

Bringing GENI to the Classroom: Three Sample Assignments

**NSF Workshop on Designing Tools and Curricula for
Undergraduate Courses in Distributed Systems**

Boston, Massachusetts

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www.geni.net

Thank you to ...

NSF for sponsoring this important workshop.

Jeannie Albrecht for the opportunity to speak here today.

Sunae Shin, Kaustubh Dhondge, and Baek-Young Choi (UMKC) and Jeannie (again) for allowing us to base sample assignments on their work.

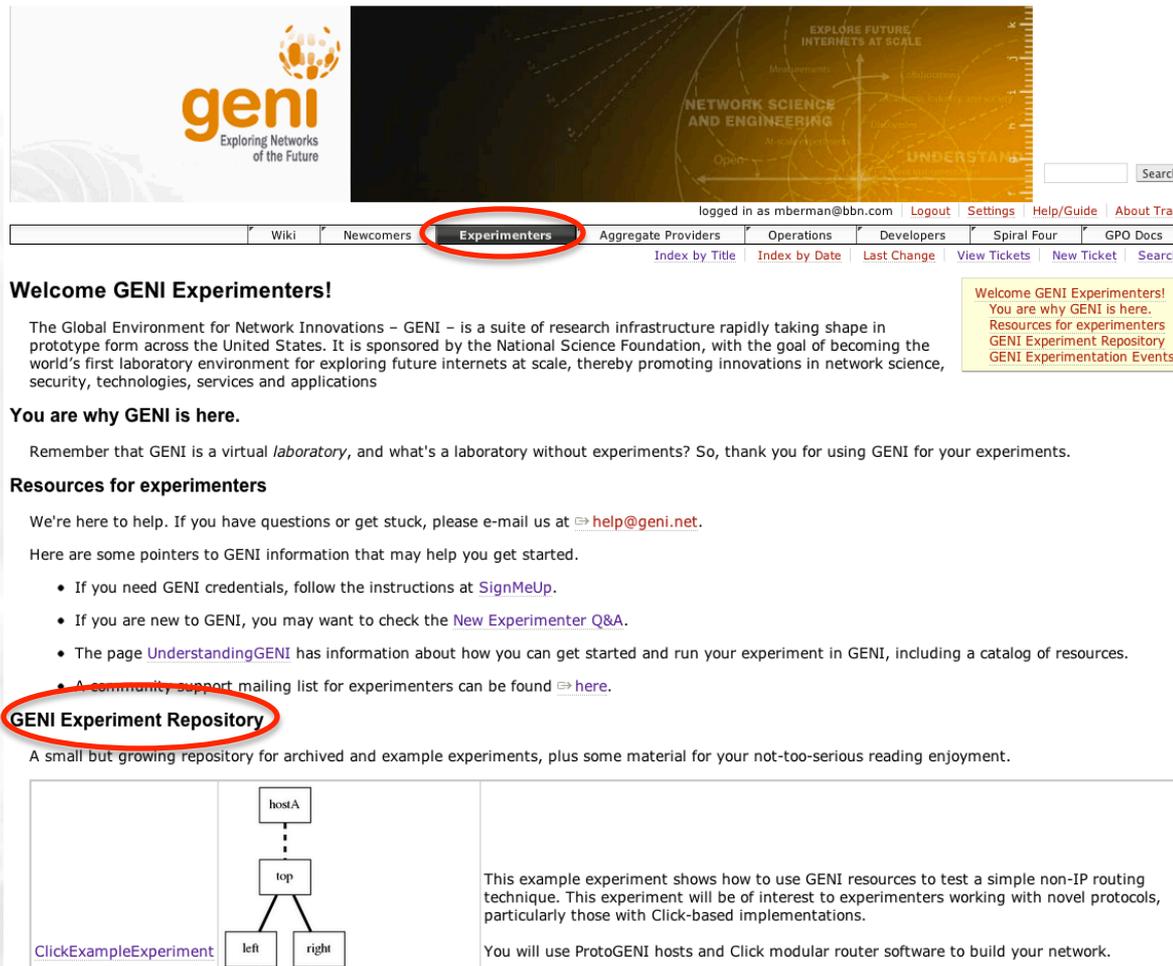
- Brief commercial announcement
- Three sample assignments using GENI
 - Software routing in a non-IP network with Click (guided tour)
 - Compare two transfer protocols (structured experiment)
 - Develop a web server (open-ended programming assignment)
- An offer of help

- GENI is a distributed virtual laboratory for **exploring future internets at scale**, now rapidly taking shape in prototype form across the United States.
 - Computers (virtual and/or physical) connected in experimenter-specified topologies at layer two and/or three.
- Testbeds like GENI provide an opportunity to conduct more classroom-based experiments in situations where paper analysis and simulation are frequently used.
- GENI has a strong interest in encouraging the use of testbeds (and GENI in particular) in networking and distributed computing education.
 - The GENI project office is eager to devote resources (both testbed resources and people) to this effort.
 - We need help from you to target the effort productively.

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The following three assignments are on the GENI wiki:

<http://groups.geni.net/geni/wiki/GeniExperimenterWelcome>



logged in as mberman@bbn.com | Logout | Settings | Help/Guide | About Trac

Wiki | Newcomers | **Experimenters** | Aggregate Providers | Operations | Developers | Spiral Four | GPO Docs

Index by Title | Index by Date | Last Change | View Tickets | New Ticket | Search

Welcome GENI Experimenters!

You are why GENI is here.
Resources for experimenters
GENI Experiment Repository
GENI Experimentation Events

The Global Environment for Network Innovations – GENI – is a suite of research infrastructure rapidly taking shape in prototype form across the United States. It is sponsored by the National Science Foundation, with the goal of becoming the world’s first laboratory environment for exploring future internets at scale, thereby promoting innovations in network science, security, technologies, services and applications

You are why GENI is here.

Remember that GENI is a virtual *laboratory*, and what’s a laboratory without experiments? So, thank you for using GENI for your experiments.

Resources for experimenters

We’re here to help. If you have questions or get stuck, please e-mail us at help@geni.net.

Here are some pointers to GENI information that may help you get started.

- If you need GENI credentials, follow the instructions at [SignMeUp](#).
- If you are new to GENI, you may want to check the [New Experimenter Q&A](#).
- The page [UnderstandingGENI](#) has information about how you can get started and run your experiment in GENI, including a catalog of resources.
- A [community support mailing list](#) for experimenters can be found [here](#).

GENI Experiment Repository

A small but growing repository for archived and example experiments, plus some material for your not-too-serious reading enjoyment.

[ClickExampleExperiment](#)

```

graph TD
    hostA[hostA] -.- top[top]
    top --- left[left]
    top --- right[right]
  
```

This example experiment shows how to use GENI resources to test a simple non-IP routing technique. This experiment will be of interest to experimenters working with novel protocols, particularly those with Click-based implementations.

You will use ProtoGENI hosts and Click modular router software to build your network.

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Prerequisites

- Student can start a GENI experiment
 - Has GENI credentials
 - Can use Flack (GUI) or omni (CLI) tool to create a GENI slice
- Somewhat comfortable at Unix command line
- Rough understanding of the purpose of a router, IP headers, IP v. MAC addressing

Goals

- Exposure to software routers (Click)
- Exposure to a (contrived) non-IP protocol

Style

- Guided tour – student follows a set sequence of steps

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Prerequisites

- Student can start a GENI experiment
 - Has GENI credentials
 - Can use Flack (GUI) or omni (CLI) tool to create a GENI slice
- Somewhat comfortable at Unix command line
- Aware of the role of TCP and performance concerns in high bandwidth-delay product situations

Goals

- Explore effects of delay, bandwidth, and packet loss on two transfer protocols
- Analyze and report results

Style

- Structured experiment – procedure is described, student discovers interesting range of parameters and completes analysis.

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Prerequisites

- Student can start a GENI experiment
 - Has GENI credentials
 - Can use Flack (GUI) or omni (CLI) tool to create a GENI slice
- Elementary systems programming in C/C++

Goals

- Develop a web server
- Assess performance in a networked environment
- Reason about protocols and performance tradeoffs

Style

- Open-ended – a test harness and basic instructions are provided, student writes substantial code, then tests and analyzes results.

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- Our goal is to nourish a thriving exchange of useful educational materials that use testbeds to encourage classroom-based experiments
 - Is there an example that you would like to see available?
 - Do you have an assignment that others could use?
 - Do you need help to implement a project / experiment in GENI?
- What kind of logistical support is needed?
 - Should we help train your TAs? How?
 - What's the most convenient approach to setting up accounts for a class full of students?

Best

- “I’m ready to use GENI in my ... class in the Spring. Please help me to get ready.”

Good

- “I’d like to use GENI, but I’m concerned that the {curriculum, support, training, ...} isn’t ready.”
- “I need to know more about GENI.”

Important (but sad) to hear

- “I don’t see any benefit.”
- “You GENI folks are on a fool’s errand, and let me tell you why.”

If you have one of these messages, see me or participate in the Monday curriculum session at the GEC.

GENI Engineering Conferences

We welcome your participation in creating GENI

- **14th meeting, open to all:
Monday – Wednesday, right here**
 - Planning & discussion for experimenters, software, infrastructure
 - Tutorials and workshops
- mberman@bbn.com or help@geni.net
- www.geni.net



2nd GENI Research and Educational Experiment Workshop (GREE2013)

- March 2013
- University of Utah, co-located with GEC 16
- Format
 - Keynote speech
 - Paper presentation
 - Research, education, tutorial papers
 - Panel/open discussion
 - Tutorials and demos
- Contact
 - Kaiqi Xiong (RIT)
 - Bing Wang (University of Connecticut)

If you develop educational materials using GENI resources,
consider submitting them to the workshop.