

Nature Knows Best ?

How can biological systems be exploited in engineered systems ?

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Outline

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Introduction

- ▶ Routing strategies are highly important for computer networks performance.
- ▶ The emergence of mobile/sensor networks raised several novel problems mainly due to resource constrained devices.
- ▶ Among others biological systems with the same characteristics have been exploited in order to solve several discrete optimization problems such as :
 - ▶ Ant Colonies
 - ▶ Fungal Colonies



Aim

- ▶ **This case study focus in :**
 - ▶ Comparing “Ant Colony Optimization”(ACO) with other discrete optimization algorithms like Nearest Neighborhood Tree(NNT).
 - ▶ Exploring a recently introduced systems inspired by Fungal Colonies
- ▶ **3 scenarios have been used in order to measure :
Efficiency , Scalability and Robustness**



Scenarios

- ▶ **Scenario 1 : Static Network**
 - ▶ Focus on the performance of NNT and ACO in a static network where there is no update frequency/proactive ants.
- ▶ **Scenario 2 :**
 - ▶ Focus on the performance of NNT(no update) and ACO(with proactive ants) in a static network.
- ▶ **Scenario 3:**
 - ▶ Focus on the performance of NNT(with update) and ACO(with proactive ants) in a dynamic environment (possible failures).

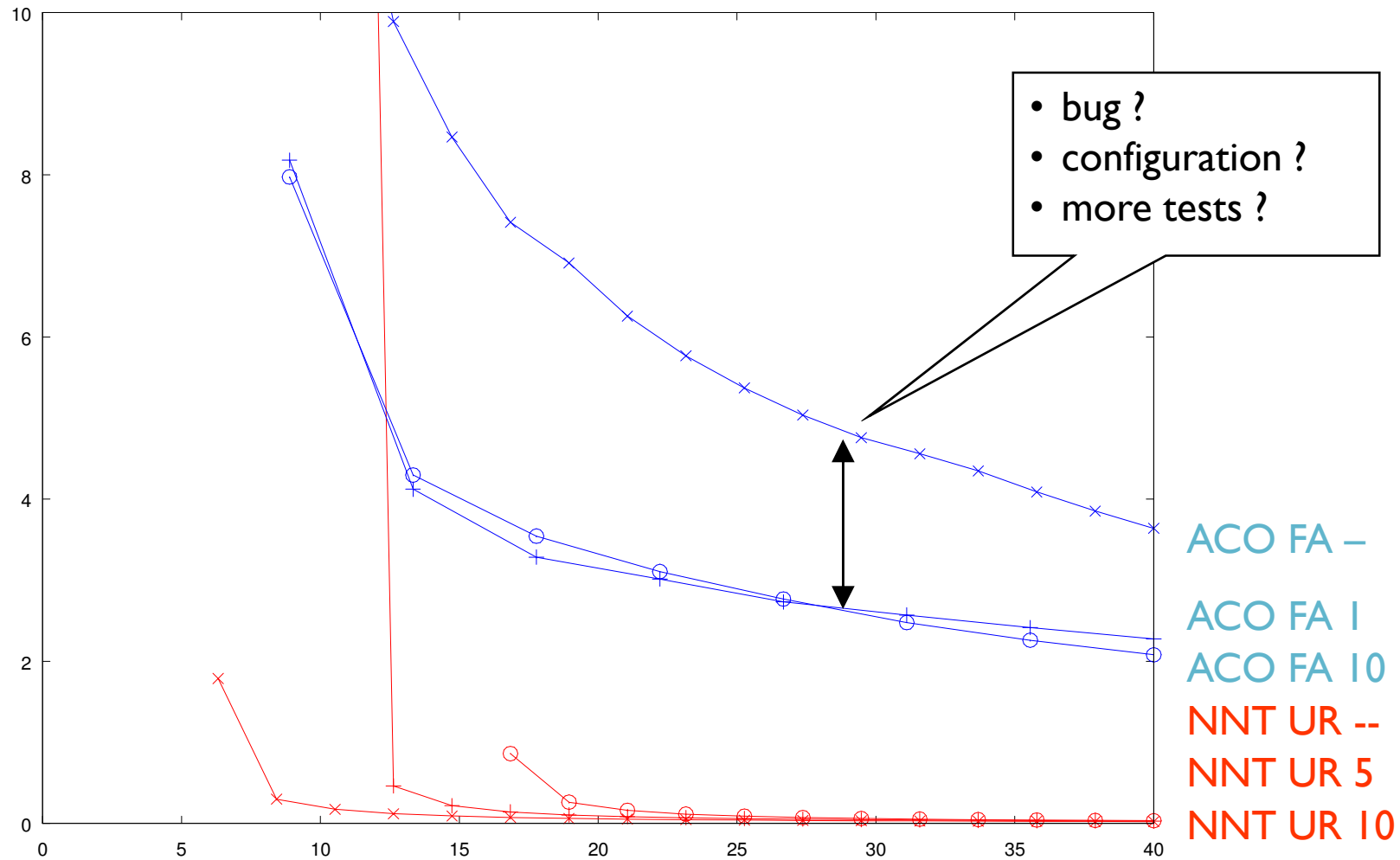


Network Settings

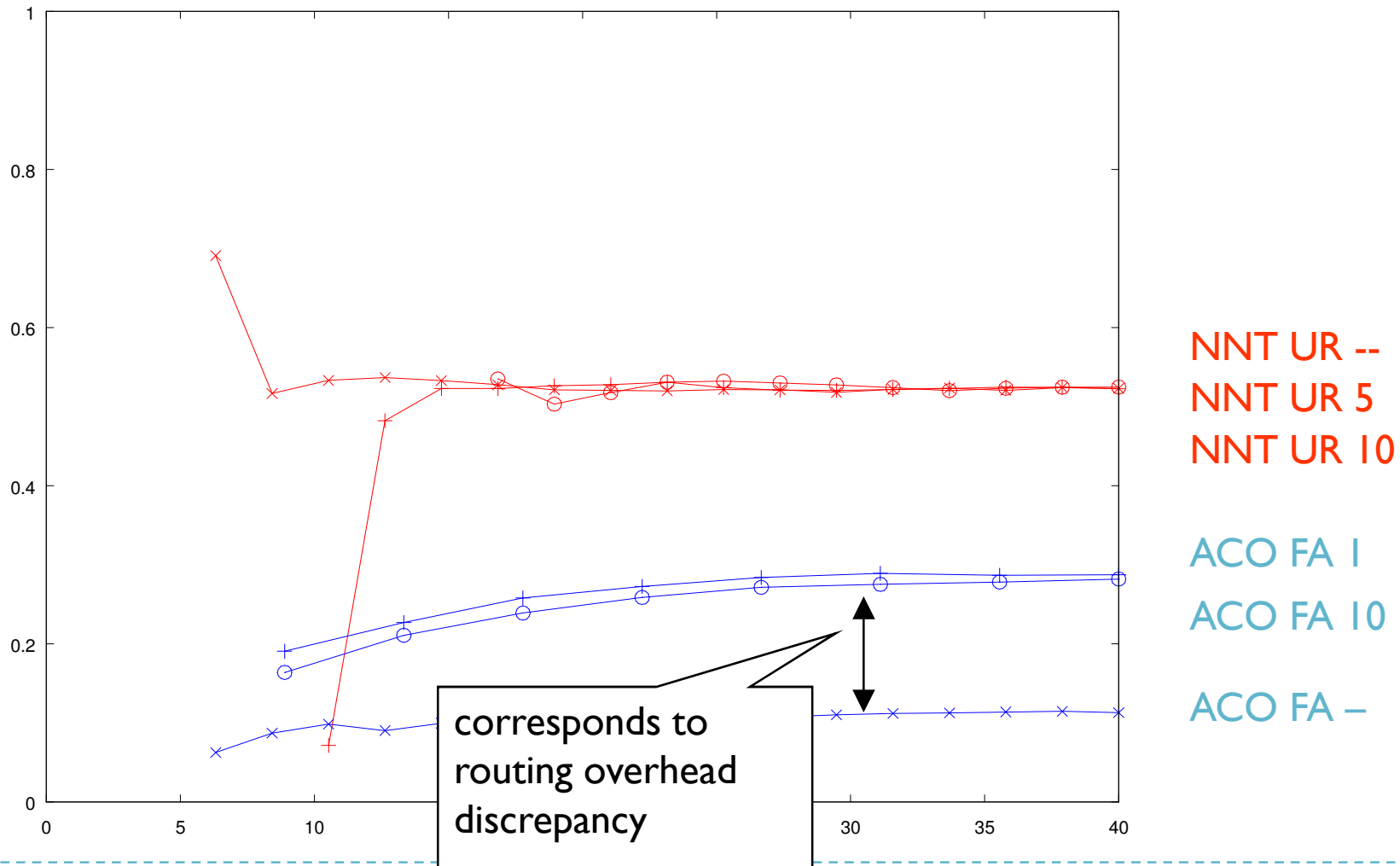
- ▶ **Typical Network 1 :**
 - ▶ Population : 50
 - ▶ Distance : 0.09
- ▶ **Futuristic Network 2 :**
 - ▶ Population: 400
 - ▶ Distance : 0.04



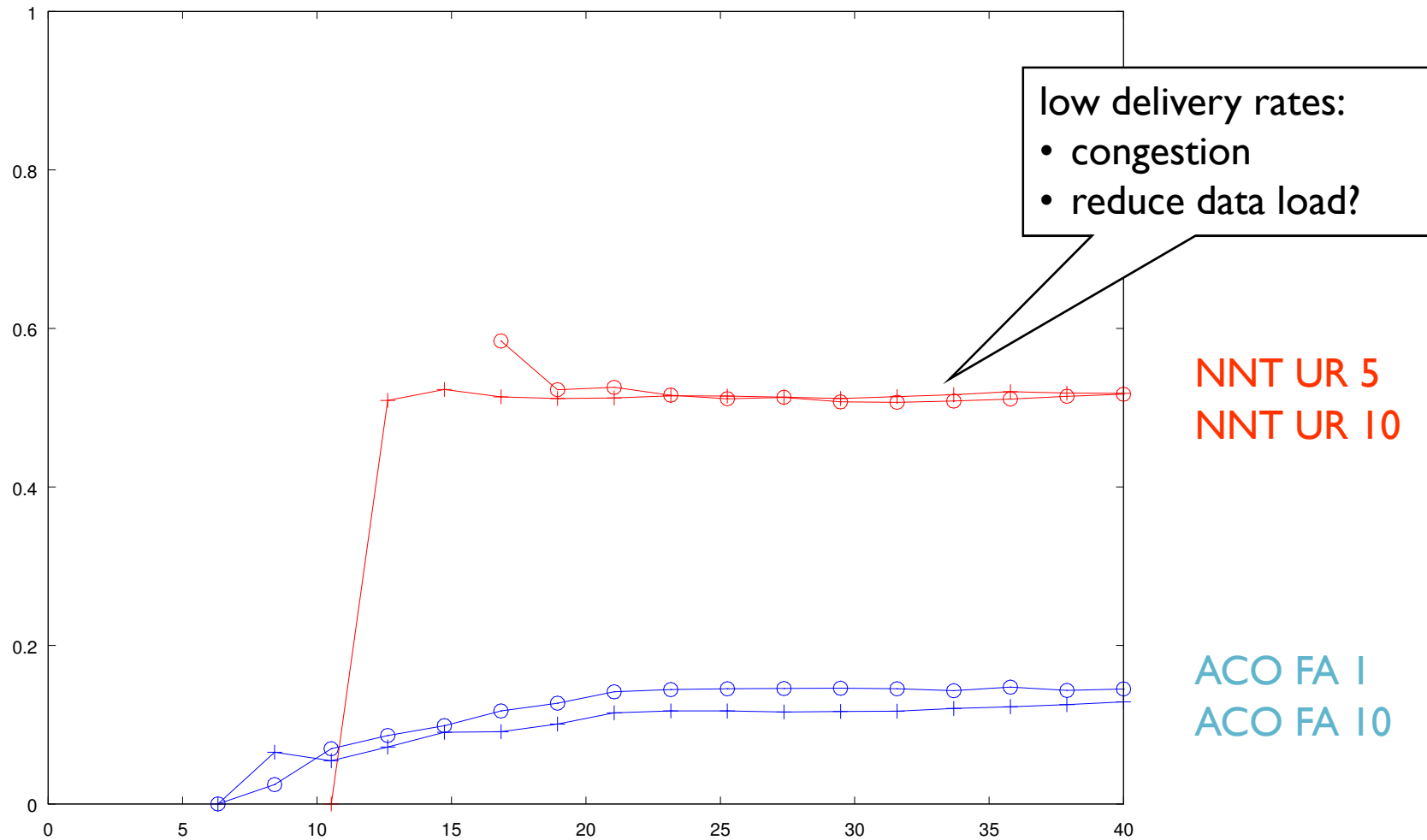
Routing Overhead



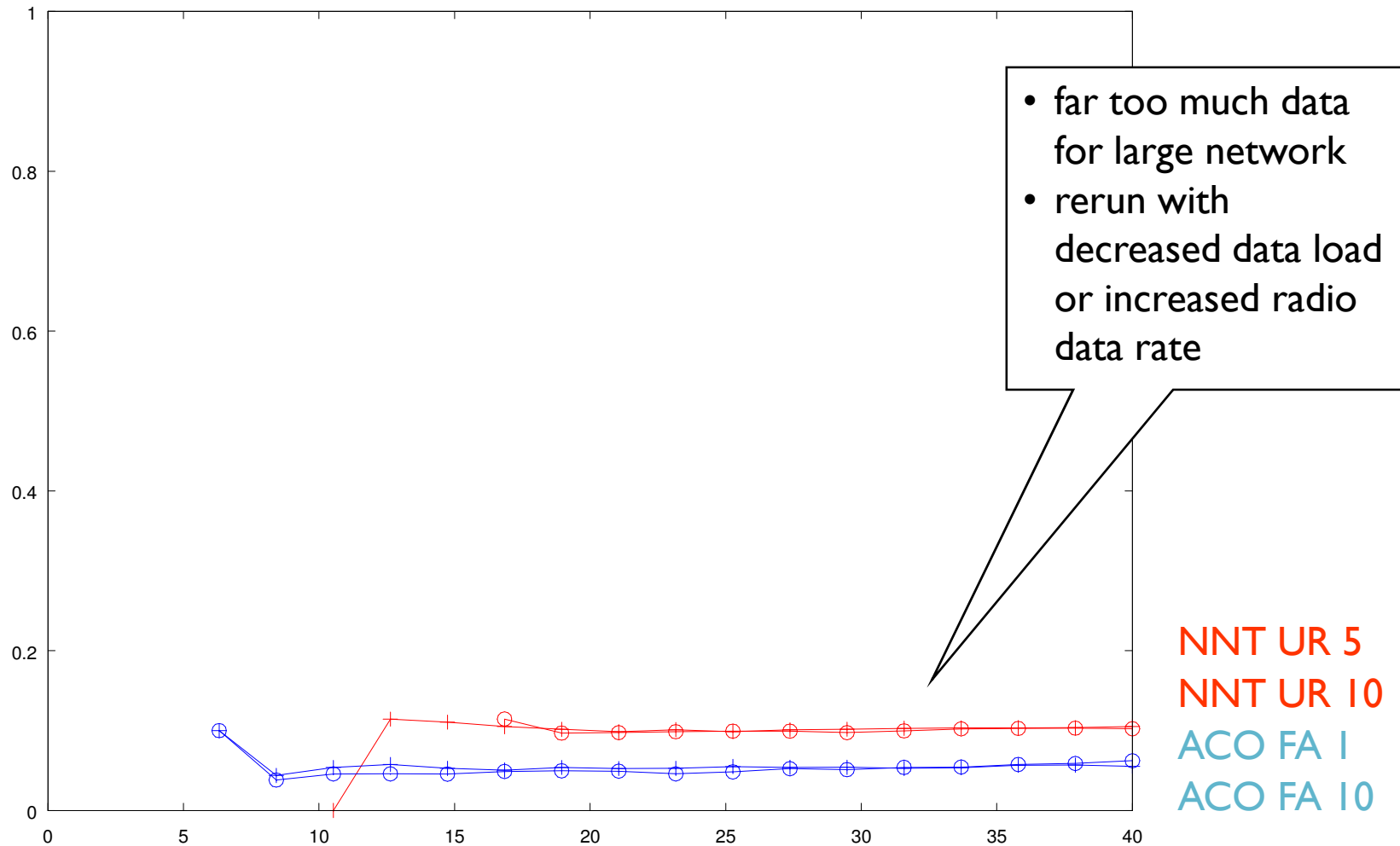
Delivery Ratio



Delivery Ratio (Failure t=20)



Delivery Ratio (400 nodes)



Conclusions

- ▶ Ant algorithm struggles with (almost) static network scenarios
- ▶ Network congestion leads to low delivery ratio

Future Work:

- ▶ Investigate situation in more dynamic networks
 - ▶ Volatile environment (high node failure rates)
 - ▶ Mobile nodes
- ▶ Optimization of parameters
- ▶ Longer simulation timespan



▶ Fungi Colonies

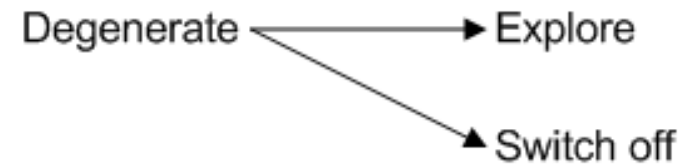
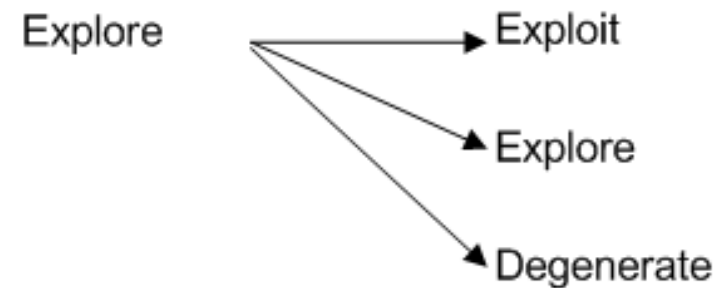


Fungal Colonies

Processes

- Explore (sparse branching)
- Exploit (dense branching)
- Degenerate

Transactions



Processes

- ▶ Explore
(sparse branching)
- ▶ Exploit
(dense branching)
- ▶ Degenerate

Triggers

- ▶ Fitness function
- ▶ Data message
- ▶ Energy $< P_{\text{degenerate}}$



Mappings

SpeckSim

- ▶ Energy
- ▶ Data
- ▶ Established route

Fungal Colony

- ▶ Nutrients
- ▶ Mobile biomass
- ▶ Structural biomass



Message Type

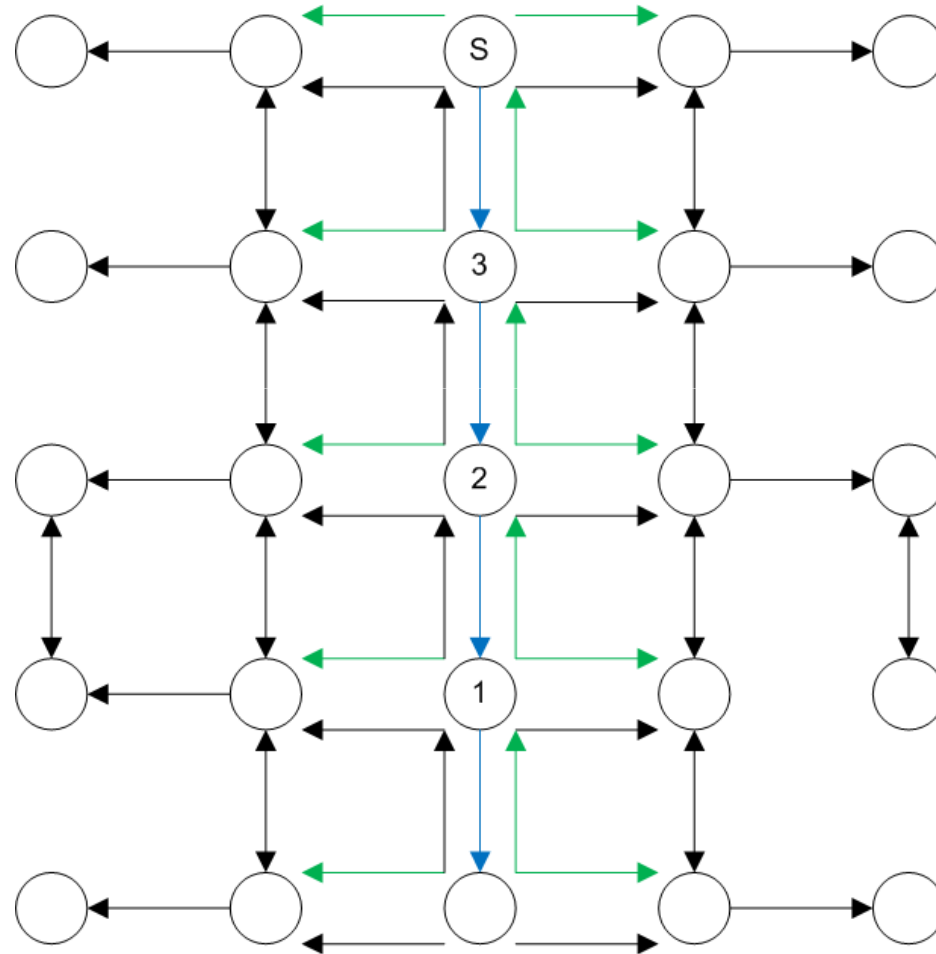
- ▶ Data message
- ▶ Explore message
- ▶ Establish route message

Transmission type

- ▶ Broadcast
- ▶ Broadcast
- ▶ Unicast



Network Flow



Thank you ...

Questions ?

