Implementation of Cluster Establishing algorithm to improve delay in Vehicular Networks

Presenter: Doan Lien Huong

Supervisor: Dr. Nguyen Minh Huong

ICT Department - USTH

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Section 1

Problem Statement

Introduction to VANETs

- **V**ehicular **A**d-hoc **NET**works
- improve road safety, information transmission
- **safety application**, non-safety application

Introduction to VANETs

Problem:

- Low packet coverage (due to nature of VANET)
  ➔ retransmission
  - How to manage the retransmission
  - Trade-off in delay

Solution: Cluster establishment

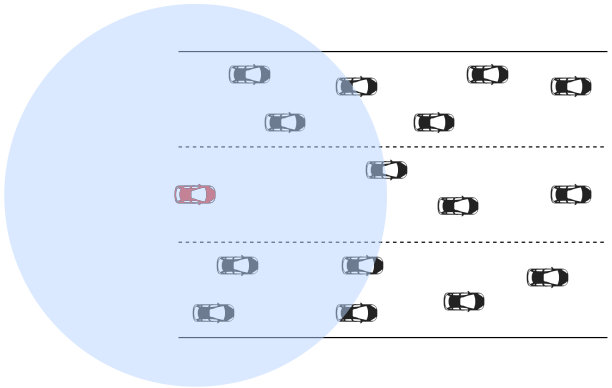


Figure 1: Connectivity problem

Objectives

- Implement the protocol using ns-3 simulator
- Design simulation scenarios for safety application
- Investigate the protocol in terms of improving the connectivity of the network while optimizing the delay

Section 2

Methodologies and Tools

Cluster establishment

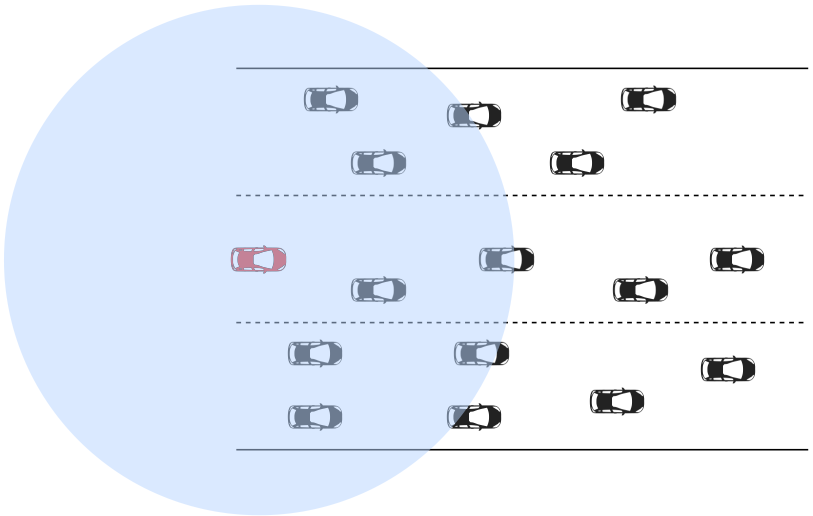
General definition:

- Group similar nodes in the same cluster
- Cluster Head and Cluster Members

Cluster Head criteria:

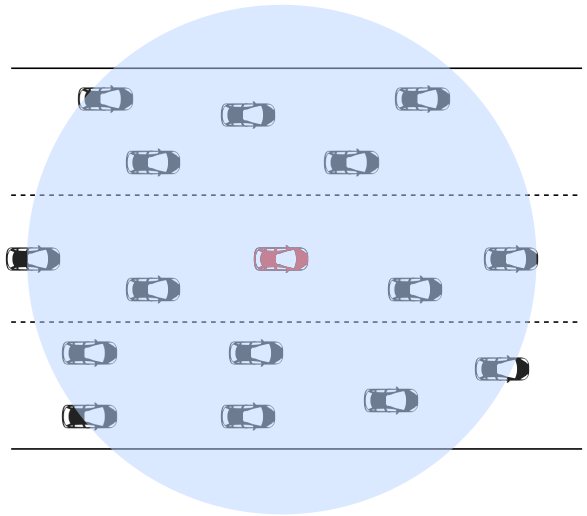
- The most number of neighbours
- Nearest to the RSU (in case RSU available)

Cluster establishment in message dissemination



- CM broadcasts a safety message

Cluster establishment in message dissemination



- CH rebroadcasts that message

System overview

- Vehicle nodes operate in cycles
- A cycle consists of 3 processes

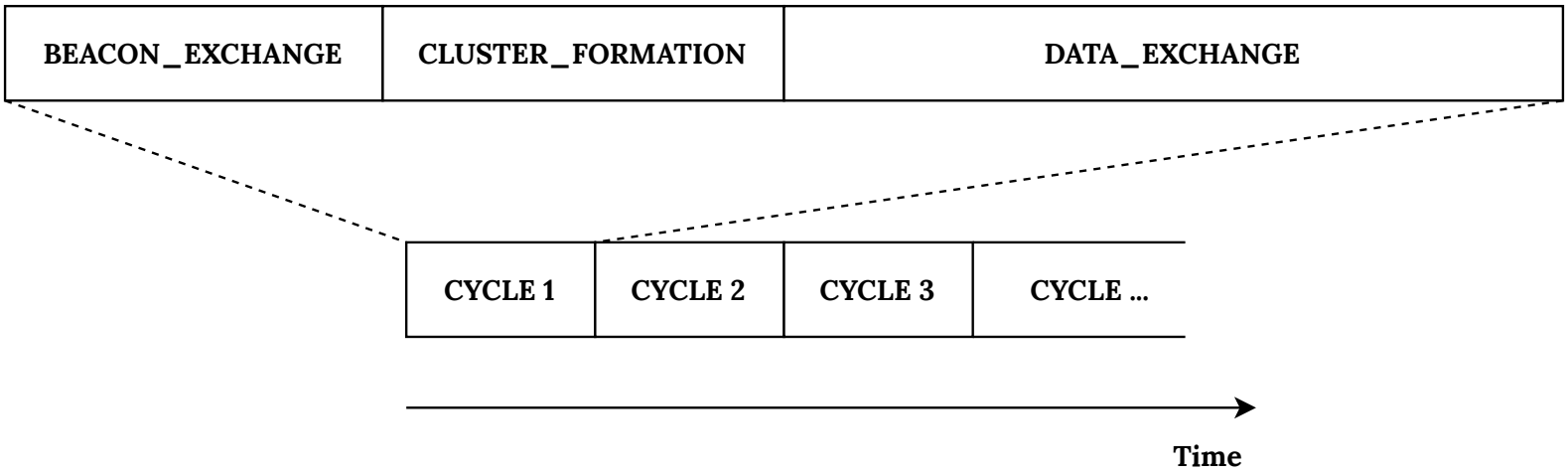


Figure 2: Time cycle in clustering protocol

Process descriptions

BEACON_EXCHANGE process

- nodes are in UN (Unknown) state
- nodes exchange beacon messages (position, velocity)
- nodes construct their neighbor list

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CLUSTER_FORMATION process

- nodes wait to become CH in T_{wait} seconds
- If a node receive FormationMsg, it joins that cluster as a CM.
- Else, it becomes CH and broadcasts its own FormationMsg

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DATA_EXCHANGE process

- If CH receives a data packet, it rebroadcasts that packet

ns-3 simulator

- A discrete-event network simulator
- Developed for networking research and education
- Programs can be written in C++ or Python

Section 3

Implementation

Design of classes

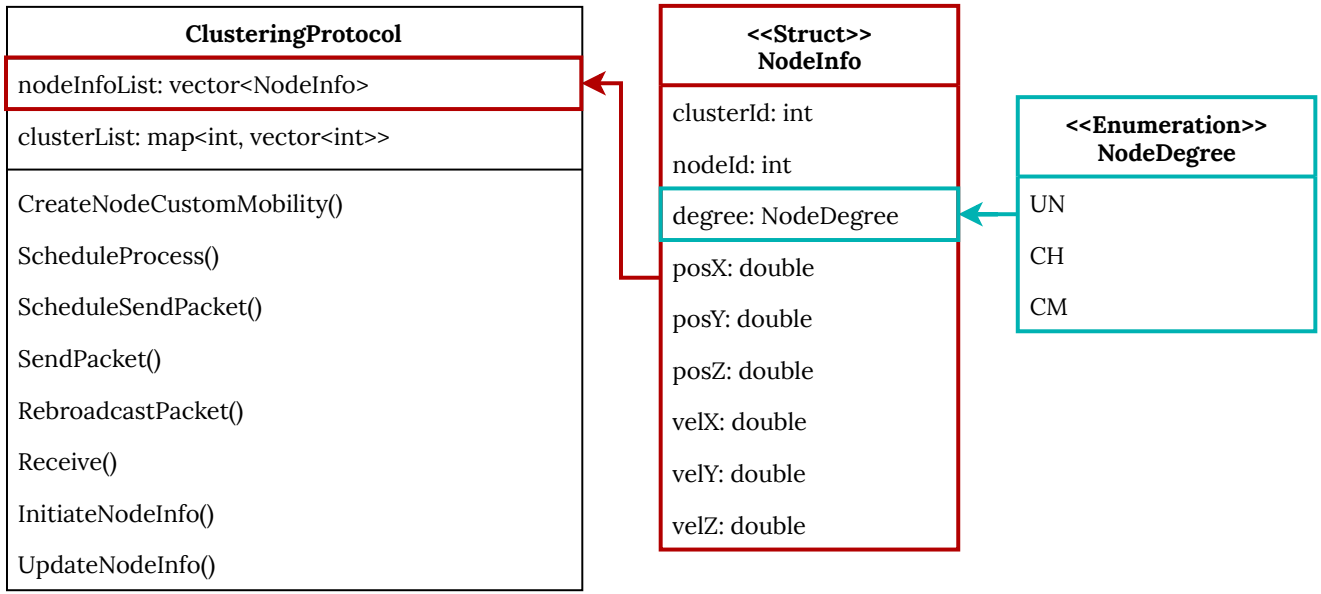

Figure 3: Design of Classes

Design of Headers

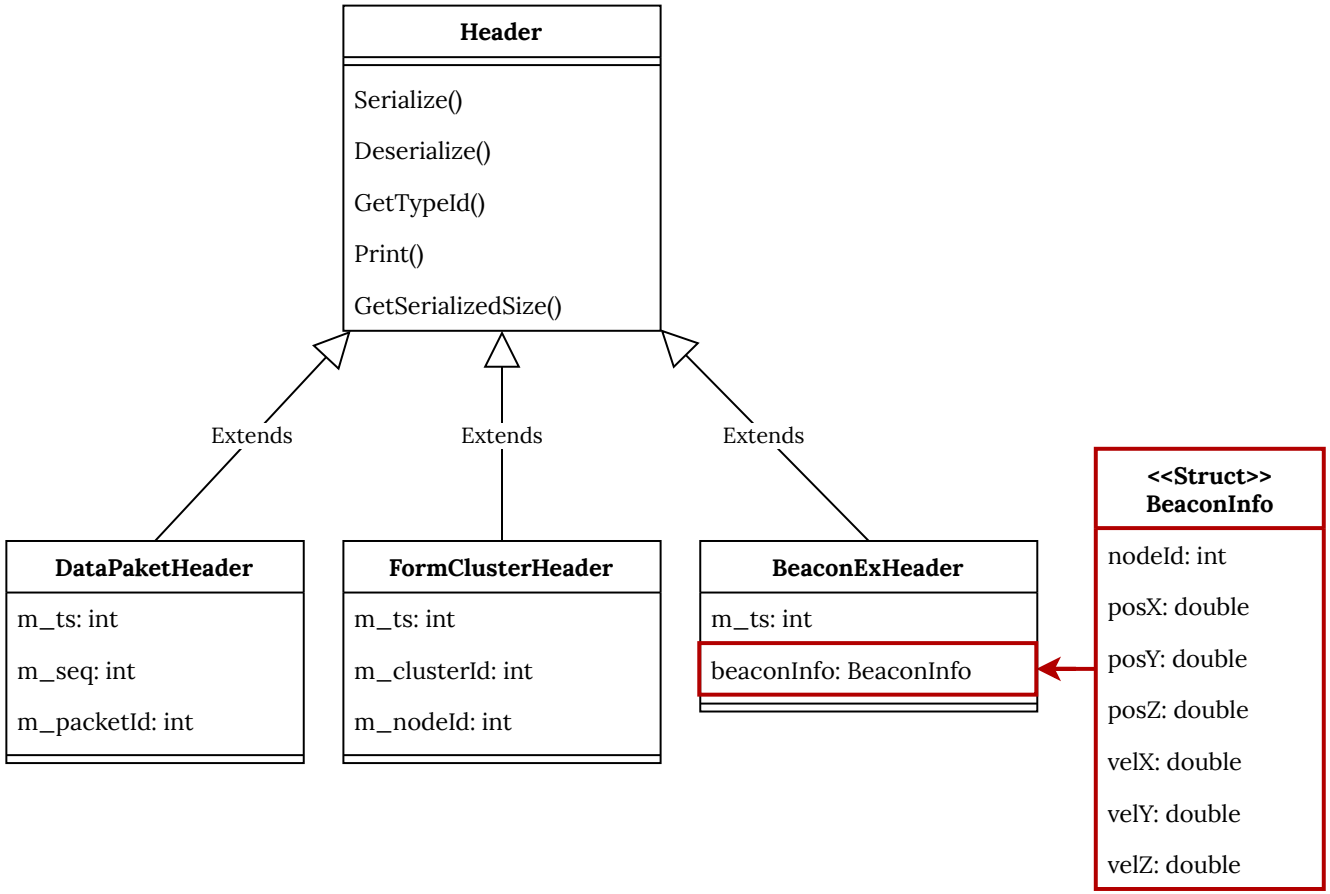

Figure 4: Design of Headers

Section 4

Results

Scenario Descriptions

Table 1: Simulation cases

Simulation no.	No. of sender(s)	No. of packet(s)
1	1	1
2	1	10
3	2	1
4	2	10

Evaluation metrics:

- PDR (Packet Delivery Rate) = $\frac{\text{No. of receiver nodes}}{\text{Total nodes - 1}}$
- Average Delay (s): average delay time of received packets

Comparison

Blind rebroadcast technique:

- All nodes rebroadcast packets after an amount of time.
- **Advantages:** increase connectivity
- **Drawbacks:**
  - channel congestion
  - packet collision
  - high delay time

Simulation case 1: 1 node broadcasts 1 packet

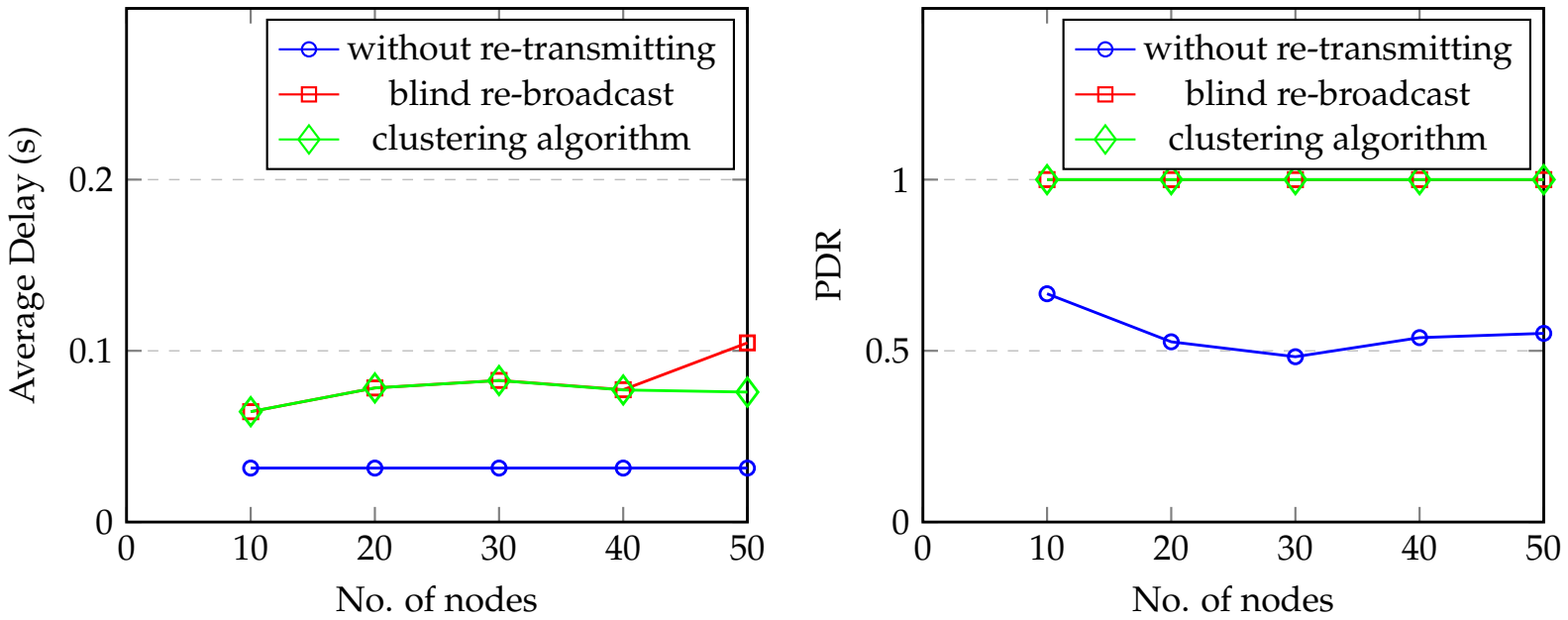

Figure 5: Average Delay and PDR in case: 1 node broadcasts 1 packet

Simulation case 2: 1 node broadcasts 10 packets

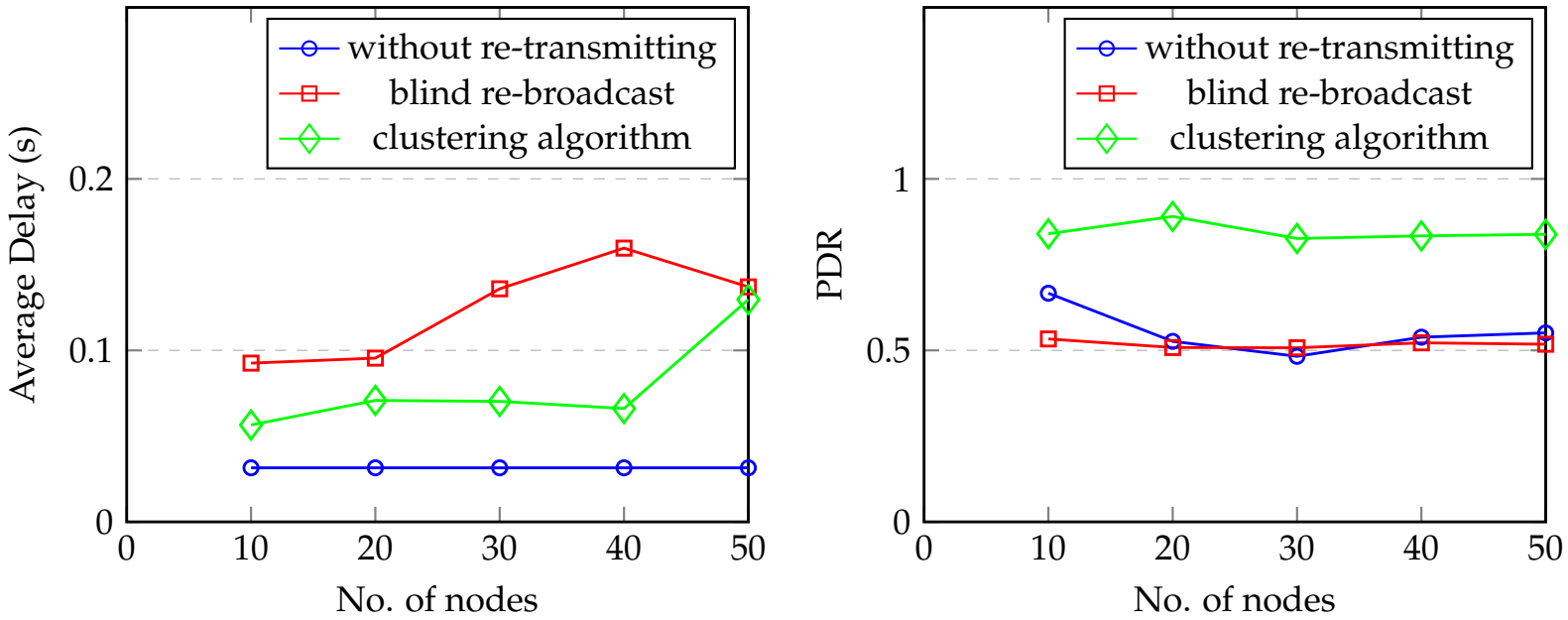

Figure 6: Average Delay and PDR in case: 1 node broadcasts 10 packets

Simulation case 3: 2 nodes broadcast 1 packet

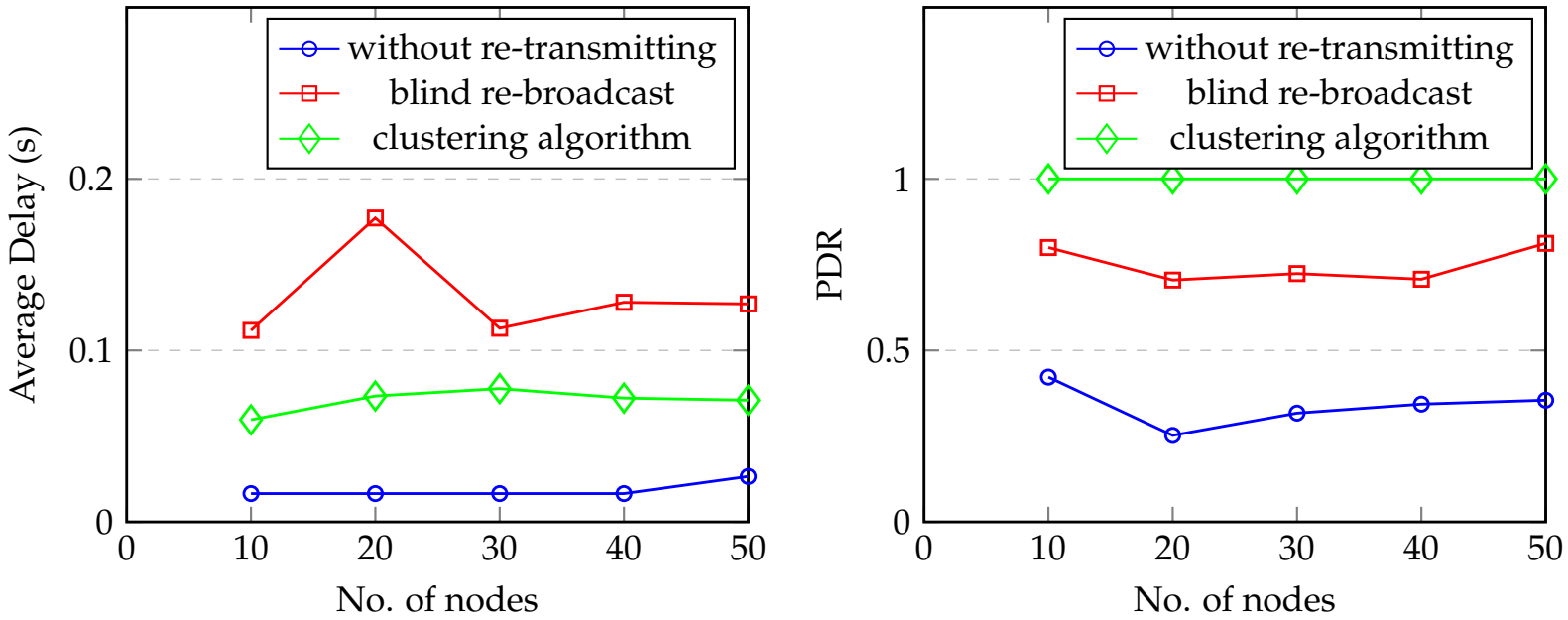

Figure 7: Average Delay and PDR in case: 2 nodes broadcast 1 packet

Simulation case 4: 2 nodes broadcast 10 packets

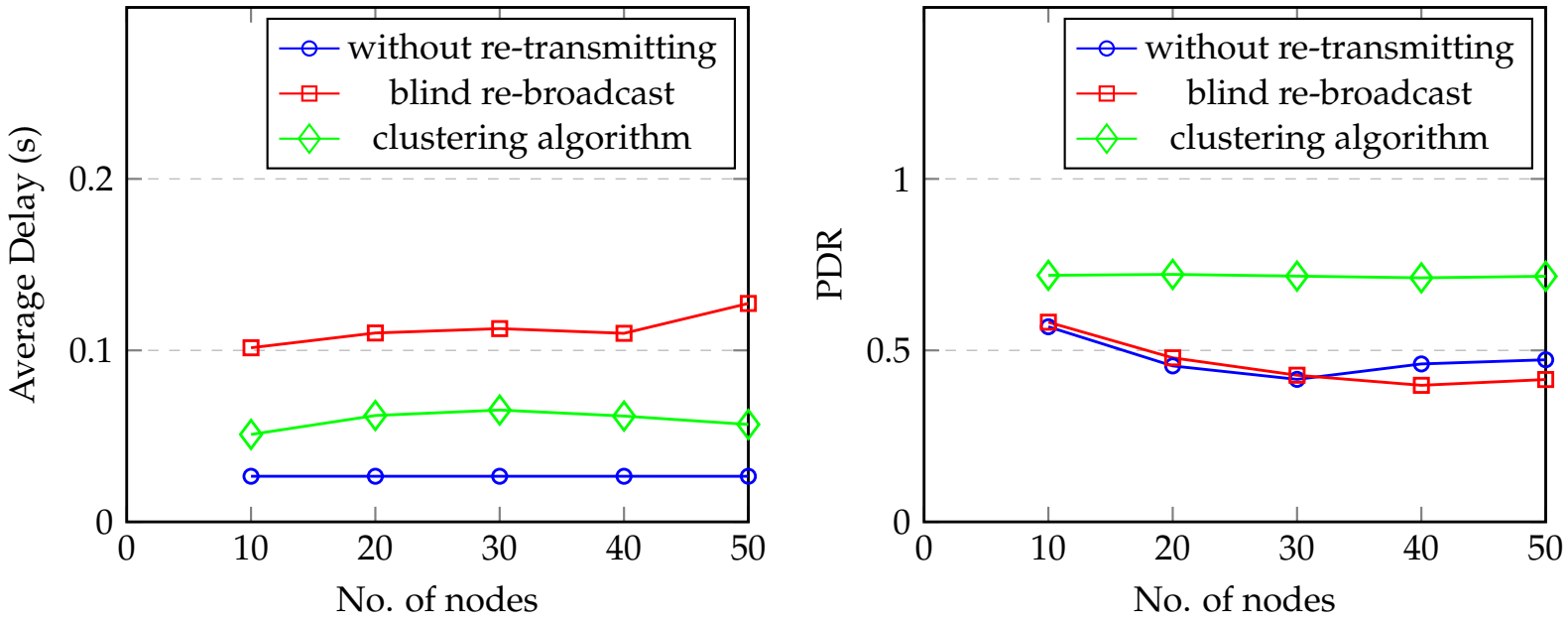

Figure 8: Average Delay and PDR in case: 2 nodes broadcast 10 packets

Section 5

Conclusion and Future Work

Conclusion and Future Work

- Include channel parameters
- Inter-communication implementation
- Modify the calculation formula

Thank you for your attention!