

Robust, Secure, and Efficient Internet Control Plane (NSF ANI# 0238348)

Chen-Nee Chuah, <http://www.ece.ucdavis.edu/rubinet/rose.html>



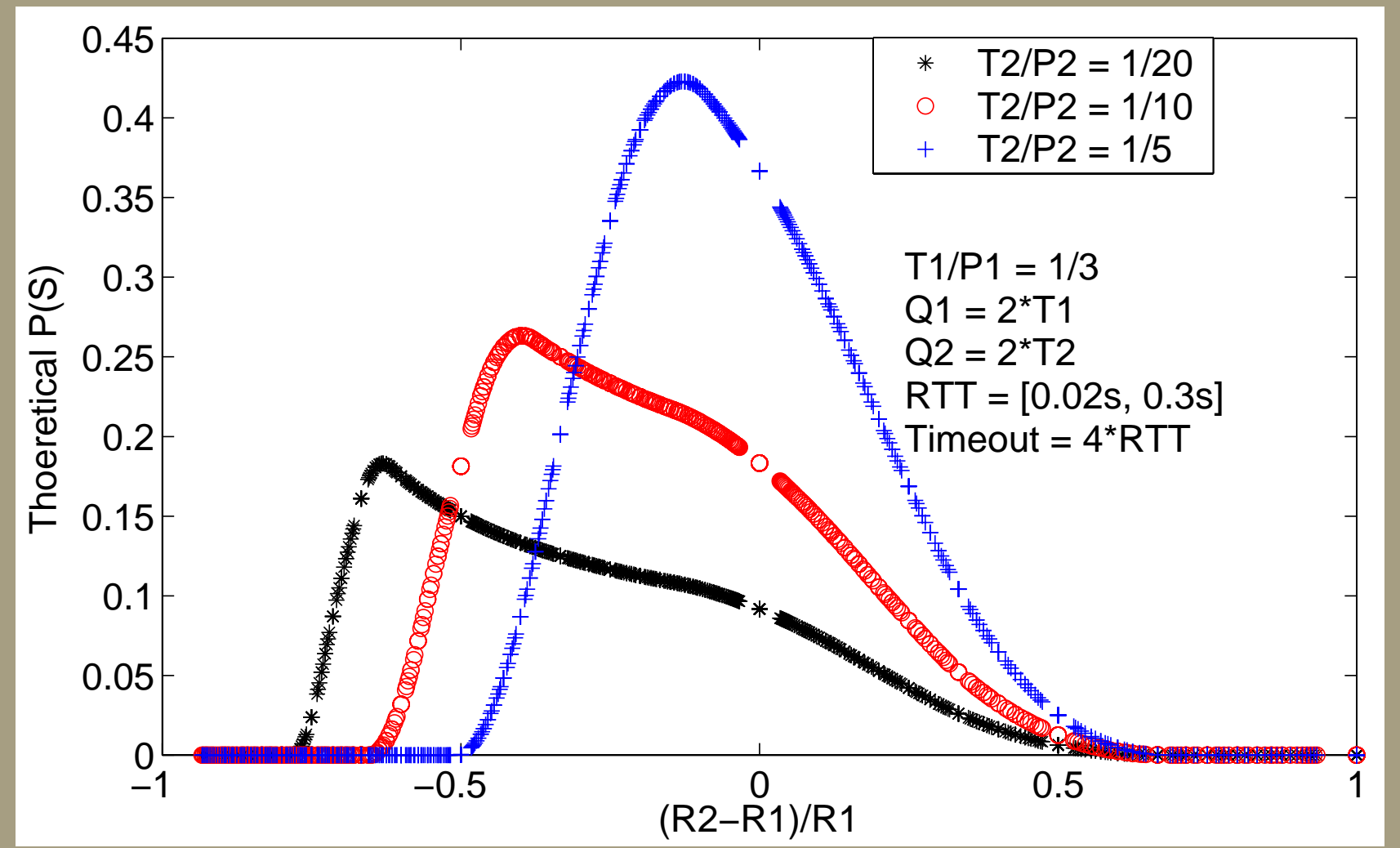
Project Goals

Improve fault-resilience, stability, and security of Internet routing infrastructure.

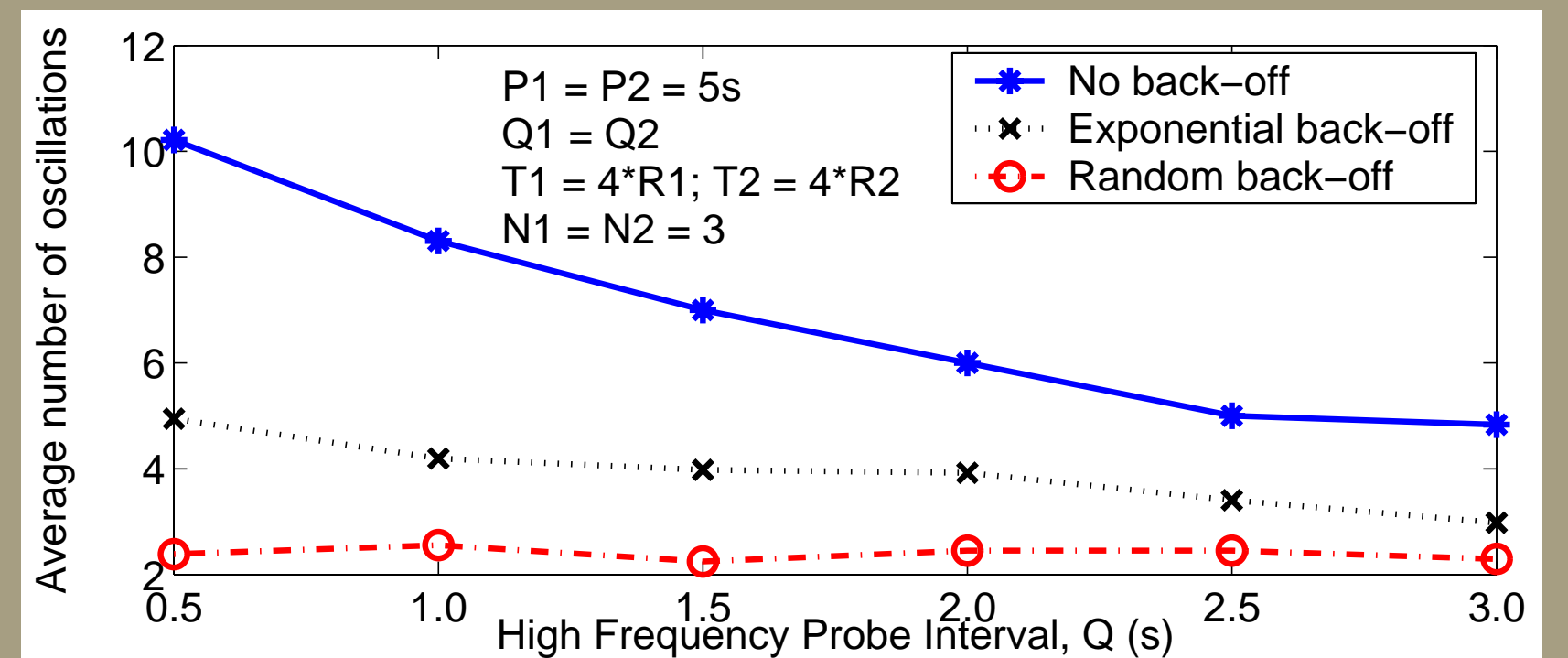
Deliver highly predictable performance to a diverse set of applications running over heterogeneous access networks.

Research findings & Applications

- Characterize and minimize race conditions between multiple overlays [ICNP'05, TON'07]
- Develop real-time analyzer/visualizer for BGP activities [VizSec'06]
- Optimize graceful network upgrade to minimize impact on IP service-availability [SIGCOMM INM'06]
- Adapt multimedia streaming strategy using routing-layer feedback [Trans. Multimedia'06]



Proportional parameter overlays with mixed aggressiveness and round-trip-time (RTT)



Mitigating oscillations with backoff techniques

Synchronization between overlays

- Three conditions for synchronization:
 1. Topology: partially overlapped primary/backup paths
 2. External events (failures, congestion) that trigger re-routing
 3. Periodic path probing process
- Probability of synchronization, $P(S)$, depends on the path probing parameters and round-trip-times on the affected paths:
 - Probe Interval – P_i , High Frequency Probe Interval – Q_i
 - Timeout – T_i , Number of High Frequency Probes – N_i
 - For identical overlay: $P(S) = T(2P-T)/P^2$
- Aggressiveness factor defined as T_i/P_i

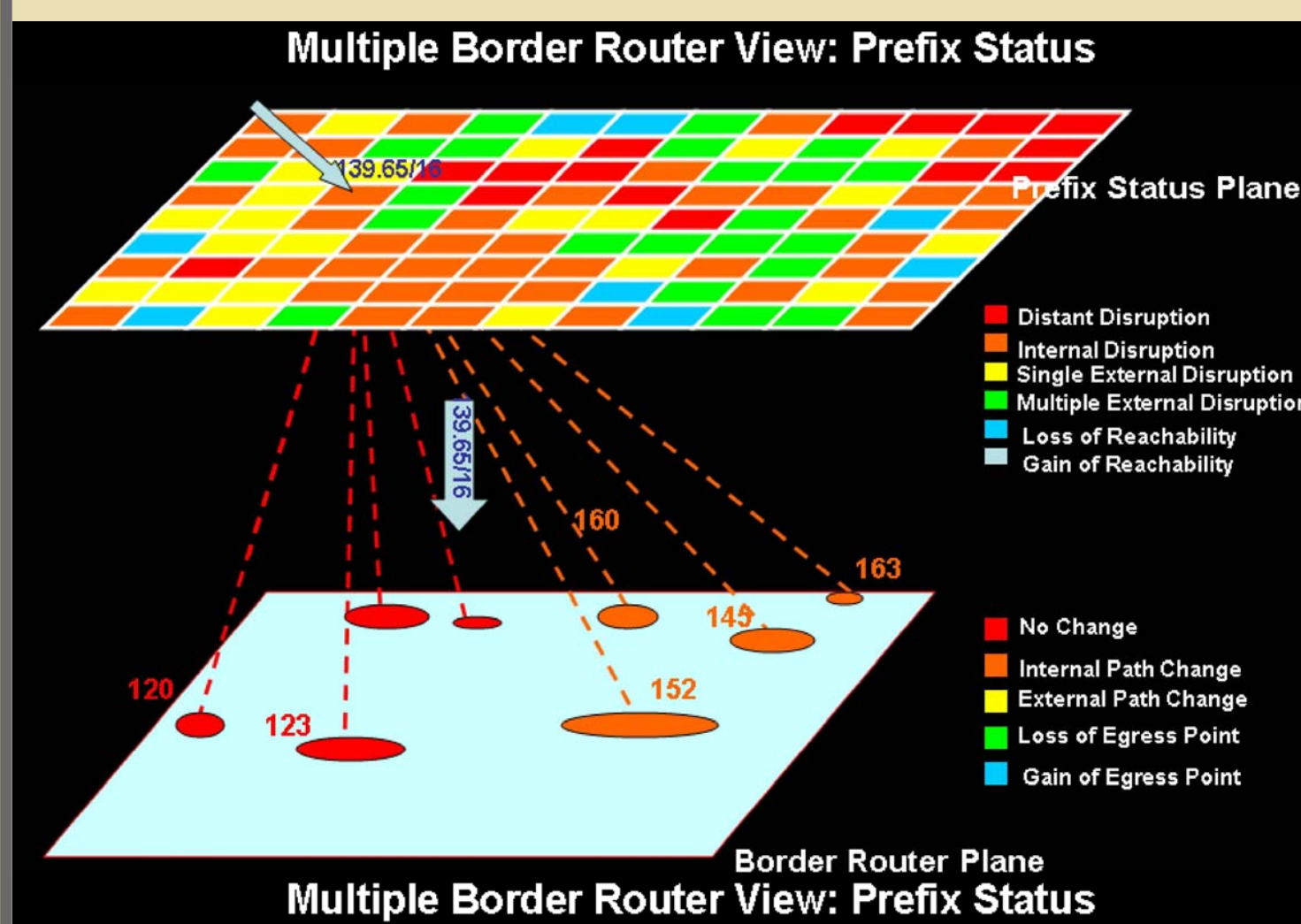
Approach and Impact

New approach

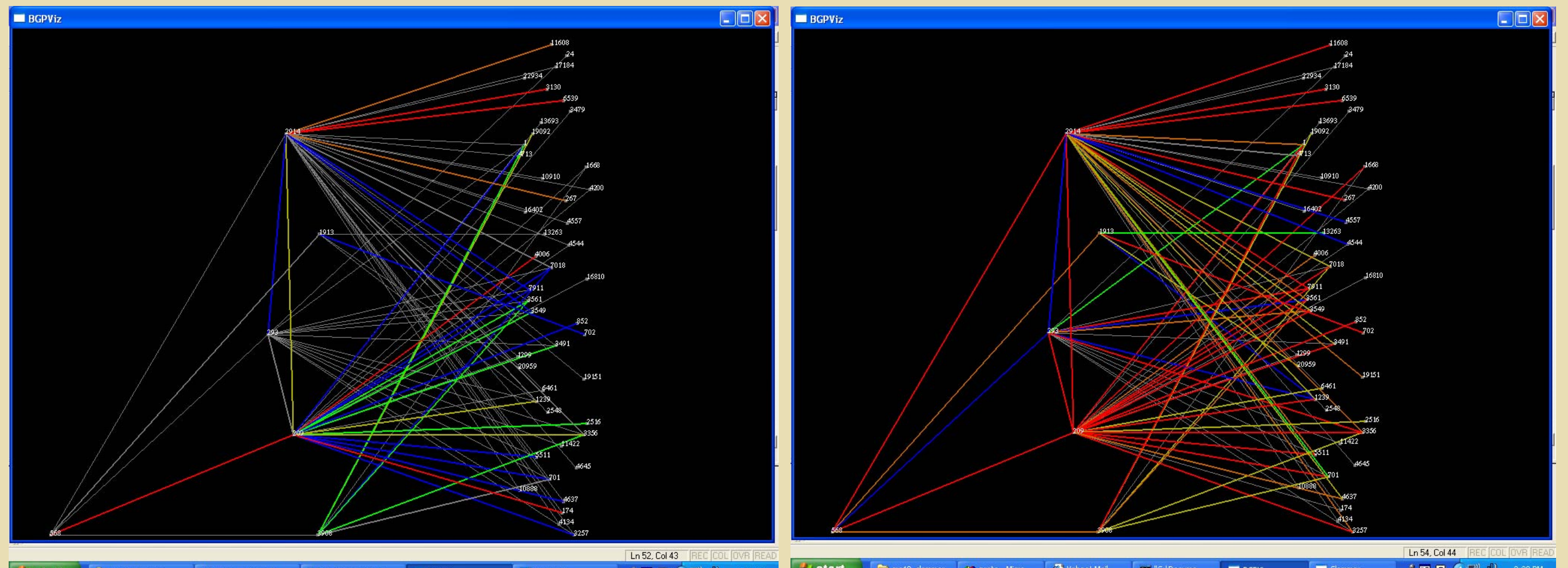
- Track transient routing dynamics to better predict service availability of IP-networks
- Model interactions across multiple entities or protocol layers to avoid race conditions => an exploitable vulnerability
- Analyze and visualize BGP activities from multiple perspectives

Research Impact

- Guidelines for large-scale deployments of overlay networks
- Better model of IP service availability for capacity planning and network upgrade
- Joint adaptation of application-layer and transport-layer mechanisms (e.g., multimedia coding and streaming) using routing feedback.



Prefix status from multiple border routers



Topology map with AS 568 as root, showing snapshot of BGP activity (a) before and (b) during Slammer worm (after 10 minutes)