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

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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).

Our thinking is primarily based on the routing games model of [LSZ08], where node's objectives are simply to get better paths to a destination. Additional consideration is given to the model of [GHJ$^+$08], where nodes seek to attract traffic as well as get better paths.

1 Definitions

We follow the model of [LSZ08] and [FSS07], and start with the following model.

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

Intuitively, if a node lies to get a better path, the node it lies to and the node it routs through must be connected. The following conjecture, which we hope to prove formally, makes this precise.

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. Moreover, no node along this path benefits from the manipulation performed by m.*

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. There must be a path from r

to d not containing m, because m cannot appear twice on it route to d in the manipulated tree. Thus, every path from v to d must contain m.

Let T denote the original routing tree, and for each node n let T_n denote the path n receives to the destination. Let M_n denote the advertised route that n selects in the manipulated routing tree, i.e. the route n believes it receives, while $\widetilde{M}$ is the actual manipulated routing tree and $\widetilde{M}_n$ is the actual route n's traffic follows. Note that the path M_n need not actually exist in the graph. □

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.

References

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