G E N I

Global Environment for Network Innovations

Solicitation 3 for GENI Development & Prototyping

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Prepared by:
The GENI Project Office
Raytheon BBN Technologies
10 Moulton Street
Cambridge, MA 02138 USA

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1 General Information for this Solicitation

1.1 Important: This is a solicitation for engineering, not research

This solicitation is *not* requesting research proposals – rather, it is requesting engineering Development and Prototyping (D&P) proposals to inform GENI's planning and design. As such, this solicitation is requesting proposals for engineering subcontracts, not for research grants. If you have interesting new ideas for research, such as ideas for novel network architectures you should contact NSF CISE directly. The GPO reserves the right to return without review any proposals that do not adhere to the guideline described in this solicitation.

1.2 Stimulating Competition

The GPO intends to **encourage competition**, and will if possible fund **multiple competing efforts** for every major part of GENI.

1.3 Letter of Intent

Not required.

1.4 Proposal Submission and Deadline

Submission:	Proposals must be submitted via www.geni.net.
Deadline:	5 p.m., August 20, 2010 (Eastern Standard Time).
Confirmation:	Proposer should contact Point of Contact (POC) identified in section 1.7.1 if no email confirmation is received within 3 days after submission.

1.5 Soliciting Organization

The GENI Project Office (GPO) has been formed under a Cooperative Agreement between the National Science Foundation (NSF) and Raytheon BBN Technologies, and has assumed responsibility for project management in GENI's planning phase. Under this agreement, the GPO is issuing the Solicitation for GENI expanded Development & Prototyping Proposals.

1.6 Revision Notes

At present there are no revisions to this solicitation. It is the proposer's responsibility to check www.geni.net for updates to this solicitation.

1.7 Contact Information

1.7.1 Point of Contact (POC)

All administrative correspondence and questions concerning this solicitation must be directed, in writing, to the GENI Proposal Point of Contact (POC), through email to:

proposalpoc@geni.net

1.7.2 GENI Project Officers

- Chip Elliott, GENI Project Director, telephone: (617) 873-2615
- Henry Yeh, GENI Project Manager, telephone: (617) 873-4821

1.7.3 GENI Subcontract Representative

Linda Cribbis
BBN Technologies
10 Moulton Street
Cambridge, MA 02138

Voice: 617-873-8030
Fax: 617-873-3797

1.8 Subcontract Information

This solicitation is *not* requesting research proposals – rather, it is requesting engineering Development and Prototyping (D&P) proposals to inform GENI's planning and design. As such, this solicitation is requesting proposals for engineering subcontracts, not for research grants. If you have interesting new ideas for research, such as ideas for novel network architectures, you should contact NSF CISE directly.

Anticipated Type of Subcontract: It is anticipated that university participants will receive Cost Reimbursement contracts. Other contract types – Firm Fixed Price Contracts (FFP), Cost Reimbursement Contracts (CR), Cost Plus Fixed Fee Contracts (CPFF), and Cost Sharing Contracts (CS) – will be considered for awards to other types of organizations.

While the Proposer shall submit proposals in accordance with one of the anticipated award types, the GPO reserves the right, at the sole discretion of the GENI Subcontract Representative, to make a final determination of the appropriate award instrument.

Anticipated Funding Amount: Refer to the table below and the additional information described in the later sections. All awards are subject to the availability of funds. The GPO oversees the process for identifying, prioritizing and supporting development and prototyping activities as described in this solicitation. Fee is allowed with a maximum cap not exceeding 5%.

Estimated Number of Subcontracts: The GPO anticipates awards will be in the ranges shown in the table below. All awards are subject to the availability of funds, and these figures are only preliminary estimates. Although previous GPO solicitations have requested both "large" and "small" classes of efforts, this solicitation requests only "large" proposals of the specific classes identified below. See Section 3 for details of the specific efforts requested.

FIGURES BELOW FOR DISCUSSION ONLY

Classes	Suggested Duration	Suggested Value	Estimated # Subcontracts
Large (A): Enhanced Meso-scale prototyping 1a. Regional switches 1b. Backbone switches 2. WiMAX 3. GENI-racks	36 months	 $100 K per year $150 K per year $250 K per year $650 K per year	 6 2 1-2 2
Large (B): Instrumentation and Measurement System	36 months	$600 K per year	2
Large (C): Experiment support, training, education, and curriculum development	36 months	$50 - 100 K per year	5 - 8

1.9 Eligibility

Any organization meeting the criteria listed in this section, and with an approved United States Government accounting method in place, may submit a proposal. In particular, teams already receiving GPO funding, as well as those not already so funded, are eligible.

1.9.1 Organizations Allowed

Proposals may be submitted by the following types of organizations:

Organization Type	Description
Unaffiliated individuals	Scientists, engineers or educators not employed by, or affiliated with, an organization.
Academic institutions	Universities and two- and four-year colleges, including community colleges, acting on behalf of their faculty members.
Non-profit, non-academic organizations	Independent museums, observatories, private research labs, government research labs, professional societies, and similar organizations associated with educational or research activities.
For-profit organizations	Commercial organizations with strong capabilities in scientific or engineering research.

The GPO strongly encourages participation from teams composed of academic and industrial participants, and strongly urges foreign organizations to be part of a team led by U.S. participants.

1.9.2 Limits on Proposals

Each proposal must identify a single Principal Investigator (PI) who is responsible for the project. However, any number of co-PIs may also be identified.

An individual may appear as Principal Investigator or co-PI on no more than one Large GENI Development & Prototyping proposal submitted to this solicitation. However, an individual who is PI on one proposal may also participate in other proposals, e.g., as key personnel.

An individual who already serves as PI or co-PI for an existing GENI effort (e.g. funded by Solicitation 1 and/or 2) is not precluded from serving as PI or co-PI for proposal(s) submitted under this solicitation 3. The PI and Co-PIs should follow the guidelines as stated above.

There is no limit on the number of proposals that an organization may submit.

Note that the GPO reserves the right to return without review any proposals that do not adhere to the spirit of these rules.

1.10 Intellectual Property

Every proposal must explicitly state its acceptance of one of the two (2) GENI intellectual property rights licenses – the GENI Public License or the GENI Project License. The two licenses are posted at http://www.geni.net/office/office_ip.html.

IMPORTANT – Proposals that do not clearly state their agreement to one of the two Intellectual Property licenses, unmodified, will not be considered. Please attach a support letter from an official of your sponsored research organization stating the organization's support of the Intellectual Property Rights License selection.

2 Background Information

The Global Environment for Network Innovations (GENI) promises a major paradigm shift in the way research in network science and engineering research is conducted. This section provides a reference to the online repository for all GENI material, background information on GENI's motivation and overview, and the GPO's plans for evolving GENI over time.

2.1 Current GENI Information

Please see www.geni.net for an overview of the GPO's planned spiral development and federation approaches. The GENI Wiki contains documentation on GENI's current status and evolving design; see http://groups.geni.net/geni/wiki/GpoDoc for the GENI document collection. The Spiral 2 Overview document describes projects engaged in GENI and how they inter-relate.

Note that some documents in the repository are of historical interest only. In particular, current designs are being created by GENI Working Groups and can be found in the relevant working group areas within the GENI Wiki, e.g., in a working group's email archives, meeting minutes, wiki pages, and draft documents as they are created. As discussed below, GENI prototyping efforts are proceeding in parallel with design efforts.

2.2 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 new research challenges us to understand networks broadly and at multiple layers of abstraction from the physical substrates through the architecture and protocols to networks of people, organizations, and societies. The intellectual space surrounding this challenge is highly interdisciplinary, ranging from new research in network and distributed system design to the theoretical underpinnings of network science, network policy and economics, societal values, and the dynamic interactions of the physical and social spheres with communications networks. Such research holds great promise for new knowledge about the structure, behavior, and dynamics of our most complex systems – networks of networks – with potentially huge social and economic impact.

As a concurrent activity, community planning for the suite of infrastructure that will support network science and engineering experiments has been underway for several years. This suite is termed the Global Environment for Network Innovations (GENI). Although its specific requirements will evolve, GENI is now taking shape as an end-to-end suite of meso-scale prototypes and interoperable software. Its core concepts are as follows:

- **Programmability** – researchers may download software into GENI-compatible nodes to control how those nodes behave;
- **Virtualization and Other Forms of Resource Sharing** – whenever feasible, nodes implement virtual machines, which allow multiple researchers to simultaneously share

the infrastructure; and each experiment runs within its own isolated slice, created end-to-end across the experiment's GENI resources;

- **Federation** – different parts of the GENI suite are owned and/or operated by different organizations, and the NSF portion of the GENI suite forms only a part of the overall 'ecosystem'; and
- **Slice-based Experimentation** – GENI experiments will be an interconnected set of reserved resources on platforms in diverse locations. Researchers will remotely discover, reserve, configure, program, debug, operate, manage, and teardown distributed systems established across parts of the GENI suite.

As envisioned in these community plans, the GENI suite will support a wide range of experimental protocols, and data dissemination techniques running over facilities such as fiber optics with next-generation optical switches, novel high-speed routers, city-wide experimental urban radio networks, high-end computational clusters, and sensor grids. The GENI suite is envisioned to be shared among a large number of individual, simultaneous experiments with extensive instrumentation that makes it easy to collect, analyze, and share real measurements.

2.3 GENI Planning, Design, and Prototyping Cycles

The GENI infrastructure suite currently exists as an evolving conceptual design together with an expanding suite of end-to-end, meso-scale infrastructure and interoperable software systems. The suite will be planned and prototyped over several years, during which time networking technology will continuously evolve. Its design must be flexible enough to incorporate new technologies as they develop, but reliable enough to simultaneously support ongoing research. The design must also be flexible enough to operate as new organizations join the GENI effort, allowing resources that are owned and managed by different organizations to be used effectively for individual research projects that themselves may have many users and developers.

Please see www.geni.net for an overview of the GPO's planned spiral development and federation approaches. The GENI Wiki contains documentation on GENI's current status and evolving design; see http://groups.geni.net/geni/wiki/GpoDoc for the GENI document collection. The Spiral 2 Overview document describes projects engaged in GENI and how they inter-relate.

Prototypes and integration efforts proposed for this solicitation must explicitly address how they will be integrated with the evolving GENI meso-scale prototype suite of infrastructure and its interoperable software systems, and accommodate spiral development, federation and interoperability during the funded performance period, including any technical or administrative procedural advantages that differentiate the proposed effort from others. Prototypes and integration efforts funded under this solicitation should expand the GENI meso-scale deployment, improve interoperability within GENI, provide inputs to the GENI working groups, and reduce technical, operational, and programmatic risks for the GENI system overall.

Because this solicitation funds prototype and integration work in parallel with design work, proposers will need to be actively involved in GENI working groups, and to build in opportunities to incorporate new results from those groups and from other prototype efforts as they develop. Interoperability should be demonstrated early and often, preferably at every GENI Engineering Conference. Proposals must describe how they achieve demonstrable end-to-end interoperability as part of the growing GENI meso-scale deployment.

There is no pre-ordained outcome for these design and prototyping activities: the resultant GENI infrastructure suite could be the existing Internet, existing testbeds, federations of testbeds, something brand new (from small to large), federation of all of the above, and perhaps a federation with related international efforts.

2.4 GENI Control Framework "Clusters"

The GPO **requires** that your proposal integrates into **two or more** of the existing control framework clusters, listed below. More than two is desirable. Please state clearly how you plan to integrate with the clusters.

Note: in Spiral 2, the control framework clusters and the GPO are developing an initial version of an integrated aggregate manager (AM) interface which allows multiple control frameworks to be interoperable in resource discovery and reservation. We expect that initial versions of such interoperable frameworks will be available in Spiral 3.

Current GENI clusters are:

B. "PlanetLab" framework, based on the PlanetLab system from Princeton.

C. "ProtoGENI"control framework, based on the Emulab system from the University of Utah.

D. "ORCA" control framework from Duke University and RENCI.

E. "OMF" control framework from Rutgers University.

3 Goals of this Solicitation

The GPO has the responsibility for project management to successfully complete all planning, design, and development activities for GENI. The GPO is using a "spiral development" methodology in which a series of integrated prototype systems drive forward GENI design and development. This solicitation offers funding for the computing research community to perform GENI's engineering design, development, and prototyping activities.

The GPO intends to **encourage competition**, and will if possible fund **multiple competing efforts** for every major part of GENI.

The GPO suggests that some or all of these efforts may best be tackled by teams comprising multiple organizations. Each such team proposal must have a clearly-identified, single Principal Investigator who leads the ensemble effort, and must clearly specify the responsibilities, personnel, cost, and schedule for each organization in the team; it must also clearly describe how team members will communicate and interact so that they can function as a team.

3.1 Development and Prototyping Subcontracts

This solicitation requests proposals for GENI Development and Prototyping (D&P) subcontracts, both in terms of further clarification of GENI's architecture, and in terms of practical, demonstrable, and scalable prototypes that will enable network science and engineering research experiments to be performed across the growing GENI meso-scale deployment.

The specific areas being solicited are as follows.

3.1.1 Large (A): Enhanced Meso-scale Prototyping

GENI meso-scale prototyping has begun in Spiral 2, with initial build-outs through more than a dozen US campuses and two national research backbones (Internet2 and NLR).

The GPO is interested in enhancing this meso-scale buildout in three ways as described below. All proposed efforts in meso-scale prototyping must provide maximal opportunity for creating end-to-end GENI slices across the growing meso-scale deployment, e.g., by enlarging the interconnected footprint of GEN-enabled infrastructure. They should expand the GENI meso-scale suite of infrastructure both technically and geographically, and must include clear, well-defined plans for end-to-end integration and shakedown into this growing GENI meso-scale suite.

Reminder: The GPO **requires** that your proposal integrates into **two or more** existing GENI control framework clusters as identified in Section 2.4. More than two is desirable. Please state clearly how you plan to integrate with the clusters.

1. Deployment and operation of **GENI-enabled network switches within regional and national research networks**, which can then join into a larger system with existing GENI resources. We are <u>not</u> soliciting new or enlarged campus deployments; they may be funded separately. The definition of a "GENI-enabled" switch is one that is controlled by one or more of the existing GENI control frameworks. The GPO is interested in enhancing the existing set of GENI-enabled switches in both Internet2 and NLR, and in

introducing sets of GENI-enabled switches into as many regional research networks as is feasible. All of these GENI-enabled switches will then be interconnected with each other, and with existing and new GENI resources and campuses, to form an enhanced meso-scale prototype. The GPO requests that backbone service providers submit individual proposals; regional network operators may submit individual or combined proposals.

2. Deployment and operation of **GENI-enabled WiMAX base stations into additional campuses**; if feasible, virtualized and programmable WiMAX handsets should also be included. The GPO is particularly interested in proposals that create multiple (e.g. 3+) base stations within a single metropolitan area so that researchers can experiment with city-wide coverage, hand-offs, etc. We would prefer to have multiple institutions own and operate these base stations within a metropolitan area, so that issues of federated operations can also be explored, and would prefer to fund a combined effort engaging multiple institutions (rather than individual proposals from individual campuses).
3. Creation, deployment, and operation of a large number of **"GENI racks"** within US campuses, regional networks, and national backbones. Each compliant proposal should describe how at least 40 racks will be deployed over the 3 year period-of-performance, into multiple organizations, with at least 8 locations operational by 12 months after contract award. Letters of support from each organization's CIO or CTO must be included. These racks will be used for a wide variety of research experiments, including serving as programmable routers, distributed clouds, content distribution nodes, caching or transcoding nodes, etc. The GPO envisions such GENI-racks as the basic unit of computation / disk storage within the GENI meso-scale prototype; each rack might consist of 20-40 computers, suitable for virtualization, and with significant "sliceable" storage, plus a GENI-enabled switch to link them together in arbitrary topologies. The entire rack, or multiple racks as an ensemble, would be employed as a GENI aggregate. Such racks should be first created and shaken down at a few locations, then inserted throughout the GENI meso-scale prototype at topologically significant points in the overall network such as junction points in the national backbones, regional networks, and campuses. Proposers should use their creativity in deciding the technology used in racks, whether all racks are fully populated, whether some locations receive multiple racks, etc.; however, all such decisions must be clearly documented and explained.

A single proposal may cover only one of these topic areas, or may combine multiple areas into one overall proposal.

3.1.2 Large (B): Instrumentation and Measurement System

The GENI project contains a number of useful instrumentation and measurement tools but currently lacks an overall software framework into which these tools can be integrated.

Since experimental research requires a well-instrumented suite of infrastructure, the GPO solicits proposals to create, deploy, and help operate the software that provides this overall framework for the GENI Instrumentation and Measurement System. This software should integrate existing GENI instrumentation tools into an overall system that allows researchers to define the instrumentation they need for an experiment, allocate / instantiate such instrumentation, collect and process measurements from an experiment, and store, analyze, and

share the measurements. It should also incorporate infrastructure status and performance data (e.g. network utilization, outages, etc.) from operations and management systems so that researchers can properly understand the status and performance of those GENI aggregates that are being used in their experiments.

Compliant proposals will provide clear plans and timelines for how existing GENI instrumentation tools can be integrated into this new framework with modest effort. We request that an initial version of this framework become operational as part of the interoperable set of GENI control frameworks within 12 months after contract award. We will strongly favor software that is based on an existing, already-proven system with significant operational experience.

Reminder: The GPO **requires** that your proposal integrates into **two or more** existing GENI control framework clusters as identified in Section 2.4. More than two is desirable. Please state clearly how you plan to integrate with the clusters.

The GENI Instrumentation & Measurement Working Group is currently actively performing design work in this area. Proposers should make it obvious that they understand ongoing GENI efforts in this area, and describe how their system compares with the working group's notional architecture (both in similarities and in differences).

3.1.3 Large (C): Experiment support, training, education, and curriculum development

The GPO is very interested in helping to encourage a generation of young researchers who perform experimental research in network science and engineering using the GENI suite of infrastructure. To this end, we solicit proposals for:

- Training of graduate students and other researchers in how to run experiments using GENI. We particularly encourage proposals that will help create a generation of young PIs who know each other and exchange ideas and insights on research experimentation that takes advantage of GENI, e.g., via hands-on experiences at summer camps, workshops, etc.
- Education and curriculum development for both undergraduate and graduate courses that use GENI as a teaching / research tool.
- Establishing and maintaining "help desk" support for researchers who are using GENI for experiments.

3.2 Specific Areas for this Solicitation

This section illustrates the kinds of proposals that may be submitted. The list below is not exhaustive as we recognize that there could be many other good ideas. However, every proposal must directly respond to one or more specific areas being solicited. **Proposals that suggest efforts outside of these identified areas may be returned without review.**

GENI's current conceptual design is documented in the evolving GENI System Overview document, identified on the geni.net solicitation page. Please do not hesitate to contact the GENI Project Office if you wish to discuss ideas prior to writing a proposal.

Proposal Type	Specific areas solicited
Large (A): Enhanced Meso-scale prototyping	• Expansion of current meso-scale prototyping efforts with addition of GENI-enabled switches into regional networks and US national research backbones, integration of these switches together with all other parts of the evolving GENI meso-scale build-out, and ongoing operations and management to support running research experiments. • Expansion of current WiMAX deployments, to include (a) at least 5 additional campuses, (b) at least 3 base stations within a single metropolitan area that permit hand-off experiments between base stations, and if feasible, (c) virtualized and programmable WiMAX handsets. • Creation and deployment of "GENI racks" into the meso-scale national build-out. Such racks notionally consist of a GENI-enabled switch and a number of rack-mounted PCs, controlled as an ensemble by interoperable GENI control frameworks. These racks must be deployed into topologically significant locations throughout the meso-scale prototype, including juncture points in the national backbones, regional networks, and campuses. Compliant proposals will identify where and when deployments will occur, and contain letters of support from relevant campus, regional, and backbone CIOs / CTOs. Since direct deployment into backbone points of presence (PoPs) does not appear cost-effective, compliant proposals will describe how GENI racks will "logically" be deployed / operated at such points while physically located in cheaper and more accessible locations. Each compliant proposal will describe how at least 40 racks will be deployed over the 3 year period-of-performance, with at least 8 locations operational by 12 months after contract award.
Large (B): Instrumentation and Measurement System	• The GENI project contains a number of useful instrumentation and measurement tools but currently lacks an overall software framework into which these tools can be integrated. We solicit proposals to create, deploy, and help operate the software that provides this overall framework for the GENI Instrumentation and Measurement System. Compliant proposals will provide clear plans and timelines for how existing GENI instrumentation tools can be integrated into this new framework with modest effort. We request that an initial version of this framework be operational as part of the interoperable set of GENI control frameworks within 12 months after contract award. We expect that this software will be based on an existing, already-proven system with significant operational experience.
Large (C): Experiment support, training, education, and curriculum development	• Training of graduate students and other researchers in how to run experiments using GENI. We particularly encourage proposals that will help create a generation of young PIs who know each other and work collaboratively on research experimentation, e.g., via experiences at summer camps, workshops, etc. • Education and curriculum development for both undergraduate and graduate courses. • Ongoing "help desk" support for researchers who are using GENI for experiments.

3.3 Important Note: Subcontracts are NOT Research Grants

This solicitation is *not* requesting research proposals – rather, it is requesting engineering Development and Prototyping (D&P) proposals to inform GENI's planning and design. As such, this solicitation is requesting proposals for engineering subcontracts, not for research grants. If you have interesting new ideas for research, such as ideas for novel network architectures, this solicitation is not the right venue.

Successful proposals will receive *subcontracts,* rather than research awards, with the following implications:

- "Large" proposals must show realism for the management approach, and practical understanding of the effort, as well as technical merit.
- Specific deliverables and associated milestones must be clearly described.
- Proposals should emphasize concrete, near-term results.
- Leveraging existing infrastructure (software, testbeds, etc.) is *good* because it reduces the risk of failure and may also reduce the cost.
- Clever ways to avoid new development work are *good* because they reduce the risk of failure and may also reduce the cost.
- Funded efforts will receive ongoing review by the GPO for GENI-relevant progress.
- Efforts with ongoing inability to make progress will be terminated.

The GPO currently intends to structure large subcontracts as follows: one year of funding, followed by two option years which will be exercised (funded) if the GPO determines that the subcontract is making useful progress. The GPO reserves the right to change this approach during negotiation of subcontracts.

4 "Small" Proposal Format

The GPO is not soliciting small proposals in this solicitation.

5 "Large" Proposal Format

This section specifies how "large" proposals (subcontract value over $30,000 per year) must be prepared and submitted.

Proposals should be written in English, fonts size 11 point or larger, formatted for American letter paper size (8.5 x 11 inches) with reasonable margins. They must be submitted in Portable Document Format (PDF).

The technical part (sections I, II, and III) of the proposal must not exceed ten (10) pages including figures, charts, graphs, maps, photographs, and other pictorial representations. Proposals of $100,000 budget or less should have a technical part no longer than 5 pages. This page limit does not include the budget section or letters of support, which has no page limit.

The proposal **MUST** contain the following sections with the headings and contents as shown below. Non-conforming proposals may be rejected without review.

5.1 Section I. Header

Section / Heading	Required Contents
Section I. Title and Proposer List	Proposal title; name, organization, address and contact information for the Principal Investigator and contracting officer; name, organization, and contact information for all subcontractors, if any; Period of Performance; total cost
I.1 Proposal Type	Large

5.2 Section II. Contributions of Key Personnel in Past 3 Years

Section / Heading	Required Contents
Section II. Contributions of PI & Key Personnel in Past 3 Years	For the Principal Investigator and other Key Personnel, provide a brief biographical sketch that discusses relevant work, e.g.: • Experience with advanced networking infrastructure planning, construction, deployment and operations; • Effective project management, on-schedule and within budget; and • Effective management of software-intensive or rapid hardware prototyping projects.

5.3 Section III. Proposed Activities

Section / Heading	Required Contents
III.1 Scope of Work	Define the scope of work that you are proposing; identify and discuss project goals and associated milestones. State clearly what

	you are proposing to deliver. Identify specific analysis, development and/or prototyping activities. Describe the methods/metrics that will be used to evaluate work-product. If there are subcontractor(s) on the team, clearly state who is responsible for what tasks and deliverables.
III.2 GENI Relevance	Provide a clear rationale for these activities and how they tie into GENI's vision and its evolving meso-scale deployment. Describe in detail how you will integrate your project into GENI, how researchers in network science and engineering will take advantage of your efforts as they perform experiments, and concrete, near-term advantages that your work will bring. Explain how GENI technical risk is reduced by your proposal.
III.3 Deliverables	List the important technical deliverables and goals that you plan to achieve and demonstrate. It is expected that performers will deliver the relevant work-product to GENI. Deliverables must also include quarterly reports and a final report. All deliverable documents will be published on geni.net with proper credit. (See Section 7.2.)
III.4 Technical Approach	Describe in detail your technical approach, with a particular emphasis on how and when your work will become fully interoperable with the expanding GENI meso-scale deployment, and (if relevant) when it will first be available for NSF researchers to use in their experiments. Detailed plans, with dates of major milestones, are required. If your project requires integration of software components, hardware, end-to-end systems, etc., please describe in concrete terms how and when such integrations will occur and when they will be demonstrated.
III.5 Additional criteria	Provide a concrete, explicit description of how the proposed effort meets this solicitation's additional review criteria (sec. 6.1). These criteria are important and may form a fundamental part of the proposal strategy (e.g. may drive team formation).
III.6 Outreach Plan	Provide a concrete, explicit description of your plan for involving under-represented institutions, geographic areas and communities.
III.7. Project Schedule	Provide a Gantt chart identifying key milestones and major activities over the project period. Key milestones should be no more than 4 months apart, aligned with GENI Engineering Conferences if possible, and their success should be clearly demonstrable. We strongly recommend demonstrations at every GENI Engineering Conference. Identify and discuss the critical path for development over proposed duration. The schedule should show the sequencing of all **major** activities to be conducted in sufficient detail to justify the proposed budget.
III.8 Intellectual Property	Clearly state acceptance of one of the following intellectual property rights for GENI participants: _____ GENI Public License _____ GENI Project License Each quarterly report and final report must also include copyright-

	free images and description of work performed (suitable for publication on the web at geni.net, in brochures, etc); proper credit will be given.
III.9 Management Plan, Organizational Structure, and Project Staffing	All proposals with budget $100,000 or greater must describe the project organizational and management structure; otherwise this section may simply state "not required." Proposal should include a table that provides the following information for each individual participating in the project: name, position/title on the project, level of effort (monthly and annually), activities assigned, and responsibilities for achievement of key project goals and milestones. Provide a functional project budget in tabular form showing how resources will be allocated.
III.10 Letters of Support	1. Integration partners' proposals for "Large" projects are requested to include at least one letter of support from the PI's of projects with which they will integrate. 2. Campus CIO. All proposals for "Large" projects that involve participants on an academic campus are required to include a letter of support from the campus Chief Information Officer (CIO) or equivalent. (Letters of support from regional networks are also helpful.) 3. Contracts Representative. All proposals for Large projects are requested to include a letter of support from the lead organization's contracts personnel, stating organizational support of the selected Intellectual Property License. This requirement will be waived for those organizations already under subcontract from the GPO that already have the relevant licenses in place.

5.4 Section IV. Budget

Your cost proposal should have sufficient detail to allow a thorough understanding of the pricing methodology used and assumptions made. The GPO will conduct a cost analysis of each proposal and any unsupported costs may be deducted from the proposer's total budget.

Provide the basis of estimate for proposed hours, labor rates, indirect costs and other direct costs as appropriate. State any assumptions upon which the estimates of your costs were based. Specifically state whether any Government furnished equipment, facilities, data or software is required. If any portion of the research is predicated upon the use of Government Owned Resources of any type, the proposer shall specifically identify the property or other resource required, the date the property or resource is required, the duration of the requirement, the source from which the resource is required, if known, and the impact on the research if the resource cannot be provided. If no Government Furnished Property is required for conduct of the proposed research, a statement to that effect will be included in the basis of estimate section of the cost proposal.

Section / Heading	Required Contents
IV.1 Type of Subcontract Requested	Specify the Subcontract instrument requested: Firm Fixed Price Contracts (FFP), Cost Reimbursement Contracts (CR), Cost Plus Fixed Fee Contracts (CPFF), or Cost Sharing Contracts (CS)
IV.2 Name and cost of Senior Personnel	Show individual labor category or person, with associated labor hours (or percentage of time for non-profit educational institutions) and unburdened direct labor rates;
IV.3 Name and cost of other Personnel	List of total post doctorial, other professionals, graduate students, undergraduate students, administrative support, etc. with labor category or person, associated labor hours (or percentage of time for non-profit educational institutions) and unburdened direct labor rates;
IV.4 Equipment	List item and dollar amount for each item exceeding $2500.00.
IV.5 Travel	List domestic and foreign estimated travel (# of trips, purpose and cost). All successful proposers must participate in GENI Working Groups (by email lists) and attend 3 GENI Engineering Conferences per year. Please budget travel costs in this section; estimate travel costs by assuming that engineering conferences are 3 days long, and take place in hotels in major cities across the US. Number of trips, number of travelers and days per trip, departure and arrival destinations, etc. Per diem rates must not exceed those published in the Federal Travel Regulations (or costs must be consistent with university travel policies).
IV.6 Participant support costs	Include any participant support costs.
IV.7 Other direct costs	Include itemization for materials & supplies, publication costs, consultant services, computer services, and other. An explanation of any estimating factors, including their derivation and application, shall be provided, as well as a brief description of the Proposer's procurement method to be used. If none, state "none".
IV.8 Indirect Costs	Estimate indirect Costs, by category – Fringe Benefits, Overhead, General and Administrative Expense, Cost of Money, etc. (Must show base amount and rate). If none, state "none".
IV.9 Fee or Cost Sharing	State fee in dollars and as a percentage; if none, say "none". If proposing cost sharing, include both dollar amount and percentage and explain the basis for the estimate.
IV.10 Total	Amount of total funds requested.
IV.11 In-kind Contributions	In-kind contributions are desirable but not required. If you provide such contributions, state clearly what is being contributed, and provide a reasonable estimate with your rationale for the stated value.

ADMINISTRATIVE INFORMATION (to be filled-in then attached with your proposal)

1. Signature of authorized individual _____
   Name of Individual _____
   Title of Individual _____
   Name of Organization _____
   Type of Organization _____

2. Organization Information
   First Line Address: _____
   Street Address: _____
   City/State/Zip Code: _____

3. Identifying Numbers
   Taxpayers Identification Number (TIN) _____
   Corporate and Government Entity Code (CAGE) _____
   North American Industrial Classification System (NAICS)
   _____
   DUNS Number _____

4. Administrative Contact Information
   Name of Offerors' Point of Contact: _____
   Title of Point of Contact: _____
   Telephone Number of Point of Contact _____
   Email address of Point of Contact _____

5. Proposed Costs
   a. Cost: _____
   b. Profit/Fee or (Cost Sharing) _____
   c. Total: _____

6. Provide the Following
   Place of Performance: _____
   Period of Performance: _____

7. Name of Administrative Contract Office: _____
   Street Address: _____
   City/State/Zip Code: _____
   Point of Contact: _____

Telephone number: _____

8. Name of Audit Office: _____
   Street Address: _____
   City/State/Zip Code: _____
   Point of Contact _____
   Telephone Number: _____

9. Accounting System approved for federal cost-type contracting
   ☐ Yes ☐ No

10. Negotiated Indirect Rate Agreement, or other Rate Agreement, is attached
    ☐ Yes ☐ No

11. Purchasing System approved for federal contracting
    ☐ Yes ☐ No

12. Billing System approved for federal contracting
    ☐ Yes ☐ No

13. Estimating system approved for federal contracting
    ☐ Yes ☐ No

14. Pricing based on established catalog or commercial pricing
    ☐ Yes ☐ No

15. OMB-133 Audit Results attached
    ☐ Yes ☐ No

6 Proposal Review

All proposals will be treated as confidential.

"Small" proposals are not being solicited in this solicitation.

"Large" proposals will first be evaluated for compliance to the specific areas being solicited. Those which are outside any of specific areas may be returned without review.

Those which are compliant will be assigned to panels of appropriate reviewers drawn from the academic and industrial research community. All proposals will be carefully reviewed, typically by three to five persons who are experts in the particular fields represented by the proposal. These reviewers will be selected by GPO Project Officers charged with the oversight of the review process; care will be taken to ensure that reviewers have no conflicts with the proposer.

6.1 GENI Review Criteria

Review Criteria for this solicitation are as follows:

Criterion	Discussion
Relevance to GENI Development & Prototyping	How well do the proposed work and its outcome meet the GPO's stated goals for this solicitation?
Best Value	How much value does the proposed work provide for its cost? Potential areas of value includes high impact, enabling a broad range of research, near-term demo of integration & trials, etc
Type of IPR license	Which Intellectual Property Rights (IPR) license is proposed? The GENI Public License is preferred over the GENI Project License.
Cost and schedule realism	Are the costs and schedule reasonable? Reviewers will be asked to evaluate the proposed costs in relation to reasonableness, technical and management approaches.
Probability of success and high impact	Does the proposer demonstrate a practical understanding of the technical challenges? Is success likely? Will a successful effort have a high impact on enhancing GENI and/or reducing its risk?
Academic / industrial team	Combined academic / industrial teams will be preferred over other types of teams.

In addition, the following criteria will be considered:

Criterion	Discussion
Active involvement of under-represented institutions, geographic areas, communities, etc.	Proposals with strong, clear plans for actively involving under-represented institutions, communities, and areas will be preferred over those that present vague plans or no plans at all.
Additional mechanisms, e.g., involvement of high schools, interns, etc.	Proposals that present strong, clear plans to further core NSF interests such as education, involvement of high schools, an active involvement of interns in the projects, etc., will be preferred over those that present vague plans or no plans at all.
Letters of Support	All letters of support as requested in this solicitation, potentially including letters from the relevant integration partners, academic campus Chief Information Officer (CIO) or equivalent, and contracts personnel.

6.2 Review and Selection Process

"Large" proposals will be reviewed by external reviewers as indicated in section 6. After scientific, technical and programmatic review and consideration of appropriate factors, the reviewers will advise the GPO whether the proposal should be declined or recommended for Subcontract. The GENI Project Director will make the final determination and will submit a proposal for NSF review.

A summary rating and accompanying narrative will be completed and submitted by each GPO-assigned reviewer. In all cases, reviews are treated as confidential documents. The proposer will receive a notification of the decision to award or decline funding.

In cases of programmatic approval, the proposals recommended for funding will then be forwarded to the GENI Contracting Officer for review of business, financial, and policy implications and the processing and issuance of an agreement. (See Section 7.1)

7 Award Administration

7.1 Notification of the Subcontract

Notification of the selection for Subcontract award will be made to the submitting organization by the GENI Contracting Officer. Organizations whose proposals are declined will be informed as promptly as possible by the GENI Contracting Officer.

Proposers are cautioned that only the GENI Contracting Officer or the Senior Manager of Subcontracts may make commitments, obligations or awards on behalf of the GPO or authorize the expenditure of funds. No commitment on the part of the GPO should be inferred from technical or budgetary discussions with a GENI Project Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a subcontract signed by the GENI Contracting Officer or Senior Manager of Subcontracts does so at their own risk.

7.2 Estimated Timeline

The GPO is currently expects to announce its selections by late autumn 2010 and start subcontract negotiation in early 2011. For budget purposes, you should use April 4, 2011 as the project start date.

7.3 Reporting Requirements

For all Subcontracts, the Principal Investigator is expected to report current project status in person at every GENI Engineering Conference, and must submit quarterly and final project reports to the GENI Project Officer. The quarterly reports are due at end of the calendar quarterly, i.e. March 31, June 30, September 30 and December 31. The final report is due within 30 days after expiration of a Subcontract.

Each quarterly report and final report must also include copyright-free images and description of work performed (suitable for publication on the web at geni.net, in brochures, etc); proper credit will be given. Other forms of publication material are also encouraged.

Failure to provide the required quarterly project reports may affect any future funding increments as well as any pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

The quarterly report will be submitted electronically via http://geni.net. Such reports provide information on activities and findings, project participants (individual and organizational) publications and other specific products and contributions. For the quarterly report, PIs will not be required to re-enter information previously provided. Submission of the report via http://geni.net constitutes certification by the PI that the contents of the report are accurate and complete. Report is not complete until the GENI Project Office has reviewed and accepted via electronic email notification. The GPO will notify the PI within 10 days of receiving the report submission confirmation with either “accept” or “additional information is requested”.

7.4 Other Information

The geni.net website provides the most comprehensive source of information about the GENI initiatives. Consultation of this website by potential proposers is strongly encouraged.