Sorcery: Could We Make P2P Content Sharing Systems Robust to Deceivers?

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Background

What is the deceptive behavior in P2P content sharing systems ?

What are the existing solutions on this problem ?

Our approach ?

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Deceptive Behavior

Individual or collusive attackers (deceivers) publish some polluted content items, and cast incorrect votes on them ... ...

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Normal users are deceived by votes and download these polluted content items.

Deceptive Behavior

Alice's Content items

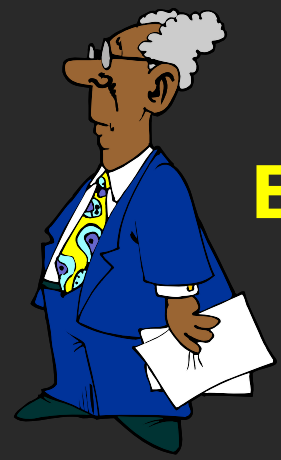
1 3 4

Alice's Votes

1 4

7 10 15

I would like to download File 4.



Bob

Deceptive Behavior

4

However, after downloading content 4, Bob finds this content item is polluted.

We say Bob is deceived by Alice's vote.

Bob

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Existing Solutions

- Reputation Models:
  - ✓ Peer-based: EigenTrust, PeerTrust, Scrubber ...
  - ✓ Object-based: Credence, FileTrust ...
  - ✓ Hybrid: XRep, X^2Rep, Extended Scrubber...
- Micropayment Techniques: MojoNation.
- Exchange Protocol

... ...

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Some Problems!

Analysis

The above situation can be explained the attackers sit on the *dominant position*, and the solution is we need to achieve the conversion of the dominant position through constructing our own *dominant information.*

Analysis

The fundamental insight driving our work is social network can help the users construct the confidential and reliable friend-relationships, and we treat the confidential information of friends as the dominant information.

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Sorcery

1. Introducing Social Network
2. Challenge-response Mechanism
3. Punishment Mechanism
4. Practical Issues

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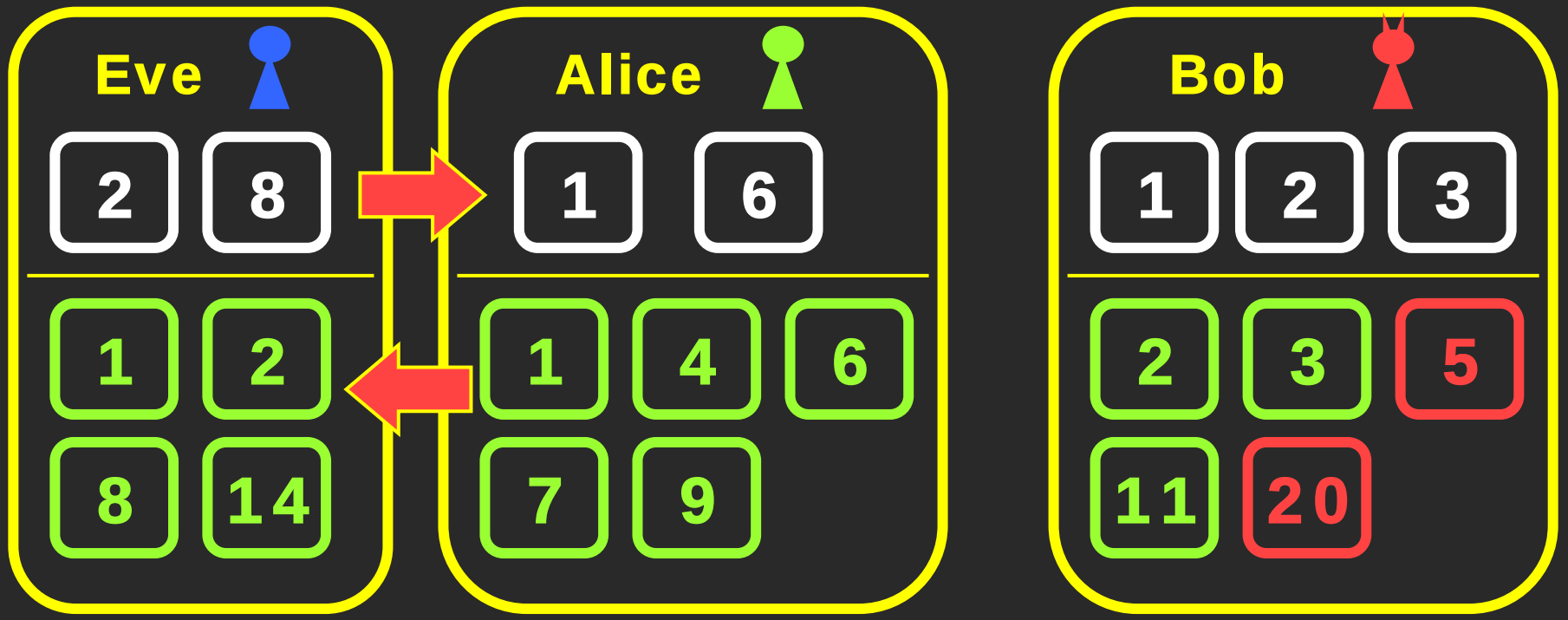
This is the dominant information for the client

Introducing Social Network



Eve is Alice's friend, but Bob cannot know the friend-relationship between Alice and Eve.

Introducing Social Network

Because friends' experiences can be used, social network can address cold start problem which cannot be solved by the existing reputation models … …

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New user joins in the system, he is easily to be deceived due to lack of experiences.

Sorcery

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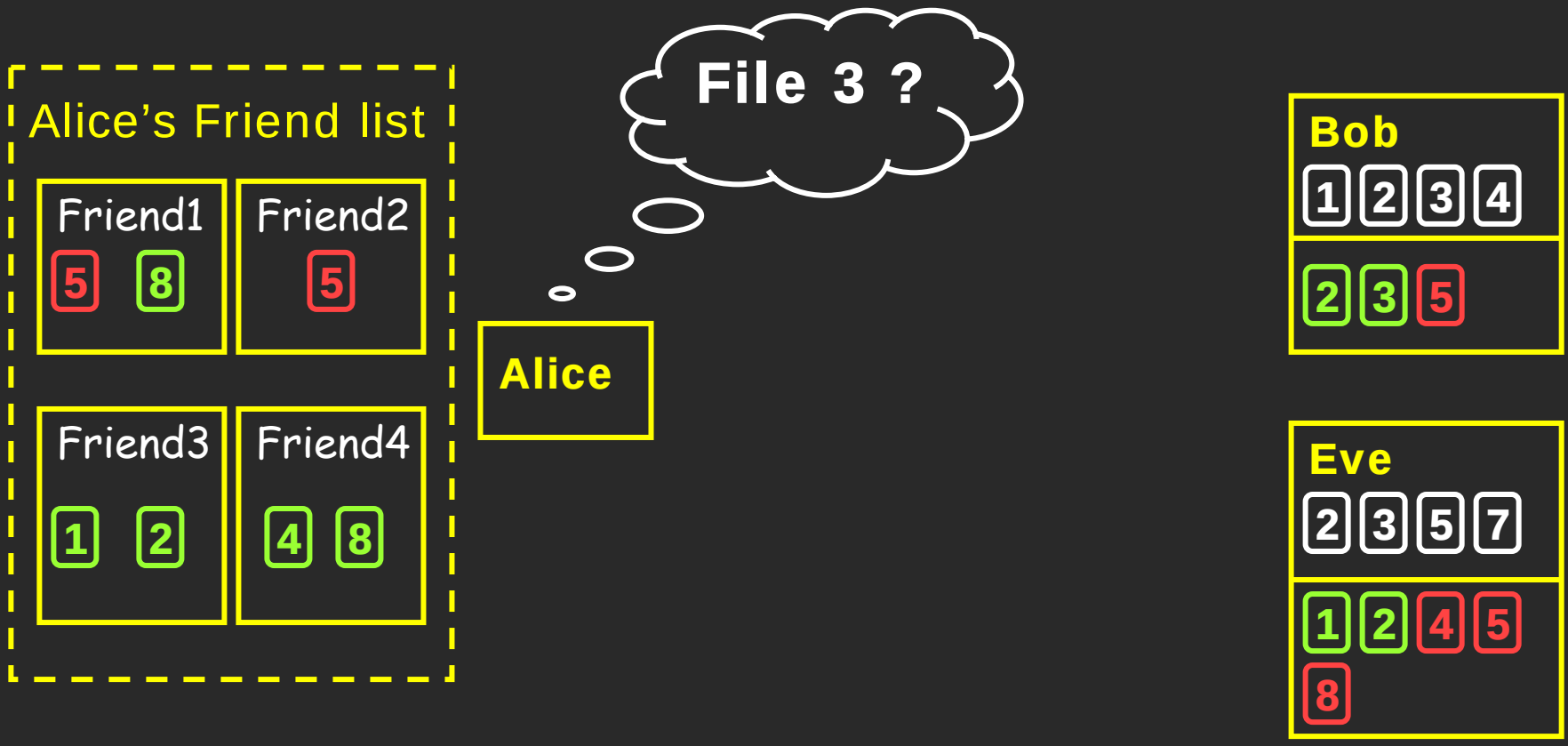
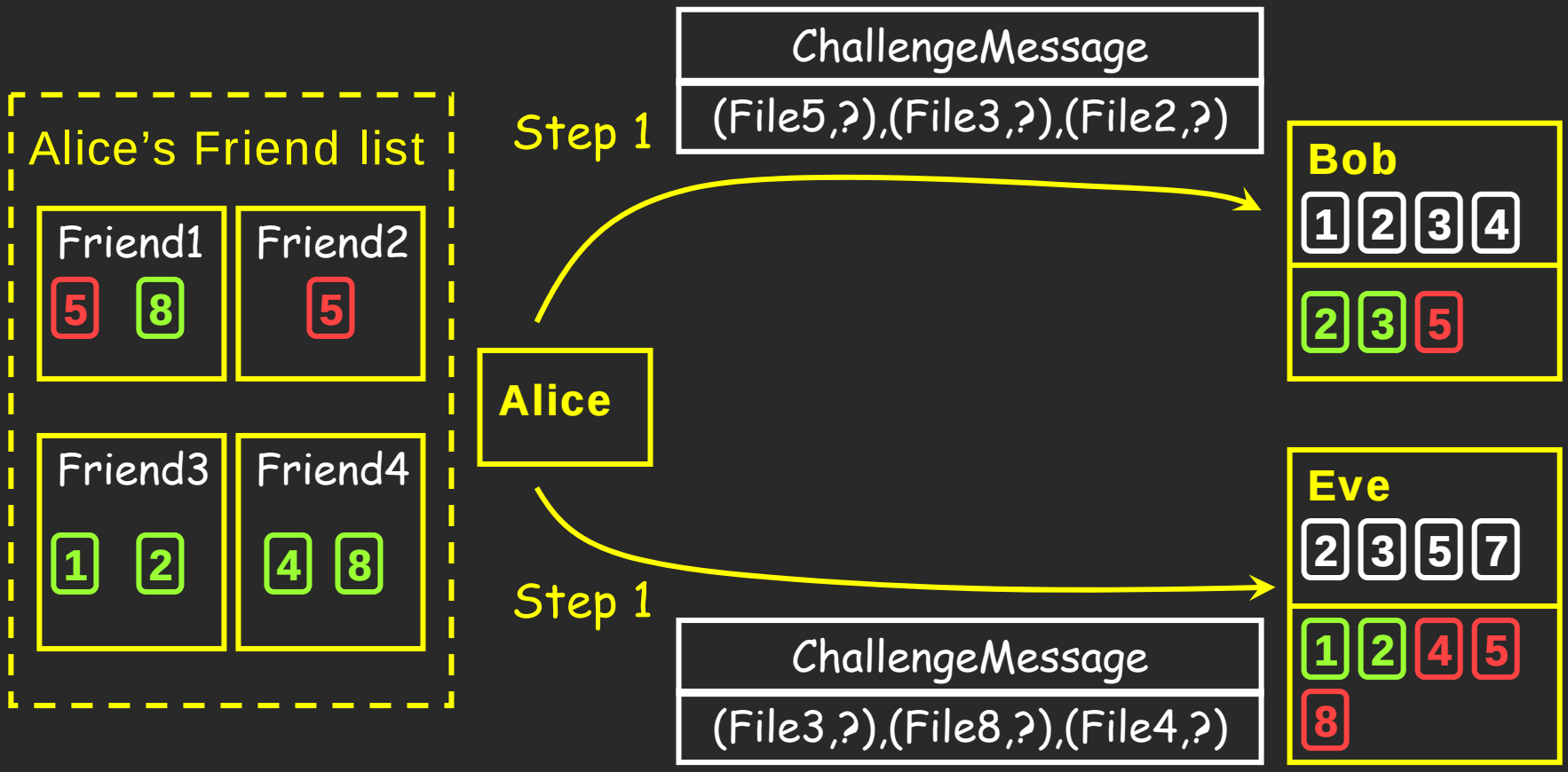
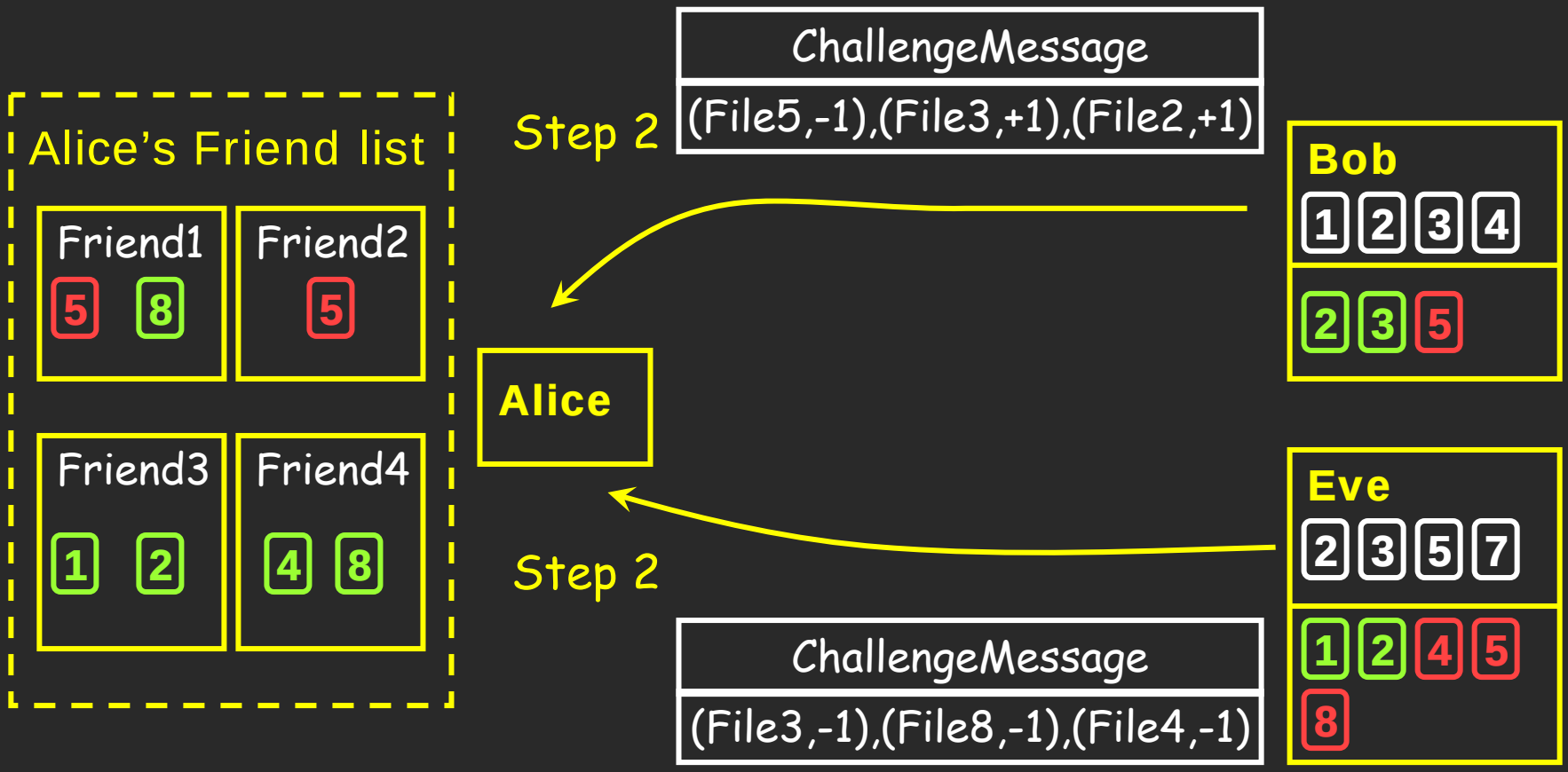
Challenge-response



Challenge-response



Challenge-response



Sorcery

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Punishment Mechanism

Sorcery introduces reliability degree to punish deceivers, thus reducing the p-ossibility of impact brought by them ... ...

Punishment Mechanism

$$RD_{i(j)} = \begin{cases} \max(-1, RD_{i(j)} - pn^2) \\ \\ \min(1, RD_{i(j)} + r) \end{cases}$$

$RD_{i(j)}$: the reliability of i with respect to j;

p: the penalty factor;

r: the recompense factor;

n: the number of i being deceived by j.

Punishment Mechanism

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If *j* is a deceiver ... ...

Punishment Mechanism

$$RD_{i(j)} = \begin{cases} \max(-1,\ RD_{i(j)} - pn^2) \\ \min(1,\ RD_{i(j)} + r) \end{cases}$$

If *j* is not a deceiver, and *i* would like to upgrade $RD_{i(j)}$ ... ...

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Practical Issues

- Lack of the Overlapping Votes
- Unreliable Friends

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Non-overlapping Voting Histories

The studies in [J. Liang, INFOCOM'05] and [K. Walsh, NSDI'06] indicated it's a high probability that most peers have overlapping votes with the voters of any content item … …

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The client should challenge some of voters of the target content item (Details see paper please).

Practical Issues

- Lack of the Overlapping Votes
- Unreliable Friends

Unreliable Friends

In the practical applications, some friends may be online deceivers or compromised, Sorcery utilizes similarity based on cosine technique to filter those unreliable friends (The concrete equation see paper please) … …

Evaluation

I Simulation Setup

II Experimental Results

Evaluation

I **Simulation Setup**

II **Experimental Results**

Simulation Setup

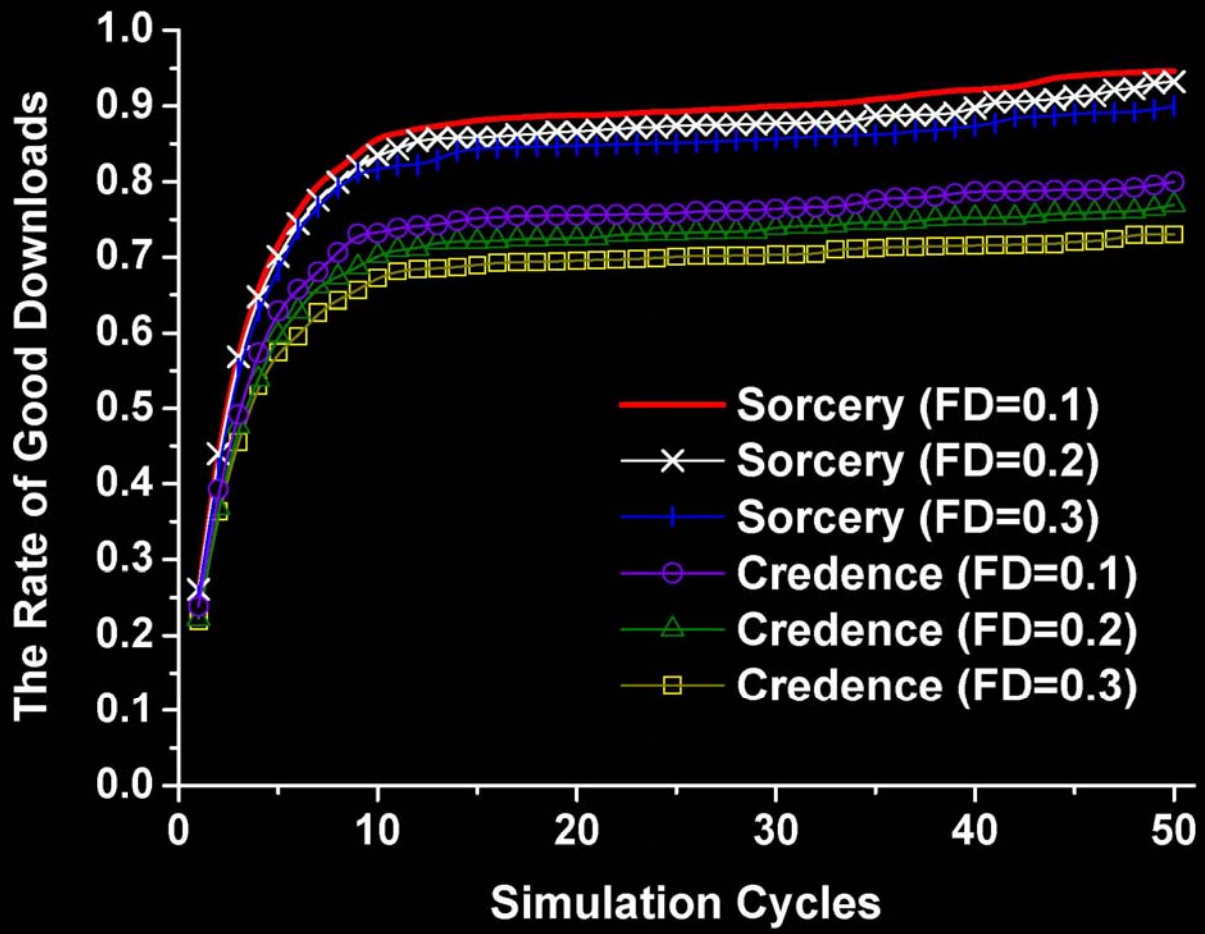
- Network Model: Gnutella Prototype
- Peer Model: 5, 000 Peers
- Social Model: Kleinberg Model
- Content Model:
  - 1,000 (Titles) X 500 (Versions) (50 good)
  - Zipf Distribution a=0.8

Evaluation

I Simulation Setup

II Experimental Results

Normal Deceivers



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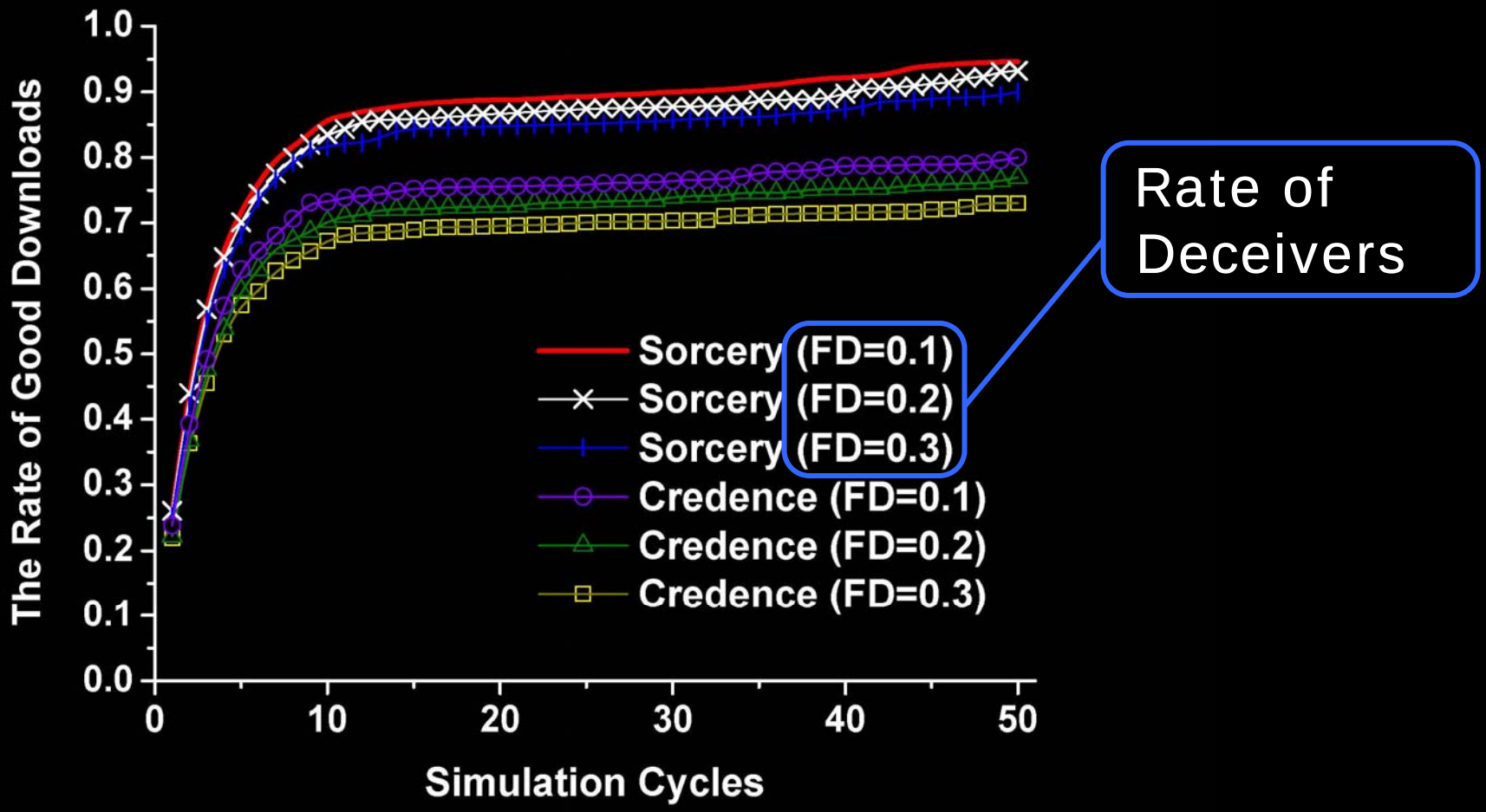

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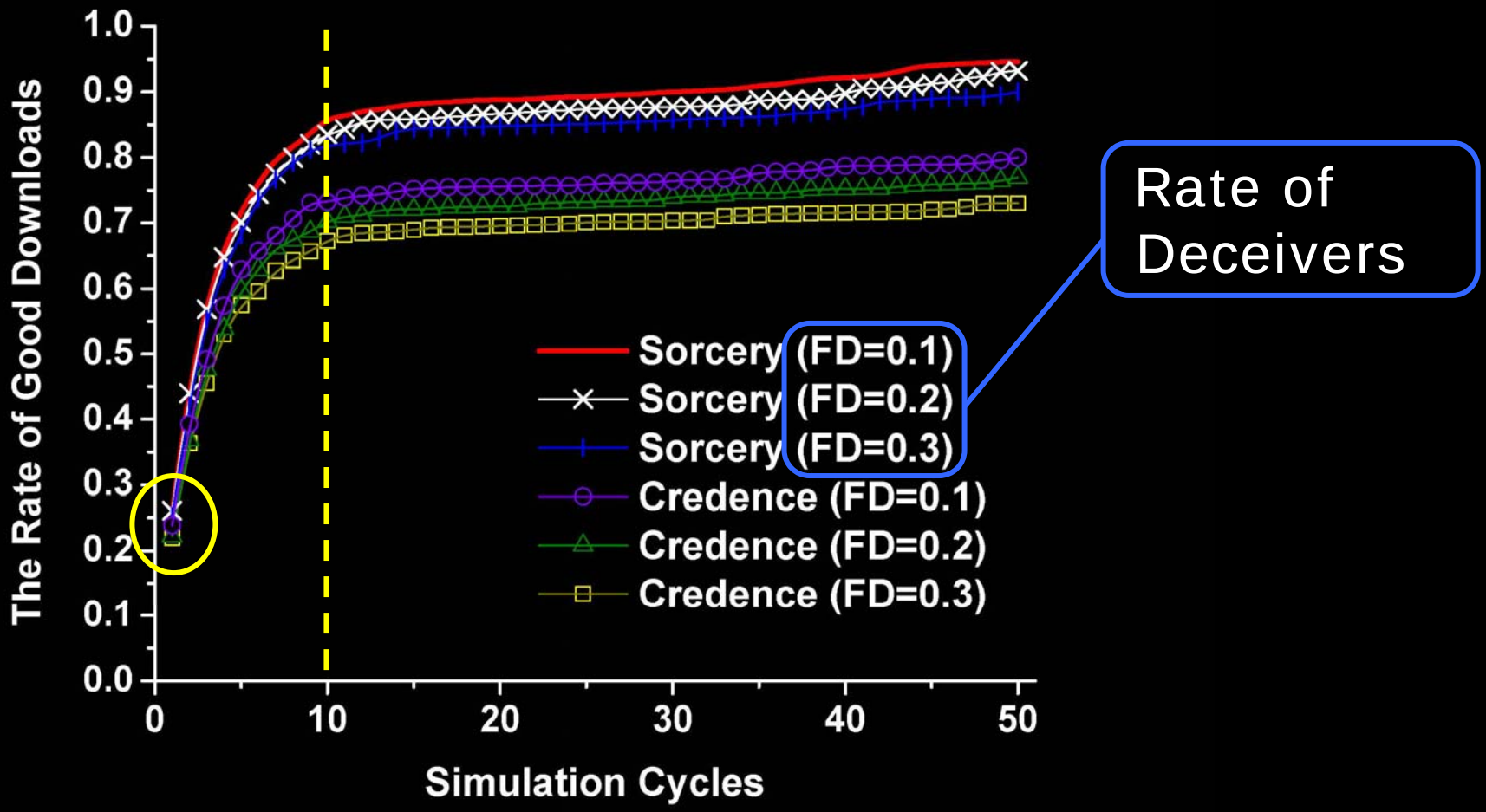
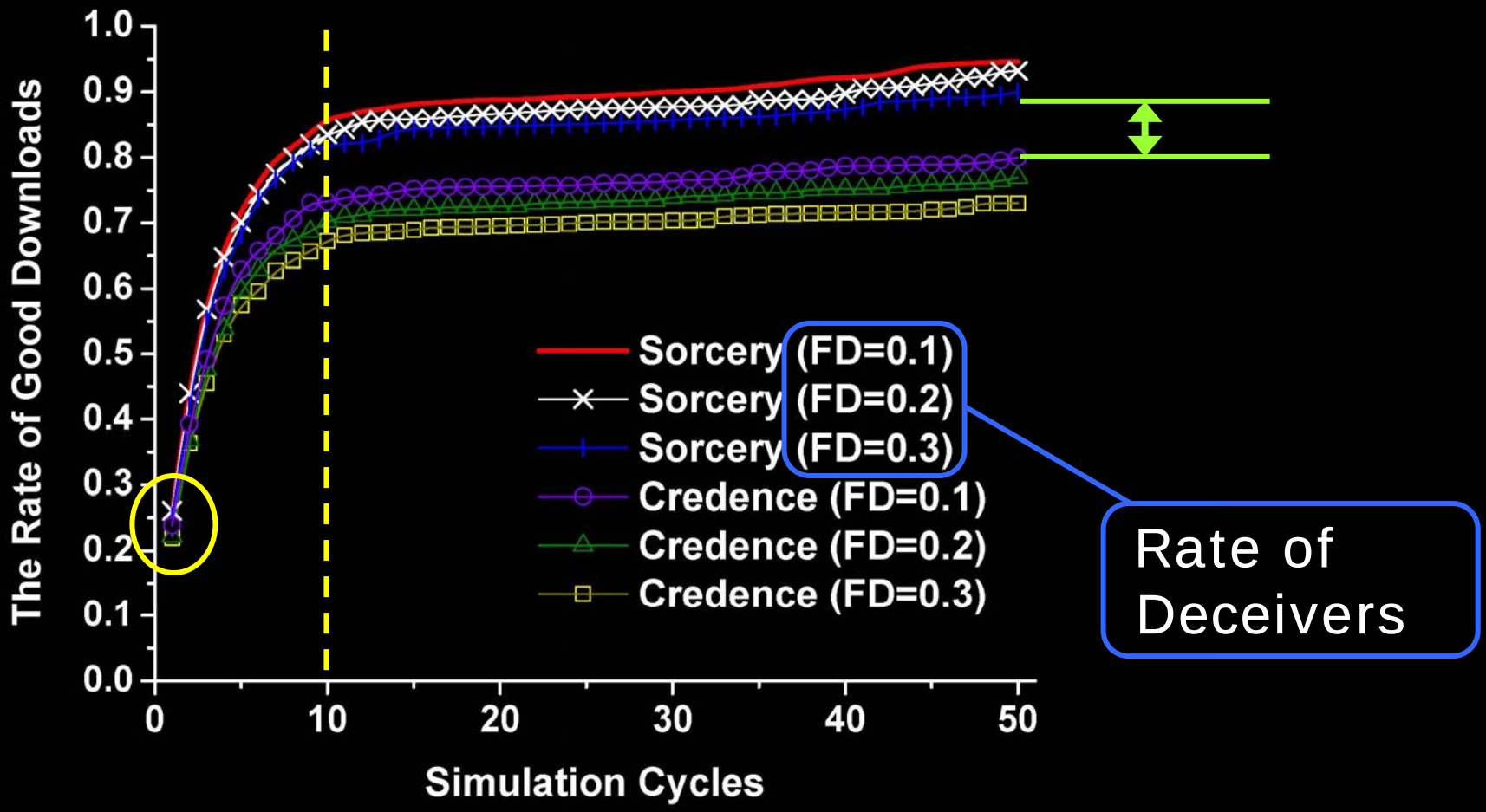
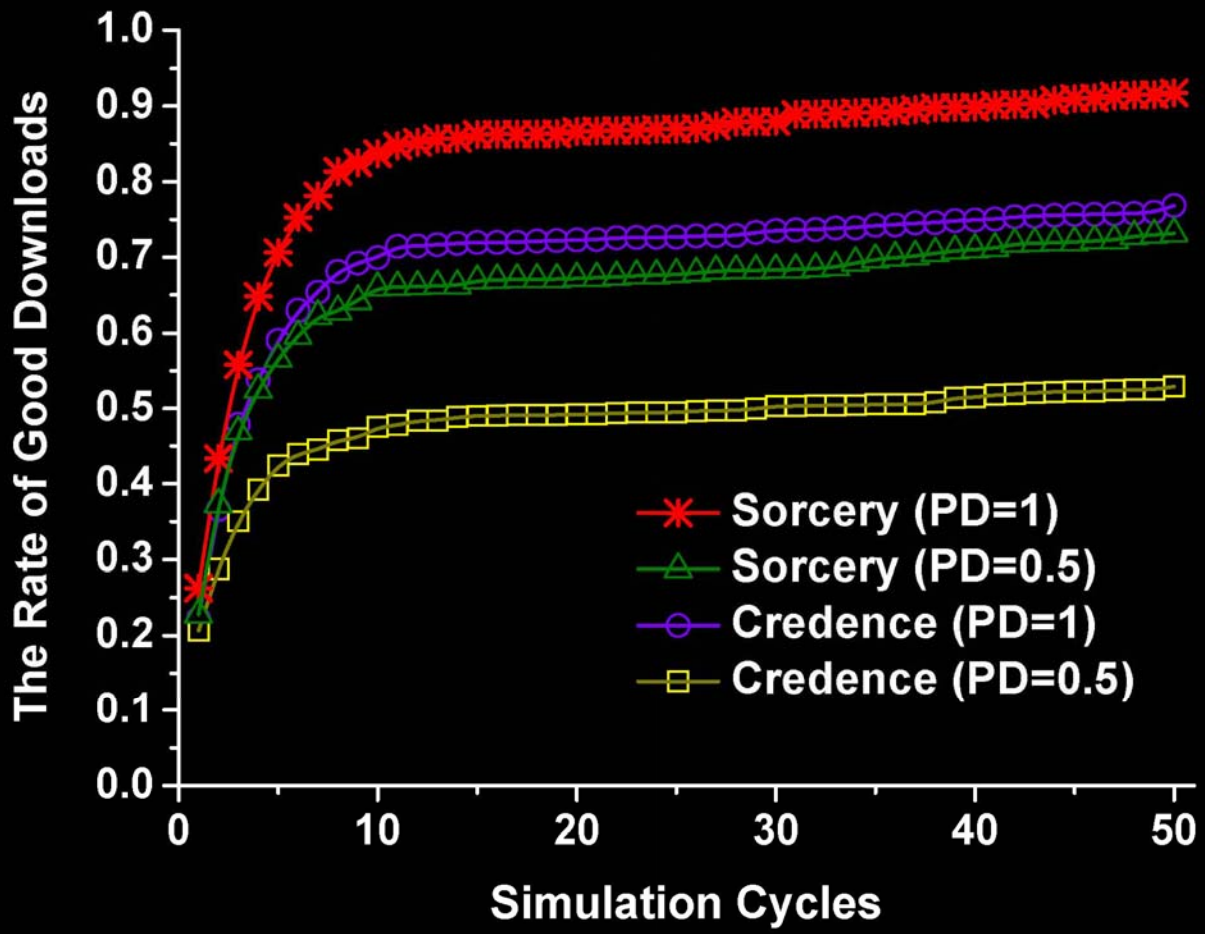


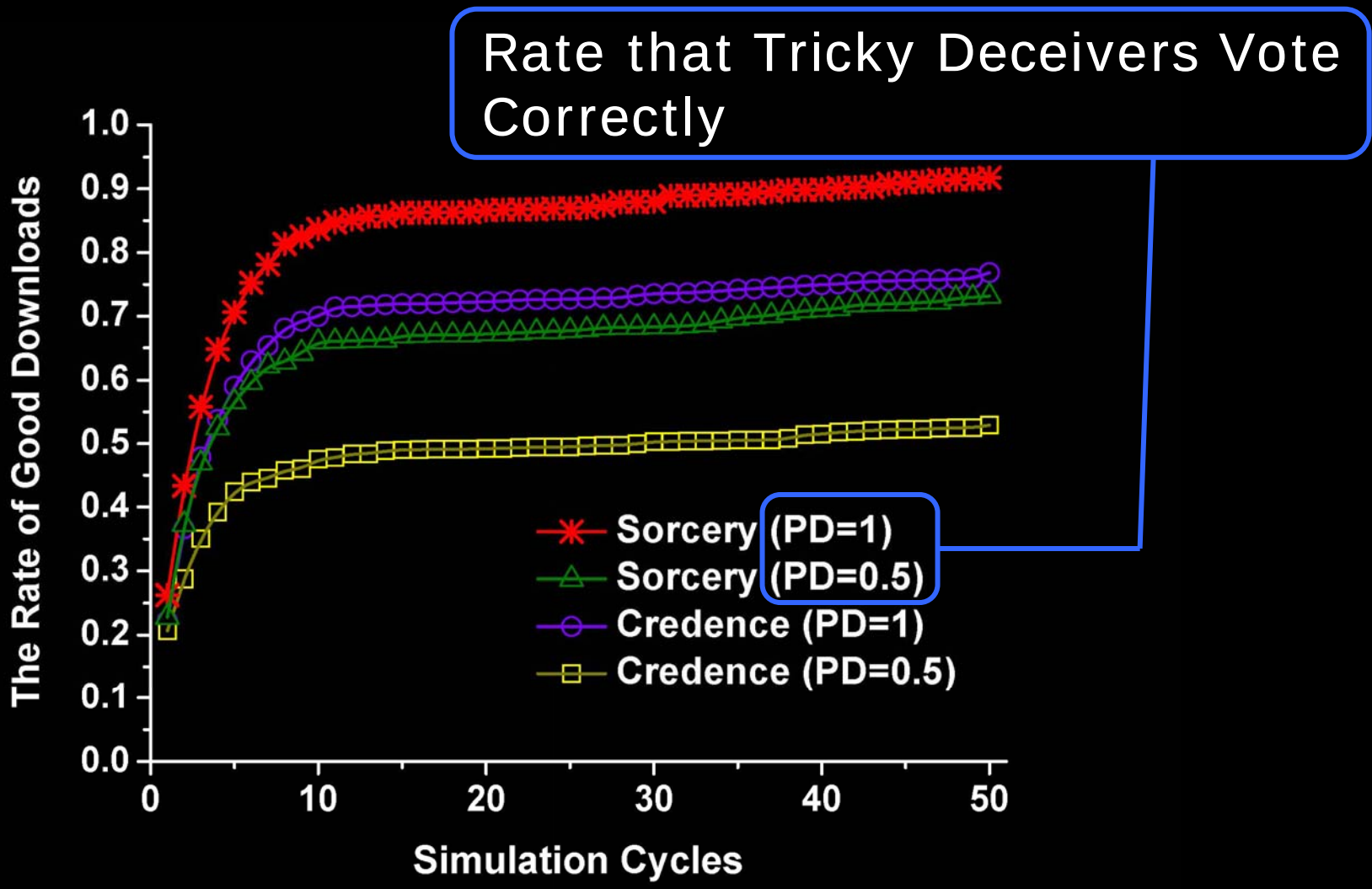
Normal Deceivers



Tricky Deceivers



Tricky Deceivers



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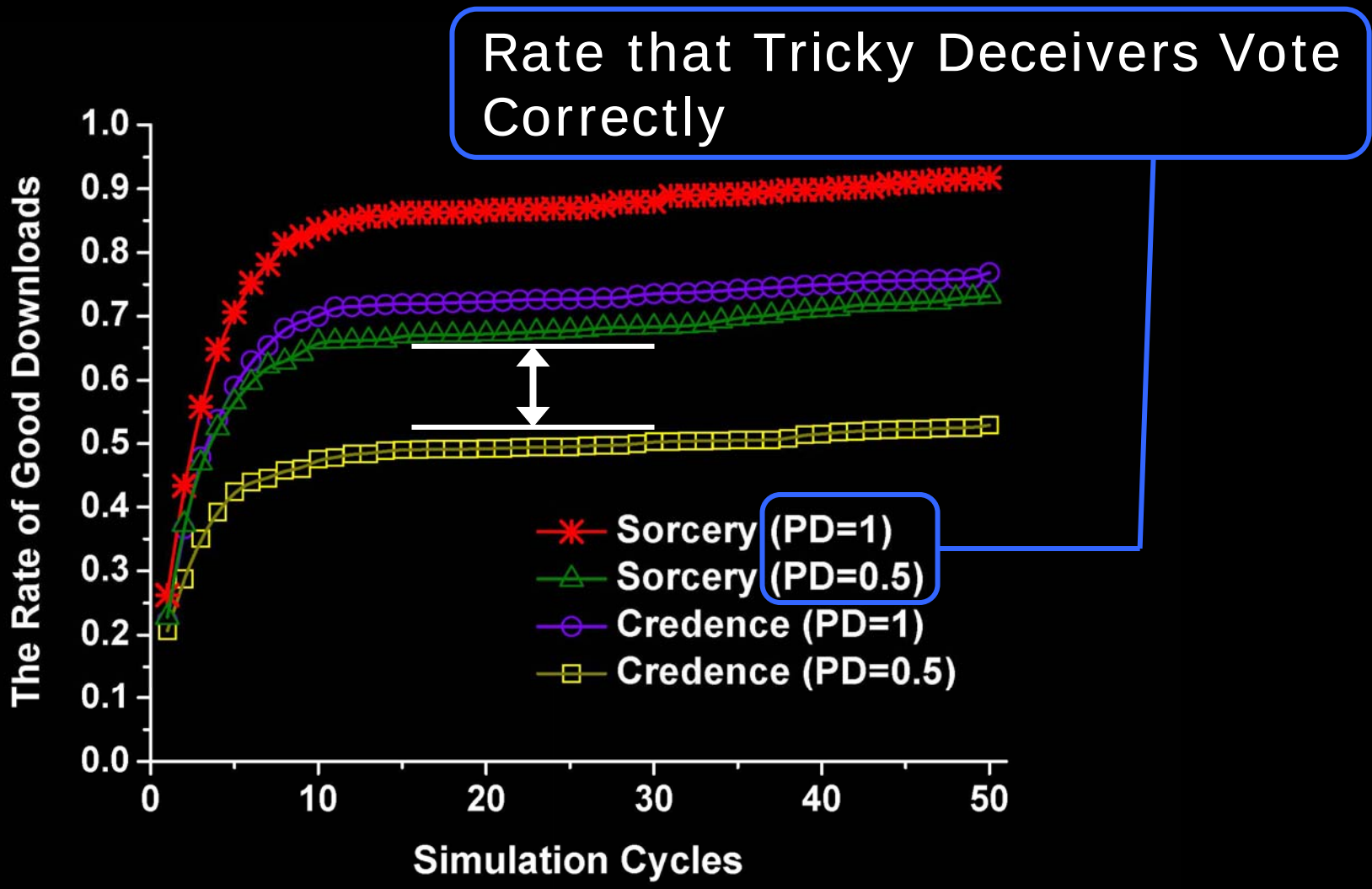

Conclusion and Discussion

- How to resist three types of attacks?
  - Man-in-the-Middle (MITM) Attack
  - Sybil Attack
  - Denial-of-Service (DoS) Attack

Q & A

Thank you !