GENI Overview: An End-User Perspective

GENI Project Office (GPO)

March 27, 2008

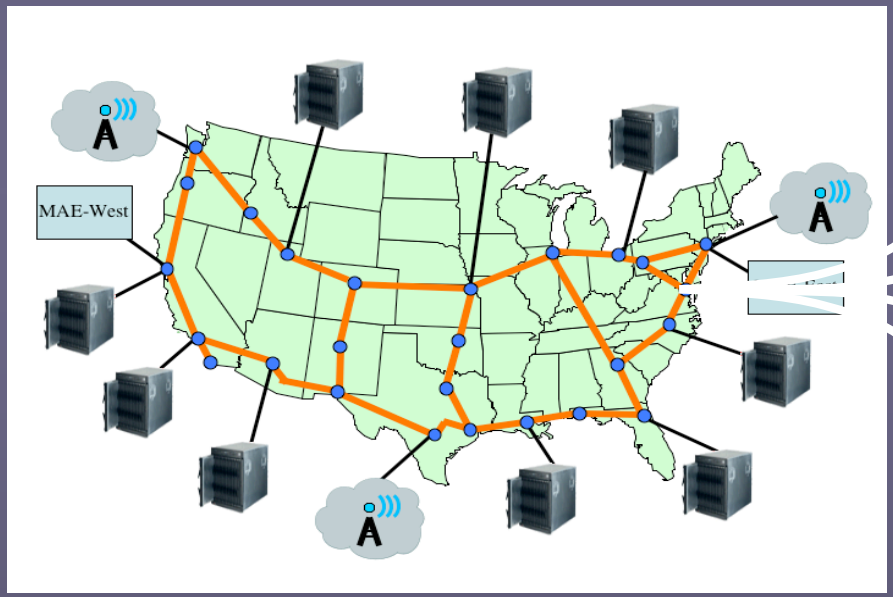
What is GENI? [facility view]

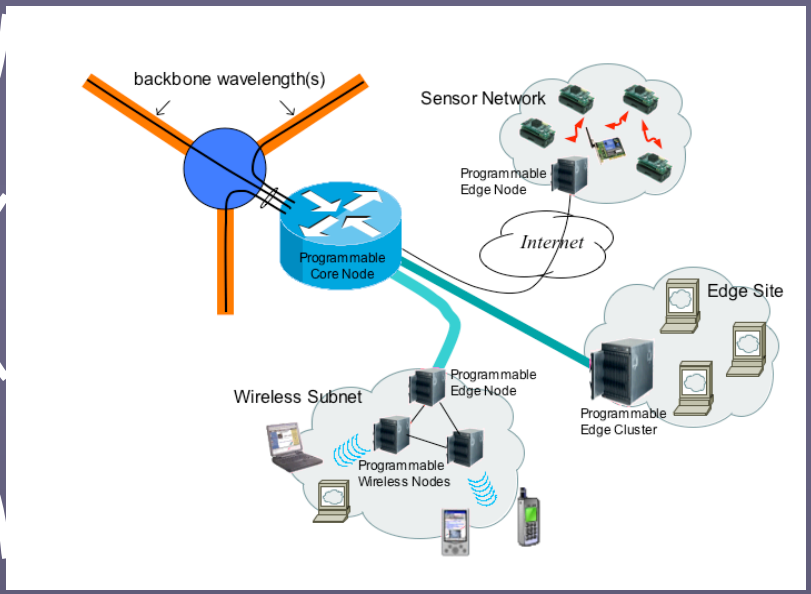
a national-scale network facility for *experimentation*

with radically innovative network architectures, protocols, services, applications…

also

with novel economic & pricing models, social networks, legal frameworks, public policy …

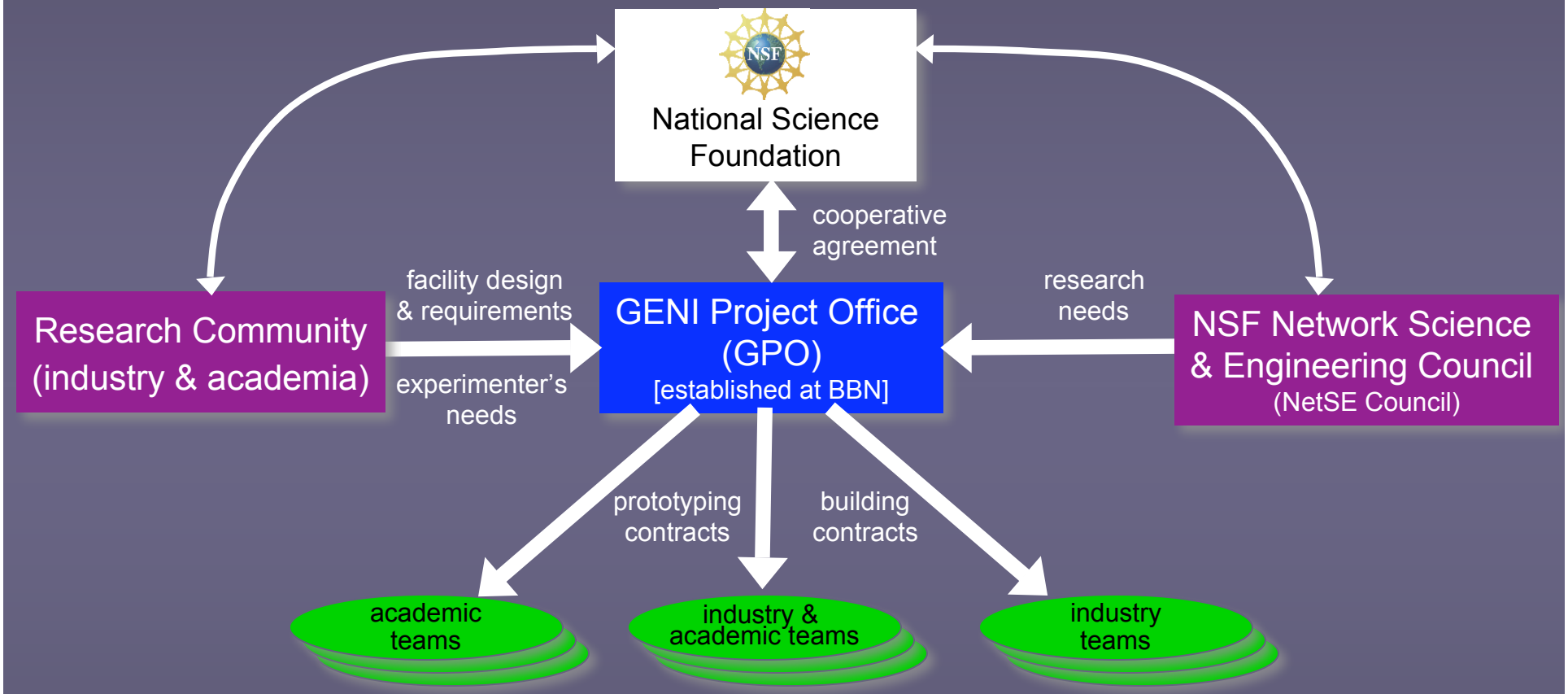




- large, wide-area footprint
- enables large-scale, end-to-end experiments
- shared among experiments by virtualization & slices

- high capacity optical nets and programmable cores
- large clusters of CPUs, storage
- edge / access technologies (e.g. cellular, wireless, sensor networks)

Who is creating GENI? [programmatic view]

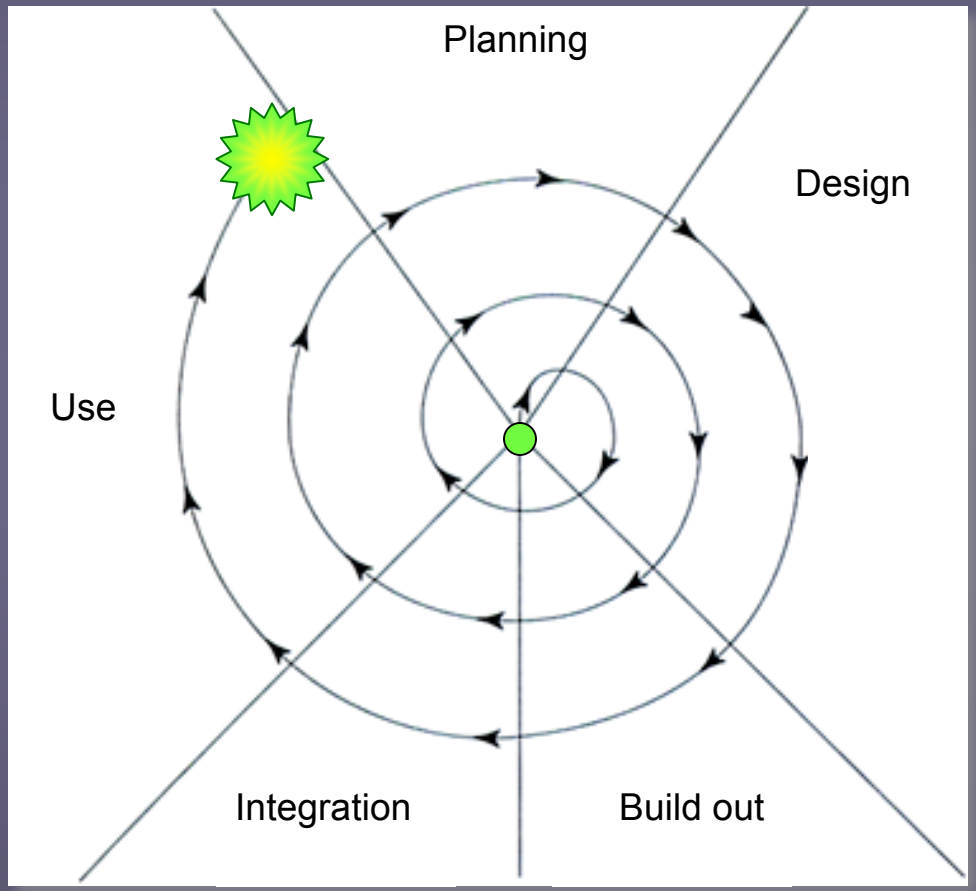


GENI is being created by the academic and industry research community, and will be built mostly by industry

(meetings: 3 GENI Engineering Conferences per year)

How is GENI being built? [development view]

GENI grows via a well-structured, adaptive process



Strawman GENI Construction Plan

Achievable *starting point*

Rev 1 facility control framework, federation of multiple substrates (clusters, wireless, regional / national optical net with early GENI 'routers', some existing testbeds), Rev 1 user interface and instrumentation

Near-term (w/ experimentation support)

- early subsystem prototype op. ~ 12 mo
- E2E prototype operational ~ 36 months

Envisioned *ultimate goal*

e.g. desired GENI facility, incorporates large-scale distributed computing resources, high-speed backbone nodes, nationwide optical networks, wireless & sensor nets, etc.

Spiral Development

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

10 - 20 year timeframe

use and evolution

Federation

incorporate other international facilities

What will GENI look like? [functional view]

GENI End-user Applications

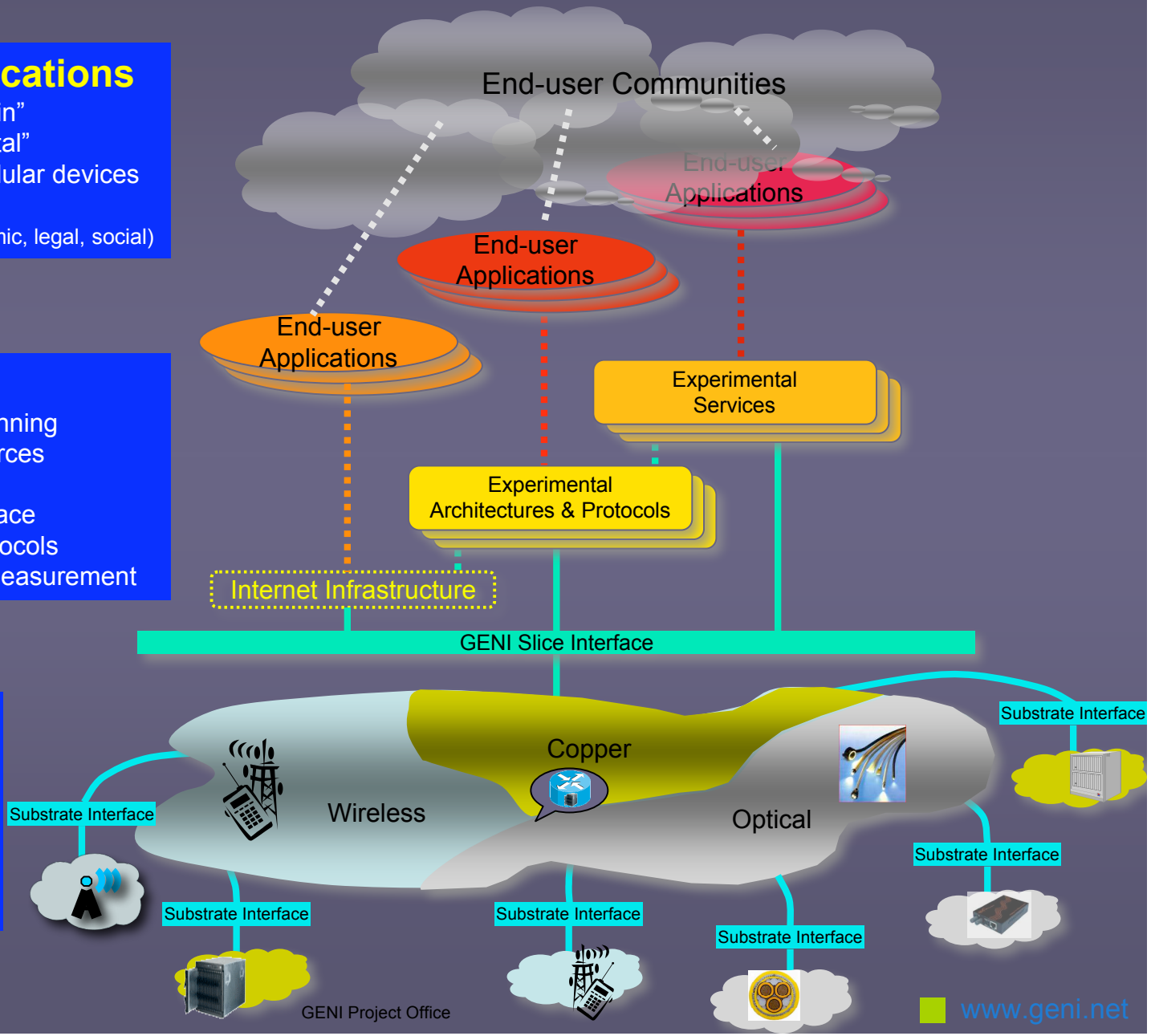
- real users communities "opting-in"
- tunnel via Internet to GENI "portal"
- connect directly via wireless/cellular devices
- interested in new services
- new degrees of freedom (economic, legal, social)

GENI Experiments

- short (secs) or long (months) running
- acquire a "slice" of GENI resources
- view a "GENI virtual machine"
- composable experimental interface
  i.e. services built on top of protocols
- high fidelity instrumentation & measurement

GENI Substrates

multiple backbone providers, programmable switches/routers, computing/storage clusters at edge sites, wireless subnets, ISP peers, cellular networks



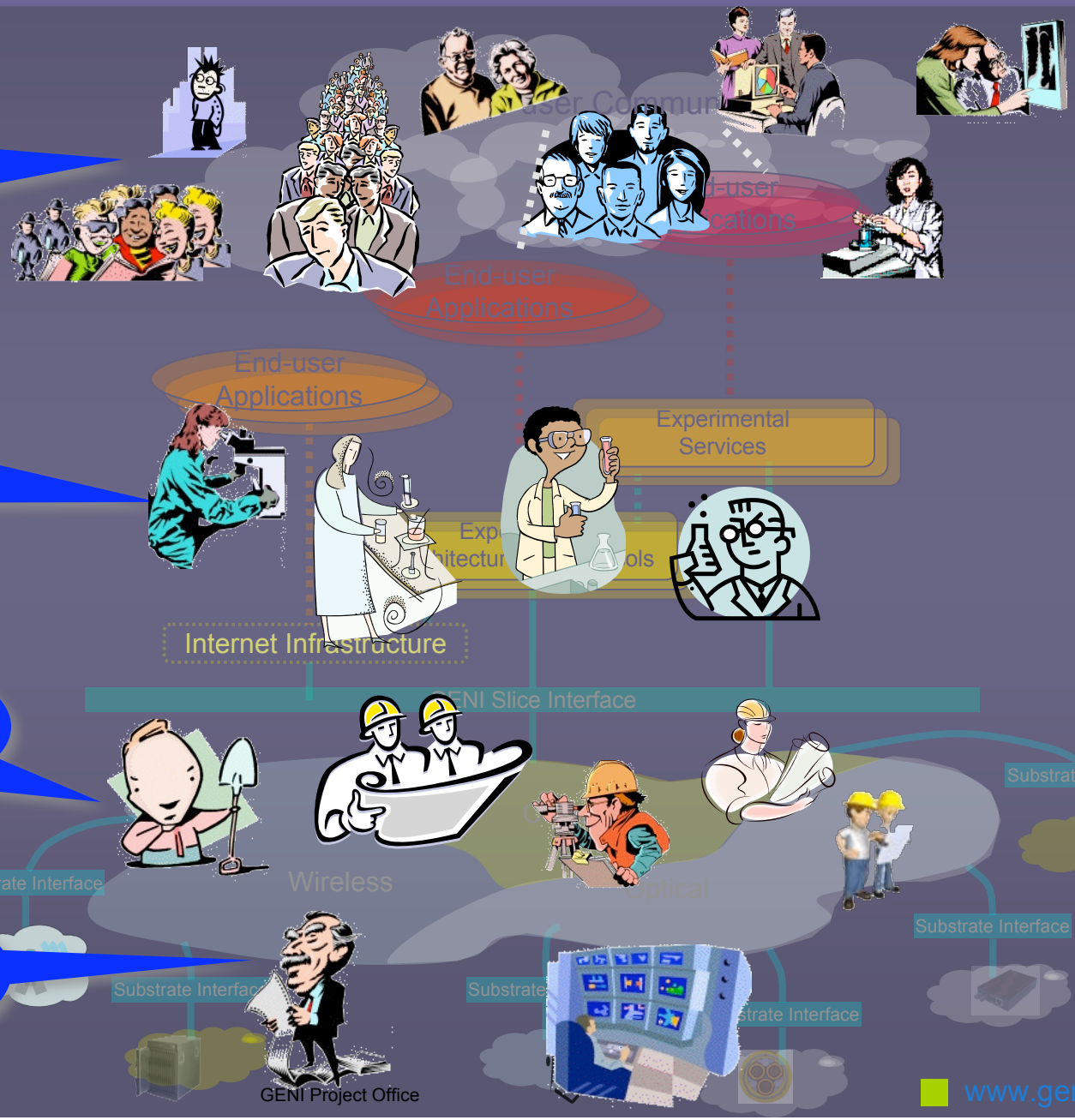
Who are the players? [role view]

real end-users
business, social, media, medical, education, government …

experimenters
computer science/engineering, economics, law, social science, e-service industry

facility designers & builders
industry & academic teams

network owners & operators
campuses & ISPs



What to expect from GENI? [design requirements view]

1. Generality
- minimal architectural constraints
- allow new formats, new functionality, new paradigms
- breadth of representative network technology

2. Sliceability
- support many experiments in parallel
- isolate experiments from each other (VMs)

3. Composeability
- possible to compose multiple experiments
- enables building more complex systems
- enables building user services on new architectures

4. Fidelity
- ***Device level***: expose useful levels of abstraction that faithfully emulate real thing
- ***Network level***: arrange nodes into topologies across physical space in a realistic manner; scale to large sizes and expose useful network-wide abstractions
- ***GENI-wide***: E2E topology, relative performance, reflect economic cost factors

5. Real Users
- allow access to real content via real applications
- provide incentives & mechanisms to encourage this
- support long-lived experiments and services

6. Research Support
- tools to lower barrier-to-entry for researchers
- community builds useful tools
- observable and measurable operation of experiment

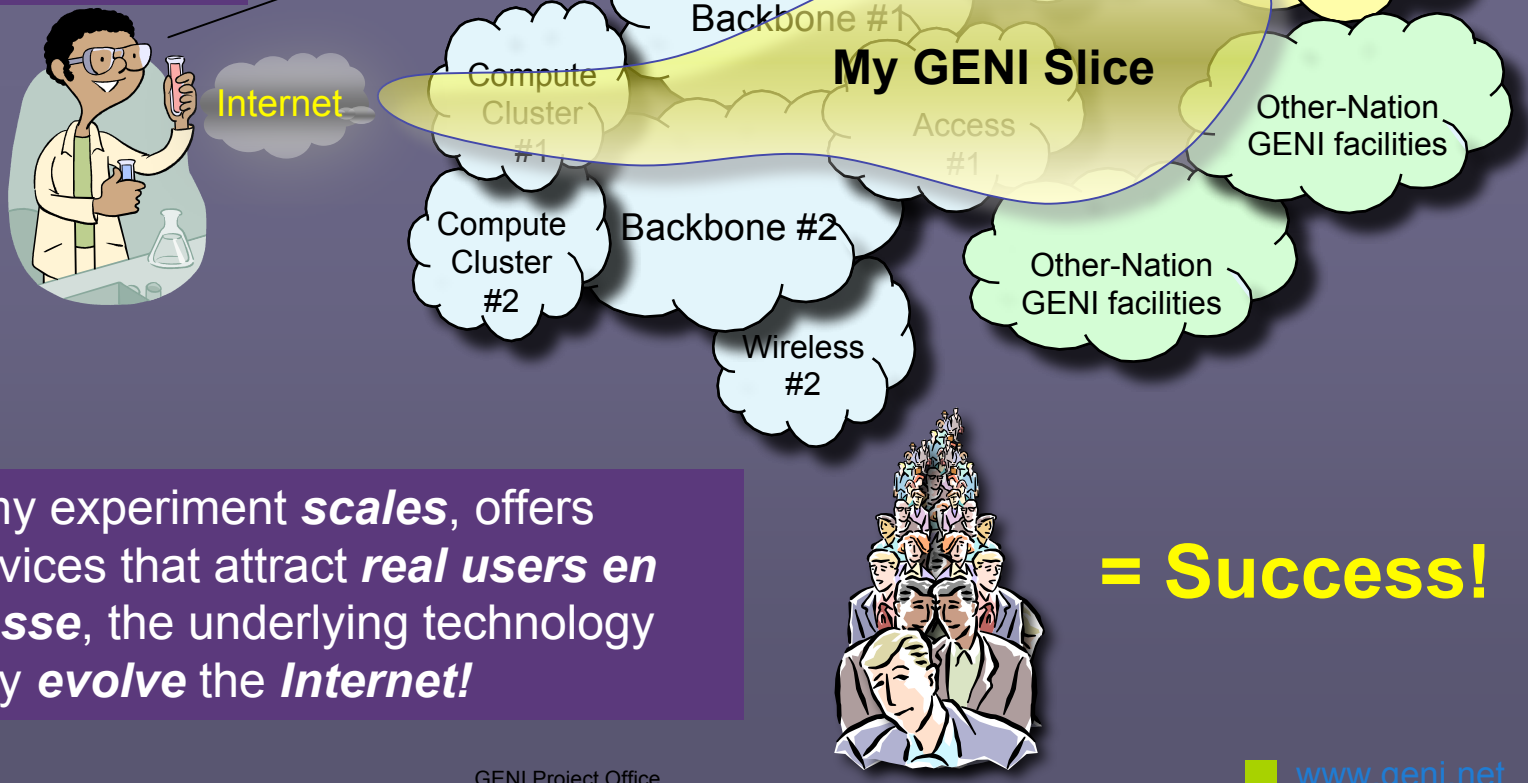
7. Sustainability
- ***Extensible and Evolvable***: accommodate existing network technologies & new emerging technologies, support technology roll-over without service disruption
- ***Operational Costs***: facility supports experiments long after construction is complete; tradeoff increased capital cost for decreased operational cost when possible

Will GENI replace the Internet?

NOT the goal, it is an *experimentation* testbed of national (and global) scale

but…

Users may access GENI via the ***Internet*** (tunnel to a GENI "portal") or wireless devices



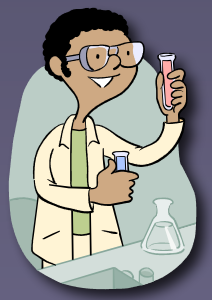
If my experiment ***scales***, offers services that attract ***real users en masse***, the underlying technology may ***evolve*** the ***Internet!***

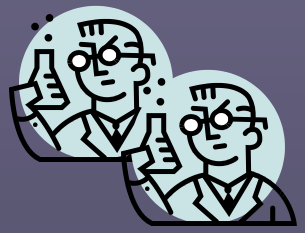
= Success!

New services -- like what? [research view]

Innovative Architectures -- sample trends

- declarative policy networking
- content-aware networks
- location-based networks
- disruption or delay tolerant delivery
- opportunistic wireless spectrum sharing
- security as a first class construct
- network unequivocally *knows* the user
- extensible global identifiers for devices
- global sensor networks - reconcile information & privacy
- merge cellular and WiFi technology
- "green" very low energy wireless networks
- vehicular networks
- real-time delay-intolerant networking
- self-diagnosing networks and applications





New Services -- possible directions

- tele-surgery
- other tele-presence (e.g. dance, musical performance)
- e-mail without spam
- distributed video store [anytime, any place]
- disaster relief collaboration
- high quality video conference center
- ubiquitous devices self-adapting to local policies
- self-organizing and adapting mission applications
- group interactive collaborative tools
- financial services linked to physical user
- virtual bazaars (real-time interactive e-commerce)
- multi-media annotated tourism (explanatory reality)
- augmented reality (inferring desires to control physical environment)
- multi-peer interactive virtual reality engagement
- wild life sensor tracking

What is End-user Opt-in? [participation view]

A critical aspect of GENI !!

- realistic user traffic
- new applications/services need to adapt to user needs
- new ideas are viable if they scale in size and quality over a large user base

Opt-in Motivators?

innovative explorers
"A viable emergent app?"

free loader
"hey, it's cool and free!"

bragging rights
"I was the first to use!"

commercial impact
"we can do business!"

Academics - what's in it for me?

- innovative emerging applications and services
- what are the social, legal, economic, policy implications for your research? for education? for business? for regulation? for public health?
- do these issues spawn new research areas?
- can you participate in GENI solicitations? other related NSF programs? propose new programs?
- GENI wants your expertise for End-user Opt-in!

Industry - strategic advantage?

- how can you use GENI?
- are you a builder? an experimenter?
- do you have experimental services for testing?
- is emerging research changing your business model?
- You have customers, GENI wants their traffic!

What is G-WEB? [workshop view]

GENI Workshop for End-user opt-in Broadening

When?
July 21, 2008 - discussion
report out on July 22, 2008

Where?
HP Labs, Palo Alto, CA; co-located with
3rd GENI Engineering Conference (GEC)

Who?
up to 20 select visionary thinkers from
academia and industry leaders

Invitation Criteria?
recommendations, reputation, research
relevance, seminal works

Fields?
social science, law and ethics,
economics, public policy

Topic?
End-user Opt-in: identification,
strategies, methodologies, implications

Structure?
- submit 4-8 page position paper by May 19
- Nadia produces summary by topics
- summary & all papers posted for review
- identified topics drive the G-WEB agenda
- July 21, 12-5: brainstorming discussion with the up to 20 invitees
- July 22: report recommendations to GEC