Improving Query Response Delivery Quality in Peer-to-Peer Systems

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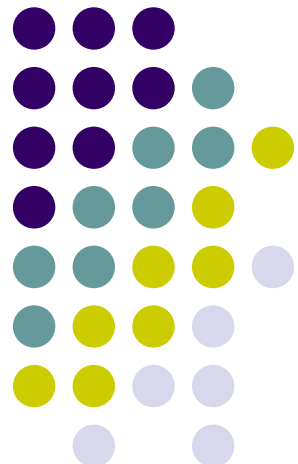


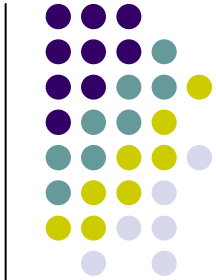
Outline

- Introduction
- Response Loss Problem
- Three techniques to remedy the problem
  - **Redundant Response Delivery (RRD)**
  - **Adaptive Response Delivery (ARD)**
  - **Extended Adaptive Response Delivery (e-ARD)**
- Simulations
- Conclusion

Introduction

- P2P systems can be divided into three different categories:
  - Centralized
  - Decentralized structured
  - Decentralized unstructured
- Decentralized unstructured
  - No correlation between file placement and network topology
  - Flooding search mechanism

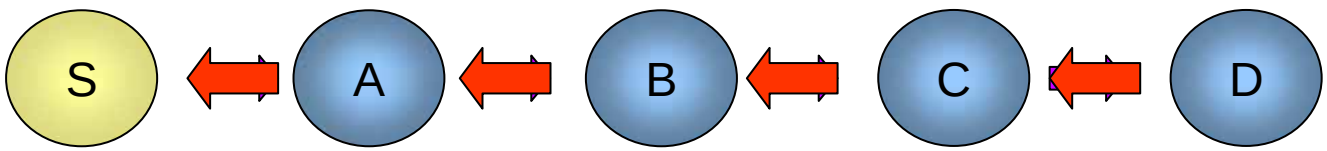
Flooding search mechanism



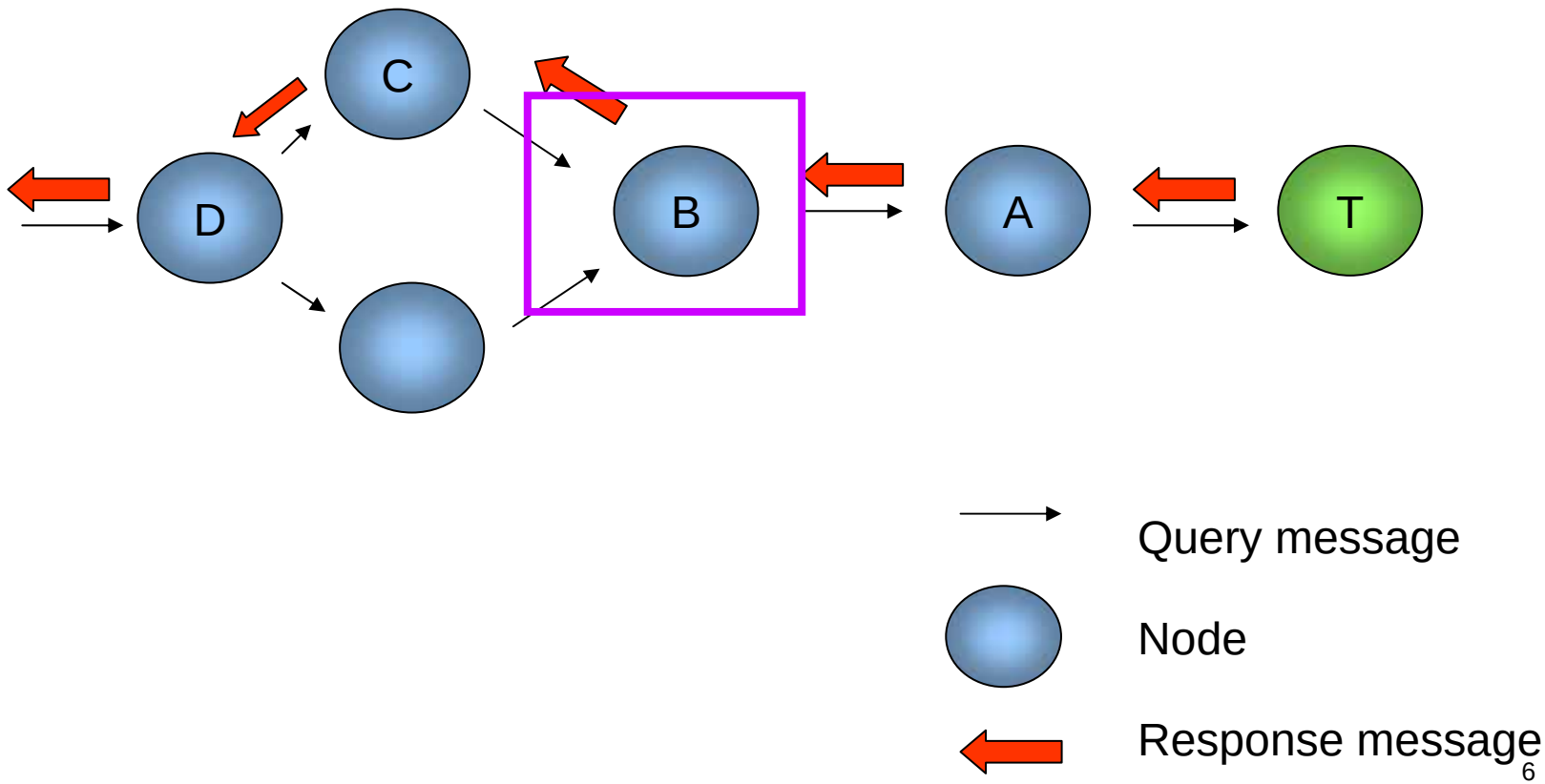
- Each peer makes duplicate copies of a query it receives and broadcasts to all its directly connected neighbors.
- The duplication process is terminated only when the TTL value of the query is reduced to zero, or a satisfying result has been found.

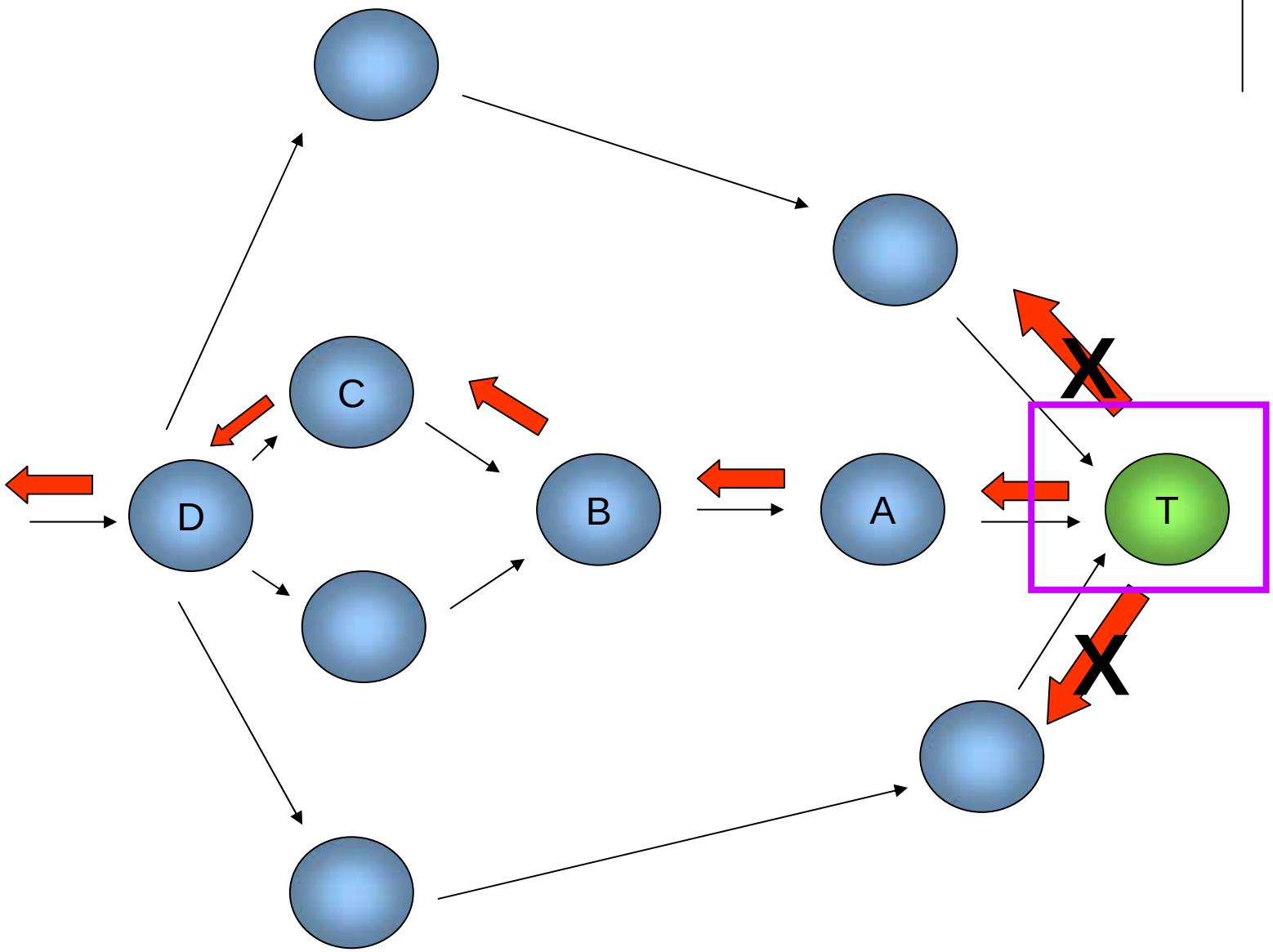
Flooding search mechanism

- Simplicity
- Anonymity
  - No information of query requestor is included in the query request message.



- To reduce the response traffic, responses will be sent back to the requestor along the query incoming path instead of by flooding

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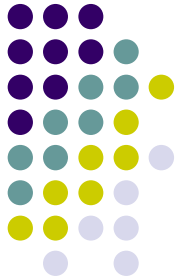
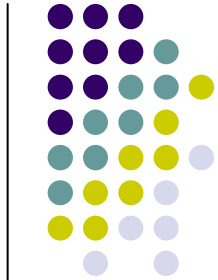
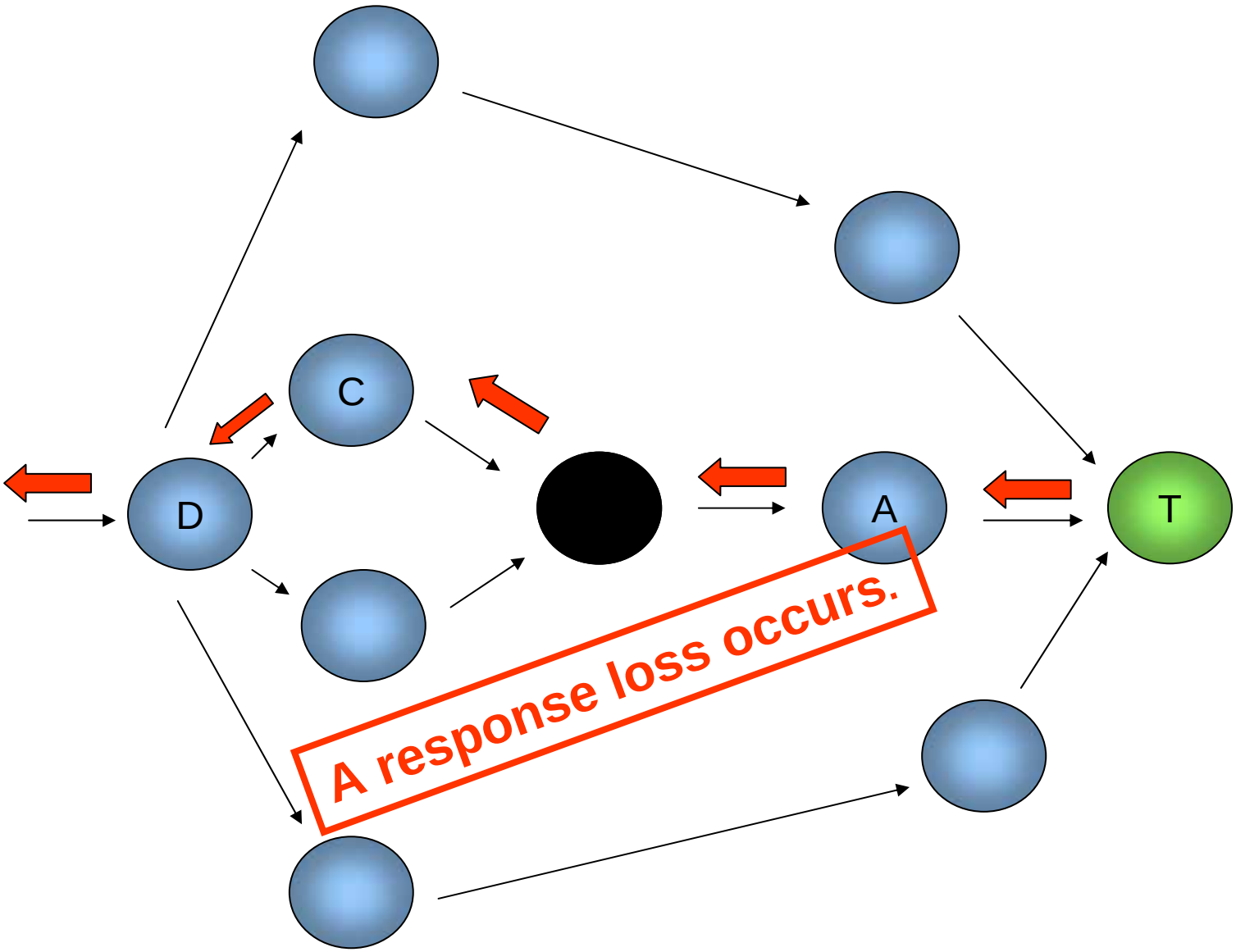


- The unstructured P2Psystem is a highly oscillating system.
- The response message will be lost if any node on the response path fails.
- 35% of the responses are lost in a P2P system (simulations)

Response Loss Problem



- Previous studies show that a peer's lifetime varies from less than 10 minutes to 60 minutes.
- Many new techniques trying to improve the performance of P2P system require peers to adjust their connections to find better neighbors or active optimized overlay topologies.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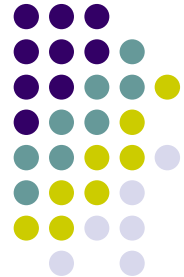
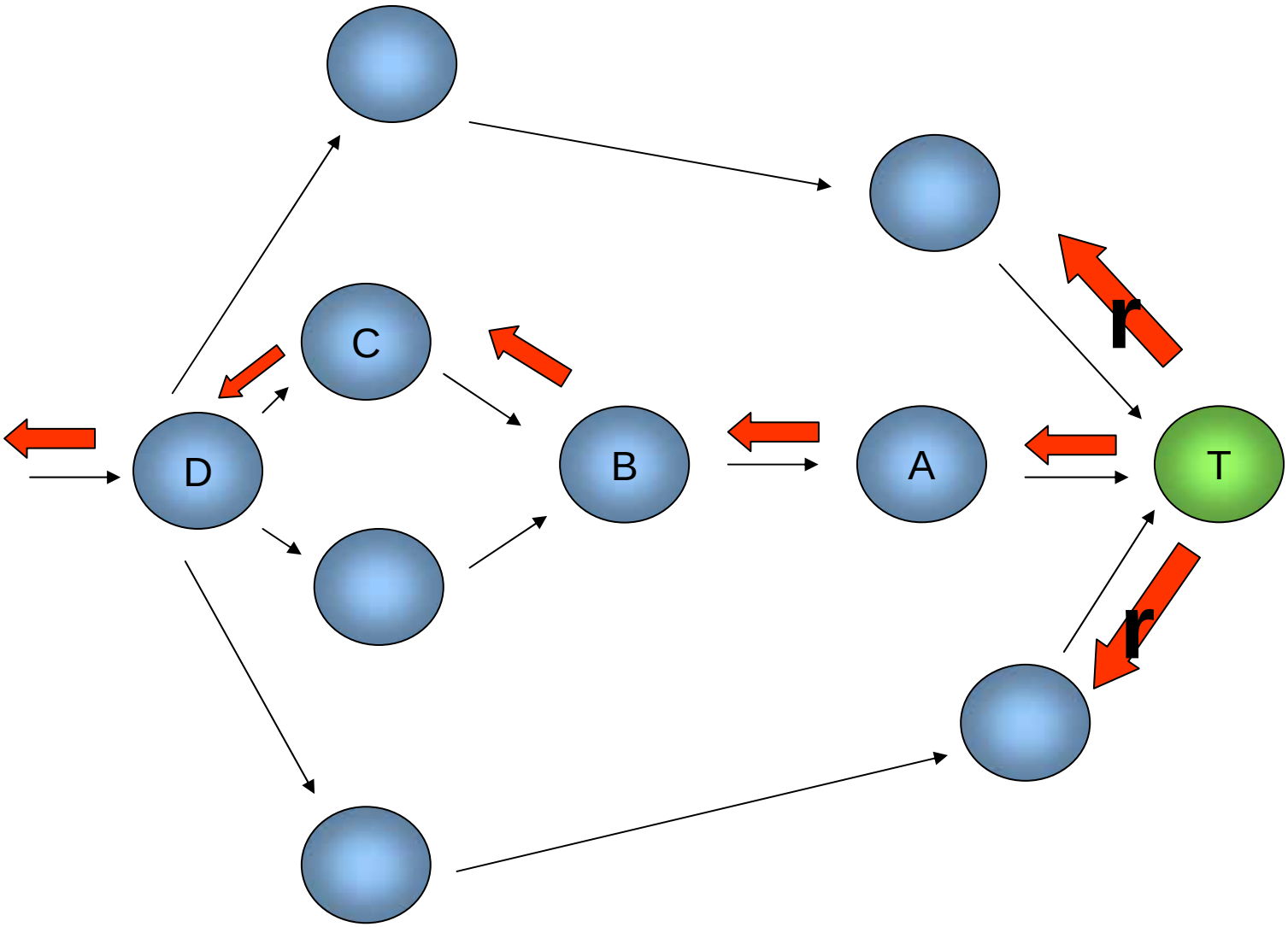
A response loss occurs.

Redundant Response Delivery (RRD)

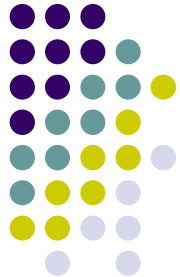


- To alleviate the response loss problem via backup paths.
- Peer T selects other neighbors as back up neighbors with redundancy probability r.

RRD

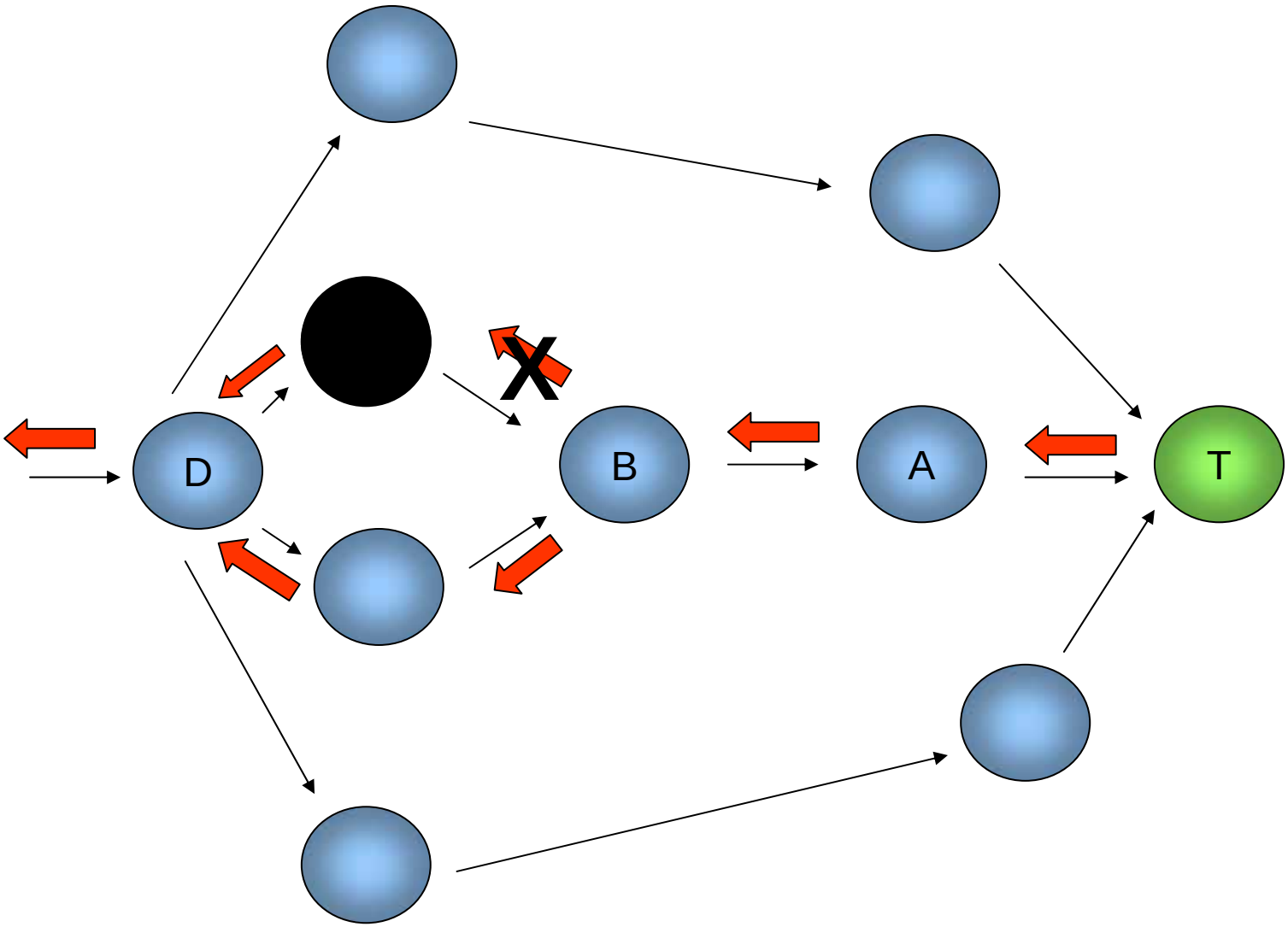


Adaptive Response Delivery (ARD)

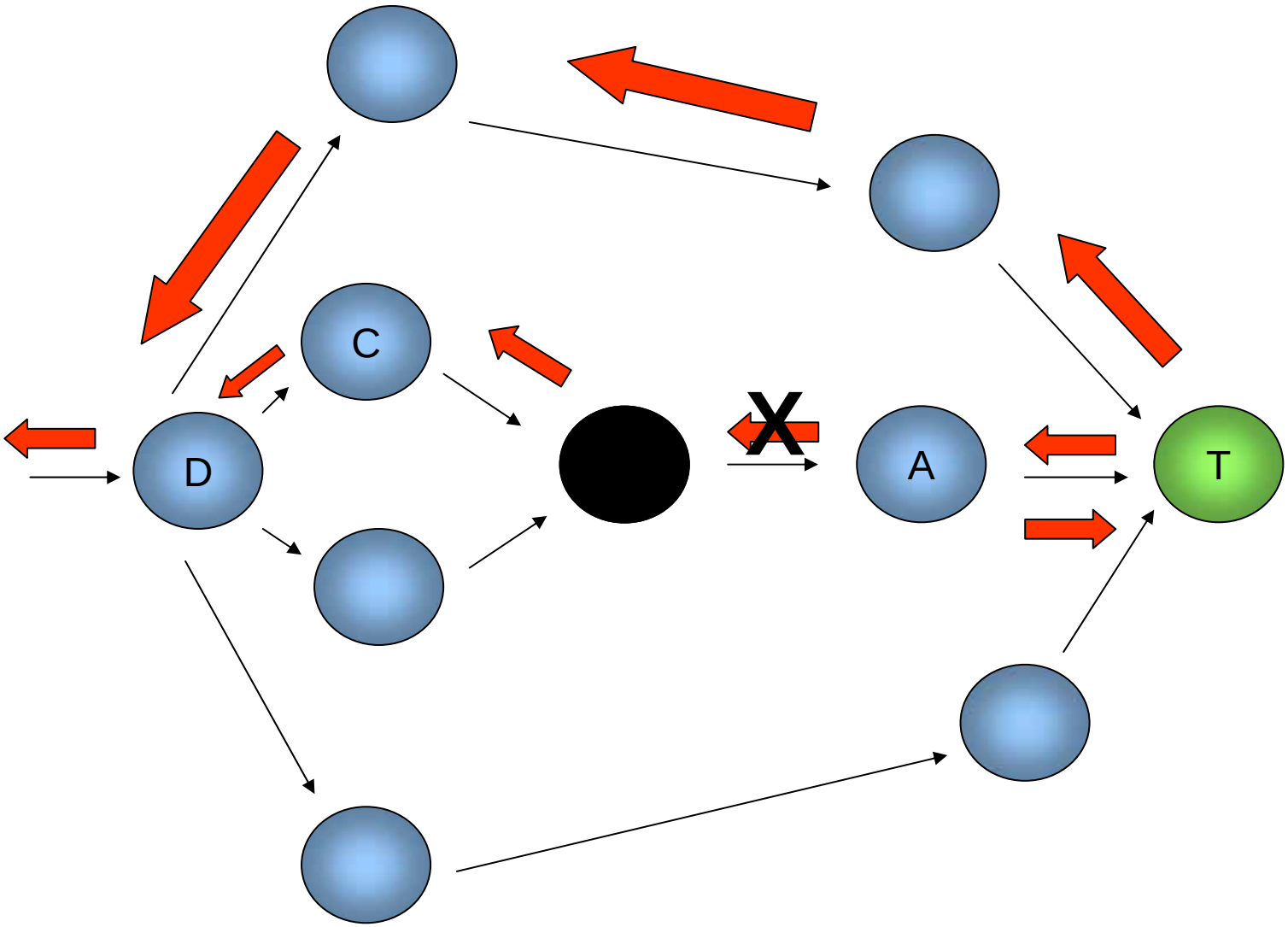


- Each peer keeps a forwarding neighbor list for each query message within a certain period of time.
- Peers deliver the response to a different neighbor when the primary forwarding neighbor fails.

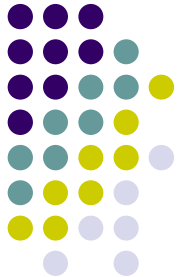
ARD



ARD



Extended Adaptive Response Delivery (e-ARD)



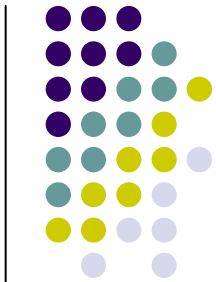
- In the e-ARD mechanism, an IP address used for adaptive response delivery is appended to each query message.
- When the next hop neighbor in the response transfer fails, the peer can forward the response to the node of this IP address.

Anonymity???

-> backup response delivery agent

Backup Response Delivery Agent (bRDA)

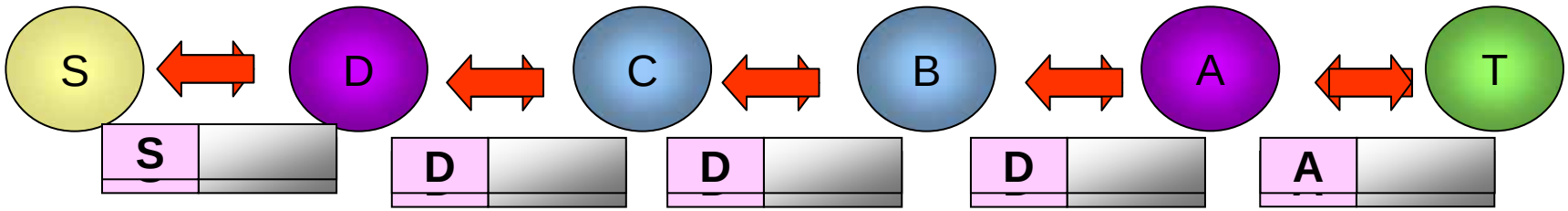
- The authors add a new field of bRDA address on the query request and the response message
- A requestor will put its own address in the field of the bRDA address of the request message.

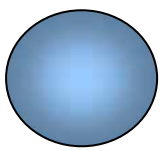


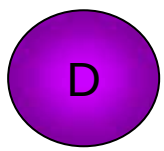
- The peer who receives the query will replace the bRDA's IP address with a wrapping probability α.
- We call the node that decided to append its own IP address to the query message the backup response delivery agent (bRDA).
- When a bRDA appends its own IP address in the query message, it also stores the old IP address in the query message.

- A responder will copy the bRDA address of the received query to its response message
- The bRDA will remove the old bRDA address and append the previous bRDA address stored in its forwarding neighbor list.

Adaptive Response Delivery

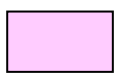


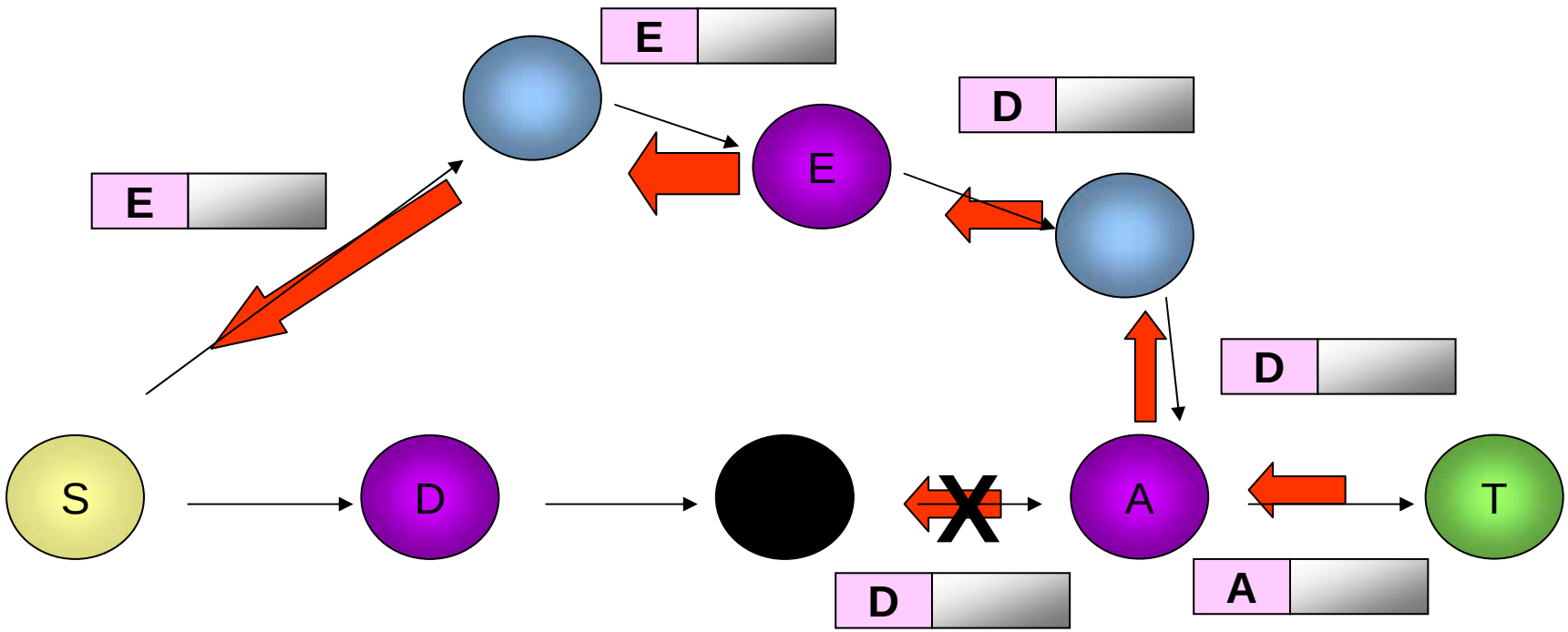

node



bRRA node


message


bRDA address field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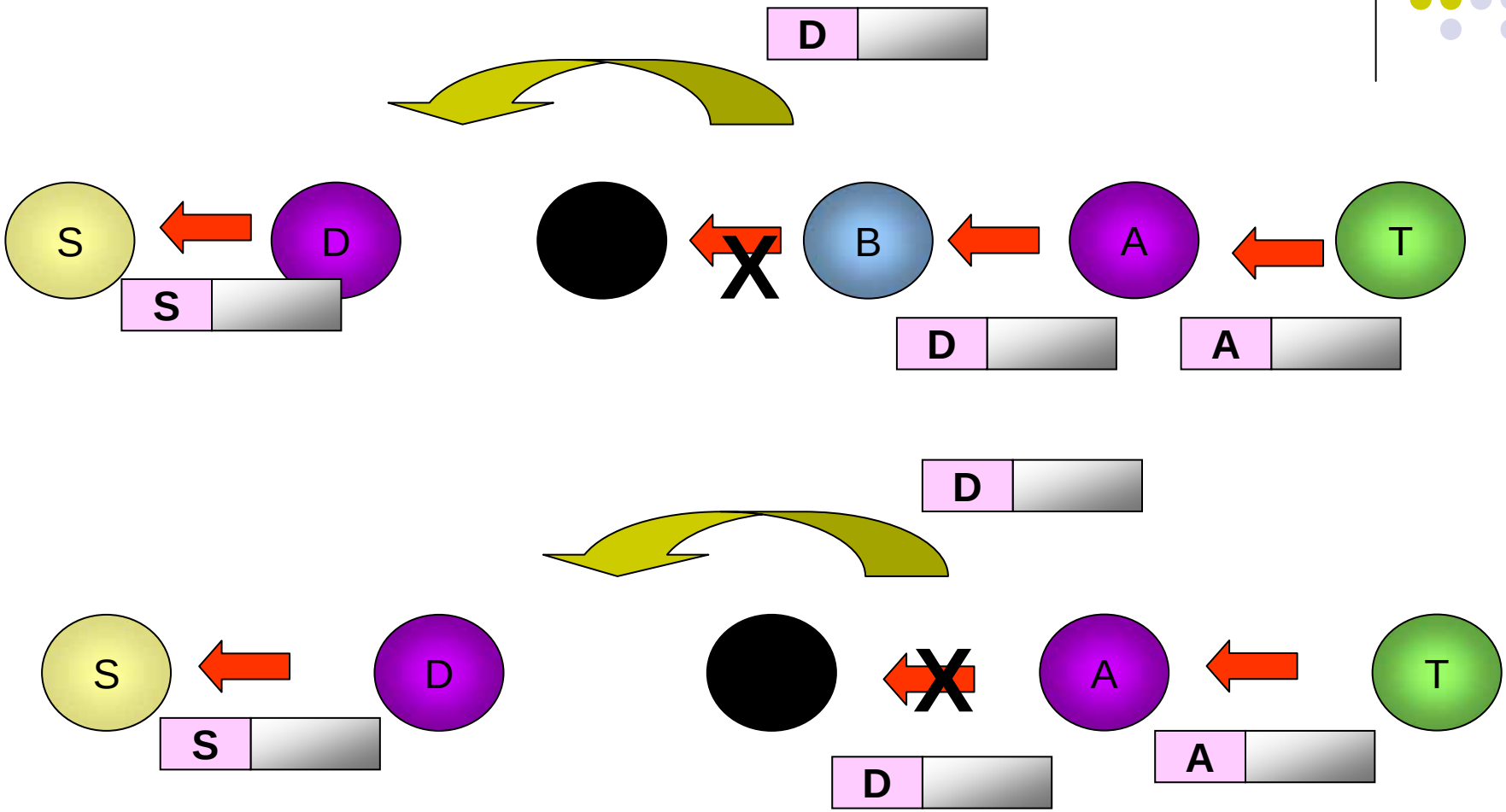
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Simulation

TABLE 3
Parameter Settings of the Simulation

Name	Default	Description	Name	Default	Description
Logical network size	8000	Number of peers in the logical network	Redundancy probability	0.2	Probability of responder to select each neighbor as redundant response back-ward neighbor in RRD
Neighbors per node	6	Average number of neighbors each peer has	Wrapping const	70	Constant to adjust acceler-ant of wrapping probability α in e-ARD
Query rate	0.3	Average number of queries each peer issues per minute	Forwarding neighbor list uptime	Average response time	Time forwarding neighbor record expires
Peer lifetime	10	Average peer online time (minutes)			

Response return rate

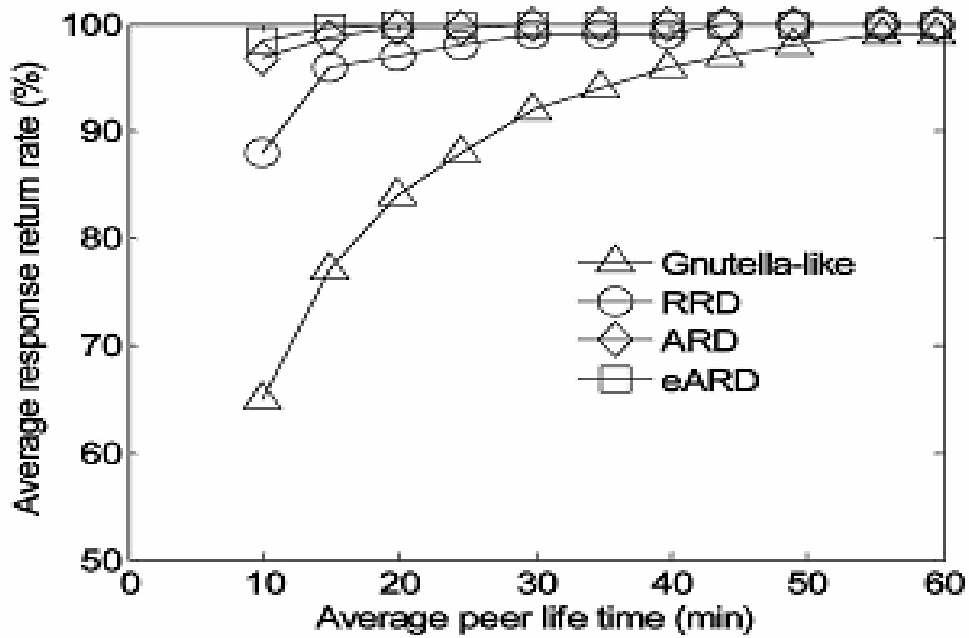


Fig. 5. Response return rate versus peer lifetime.

Response return rate versus query frequency

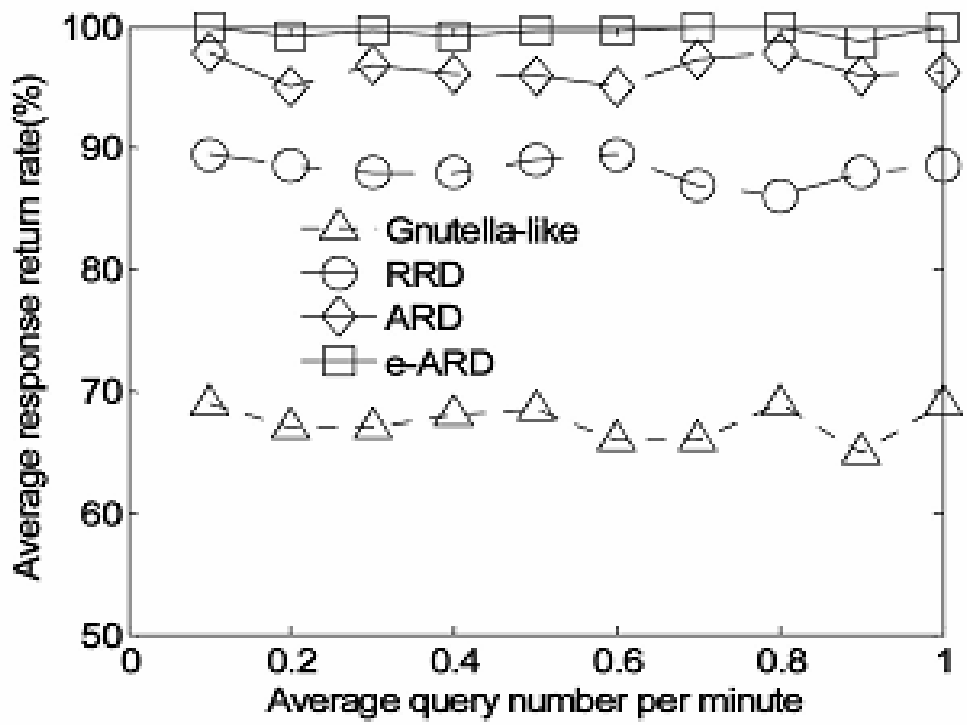


Fig. 6. Response return rate versus query frequency.

Response Traffic Cost

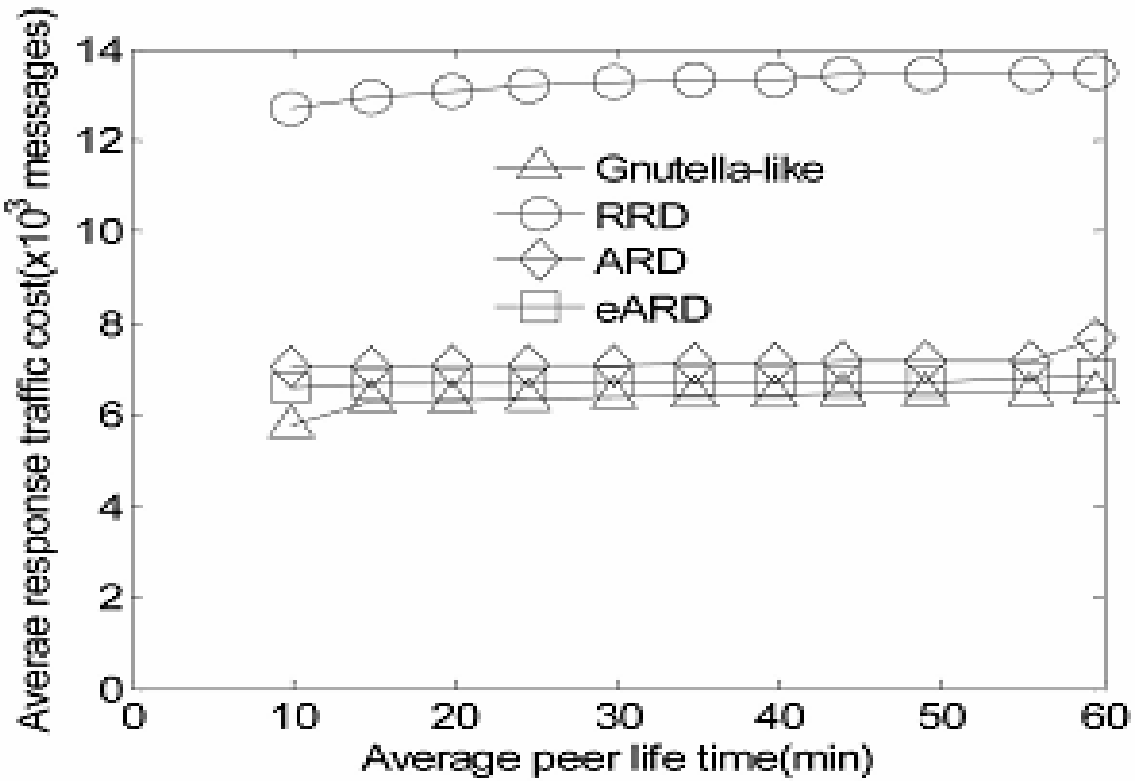


Fig. 8. Response traffic cost versus peer lifetime.

Response time

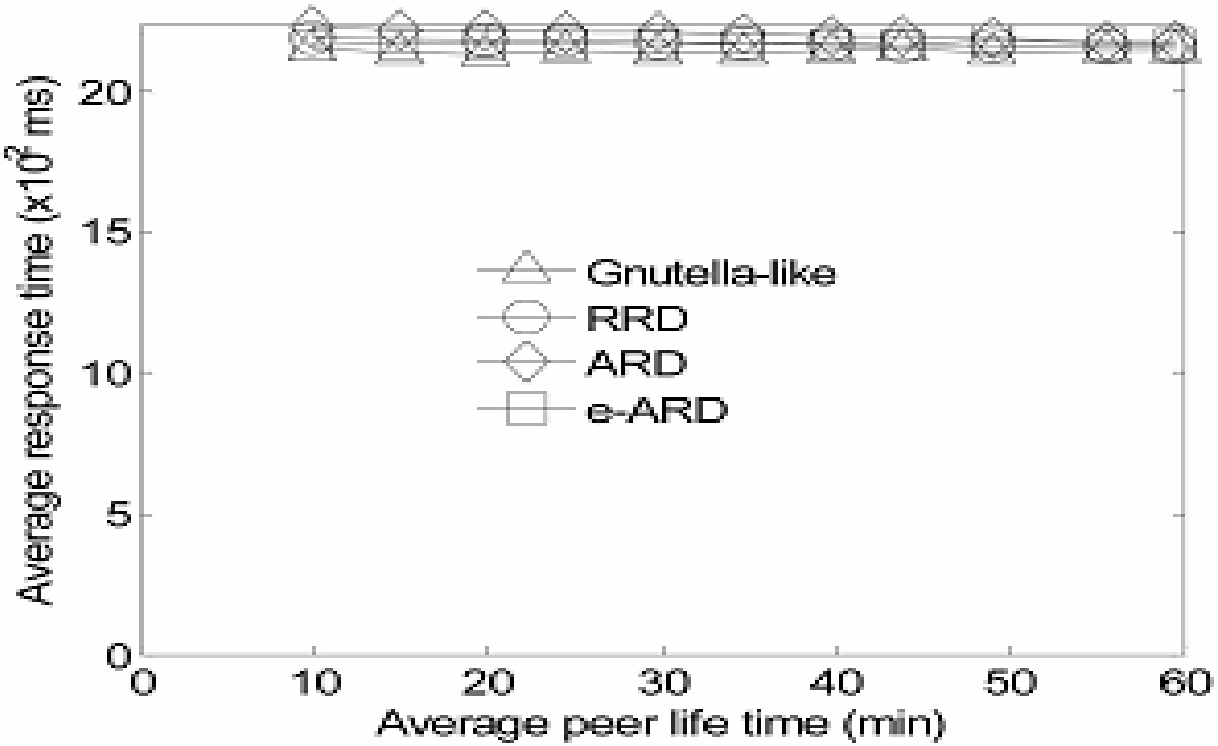
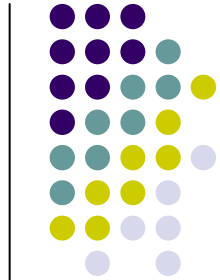


Fig. 12. Response time versus average peer lifetime.

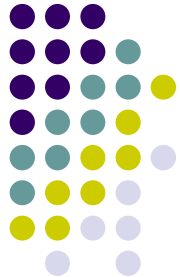
Comparison

	RRD	ARD	e-ARD
Response Return Rate	Effective	More effective	Most effective
Extra Traffic cost	Double the response cost	Less extra traffic overhead (<9%)	Lest extra traffic overhead (<6%)
Response Time	shorter	longest	shortest
Implementation Complexity	No extra complexity	Each node maintains a forwarding list	Each node maintains a forwarding list; New message formats are introduced;

Conclusion



- The P2P system is a highly dynamic system. This leads to a response loss problem, with up to 35 percent of the responses being lost.
- This paper present three techniques :RRD,ARD, and e-ARD. All these techniques reduce response loss rate with limited extra cost.



Thank you ☺