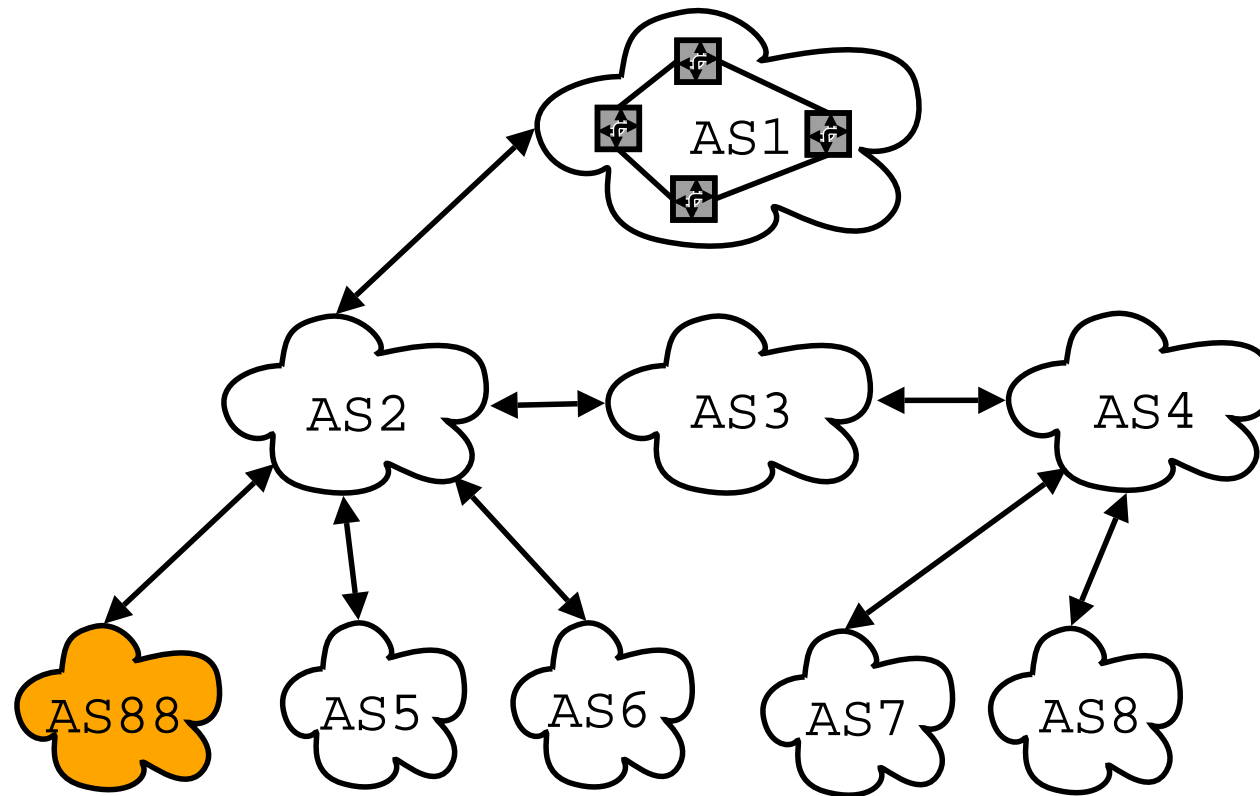


# A Distributed Reputation Approach to Cooperative Interdomain Routing Protection

Harlan Yu, Jennifer Rexford, Edward W. Felten

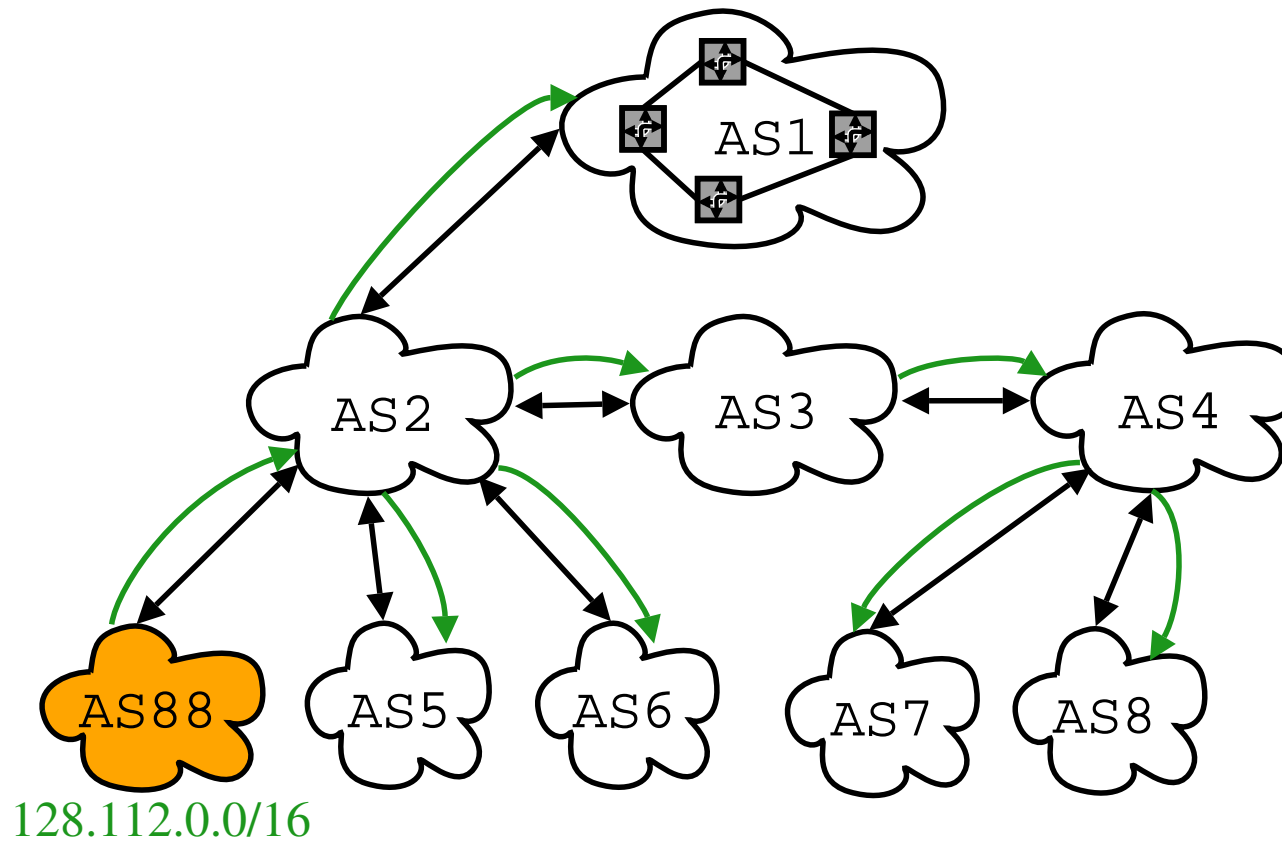
Department of Computer Science  
Princeton University

# BGP Interdomain Routing



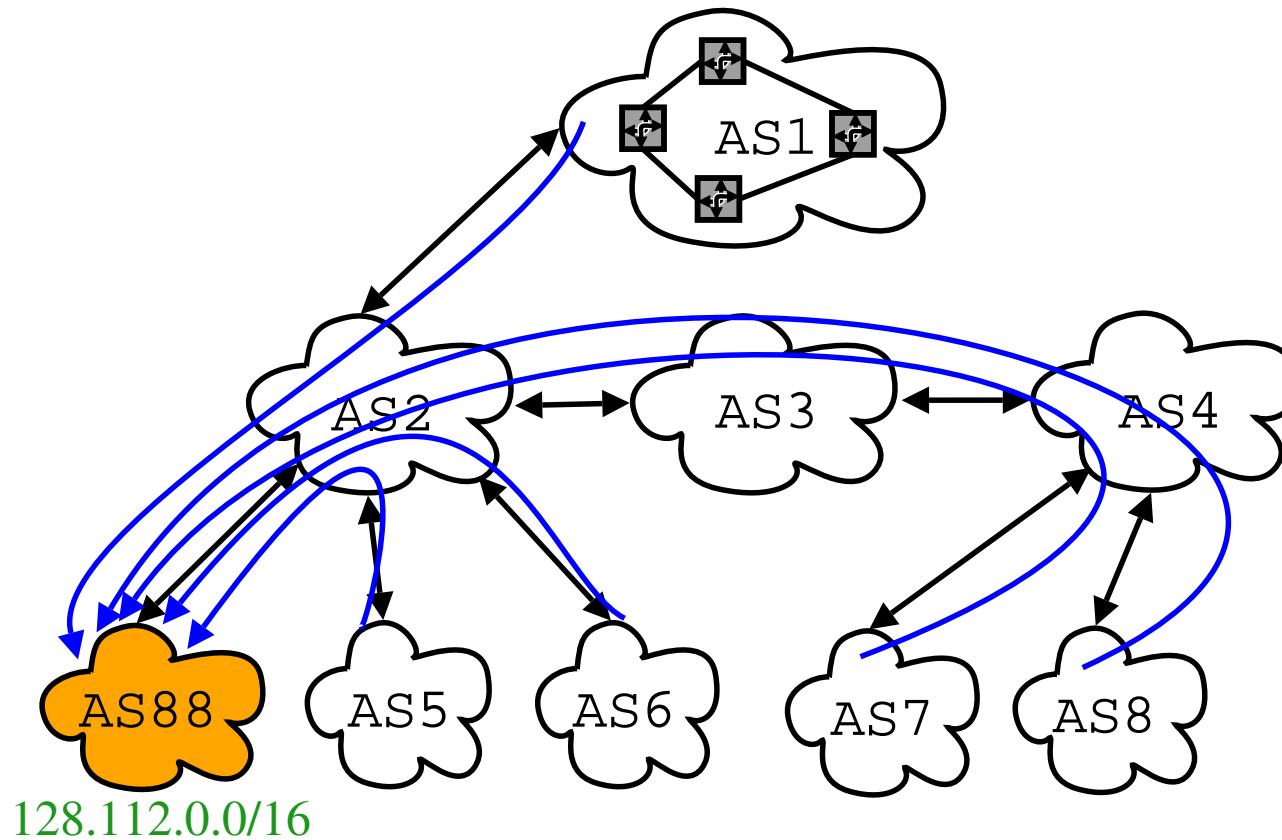
- Border Gateway Protocol is vital to the Internet

# BGP Interdomain Routing



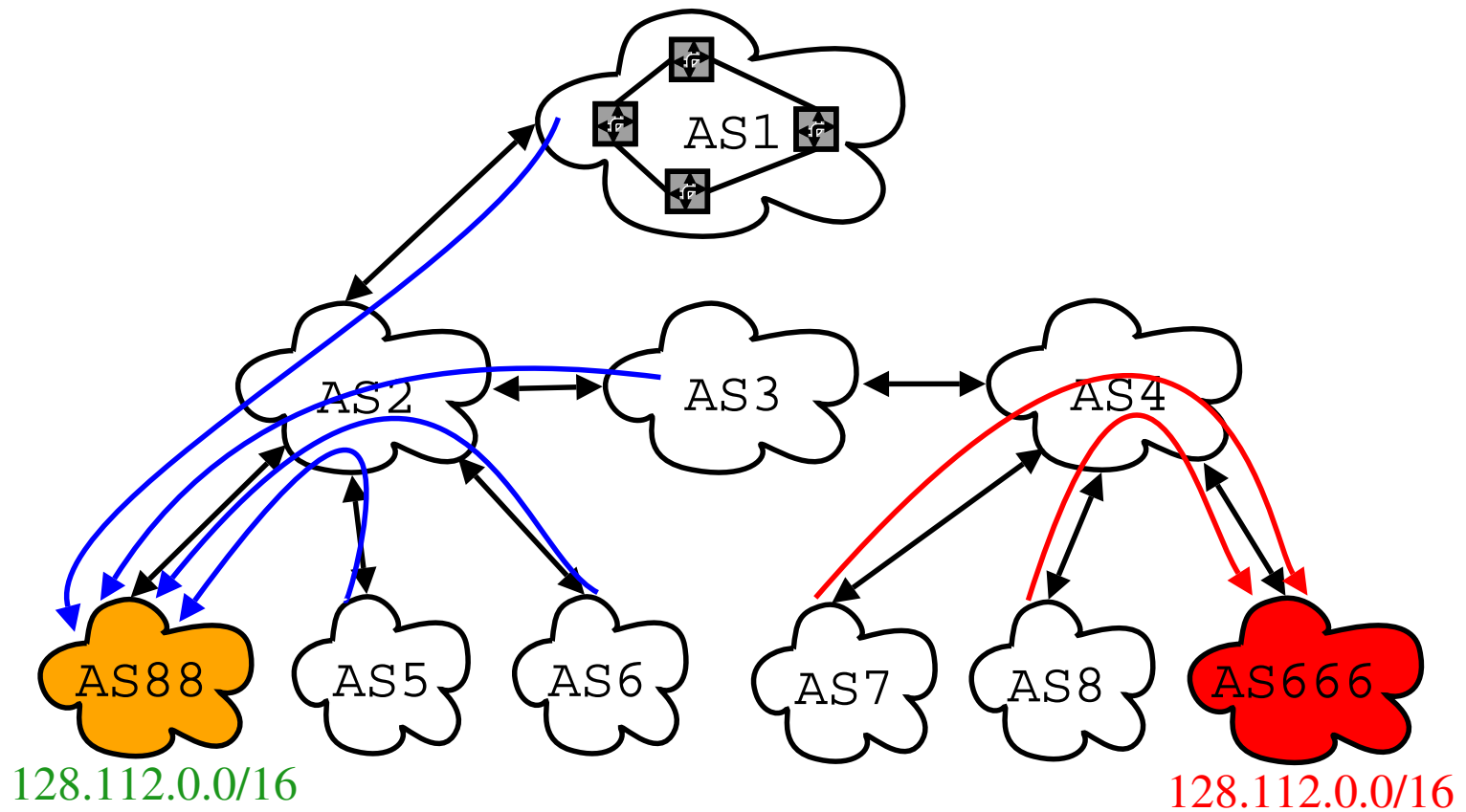
- AS88 (Princeton) announces it owns 128.112.0.0/16

# BGP Prefix Announcement



- AS7 routes to `128.112.0.0/16` ( $7 \rightarrow 4 \rightarrow 3 \rightarrow 2 \rightarrow 88$ )

# 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

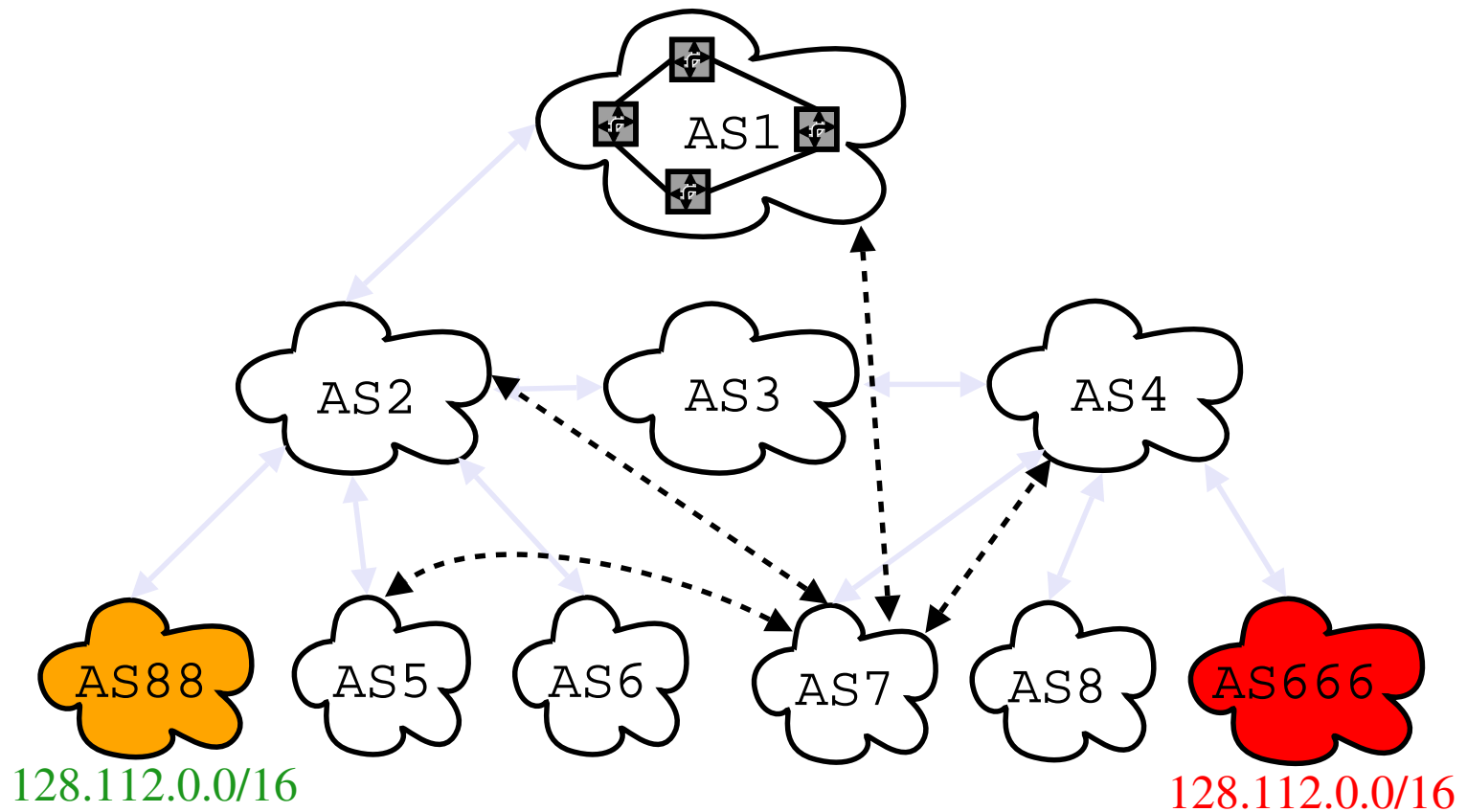
# Online Reputation Systems

- 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

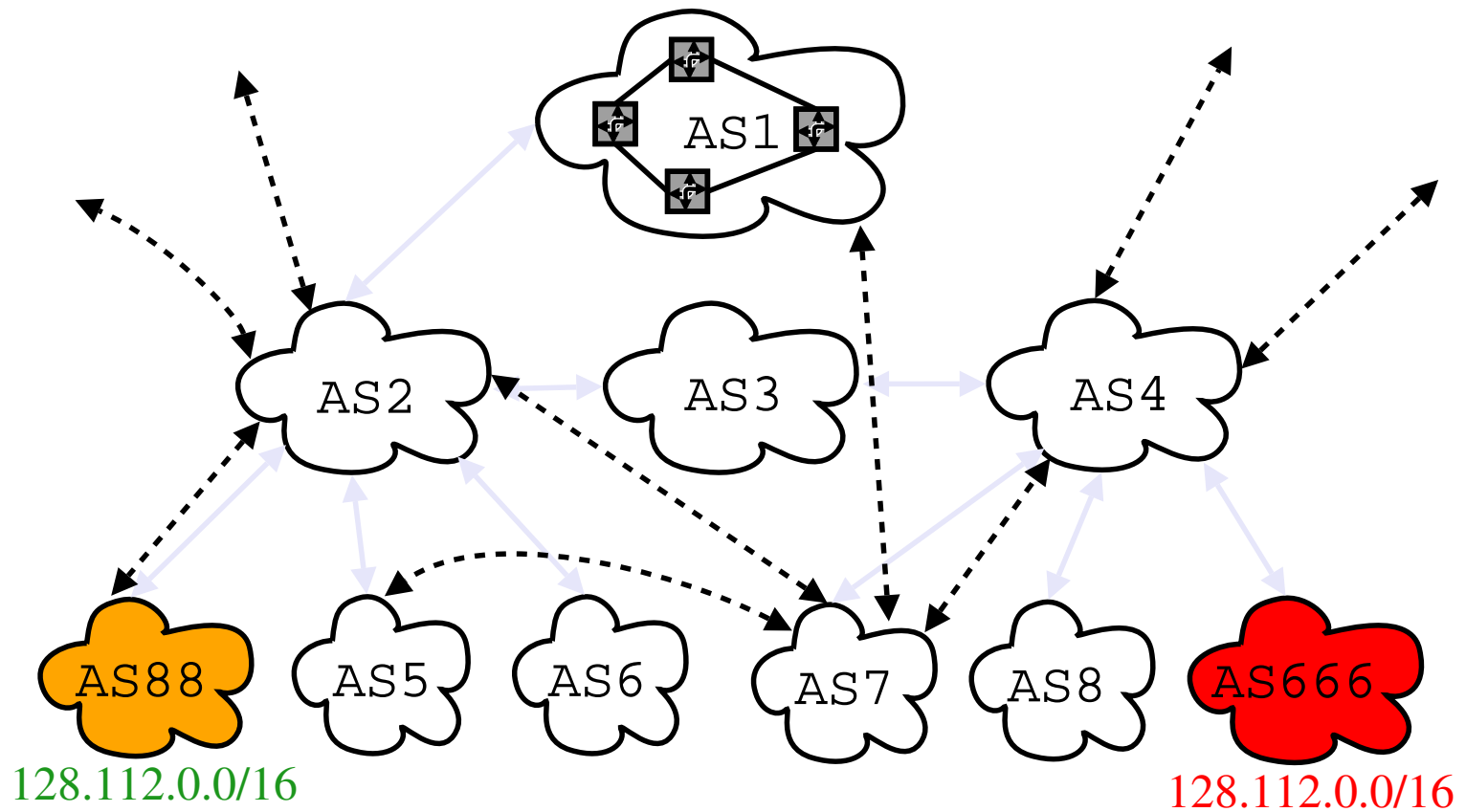
1. Trust-based overlay network
2. Distributed voting protocol

# Trust-based Overlay Network



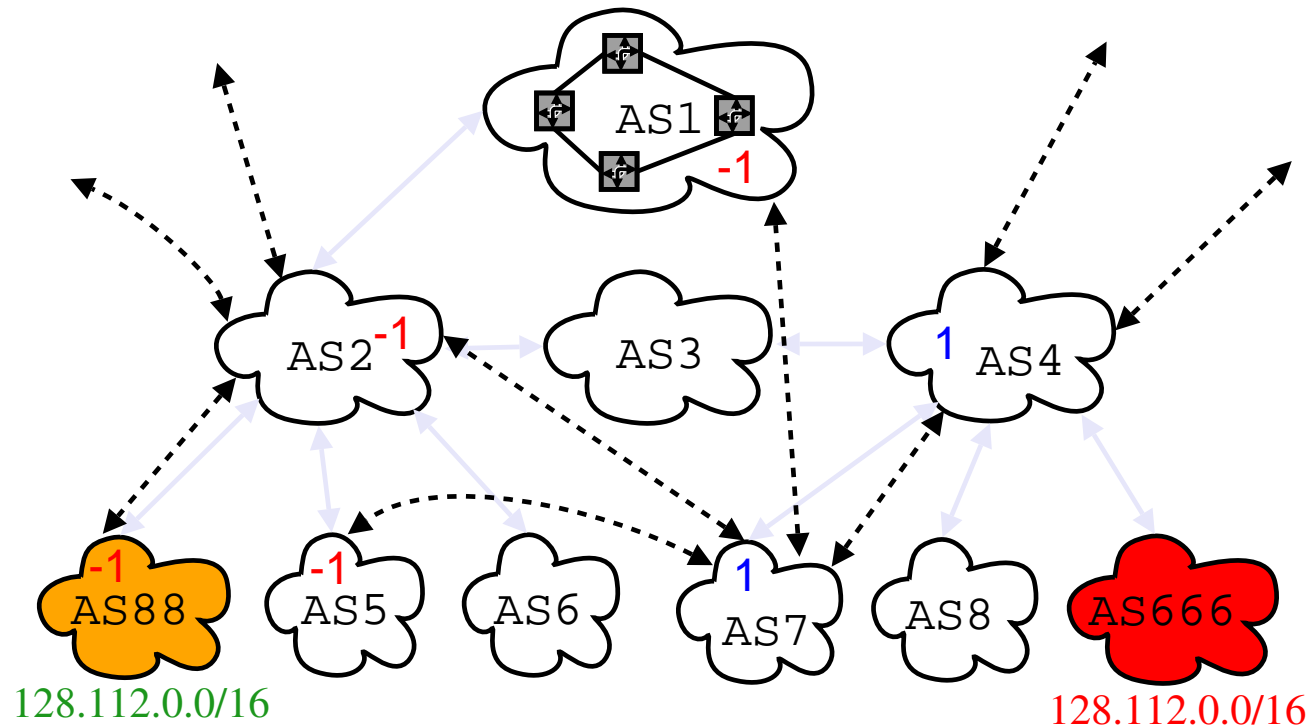
- Trusted links not confined to physical neighbors

# Trust-based Overlay Network



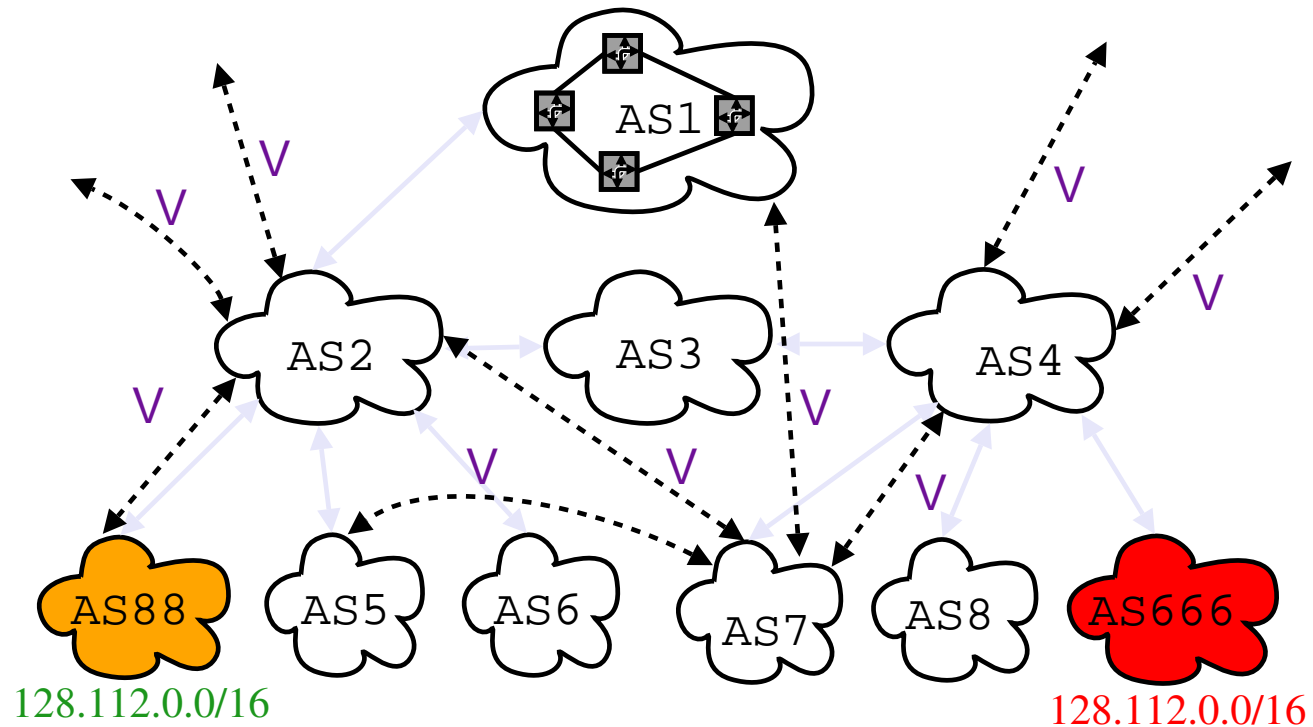
- Trusted links not confined to physical neighbors

# Distributed Voting Protocol



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

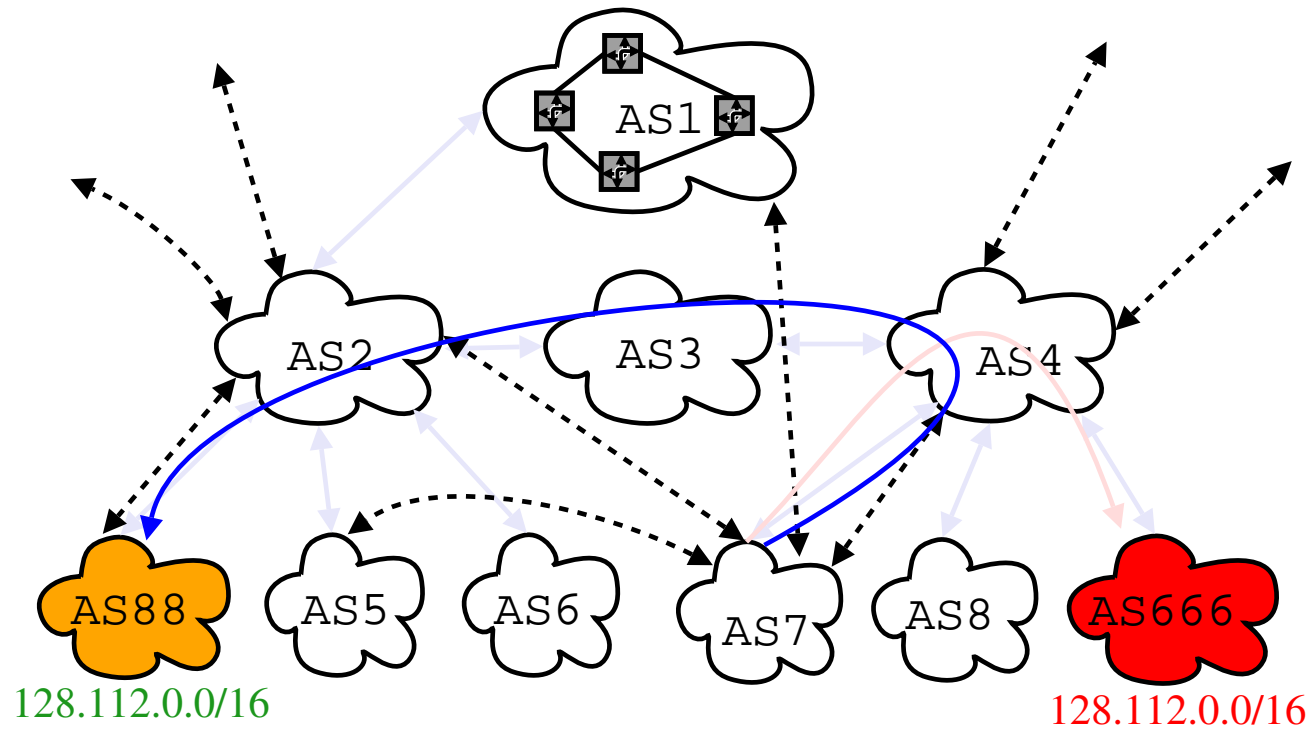
# Distributed Voting Protocol



- Apply weight function on average of neighbors' votes

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

# 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



- 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?