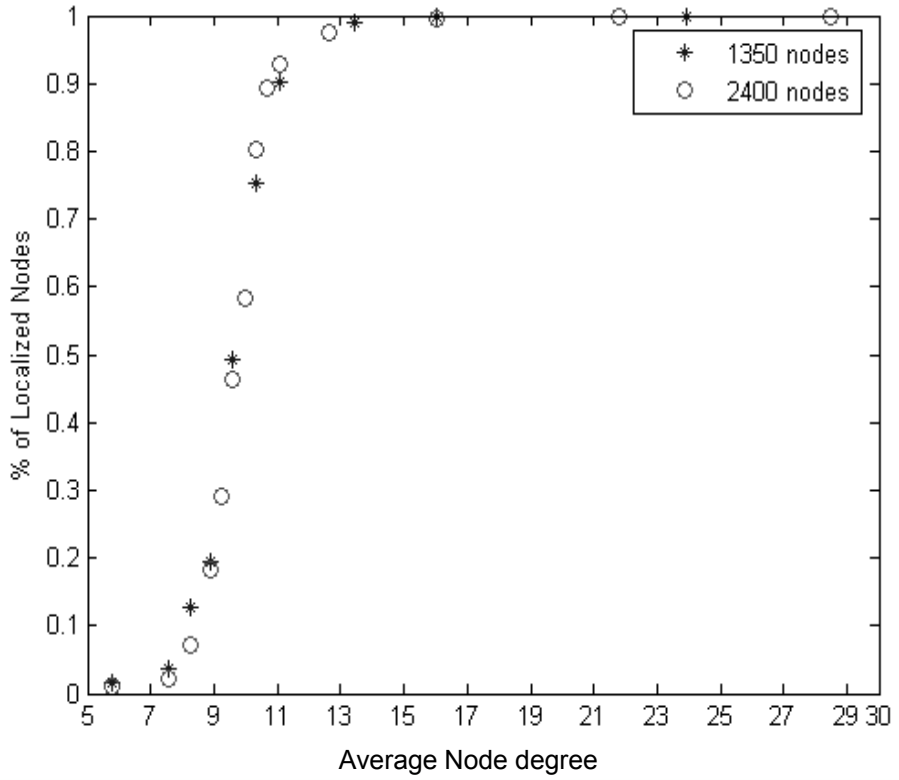

Sink
State Control
Rx
Ideal Propagation/Unit Disk graph model
Antenna
Tx
Packet Arrival: Poisson Process
Source
MAC
Pure CSMA

Simulation Results

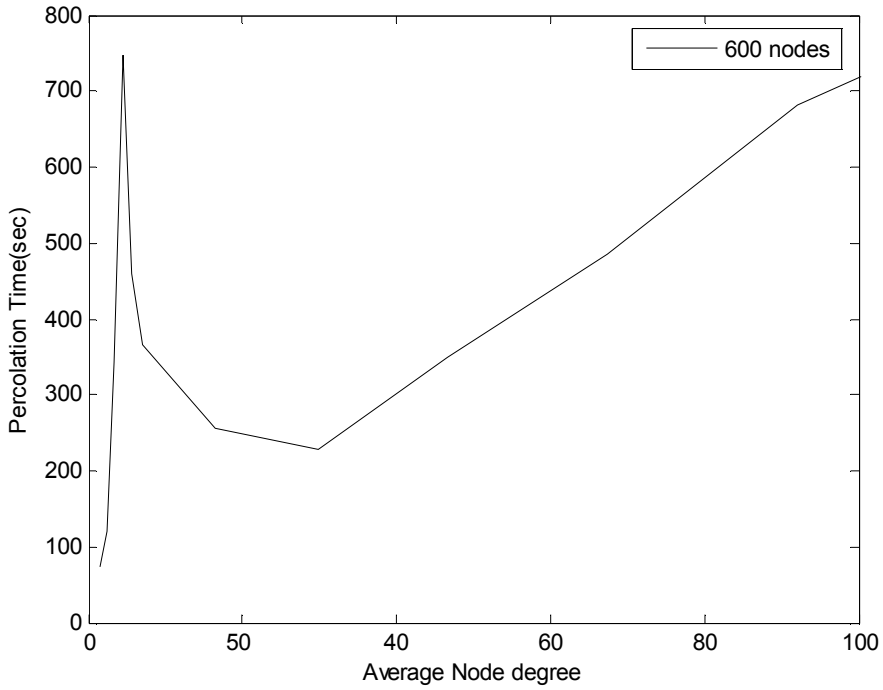
Protocol Convergence



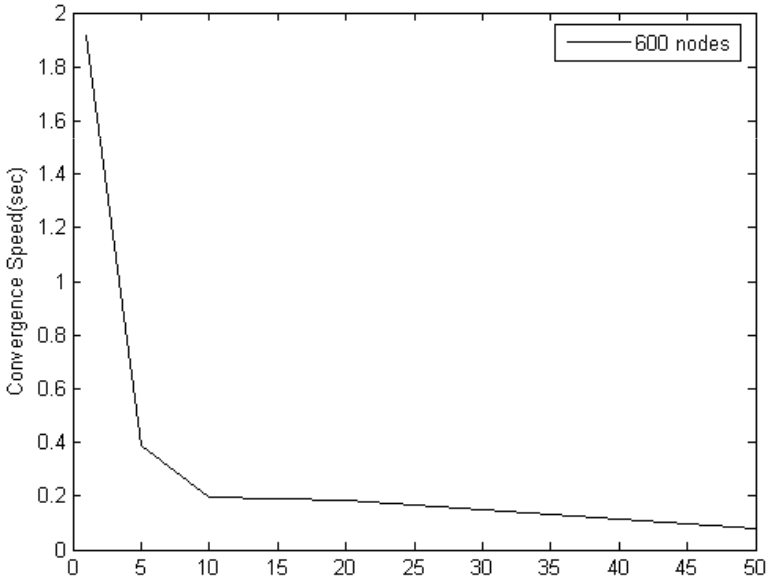
Network Degree



Percolation Time vs. Average Node degree



Packet Interarrival Time



Packet Interarrival Time:λ(sec)

Observations/Open questions

-Relevance to the “Percolation Theory”

-Estimate Convergence Speed?

-Determine Critical Network Degree?

MERCI!