

Workshop Report:  
GENI Future Planning Workshop  
Washington DC  
December 10-11, 2015

January 2016

# Contents

<b>1 Summary</b>	<b>3</b>
<b>2 Background</b>	<b>3</b>
<b>3 Context Setting Talks</b>	<b>4</b>
<b>4 Working Groups</b>	<b>5</b>
4.1 Governance and transition . . . . .	5
4.2 Technical priorities . . . . .	6
4.3 Budget and operations . . . . .	6
4.4 Community engagement . . . . .	7
<b>Appendices</b>	<b>10</b>
<b>Appendix A Workshop Agenda and Goals</b>	<b>10</b>
<b>Appendix B Workshop Participants</b>	<b>12</b>

# 1 Summary

The GENI Future Planning Workshop, sponsored by the GPO and the NSF, was held in Washington DC on December 10-11, 2015. A total of 48 participants attended the workshop. The majority were from academic institutions, with significant representation from industry and from US government research organizations.

The primary workshop goal was to gather members of the research community with an interest in GENI to plan the future of GENI and its relationship to future funded research programs. Workshop participants sought to reach rough consensus on elements of a working plan that addresses GENI's transition to a new, community-driven governance model by the end of 2017, as well as key questions for GENI's continued success, ongoing contributions to mid-scale cyberinfrastructure, and future sustainment.

Workshop participants reached consensus on several key elements of a GENI plan, including:

- A rough timeline and milestones for GENI transition in 2016 and 2017.
- A governance model built on two entities, a policy group (*GENI Council*), and an executive / administrative team.
- Budget breakdown for basic centralized expenses of ongoing GENI operations and sustainment.
- Priorities for GENI's ongoing technical development and for community engagement activities.

The workshop also identified several remaining questions. Chief among these were:

- Are there adequate sources of revenue for ongoing GENI operations and sustainment?
- Who (specific individuals and organizations) will staff and host the GENI governance bodies beyond 2017?

Workshop participants agreed that answering these questions and beginning work on GENI transition requires near-term action. Participants recommended

the formation of a transition team to work on an interim basis to refine the transition plan and address the most pressing risks: retaining key expertise, maintaining budget security, and expanding GENI's research contributions. The workshop asked the current GENI project director, Mark Berman, to chair the transition team and recruit additional members as needed.

Additional information on the workshop is provided in this report. Full details of the workshop, including all presentations, are archived at the workshop web page, <http://groups.geni.net/geni/wiki/GENIFuturePlanning/December2015Meeting>.

# 2 Background

Over the next two years, the NSF's Global Environment for Network Innovations (GENI) project will transition from a stage of development and deployment managed by the GENI Project Office (GPO) to a phase of continuing operations and support of research innovations under a new governance model, with roots in the larger research community. During the period through Fall 2017, the relevant community, to include academia, industry, and government stakeholders, including NSF, will establish governance, administrative, and operations resources and procedures to meet the following goals:

- Continue and expand GENI's success as a platform for research and education;
- Identify and recommend research investment opportunities in support of future GENI operations and capabilities; and
- Maximize the contribution of existing cyberinfrastructure design and community to future research cyberinfrastructure projects.

This transition process is expected to play out over the coming two years and complete by the end of 2017.

Since June 2015, the GENI community has been involved in an open and participative planning process, which is documented more thoroughly at the

GENI Future Planning web page, <http://groups.geni.net/geni/wiki/GENIFuturePlanning>. Highlights of this planning process include:

1. June 2015: Future planning kickoff at GEC23 (see <http://groups.geni.net/geni/wiki/GEC23Agenda/GENIFuturePlanning>)
2. Summer 2015: Gather community input (see <http://groups.geni.net/geni/wiki/GENIFuturePlanning/InitialCommunityInput>)
3. Fall 2015: Community discussion period (see <http://lists.geni.net/pipermail/future-discuss/>)
4. December 10-11, 2015: Future planning meeting in DC (summarized in this document, also see <http://groups.geni.net/geni/wiki/GENIFuturePlanning/December2015Meeting>)

The purpose of this workshop was to complete transition planning, document areas of consensus and ongoing debate, and begin the transition process.

### 3 Context Setting Talks

Jim Kurose opened the workshop with an overview of NSF’s perspective on the contributions of GENI to research, to community development, and to research cyberinfrastructure development. Jim emphasized his opinion that GENI is critical to the future of mid-scale cyberinfrastructure, which he called out as a key element of NSF CISE’s ongoing strategy. He asked workshop participants to pursue approaches both to sustain current GENI capabilities and to “propagate GENI infrastructure” and technology in future programs.

After Mark Berman outlined the workshop organization and goals, nine members of the community presented their position papers outlining their perspective on strategic goals and transition approaches for GENI.

- John Moore (Internet2)
- Glenn Ricart (US Ignite)

- Jim Bottum (Clemson)
- Rob Ricci (Utah)
- John Geske (Kettering)
- Ilya Baldin (RENCI)
- Joe Mambretti (Northwestern)
- Rick McGeer (US Ignite)
- Andy Bavier (Princeton) & Jim Griffioen (Kentucky)

The presentation material for these statements is available on the workshop web page. Some themes that were common to multiple position statements or captured the sense of the workshop are summarized below.

1. There was a strong consensus (see, e.g., Moore, Ricart, Ricci, Geske, Baldin, Mambretti, McGeer) that GENI has become a vital tool for research and education and that sustaining and consolidating current GENI capability is of central importance.
2. Several presenters (e.g., Geske, Ricci, McGeer) emphasized the importance of a centralized administrative body, similar to the existing GENI project office. Two groups, Internet2 (Moore) and USIgnite (Ricart), went a step farther and expressed explicit interest in assuming administrative responsibility for GENI in the post-2017 period. Others (e.g., Mambretti, Geske) both advocated for central organization and recommended specific governance approaches to ensure GENI’s future research benefit.
3. The workshop acknowledged a potential tension between sustainment and additional capability development and technology propagation. While a minority (see Baldin) argued against emphasizing sustainment to focus on transitioning GENI technology to new efforts, the sense of the participants was that this tension could be managed through good engineering discipline (see, e.g., McGeer, Geske, and the report from the technical priorities working group).

4. GENI should continue its practice of exposing researchers both to larger scale and wider resource diversity through federation with partner testbeds and organizations (see, e.g., Baldin, McGeer, Mambretti).
5. Rick McGeer argued that GENI must both plan for and actively solicit continued rapid growth in adoption, advocating a strategy of minimizing the barriers to entry for both end users and institutional partners. Workshop participants embraced the rapid growth goal, and the community engagement working group identified concrete implementation actions.
6. Workshop participants agreed on the importance of consistent funding to enable researchers and educators to adopt GENI with confidence.

## 4 Working Groups

Most of the meeting’s work was accomplished by four working groups. Each group was co-chaired by two researchers, representing different US academic institutions. Initial working group sessions were held in two parallel tracks on the first day of the workshop, with workshop participants self-selecting their working group participation according to interest and expertise. After “quick look” workshop outbriefs on day one, each working group’s interim reports were reviewed and discussed by the full group of workshop participants. They were then updated to reflect consensus, where possible, or to document key decisions or areas of continuing debate.

### 4.1 Governance and transition

**Co-chairs:** Deep Medhi (UMKC) and KC Wang (Clemson). <sup>1</sup>

The governance and transition working group addressed organizational and scheduling issues around

<sup>1</sup>Working group outbrief: <http://groups.geni.net/geni/attachment/wiki/GENIFuturePlanning/December2015Meeting/Governance%20and%20Transition%20Outbrief.pdf?format=raw>

the transition from current GENI management to a research community-driven governance model.

The group reached consensus on a number of central issues:

1. The group found a two-year time frame for transition challenging, but achievable, and agreed to use the provisional timeline outlined in the read ahead material as a starting point. <sup>2</sup>
2. There was general concurrence on a two-body governance system, a *GENI Council* with policy responsibility, and an administrative body with an executive director and modest staff.
3. While GENI sustainment is an important near-term goal, long-term viability and success demand that GENI continues to present a dynamic research platform aligned with future research needs, particularly mid-scale cyberinfrastructure projects.
4. The GENI Council should draw from multiple constituencies within the GENI community, including end users (researchers and educators), campus CIOs and infrastructure hosts, and infrastructure developers.

The working group devoted significant time to discussing qualifications of the members of a future GENI council. The group observed that the council may need to represent multiple current and future constituency groups of GENI (a topic that was also addressed by the community engagement working group, see section 4.4). In addition, participants felt it would be important for the council to advance a visionary agenda, to ensure that GENI remains well-aligned with compelling new research and drive continued dramatic growth in adoption. After some discussion, the working group deferred decisions on detailed procedures of governance, including the process for selecting council members. There was only limited discussion on the advantages and disadvantages of various potential host institutions for future

<sup>2</sup>Read ahead: <http://groups.geni.net/geni/attachment/wiki/GENIFuturePlanning/December2015Meeting/Governance%20and%20Transition%20Background.pdf?format=raw>

GENI management, and the group did not feel sufficiently informed to make a firm recommendation.

As the full workshop discussed the working group's outbrief, participants expressed concern that the process of recruiting GENI Council members would be time-consuming and could cause unacceptable delays to the transition timeline. Kate Keahey suggested the formation of a transition team, with responsibility to push the transition agenda forward on an interim basis. The workshop participants agreed with this approach and named Mark Berman to lead the transition team and recruit additional members as needed. The transition team was asked to present initial progress at the upcoming GENI Engineering Conference (GEC24) in March 2016.

## 4.2 Technical priorities

**Co-chairs:** Dipankar Raychaudhuri (Rutgers) and Mike Zink (UMass).<sup>3</sup>

The technical priorities working group worked to identify technical priorities for a future GENI across multiple time ranges. The group took into consideration both current user sentiment and anticipated needs to support forthcoming research goals. Based on the efforts of the working group, the workshop participants ratified in large part the technical needs expressed by GENI's current researcher and educator user communities, as expressed in the read ahead material.<sup>4</sup> Because resources are limited and because of the inherent tension between the goals of stability and continued feature deployment, the working group recommended the following priorities in planning GENI's future development and operations.

1. First sustain GENI and its technologies and then augment the existing infrastructure with new technologies.
2. Retain GENI's identity as a heterogeneous federation and its ability to enter into new federations

---

<sup>3</sup>Working group report: <http://groups.geni.net/geni/attachment/wiki/GENIFuturePlanning/December2015Meeting/Technical%20Priorities%20Report.pdf?format=raw>

<sup>4</sup>Read ahead: <http://groups.geni.net/geni/attachment/wiki/GENIFuturePlanning/December2015Meeting/Technical%20Priorities%20Background.pdf?format=raw>

with other testbeds.

3. Make it easier for users to use GENI for purposes for which it was designed.

Participants expressed concern that GENI's future goals should not be derailed by attempts to replicate services that are readily available through commercial providers. (E.g., GENI should not seek to compete with Amazon Web Services for providing generic virtual machine provisioning.) Rather, GENI should pursue federation-based approaches to combine GENI's unique capabilities with commercially-available services, where sensible. Participants also favored a federation strategy leading to interoperability with diverse cyberinfrastructure resources, such as new, unique, or expensive scientific instruments, sensors, actuators, and cyberphysical systems.

Given these caveats, the working group identified the following specific capabilities as desirable additions / enhancements to available GENI capabilities.

- More storage should be added to the GENI racks.
- It should be possible to assign routable data plane IP addresses to nodes in a GENI slice.
- Physical topology awareness and control should be offered for the execution of resilience experiments.
- GENI testbeds should offer optical networking equipment for experimentation.
- 5G technology and technology the FCC does not want to see in the wild.
- Dynamic topology in which resources can be added and removed at any time.
- VLANs that allow a unified data plane.

## 4.3 Budget and operations

**Co-chairs:** Andy Bavier (Princeton) and Jim Griffioen (Kentucky)<sup>5</sup>

---

<sup>5</sup>Working group outbrief: <http://groups.geni.net/geni/attachment/wiki/GENIFuturePlanning/December2015Meeting/Budget%20and%20Operations.pdf?format=raw>

The budget and operations working group evaluated GENI's ongoing financial feasibility under different revenue and expense models. Working from current GENI budget information, the working group was able to characterize the key centralized expenses that are currently administered by the GENI project office. The group felt that continuing these activities in the post-2017 era was consistent with reasonable funding models. These well-understood expenses area include

- Management
- Site engineering support
- Operations & maintenance
- Software maintenance
- Community outreach and support
- GENI conferences and workshops
- Limited hardware refresh
- Reasonable allowance for new site provisioning

However, the group felt that there were some key areas whose potential costs are less clearly understood, for a variety of reasons discussed briefly below.

1. Participants felt that GENI's installed hardware base is already aging and would benefit from a full refresh. The one-time costs for such a refresh are reasonably well understood, but would exceed the current GENI funding profile.
2. The institutions that host GENI equipment currently do so at no cost to the GENI project, providing power, network connectivity, and staff support in exchange for a perceived institutional benefit. The workshop participants expressed concern that many host universities might become unable or unwilling to continue to operate in this fashion, as the initial investigators move on to other projects and the equipment becomes older and harder to maintain.

<http://groups.geni.net/geni/attachment/wiki/GENIFuturePlanning/December2015Meeting/Budget%20and%20Operations%20Outbrief.pdf?format=raw>

3. A sustainment-only approach excludes allowances for substantial ongoing innovation and major capability development. Because the GENI project has historically been highly successful in building a vital community around innovative development, participants were concerned that a sustainment-only budget would damage the enthusiasm of the GENI community. While participants were in full agreement on this point, there was diversity of opinion as to whether an innovation and development budget must be incorporated into the GENI budget proper or a similar effect could be achieved by aligning GENI with other existing and future funded research projects.

In addition to the expense budget, the working group considered potential revenue sources for future GENI. Based on feedback from the NSF, workshop participants understand that substantial funding from NSF would remain an important element of GENI funding in the post-2017 period. Participants discussed several other funding sources, including other research funding institutions, a pay-per-use or subscription scheme, and industry sponsorships/partnerships. Participants believed that some of these sources are promising. However, the group also had concerns about the feasibility and/or desirability of each of these revenue sources and was not able to reach consensus on the best way forward, identifying diversity of revenue as an important risk area.

#### 4.4 Community engagement

**Co-chairs:** John Geske (Kettering) and Joe Mambretti (Northwestern) <sup>6</sup>

The community engagement group discussed the effectiveness of current activities and considered new strategies to reach and support existing and potential GENI user communities. The group's sought to identify communities that should be continuing or new

<sup>6</sup>Working group report: <http://groups.geni.net/geni/attachment/wiki/GENIFuturePlanning/December2015Meeting/Community%20Engagement%20Report.pdf?format=raw>

targets for engagement and the strategies and activities that should be initiated, continued, increased, or deemphasized to best serve these communities.

Outreach goals include:

1. Growing the community of GENI users by informing researchers and educators about its capabilities and help them get started using it.
2. Supporting existing users so GENI is more useful for their research and teaching,
3. Fostering a sense of community to encourage users to help one another by sharing their GENI knowledge and experiences.

The working group reviewed a number of ongoing community engagement activities, being executed by the GPO and other GENI community groups and individuals, as outlined in the read ahead material.<sup>7</sup>

The longest-running engagement activity has been the GECs (GENI Engineering Conferences), which have been the largest community building events, drawing from the experimenter, educator, network and campus operations and software developer communities. In the past year, there has been a shift to supplement GECs with other community building events, including a GENI Network Innovators Community Events (NICE), a community run workshop (CNERT) with a largely volunteer organizing committee, competitions for experimenters, and specialized education workshops.

Other existing related activities include:

1. Tutorials at GENI Engineering Conferences (GECs).
2. GENI Regional Workshops.
3. Summer and winter camps.
4. Tutorials at conferences and workshops.
5. Talks at conferences, workshops and university seminars.

<sup>7</sup>Read ahead: <http://groups.geni.net/geni/attachment/wiki/GENIFuturePlanning/December2015Meeting/Community%20Engagement%20Background.pdf?format=raw>

## 6. Direct user Support.

The working group quickly reached a consensus that current outreach efforts are largely effective but could benefit from additional tuning and targeting to different user communities: “While existing initiatives in this area are of very high quality, there are opportunities for improvement in these processes, particularly with regard to addressing the specific requirements for each.”<sup>8</sup>

Much of the group’s discussion centered on the relative importance and likely effectiveness of engagement activities targeting different communities. The group felt that it is of central importance to continue to support GENI’s “core communities” of networking and distributed computing researchers and educators, but there was substantial debate on how much effort should be directed to other possible constituencies. Some of these groups discussed included data- and compute-intensive domain scientists, industry partners, advanced application, and developers (e.g. US Ignite participants). The working group did not reach consensus on strategies for (regardless of the desirability of) increasing engagement with these groups, but it did feel that additional consideration is merited.

The group also considered the degree of GENI adoption within the network and distributed computing research communities. While GENI has enjoyed considerable success in these communities, adoption is far from universal. Participants noted that many of the most prominent researchers in these communities are not turning to GENI. While acknowledging that it is not likely that GENI will attract all of these users, who have more options for access to infrastructure than other researchers, the working group identified the following two strategies as likely to increase GENI’s attractiveness both to these researchers and also to current and potential research users.

- Continue and expand the approach of conducting more GENI community engagement events and activities in conjunction with key annual events (conferences, workshops, etc.) that al-

<sup>8</sup>Working group report, p. 1.



ready draw researchers from the target communities.

- Take advantage of GENI's dynamic federation-based architecture to grow not only the scale and diversity of infrastructure available to researchers, but also the community of infrastructure developers and owners who contribute to the federated infrastructures of which GENI is a part.

## Appendix A Workshop Agenda and Goals

Agenda and Goals for GENI Future Planning Workshop December 10-11, 2015 Hyatt Regency Washington 400 New Jersey Avenue NW, Washington, DC		
Meeting rooms are on the <u>Ballroom Level</u> : Bunker Hill (breakfast), Lexington & Concord (main session), Columbia A (breakout).		
<b>Wireless Information</b>		
SSID: HYATT-MEETING; Password: GENI2015 (all caps) Note: connections are limited. Please connect only one device.		
<b>Thursday, December 10</b>		
8:00am	Breakfast and welcome	
8:30am	Introductory talks and workshop goals <i>Jim Kurose (NSF CISE)</i> <i>Mark Berman (GPO)</i>	
8:50am	Position statements <i>John Moore (Internet2), Glenn Ricart (US Ignite), Jim Bottum (Clemson), Rob Ricci (Utah), John Geske (Kettering), Ilya Baldin (RENCI), Joe Mambretti (Northwestern), Rick McGeer (US Ignite), Jim Griffioen (Kentucky)</i>	
10:30am	Break	
10:45am	Breakout: Governance and transition <i>Co-chairs: Deep Medhi (UMKC), KC Wang (Clemson)</i>	Breakout: Technical priorities <i>Co-chairs: Dipankar Raychaudhuri (Rutgers), Mike Zink (UMass)</i>
12:30pm	Lunch	
1:30pm	Breakout: Budget and operations <i>Co-chairs: Andy Bavier (Princeton), Jim Griffioen (Kentucky)</i>	Breakout: Community engagement <i>Co-chairs: John Geske (Kettering), Joe Mambretti (Northwestern)</i>
3:15pm	Break	
3:30pm	Breakout session quick looks	
4:30pm	Writing session	
5:00pm	Adjourn	
<b>Friday, December 11</b>		
8:00am	Breakfast	
8:30am	Governance session outbrief, discussion	
9:15am	Budget session outbrief, discussion	
10:00am	Technical priorities session outbrief, discussion	
10:45am	Break	
11:30am	Community engagement session outbrief, discussion	
12:15pm	Identification and documentation of open issues	
1:00pm	Adjourn	

Figure 1: Workshop Agenda

## Working Group Topics

### **Governance and Transition** – governance model and timeline for transition

#### Key questions

- What will be the composition of GENI's governing body in 2017 and beyond?
- How will the governing body interact with sponsors, GENI staff (if any) and host institution (campus) staff?
- What corporate/legal form will GENI have?

#### Work products

- Governance model summary
- Transition milestones and timeline
- Candidate people (or types) for governance roles

### **Technical priorities** – the most important needs for current and future research

#### Key questions

- What capabilities are needed for
  - GENI baseline functions?
  - Robustness / reliability?
  - Meeting campus needs?
- How does GENI support and drive future research programs?
- What existing activities and capabilities are candidates for reduction / elimination?

#### Work products

- Lists of desired capabilities and priorities, caveated by likely implementation and cost realities.

### **Budget and Operations**

#### Key questions

- What are the major budget items, on both revenue and expense sides?
- Are there likely budget gaps, and how can they be addressed?

#### Work products

- Rough revenue and expense budget by category, with risk assessment

### **Community engagement** – continuing to serve and grow the GENI community

#### Key questions

- Who are the most important constituencies to retain and attract to GENI?
- What strategies and activities will best engage these people?

#### Work products

- Identification and prioritization of target community segments.
- Lists of candidate activities, events, and organizers.

Figure 2: Workshop Goals

## Appendix B Workshop Participants

The following people attended the workshop (remote attendees are noted).

Ilya Baldin (RENCI)	Jason Liu (FIU)
Andy Bavier (Princeton)	Marc Lyonnais (Ciena)
Mark Berman (GPO)	Rick McGeer (US Ignite)
Jim Bottum (Clemson) ( <i>remote</i> )	Joe Mambretti (Northwestern)
Eric Boyd (Internet2)	Deep Medhi (UMKC)
Jack Brassil (NSF)	Vinod Mishra (ARL)
Marshall Brinn (GPO)	Greg Monaco (GPN)
Cody Bumgardner (U. Kentucky)	John Moore (Internet2)
Shannon Champion (Matrix)	Heidi Picher Dempsey (GPO)
Marianne Chitwood (Indiana)	Ray Raychaudhuri (Rutgers)
Russ Clark (Georgia Tech)	Glenn Ricart (US Ignite)
Chip Elliott (GPO)	Rob Ricci (U. Utah)
Darleen Fisher (NSF)	Niky Riga (GPO)
Peter Freeman (Mindspring)	Dorene Ryder (GPO)
John Geske (Kettering)	Ivan Seskar (Rutgers)
Aadil Ginwala (OSTP)	James Sterbenz (Kansas)
Jim Griffioen (U. Kentucky)	Violet Syrotiuk (Arizona State)
Ron Hutchins (U. Virginia) ( <i>remote</i> )	Vic Thomas (GPO)
Julio Ibarra (FIU)	Kevin Thomson (NSF)
Kate Keahey (U. Chicago/ANL)	KC Wang (Clemson)
Thanasis Korakis (NYU Poly)	Steve Wolff (Internet2)
Jim Kurose (NSF)	John Wroclawski (USC/ISI)
Larry Landweber (Wisconsin)	Hongwei Zhang (Wayne State)
Tom Lehman (U. Maryland)	Mike Zink (UMass)