

# **iGENI Quarterly Report**

## **GENI Project #1719**

**For the Period Jan 1, 2010 through March 31, 2010**

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### **1. Major Accomplishments**

This project is defining, designing, and implementing iGENI, a distributed network research infrastructure, which will be integrated with current and planned GENI resources and operated for GENI researchers, who will conduct experiments that involve multiple aggregates (at multiple sites). The iGENI infrastructure is being defined in collaboration with the GPO and other GENI projects to expand the variety of controllable transport services available to GENI researchers, to add additional capabilities to that infrastructure, and to make GENI available to more research communities. During Q2, iGENI participated in the primary Cluster-D demonstration at GEC 7 and also led a second large scale demonstration showcasing a new technique for using dynamic testbed provisioning for testing high performance protocols over wide area distances.

### **Current Capabilities**

The preliminary infrastructure architecture and design concepts have been developed for the iGENI US infrastructure and presented and discussed at various forums, including at GEC forums, most recently at GEC 7 on the campus of Duke University in Durham, North Carolina, March 16-18, 2010. An ORCA clearinghouse has been implemented at iCAIR and a high performance router and switch as well as optical fiber paths as core resources for the Cluster-D community. This core facility, which has been implemented within one of the iCAIR network research labs, has been connected by dedicated optical fiber to high performance switches at the StarLight International/National Exchange Facility. Also, private dedicated fiber was implemented between iCAIR/StarLight to the NLR core node at 111 North Canal in Chicago. A preliminary design was developed for a network that will interconnect all GENI Cluster-D sites – a GENI Cluster D network or GCDnet. Subsequently, a 10 Gbps path was established between the GCDnet node at StarLight and RENCIBEN in North Carolina, on the NLR FrameNet. Extensions were also provisioned to the University of Massachusetts at Amherst through the NOX in Boston and to the BBN Research Lab. Also, the initial design has been completed for extensions among the GCDnet at StarLight and Wayne State University and Ohio State University. Another design has been developed for a second 10 Gbps path to RENCIBEN. In addition, The iGENI community has begun planning connections from existing resources at the StarLight national and international communications exchange with current GENI backbone transport resources, with an initial path based on NLR Layer 2/Ethernet VLANs) using 10 Gbps NLR FrameNet and C-Wave lightpaths. Preliminary concepts and options are being explored for international path implementations, to Canada, Asia, and Europe.

## **1. Milestones Achieved**

iGENI milestones are described on the GENI wiki.

iGENI: S2.a The initial design of the iGENI infrastructure has been developed and reviewed, and the initial prototype has been implemented.

iGENI: S2.b The initial cluster plans for vLANs among testbeds that were first developed and presented at the GEC 6 workshop in Salt Lake City, November 16-18, 2009 have now been implemented within an initial distributed facility prototype. iGENI has been integrated as an aggregate with the ORCA control framework in Cluster D, with persistent and dynamic L1/L2 paths initially between StarLight and RENCI/BEN using GCDnet. This first implementation is now serving as a demonstration model for establishing similar connections to other Cluster D sites. This initial implementation was implemented in part to support Cluster-D demonstrations at the GEC 7 workshop.. Initially, the ORCA clearinghouse at RENCI is being used for GCDnet provisioning. The ORCA GENI Cluster D implementation includes one Broker, multiple Service Managers, and multiple Site/Domain Authorities.

iGENI: S2.c iGENI has been integrated with ORCA, through an initial lab implementation at iCAIR. This integration was demonstrated at GEC7.

## **2. Description of Work Performed During 2<sup>nd</sup> Quarter**

### **2.a. Activities and Findings**

Q2 activities were focused on designing and implementing prototypes based on core infrastructure architectural concepts and implementation plans. The iGENI initiative is developing processes and procedures for integrating core resources with an ORCA based control plane framework, including L2/L1 paths. iGENI is also moving forward with initial prototype implementations. These implementations allow for resources to selectively advertise their external interfaces, including vLANs, enabling interconnects among dedicated GENI resources, initially Cluster-D sites, and later, among resources provided by regional networks, national R&E networks, international R&E networks, non-profit R&D organizations, corporate R&D organizations, and other sites, facilities and institutions. Consideration is being given also for supporting multiple types of L1/L2 paths, including vLANs, tunneling services, e2e lightpaths, standard optical L2 framing, and others. Plans are also being developed to enable core L1/L2 resources to be identified using standard L1/L2 resource addressing while experimental L1/L2 core resources will be identified by using a method that allows for a level of abstraction that will be integrated into an XML-based resource description language. The ORCA control framework will provide for the network resource allocation. Within the iGENI infrastructure, calls will be mapped onto an addressable L1/L2 path infrastructure, using static, semi-dynamic and dynamic infrastructures. Edge resources will use a private addressing scheme. This scheme will be implemented under common agreement among participants. The addressing will be incorporated into an XML-based description language. (The Cluster-D lead organizations sponsored a network description language workshop at GEC7.) This design anticipates that the core resource infrastructure framework and the experimental research infrastructure will be operated by distributed operational NOC processes. Core infrastructure will be addressed by a management plane based on common L3 secure channels in addition to the control plane framework.

The ORCA control framework has been integrated with the iGENI infrastructure. iGENI Consortium has implemented the Open Resource Control Architecture (ORCA) control framework at the StarLight international exchange facility. An instantiation of ORCA was installed on a server in one of the iCAIR research labs and it has been integrated with facilities equipment. A second implementation integrates iCAIR and StarLight facilities with the ORCA clearinghouse at RENCI. This implementation is integrated with switches and servers at a core node in the StarLight facility. iGENI is now integrated as an aggregate with that implementation of the ORCA control framework in Cluster D, with L1/L2 paths among StarLight, RENCI/BEN, and other Cluster-D sites. This initial implementation is serving as a model for establishing connections to other sites. Through ORCA, available resources in iGENI can be discovered; services can be setup and managed; and, individual traffic streams will be controlled and managed. This project has implemented interfaces to ORCA that allow dynamic control of network services involving iGENI, associated transport resources and GENI aggregates. It is possible to setup services using prepackaged or customized configurations and topologies.

The initial prototype was demonstrated at the GEC 7 workshop.. In partnership with RENCI (Renaissance Computing Institute), Duke University, the University of Massachusetts, and other D-Cluster participants and supported a demonstration of dynamic vLAN provisioning for GEC 7, based on dynamic and static L1/L2 paths among multiple Cluster-D sites. (Ref : Figure 1 below). The paths were established to interconnect the StarLight communications exchange facility in Chicago, RENCI/BEN in North Carolina, the Duke University demonstration site, and the University of Massachusetts at Amherst. (Recently, planning meetings have been held to enable extensions between the GCDnet at StarLight and Wayne State University and Ohio State University using paths based on regional optical fiber.)

A second, related GEC 7 demonstration showcased the potential for creating a highly scalable network research lab instrument. This demonstration indicated the potential for using dynamic large scale infrastructure for highly distributed network experiment instrumentation, including a 7000 mile network testbed for high performance protocols. The Challenge: Currently, enabling researchers to conduct experiments over large distances, such as thousands of miles has been a difficult complex process, requiring many manual tasks and physical implementations. This demonstration, using an innovative high performance transport protocol, showed how such experiments can be conducted on large scale flexible infrastructure. The Current Solution: This demonstration compared the performance of UDX and UDT over multiple distances, including 7,000 miles. The testbed used for the demonstration was been created on the national C-Wave infrastructure, which has been implemented within the National Lambda Rail.

## **2.b. Project Participant Activity**

The primary activities in Q1 have been a) designing and implementing infrastructure, b) designing and conducting demonstrations for GEC 7, and c) R&D meetings with GENI Cluster D partners, national research networking organizations, and international research network organizations, as well as conference calls and meetings at GEC with the ORCA framework developers.

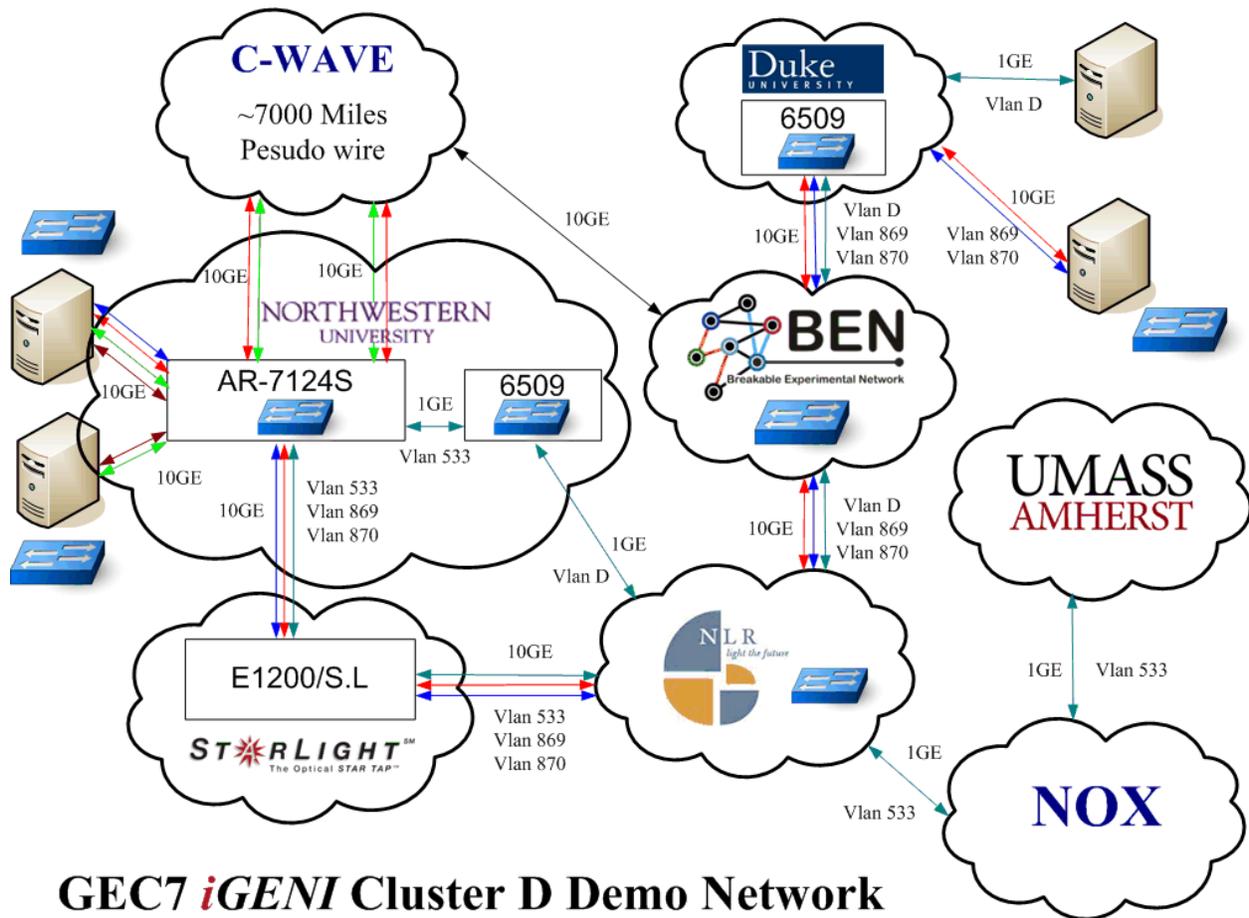
## **2.c. Publications and Presentations**

The iGENI community presented the iGENI project during GEC 7 and at meetings with several groups of international visitors at iCAIR. The iGENI project was also the topic of a presentation at the quarterly meeting of the Executive Committee of the Metropolitan Research and Education Network (MREN) in

March. Plans are being made to organize iGENI presentations in Daejeon and Seoul, South Korea in June, and at the GLIF 10th Annual Global LambdaGrid Workshop, 12-14 October 2010 in Geneva, Switzerland an event hosted by CERN. GLIF (Global Lambda Integrated Facility) participants include National Research and Education Networks (NRENs), consortia and institutions who are creating a globally distributed infrastructure testbed facility based on optical-fiber lightpaths and are involved in multiple, innovative communication services and technology projects.

### 2.d. Outreach Activities

iGENI participated in planning meetings for demonstrations at the SC10 international supercomputing conference in November 2010 in New Orleans, and at the international 2010 Global LambdaGrid (GLIF) Workshop in Geneva, Switzerland.



**GEC7 iGENI Cluster D Demo Network**

**Figure 1**