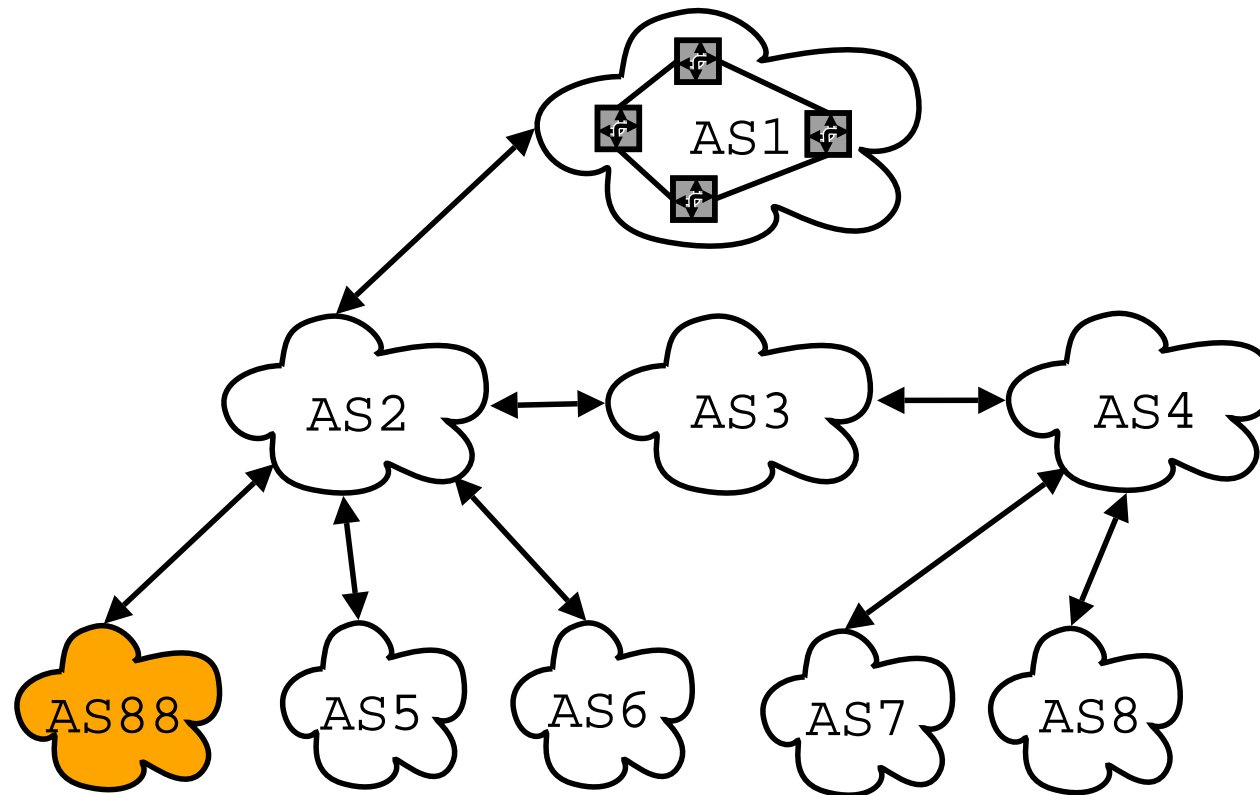# A Distributed Reputation Approach to Cooperative Interdomain Routing Protection

Harlan Yu, Jennifer Rexford, Edward W. Felten
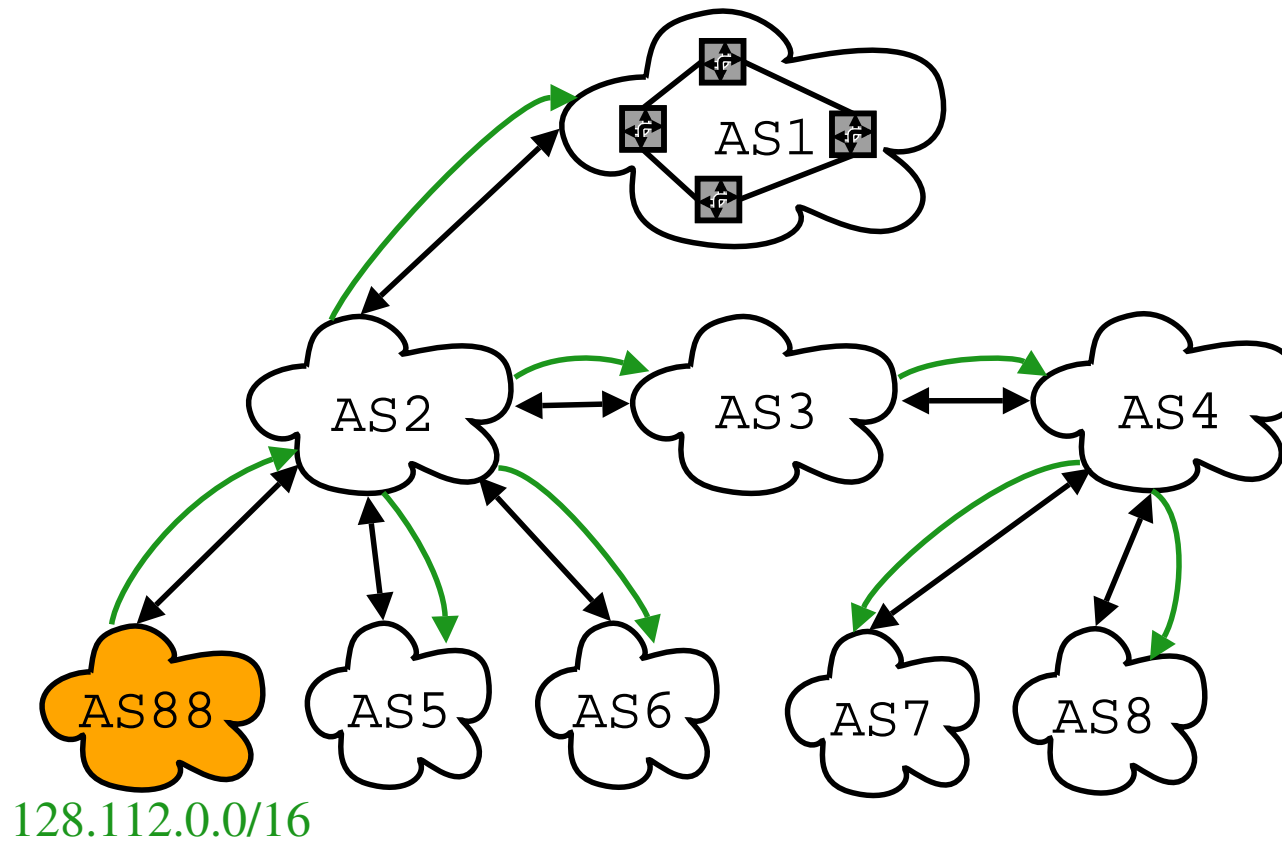
Department of Computer Science
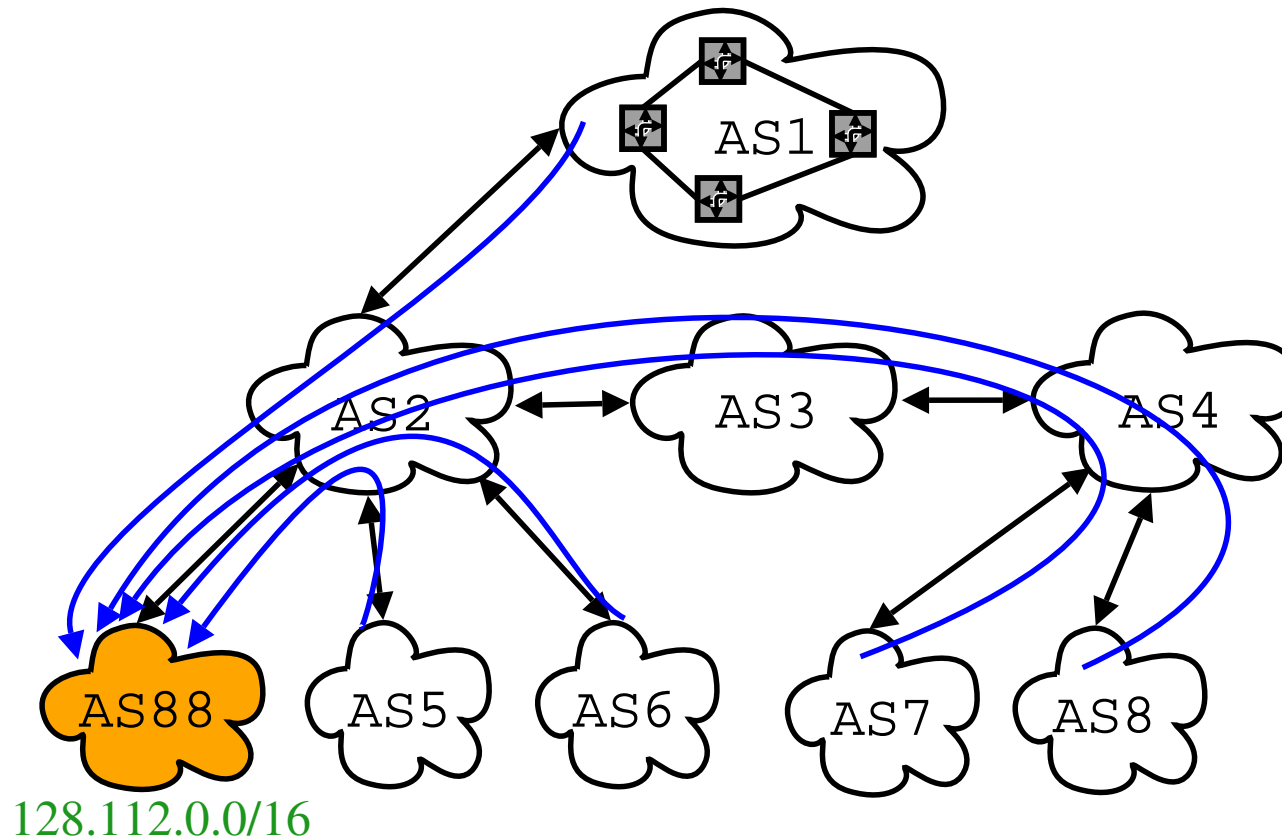Princeton University

BGP Interdomain Routing

- Border Gateway Protocol is vital to the Internet

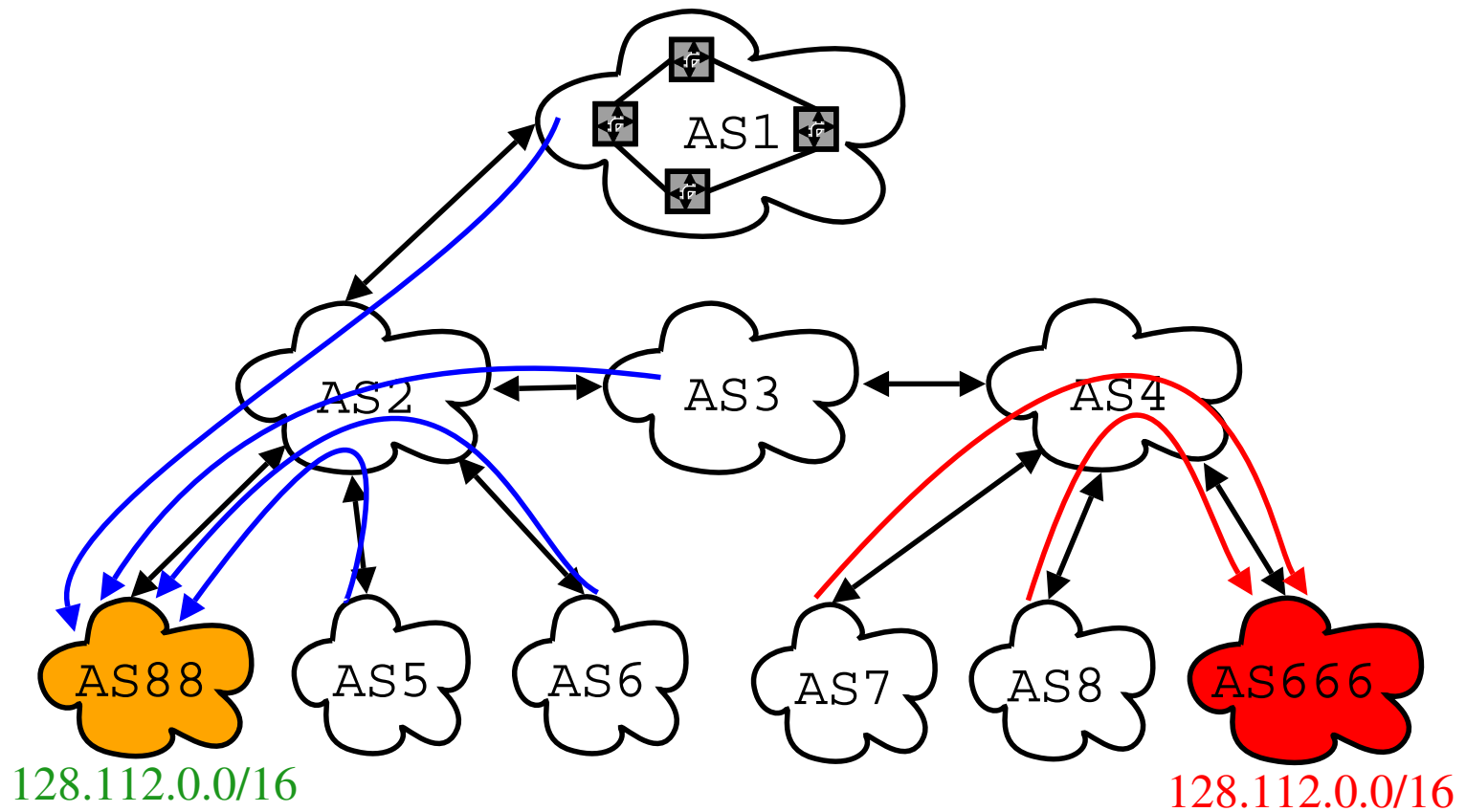# BGP Interdomain Routing

- AS88 (Princeton) announces it owns 128.112.0.0/16

BGP Prefix Announcement

128.112.0.0/16

- AS7 routes to 128.112.0.0/16 (7 → 4 → 3 → 2 → 88)

BGP Prefix Hijack

- AS666 maliciously announces it owns 128.112.0.0/16

Problem of Trust

- ASes blindly use advertised routes

- What if trustworthy ASes could cooperate?

  – Multiple vantage points for troubleshooting

  – Share existing local debugging results

- Can leverage existing real-world trust relationships

  – Personal relationships (i.e. NANOG)
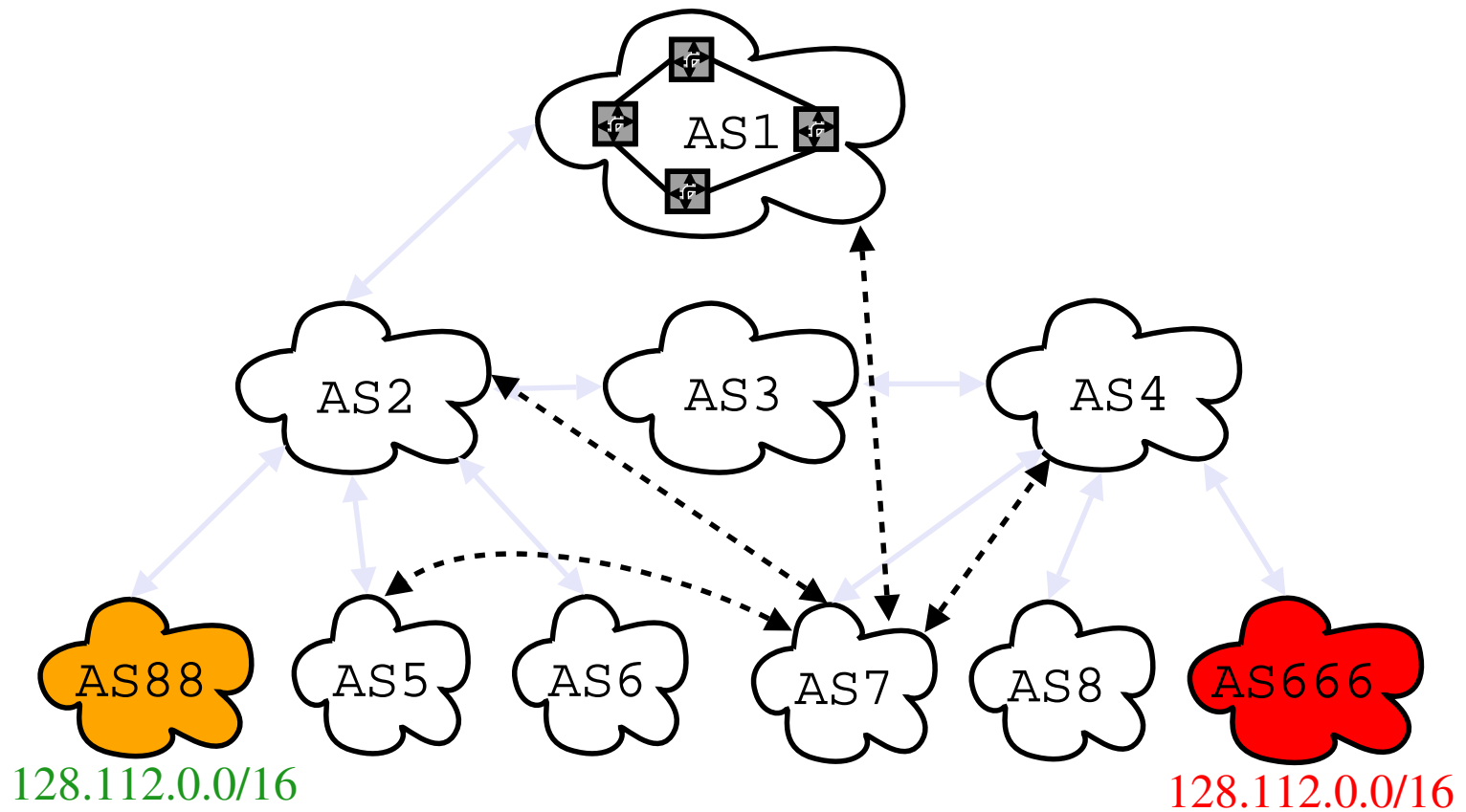
  – Institutional trust

Online Reputation Systems

- Most deployments:

  - Centralized model (eBay)

  - Focus on reputation of actors (people)

- Our work:

  - Decentralized peer-to-peer model (overlay network)

  - Focus on reputation of objects (BGP routes)
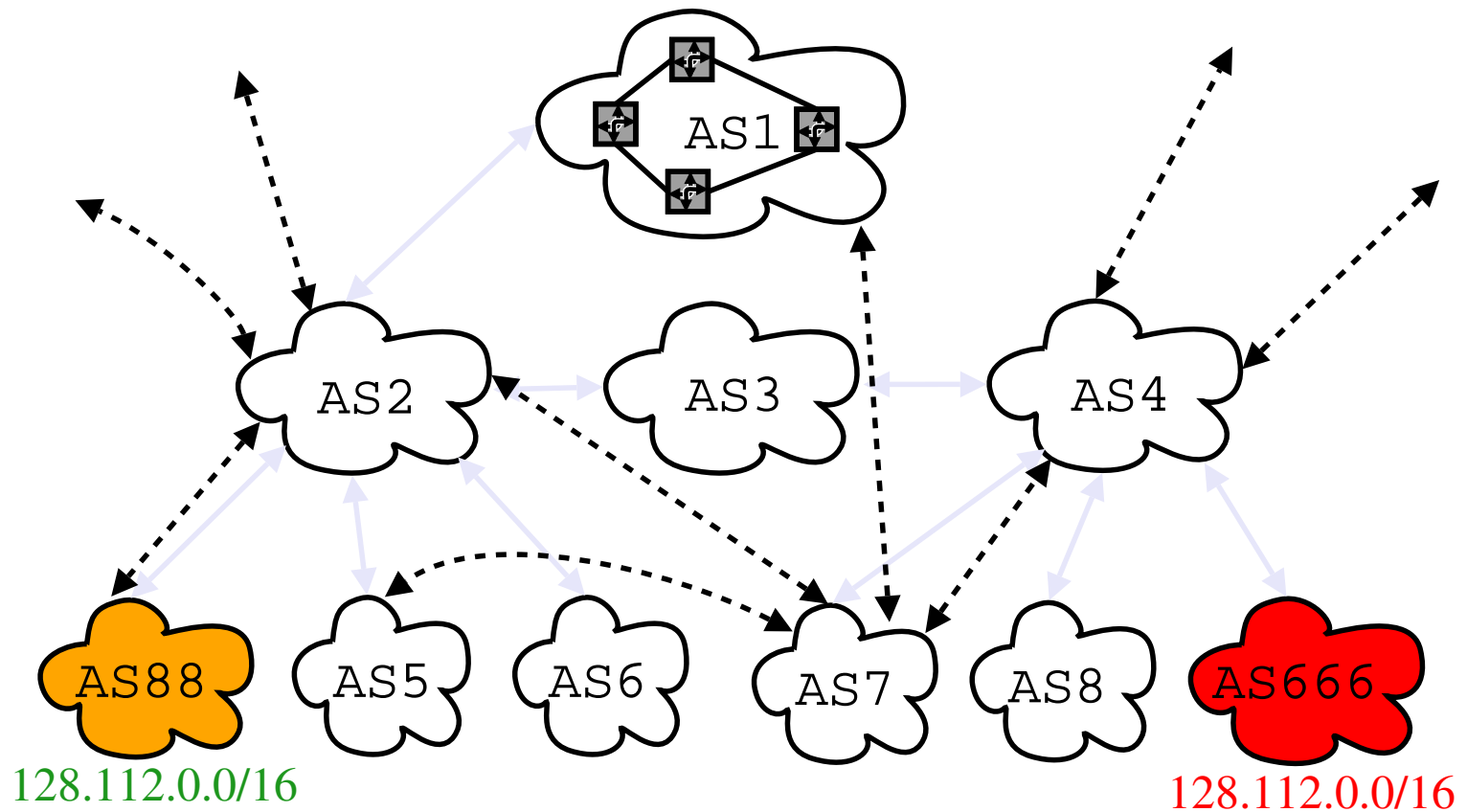
Proposed Architecture

1. Trust-based overlay network

2. Distributed voting protocol
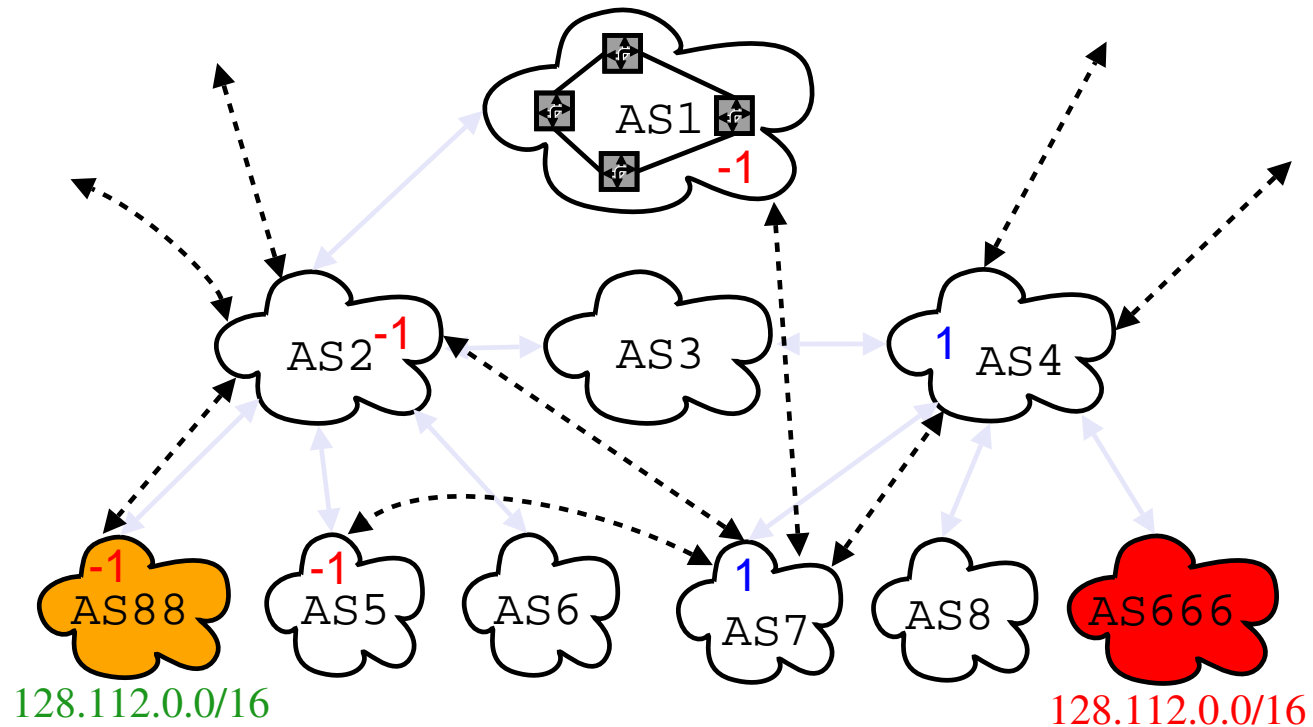
Trust-based Overlay Network

- Trusted links not confined to physical neighbors

9

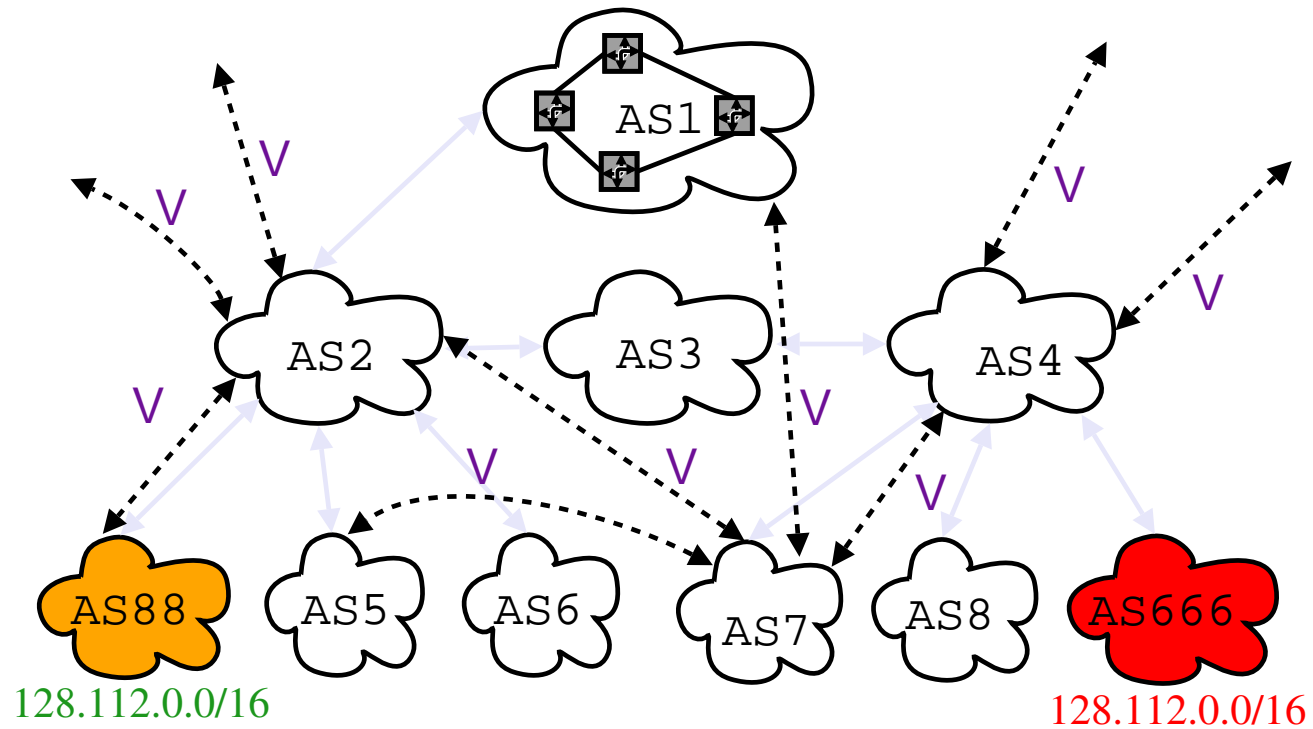# Trust-based Overlay Network

128.112.0.0/16

128.112.0.0/16

- Trusted links not confined to physical neighbors

Distributed Voting Protocol

- Vote on truth of propositions: {-1, 0, +1}
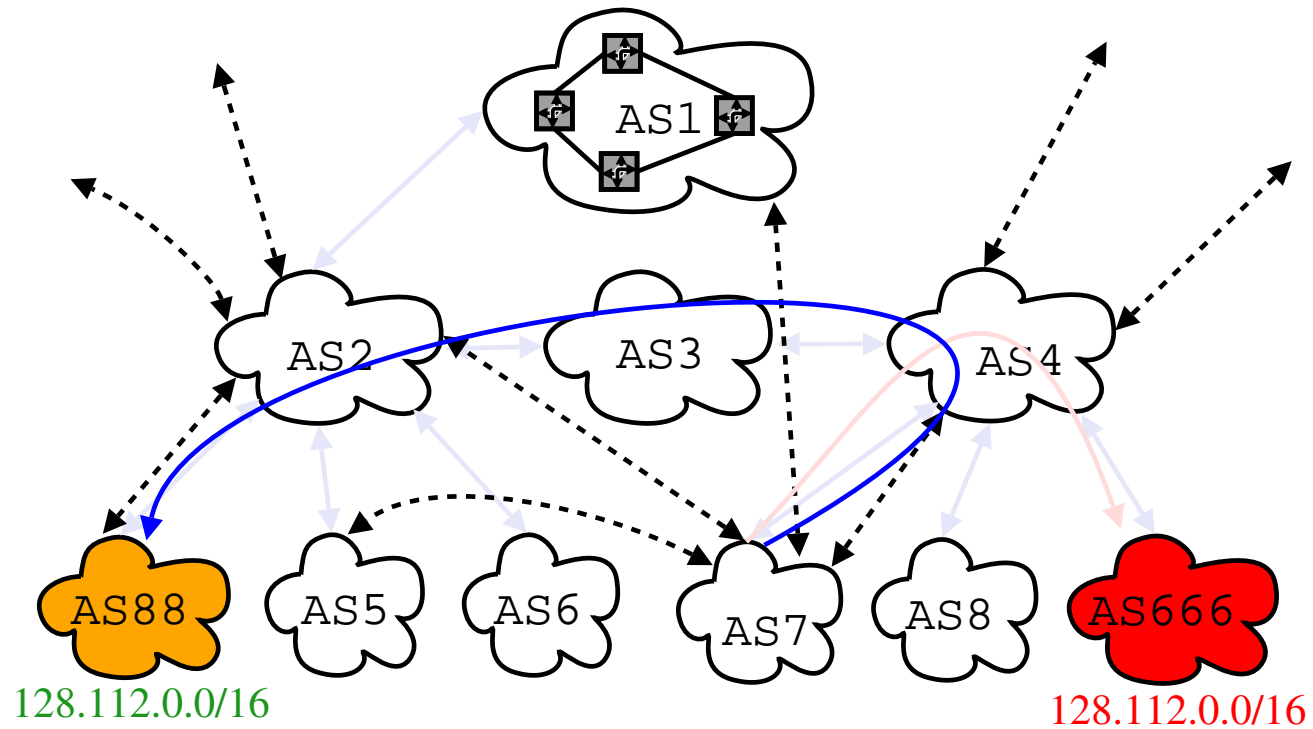 - "Can AS666 originate prefix 128.112.0.0/16?"

Distributed Voting Protocol

- Apply weight function on average of neighbors' votes

$$V = \alpha V_N + (1 - \alpha)V_{avg} \qquad (0 \le \alpha \le 1)$$

Distributed Voting Protocol

- AS7 recalculates V until convergence

- If $V \leq$ threshold T, re-install old route to AS88.

Advantages

- Difficult to shill the entire system

$$\alpha = 0.5$$

- Incrementally deployable

- Multiple vantage points
  - A shortcut to valuable debugging information

- Agnostic to the nature of the fault

- Automated router reconfiguration upon detection

Limitations

- Not inherently capable of detecting faults

- Possible to propagate false information

- Overlay network susceptible to the same faults

Summary

- Leverage real-world network operator trust relationships

- Build trust directly into the network architecture

- Distributed voting for cooperative information sharing

- Enhance ability to fix and avoid faults in BGP routing

A Distributed Reputation Approach to Cooperative Interdomain Routing Protection

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Questions?