

A Methodology for Building Large-Scale BGP Experiments on the DETER Testbed

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Applications

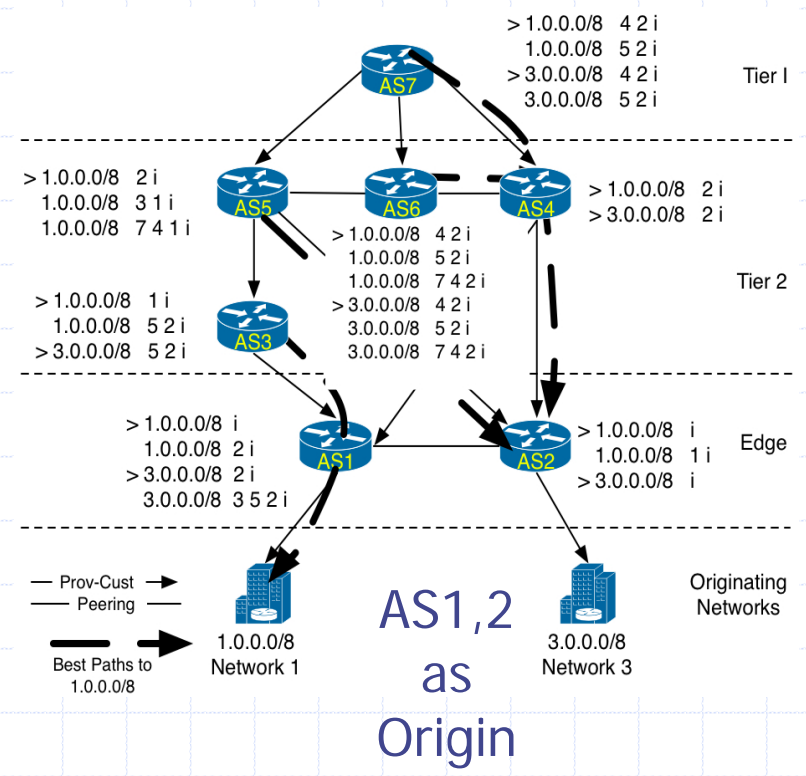
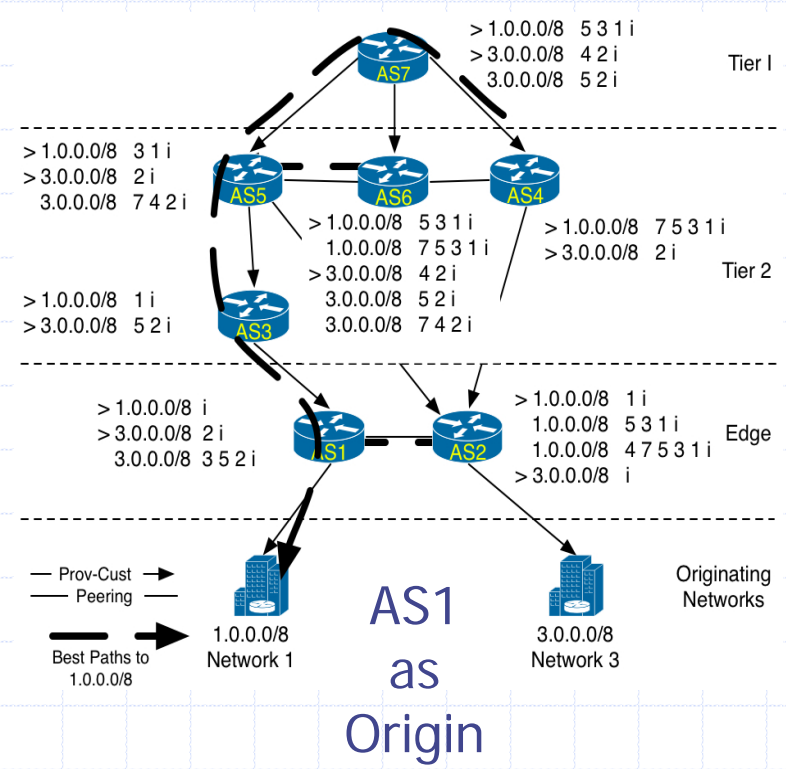
- ◆ Large-Scale BGP evaluation.
 - BGP Performance Analysis. Problem Diagnosis.
 - ◆ Convergence, Stability, Non-Determinisms.

- ◆ Basic Interdomain Routing Protocol Research.
 - (New) Clean-Slate Policy-based Routing Protocols.
 - BGP Protocol Enhancements.
 - Overlay Networks.
 - ◆ Backwards Compatibility, Incremental Deployment Testing.

- ◆ BGP Security : Attack Recreation and Mitigation Testing.
 - Direct Attacks on Routing Plane.
 - Indirect Attacks (e.g. via Worm Congestion).

Specific Example : MOAS

- ◆ MOAS : Multiple-Origin Autonomous System
- ◆ IP prefix that is originated by two or more networks.



Constructing BGP Experiments

◆ Basic Requirements

- BGP Protocol Model.
- Internet Interdomain Topology.
- Routing Policies.

◆ Also of importance, but difficult to model.

- iBGP Topologies. Route Reflectors.
- IGP Interactions.
- Multiple Peering Connections. MED Usage.
- Prefix Aggregations.

Leverage Existing Techniques

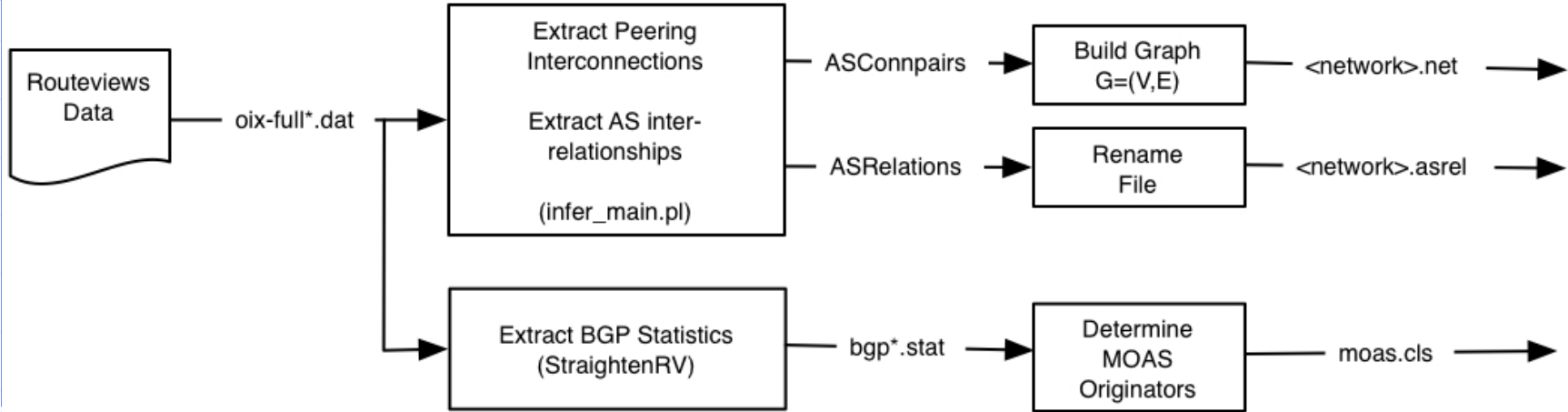
◆ Proven Techniques.

- Dimitropoulos, X., and Riley, G, "Large-Scale Simulation Models of BGP".

◆ Detailed BGP Protocol Models.

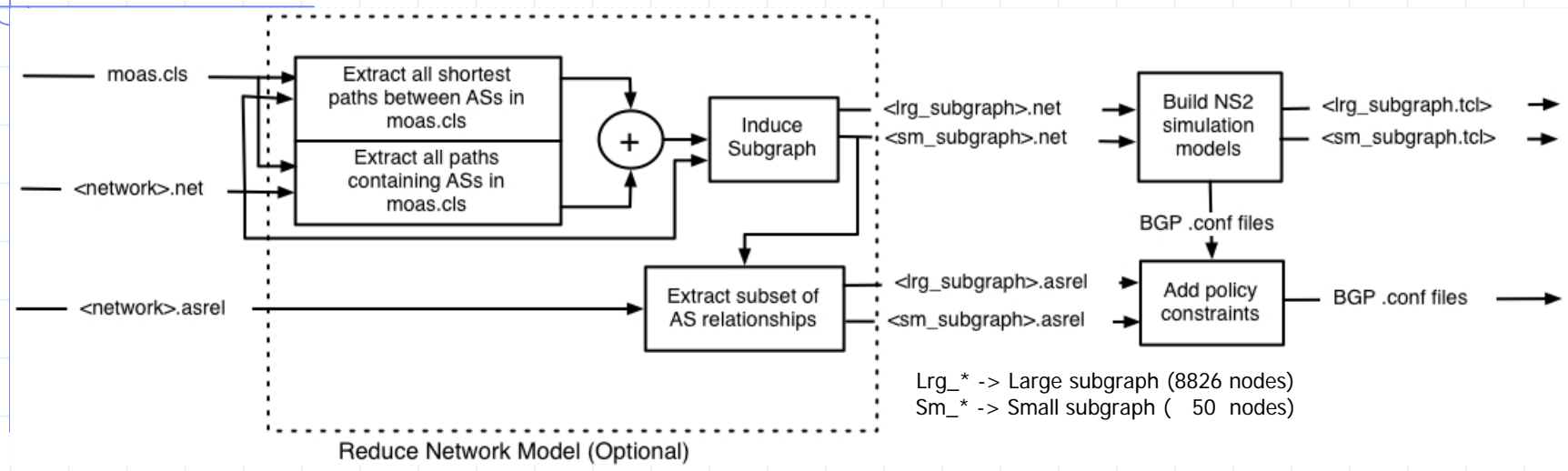
- Zebra routing software.
- Simulation-based (ns2, SSFNET, OPNET).
- All support:
 - ◆ Policy Mechanisms : Access lists, Route Maps, Local Pref.
 - ◆ Timers. Route Damping.
 - ◆ iBGP. Route Reflectors.

Build Network Topology



- ◆ Routeviews measurement data better than topology generators.
 - Directly influenced by network build-out.
 - Allows for routing policy inference.
 - Can contains additional information (e.g occurrence of MOAS conflicts).

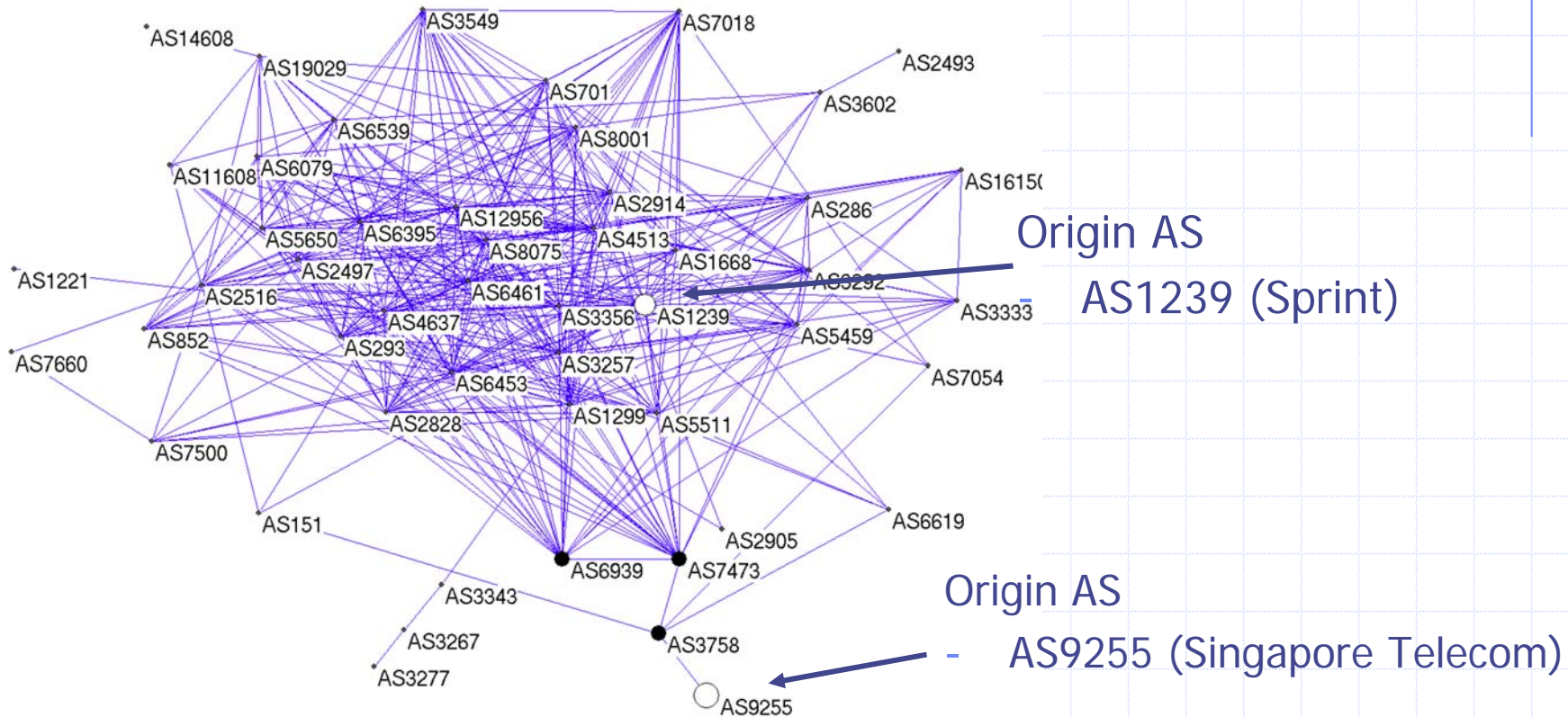
Model Building



- ◆ Multiple model sizes : 50 and 8826 AS¹ (Autonomous Systems)
 - Small subgraph (50 AS)
 - ◆ Easier analysis.
 - ◆ Adequate for emulation-based validation.
 - Large Subgraph (8826 AS)
 - ◆ Closer to Internet's scale.

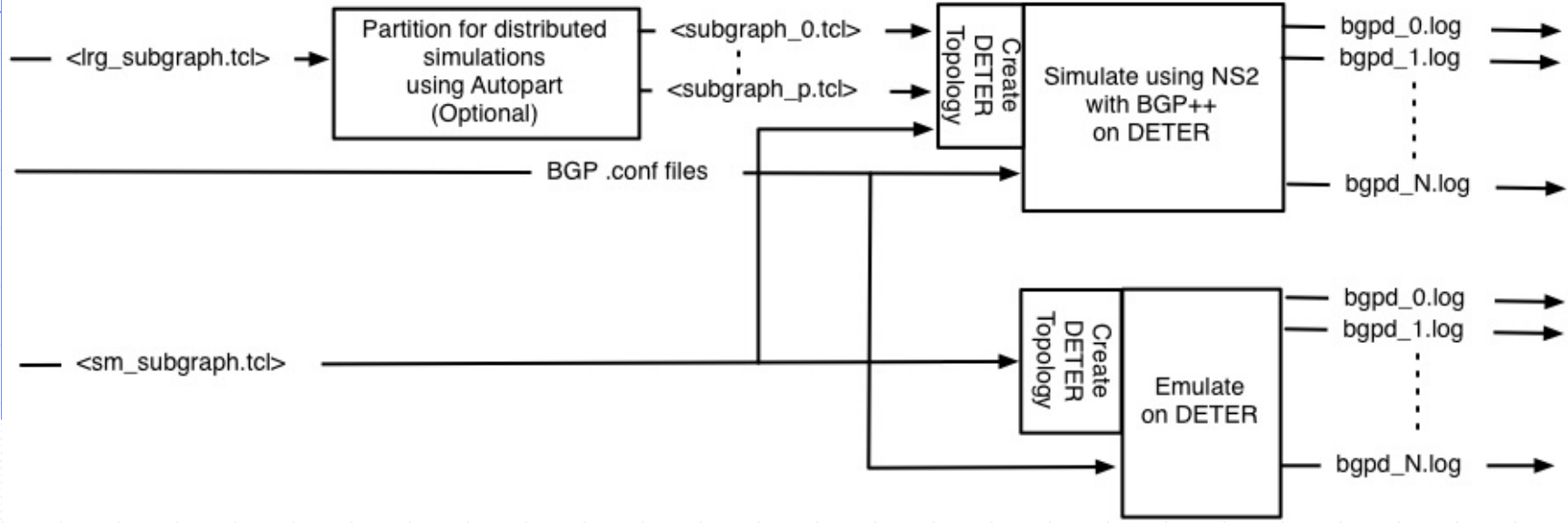
¹ Each AS is modeled as a single BGP router.

Small Subgraph Topology : 50 AS



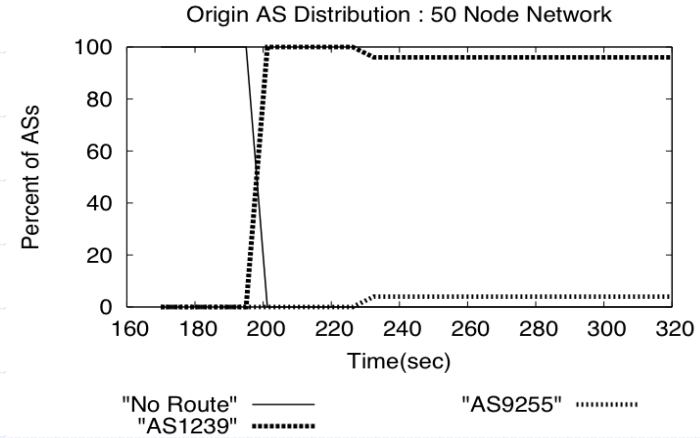
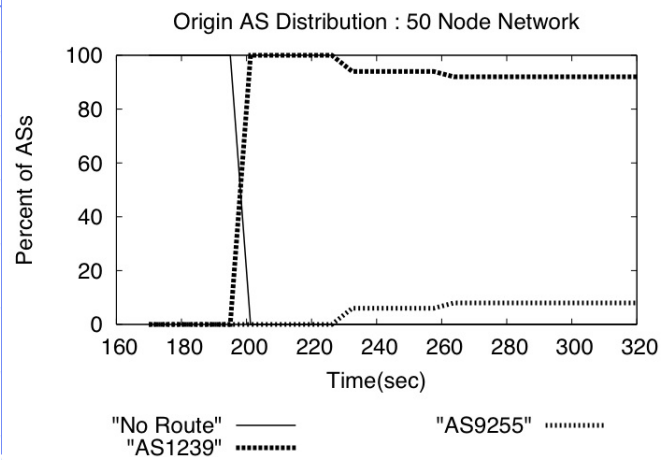
- ◆ Contains all shortest paths between AS1239 and AS9255.
- ◆ Contains all Routeviews AS paths to AS1239 and AS9255.

Model Implementation

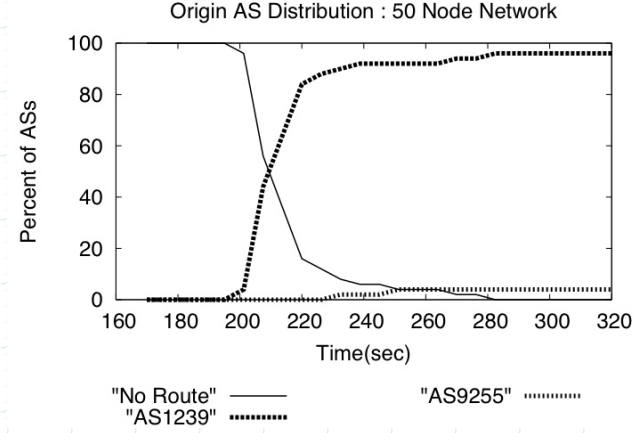
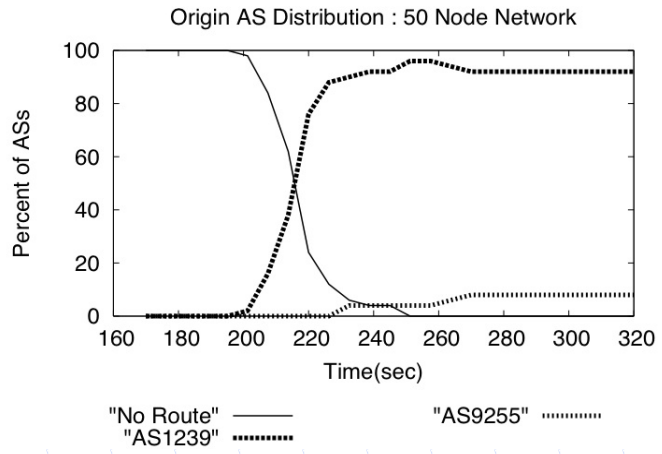


- ◆ Distributed simulation for large subgraph.
 - Addresses memory needs.
- ◆ GNU Zebra software for emulation.
- ◆ Use same BGP configuration files for both techniques.

MOAS Bias on Traffic Routing – 50 AS



Simulation

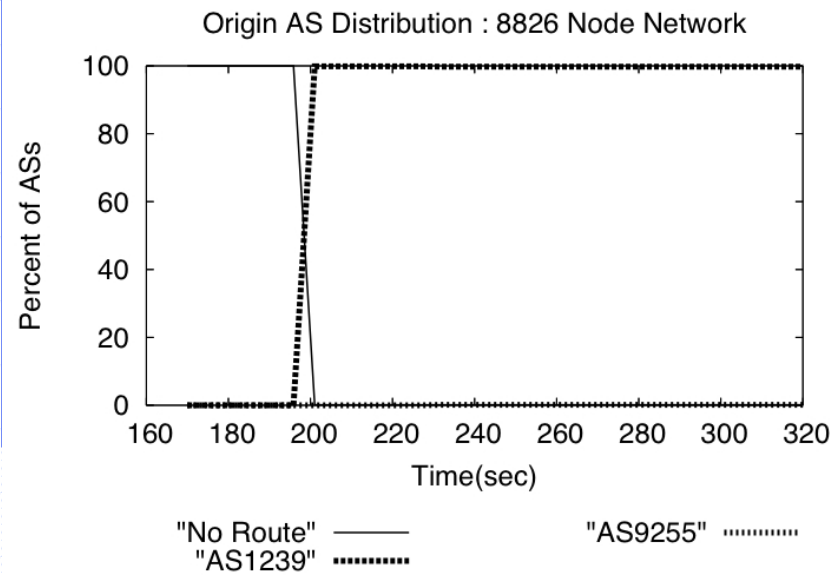


Emulation

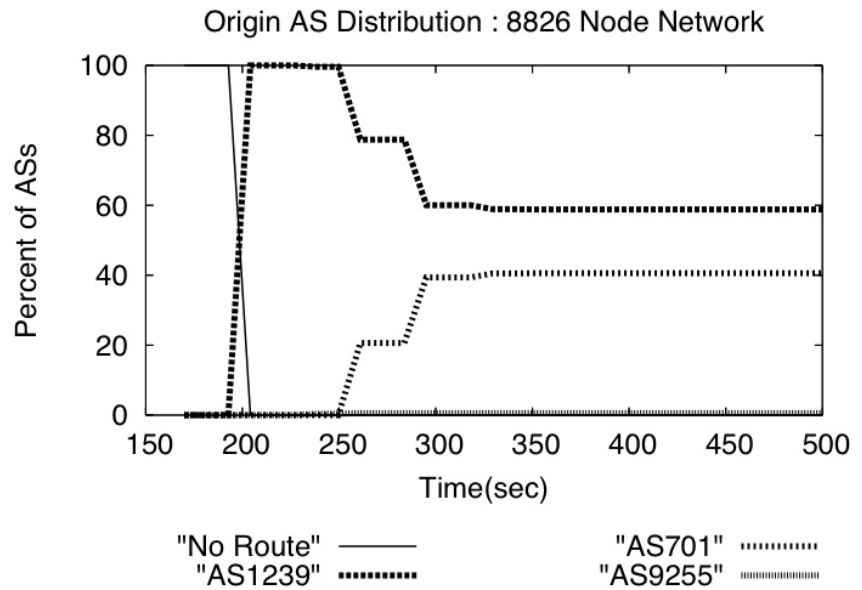
Inferred Policy

Shortest-Path Policy

MOAS Bias on Traffic Routing – 8826 AS



AS1239, AS9255
as Origin AS.



AS1239, AS9255, and AS701
as Origin AS.

Distributed simulation^{1,2} using 30 instances.

¹ PDNS : <http://www-static.cc.gatech.edu/computing/compass/pdns/>
² BGP++ : <http://www.ece.gatech.edu/research/labs/MANIACS/BGP++/>

DETER Experience

- ◆ The good . . .
 - Easy access to clustered computing resources.
 - Common platform for both emulation and simulation.

- ◆ Difficulties.
 - PCs have only 2GB memory.
 - ◆ Restricts the maximum size of simulation input files.
 - ◆ Deadlocks experienced during distributed simulation.

 - Limited number of control events available for emulation.
 - ◆ Used program objects for
 - Zebra software initialization.
 - Prefix insertion.
 - BGP table logging.
 - ◆ 30+ events/BGP node could not be scheduled using program objects.

Future Work

- ◆ Advanced Experimental Techniques.
 - Hybrid Simulation/Emulation.
 - Network Topology Scale-Down.

- ◆ More Detailed Modeling.
 - Include iBGP Topologies. Route Reflectors.
 - Multiple Interconnections between peers.

- ◆ BGP Application Research.
 - BGP Security Issues.
 - ◆ MOAS Detection. BGP UPDATE message trustworthiness.
 - BGP Overlay Testing.
 - ◆ Incremental Performance Measurements.
 - ◆ Backwards Compatibility with today's BGP.