Network Research Update
Overview

• Part I: Matt Z: General Overview
  – “meta activity”
    • Strategic Planning emphases
    • Network Research Review Committee
  – Activity
    • Internet2 Observatory status
    • Research using data, network
    • One-off Research support
  – GENI and Internet2 introduction
• Part II: Rob Ricci: The ProtoGENI project
Supporting research is core to our mission. Re-affirmed during strategic planning process.

We’ve been doing it since the beginning.

Because Internet2 runs a network, and is non-profit, we are in a unique position to provide data simply not available from commercial networks.
A Community Team was commissioned by the RAC to examine three tasks: network testbeds, provide data to researchers, and an Internet2 research agenda.

Three whitepapers were generated for the three tasks; these generated a number of potential next steps, the most being for providing data. (See links.)

The RAC summarized potential FY10 next steps

The community team prioritized them

Now in the budgeting mix for FY10
Strategic Planning – lead next steps

- Assist GENI researchers to connect multiple projects to testbed
- Convene community to agree on data sharing policies
- Continue support of observatory, curate collections & projects
  - Create a repository of tools that operate on observatory data
- Coordinate with other peer data owners for research requiring data from multiple networks
- Work with funding agencies to ensure sustainable funding for a broadly-agreed research agenda
- Thoughtful notes on research funding and testbeds
Strategic Planning References

• Strategic planning portal
  http://www.internet2.edu/strategicplanning/

• Task K (provide data to network researchers) whitepaper

• Task A (testbeds)

• Task M (research agenda)
The Network Research Review Committee

- The Research Advisory Council has commissioned a Network Research Review Committee
  - Examine policies on passive data collection, potentially recommend changes
  - Look at Internet2 network research priorities
  - Review ad-hoc requests that require resources
  - Led by k claffy UCSD/CAIDA
- http://www.internet2.edu/networkresearch/nrrc.html
NRRC Activities

- Examining privacy-sensitive data
  - Current strategies
  - Matt and kc to embellish network research part of Internet2
    Research retrospective done for RAC, submit to ACM CCR
  - Creating a template – what are issues to consider
  - Looking at PREDICT (DHS project for security researchers)
  - Looking at code-to-data
  - Work a couple of specific examples to learn from

- Review proposal on IPv6 anonymization
  http://www.uoregon.edu/~joe/ipv6-mask.html

- Look at NetSE Research Agenda, see if useful for Internet2
General Philosophy

- Internet2 does not do network research per se, but seeks to facilitate and support research projects led by faculty at member institutions
  - Make accessible network resources readily available to this community
  - Participate in research collaborations and provide support for proposals
  - Integrate research findings into the evolution of Internet2 network initiatives and services
What do we do?

• The Internet2 Observatory.
  – Supply data
  – Provide limited space for collocation
    • Where it makes sense; power issues

• Occasionally run programs or tweak network parameters

• Support grant proposals (and grants)
  – Data, space, expertise

• Provide connectivity; circuits
Observatory Data

- Six categories: utilization, flow, latency, throughput, routing, router data
- Some just for research
- Router proxy allows personal exploration
- Evolving export of data via perfSONAR
- Evolving datasets for circuit networks
Data in more detail

- One way latency, jitter, loss
  - IPv4 and IPv6 (“owamp”)
- Regular TCP throughput tests — ~1 Gbps
  - IPv4 and IPv6; On-demand available (“bwctl”)
  - 10GE now also possible (ask)
- Utilization
  - Octets, packets, errors; collected every 10 seconds
- Flow
  - IPv4 only, addresses anonymized by 0-ing the low order 11 bits
- Routing updates
  - *Both IGP* and *BGP* - Measurement device participates in both
- Router configuration
  - Visible Backbone – Collect 1/hr from all routers
- Dynamic updates
  - Syslog; polling via router proxy
Collocation

- VINI (and formerly PlanetLab)
- 100x100, NetFPGA
- Phoebus
- Past: AMP
- Past: passive measurement [router clamp]
- ... and GENI
Phoebus

- End-to-end session via adaptation points
- Current focus on using ION/"dynamic circuit networking" transparently
- Partial deployment on the Internet2 Backbone
  - Chicago, Houston, Los Angeles, New York, and Salt Lake City
- Several concurrent Research Projects
  - 10G Phoebus Exploration – University of Delaware
  - SC09 Bandwidth Challenge – REDDnet, University of Delaware
  - Data movement with LIGO – NYSERnet, Syracuse University, University of Wisconsin (Milwaukee)
  - Movement of Visible Human Project data – University of Wisconsin (La Crosse)
General Observatory Use

- Use data as input to algorithms, thinking
- Test algorithms
- Test ideas
- Use network (physical topology, data) as ground truth
What are people doing?

- Security
- Transport development
- Develop performance debugging techniques
- Improving operations
- New routing techniques
- Characterization (of traffic)

- Characterization (of network)
- Topology, Link sizes, Peering
- Anomaly detection
- Ways to save power

* These are a random smattering and not exhaustive
Security

- A currently fairly well-funded area
  - Avoid the “New York Times” event
  - Shift from “hackers” toward monetary gain
- Intrusion detection
- “malware” propagation
- Researchers desire data we currently don’t collect due to privacy concerns
Improving Operations

• Ways to reduce human error causing network outages
  – Two PhDs involved looking at our router configs
  – Another working on automated anomaly detection
• Better ways to structure networks for resiliency
• Our trouble-ticket data is unique and valued
• Commercial folks don’t tell
• Interesting as input to simulations
• Algorithms to detect interesting topological features (links, node degree, network peers)
• Use Internet2 Network data as “ground truth” – how well does the algorithm do on a real (albeit somewhat small) network
• 2 SIGCOMM 08 papers
Characterization Examples

• Brian Carpenter (former IETF chair, former IBM Research employee, now at U Auckland): is UDP use increasing? (are people avoiding TCP to avoid congestion control, other problems?)

• Do you have any IPv6 traffic? 200Mbps? What is it? [we don’t currently have instrumentation to tell]

• How much peer-to-peer traffic do you have? [very hard to discern on backbone]
Other one-offs

• Nick McKeown, Guido Appenzeller (Stanford): reduced buffers using feature of Juniper routers on one link in core, did not observe any additional drops. Thesis work, SIGCOMM paper

• Occasionally run code on Observatory PCs
  – Steven Low (Caltech): Run FAST (delay-based) TCP on PCs, congest access link (GaTech); show plays well with traditional TCP
  – Link capacity estimation (w/fast SNMP polling)
  – IPv6 reach
• The Global Environment for Network Innovation
• A place where “clean slate” (and other) researchers can test ideas (and hopefully draw “real” traffic)
• A “facility” not a network
• Originally planned to be a major NSF construction project
• Now likely to develop facilities that evolve over time
GENI and Internet2

• Several members involved with GENI
• MOU with GENI Project Office (GPO)
  – Supply one wave for 2 yrs, starting July 2008
  – Collocation, connections, anything out of pocket requires cost recovery
    – Collocation is dependent on space/power
• Started discussing what happens after July 2010
• No Internet2 mandates for Universities or Connectors
Current (“Spiral 1”) GENI Project Office Projects

- Internet-scale Overlay Hosting [PlanetLab] J. Turner/WUSTL
- Potential connection of projects within control plane clusters
  - Specific need unclear; would require more equipment to multiplex onto 10GE “wave”
  - Facilitating Rutgers-to-NICTA link
  - Also interest in Korean link to ProtoGENI and GMOC
Spiral 2 Projects

• Backbone/Observatory/Wave-related
  – ProtoGENI augmentation for U. Kentucky measurement project
  – National OpenFlow with Stanford
• Other projects with Internet2 involvement
  – Add PerfSONAR to ProtoGENI
  – Examine federated (in the Shibboleth sense) authentication for GENI
Network Research Update

7-Oct-2009, Internet2 Fall Member Meeting
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For more information, visit www.internet2.edu