Building GENI

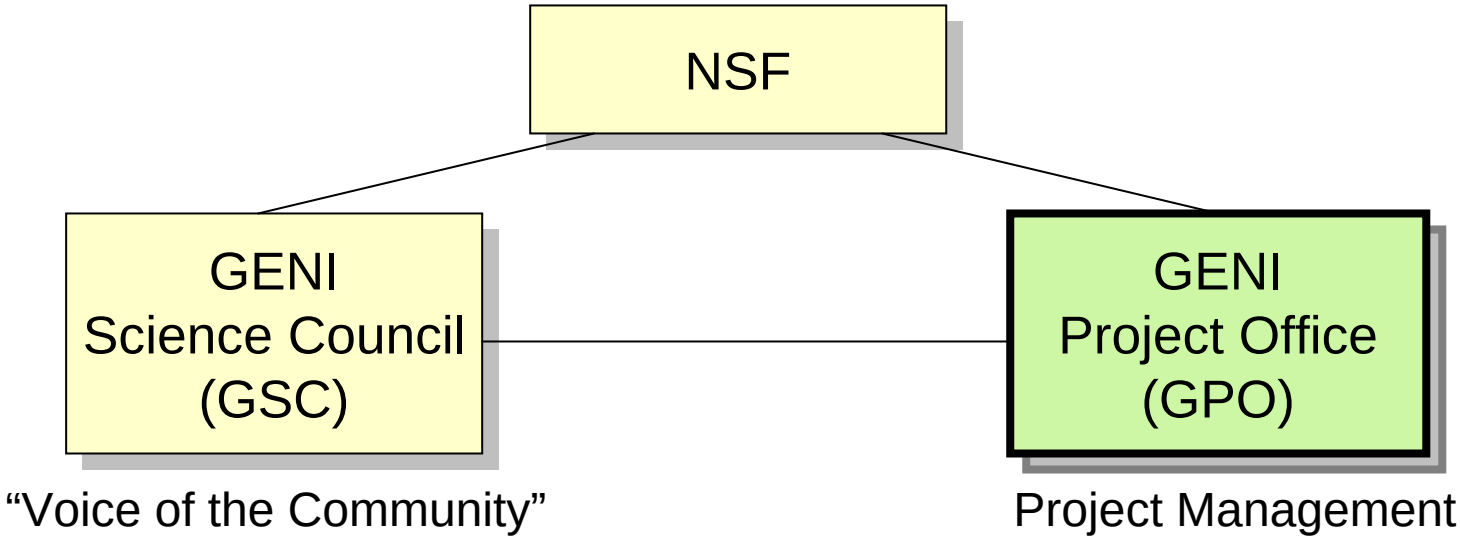
It's Time to Start

Chip Elliott
GENI Project Director

www.geni.net

Clearing house for all GENI news and documents

GENI Roles & Responsibilities



Key Roles and Responsibilities

GSC

- Definitive source of “what we need in GENI”
- Authors of GENI Research & Education Plan
- Technical advisory & oversight to GPO

GPO

- Project management and execution
- GENI architecture and system engineering
- Cost & schedule estimates for construction
- Authors of GENI facility construction plan
- Home for Working Groups

GPO Leadership

Chip Elliott
Project Director

Aaron Falk
(Community Nominee)
Engineering Architect

Kristin Rauschenbach
Substrate Architect

Henry Yeh
Project Manager

Heidi Picher Dempsey
Operations &
Integration Director

Craig Partridge
Outreach Director

GENI is a Huge Opportunity

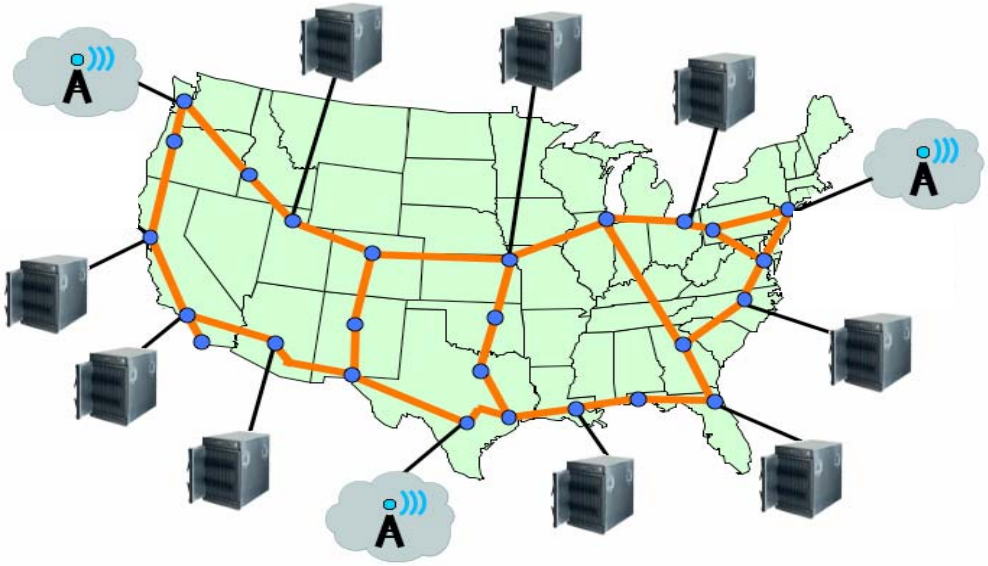
- **GENI is an unbelievably exciting project for the community**
  - a chance like this arises only once a decade and opens up major opportunities for our community to once again make history
- **We believe the whole community will pitch in and build GENI together**
  - Our vision is for a very lean, fast-moving GPO, with substantially all design and construction work performed by academic and industry research teams
- **We'd like the community to start building prototypes immediately**
  - within a GENI project framework that is open, transparent, and broadly inclusive

Outline

- Introductions
  - The GENI Vision
  - How We'll Use GENI
- GENI Planning and Construction
  - Timelines (Estimate)
  - Planning Phase Goals
  - Building by Spiral Development & Federation
- GENI will be Designed & Built by the Community
  - GENI Working Groups
  - GENI Engineering Conferences
  - GPO Solicitations
- What You can do to Get Ready

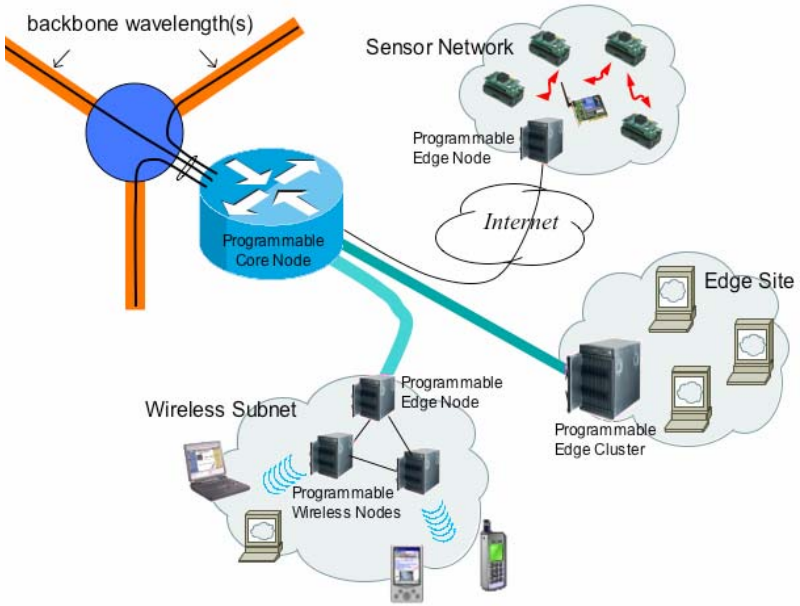
The GENI Vision

A national facility to explore radical designs for a future global networking infrastructure



- High capacity backbone and programmable core nodes
- Large clusters of CPUs and storage

- Large, wide-area footprint
- Edge / access technologies (e.g. sensor networks)
- Shared among researchers by virtualization & slices

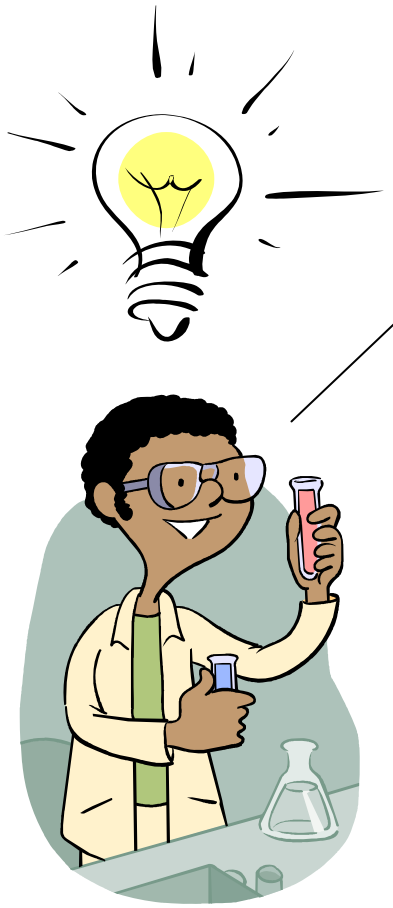


How We'll Use GENI

Note that this is the "classics illustrated" version – a comic book!

Please read the GENI Research and Education Plan to learn all about the community's vision for GENI and the research it will enable. Your suggestions are very much appreciated!

A bright idea

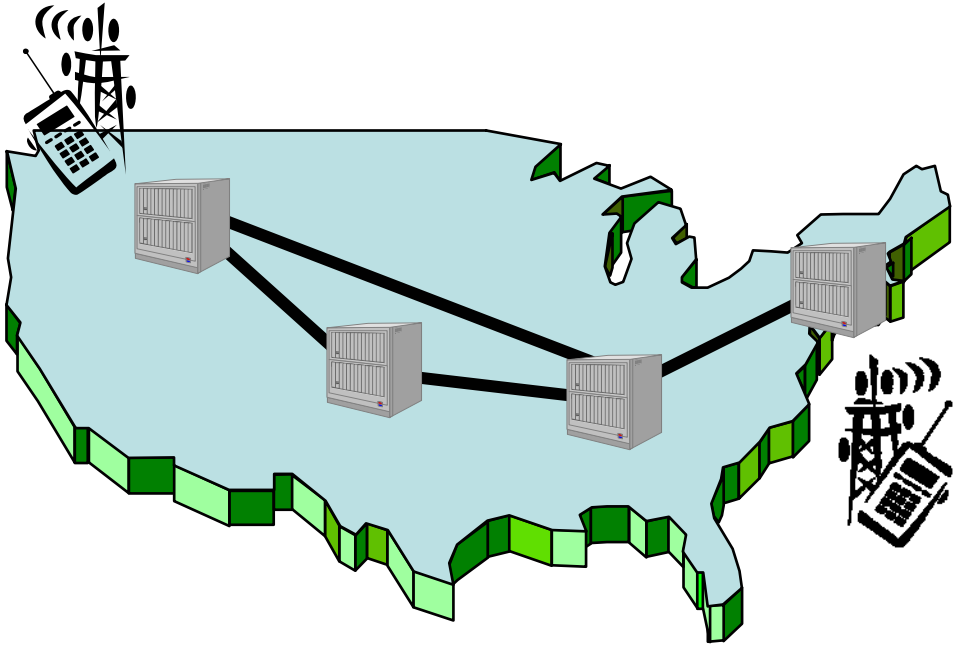


I have a great idea! The original Internet architecture was designed to connect one computer to another – but a better architecture would be fundamentally based on PEOPLE and CONTENT!

That will never work! It won't scale! What about security? It's impossible to implement or operate! Show me!

Trying it out

My new architecture worked great in the lab, so now I'm going to try a larger experiment for a few months.

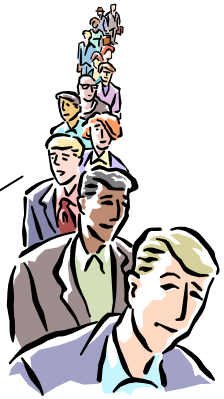


He uses a modest slice of GENI, sharing the facility with many other concurrent experiments.

And so he poured his experimental software into clusters of CPUs and disks, bulk data transfer devices ('routers'), and wireless access devices throughout the GENI facility, and started taking measurements . . .

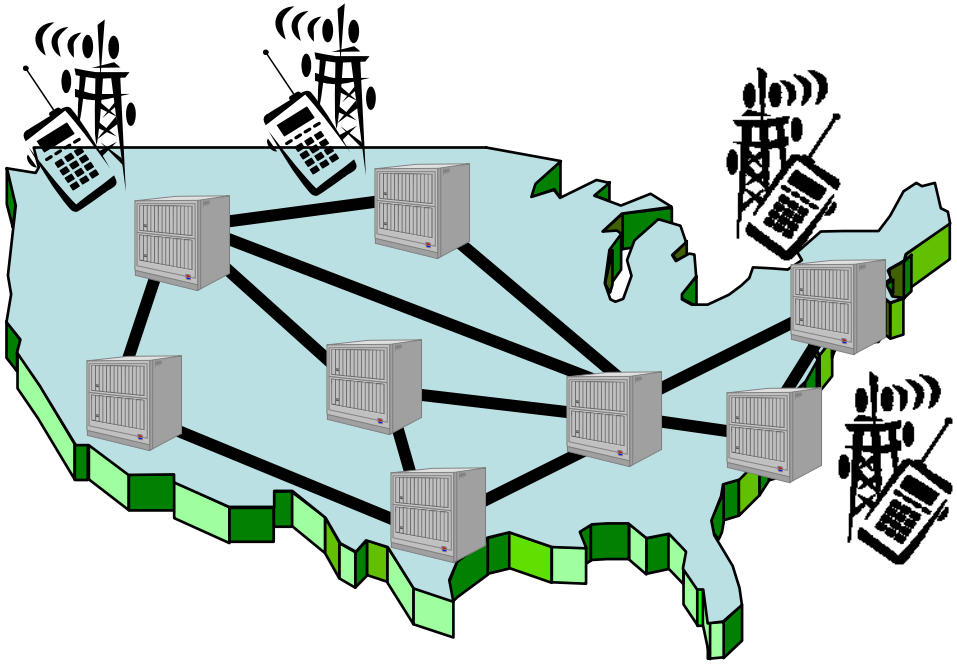
It turns into a really good idea

Boy did I learn a lot! I've published papers, the architecture has evolved in major ways, and I'm even attracting real users!



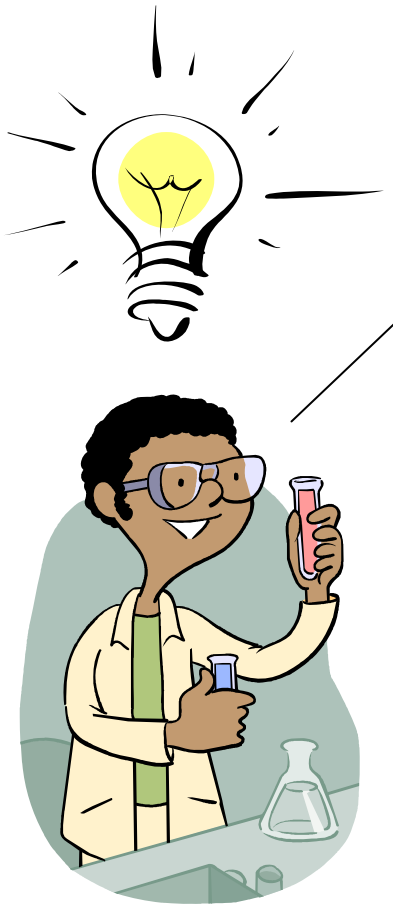
Location-based social networks are really cool!

His experiment grew larger and continued to evolve as more and more real users opted in . . .



His slice of GENI keeps growing, but GENI is still running many other concurrent experiments.

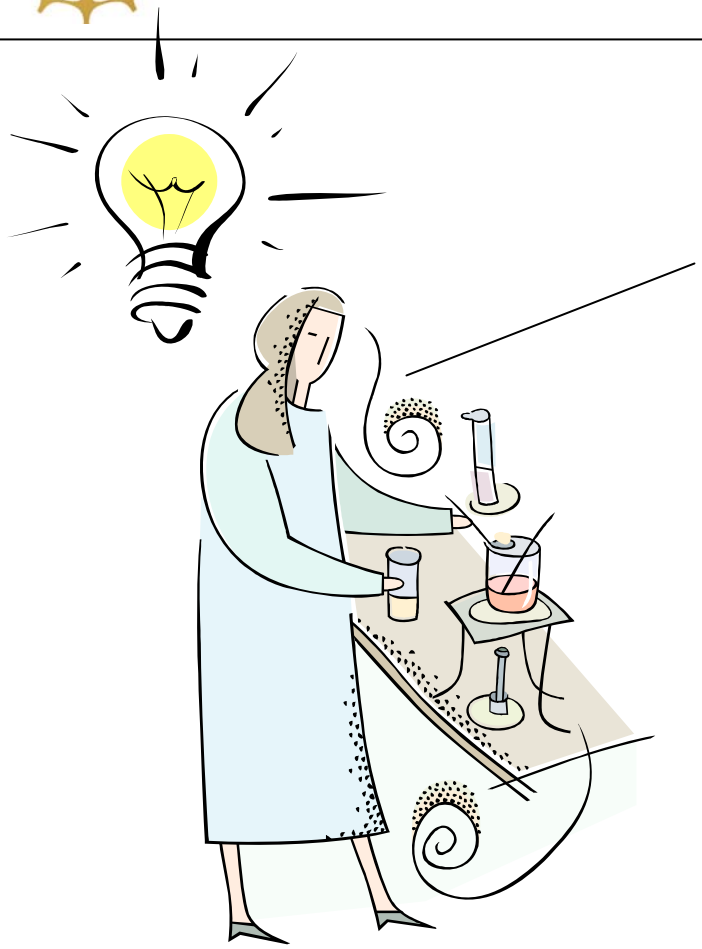
Experiment turns into reality



My experiment was a real success, and my architecture turned out to be mostly compatible with today's Internet after all – so I'm taking it off GENI and spinning it out as a real company.

I always said it was a good idea, but way too conservative.

Meanwhile . . .



I have a great idea! If the Internet were augmented with a scalable control plane and realtime measurement tools, it could be 100x as reliable as it is today . . . !

And I have a great concept for incorporating live sensor feeds into our daily lives !

If **you** have a great idea, check out the **NSF FIND** program which is funding new architectural work. www.nets-find.net

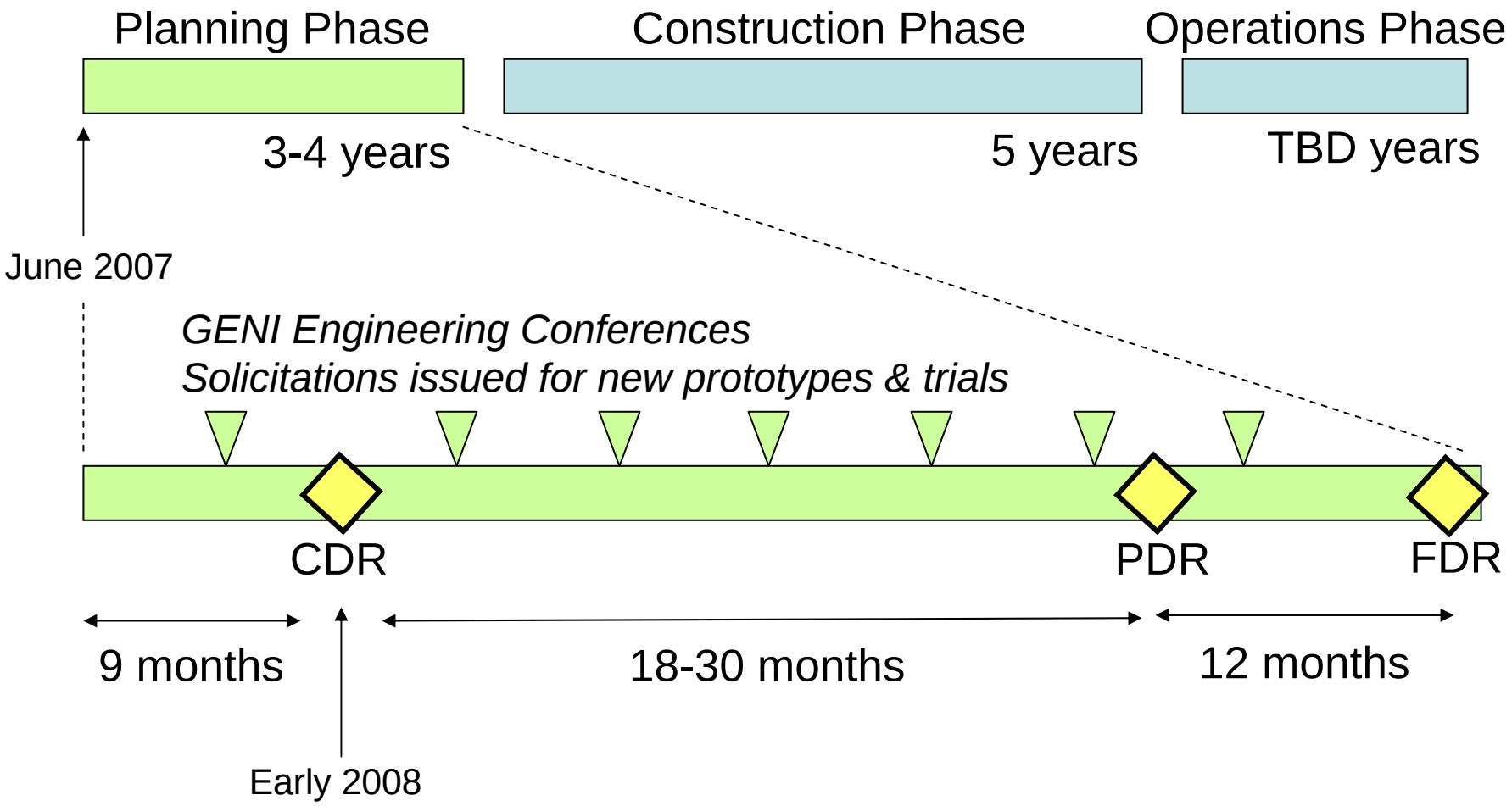
Moral of this story

- GENI is meant to enable . . .
  - Trials of new architectures, which may or may not be compatible with today's Internet
  - Long-running, realistic experiments with enough instrumentation to provide real insights and data
  - 'Opt in' for real users into long-running experiments
  - Large-scale growth for successful experiments, so good ideas can be shaken down at scale
- A reminder . . .
  - GENI itself is not an experiment !
  - GENI is a stable facility on which experiments run

GENI creates a huge opportunity for ambitious research!

- Introductions
  - The GENI Vision
  - The NSF, GSC, and GPO
- GENI Planning and Construction
  - Timelines (Estimate)
  - Planning Phase Goals
  - Building by Spiral Development & Federation
- GENI will be Designed & Built by the Community
  - GENI Working Groups
  - GENI Engineering Conferences
  - GPO Solicitations
- What You can do to Get Ready

Current Timeline for GENI Planning and Construction



Our plan for building GENI

- Start with a clear, achievable starting point and an envisioned “ultimate goal”
- Begin prototyping and trials immediately
  - Gain **practical experience** with prototypes, and adjust “wishlists” and requirements as we go
  - Make **realistic estimates** of cost and operational complexity based on early experience with prototype systems, rather than guess-work
  - Add features, complexity, and new technologies incrementally, based on experience to date
- Repeatedly assess GENI’s current risk and usefulness as planning and construction unfold, and adjust plans accordingly

GENI Needs Rapid Prototypes

Work should begin immediately by multiple teams

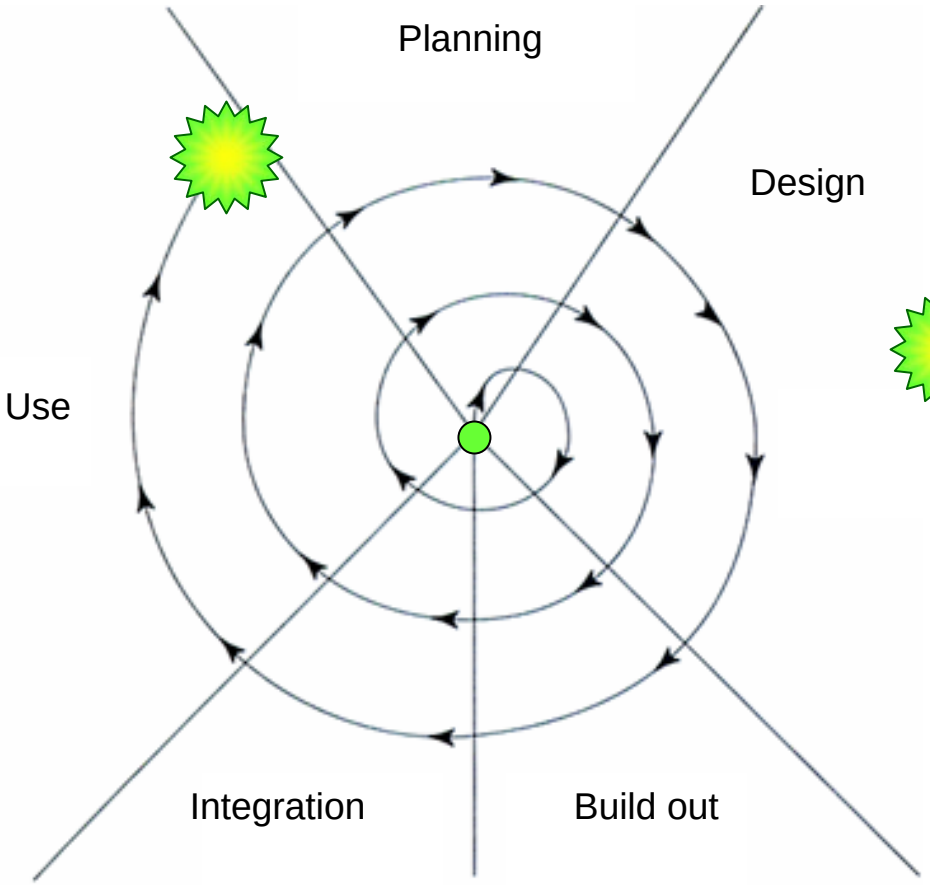
GENI's envisioned technology *TODAY*

TRL	NASA Definition, adapted to GENI Context
1	Basic principles observed and reported.
2	Technology concept and/or application formulated.
3	Analytical and experimental critical function and/or characteristic proof-of-concept achieved in a laboratory environment.
4	Component and/or breadboard validated in a laboratory environment.
5	Component and/or breadboard validated in a relevant environment.
6	System/subsystem model or prototype demonstration in a relevant lab environment.
7	System prototype demonstrated in an end-to-end "GENI-like" environment.
8	Actual system completed and demonstrated in the end-to-end GENI environment.
9	Actual system "flight proven" through successful end-to-end GENI experiments.

GENI needs to be *here* before Construction Phase decision

Spiral Development

GENI grows through a well-structured, adaptive process

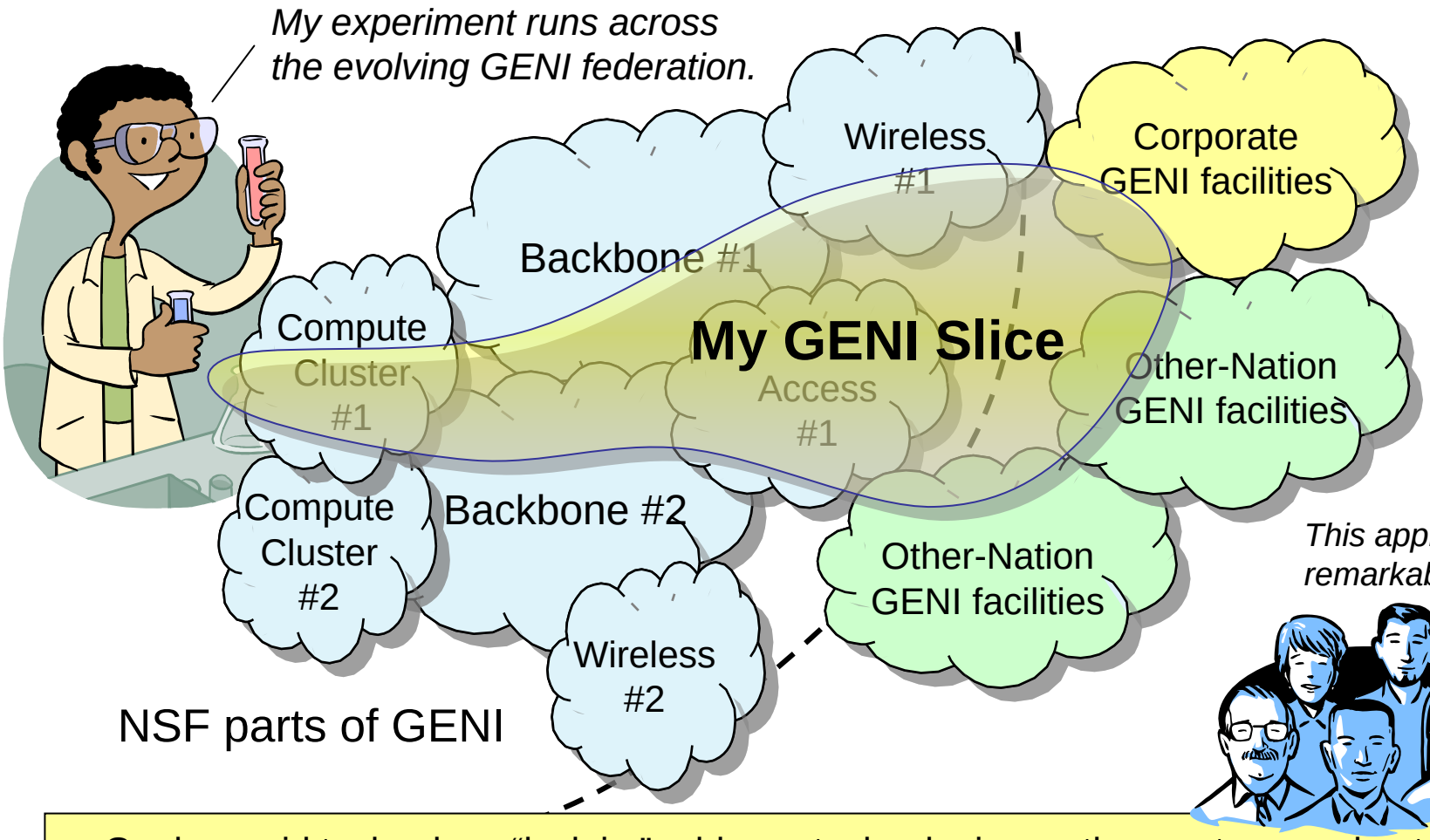


Strawman GENI Construction Plan

- An achievable **starting point**
  Example: Rev 1 “narrow waist”, federation of multiple substrates (clusters, wireless, regional / national optical net with early GENI ‘routers’, perhaps some existing testbeds), Rev 1 user interface and instrumentation.
- Envisioned **ultimate goal**
  Example: Planning Group’s desired GENI facility, probably trimmed some ways and expanded others. Incorporates large-scale distributed computing resources, high-speed backbone nodes, nationwide optical networks, wireless & sensor nets, etc.
- Spiral Development Process
  Re-evaluate goals and technologies yearly by a systematic process, decide what to prototype and build next.

Federation

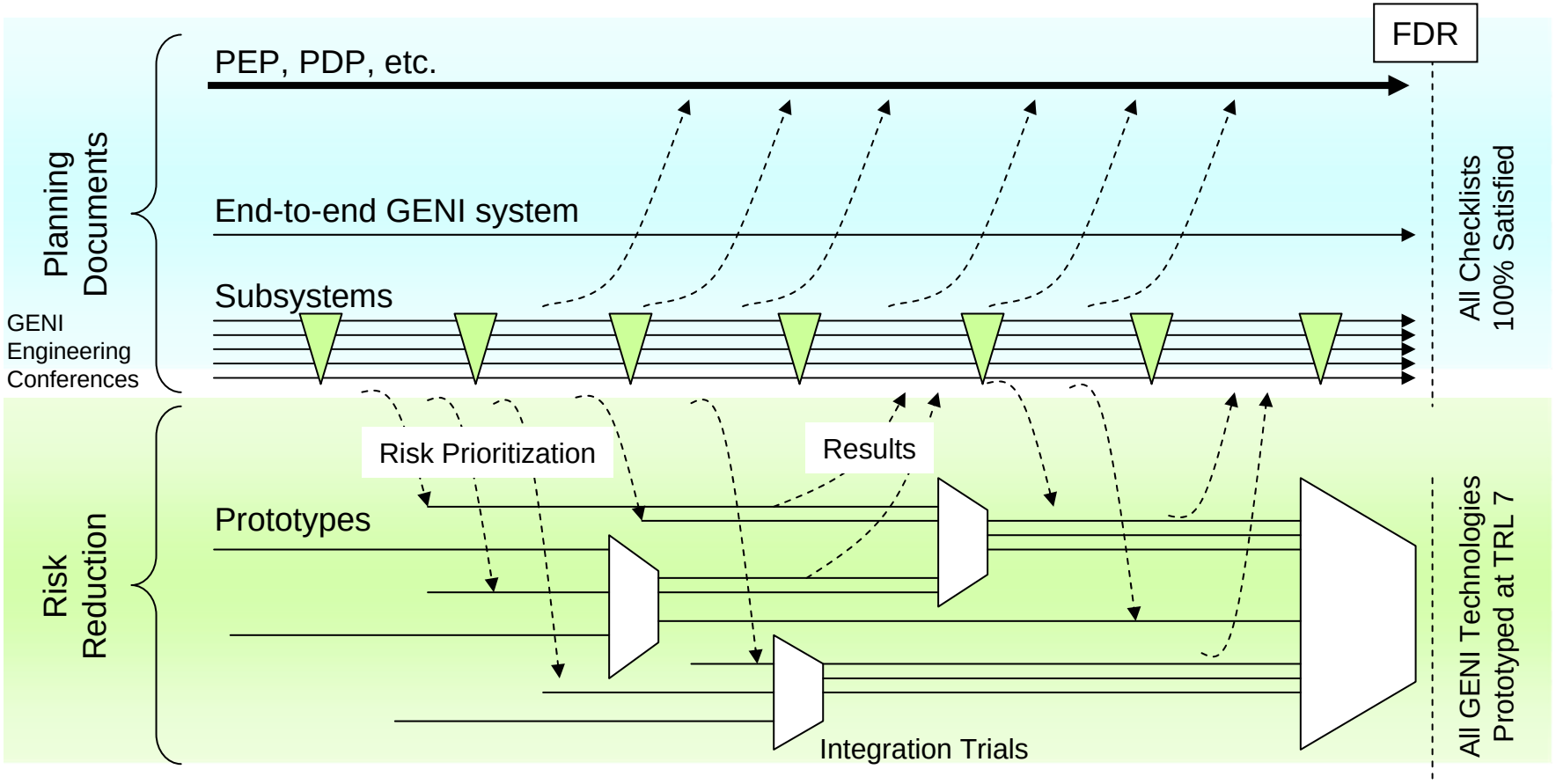
GENI grows by "gluing together" hetrogeneous facilities over time



Goals: avoid technology "lock in," add new technologies as they mature, and potentially grow quickly by incorporating existing facilities into the overall "GENI ecosystem"

GENI's Planning Phase
Prototyping while refining design & budget

"Paper" Design Documents, Schedule, Budget, etc.



Academic / Industrial Prototyping, Integration, Experiments

- Introductions
  - The GENI Vision
  - The NSF, GSC, and GPO
- GENI Planning and Construction
  - Timelines (Estimate)
  - Planning Phase Goals
  - Building by Spiral Development & Federation
- GENI will be Designed & Built by the Community
  - GENI Working Groups
  - GENI Engineering Conferences
  - GPO Solicitations
- What You can do to Get Ready

GENI will be Designed & Built by the Community
Via an Open, Transparent, & Fair GPO Process

- All design, prototyping, & construction will be performed by the research community (academia & industry)
- Openness will be emphasized
  - Design process will be open, transparent, and broadly inclusive
  - Open-source solutions will be strongly preferred
  - Intellectual property is OK, under no-fee license for GENI use
- GPO will be fair and even-handed
  - BBN brings no technology to the table
  - BBN does not intend to write any GENI software, nor does it envision bidding on any prototyping or construction activities (but “never say never”)
  - If BBN does create any GENI technology, it will be made public at no cost

Open, public GENI Working Groups

- Goals

  WGs will produce a set of formal documents for all GENI subsystems, including requirements documents, high-level design, system interfaces, lists of known risks, etc. All will be public on geni.net.

- Constitution

  Each WG will have a public charter with specific set of deliverables; a chair with a clear, transparent process for governance; and a GPO-paid System Engineer responsible for producing the requisite documents. WGs are overseen by the GPO's Engineering Architect who will ensure a coherent GENI design.

- Timelines

  WGs will be established over the summer, and will produce their first written documents in Fall 2007, with documents evolving throughout the GENI Planning Phase. Documents will be formally reviewed by the GSC and GPO every 4 months to ensure satisfactory progress.

New GENI Working Groups (WGs)

- **Substrates**
  All hardware, real-estate, facilities, etc., required for the GENI facility (including optical networks, wireless, computers, etc.) Includes Operational Expenses for the facility except Operations & Management costs.
- **“Narrow Waist” with Federation**
  Written definitions of the core GENI mechanisms for providing experimental control of a node or collection of nodes. The very earliest version must incorporate federation.
- **Experiment Workflow**
  Tools and mechanisms by which a researcher designs and performs experiments using GENI. Includes all user interfaces for researchers, as well as data collection, archiving, etc.
- **User Opt-In**
  How do “real users” (not researchers) participate in GENI. Includes both mechanisms and considerations such as privacy, etc.
- **Operations, Management, and Security**
  How do operators provision, operate, manage, and trouble-shoot GENI? Includes all mechanisms for securely operating the facility, and Operations & Management costs.

GENI Engineering Conferences
Meet every 4 Months to Review Progress Together

- First meeting October 9-11, 2007 in Minneapolis, open to all
  - "Bidders' conference" that explains first GPO solicitation, how to submit a proposal, evaluation process & criteria, how much money, etc.
  - Also reviews current GENI status, Working Group meetings
- Subsequent Meetings, open to all who fit in the room
  - Held at regular 4-month periods
  - Held on / near university campuses (volunteers?)
  - All GPO-funded teams required to participate
  - Systematic, open review of each Working Group status (all documents and prototypes / trials / etc.)
  - Also time for Working Groups to meet face-to-face
  - Results in prioritized list for next round of prototype funding areas (priorities decided by GSC and GPO)

How the GPO will Fund Rapid Prototyping and Experiments

- Needs are driven by “long poles” in GENI construction – the high risk technology
  - High risks are identified at 4-month intervals by GSC / GPO review panel
  - GPO issues solicitations once or twice per year
  - Proposals are merit-reviewed by NSF-style panels
  - GPO continuously monitors contracts for performance
  - Quick decisions and quick funding are essential
- Goal is to have multiple research teams up to speed in each area before construction begins, who can then bid on the big construction contracts

The Role of Optical Networks in GENI

- GENI's focus is end-to-end network architectures
  - Emphasizing **programmability** across all elements
  - As well as virtualization and 'slices'
- Optics will drive much of communications technology for the foreseeable future
  - If GENI is a facility for future global networking architectures . . .
  - . . . how can it ignore the impacts driven by advances in optics?
- Optics in GENI can be forward-looking and unconstrained by today's communication architectures
  - Such as light-path setup, burst switching, optical packet switching . . .
  - . . . as well as non-grid spectrum allocations, variable bit rates, optical broadcast, etc.
- The core GENI interest: **impacts on end-to-end architecture**

GPO Solicitations

- First solicitation coming soon
  - Solicitation will issue ~ November 2007
  - Proposals due ~ January 2008
  - Awards will be made ~ 8 weeks after proposals due, assuming that the GPO has NSF funds in hand at that point
- What will we solicit?
  - Analyses & idea papers
  - Prototypes of high-risk GENI technology
  - Integrations and trials of prototypes
  - Experimentation with prototypes
- How will proposals be judged?
  - Merit review (exact process still being designed)
  - Joint academic / industrial teams will be favored but not required
  - Open source will be favored but not required
    (IP licensing still being designed)

What You can do to Get Ready

- Everyone
  - Join the new GENI Working Groups
  - Read and comment on current GENI documents
  - Attend October GENI Engineering Conference
- Academics
  - Think about research that GENI could enable for you
  - Think about what GENI needs to make that research really amazing
  - Start thinking about your proposals!
- Industry
  - Think about research that GENI could enable for you
  - Start teaming with academics to build GENI prototypes

www.geni.net

Clearing house for all GENI news and documents

Questions ? Concerns ?
Suggestions for Improvement ?

www.geni.net

Clearing house for all GENI news and documents