Internet Topology Generation for Large Scale BGP Simulation

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Outlook

- BGP: Border Gateway Protocol
- Large Scale Simulation: motivations
- Large Scale BGP Simulation Model
  - Realistic Topologies Generation
- Conclusion and future works
BGP, Interdomain Routing Protocol

- Internet Routing Hierarchy
- Interdomain routing protocol: BGP
- BGP routing domains: Autonomous System (AS)
- Messages exchange between AS: routes announcements and withdrawals
- Independent paths choice (routing policies)
- IBGP: inter-AS BGP communication
BGP Vocabulary

Autonomous System
BGP Vocabulary

BGP Speaker

Autonomous System
BGP Vocabulary

Autonomous System

BGP Speaker

IBGP Session

BGP Session

Peers
Interdomain Routing Instability

- Routing Instability: Fast changes of networks accessibility and topology information
  - BGP slow convergence (inherent)
  - Theoretical Persistent routing oscillation (observed)
  - Sensitiveness to traffic fluctuations (observed)
- May impact user traffic and routing infrastructure
- Worms (Viruses) propagation effects on BGP routing
- Need to simulate proposed interdomain solutions to validate their implementation in real world network
Why large scale Simulation?

- Several proposed enhancements to BGP:
  - Grapevine-BGP, Ghost flushing, Consistency assertions, Root cause notification, ...
- Enhancements experiment lacks realistic constraints
- Our Goal:
  - Recreate BGP instability on simulator before trying to correct them.
  - Recreate realistic implementation conditions and execution circumstances to guarantee solutions validity
BGP Large Scale Simulation

• Creating realistic instabilities in the simulator:
  – Large AS Topologies
  – Topology Shape
  – Elaborate AS structure and behaviour
  – Temporal dimension: timers and messages delays
  – Traffic effects on sessions

• Produced instabilities characteristics:
  – BGP messages volume equivalent to Internet produced BGP messages volume
  – Internet comparable distribution of instability sources
BGP Large Scale Simulation Model

• Proposed simulation model for realistic BGP instability generation.

• Model components:
  – BGP Speaker Model: specification abstraction
  – Simulation Topology Model: Large scale BGP Sessions Topologies
  – AS Model: Sessions Topology requires complex AS interior
  – Routing Policies: chosen policies & implementation
  – Message Delays: Simulations Temporal Dimension
BGP Simulation Model: BGP Speaker
BGP Simulation Model: Topology Model

- “Classical” BGP Simulation Topologies
- Extracted from BGP logs (RouteViews Project)
- Different Behaviour compared to real AS
- Logical AS
- Single linked neighbours
- Restrictions on Observed Behaviours
BGP Simulation Model: Topology Model

- Realistic topologies
- *BGP Sessions Topologies*
- Multiple linked neighbours
- Complex AS representation
- BGP Sessions Topology Generation: AS Topology + Router Level Information
BGP Simulation Model: Routing Policies and Message Delays

• Routing Policies:
  – Achieve transit service agreements between Ass
  – Implemented as Decision Rules
  – Neighbour AS Relationships: customer-provider and peer-peer

• Messages Delays:
  – Link crossing delay
  – CPU charge induced delay
Conclusion

- Proposed BGP Simulation Model
- BGP Sessions Topologies generation algorithm
- Completed work:
  - BGP Session Topologies Inference algorithm implementation
  - AS Topology hierarchy Deduction algorithm
- Next Steps:
  - Routing Policies generation from Topological data