You can't handle the lie: Catching lying actors in the BGP protocol

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Abstract

In many BGP networks, nodes can get their preferred path by advertising a certain path, but forwarding traffic along another. However, in many of the example networks from the literature, other nodes can collectively detect these lies by comparing the route that is advertised (known by the node the manipulator lies to) to the route actually taken (known by the node the manipulator actually forwards traffic to). We want to study the conditions under which nodes can lie without being detected, as well as the economic incentives of other nodes to collaboratively check each other (such as providers helping customers detect liars).

1 In the [LSZ08] model, you can always catch a liar

Conjecture 1. *Suppose No Dispute Wheel holds, but route verification does not, and assume that the network is connected. Suppose that (assuming other nodes play truthfully) a node m can achieve a better path to d by announcing a route that does not exist to a node v. Let m's next hop in the manipulated routing tree be denoted r. Then there exists a path in the network, not containing m, between v and r.*

Proof. For the sake of contradiction, assume that all paths between r and v include m. One of r or v is on the "same side of m" as the destination node d. But the routing on different sides of m cannot directly effect each other, or at least that would be really weird.

It would be nice if I could make this precise before Friday.

□

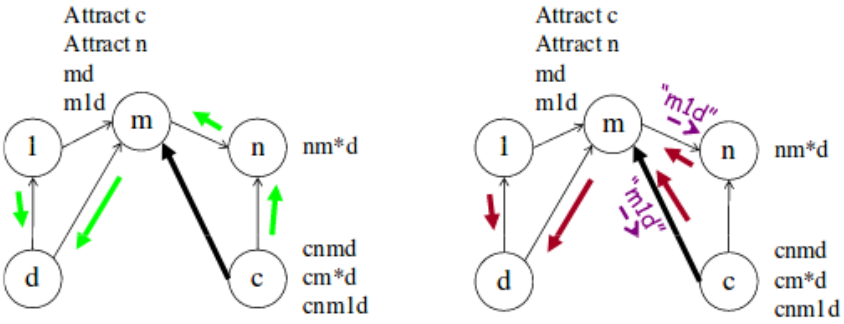
This means that, if all nodes other than m are fully collaborative and honest, the nodes will be able to detect m's lie by communicating along the links that already exist in the network.

(a) In the [GHJ+08] model, you can't

Consider Bowtie (figure 1), an example taken directly from [GHJ+08]. In this case, node m needs to lie to nodes c and n, but actually forward traffic to node d. The only nodes between

d and c (or n) pass through node m. Thus, the honest nodes cannot catch m in its lie solely using the communication channels provided by the network itself.

Figure 1: Bowtie

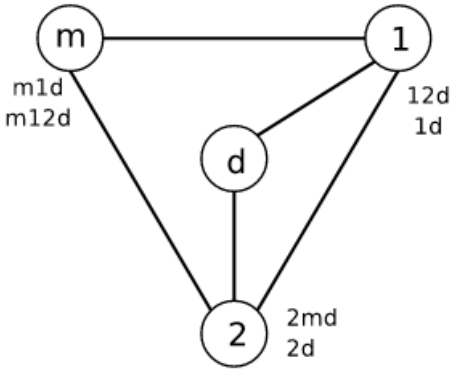


One objection may be that real-life networks are much more highly connected than the small counterexamples presented in these papers. However, we believe that very small sets of nodes surrounding the adversary m can reasonably model the set of nodes that actually *care* enough to try and catch m lying. Thus, it makes sense to ask if small subnetworks can catch m communicating only along links among themselves.

2 But will you?

Figure 2 shows an example network, taken directly from [LSZ08], where m has an incentive to advertise a path that does not exist. We regard this network as the canonical example of Conjecture 1. Indeed, node 1 can inform node 2 that it is receiving traffic from m, so 2 will know that m is lying about its path.

Figure 2: Nonexistent



This example is a Gao-Rexford network, for suitable customer-provider relationships.

However, as discussed in [LSZ08], node 1 is a customer of node 2[1]. Thus, it is not reasonable to assume that 1 will want to help 2 detect the lies of m, because 1 does not perform services for its provider 2.

References

[GHJ+08] Sharon Goldberg, Shai Halevi, Aaron D. Jaggard, Vijay Ramachandran, and Rebecca N. Wright. Rationality and traffic attraction: Incentives for honest path announcements in bgp. In *Proceedings of the ACM SIGCOMM 2008 Conference on Data Communication*, SIGCOMM '08, pages 267–278, New York, NY, USA, 2008. ACM.

[LSZ08] Hagay Levin, Michael Schapira, and Aviv Zohar. Interdomain routing and games. In *Proceedings of the Fortieth Annual ACM Symposium on Theory of Computing*, STOC '08, pages 57–66, New York, NY, USA, 2008. ACM.

[1]Note: I don't actually know if this is forced...