



GENI

Welcome !

GENI Engineering Conference 12

Kansas City, Missouri

Chip Elliott
GENI Project Director
www.geni.net

- **GEC 12: THANK YOU to Deep & everyone involved!**
- **GEC 13: March 13-15, 2012, in Los Angeles**
 - *With many thanks to Mario Gerla & Giovanni Pau, UCLA*
- Subsequent Meetings, open to all who fit in the room
 - Held at regular 4-month periods; see GENI Wiki for dates / places
 - Geographic rotation through US (central, east, west)
 - Held on / near university campuses – **volunteers?**
 - **Travel grants** for participant diversity (US academics only)



Experimenters
2x oversubscribed

Campus

Software

US Ignite
(invite only)

start time	Day 1: Wed Nov 2				Day 2: Thurs Nov 3				Day 3: Fri Nov 4			
	Experimenter Track	Campus Track	Software Track	Spare Track	Experimenter Track	Campus Track	Software Track	Ignite Track	Experimenter Track	Campus Track	Software Track	Ignite Track
7:30 AM	Breakfast (7:30 - 8:30)											
8:00 AM	Breakfast (7:30 - 8:30)											
8:30 AM	★ GENI Concepts & Resources		Project Highlights	I & M Working Session	Plenary Session: GENI Updates				★ Tutorial: OMNI & Topologies	Experimenter Roundtable (w/SW track)	ORCA Cluster	Ignite Workshop (by invite only)
9:00 AM					Break (9:30 - 10:00)				Meso-scale Networking: Looking Ahead	ProtoGENI Cluster		
9:30 AM					Plenary Session: Ignite				Break (10:30 - 11:00)			
10:00 AM	Break (10:00 - 10:30)											
10:30 AM	★ Tutorial: Introduction to GENI using Flak and the Instrumentation	GENI Deployment Updates	Control Framework Topics	I & M Working Session (continue)	Plenary Session: Experimentation				Outbriefs / Feedback / Wrap-up			
11:00 AM					Lunch (noon - 1:00)				Ignite Workshop (by invite only)			
11:30 AM					Lunch (noon - 1:00)				Lunch (noon - 1:00)			
12:00 PM	Lunch (noon - 1:00)											
12:30 PM	Lunch (noon - 1:00)											
1:00 PM	★ Tutorial: Measurement System	OpenFlow update	AM API	★ Tutorial: PrimoGENI	Plenary Session: Experimentation				WIMAX Camp Deployment Experimentation	Coding Sprint for Developers and Experimenters		
1:30 PM		Managing GENI Resources			Break (3:00 - 3:30)							
2:00 PM					Break (3:00 - 3:30)							
2:30 PM	Break (2:30 - 3:00)											
3:00 PM					Break (3:00 - 3:30)							
3:30 PM	Tutorial: DI Cloud	Managing GENI Resources (continue)	Authorization	New Projects: Experimenter Support and Training	Adv. Tutorial: NetServ	Meso-scale Monitoring	Cloud Computing in GENI	Ignite Workshop (by invite only)				
4:00 PM		1st Bus leaves at 3:30 for those who need to setup demos										
4:30 PM	END EARLY TO TRAVEL TO DEMO (4:30 -)											
5:00 PM	END EARLY TO TRAVEL TO DEMO (4:30 -)											
5:30 PM	Demo & Networking Event											
6:00 PM	Demo & Networking Event											
6:30 PM	Demo & Networking Event											
7:00 PM	Demo & Networking Event											
7:30 PM	Self-Organized BoF Dinners (start times vary)											

★ Recommended for newcomers

REVISION: 19Oct11

New



Dr. Gail Hackett

Executive Vice Chancellor and Provost
University of Missouri at Kansas City

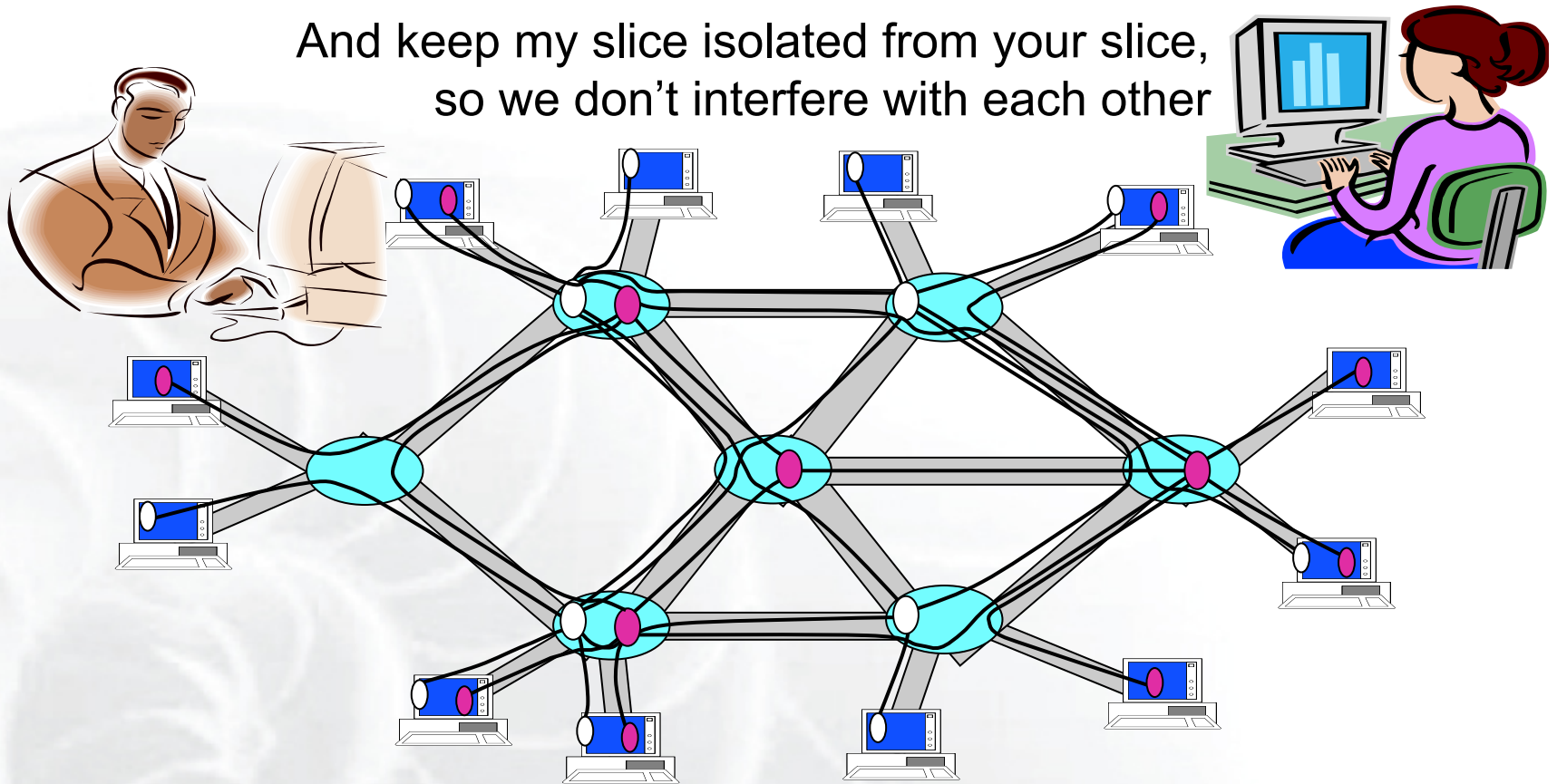


Dr. Suzanne Iacono

Senior Science Advisor
Directorate for Computer and Information
Science and Engineering (CISE)
National Science Foundation

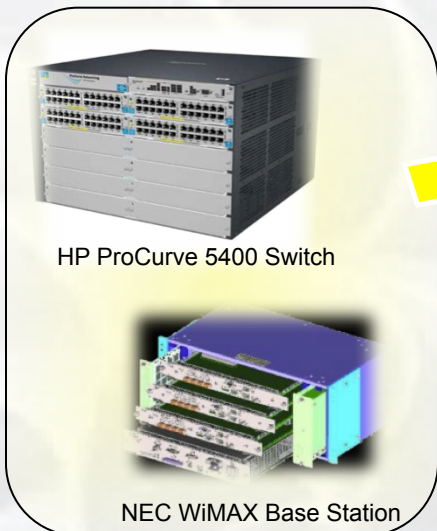
Install the software I want *throughout* my network slice
(into firewalls, routers, clouds, ...)

And keep my slice isolated from your slice,
so we don't interfere with each other



We can run many different “future internets” in parallel

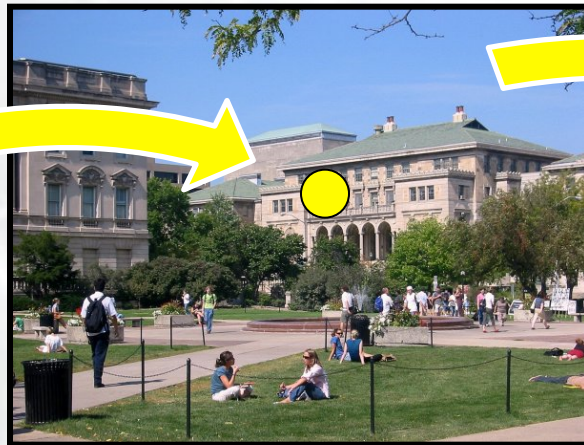
- **How can we afford / build GENI at sufficient scale?**
 - Clearly infeasible to build research testbed “as big as the Internet”
 - Therefore we are “GENI-enabling” testbeds, commercial equipment, campuses, regional and backbone networks
 - **Students are early adopters / participants in at-scale experiments**
 - Key strategy for building an at-scale suite of infrastructure



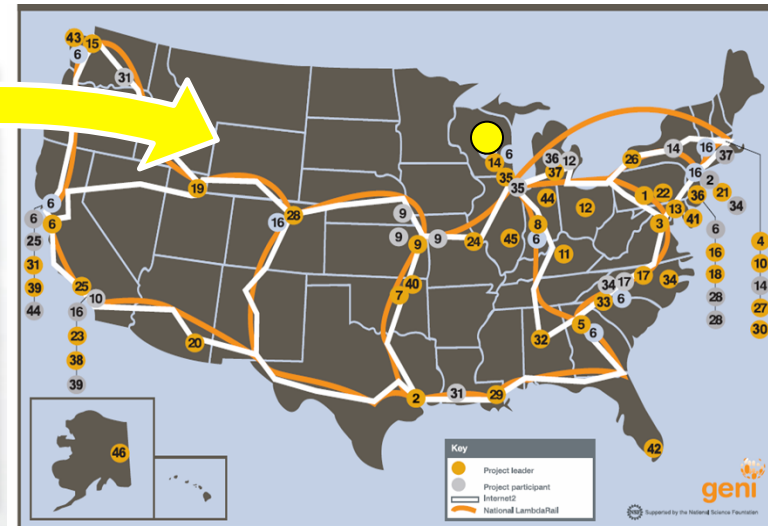
HP ProCurve 5400 Switch

NEC WiMAX Base Station

GENI-enabled equipment

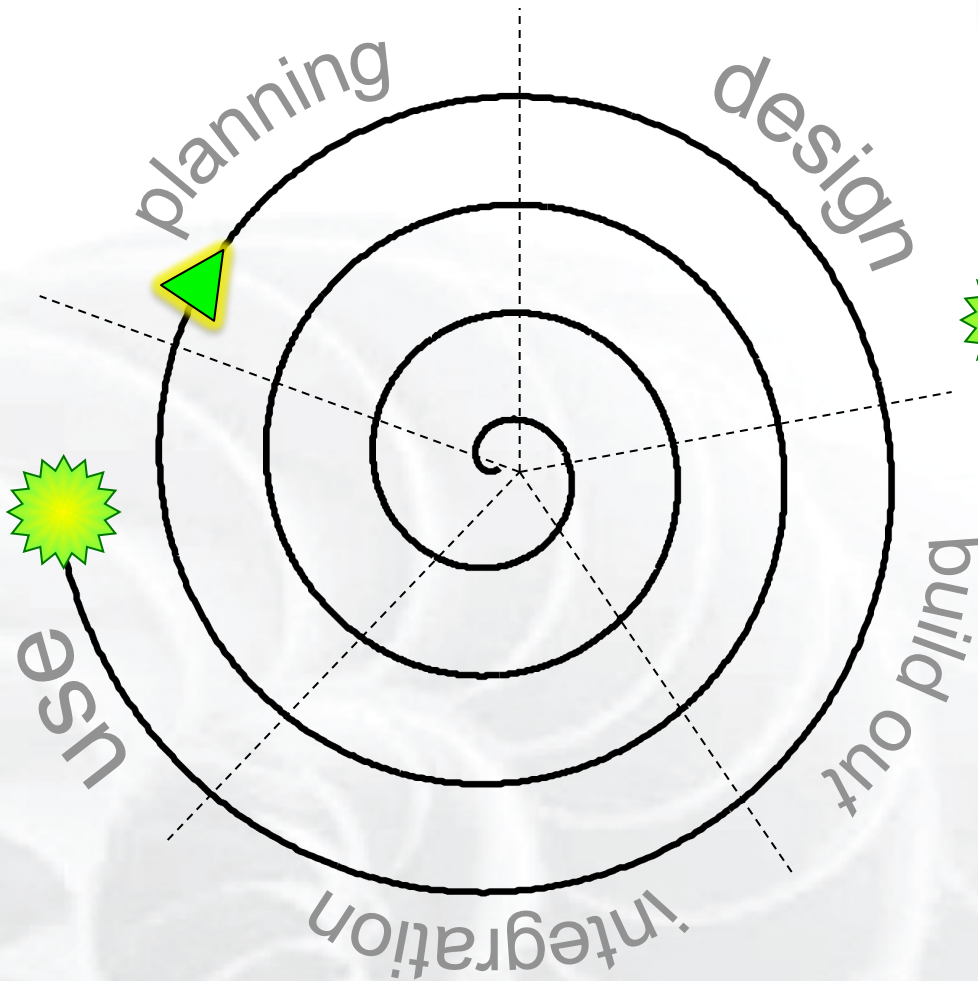


GENI-enabled campuses, students as early adopters



“At scale” GENI prototype

Start the transition to “real GENI”



GENI Prototyping Plan



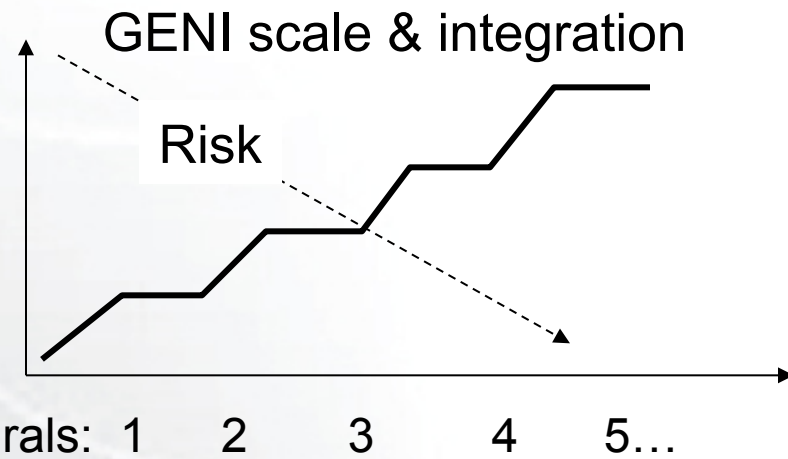
GENI Spiral 4

Ramp up experiments, 24 x 7 support (GMOC), formalize design, add GENI racks, deploy more OpenFlow and WiMAX, create first rev of GENI instrumentation system.



Envisioned **ultimate goal**

Large-scale distributed computing resources, high-speed backbone nodes, nationwide optical networks, wireless & sensor nets, etc.



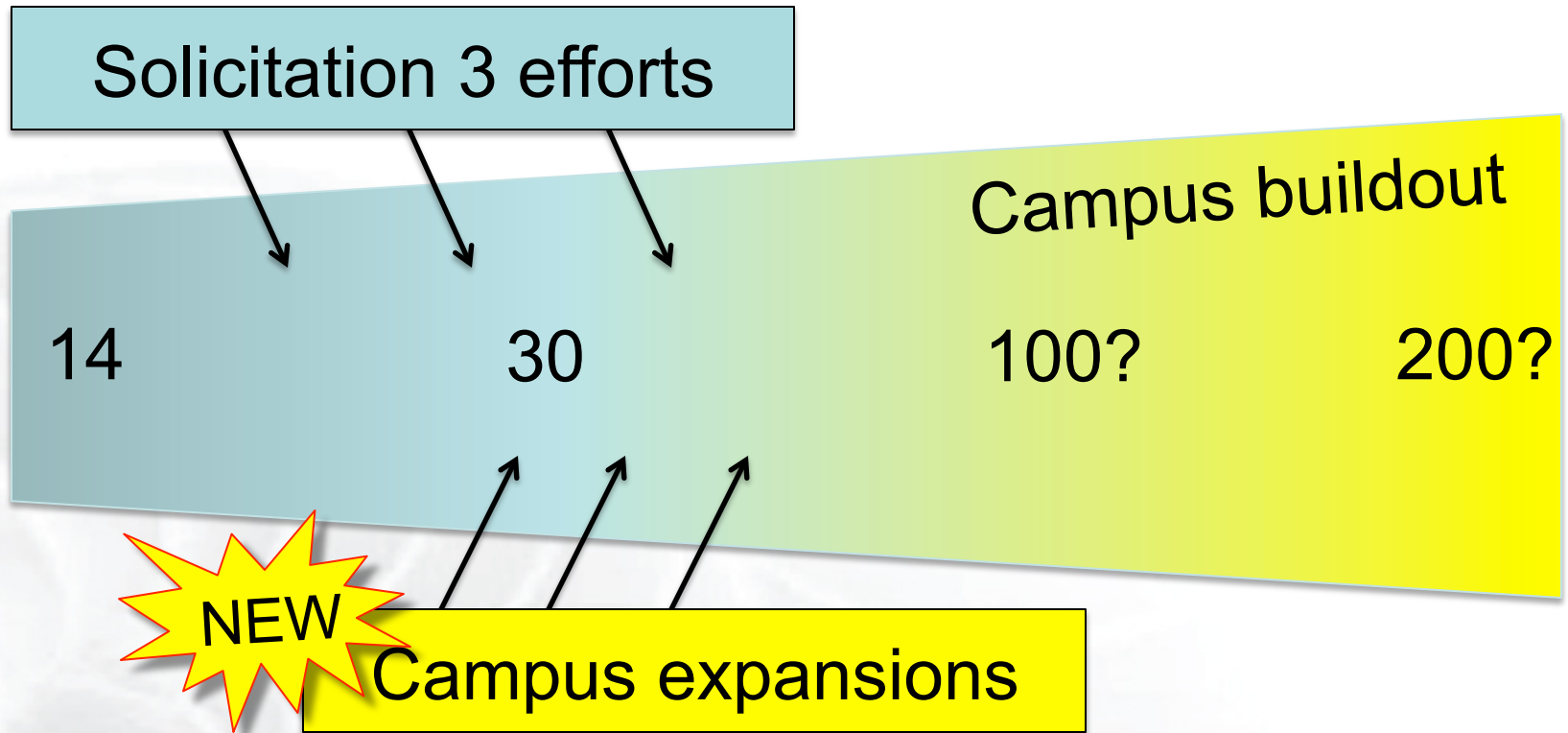
Introducing the GPO's Marshall Brinn



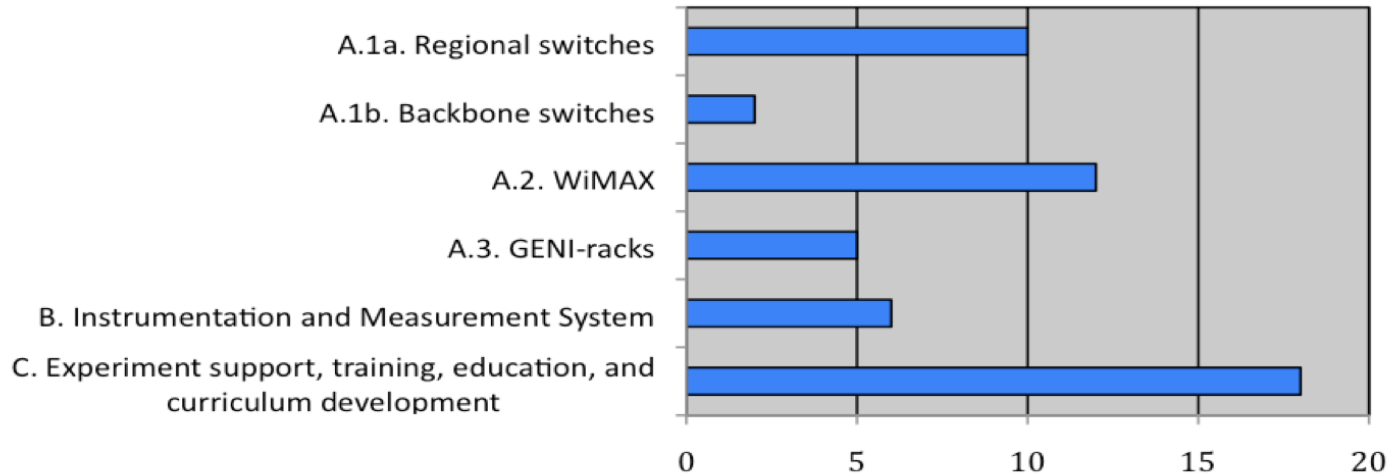
- Replaces Aaron Falk, but with a very different set of talents and abilities
- Widely regarded as one of the best software architects within BBN
- Significant evolution in GPO staffing to help move GENI from “proof of concept” to robust system

Growing GENI to 100-200 campuses

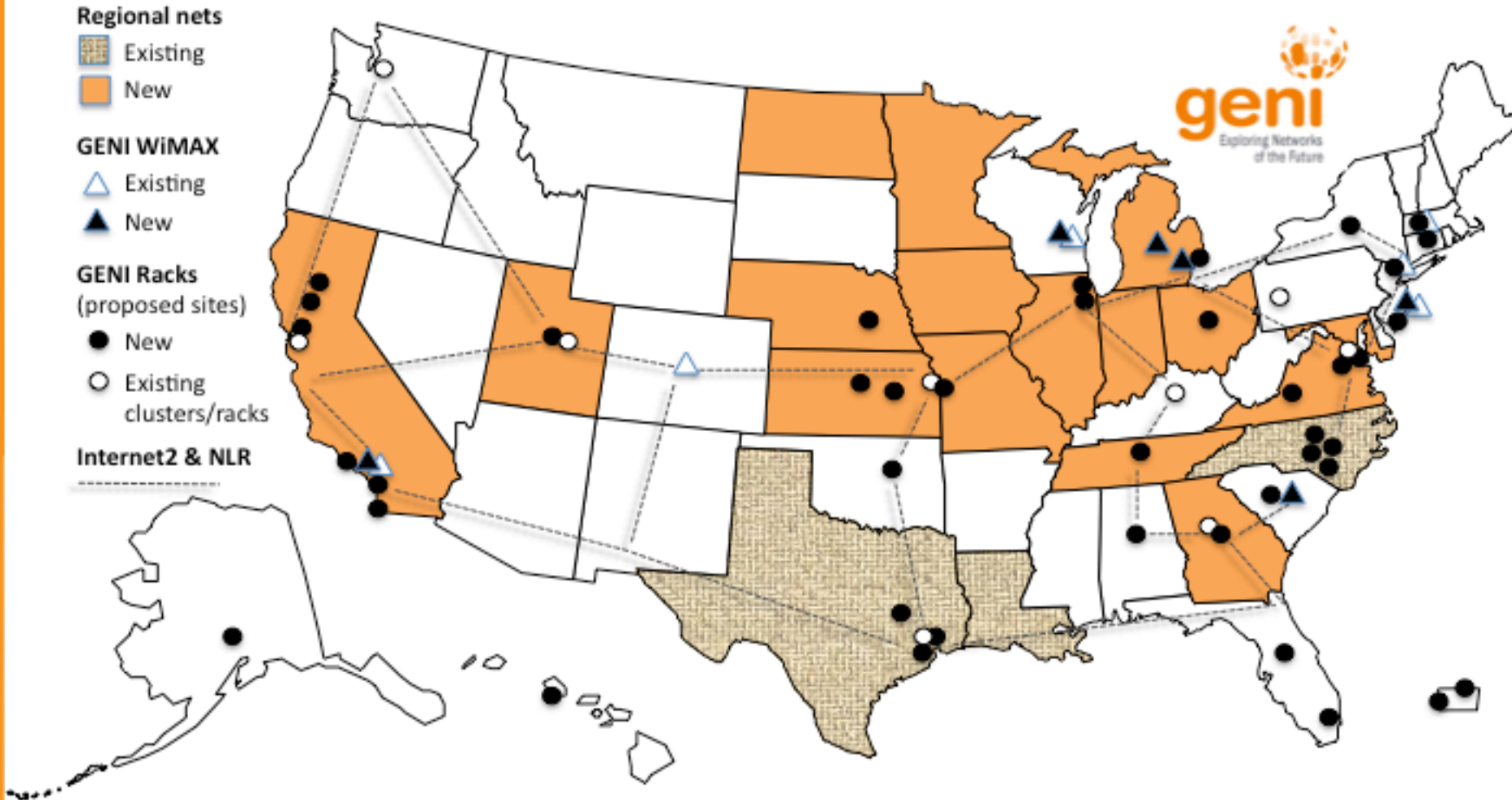
GENI racks, OpenFlow, WiMAX, training, ops



Solicitation 3: Number of Proposals Received

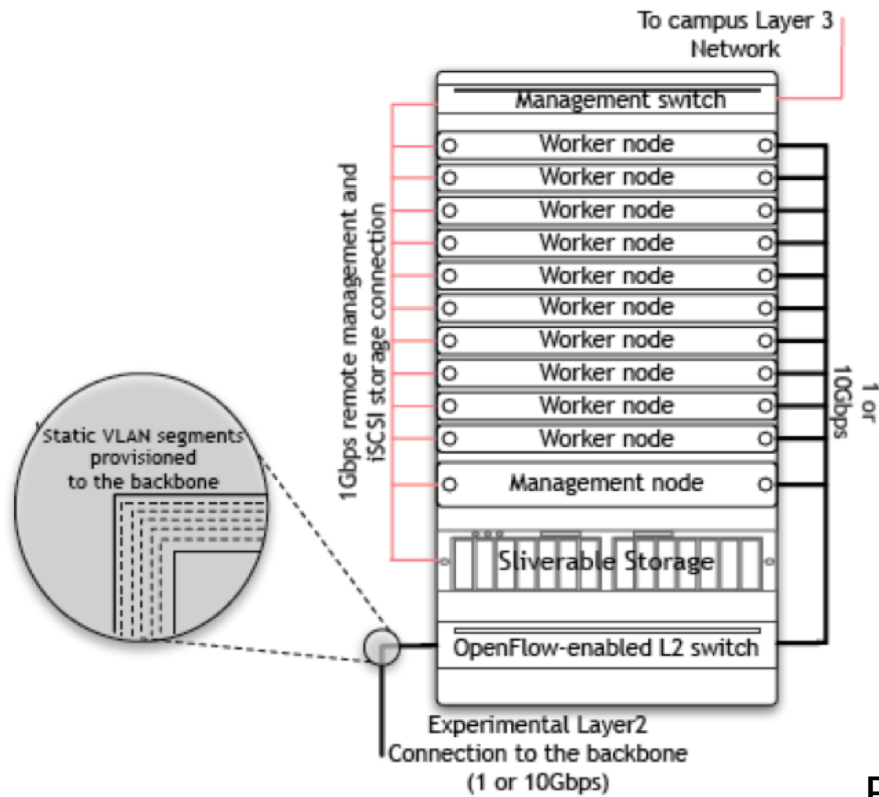


Category	# Received	Total Proposed \$
A. Enhanced Meso-scale prototyping		
A.1a. Regional switches	10	\$3,532,641
A.1b. Backbone switches	2	\$905,472
A.2. WiMAX	12	\$6,204,937
A.3. GENI-racks	5	\$10,365,096
B. Instrumentation and Measurement System	6	\$6,595,367
C. Experiment support, training, education, etc.	18	\$5,722,178
Total	53	\$33,325,691



(as proposed; actual footprint to be engineered)

Creating and deploying GENI racks



RENCi's design
(as proposed)



Ilia Baldine
RENCI

More resources / rack,
fewer racks

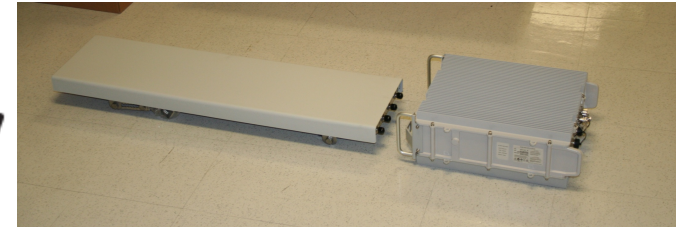


Rick McGeer
HP Labs

Fewer resources / rack,
more racks



Lots more OpenFlow and WiMAX



Courtesy
WINLAB

- **New OpenFlow builds through regional networks**

- **Eric Boyd**, Internet2
- **Peter O'Neil**
National LambdaRail
- **Jon-Paul Herron**
Multiple midwestern regionals
- **David Reese**, CENIC
- **Steve Corbato**, Utah
- **James Sterbenz**
Kansas
- **Russell Clark**
Georgia Institute of Technology,
Southern Light Rail

- **More WiMAX, in midsize deployments**

- **Ivan Seskar** (*ringleader*)
Rutgers University
- **Hongwei Zhang**
Wayne State University
- **Suman Banerjee**
University of Wisconsin,
Madison
- **Kuang-Ching Wang**
Clemson University
- **Z. Morley Mao**
University of Michigan

These efforts have been selected; negotiations now in progress.

Instrumentation and measurement



Martin Swany



Mike Zink



Max Ott

- **GENI Instrumentation and Measurements Architecture**
 - <http://groups.geni.net/geni/wiki/GeniInstrumentationandMeasurementsArchitecture>
 - <http://groups.geni.net/geni/wiki/GeniInstMeas>
- GENI's measurement system
 - Both inside / outside slices
 - Experimenter controlled
 - Flexible, extensible
 - With archival storage
- Outside slices . . .
 - Martin Swany
 - Leverages PerfSONAR
- Inside slices . . .
 - Mike Zink, Max Ott
 - Leverages OML



Dr. Larry Landweber, U. Wisconsin

- **“GENI-enabled” means . . .**
OpenFlow + GENI racks, plus
WiMAX on some campuses
- **Funding still being worked . . .**
Congress is still deciding NSF’s
budget for this year (2012)

- **Current GENI campuses**
Clemson, Colorado, Columbia,
Georgia Tech, Indiana,
Princeton, Kansas State, NYU
Poly, Rutgers, Stanford,
UCLA, U MA Amherst, U
Washington, U Wisconsin
- **18 campus visits in progress**
Case Western, Chicago,
Colorado, Cornell, Duke,
Florida International, U Kansas,
NYU, Purdue, Tennessee,
UDC, U FLA, University of
Houston, UIUC, U MA Lowell,
Utah, Washington, Wisconsin
- **Rapidly growing waitlist**

Ramping up experimenter workshops and training sessions for IT staff

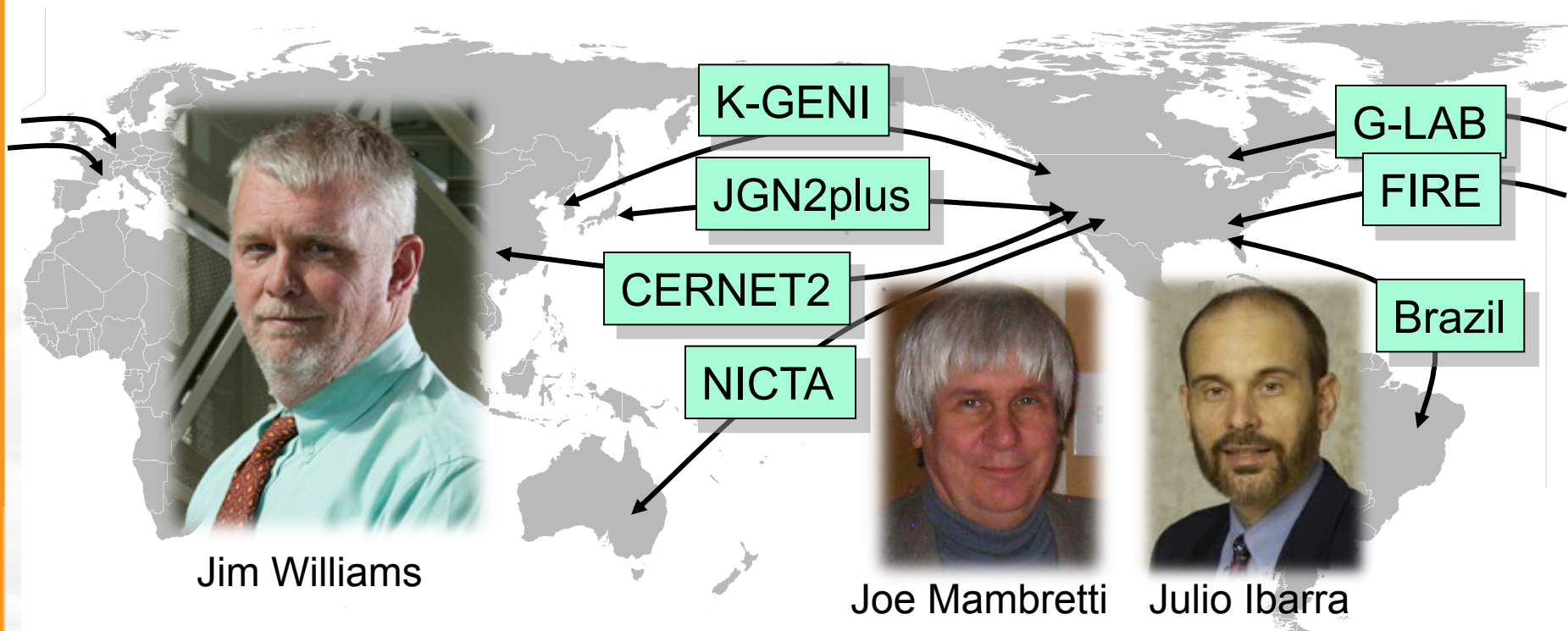


Network Engineers “boot camp” on the day before this GEC, organized by Larry Landweber and given by Matt Davy and Steve Wallace, Indiana University

- GPO funding 3 workshops / year by Indiana University
- Goal: train IT staff on OpenFlow and (when available) GENI racks
- This week:

Case Western Reserve	Cornell
Duke	Florida International
NYU	Purdue
Univ Chicago	Univ DC
Univ Florida	Univ Houston
UIUC	Univ Colorado
Univ Kansas (Lawrence)	Univ Massachusetts, Lowell
Univ Massachusetts, Amherst	Univ Michigan
Univ Tennessee, Chattanooga	Univ Utah
Univ Washington	Univ Wisconsin, Madison

- 35 additional schools have expressed interest and are on waitlist



The GENI project is actively collaborating with peer efforts outside the US, based on equality and arising from direct, “researcher to researcher” collaborations.

It’s time to try out “worldwide experiments”

New

GENI Architecture Team



- **Team Charter**

- Define and document GENI's architecture
- Ensure that GENI software implementations and deployments are interoperable & comply with this architecture

- **Logistics**

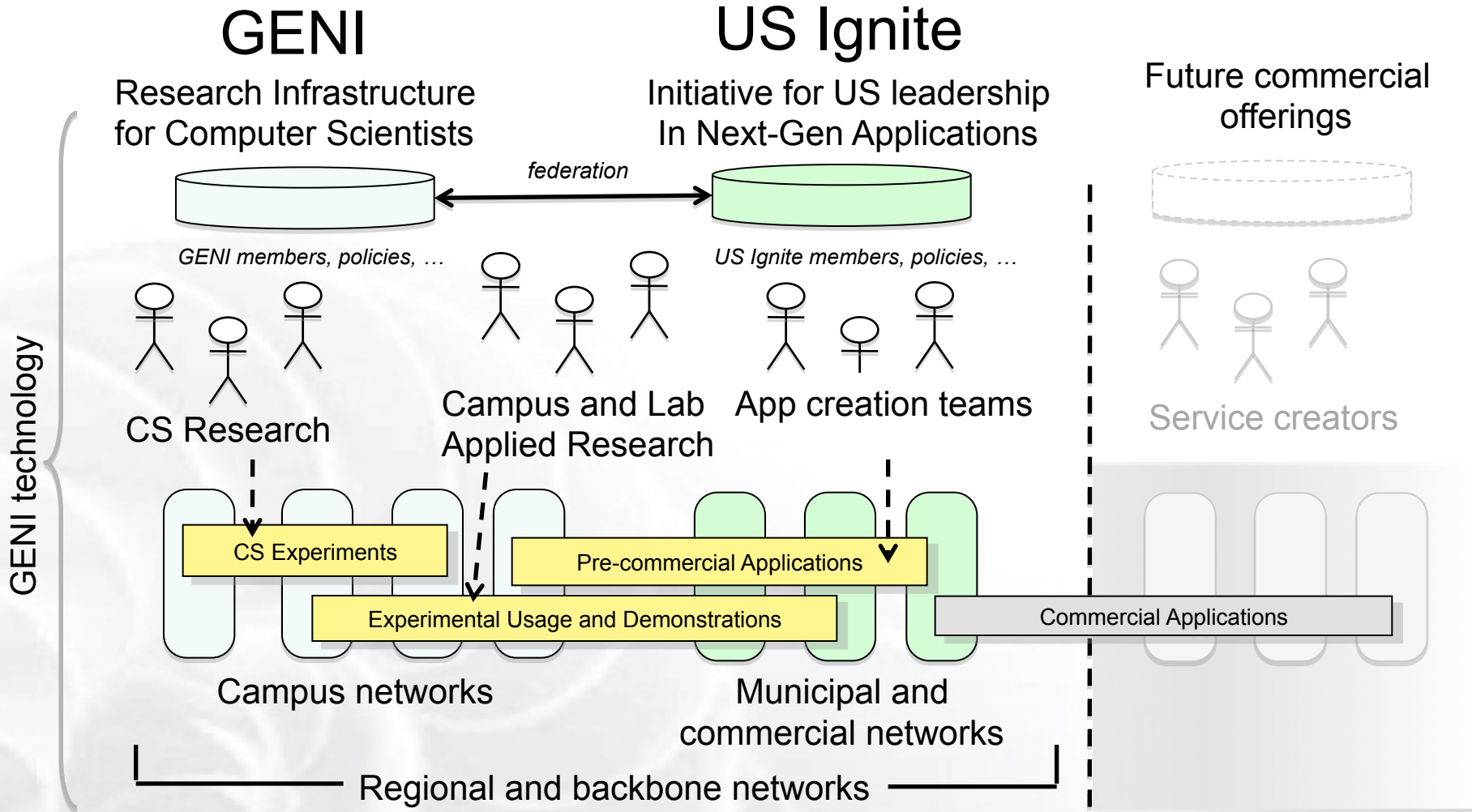
- One-year, renewable terms
- Appointed by Project Director
- Most work done between GECs
- Inputs & help encouraged
- Documents approved at formal meetings (minutes published)

- **Initial membership**

- Rob Ricci, Marshall Brinn, co-chairs
- Jeff Chase, Larry Peterson, Max Ott, Nick Bastin, Chip Elliott, voting members
- Aaron Helsing, Tom Mitchell, non-voting members

- US Ignite is an initiative to spark the development of **gigabit applications and services**
- **in areas of national priority:** advanced manufacturing, health, education, energy, economic development, transportation, and public safety/emergency preparedness
- **on an ultra high speed, deeply programmable, and sliceable network testbed.**





US Ignite is a new initiative that will promote advanced applications and infrastructure leveraging GENI research and technologies.

- Very strong interest from 6 US cities to date
 - Chattanooga, Cleveland, Lafayette LA, Philadelphia, Salt Lake City region, Washington DC
 - Their citizens will be able to “live in the future”
- Cities can be GENI-enabled very rapidly
 - We have visited all 6 cities for surveys, discussions
 - GENI rack, OpenFlow, and Layer 2 connectivity appear quite feasible
 - Can be federated into GENI very quickly
- Can support experimental, gigabit applications in GENI slices through cities
 - Creates **tremendous** new research opportunities

Installing GENI racks in US Ignite cities



- “Starter racks”
 - Eucalyptus based
 - Chattanooga & Cleveland
 - Estimate: Nov 2011
- Real GENI racks
 - Created by HP, RENCi
 - Adds OpenFlow, Layer 2, control framework . . .
 - Operational: Q3 2012 ?
- Limited # of GENI racks at first, so deployment planning will be interesting



GENI has tremendous momentum



Experimenter workshops overbooked 2 x



We're now starting to transition from the
“proof of concept” stage to the real GENI



GENI is squarely on track for ramping up
to 100 – 200 campuses