

Technical Report for the project of “Integrating a CRON (Cyberinfrastructure of Reconfigurable Optical Network) Testbed into ProtoGENI” (GENI Proposal 1794)

Period: Nov 2010 – March 2011

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I. Major Accomplishments

Scope

This effort provides a reconfigurable optical network emulator aggregate connected to the GENI backbone over Louisiana Optical Network Initiative (LONI). The role of optical network emulation in GENI is to provide a predictable environment for repeatable experiments, and to perform early tests of network research experimentation prior to acquiring real network resources. The tools and services developed by this project will integrate with the ProtoGENI suite of tools. The aggregate manager and network connections between LONI and GENI for this project will also allow other LONI sites to participate in GENI.

For the second year from 2010 to 2011, the scope of work includes

- (1) implementation of GENI AM API,
- (2) trusting all four GENI Clearinghouses,
- (3) finding experimenters and providing supports for experimenters,
- (4) performing demos with experimenters at GECs,
- (5) exporting the status of CRON to the GMOC, and
- (6) hosting tutorials at GECs.

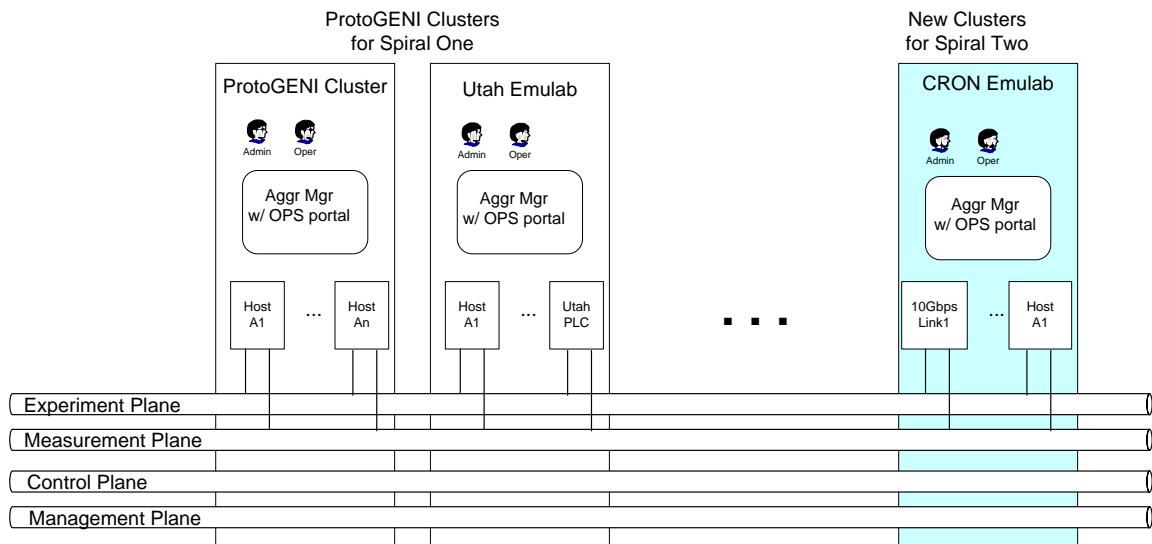


Figure 1. Implementation of Federation of CRON into ProtoGENI Cluster C at the Spiral 3

A. Milestones Achieved

Note: (6mo) means activity that completes by the 6th month after start of project. Also, (7-12mo) means activity that starts in the 7th month and continues through the 12th month.

Milestone 1: Demonstration and outreach at GEC9.

Description: Demonstration of a GENI experiment (OnTimeMeasure Project@ Ohio State University) that uses CRON resources.

Milestone date: 2 Nov 2010

Status: Accomplished

In the demonstration, we showed two different kinds of federations: (1) federating the CRON testbed with ProtoGENI testbed at BBN and (2) federating the OntimeMeasure project with the CRON testbed.

Milestone 2: CRON aggregate manager is functional. Due 2/18/11.

Milestone date: 18 February 2011

Status: Accomplished partially

Regarding the task of aggregate manager, there are three sub-tasks to be finished as follows:

- Recognize GENI credentials from at least 2 clearinghouses
- Export status information to the GMOC
- GENI experimenter guide (web pages or document) for using CRON resources

The CRON testbed has been recognized by the clearinghouse of ProtoGENI since November 2010. And CRON testbed will be recognized by the clearinghouse of PlanetLab after our team finishes GENI API over Internet2 by June 30, 2011. Because CRON testbed needs to be connected through Internet2, it takes additional time for us to implement interface to the ION service of Internet2.

Milestone 3: Demonstration and outreach at GEC10

Milestone date: 5 March 2011 (before GEC).

Status: Postponed

A new demonstration showing a federation with PlanetLab testbed is planned at GEC11 after implementing GENI API over the ION service of Internet2. To prepare a demonstration, PI has collaborated with a staff (Andy Bavier) at PlanetLab project.

B. Deliverable Made

Not available during this quarter

II. Description of work performed during last quarter

A. Activities and Findings

1) Demonstration and outreach at GEC9.

In the demonstration, we showed two different kinds of federations:

- (1) federating the CRON testbed with ProtoGENI testbed at BBN and
- (2) federating the OntimeMeasure project with the CRON testbed.

Demonstration scenario 1:

At the GEC 9, our team demonstrated the federation between CRON testbed and ProtoGENI testbed at BBN through Internet2 ION service as shown in Figure 2. We federated CRON testbed with ProtoGeni test by connecting one server at the CRON testbed and one server at GPOLab at BBN. Using the ProtoGeni package on Emulab, we were able to reserve external resources from other ProtoGeni site. The data interfaces at both sides are connected into Internet2 through ION layer 2 services. This demo between CRON resource and GPOLab resource will be useful for future collaboration between ProtoGeni sites.

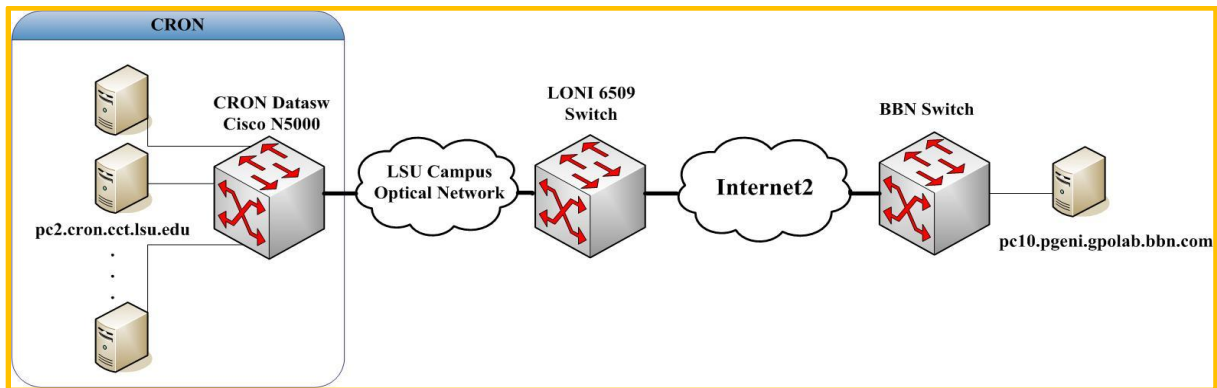
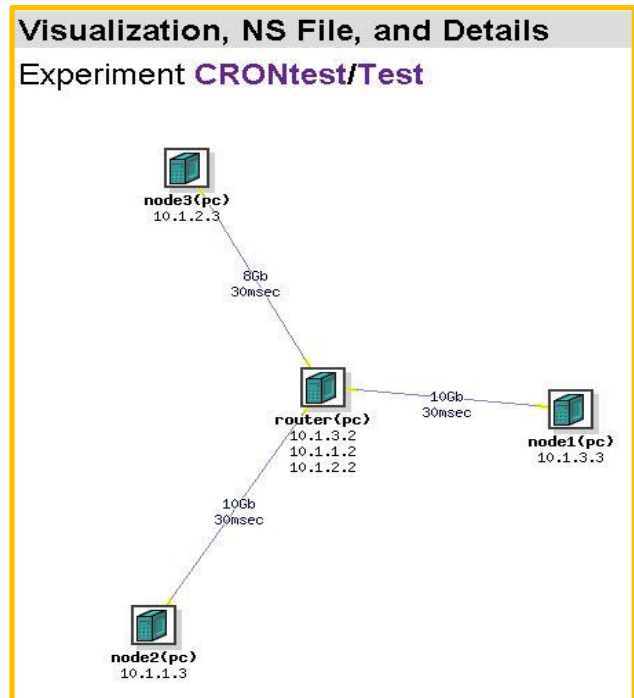


Figure 2. Configuration of Federation Demonstration between CRON testbed and ProtoGENI at BBN with ION service of Internet2.

Demonstration scenario 2:

To demonstrate the CRON testbed, A Y-shaped networking topology, which has two senders, one receiver and one intermediate router, was created. In this Y-Topology, each link has delay for 50ms; and each sender sends 10Gbps TCP competing flow through the router to the receiver. Our current solution for this high-speed bandwidth-delay-product was based on the optimized software emulator (Dummynet). The result showed the bandwidth could be up to 7Gbps in aggregation (more than 3Gbps for each flow). We believe that this kind of basic networking topologies in 10Gbps networking environment will be very helpful for you to start your high speed networking researches.



Federation between the CRON testbed and the OnTimeMeasure Project at Ohio State University:

We integrated the OnTimeMeasure slice on CRON experiment slice shown in the Figure 3.

The OnTimeMeasure developed at OSC/OARnet is a centralized model which requires two main components: 1) Node Beacon and 2) Root Beacon. Node Beacon Installs tools that measure network health metrics such as: route changes, delay, jitter, loss, and bandwidth. Those measurements run based on a schedule and outputs results. Root beacon generates measurement schedules for node beacons. It has a node beacon data collection mechanism based on MySQL database system and configuration files

and provides dashboard visualization, statistical analysis with alert generation. But user must log into a centralized OnTime Beacon web interface hosted by ontime.oar.net.

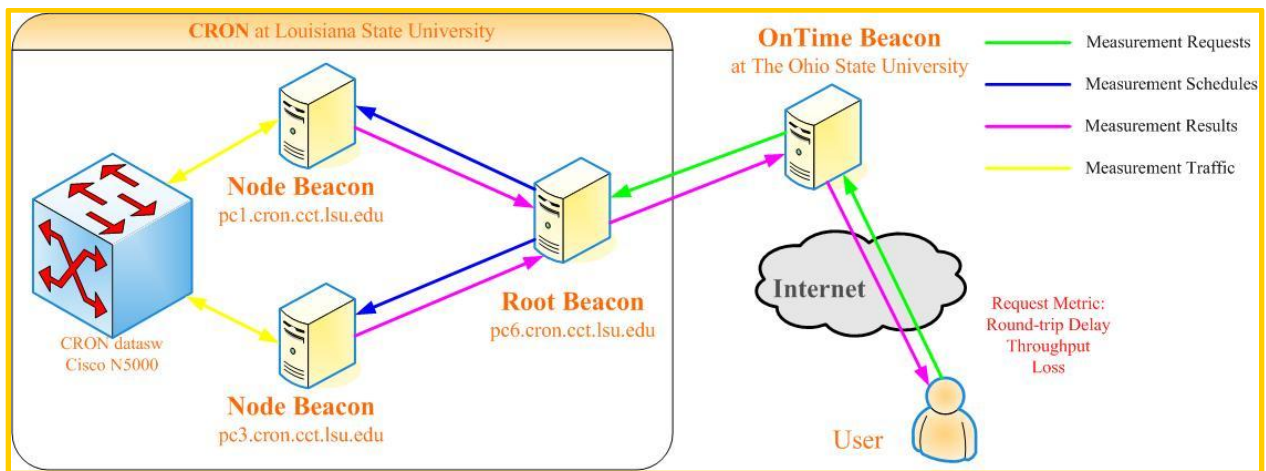


Figure 3. Configuration between CRON testbed and OnTimeMeasure Service

With the above configuration, we showed the measurement data which were collected over the Y-shaped network topology.

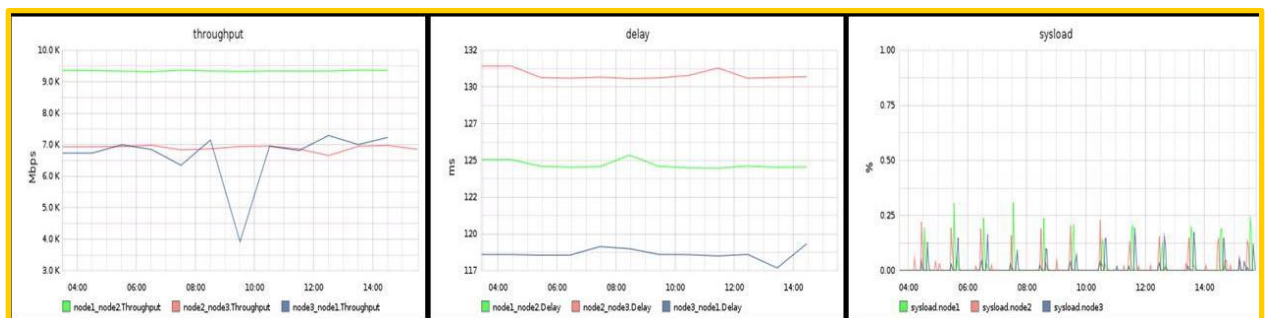


Figure 4. Real time data diagnosis at experiment over CRON testbed federated with OnTimeMeasure slice.

2) Making CRON aggregate manager functional

Regarding the task of aggregate manager, there are three sub-tasks to be finished as follows:

- (1) Recognize GENI credentials from at least 2 clearinghouses
- (2) Export status information to the GMOC
- (3) GENI experimenter guide (web pages or document) for using CRON resources

The CRON testbed has been recognized by the clearinghouse of ProtoGENI since November 2010. And CRON testbed will be recognized by the clearinghouse of PlanetLab after our team finishes GENI API over Internet2 by June 30, 2011. Because CRON testbed needs to be connected through Internet2, it takes additional time for us to implement interface to the ION service of Internet2.

The ProtoGENI implementation of GENI AM is live in Utah and Kentucky, and is part of emulab-stable. ProtoGENI has trusted the PlanetLab root certificate (it is included in their standard certificate bundle that all ProtoGENI installs receive), meaning that PlanetLab users can use the GENI API to reserve ProtoGENI resources. But this is still in its very early stages, so plenty of stuff is not ironed out yet. CRON source package from Emulab at Utah includes the source package for GENI AM, including functions of GetVersion, ListResources, CreateSliver, DeleteSliver, SliverStatus, RenewSliver, and Shutdown.

Our team has collaborated with staffs (POC: Camilo Viecco) at GMOC project to export the status of CRON testbed to the GMOC (GENI Meta-Operations Center). To export the status information, GMOC requires two conditions: (1) public IP connectivity and (2) SNMP compatibility. Until now, switches inside CRON testbed do not have public IP address due to security policy of Louisiana State University. To establish a connection between GMOC and CRON switches, it is necessary for our team to move IP address space of CRON testbed to public addresses, such as LONI networks. Our team requested the IP addresses to LONI networks. And it will be finished before May 2011. After that, GMOC will be allowed to access switches inside CRON testbed to collect status information.

Regarding GENI experimenter guide, our team put tutorial documentations and videos at our testbed web page (<http://cron.cct.lsu.edu/>) and wiki page (https://wiki.cct.lsu.edu/cronwiki/Main_Page). And more documentation will be uploaded in near future.

3) Preparation of a Demonstration at GEC 11

A new demonstration showing a federation with PlanetLab testbed is planned at GEC11 after implementing GENI API over the ION service of Internet2. To prepare a demonstration, PI has collaborated with a staff (Andy Bavier) at PlanetLab project.

Before GENI, there was one 'planetlab portal' inside Emulab for establishing connection and resource sharing with PlanetLab. So there were good examples about cooperation between Emulab and PlanetLab, as so called pre-GENI. However, PlanetLab had updated the interface on their side, and Emulab had made the decision not to track the changes, because a better federation through GENI comes as the way forward. This is called GENI federation.

PlanetLab and the Utah Emulab site are now federating through GENI in the sense that, if use the GENI interfaces, users can use Emulab-issued credentials to get nodes on PlanetLab, and vice versa. This is still in its very early stages, so plenty of stuff is not ironed out yet.

We will use GENI AM API within Emulab package to make connection between CRON and other Planetlab site. However, it is still in earliest stage as GENI API in Emulab under ProtoGENI reference is under heavy refreshing due to three major reasons:

- (1) The RSpecs are not yet standardized across different control frameworks, so it requires additional support for PlanetLab's version of node and request descriptions.
- (2) PlanetLab needs to include some node identifiers in their RSpecs which do not exist currently. ProtoGENI group have been in contact with PlanetLab about this, and it should happen soon.
- (3) At least some minimal support for the Emulab client-side (creating accounts, installing tarballs, etc.) should be running in PlanetLab.

B. Project Participants

PI: Seung-Jong Park

co-PI: Rajgopal Kannan

Graduate Students: Chase Pierson, Mohammed Azad, Cheng Cui, Lin Xue

C. Publications

1. Suman Kumar, Mohammed Azad, and Seung-Jong Park, "A fluid-based simulation study: the effect of loss synchronization on sizing buffers over 10Gbps high speed networks," in the proceeding of the 8th International Workshop on Protocols for Future, Large-Scale & Diverse Network Transports (PFLDNeT), Lancaster, PA, 2010.

D. Outreach Activity

N/A

E. Collaborations

ProtoGENI Project Group at University of Utah

OnTimeMeasure Project Group at Ohio State University

GMOC Project Group at Indiana University

PlanetLab Project Group at Princeton University

Openflow Switch Project Group at Stanford University

F. Other Contributions