



# GENI

Global Environment for Network Innovations

The GENI Project Office (GPO)

**[www.geni.net](http://www.geni.net)**

Clearing house for all GENI news and documents



# “Our founders”

---

## The GENI Planning Group and Many, Many Working Group Volunteers

Larry Peterson, Princeton (Chair)  
Tom Anderson, Washington  
Dan Blumenthal, UCSB  
Dean Casey, NGENET Research  
David Clark, MIT  
Deborah Estrin, UCLA  
Joe Evans, Kansas  
Terry Benzel, USC/ISI

Nick McKeown, Stanford  
Dipankar Raychaudhuri, Rutgers  
Mike Reiter, CMU  
Jennifer Rexford, Princeton  
Scott Shenker, Berkeley  
Amin Vahdat, UCSD  
John Wroclawski, USC/ISI  
CK Ong, Princeton

---

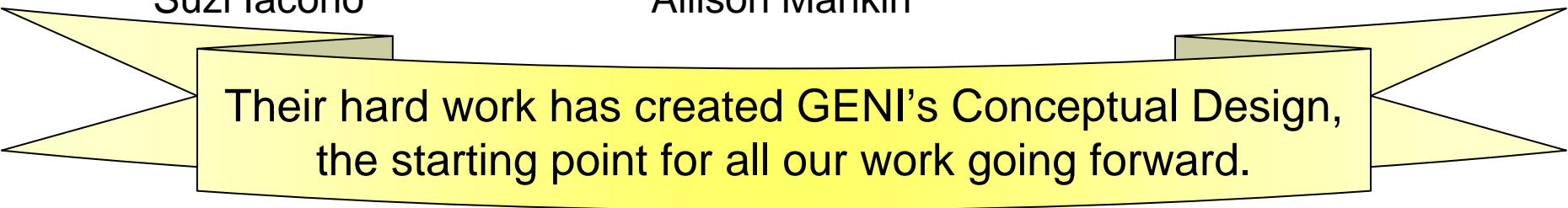
### And Within NSF

---

Peter Freeman  
Debbie Crawford  
Larry Landweber  
Suzi Iacono

Guru Parulkar  
Darlene Fisher  
Cheryl Albus  
Allison Mankin

Ty Znati  
Gracie Narcho  
Paul Morton

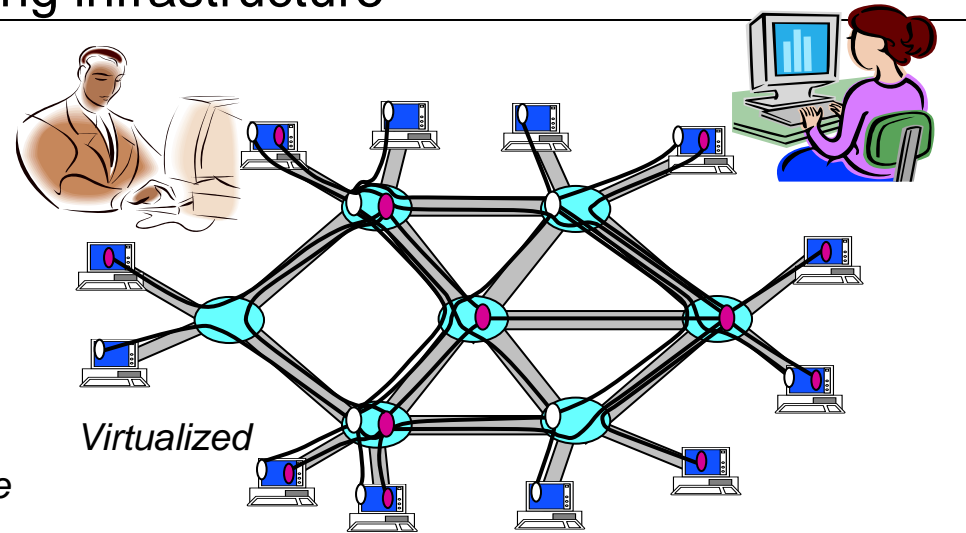
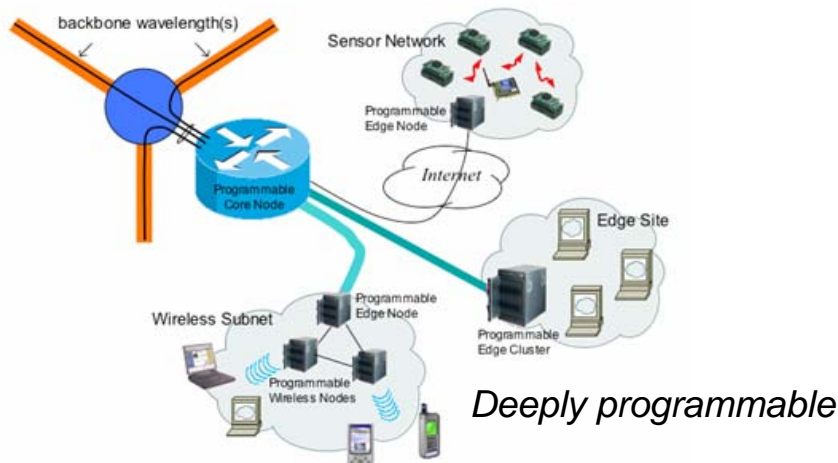


Their hard work has created GENI's Conceptual Design,  
the starting point for all our work going forward.

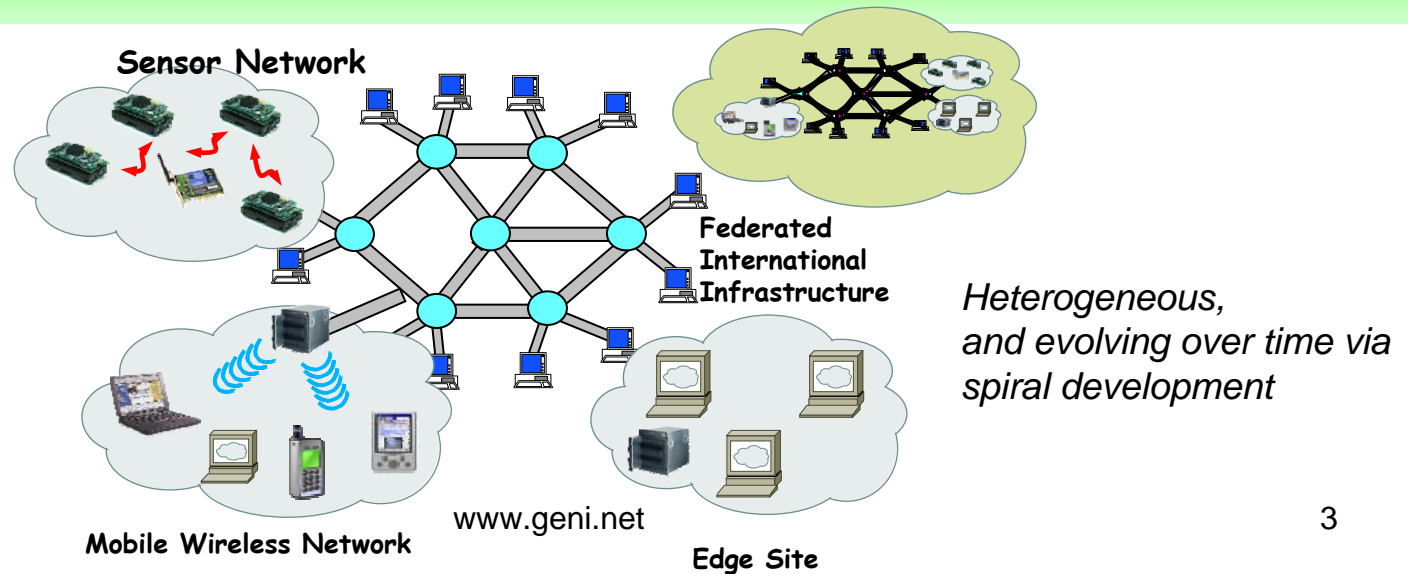


# The GENI Vision

A national-scale suite of facilities to explore radical designs for a future global networking infrastructure

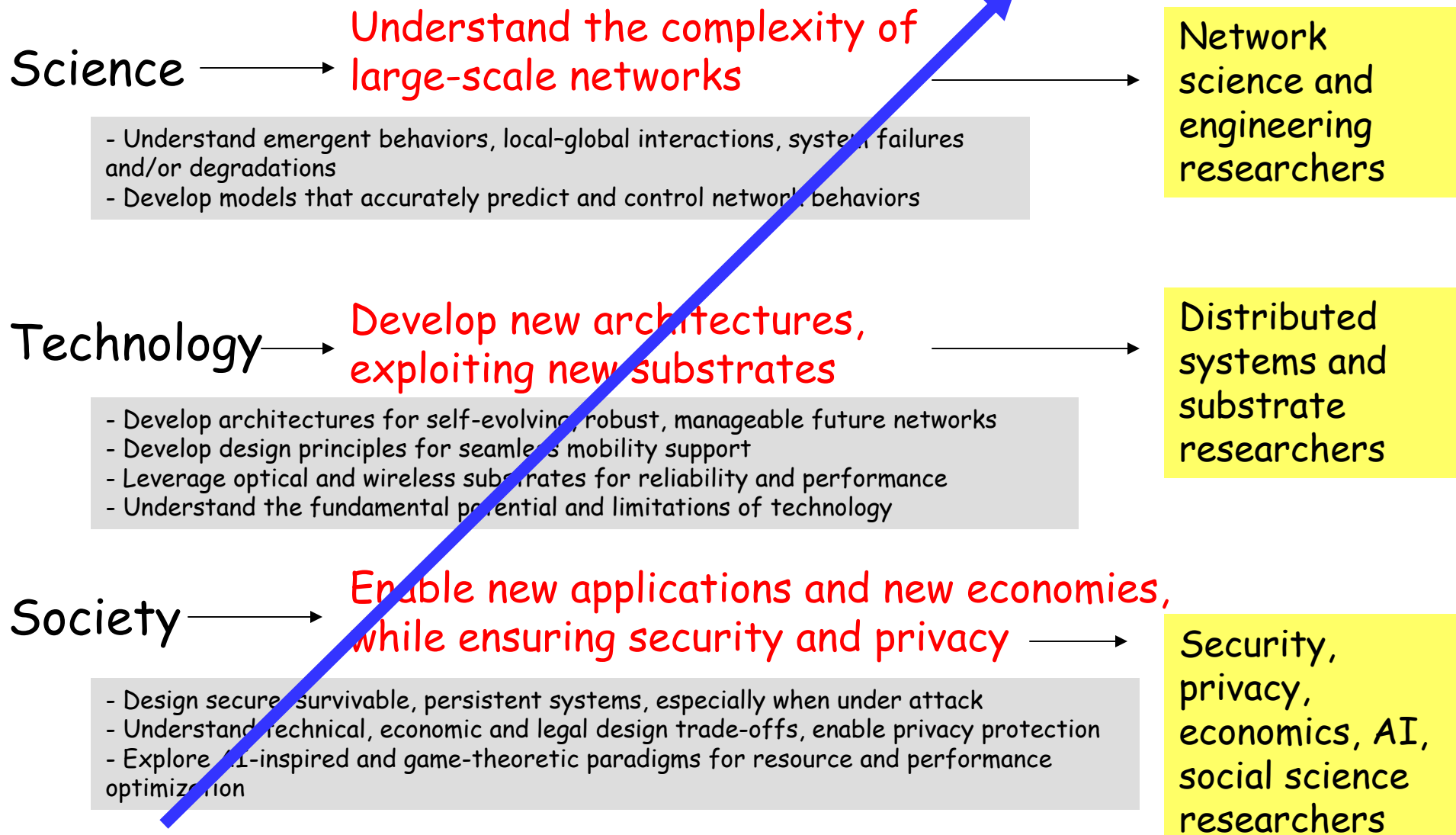


***Programmable & federated, with end-to-end virtualized “slices”***





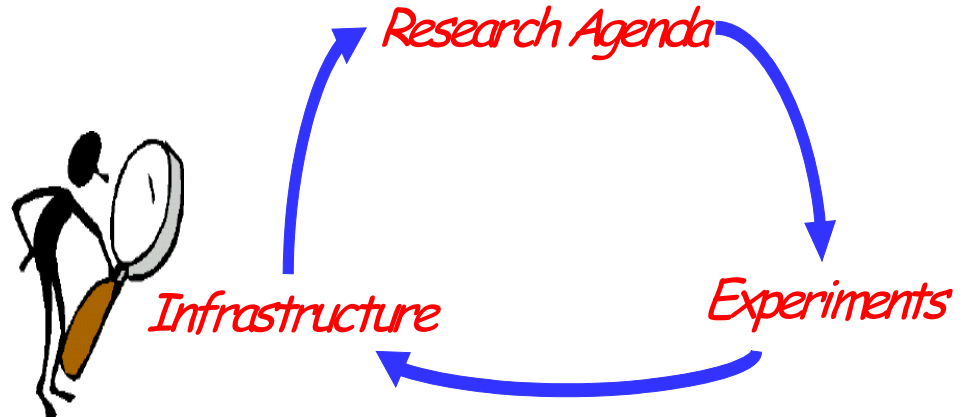
# GENI supports Fundamental Challenges Network Science & Engineering (NetSE)





# Research Agenda to Experiments to Infrastructure

- Research agenda
  - Identifies fundamental questions
  - Drives a set of experiments to validate theories and models
- Experiments & requirements
  - Drives what infrastructure and facilities are needed
- Infrastructure could range from
  - Existing Internet, existing testbeds, federation of testbeds, something brand new (from small to large), federation of all of the above, to federation with international efforts
  - No pre-ordained outcome



## Existing Input

- |   |  |
|---|--|
| <ul style="list-style-type: none"><li>• Clark et al. planning document for Global Environment for Network Innovations</li><li>• Shenker et al. "I Dream of GENI" document</li><li>• Kearns and Forrest ISAT study</li><li>• Feigenbaum, Mitzenmacher, and others on Theory of Networked Computation</li></ul> | <ul style="list-style-type: none"><li>• Hendler and others in Web Science</li><li>• Ruzena Bajcsy, Fran Berman, and others on CS-plus-Social Sciences</li><li>• NSF/OECD Workshop "Social and Economic Factors Shaping the Future of the Internet"</li><li>• Current NSF "networking" programs<ul style="list-style-type: none"><li>– FIND, SING, NGNI</li></ul></li></ul> |
|---|--|



# 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!*



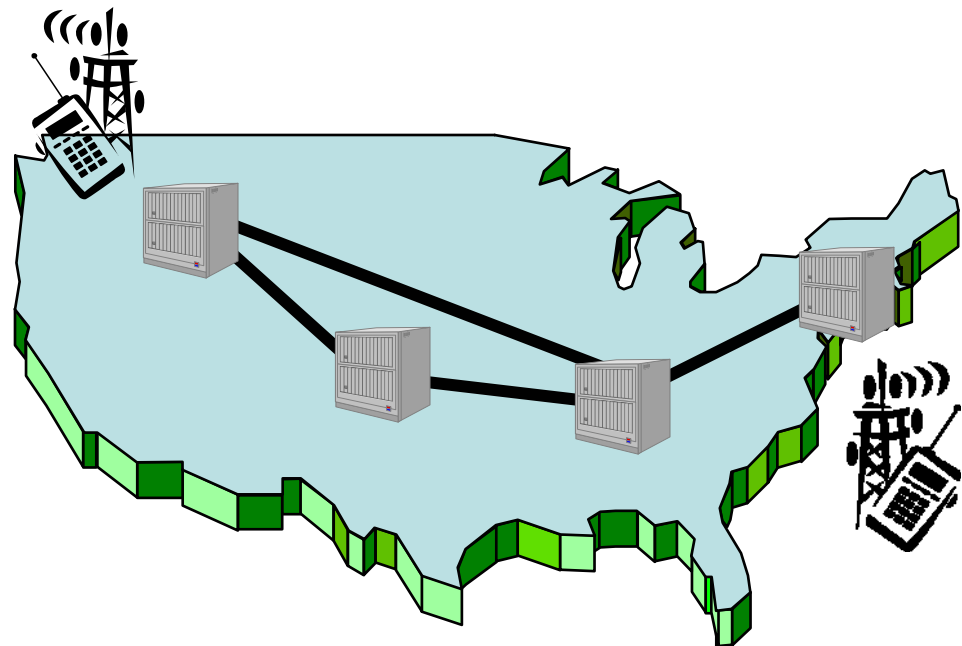


# Trying it out



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

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 suite, and started taking measurements . . .



He uses a modest slice of GENI, sharing its facilities with many other concurrent experiments.





# It turns into a really good idea

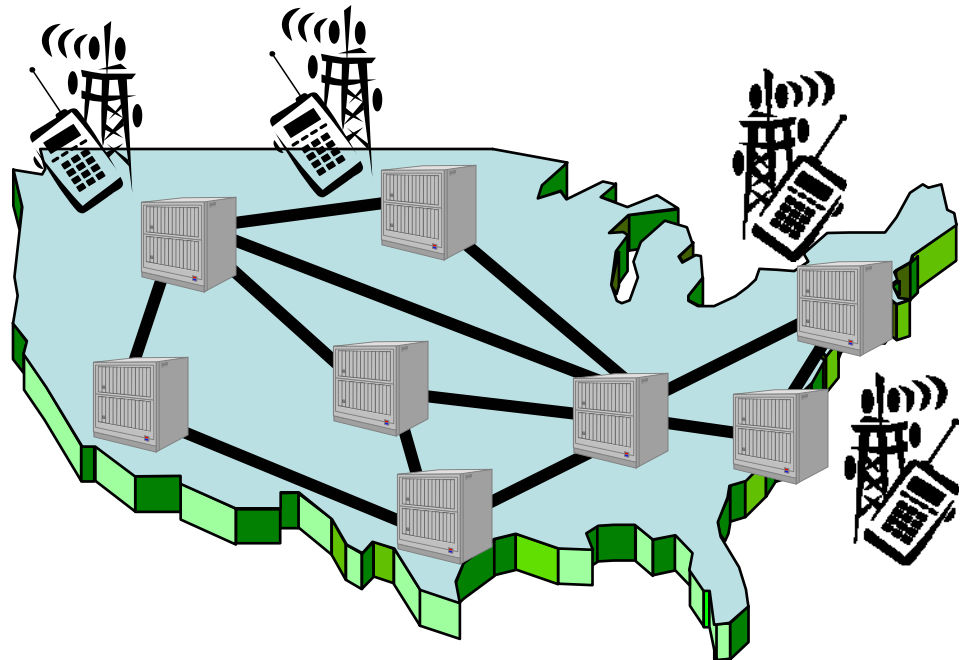


Boy did I learn a lot! I've published papers, the architecture has evolved in major ways, and I'm even attracting real users!

*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, SING, or NGNI** programs which are funding new architectural work. [www.nets-find.net](http://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 suite of facilities on which experiments run

**GENI creates a huge opportunity for ambitious research!**



# How We'll Build GENI

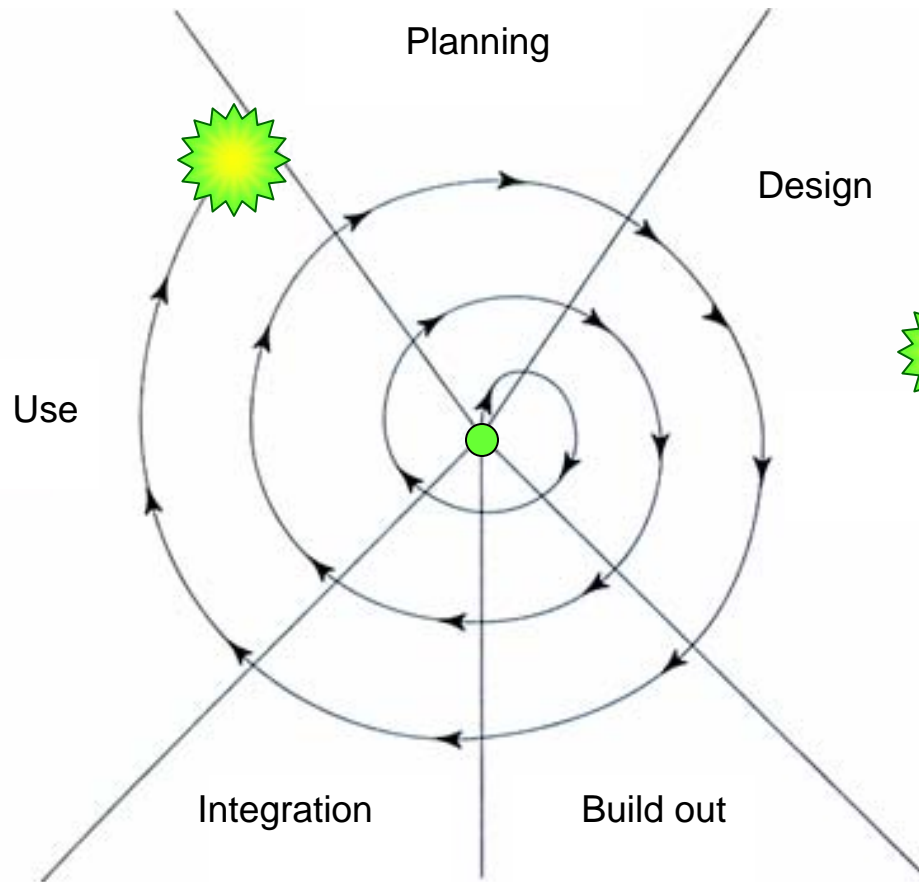
Note that this is the “classics illustrated” version – a comic book!

Please read the GENI Project Development Plan (PDP) and Project Execution Plan (PEP) for detailed planning information.



# 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.

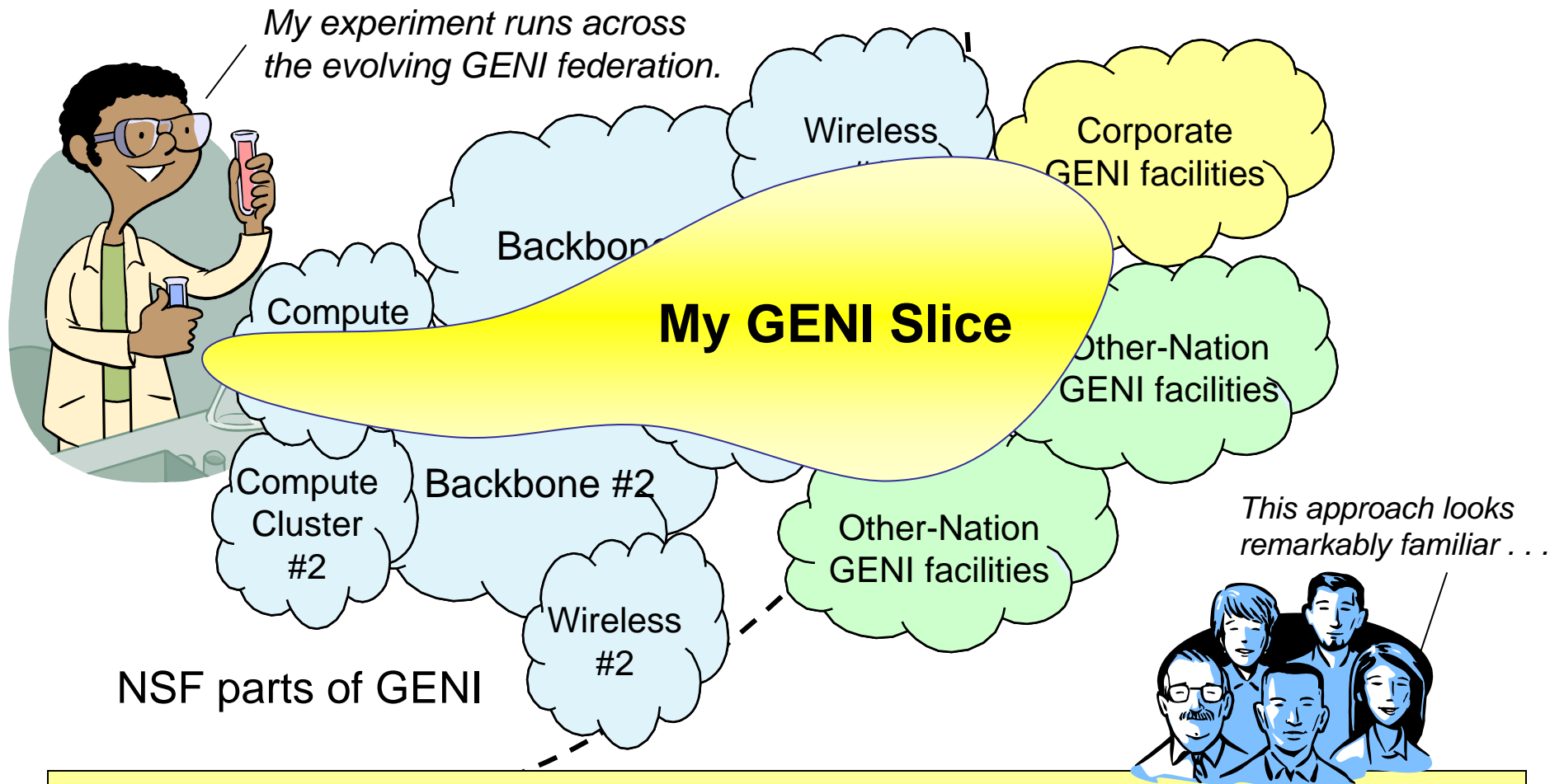
- **Spiral Development Process**

Re-evaluate goals and technologies yearly by a systematic process, decide what to prototype and build next.



# Federation

GENI grows by “gluing together” heterogeneous 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 is being 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 is emphasized
  - Design process is open, transparent, and broadly inclusive
  - Open-source solutions are 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





# GENI Engineering Conferences

Meet every 4 months to review progress together

---

- **3<sup>rd</sup> meeting Oct. 28-31, 2008 in Palo Alto, open to all**
  - Reviews current GENI status, Working Group meetings
  - Also discuss GPO solicitation, how to submit a proposal, evaluation process & criteria, how much money, etc.
  - **Travel grants** to US academics for participant diversity
- 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 NetSE Council and GPO)



# GPO Solicitations

Academic-industrial teams favored but not required

---

- **First solicitation closed recently**
  - February 2008
  - Over 70 proposals received
- **Second solicitation planned for Fall 2008**
- What kinds of proposals do we solicit?
  - Analyses & idea papers
  - Prototypes of high-risk GENI technology
  - Integrations and trials of prototypes
- How are proposals judged?
  - Merit review
  - Joint academic / industrial teams will be favored but not required
  - Open source will be favored but not required  
(IP licenses on [www.geni.net](http://www.geni.net))



# GENI is a Huge Opportunity

---

- **GENI is an unbelievably exciting project for the community**
  - Our research community has changed the world profoundly. GENI opens up a space to do it again.
- **We believe the whole community will 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.
- **GENI Spiral 1 is now underway !**
  - within a GENI project framework that is open, transparent, and broadly inclusive.

**[www.geni.net](http://www.geni.net)**

Clearing house for all GENI news and documents