

Modeling as a necessary step to understand Internet-wide route propagation

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Internet-wide routes propagation

- Claim: BGP convergence can be slow [Labovitz et al. SIGCOMM'98&00]
- Causes of routing dynamics: network engineering, flapping links, traffic engineering, misconfigurations,...
- Causes of “slow” BGP convergence: Internet size, CPU load, BGP timers, route flap damping [Agarwal et al. PAM'04, Feldman et al. PAM'04]

BGP measurements

- Locating instabilities is hard, finding out what happened even harder [Feldmann et al., SIGCOMM'04]
- Studying individual ASes does not help much quantifying AS-wide routing dynamics [Agarwal et al. SIGMETRICS'04] [Teixeira et al., SIGMETRICS'04] [Rexford et al., CCR'05]
- Studying interactions between ASes is one first step towards understanding Internet-wide BGP behavior, but impeded by getting data about routes that cross AS boundaries
- How much can we infer of the propagation of the routes that we observe?

Beyond measurements with simulated Internets

- Building models of Internet route propagation:
 - build a model of the Internet you care about
 - replay how routes propagate
 - analyze the factors that matter (topology, policies, attributes,...)
- Modeling gives flexibility:
 - define the level of details you care about: ASes, iBGP, peerings,...
 - stick to a set of prefixes and ASes
 - control the factors that you want to study (policies, peerings, iBGP,...)

Beyond measurements with simulated Internets

- Example: reproduce the propagation of observed AS paths [Muhlbauer et al., SIGCOMM'06]
 - Originate routes from observed origin ASs on one router per AS topology
 - Propagate shortest paths unless longer one has to be observed (then introduce policy)
 - Split AS when several paths have to be observed
- Lessons:
 - Propagating observed paths is possible
 - Predicts nicely unobserved paths (during model building)
 - Lot of choice in how to set policies and define AS granularity

Beyond measurements with simulated Internets

- Building models of Internet requires reverse-engineering the Internet: reproducing outcome is not enough, what caused the outcome matters!
- What is the right granularity for:
 - Topology: ASes, routing domains, and routers
 - Policies: multiple peerings, filtering performed on peerings
- The right granularity of an Internet model will depend on what you want to do with it. So first we need to try different models and see what insight they bring.