BGP is not safe

- BGP is not guaranteed to converge on a stable routing. Policy inconsistencies can lead to “livelock” oscillations.
  See “Persistent Route Oscillations in Inter-domain Routing” by K. Varadhan, R. Govindan, and D. Estrin. ISI report, 1996
- BGP is not guaranteed to recover from network failures.

"What's it going to take?"

Static analysis of routing policies
Dynamic detection of policy-induced livelock

BAD GADGET

AS 1
as-path = [2,0] rank := 2
as-path = [0] rank := 1

AS 0
as-path = [3,0] rank := 2
as-path = [0] rank := 1

AS 2

AS 3
as-path = [1,0] rank := 2
as-path = [0] rank := 1
Two stable routing trees

as-path = [1,0] \(\Rightarrow\) rank := 2
as-path = [0] \(\Rightarrow\) rank := 1

as-path = [2,0] \(\Rightarrow\) rank := 2
as-path = [0] \(\Rightarrow\) rank := 1
This system has a unique solution, and a “TRAP”

BAD GADGET 1

Configured to oscillate only when AS 1 takes the direct route to d

Complexity Results

• REACHABILITY : “Can AS v obtain a route to destination d originated by AS w?” [NP-complete]
• ASYMMETRY : “Does there exist a routing in which the path from AS w to AS v is not the reverse of the path from AS v to AS w? [NP-complete]
• SINGLE DESTINATION SOLVABILITY : “Given a BGP system, having a single destination, does it have a stable routing tree?” [NP-complete]
• …