# 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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**July 8, 2012**
**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.
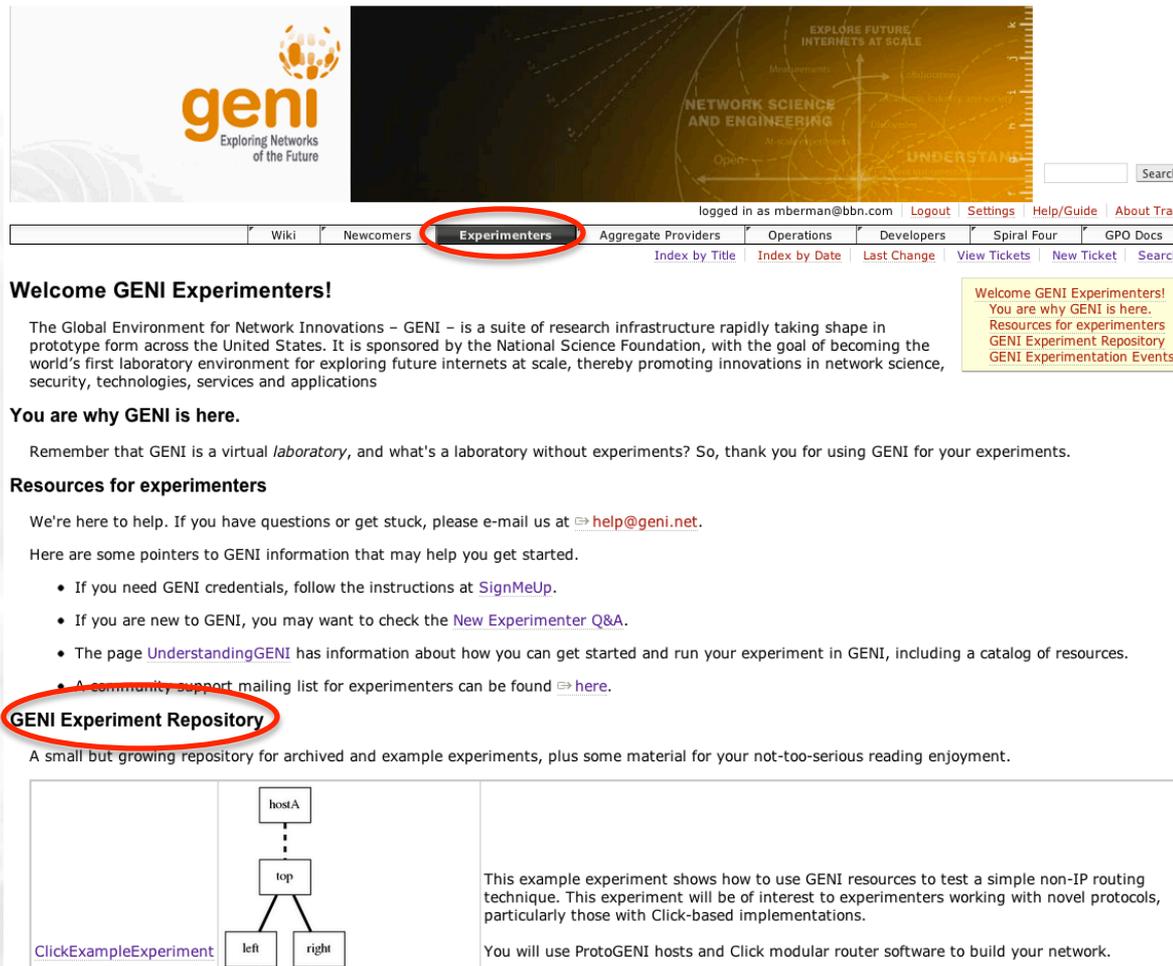
- **Brief commercial announcement**
- Three sample assignments using GENI
  - Software routing in a non-IP network with Click (guided tour)
  - Compare two transfer protocols (structured experiment)
  - Develop a web server (open-ended programming assignment)
- An offer of help

- 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

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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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(Based on work by Shin, Dhondge, and Choi at UKMC)

## 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.

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

- 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.