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Partitioning Network Experiments for the Cyber-Range

Wei-Min Yao, Sonia Fahmy

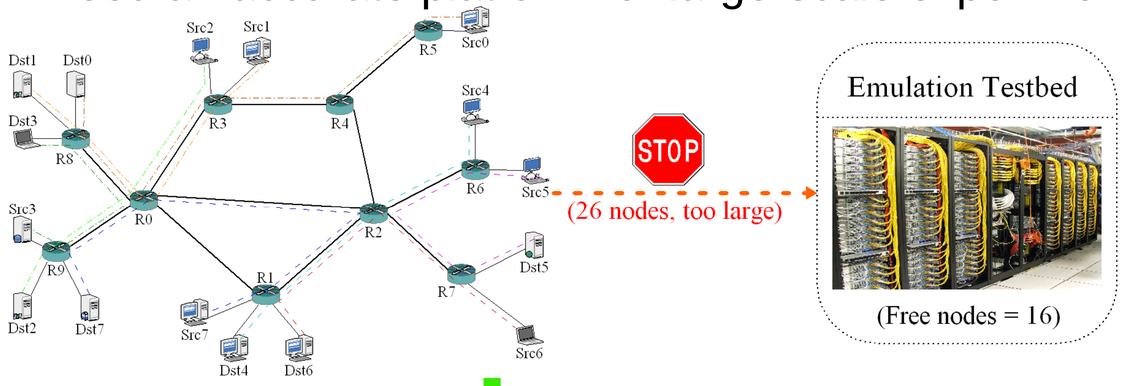
Why perform large-scale network experiments?

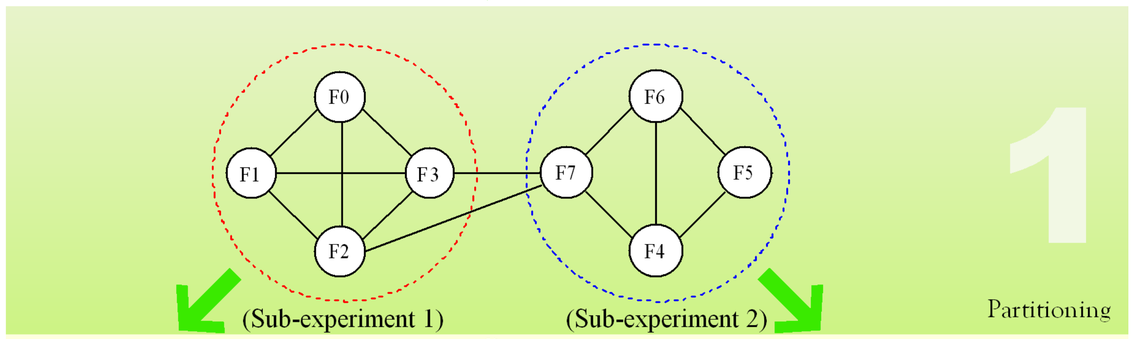
- Study network attacks (DoS, Worms)
- Verify defense mechanisms
- New routing protocols

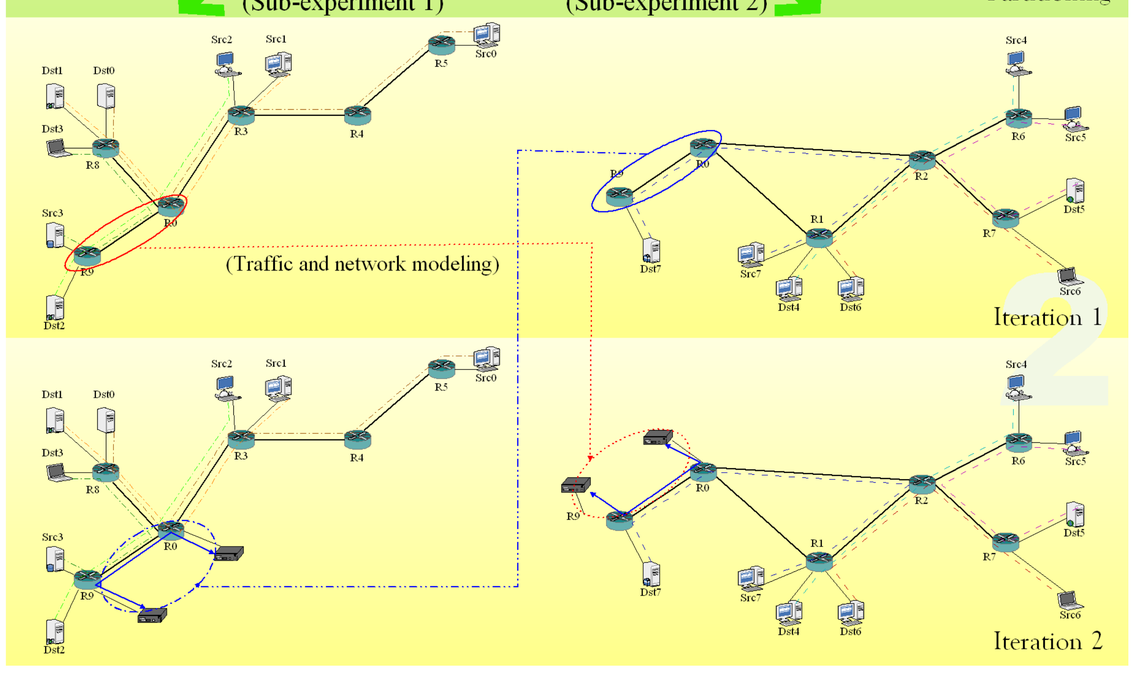
How to perform large-scale network experiments?

- Emulation testbeds provide high fidelity but have limited capacity
- Simulators and mathematical models sacrifice fidelity for scalability

➔Need an accurate platform for large-scale experiments







Can we divide a large-scale experiment into a sequence of experiments on a testbed?

- Not all flows are related
- Fine-grained metrics are not always required

➔**Flow-based scenario partitioning (FSP)**

Methodology:

Phase 1

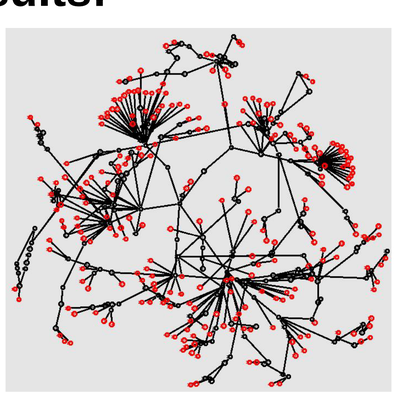
- Map flows in the experiment to a dependency graph
- Partition the graph to minimize weight of cut and generate sub-experiments

Phase 2

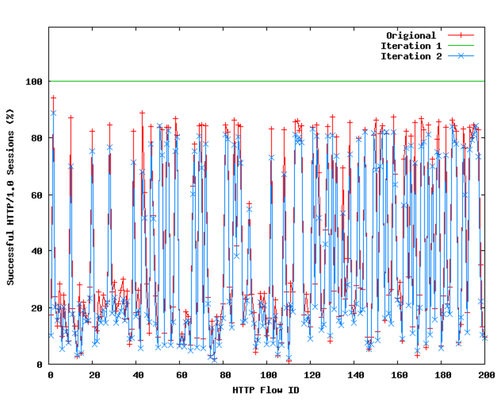
- Conduct sub-experiments independently and iteratively on a testbed
- Collect packet traces on all shared links
- After the first iteration, model interacting sub-experiments on shared links based on the collected traces

➔2 iterations are sufficient for most cases

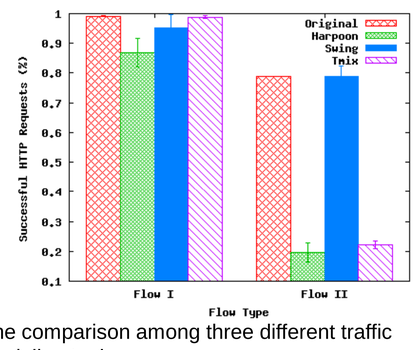
Results:



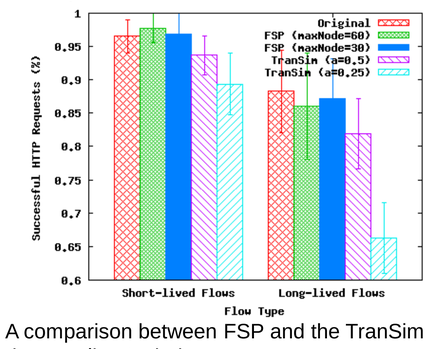
The network topology of a Botnet experiment with 438 nodes.



Percentage of successful HTTP/1.0 sessions in the Botnet experiment. The maximum number of nodes in a FSP partition is 100.



The comparison among three different traffic modeling tools.



A comparison between FSP and the TranSim downscaling technique.

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