

Network Architecture Research in SPYCE CIP/URI Project

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Highlights

- **Active network** based approach for flexibility and support of **diffuse computing**
 - On-the-fly modifiable with loaded software
- New measurement infrastructure (done by K. Anagnostakis, *et al.*)
- New results on **bottlenecks** and **congestion** (done by K. Anagnostakis, based on insights of Michael Greenwald)
- Evolving software infrastructure (done by K. Anagnostakis, *et al.*)

Reactive network monitoring

Uses:

IDS

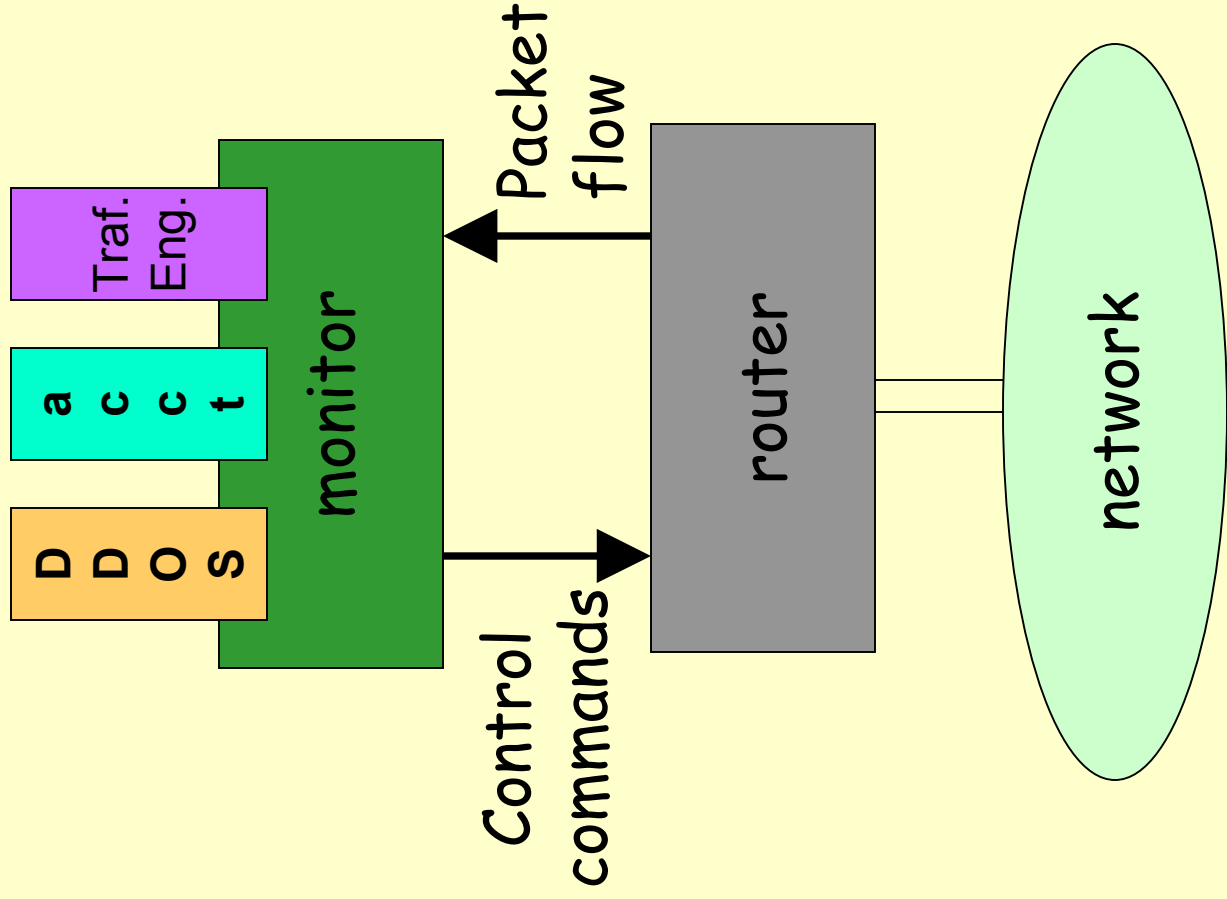
DDoS/virus detection

performance debug

traffic engineering

traffic measurement

accounting

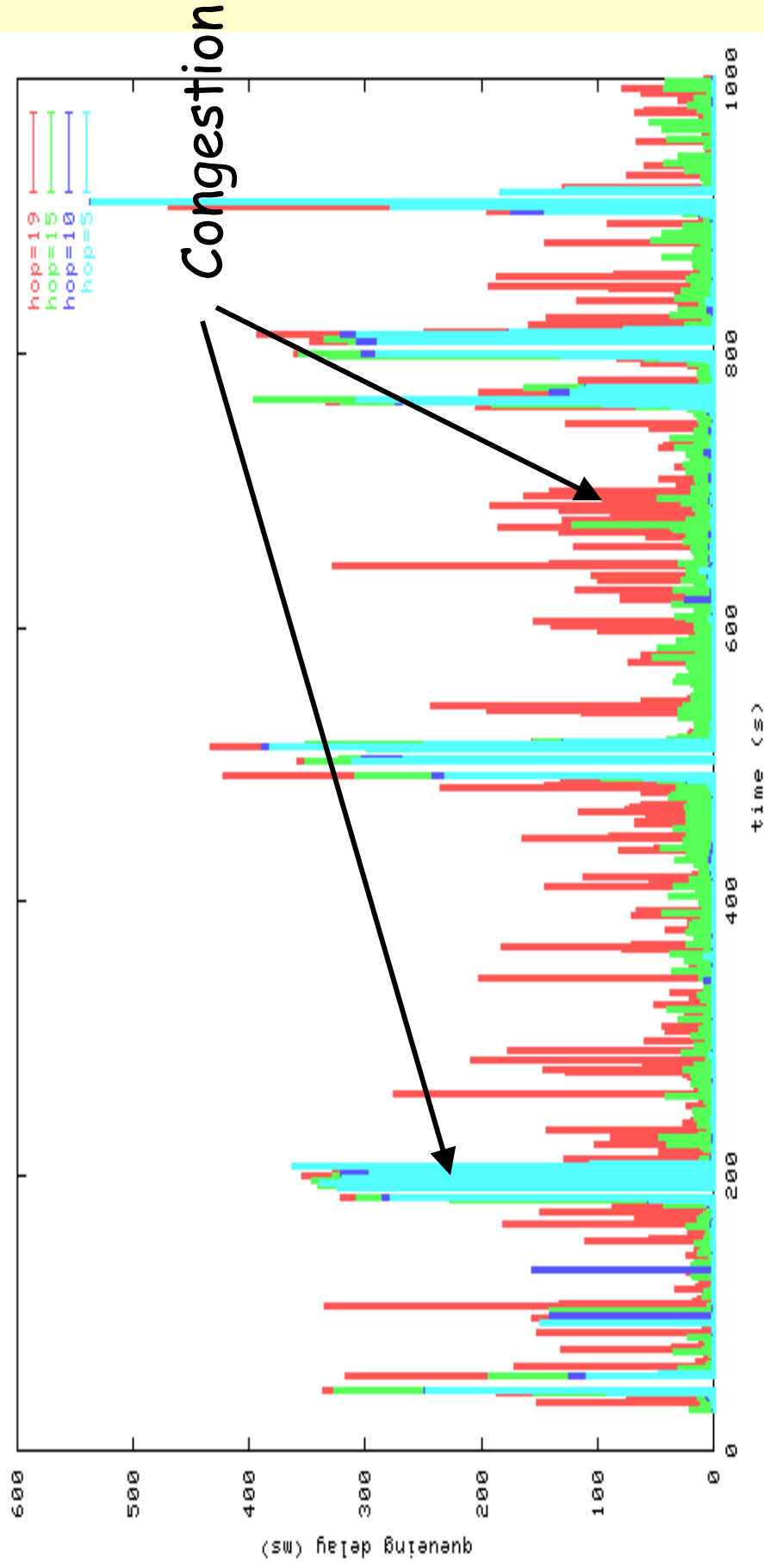


Opportunity: Internet paths

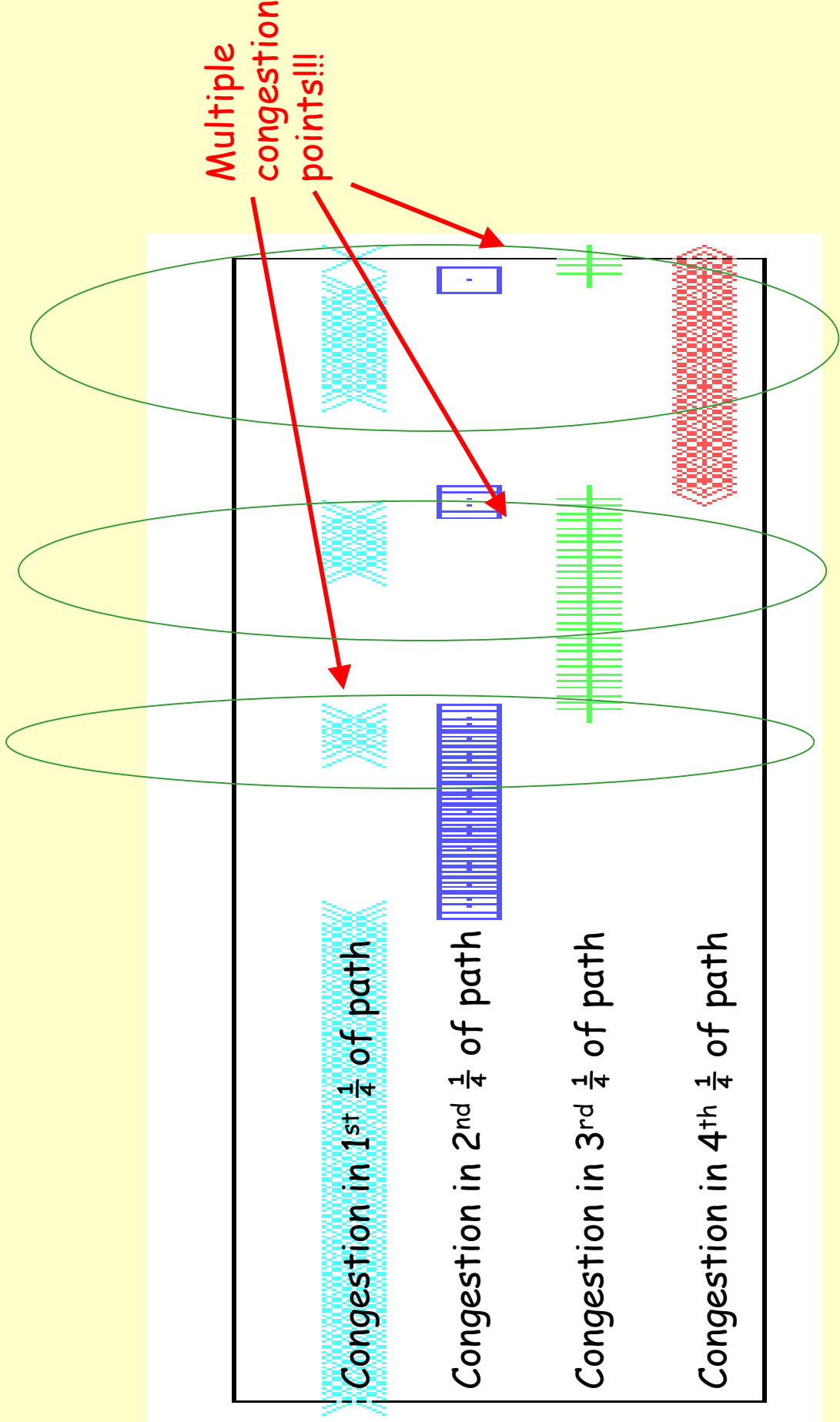
- Developed new **delay tomography** technique
 - Standalone tool - no new infrastructure support
- Studied large number of Internet paths
- Preliminary results indicate:
 - Congestion relatively "stable"
 - Single bottleneck case dominant
 - But, multiple bottlenecks not uncommon!
 - Bottleneck typically at the edge
- Great opportunity for diffuse approach!

Study of Internet paths

Tomography of single 19-hop path:



Many Path Case



Achievements/Prototypes

- **LAME/FLAME*** prototypes for network monitoring
 - Paper in NOMS 2002 / public release mid 2002
- **Bourse Of Packets (BOP)*** network simulator
 - resource control in AN / public release early 2002
- **CING*** network measurement tool
 - characterize Internet paths / public release end-2001
- **SPYCELAB** platform
 - AN platform w/ market mechanisms, trust management & service brokerage components
 - available through SPYCE web site

* Done under CIP/URI support

Next Steps

- **Reactive network monitoring:**
 - Network processor for higher performance?
 - Role and cost of safety
 - Engineering: router integration issues
- **Market-based resource control:**
 - Further mechanisms - new focus on routing
 - Hybrid IP/AN architecture (overlays)
 - Develop lightweight crypto for "pico-payments"
 - Further investigate Internet **congestion**, **fairness** etc.

Market-based resource control

- A “**Bourse of Packets**” approach using AN:
 - Network resources available at **dynamic** market-controlled prices
 - Packets look at price before taking action
 - Action can be forward, drop, take alternative path, manipulate node state etc.
- Benefits:
 - Flexibility in defining packet behavior
 - Performance by reacting locally to congestion
 - Security as design assumes selfish users

BOP packet behaviors

- "Active Self-Discard"
- "Active Congestion Notification"
- "Active Self Routing"

