Internet2 New Network Observatory Requirements
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Introduction

The new network for Internet2 is expected to provide Layer1 and Layer2 services in addition to continuing the excellent Layer3 service provided by the current Abilene network. These new services provide new challenges for measurement and monitoring. , The new capabilities also will provide new sources of data. For example, error rates on optical circuits, control plane state and control plane updates. As with the existing Observatory program, the intent is to expose as much data as possible. This document reviews the existing Abilene observatory program and then goes on to propose requirements for the new network.

This document is intended to be a living document, evolving over time, and eventually pairing with a companion design document. This version (0.0) is an initial strawman proposal from a small group[1]; we are actively seeking feedback to refine the goals and requirements, including elements we may have missed. The intent is to hand this off to a larger community working group to continue the evolution of this document, where the community can review, prioritize goals, and help commit resources to implement the observatory.

The Abilene Observatory Program

The existing Abilene Observatory program [http://abilene.internet2.edu/observatory/] has multiple purposes. The first is to collect and display data for operational needs. Utilization and syslog data are most used for this purpose, but throughput data is also used to verify link quality. [zap this (these?) diversion(s)? Mjz] The second is for debugging, typically performance debugging. The router proxy reports router state on demand. The latency and throughput measurements can verify backbone performance, and the same equipment also can be used by gigapops and universities to perform either routine measurements for quality control, or on-demand measurements to test specific paths. Internet2, ESnet, DANTE and the GEANT2 community are working towards a new general infrastructure, currently called perfSONAR, to better collect and distribute network performance data from multiple domains, and Abilene resources are also being contributed to that project. Finally, the third purpose is to support the network research community. We consider a vibrant research community integral to network development, and partnership with the research community has been essential for the development of the Internet to date.

Data collected under the observatory program consists of two parts. First, there are data sets collected by Abilene staff and made available to researchers. There are seven data sets currently: Utilization data (1 minute SNMP samples), Flow data (sampled 1/100),

[1] Jeff Boote (Internet2), Eric Boyd (Internet2), Dan Megorian (MAX), Joe Metzger (ESnet), Matt Zekauskas (Internet2, editor)

Routing data (both BGP and IGP collections from all routers), Latency data (10 packets per second among all router pairs, IPv4 and IPv6), Throughput data (20 second TCP tests among all routers pairs, IPv4 and IPv6), Router data (snapshots of "show commands" taken once an hour) and Syslog data (from the routers). The data sets have been used by a number of network research groups, and have been acknowledged in a number of SIGCOMM and INFOCOM papers.

The second part consists of data collected by separate research projects using equipment collocated in the Abilene equipment racks. The two best examples of research projects collocating equipment for data collection are the NLANR Active Measurement Project (AMP) [http://amp.nlanr.net/] and the Indianapolis router clamp installed by the NLANR measurement and network analysis group [http://pma.nlanr.net/Special/ipls5.html]. In addition, the PlanetLab project [http://www.planet-lab.org/] installed nodes in all our router nodes.

Continue the Existing Abilene Observatory Program

The group agreed that the existing IP-focused program should be maintained in the new network. This echoes the March 2005 Abilene Technical Advisory Committee report, which stated that the Abilene Observatory program should be maintained and if anything strengthened in a new network. That report also emphasized the importance of the diagnostic aspects of the observatory, essentially recommending full participation in projects like Surveyor, piPEs, and the current international measurement framework effort, perfSONAR.

The rest of this document focuses on the new aspects of the network and their implications on the NewNet Observatory.

What's New?

The telecommunication carriers have been doing circuits forever. What's new with this network? It is true that carriers have been providing circuit services. However, they generally don't try to make their data available, and in addition no carrier is providing the type of on-demand circuits envisioned for the new network, and certainly none that will cross multiple domains.

Thus, there are two potential areas of focus. First, focus on the technology itself. Is it working? How well? What do we need to provide to cooperatively solve a problem that crosses multiple domains? The control plane is the truly new piece of technology here, and will likely need the most attention initially. Second, the cross-domain aspect creates an interesting economy of circuits. How are they used? Are they being used effectively? Are their rules for creating a circuit? Is it possible to "game the system", and should we monitor to verify? Can we compare the utility of the circuit services with that of using a "vanilla" IP statistically multiplexed service?

The following sections take a cut at different requirements from different points of view. They are not all mutually exclusive, and can be used to create a master requirements list.

[*could make them all subsections of a larger section… --mjz*]

Consumer Statistics

What might a connector or other consumer of these dynamic circuits want to know?

- Availability statistics
    - Per circuit or per segment
    - Daily/weekly/monthly/yearly
    - Available seconds
    - Unavailable seconds
        - Planned (inside maintenance windows)
        - Unplanned (outside maintenance windows)
            - Breakdown: equipment/fiber/human error
- Error statistics
    - Corrected errors (pre-FEC errors)
    - Uncorrected errors
    - When errors trigger preventative maintenance
- Usage and characterization of that use by the consumer
    - Circuit creation statistics
    - Hold times/Circuit teardown statistics
    - Errors on circuits (see above)
    - For the network, the ability to audit all of these

Diagnostics

- Auditing
    - Circuit creation
    - Circuit errors
    - Circuit teardown
    - Utilization [where possible?]
- Ability to trace packets through the system to discover a dysfunctional link
    - E.g. look at link setup packets (including ARP if IP is run on it)
    - Passively tap/mirror/… (also useful for utilization where standard protocols (IP, Ethernet, …) are run on the link.
- Tools and information to identify, track, and mitigate rate policing (or limiting or mismatches)

Quality Control

- Circuit statistics
    - Circuit blocking time, rates
    - Setup times
    - Teardown times
    - In service packet [bit? –mjz] error rates
    - In service circuit failure rates
- Packet statistics (for IP or Ethernet links) (“standard SLA stats”)

    - Packet rates
    - Packet loss
    - Packet latency
    - Packet jitter
    - Utilization
- Periodic active measurements
    - Set up circuit between measurement points
    - Send traffic
    - Measure packet stats (include throughput)
    - Tear down circuit
    - This verifies control plane, and underlying transport. If possible, set up circuits using diverse paths, including paths local to measurement points, to test as many transponders as possible
    - Could also place attenuators in paths, to look for transponders, etc. that are going out of spec. [*name for this kind of testing, it's in my slide set –mjz*]

Other Economy Measurements

- Currency
    - (how is it handed out?)
    - (can it be traded, if so, see trades)
    - What is burn rate
    - (if one can bank credits, amount held in the bank)

Is the economy growing? Shrinking? Important Trends?

- Supply measurement
- Demand measurement
- Categorize demand by something more granular than connector
    - Which university or research group requested the connection
    - Purpose of connection
        - Network research
        - Application
        - Testing
        - Offloading a "production link"
    - Classify requesting entity
        - Physics
        - Chemistry
        - Humanities
        - K-12
        - Remote instruction
        - …

Are economy rules being violated (look for anomalies, assertion failures)? Can we detect when some entity is "gaming" the system?

Broad Goals – Potential Display Targets

Extend Research Data Sets

- Optical equipment statistics, including both the wave box (Infinera) and the grooming box ("ADM"), supplier TBD

Operational Portals

- Extend router proxy to optical gear
- "Weathermap" for lambda or sub-lambda utilization over footprint
    - Include utilization trends over time
    - Show current connection state

Auditing Data

- Who requested the circuit
- Who is using the circuit (plumber, app developer, app user)
- Why are they using the circuit (additional bandwidth, defined net characteristics, application isolation, security)
- What are they using circuit for (Bulk Data Transport, Experiment Control [microscopes..], Streaming media (audio, video, conferencing [so interactive]), Distributed Computation

I think we can take all but the portals, and push them up. Then go through and create a prioritized requirement list.