Cost and Collision Minimizing Forwarding Schemes for Wireless Sensor Networks

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Outline

- Introduction
- Related work
- Cost and Collision Minimizing Routing (CCMR)
- Simulation results
- Conclusions
- Discussions

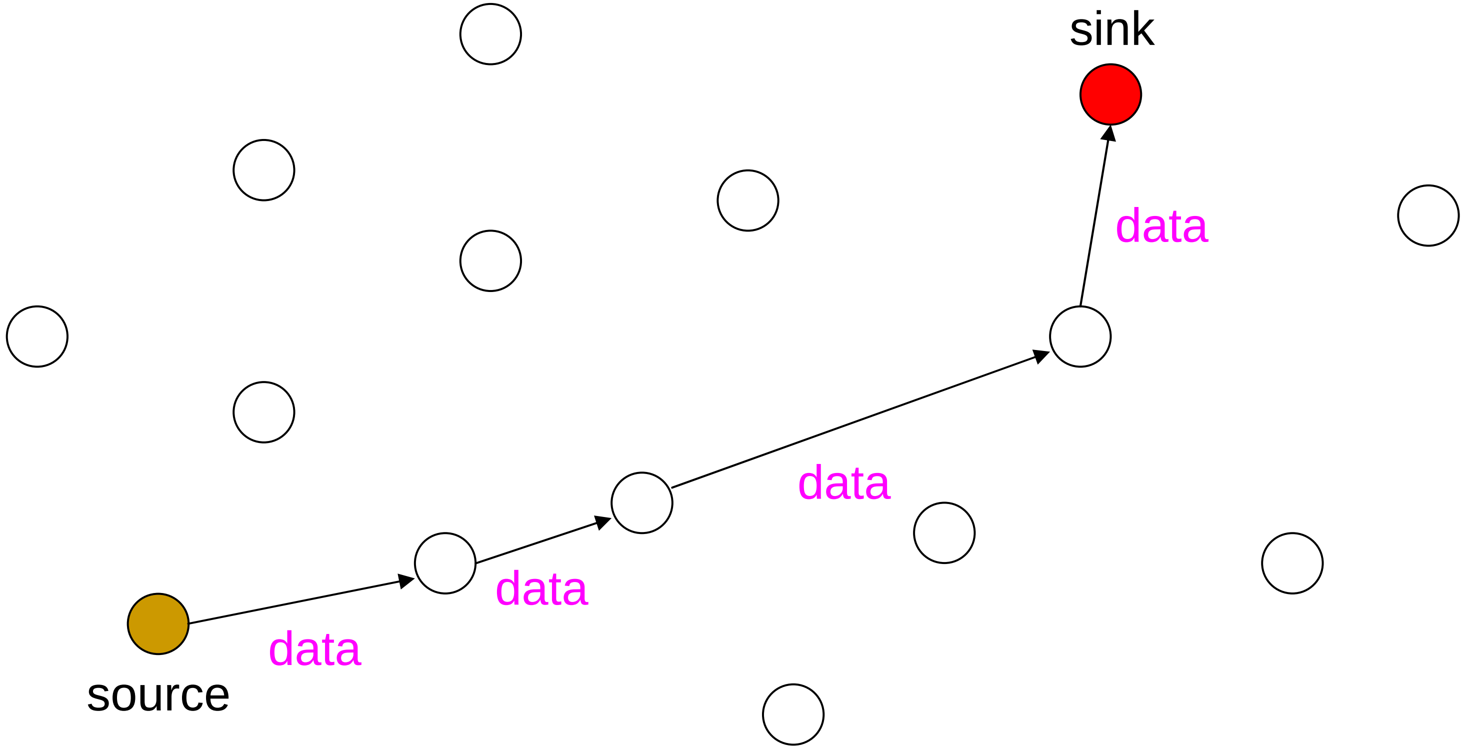
Introduction(1/2)

- Forwarding operation is commonly used for WSNs.
  - Sensor nodes are resource constrained
  - Efficient in energy consumption
  - Efficient in the quality of the paths from source to sink

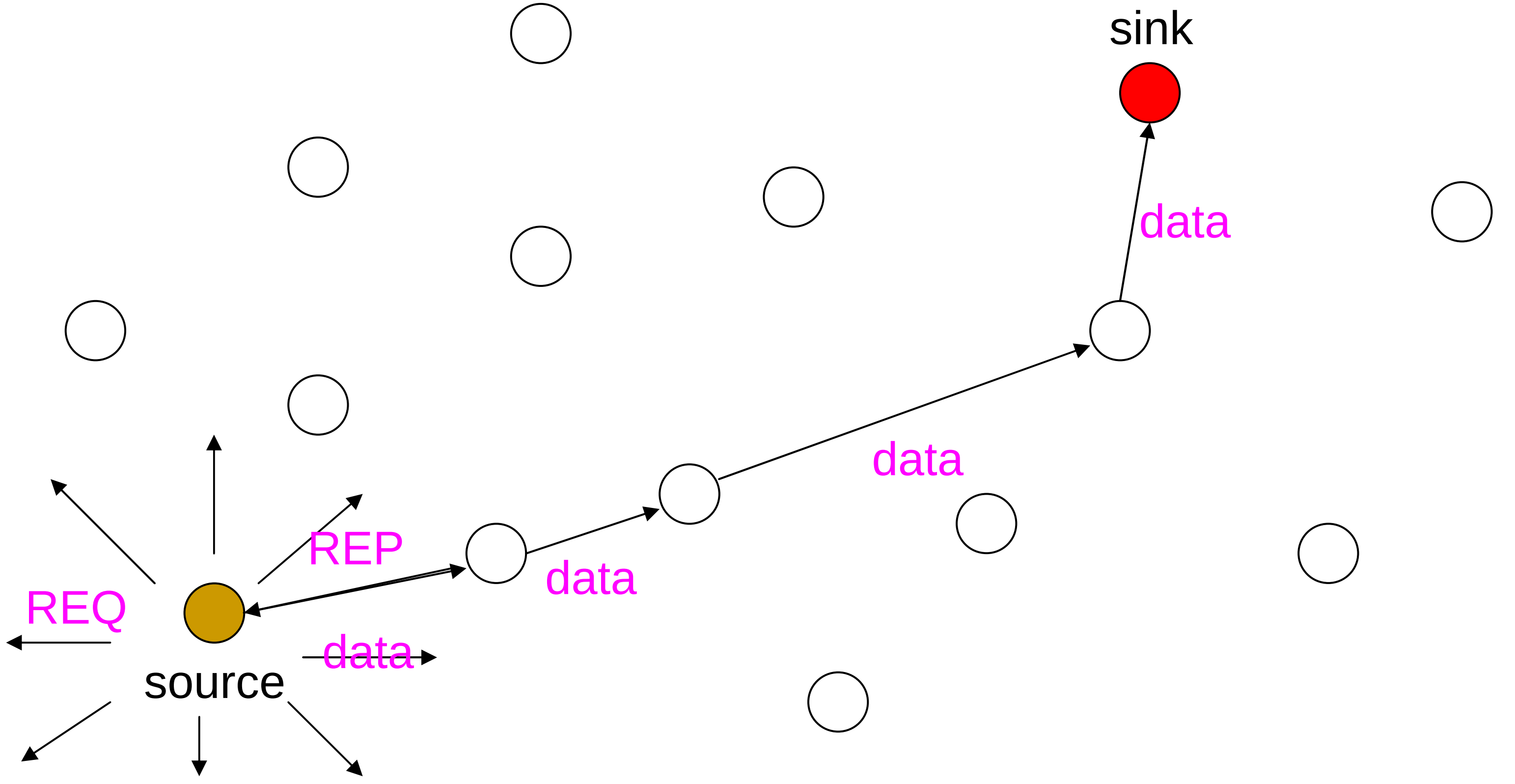
Introduction(2/2)

- Selecting next hop for data forwarding locally and without using routing tables
  - Minimizing the overhead incurred in creating and maintaining the routing paths.
- Geographical location, residual energies, and etc.

Using routing tables to forward data to sink



Event driven routing algorithms



Related work(1/2)

- GeRaF
  - Geographical method
  - Forwarding area is subdivided into a number of regions
  - Near the sink first to contend

Related work(2/2)

- CBF
  - Geographical method
  - Using biased timers
  - Near the sink first to send reply
- IGF
  - Geographical + residual energies methods
  - Using biased timers
  - Lower cost first to send reply

Cost and Collision Minimizing Routing (CCMR)

- Each node will have a cost and a token
  - Cost can be considered with geographical location, residual energies, and etc => normalized to [0,1]
  - Token is random picked in [0,1] at every contention round
  - Tokens are used to model cost-unaware access probability
    - Costs are fully correlated => only considering tokens

Cost and Collision Minimizing Routing (CCMR)

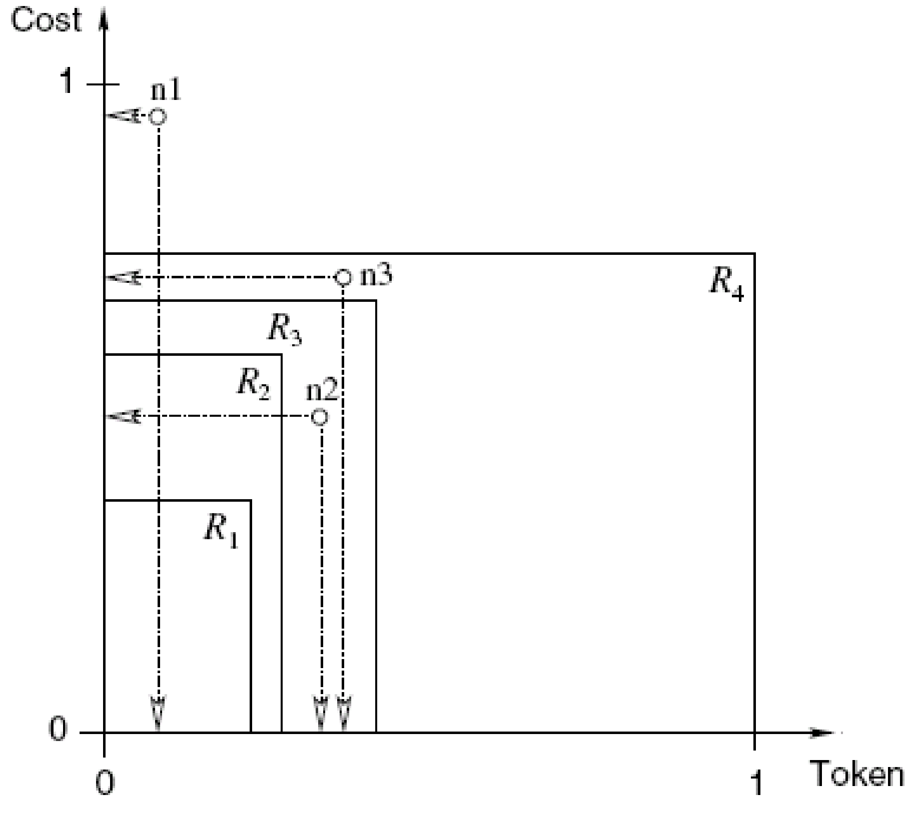


Fig. 1. Example of access regions and nodes representation for $W = 4$.

Cost and Collision Minimizing Routing (CCMR)

Successful rate

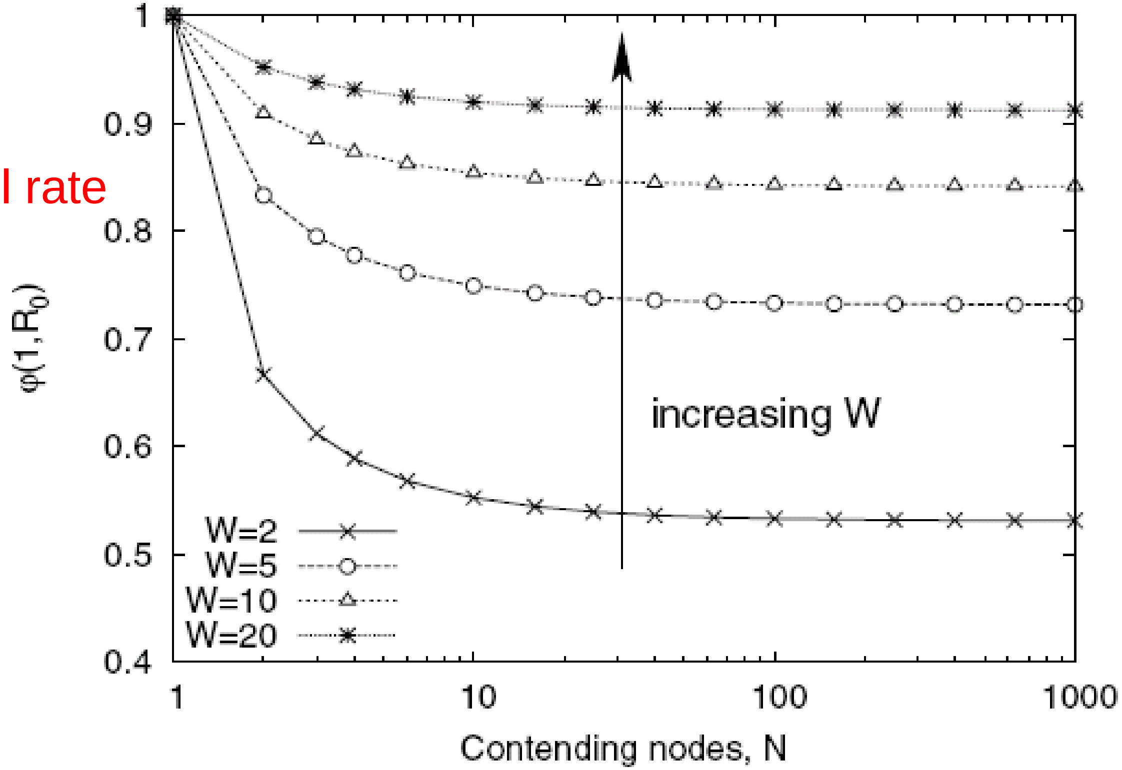


Fig. 2. $\varphi(1, R_0)$ as a function of N.

Cost and Collision Minimizing Routing (CCMR)

- CCMR-GEO
  - Only consider geographical position

$$c_n = 1 - (a_n / R)$$

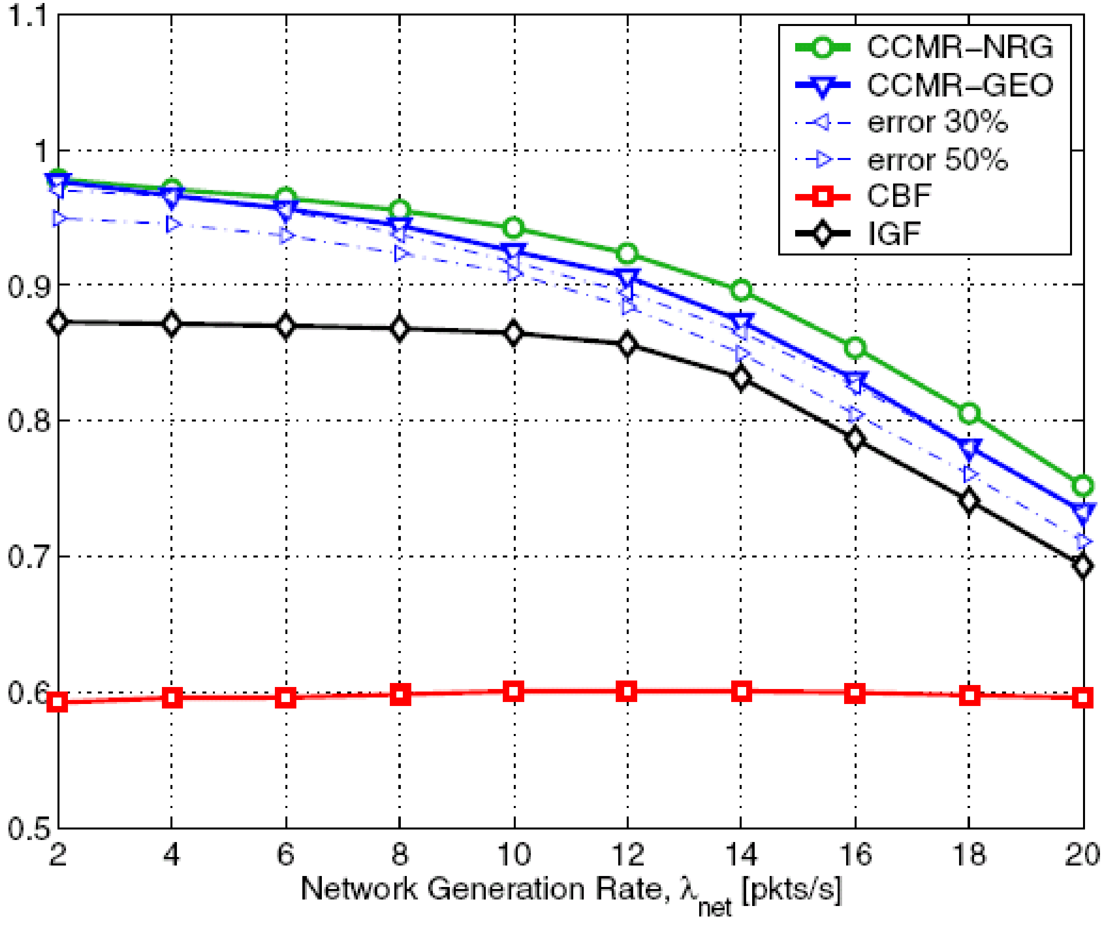
- CCMR-NRG
  - Consider geographical position and residual energies

$$c_n = 1 - (a_n / R)(e_r / E)$$

Simulation results

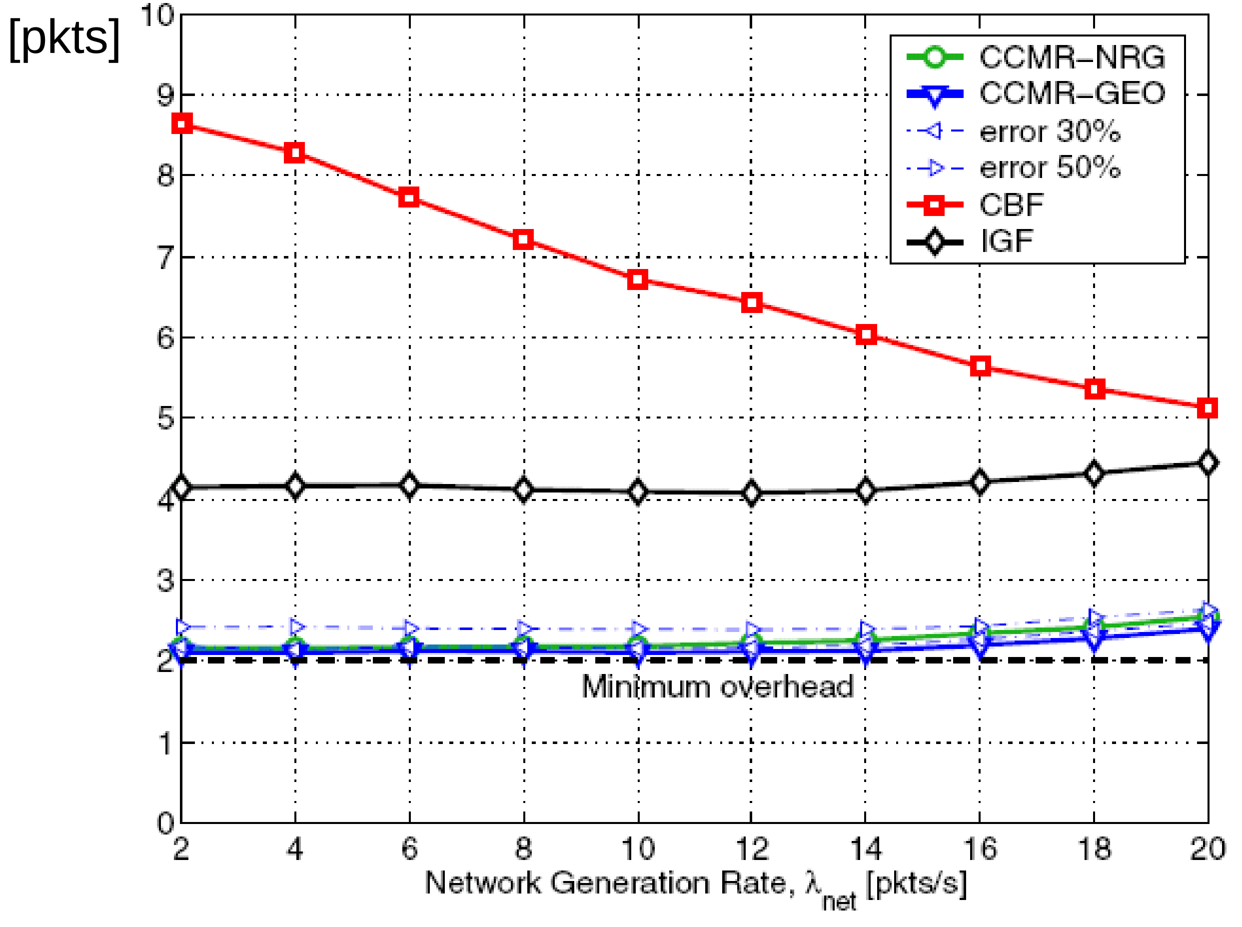
- Sensors are uniform placed within 100x100m
- Transmission range = 30m
- Bit rate = 38400bps
- Energy consumption
  - Idle = 26.1mW
  - Reception = 47.1mW
  - Transmission = 90.6mW

Delivery rate

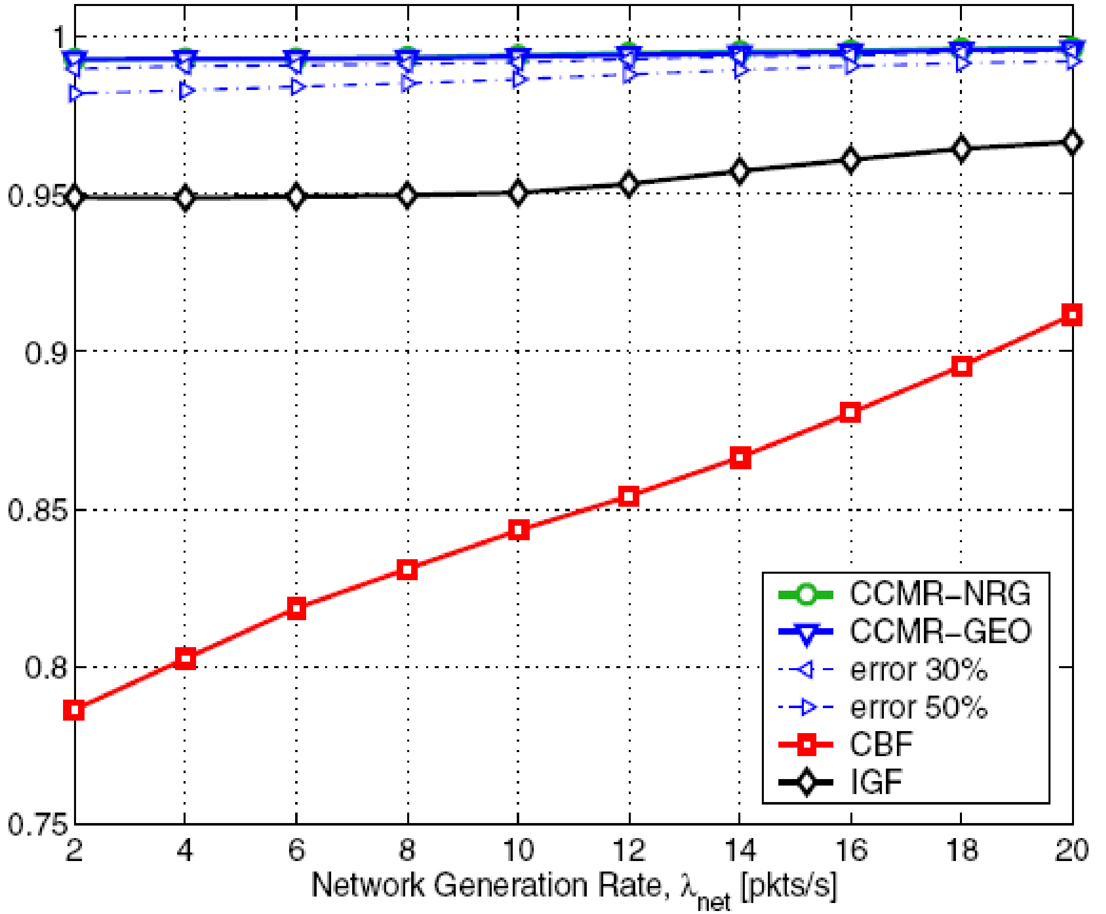


Average protocol overhead

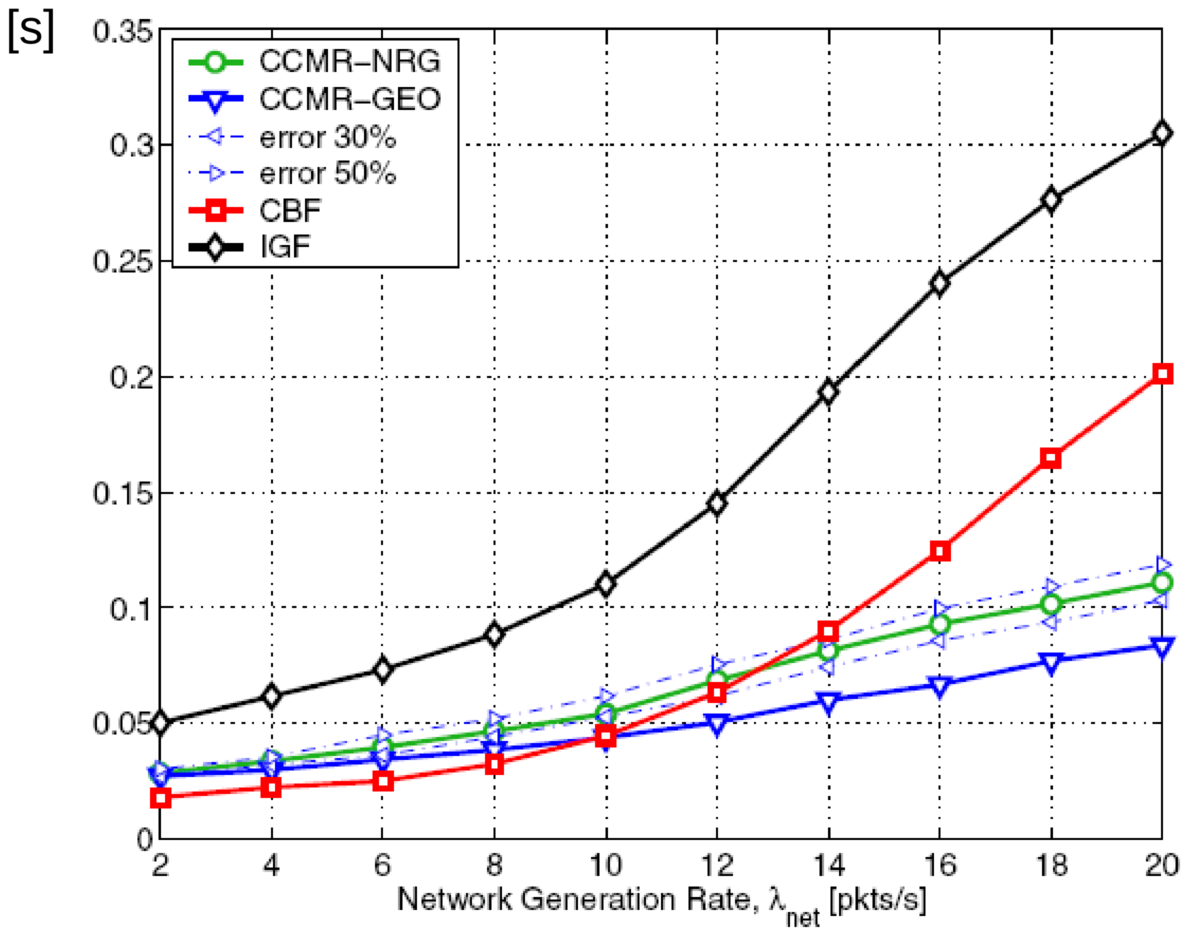
Optimal = 1 REQ + 1 REP



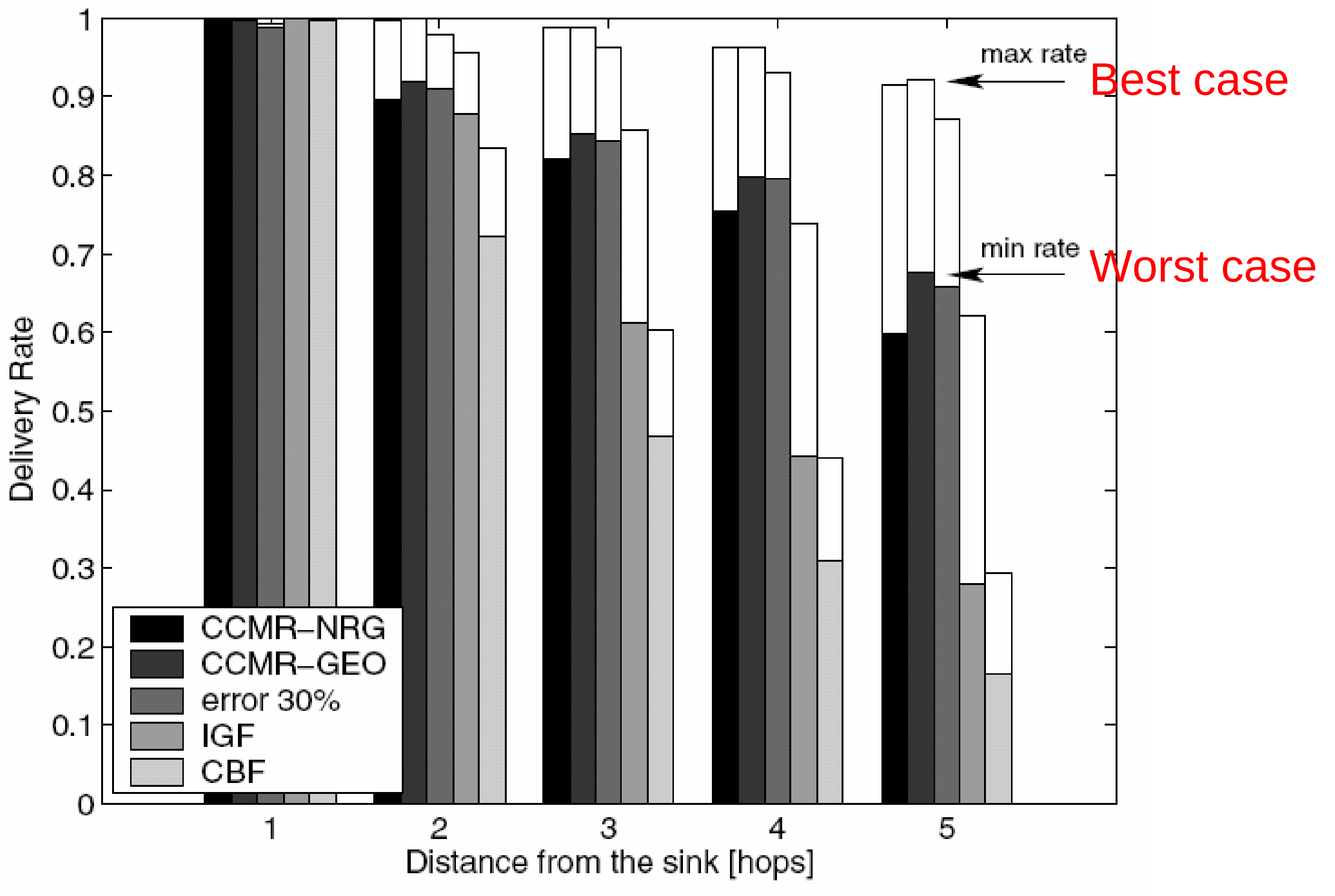
Probability of a successful contention



Duration of the channel contention



Delivery rate vs. hop distance from the sink



Conclusions

- CCMR is designed to be reactive to the network dynamics and to elect the next hop with extremely low overhead.

- The author analytically modeled the next hop selection problem by finding the optimal policy by means of a dynamic programming formulation.

Discussions

- How about routing table based algorithms?
  - Energy consumption
  - Delivery rate
  - End to end delay