

GENI D&P WiMAX Infrastructure Build-outs

Supported by NSF awards #0944089 (2009) and #1128122 (2011).

Managed by the GENI Project Office at Raytheon BBN Technologies; see below and www.geni.net.

GENI Overview

The Global Environment for Network Innovations (GENI) is a novel suite of infrastructure now being designed to support experimental research in network science and engineering. This research challenges us to understand networks broadly and at multiple layers of abstraction, from physical substrates, through the architecture and protocols, to networks of people, organizations, and societies.

GENI entered its prototyping phase in 2007, when NSF awarded the GENI Project Office (GPO) role to Raytheon BBN Technologies. The GPO subsequently initiated a community-based design and planning process, and issued a set of academic / industrial subcontracts to build, integrate, and operate the earliest GENI prototype, called GENI Spiral 1.

Completion of Spiral 1 Prototype

GENI Spiral 1 kicked off in October 2008 as multiple academic / industrial teams started creating and integrating early prototypes of the GENI suite. Spiral 1's two central goals were to demonstrate: (a) one or more early prototypes of the overarching GENI control framework, and (b) end-to-end slices operating across multiple technologies. Completion of these goals was demonstrated in October 2009 at the GENI Engineering Conference.

Beginning of Meso-Scale Prototype GENI Infrastructure in Spiral 2

Next, the building of "meso-scale" prototype GENI infrastructure was started in October 2009, at the beginning of Spiral 2. It has been built from GENI-enabled commercial hardware across 13 university campuses, linked by compatible build-outs through two US competing national research backbones (Internet2 and NLR). This work is funded by the NSF award #0944089, for "GENI D&P Infrastructure."

This has included two types of campus build-outs – OpenFlow and WiMAX – with significant commonality in the technologies employed, and significant overlap between the two sets of campuses. It has GENI-enabled more than a dozen campuses of major research universities throughout some or their entire footprint.

Enhancing Meso-Scale Prototype GENI Infrastructure in Spiral 4

Recently, an effort has started in October 2011, at the beginning of Spiral 4, to enhance the "meso-scale" prototype GENI infrastructure. This work is funded by the NSF award #1128122, for "GENI Solicitation 3 D&P Proposal."

This will grow the OpenFlow footprint in Internet2, NLR, and 6 major regional research networks across 16 states and beef up campus WiMAX deployments via multi-cell sites, Android handsets, and vehicular experiments. It will involve Ford Motors, regional transit systems and multiple state departments of transportation.

WiMAX Infrastructure Build-outs

The WiMAX build-outs will create an open, programmable, GENI-enabled “cellular-like” infrastructure through 11 major research university campuses.

Open WiMAX base stations will provide network researchers with wide-area coverage and the ability to support both mobile and fixed end-users. Campus-wide WiMAX coverage will make it possible to quickly extend GENI services for “opt-in” by large user populations with a relatively low capital investment.

These build-outs are high payoff because it opens a path towards research experimentation with open, programmable cellular telephony systems. Many researchers believe that user interaction with “future internets” will take place primarily through cell phones; this is one of the few feasible paths towards making such experimentation widely available to the research community.

In the enhanced WiMAX build-outs, there is an emphasis on “multi-cell” sites fielding more than one base station or antenna sector in a geographic area. Four of these WiMAX sites are emphasizing vehicular applications; two sites will be working with their state Departments of Transportation on deployments and innovative WiMAX applications. One site is fielding a multi-vendor WiMAX network, with mobile nodes carried on metro transit busses. Another site is deploying energy-efficient and scalable mobile storage services that make use of in-network storage and computation.

Figure 1 indicates the campuses that participated in the initial WiMAX build-out, and those that are being added as part of the enhanced build-out. Each will perform its own local experimentation with the equipment and also make it available as part of the end-to-end GENI infrastructure to researchers across the United States.

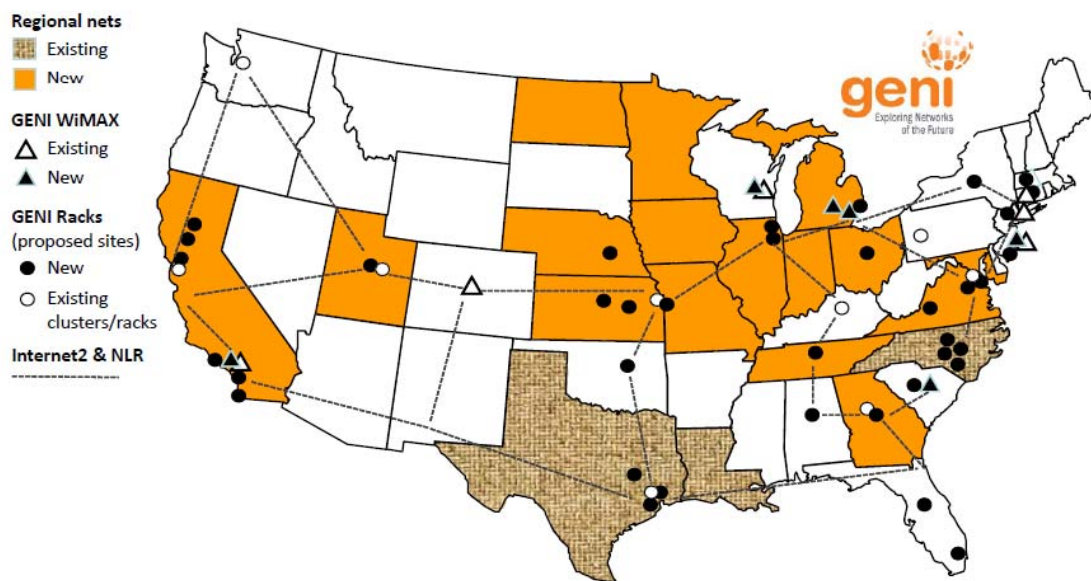


Figure 1. WiMAX campus build-outs

Table 1 provides a summary list of campuses, Principal Investigators (PIs), and campus IT leadership who will be responsible for these build-outs. All campuses have directly relevant research projects that can benefit from involvement with the GENI project (and vice versa).

Campus	PI & IT Leadership	Build-out
Columbia University New York, NY	Henning Schulzrinne	WiMAX (initial)
NYU Polytechnic Brooklyn, NY	Thanasis Korakis	WiMAX (initial)
WINLAB Rutgers University North Brunswick, NJ	Ray Raychaudhuri Charles Hedrick (CTO)	WiMAX (initial and enhanced) (and OpenFlow)
Clemson University Greenville, SC	K-C Wang	WiMAX (enhanced)
UCLA Los Angeles, CA	Mario Gerla James Davis (CIO)	WiMAX (initial and enhanced)
University of Colorado (Boulder) Boulder, CO	Dirk Grunwald	WiMAX (initial)
University of Wisconsin (Madison) Madison, WI	Suman Banerjee Perry Brunelli (Dir.)	WiMAX (initial and enhanced) ((and OpenFlow)
University of Michigan Ann Arbor, MI	Morley Mao	WiMAX (enhanced)
Wayne State University Detroit, MI	Hongwei Zhang	WiMAX (enhanced)
UMass. Amherst Amherst, MA	Mark Corner Daniel Blanchard (ACIO)	WiMAX (initial)

Table 1. Campus researchers and IT leadership committed to GENI infrastructure build-outs.

GENI D&P Infrastructure Awards

As noted above, the GENI D&P Infrastructure Build-outs are supported by two NSF awards, summarized here:

Award Abstract #0944089

GENI D&P Infrastructure

<http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0944089>

Award Abstract #1128122

GENI Solicitation 3 D&P Proposal

<http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1128122>

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