



# A Method for Network Distance Prediction

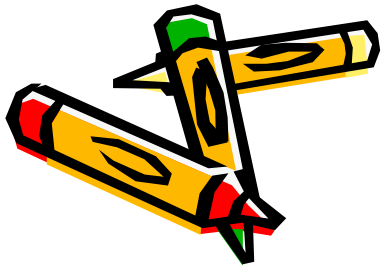
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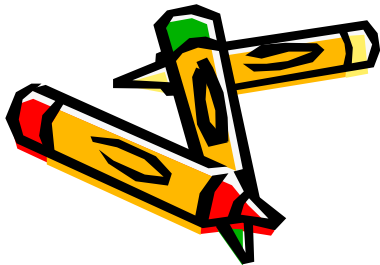
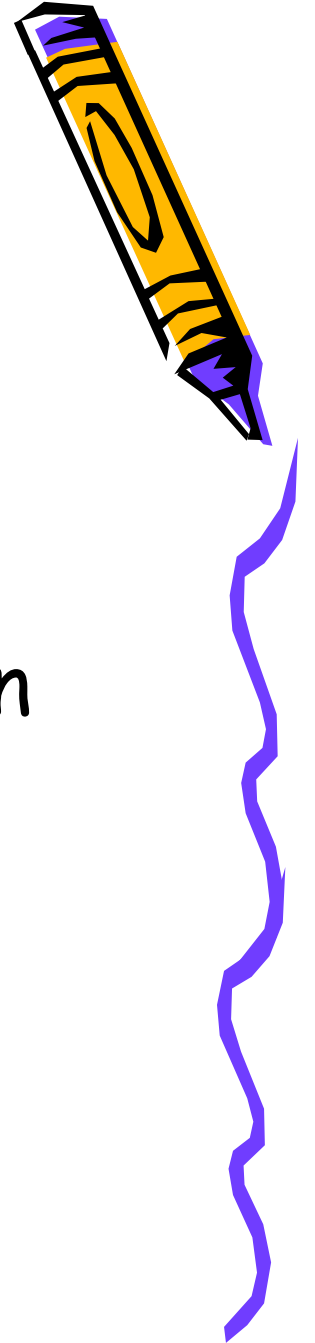
# Outlines

- Introduction
- Network Coordinate System
- System Design and Implementation
- Experiments on PlanetLab
- Conclusion and Future Work



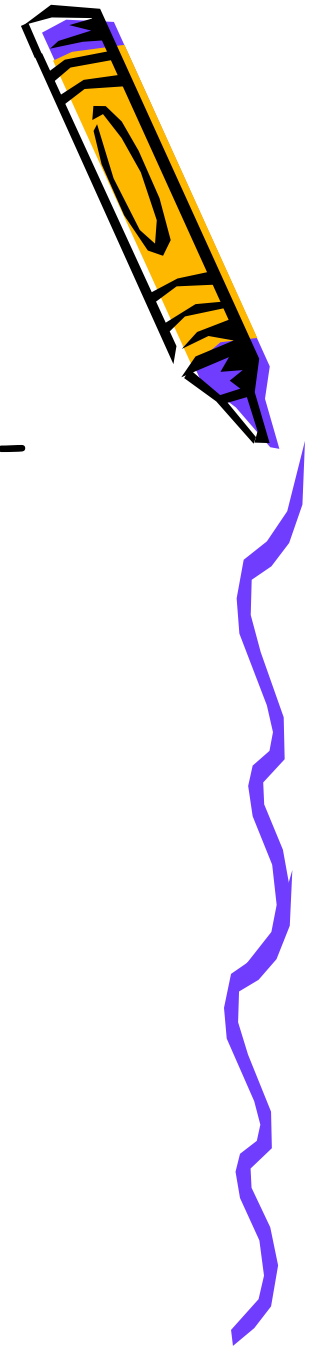
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# Introduction

- A new class of large-scale globally-distributed network services and applications have emerged.
- Network Distance
  - Application scenarios
  - Server (peer) selection and path selection

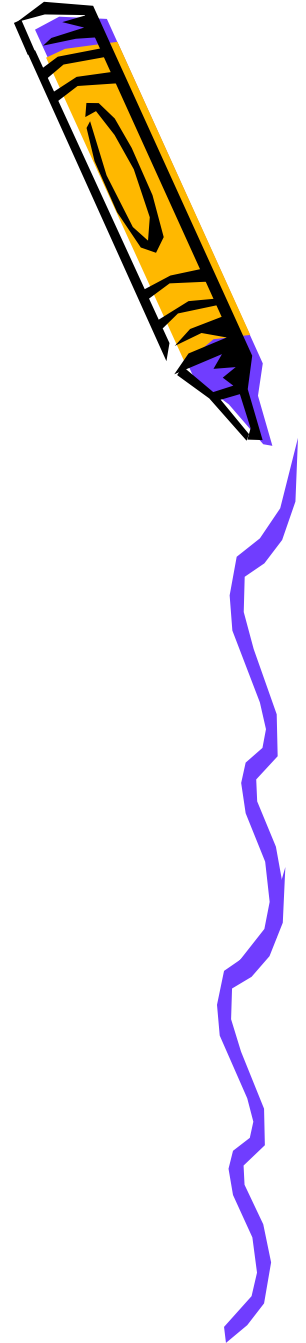


measurement

time, overhead, cost.....

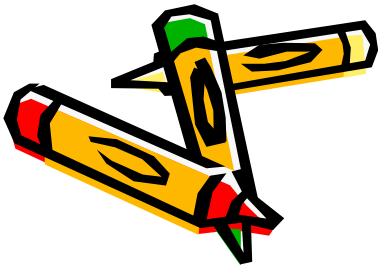
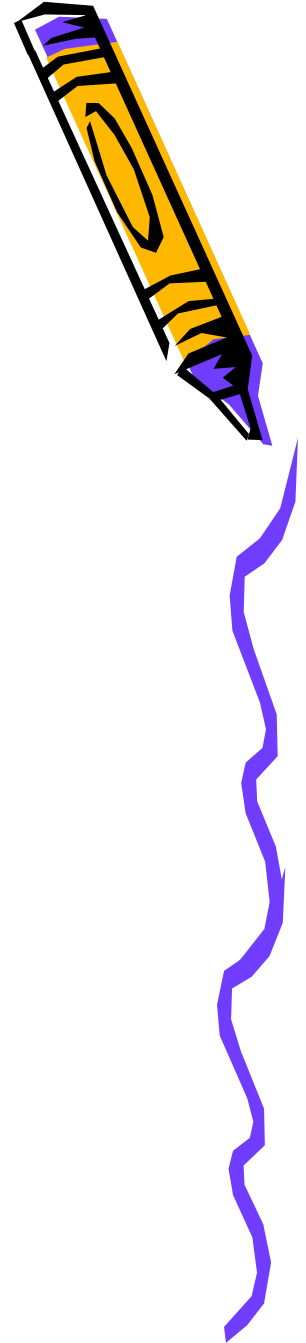
# Introduction

- Network Distance
  - Network Coordinate System
    - Fast
    - Accurate
    - Low overhead



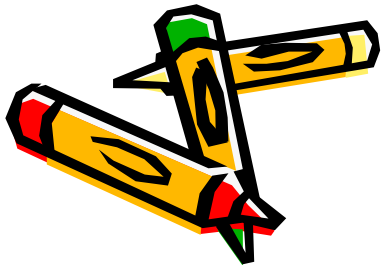
# Introduction

- Schemes
  - Network Coordinate System
    - Infrastructure based
    - Geometric space based
      - Euclidean space
      - Norm



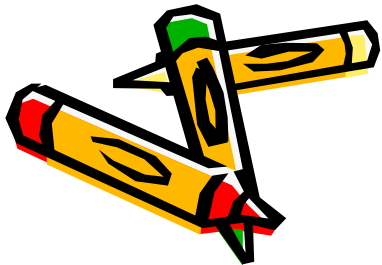
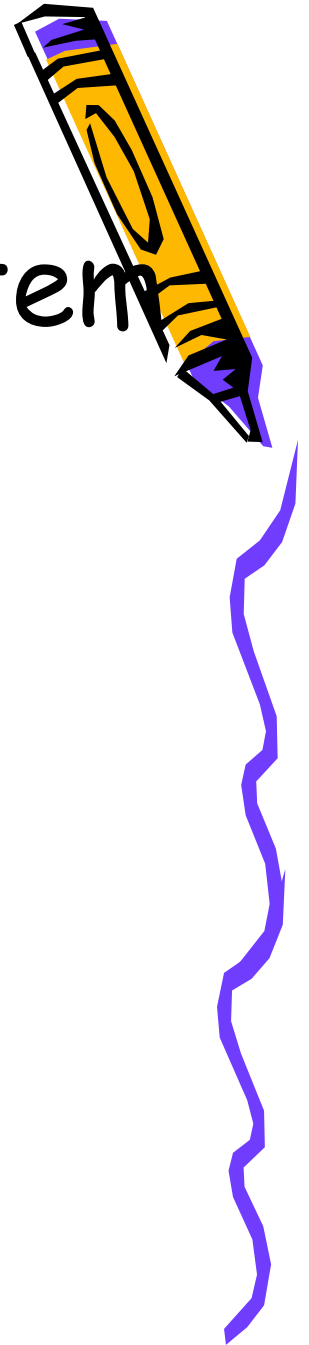
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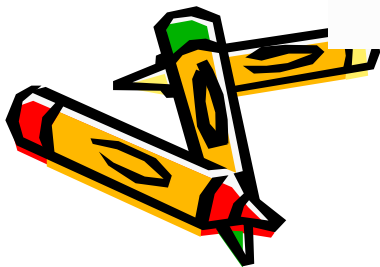
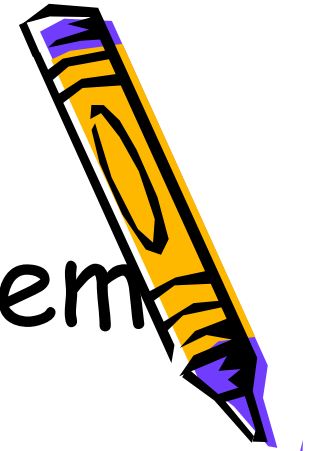
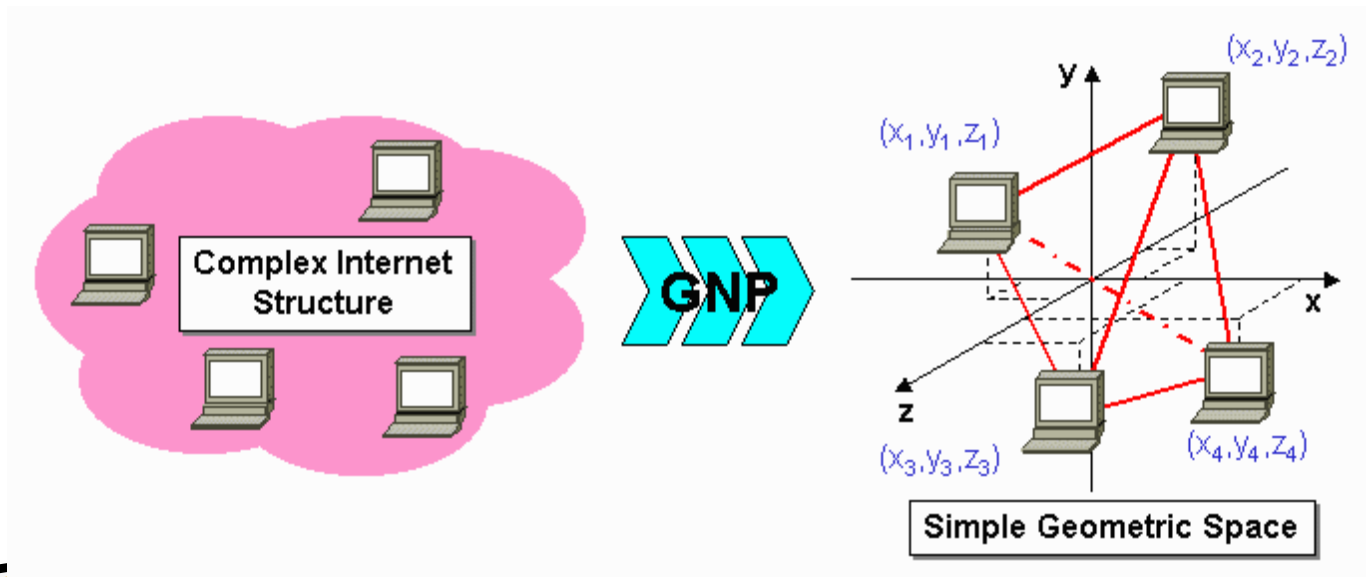
# Network Coordinate System

- Some Examples
  - GNP
  - Vivaldi



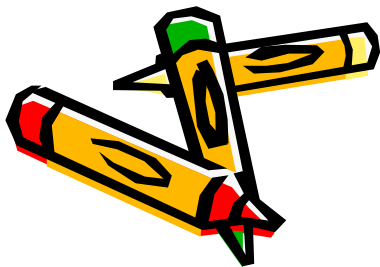
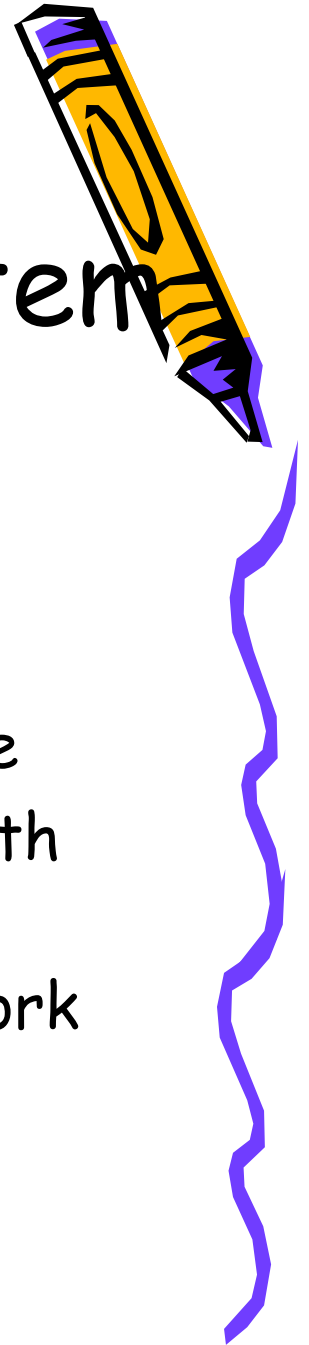
# Network Coordinate System

- Some Examples
  - GNP (Global Network Positioning)



# Network Coordinate System

- Some Examples
  - GNP
    - Landmark based
    - Model the Internet as a geometric space
    - Characterize the position of any host with geometric coordinates
    - Use geometric distance to predict network distance

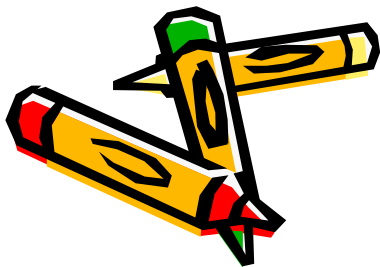
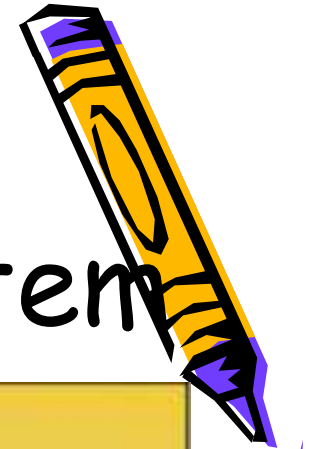
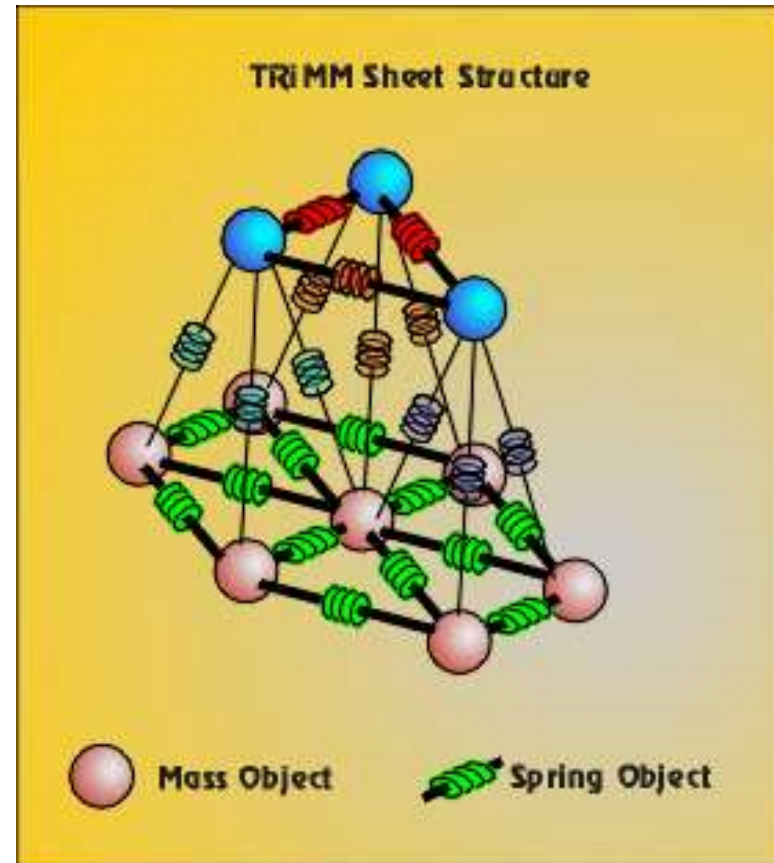


# Network Coordinate System

- Some Examples

- Vivaldi

- Similar to physical mass-spring system.
    - Nodes - mass object
    - Network Distance – spring

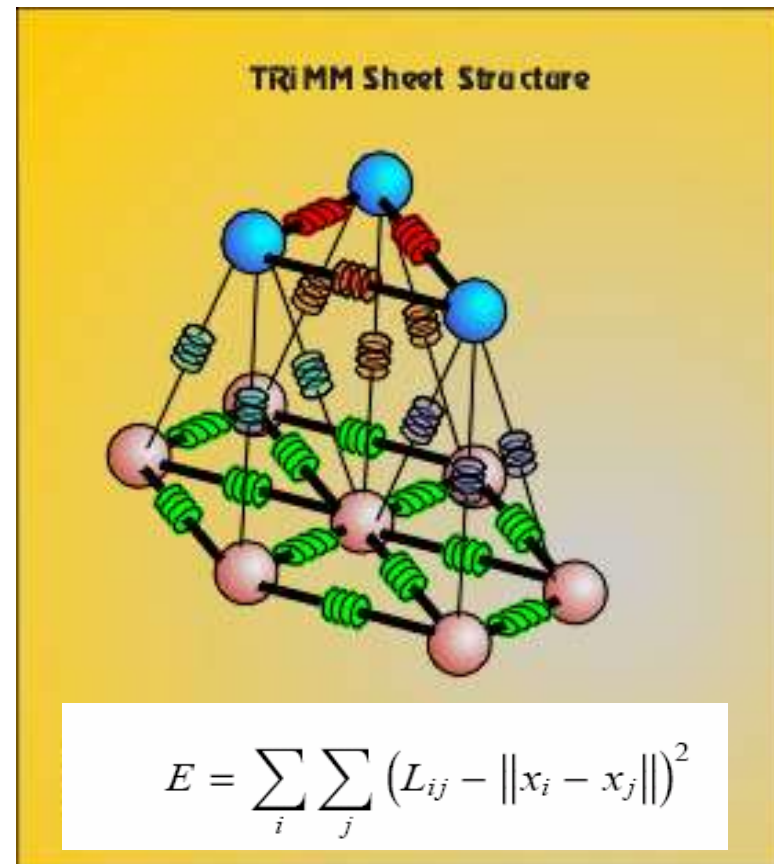
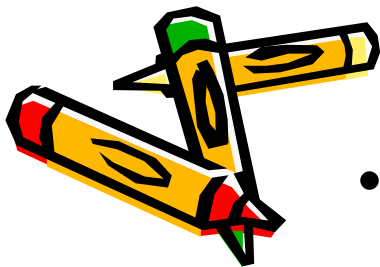


# Network Coordinate System

- Some Examples

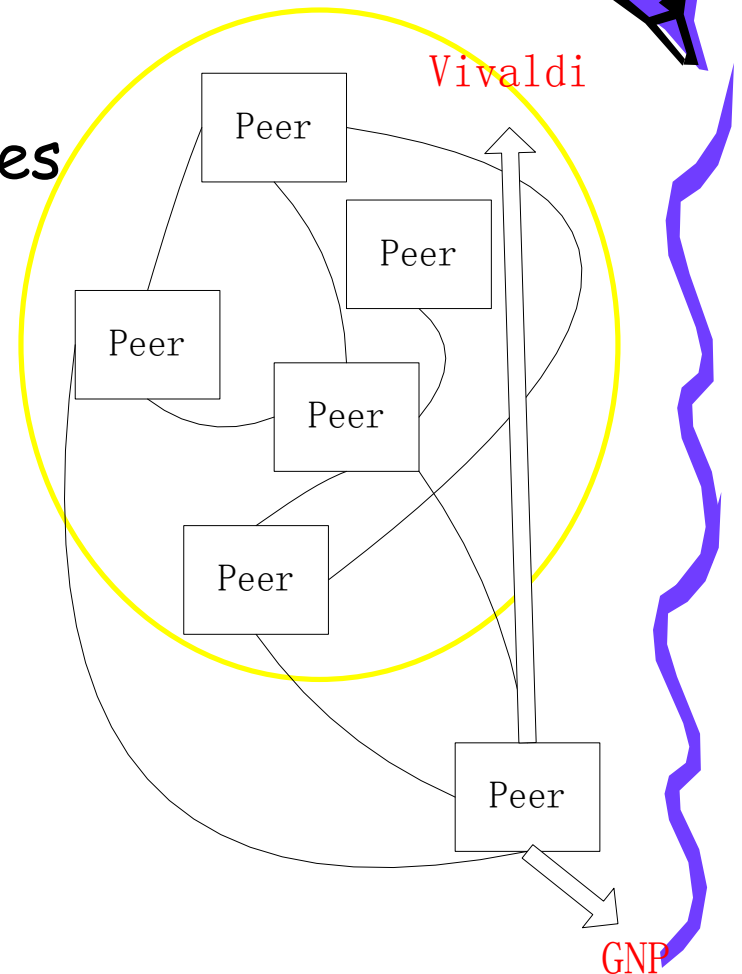
- Vivaldi

- Minimizing the energy in a spring network is equivalent to minimizing the squared-error.
    - Function the optimization object is minimizing the system potential energy.
    - Square error function:



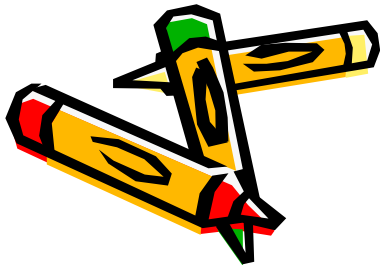
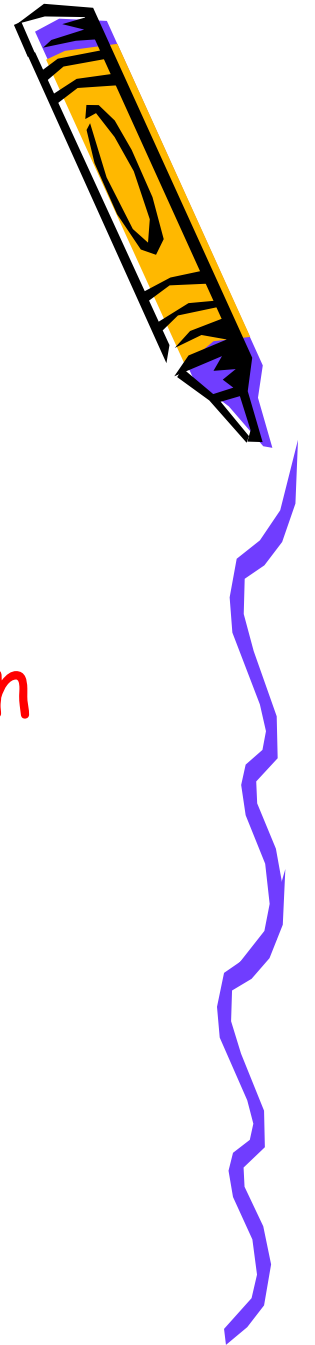
# Network Coordinate System

- Some Examples
  - Advantages and Disadvantages
    - GNP
    - Vivaldi



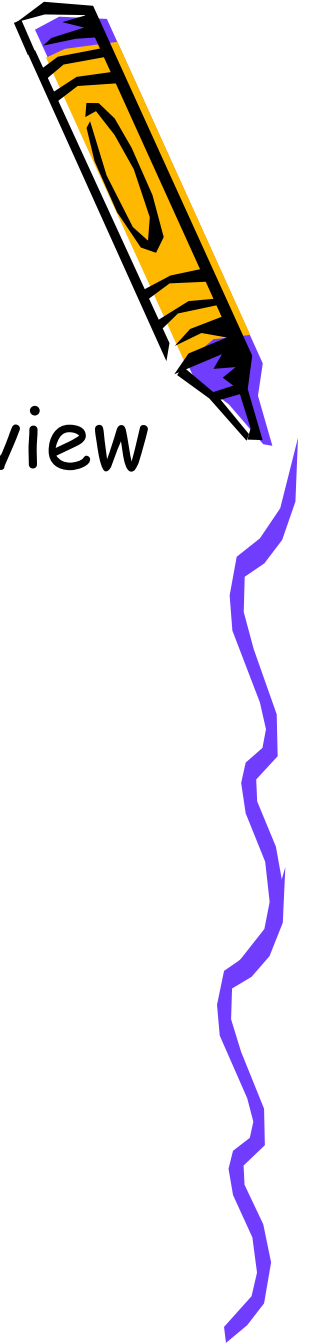
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- **System Design and Implementation**
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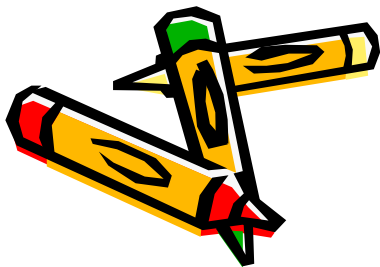
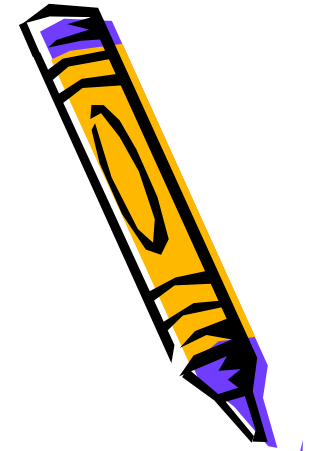
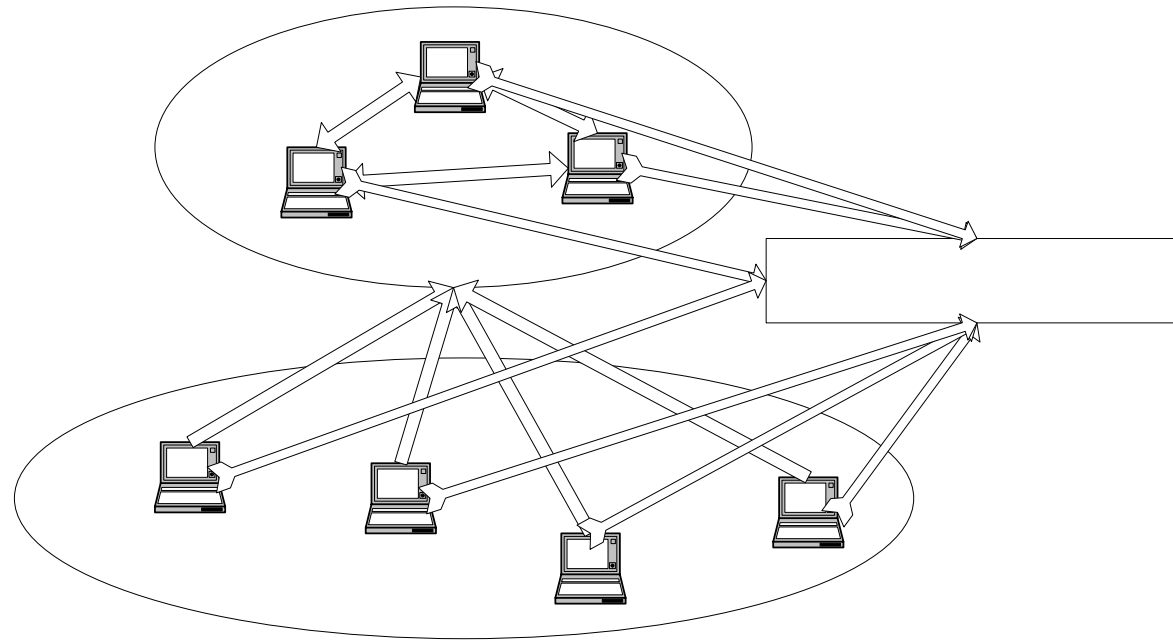
# System Design and Implementation

- Network Coordinate System Overview
  - Membership Server
  - Ordinary Nodes



# System Design and Implementation

- Network Coordinate System Overview

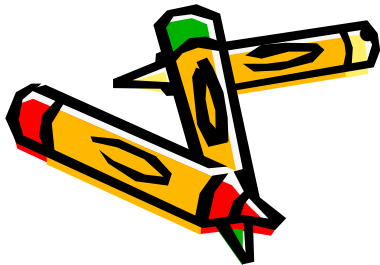


# System Design and Implementation

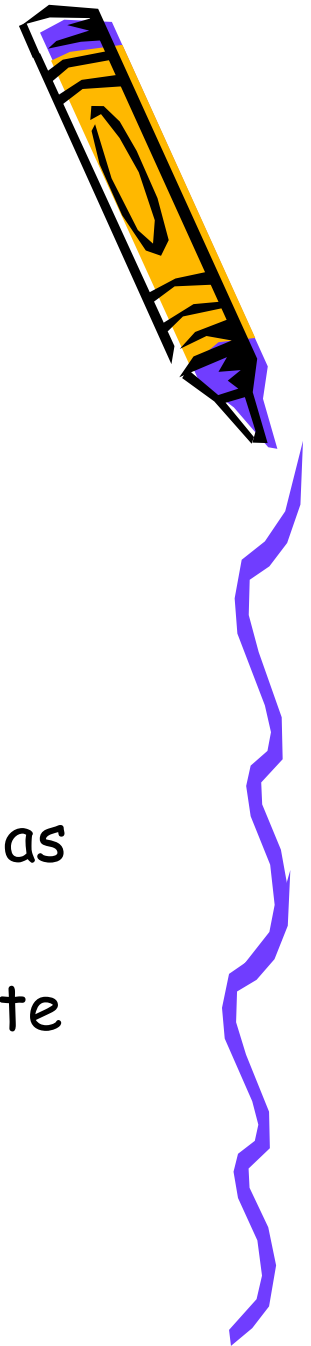


- Nodes Classification
  - Membership Server
    - To register the nodes in the system
    - To provide essentially initial configuration parameters to ordinary nodes in the system
    - To collect the measurement results in the system
    - Manage the whole overlay network
  - Ordinary Nodes
    - Construct the overlay network
    - To compute and maintain network coordinates
    - Some of them serve as landmarks for other nodes
    - To predict network distance
    - To do some measurement in the system.

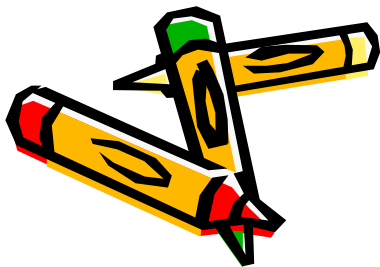
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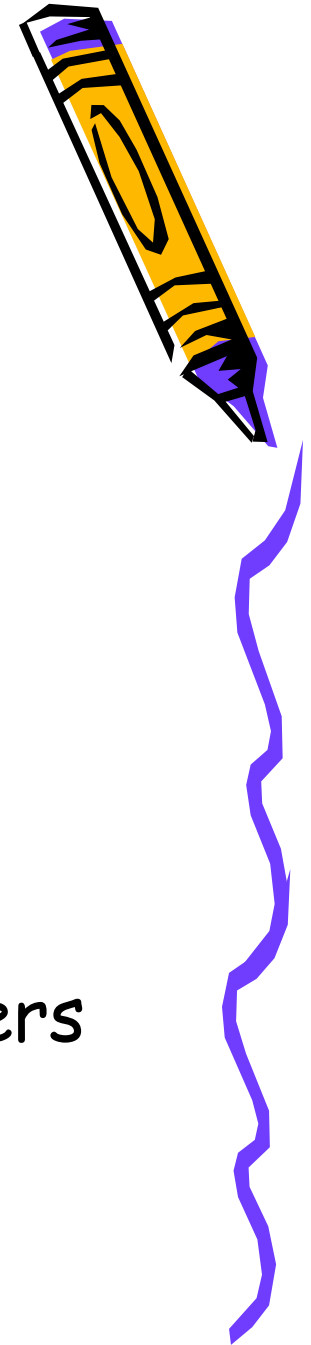
# System Design and Implementation



- Nodes Classification
  - Membership Server
  - Ordinary Nodes
    - Some nodes use Vivaldi algorithm to compute network coordinates and serve as landmarks for other nodes.
    - Most nodes use GNP algorithm to compute their network coordinates.



# System Design and Implementation

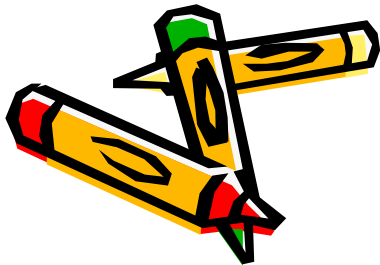


- Overlay
  - Mesh-based overlay
  - Unstructured overlay
  - Random connections between the peers



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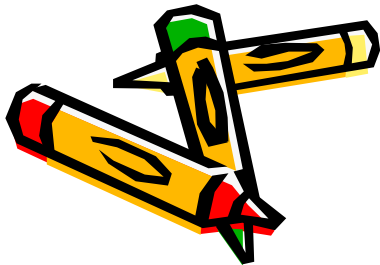
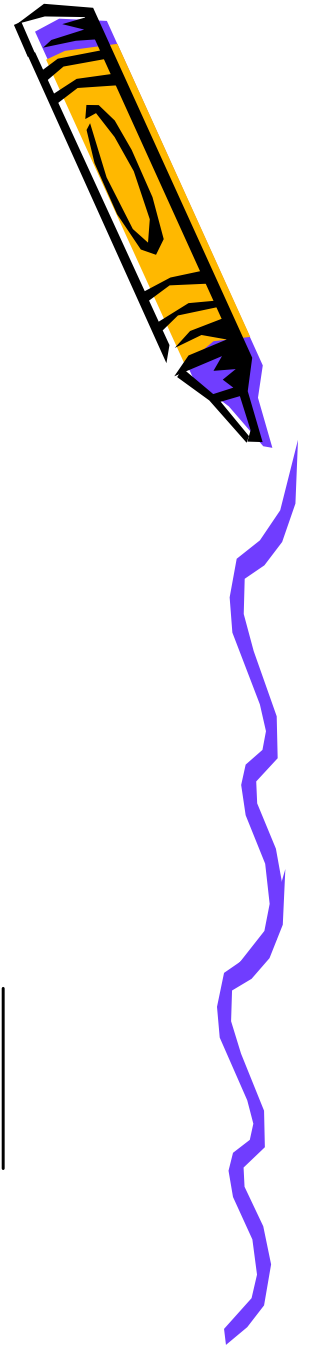


# Experiments on PlanetLab

- Experiments
  - PlanetLab
    - (<http://www.planet-lab.org/>)
  - Metric

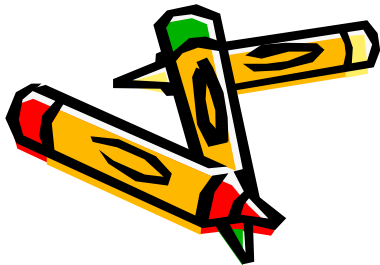
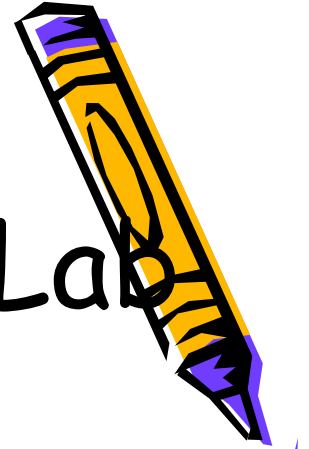
absolute value of relative error

$$= \left| \frac{\text{predicted distance} - \text{measured distance}}{\text{measured distance}} \right|$$



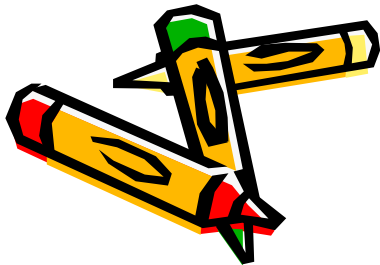
# Experiments on PlanetLab

- Experiments
  - Network Coordinate System
    - Convergence
    - Accuracy
    - Adaptability to network changes
    - Overhead



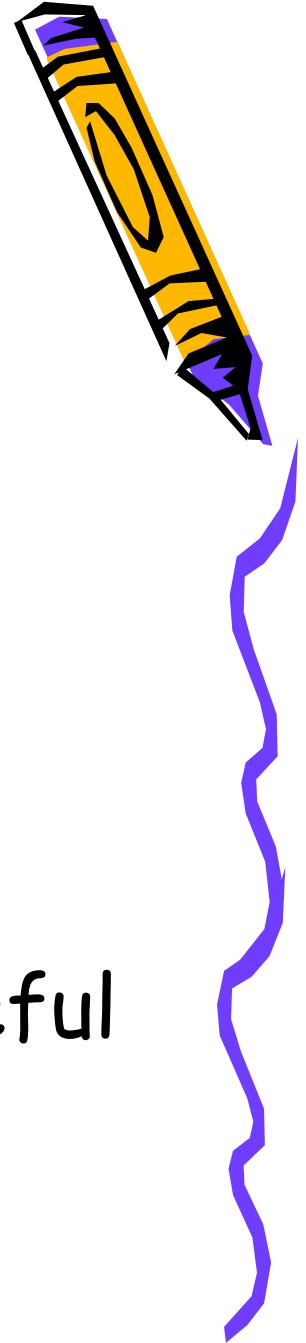
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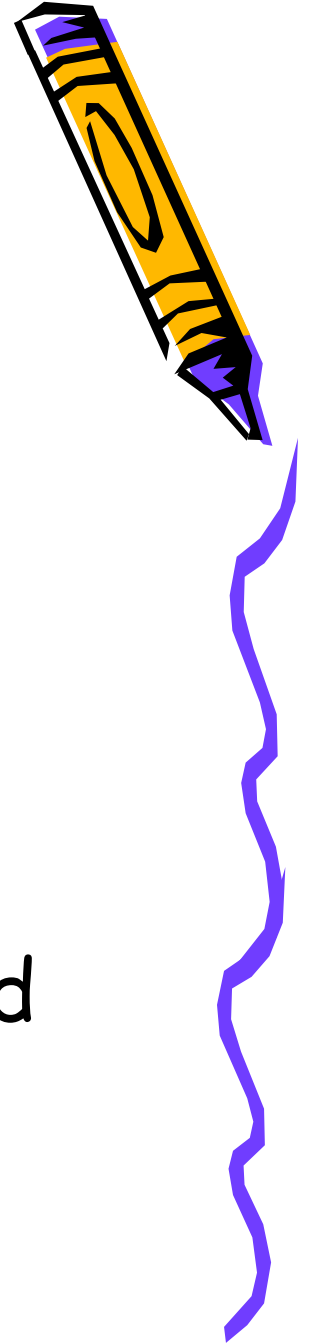
# Conclusion

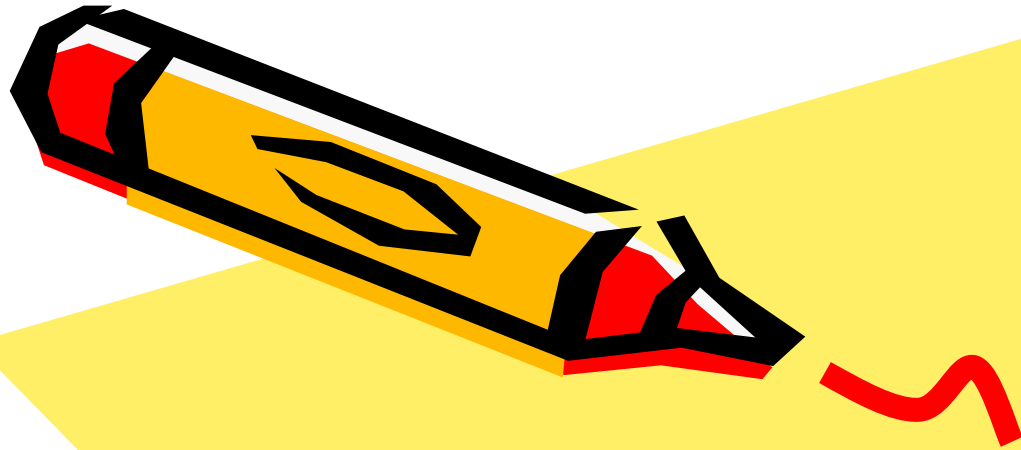
- Network Coordinate System
  - compute network coordinates
  - predict network distances
  - **Quickly and Accurately**
- Network Coordinate System is useful and helpful for other large scale applications.



# Future Work

- Deal with NAT & Firewalls
- Better algorithm for computing network coordinate and better algorithm for predicting network distance
- Network Coordinate System should be used in other network services and applications.





The END

Thank you very much!

