

Adaptive Peer-to-Peer Topologies

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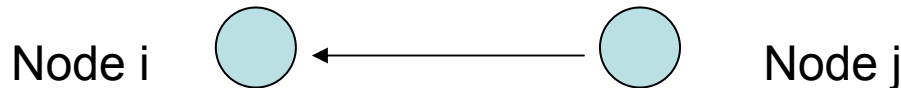
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Outline

- Introduction.
- Network Model.
- Adaptive P2P Topologies.
- Simulation Results.
- Conclusion.

Introduction

- Interaction topologies for a p2p file-sharing network:
 - A graph whose nodes are peers in the network, and whose arcs are defined by downloads.
- Example:
 - Node i downloads contents from node j :



- To design an overlay topology to match the interaction topology.

Introduction

- The adaptive p2p protocol is based on two fundamental notions:
 1. Peers should directly connect to those peers from which they are likely to download satisfactory files.
 2. Peers use past history to determine the peers from which they are likely to download satisfactory files.
- Practice implementation:
 - Each peer keeps a score of how many good files it has downloaded from each other peer in the network.
 - Usually connect to peers with high scores
disconnect to peers with low scores

Network Model

- $G = (P, E)$
P is the set of nodes
E is the set of edges (i, j)
→ the connection between peer i and peer j
- Join the network
 - A connection request message $R(i, j)$ is initiated by peer i.
 - $R(i, j)$ is sent directly to peer j.
 - Peer j decide to accept or not.
- Set TTL
 - To limit the scope of query flooding.

Adaptive P2P Topologies

- APT are based on two notions:
 1. A peer directly connects to those peers from which it is likely to download satisfactory files.
 2. A peer uses past history to determine the peers from which it is likely to download satisfactory files.
- Peer i stores a local trust value for each peer it has interacted with. Let S_{ij} denotes the local trust value
 - sat (i , j) is the number of satisfactory transactions peer i has had with peer j
 - unsat (i , j) is the number of unsatisfactory transactions peer i has had with peer j

$$S_{ij} = \text{sat} (i , j) - \text{unsat} (i , j)$$

Adaptive P2P Topologies

- APT protocol:
 - Define the trustworthiness of a network to be:

$$Q = \sum_{i=1}^v \sum_{j=1}^v \text{connection}(i, j) \times S_{ij}$$

where v is the number of nodes in P

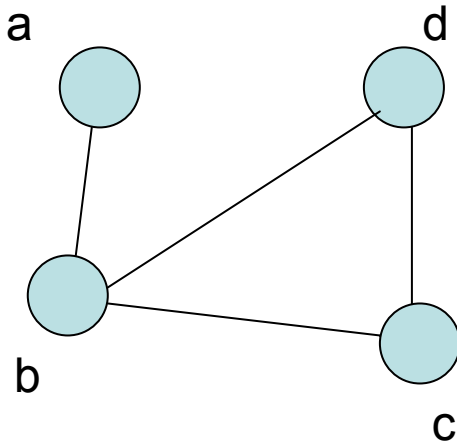
$\text{connection}(i, j) = 1$ if $(i, j) \in E$

otherwise

$\text{connection}(i, j) = 0$

Adaptive P2P Topologies

- Example:



	a	b	c	d
a		3	6	7
b	5		9	4
c	2	1		5
d	9	1	3	

- $Q = 3+5+9+4+1+5+1+3 = 31$

Adaptive P2P Topologies

- APT protocol:
 - A peer level greedy algorithm to maximizing Q

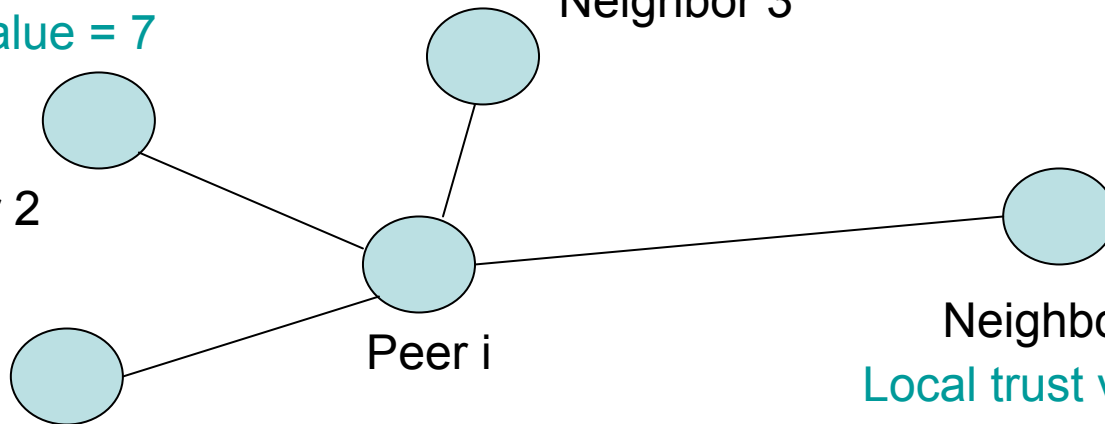
Limit of connections = 4

Local trust value = 13

Local trust value = 7

Neighbor 3

Neighbor 2

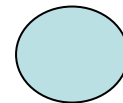


Neighbor 4

Local trust value = 9

Neighbor 1

Local trust value = 4

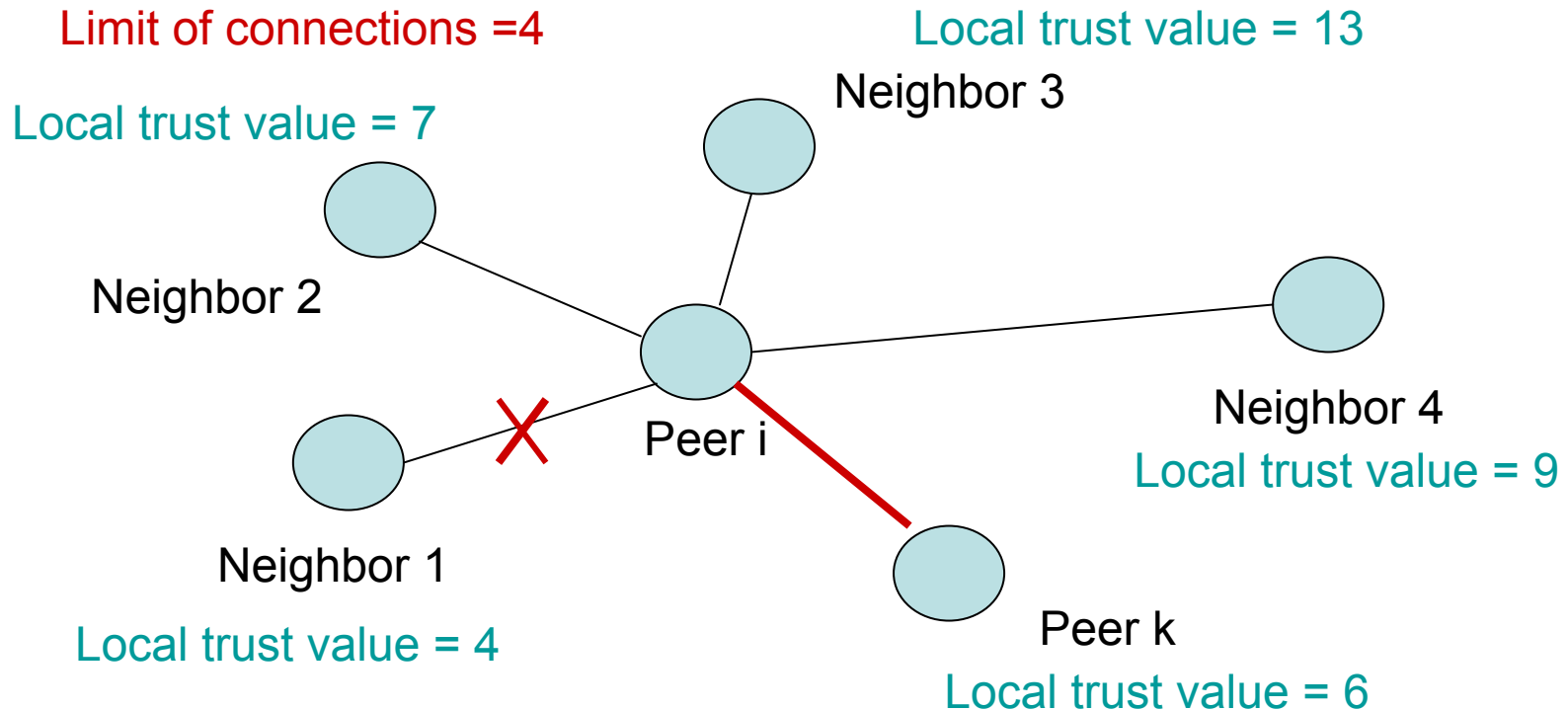


Peer k

Local trust value = 6

Adaptive P2P Topologies

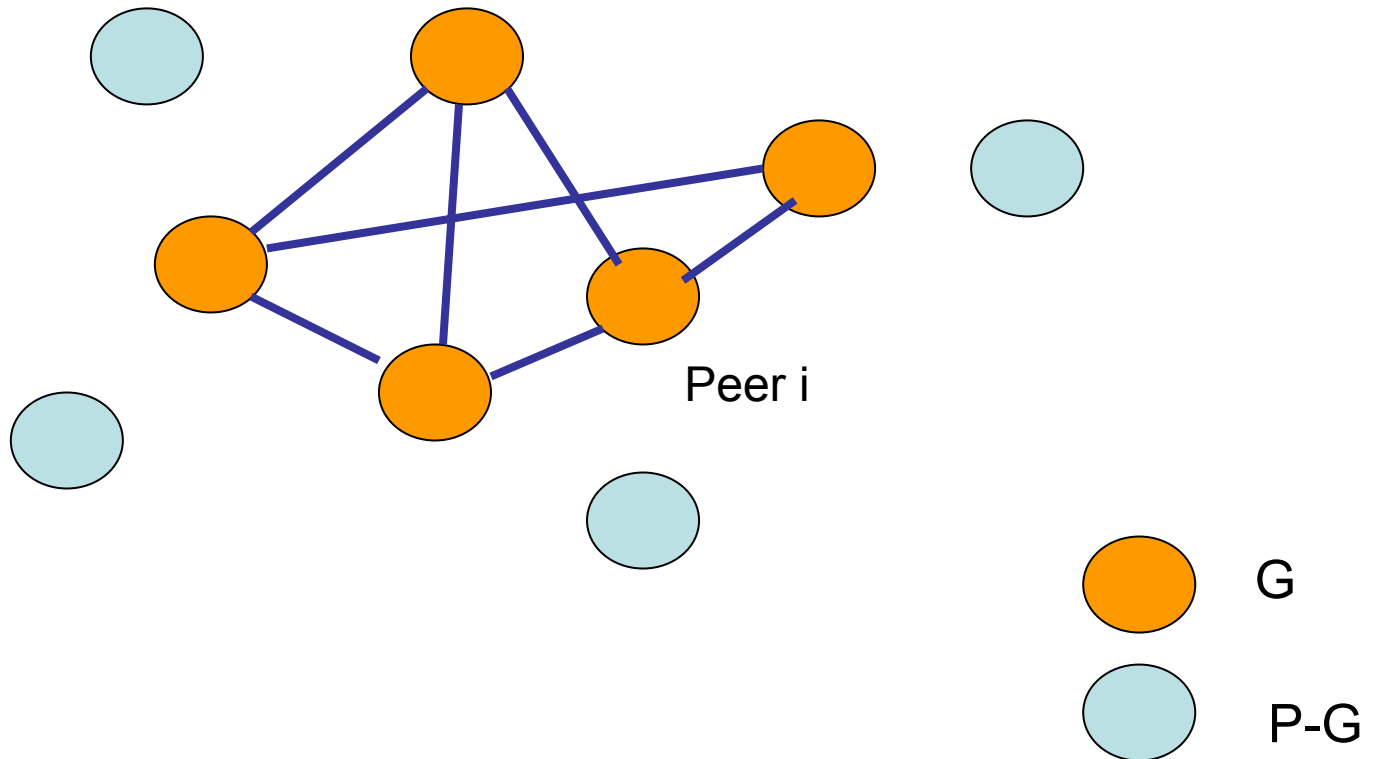
- APT protocol:



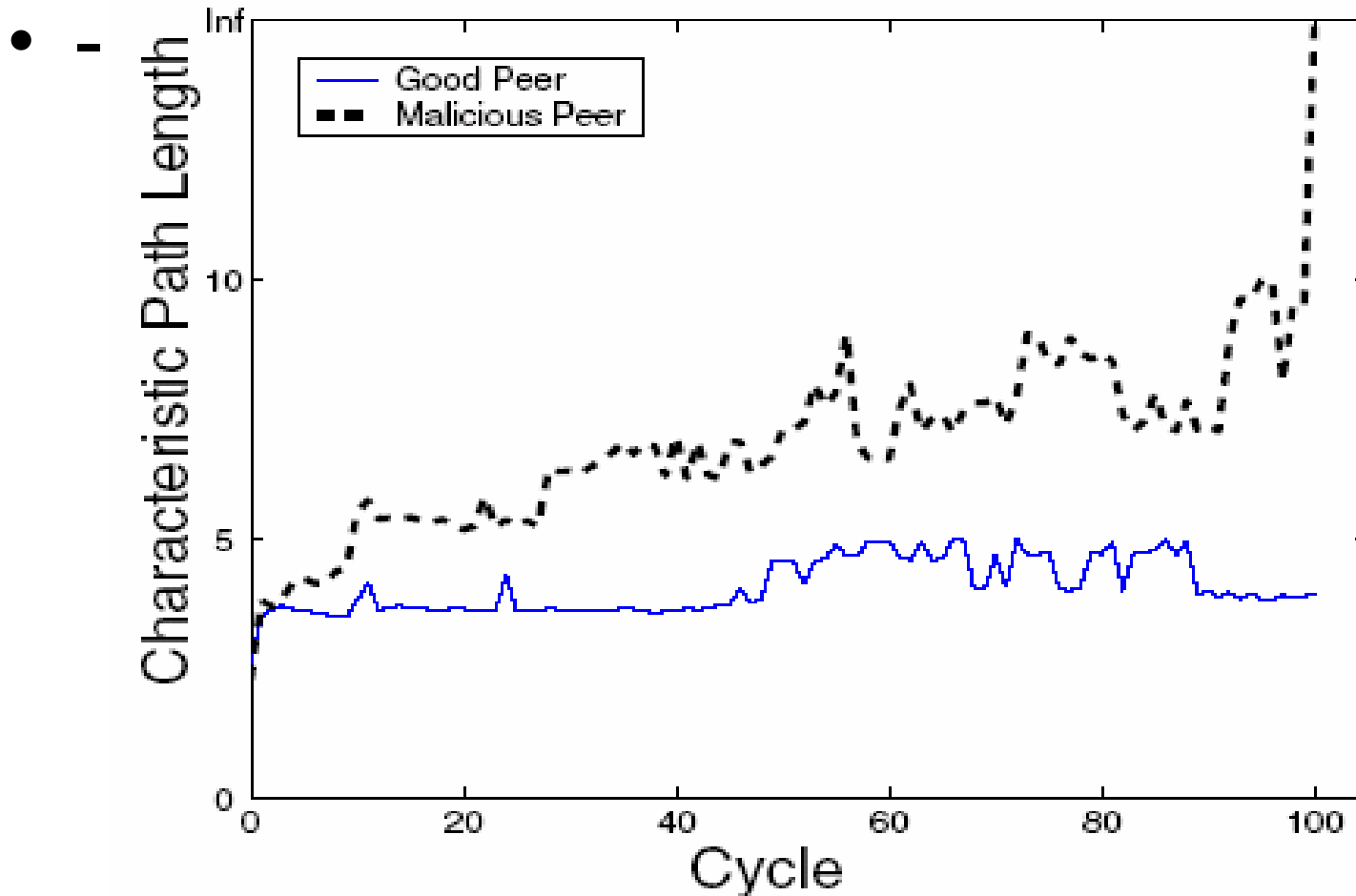
Adaptive P2P Topologies

- P : The set of all peers.
- G : The set of good peers.
- $P-G$
 - Malicious peers
may disseminate corrupt or inauthentic files.
 - Freeriders
never upload files.

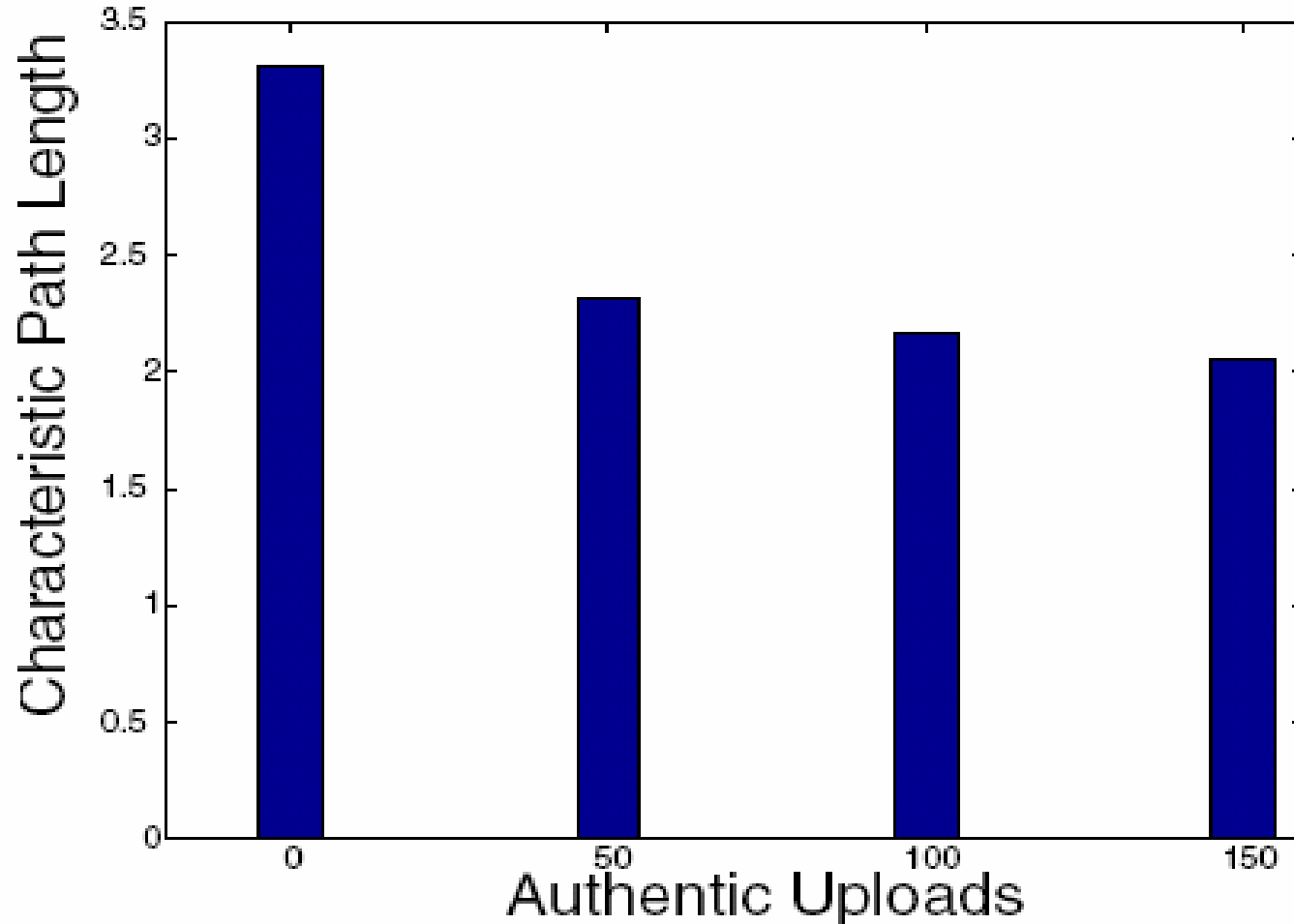
Adaptive P2P Topologies



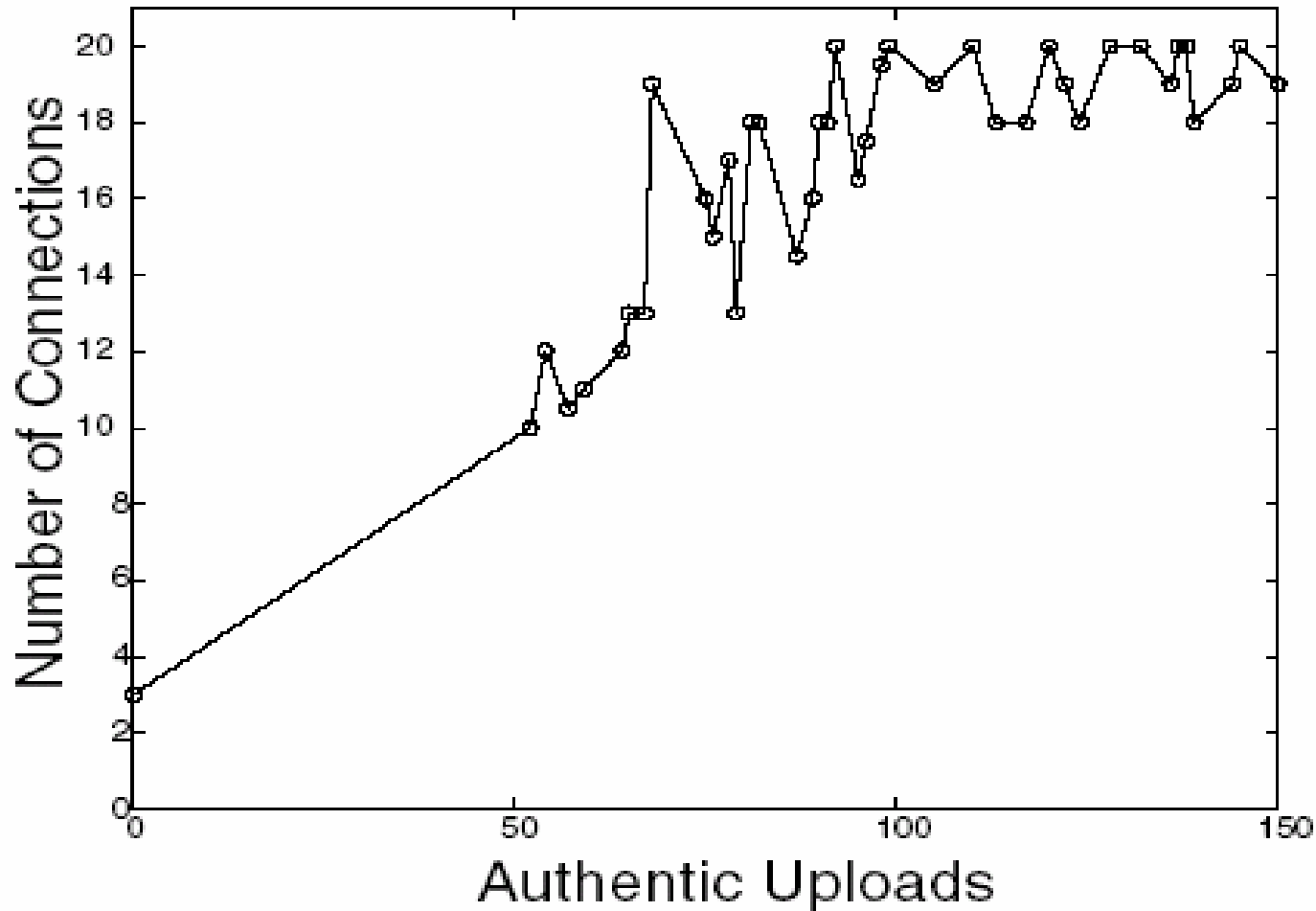
Simulation Results



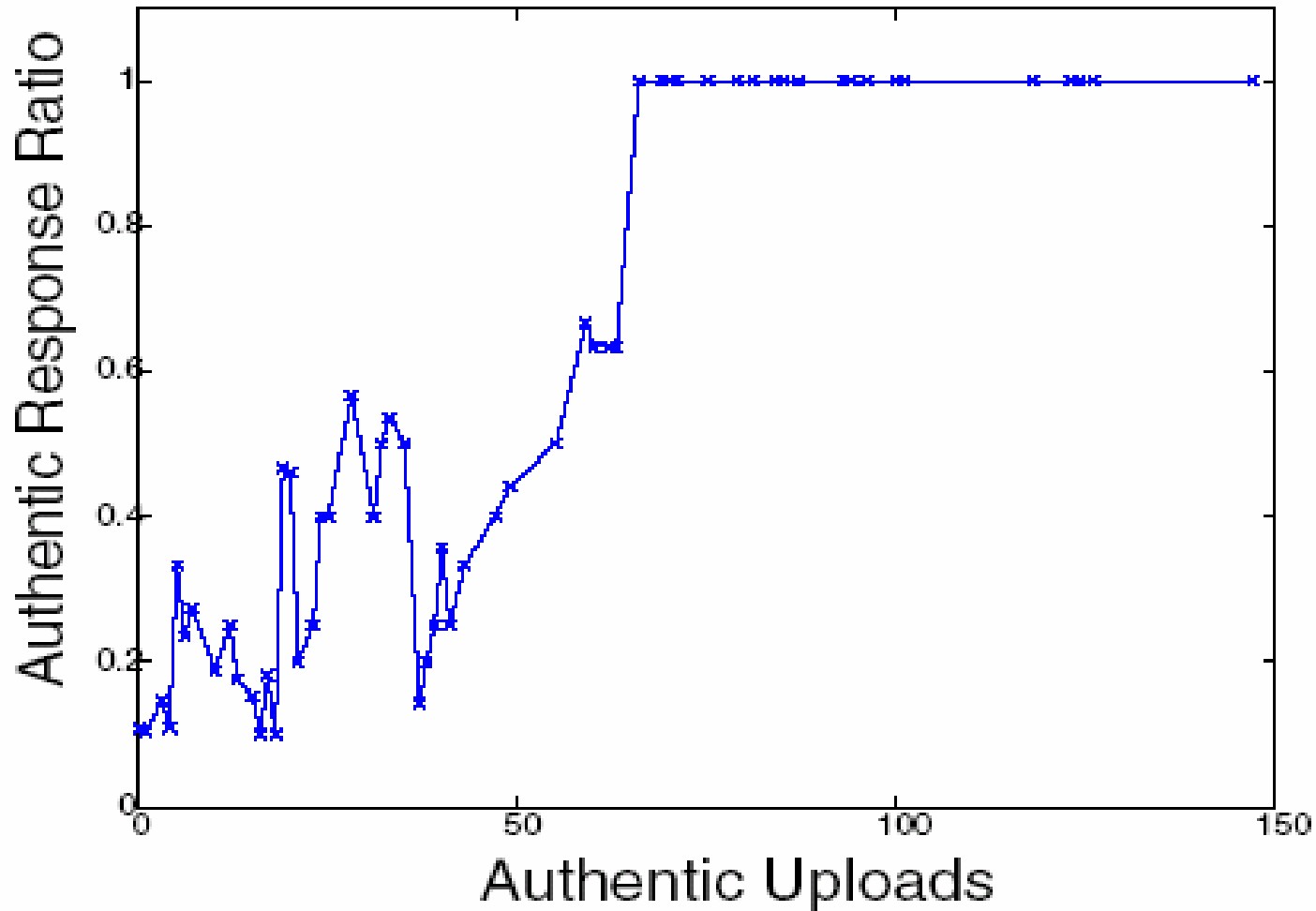
Simulation Results



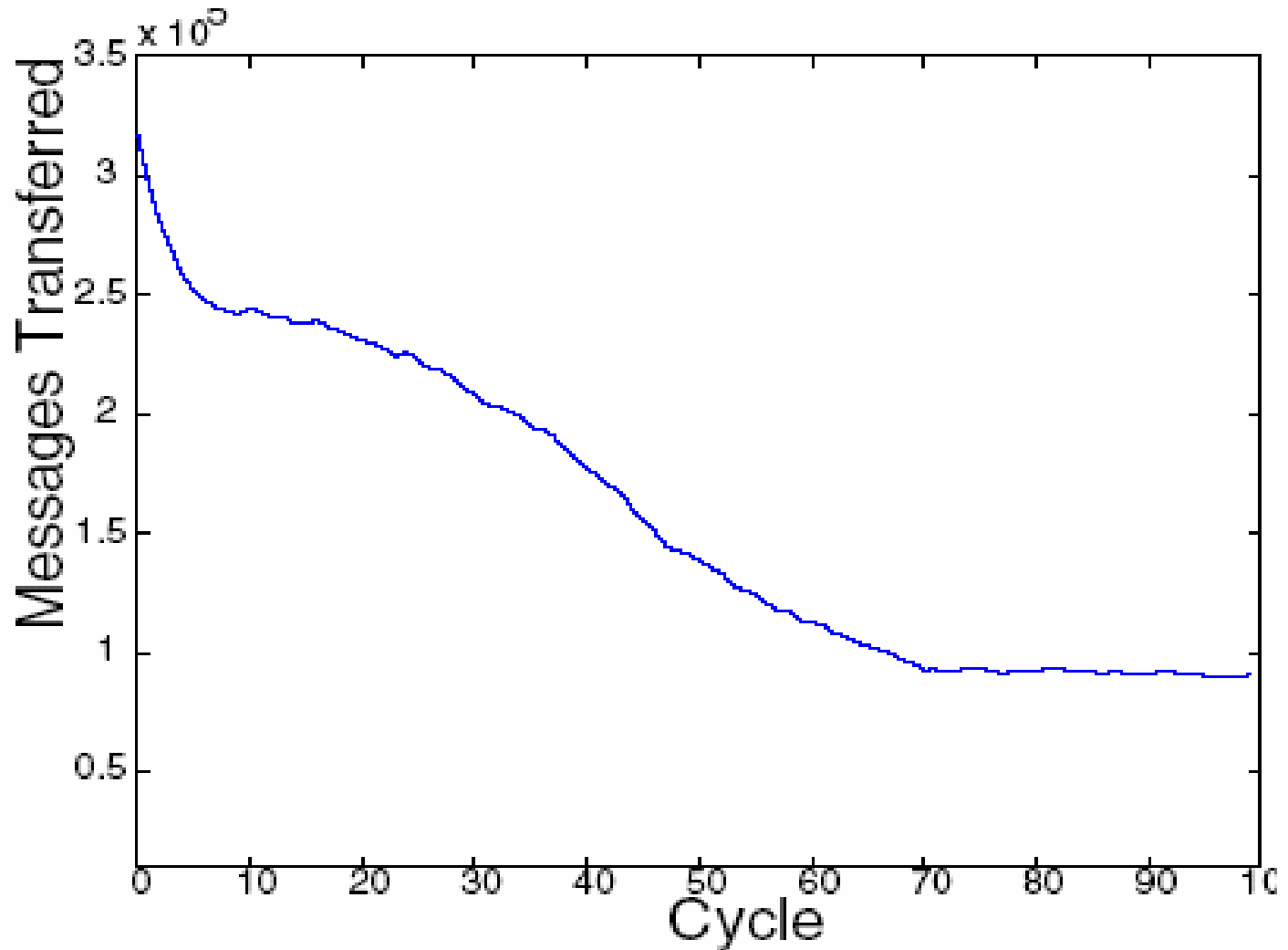
Simulation Results



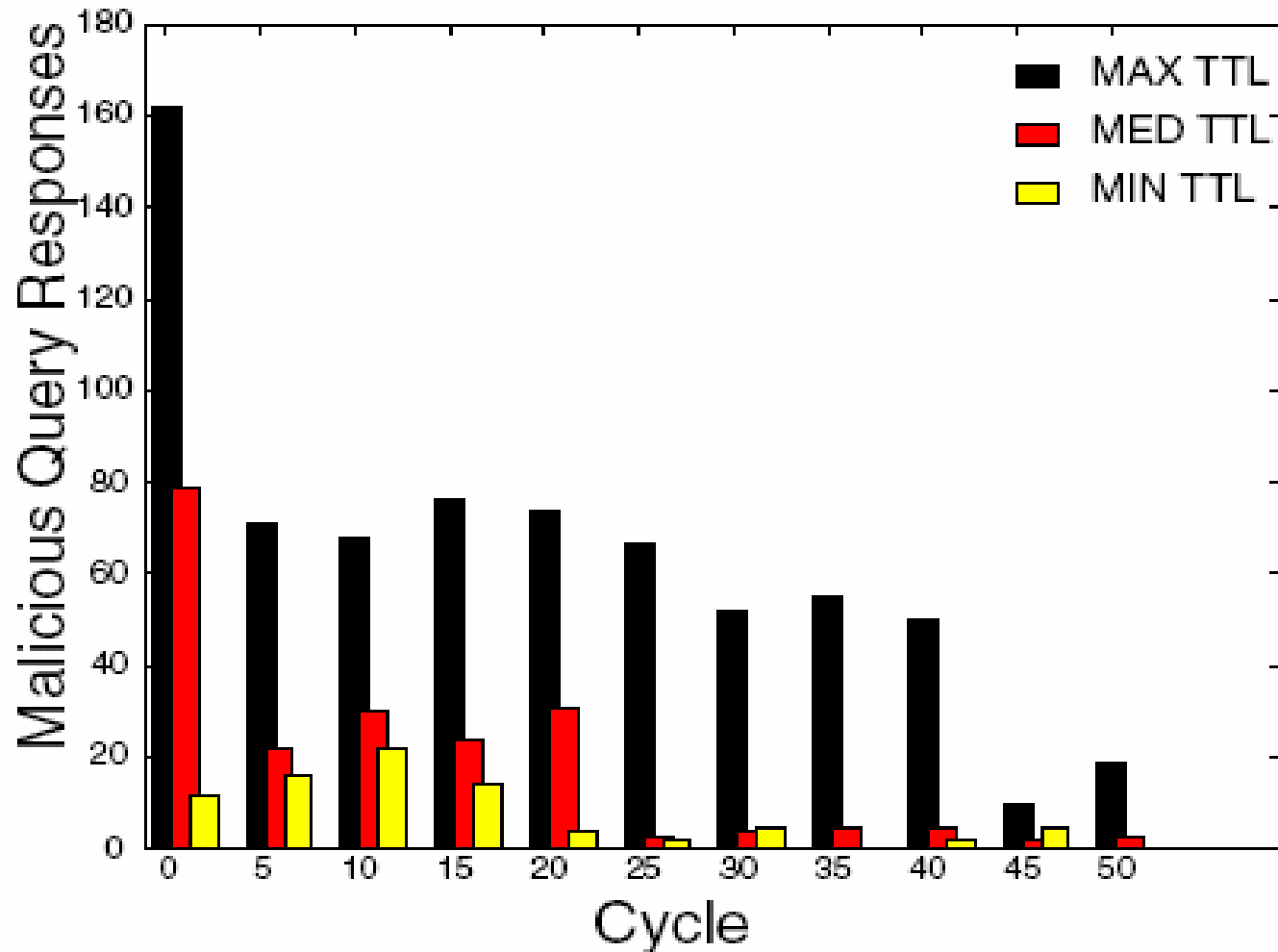
Simulation Results



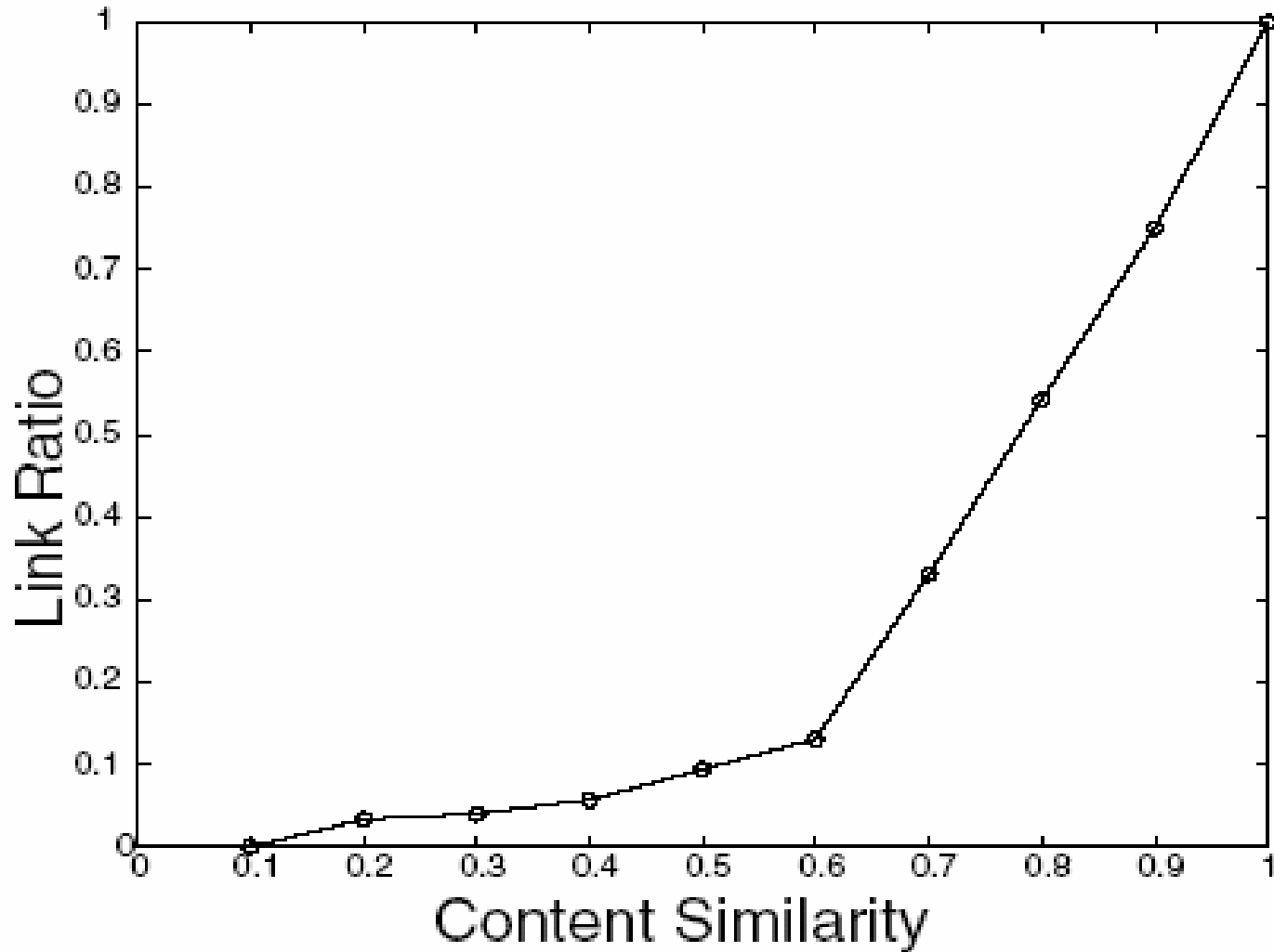
Simulation Results



Simulation Results



Simulation Results



Conclusion

- APT defines local trust value by past transactions.
- Provides incentive mechanism.
- The resulting topologies are highly efficient.