

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

Period: July 2011 – September 2011

PI: Seung-Jong Park
Computer Science and Center for Computation & Technology
Louisiana State University
289 Coates Hall
Baton Rouge, LA 70803
sjpark@csc.lsu.edu

Co-PI: Rajgopal Kannan
Computer Science
Louisiana State University
289 Coates Hall
Baton Rouge, LA 70803
rkannan@csc.lsu.edu

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.

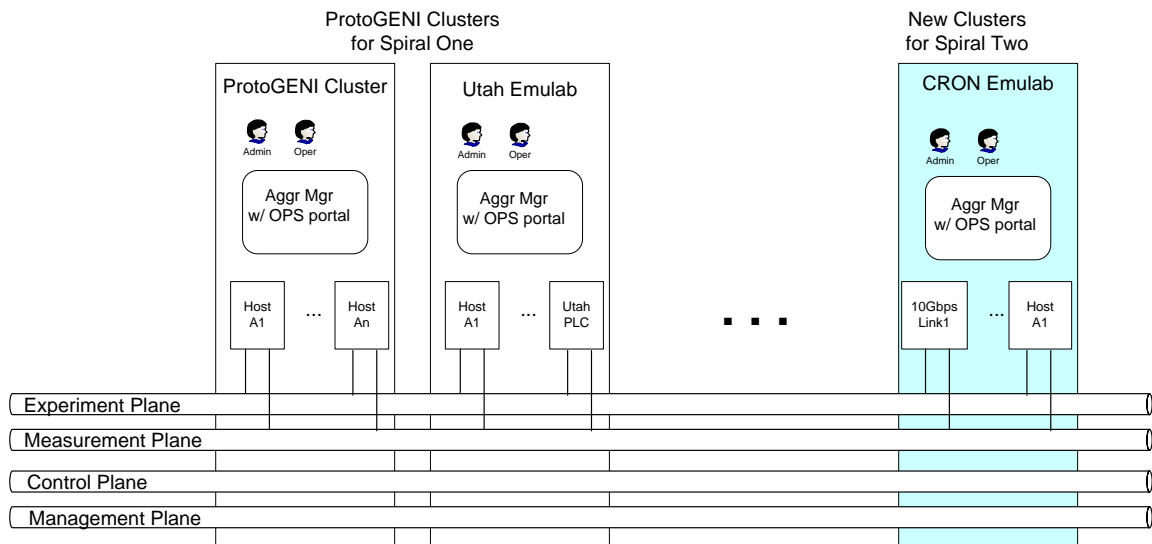


Figure 1. Implementation of Federation of CRON into ProtoGENI Cluster C at the Spiral 3

A. Milestones Achieved Between July 2011-Sept 2011

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: CRON:S3e GENI API on aggregate manager supports slices over I2 Due 6/30/11

Status: Accomplished

CRON aggregate manager uses the ProtoGENI AM version (stable version 20110420) which include GENI Aggregate Manager API that defines a key interface of the SFA 2.0 Draft. Therefore, using root certificates, CRON resource can be shard and interoperated among other framework groups including ProtoGENI and PlanetLab.

Milestone2: CRON: S3.f Demonstration and outreach at GEC11. Due 7/29/11

- Due to the lack of resources including testbed sites at other Framework groups (such as MAX testbed at PlanetLab group) connected to Internet2 ION service, demonstration was postponed to next GEC13 conference.

Status: Postponed

However, the collaboration with MAX project (led by Tom Lehman) is ongoing for future demonstration as follows:

Milestone3: CRON: S3.g Deliver software, documentation, user guides at GEC11. Due 8/19/11

- The CRON website (<http://www.cron.loni.org>) has maintained tutorials and video demonstrations for users. And softwares for CRON will be distributed to public users throughout CRON websites.

Status: Partially Accomplished

B. Deliverable Made

Tutorials and Demonstration videos have been uploaded to CRON website.
(<http://www.cron.loni.org>)

II. Description of work performed during last quarter

A. Activities and Findings

1) Upgrading CRON Aggregate Manager API based on the recent version of GENI AM API

To resolve several issues for external collaborators including GMOC project group, Pls moved CRON’s network domain from lsu.edu to loni.org (<http://www.cron.loni.org>) that can be accessed by any users from Internet as shown in Figure 2.

The screenshot displays the CRON website interface. At the top, there is a navigation bar with the text "Cyber-infrastructure of Reconfigurable Optical Networks" and a network diagram. To the right, a "Current Experiments" table shows 3 Active, 0 Idle, and 41 Swapped experiments, with 5 Free PCs available. The main content area is titled "CRON - 10Gbps High Speed Network Emulation Testbed Home". It includes an "Information" sidebar with links to CRON testbed Home, CRON News (June 21), Projects on CRON testbed, CRON Wiki, and Utah Emulab. Below this is a "Request Account" or "Log in" section with an LSU logo. The main text describes CRON as a cyberinfrastructure of reconfigurable optical networking environment that can provide multiple virtual networking testbeds consisting of routers, delay links, and high-end workstation operating up to 10Gbps bandwidth. It mentions support from NSF (award #0821741) and GENI grants, and that the LANET network research group at Louisiana State University has developed and operated the CRON testbed. Below the text are "Links to help you get started:" including "CRON Testbed Hardware Overview" and "CRON Testbed Demo Videos". The footer contains contact information for the LANET Network Research Group, LSU Center For Computation and Technology, and Louisiana State University, along with a copyright notice for 2000-2011 The University of Utah and a link to testbed-ops@cron.loni.org.

Figure 2. CRON testbed website for users (<http://www.cron.loni.org>)

After moving CRON testbed at July 2011, we have upgraded “ops.cron.loni.org” with latest Emulab API as users’ access server, public mailing server and file system, and upgraded “boss.cron.loni.org” with latest Emulab API in addition to ProtoGENI API to have direct federation to ProtoGENI and have support for map interface “Flack”. Authorized official SSL certificates have been approved from “lsu.edu”. And we have customized CRON testbed API to provide functionalities for 10Gbps optical network.

The CRON testbed has been operated to provide resource to research community including scientific researchers at LSU and networking researchers at GENI project (<http://www.geni.net>). Any user can request an account at the CRON website, and then share resources (e.g., Users from research community have accessed the CRON testbed and performed their experiments).

As of the end of September, although Flack has not developed full support for CRON SA, CRON resources are correctly displayed in Flack interface as shown in the Figure 3.

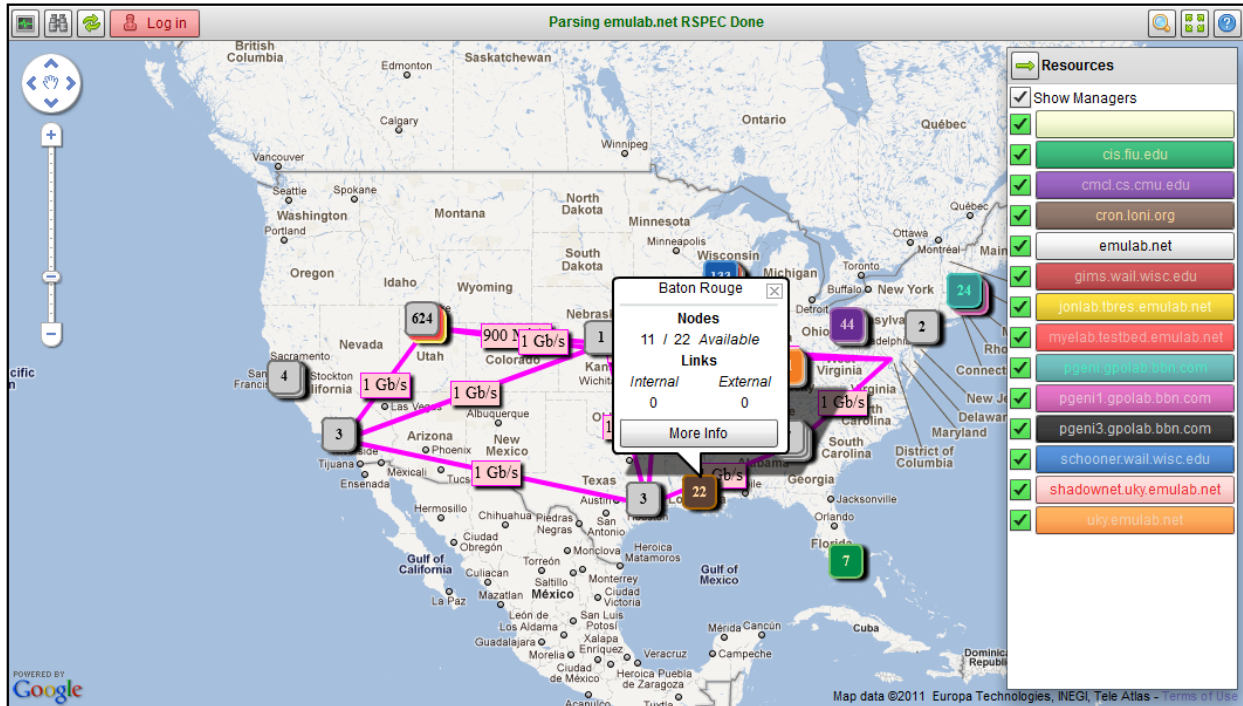


Figure 3. Flack interface showing the resources of CRON testbed

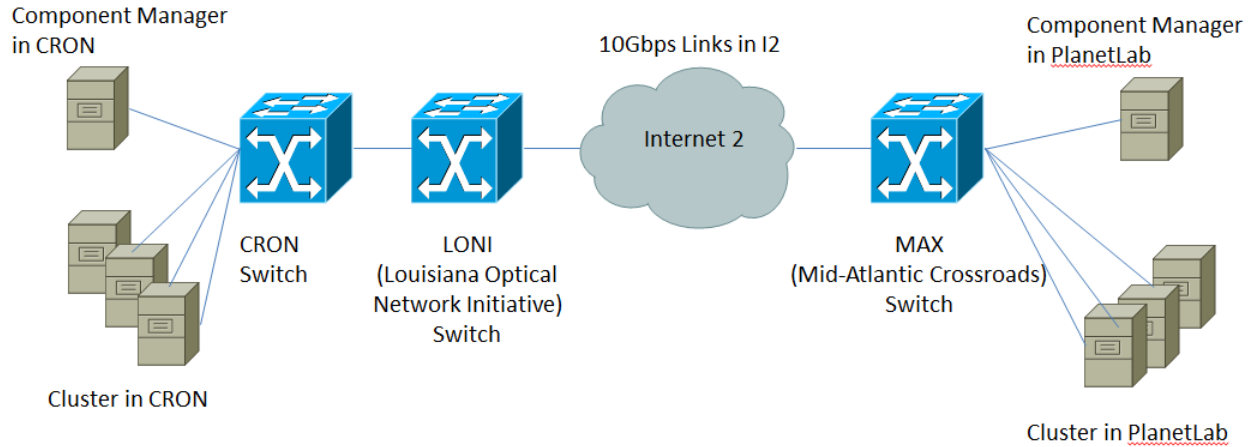
2) Federation of CRON through Internet2 in GENI framework

For GENI aggregation, at first, a GENI *clearinghouse* authenticates experimenters and issues them credentials needed to obtain GENI resources for experimentation. Then GENI *aggregates* provide resources to experimenters with GENI credentials. A GENI *slice* holds a collection of computing and communications resources capable of running an experiment or a wide area service. And *RSpec* is the mechanism for advertising, requesting, and describing the resources used by slice.

CRON uses the GENI Aggregate Manager API, including Flack and Omni. The GENI Aggregate Manager API provides a common interface to Aggregate Managers, including PlanetLab, ProtoGENI, and OpenFlow. Also, network stitching will be provided for CRON to connect into GENI through Internet2. GENI network stitching operation is to construct a topology of substrates as represented by their Aggregate Managers. Each Aggregate Manager has a unique Rspec which defines its Substrate resources. Rspecs is a topology description of the individual substrate.

We will get slivers including several machines from CRON at cron.loni.org(ProtoGeni) and several machines from MAX(PlanetLab). The steps to use Omni to get slivers at each site are as following:

1. Use Omni to request sliver on MAX AM
 - a. get the resource from MAX
 - b. get the VLAN number 1 on MAX side
2. Request ION circuit from LONI for CRON
 - a. get the VLAN number 2 on CRON side
3. Modify ION AM request to use VLAN number 1 and VLAN number 2 (change VLAN numbers in ion-request.xml), than request sliver on ION AM
4. ION will do VLAN translation
5. CRON to MAX Internet 2 connection done



3) Exporting the Status of CRON into GMOC project

To collaborate with GENI Meta-Operations Center (GMOC) located at Indiana University, which monitors status of resources and experimentations inside CRON Testbed, PIs have connected CRON testbed with GMOC center through Internet. GMOC monitors CRON's data switch CISCO N5020 by SNMP, which includes following MIBs.

- IF-MIB
- CISCO-STACK-MIB
- CISCO-VTP-MIB
- CISCO-PRIVATE-VLAN-MIB
- CISCO-VLAN-MEMBERSHIP-MIB
- CISCO-PAGP-MIB
- CISCO-CONFIG-COPY-MIB

And PIs have given all information including topology information inside CRON to GMOC as follows:

```

=====
Datasw  card1  port1  PC                port2  card2
=====
datasw  1      1      pc1                4      1
datasw  1      2      pc1                5      1
datasw  1      3      pc2                4      1
datasw  1      4      pc3                4      1
datasw  1      5      netfpga1          1      1
datasw  1      6      netfpga1          2      1
datasw  1      7      netfpga1          3      1
datasw  1      8      netfpga1          4      1
datasw  1      9      pc5                4      1
=====

```

datasw	1	10	pc5	5	1
datasw	1	11	pc6	5	1
datasw	1	12	pc7	2	1
datasw	1	13	pc7	6	1
datasw	1	14	pc7	3	1
datasw	1	15	pc7	7	1
datasw	1	16	pc8	4	1
datasw	1	17	pc8	5	1
datasw	1	18	pc9	4	1
datasw	1	19	pc9	5	1
datasw	1	21	hdem1	2	1
datasw	1	22	hdem1	1	1
datasw	1	23	hdem2	2	1
datasw	1	24	hdem2	1	1
datasw	1	25	hdem3	2	1
datasw	1	26	hdem3	1	1
datasw	1	27	hdem4	2	1
datasw	1	28	hdem4	1	1
datasw	1	29	pc2	5	1
datasw	1	30	pc3	5	1
datasw	1	33	pc6	4	1
datasw	1	37	pc4	2	1
datasw	1	38	pc4	6	1
datasw	1	39	pc4	3	1
datasw	1	40	pc4	7	1
datasw	2	1	pc13	2	1
datasw	2	2	pc12	2	1
datasw	3	1	pc11	2	1
datasw	3	2	pc10	2	1

=====

B. Project Participants

PI: Seung-Jong Park

co-PI: Rajgopal Kannan

Graduate Students: Cheng Cui, Lin Xue, Chui-Hui

C. Publications

N/A

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

MAX project at PlanetLab Control Framework

Openflow Switch Project Group at Stanford University

F. Other Contributions