A Distributed Reputation Approach to Cooperative Interdomain Routing Protection

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BGP Interdomain Routing

- Border Gateway Protocol is vital to the Internet
AS88 (Princeton) announces it owns 128.112.0.0/16
BGP Prefix Announcement

- 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
• 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

\[ V = 1 \rightarrow 0.5 \rightarrow 0.25 \rightarrow 0.125 \]

\[ \alpha = 0.5 \]

- 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
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Questions?