GENI Future Planning Workshop -- Technical Priorities

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The goal of this session was to identify technical priorities for a future GENI. To give some guidance on the discussion the participant of the session were asked to identify short-term (until the end of 2017), medium term (next 5 years), and long-term technical (next 10 years) priorities for GENI.

GENI Technical Priorities from the Experimenter's and Educator's perspective

The session started with a brief overview on technical priorities, which were expressed by current experimenters and educators that make use of GENI. While this is potentially biased towards current needs, the findings give some guidance on technical priorities the GENI community should focus on in the short-term future. The major priorities expressed by experimenters and educators can be grouped in four categories:

- **Existing Capabilities.** Capabilities that are currently available and widely used that are important to be maintained. Exiting capabilities that should be maintained are: deployed hardware support, software services, user support and helpdesk, programmable networking, multi site topologies, and the expansion of the GENI footprint.

- **Improvements to existing capabilities.** Existing capabilities that might not be as robust or as reliable as desired. Existing capabilities that should be improved are: reliability/stability, better support for programmable networking, multi site topologies over layer2, documentation, more bandwidth in the GENI core, federation with new testbeds, resource monitoring, consistency across federation, and better control over network characteristics.

- **Enhancements.** Modest improvements to current functionality that will greatly improve the user experience and broaden the research supported by the testbed. Suggested enhancements include: dynamic resource reservation, modern hardware, stitching to non-GENI resources, better integration of wired and wireless resources, better tooling, support for long-running services, and advanced reservations.

- **New Frontiers/Capabilities.** Functionality that might not be currently present but is essential in order to expand the research capabilities and be prepared for the next generation of cyberinfrastructure. Some of the interests expressed are:

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[1] Niky Riga and Vic Thomas (both from the GENI project office) provided major input for this report!

more heterogeneous resources, focus on low-latency, interactive applications, expand interoperation with new and future testbeds and other cyberinfrastructure systems.

More detailed information on these findings can be found in the session's read ahead material (link) on the workshop web page.

Observations

One important observation that was made at the beginning of the session was that GENI is **not** an artifact but a **federation** of resources (e.g., ExoGENI, InstaGENI, Orbit, WiMax, etc.). At a high-level, this federation looks like one testbed to the users. This approach for an overall GENI architecture is considerate more favorable than the creation of a very unified, homogeneous artifact for the following reasons. A federation of resources simplifies the integration of new, heterogeneous resources. This will allow the integration of new and future testbeds and other cyberinfrastructure systems (both features requested by the current GENI experimenter and educator community). While such an approach comes with the extra burden that tools require harmonization across federations, it is expected that the advantages of a federation of testbeds will outweigh smaller disadvantages.

Process to obtain wider input

While the GPO has obtained some very important and insightful input from the current user community, a process should be established to obtain additional input on future technology priorities from other communities. This is seen as an important task to gain traction with new user communities (potentially from domain sciences and other agencies besides NSF).

Stability versus new features

The request for increased stability expressed by the current user base is somewhat in contrast to the desire of adding new features to GENI. One possible idea to solve these two opposing needs is to separate GENI in two (not necessarily equal) parts. One that is a stable version for users that prefer reliability (e.g., smart cities and educators) and the other part offers more "cutting edge" technology for researchers.

An additional issue that was raised is the fact that no clear definition of the services offered by the GENI testbeds has been published. Thus, it is hard for users to identify if the resources perform as specified or not. A desire to publish such specifications was expressed at the workshop. It was also mentioned that such specifications could be guidance for current and future resource providers.

Additions to current infrastructure

The following additions to the current infrastructure were expressed during the breakout session:

- More storage should be added to the GENI racks.
- It should be possible to assign routable IPs to nodes in a GENI slice.
- 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". Especially the latter is seen as potentially valuable because researchers might not be able to obtain such resources anywhere else.
- Dynamic topology in which resources can be added and removed at any time
- VLANs that allow a unified data plane

Consensus

There was a strong agreement that we need a future path that first sustains GENI and its technologies and then augment the existing infrastructure with new technologies. Since both steps are quite interdependent, it is important to identify priorities for new technologies because they might impact the plan for sustainability. For example, if GENI will be continued as a federation how can this be considered in the planning for sustainability. One important step towards sustainability is a survey of the state of the current hardware used in the testbeds. The outcome of this survey will indicate the urgency of a refresh of the existing hardware.

GENI should stay a heterogeneous federation with the goal to federate with other existing testbeds like Chameleon, CloudLab, FIRE, SAVI, and other national and international testbeds.

We should not provide services that can be easily obtained via credit card, today. One example for such services is Amazon's AWS that allows researchers to obtain compute and storage resources as a service.

It should be made it easier for user to use GENI for what it was designed for. E.g., the easy execution of repeatable experiments that require real networks (potentially with SDN support) and compute resources.

Finally, GENI should continue to identify the needs of the user community. This could be done through workshops, specific sessions on this topic at GECs, or by surveys.

Topics that require further discussion

- Desire for scale (more resources) was much less than the desire for stability and flexibility
- Are low-latency networks a low priority?
- Do users need real isolation when resources are virtualized?
- What if hardware gets refreshed but “brains” go away?
- What are the long-term technical priorities?