Simulating Convergence Properties of BGP

September 2002

Luleå University of Technology

Lenka Car-

Motyková

Johan Nykvist

Simulating Convergence Properties of BGP
Overview

- The Border Gateway Protocol
- The routing simulator
- Some experiments and results
- Conclusion and future work
Border Gateway Protocol Version 4 (BGP)

• Exterior Gateway Protocol

• Path-vector routing algorithm

• AS-path used for routing loop prevention and policy decisions

• Update messages with announcements and withdrawals, carried over TCP

• MinRouteAdvertisement Interval (MRAI) is the maximal sending rate for announcements (default is 30 sec.)

• Border Gateway Protocol Version 4 (BGP)
Therouting-simulator - RouteSim

- Less implementation → easier to change
- Less details → more scalable

BGP model with a high abstraction level

Implemented in Java

Discrete-event system simulator

Reasons for delayed convergence

Examining complexity of routing information exchange and different
Translating delay with jitter over the links

CPU processing delay with jitter in the routers

One router per AS

Above TCP/IP, only at the routing control plane

BGPS routers, links (conections) and update messages

The routing simulator - simulation model
Work by Labovitz et al.

- Proposed the sender side loop detection (SSLD) mechanism
- Claimed to shorten convergence time
- Route bouncing occurs at route failures and fail-overs.

Proposed MRAI limits the amount of route bouncing.

- In clique topologies of size $u$, use of MRAI gives $O(\log u)$ rounds.
- Without MRAI, convergence complexity is bounded by $O(n^\Delta)$
- Conforms message exchange into "rounds"
- Clique topology is the worst case.
Simulation setup

- The routers are connected in a clique topology
- Processing latency set to \( U(0.01, 1.0) \) seconds
- Link latency set to 0.01 seconds
- Convergence time and no. of messages is measured
- The route is first announced and then withdrawn
- The route is first announced and then withdrawn

7
Temporal view of route bouncing

MRAI: 30 sec.

MRAI: 0 sec.

No. messages/s

Time (s)
Number of messages vs. MRAI - synchronized timers
Convergence time vs. MRAI - synchronized timers
Convergence time vs. MRAI - Randomly Skewed Timers
Number of messages for different mechanisms
Convergence time for different mechanisms
Simulation shows that in a clique topology:

- Timer skewing does not affect the time-optimal value for MRAI.
- SH and SSLD decrease the number of withdrawal messages.
- SH and SSLD increase the number of announcement messages.
- SH and SSLD decrease the convergence time.

- The total no. of messages is not greatly affected by SH or SSLD.
- The effect of SSLD is greater than that of SH.

Simulations show that in a clique topology:
Future work

- Run simulations with more realistic topologies and routing policies
- Examine the path history mechanism
  - Route flap dampening, etc.
- Extend simulator with more mechanisms, such as route filtering
- Survey of "real" BGP implementations