Network Science and Engineering Update

Computing Community Consortium
7 July 2008
Ellen Zegura
NetSE ("Net-see")

- Path forward for GENI Science Council
- Gets us out of the “justify the facility” or “cart before the horse” box
- NetSE Council succeeds GENI Council, for all interpretations of “succeeds”
- GENI Project Office (GPO) continues to harden designs for shared experimental facilities
NetSE Council

Mission: The primary mission of the Network Science and Engineering (NetSE) Council is to articulate a compelling research agenda for Network Science and Engineering, including inter-related theoretical, experimental and societal aspects.

- Ellen Zegura, chair
- Tom Anderson, Washington
- Hari Balakrishnan, MIT
- Joe Berthold, Ciena
- Charlie Catlett, Argonne
- Mike Dahlin, UT Austin
- Chip Elliot - GPO (ex-officio)
- Joan Feigenbaum, Yale
- Stephanie Forrest, UNM
- Roscoe Giles, Boston Univ
- Jim Hendler, RPI
- Michael Kearns, UPenn
- Ed Lazowska, Washington
- Peter Lee, CMU
- Helen Nissenbaum, NYU
- Larry Peterson, Princeton
- Jennifer Rexford, Princeton
- Stefan Savage, UCSD
- Scott Shenker, ICSI/Berkeley
- Alfred Spector, Google

Additions pending – workshop leaders, other enthusiasts
Timeline

- **June-Sept 2008** - elaborate the space
  - workshops (3)
  - meetings (2)
- **Oct 2008**
  - draft research agenda completed
  - incl. recommendations on how to advance agenda
- **Nov 2008**
  - collect feedback (from few then many)
- **December 2008**
  - finalize research agenda
Technical context

Fundamental Question: Is there a science for understanding the complexity of our networks such that we can engineer them to have adaptable behavior?

Call to Arms: To develop a compelling research agenda for the science and engineering of our evolving, complex networks.
NetSE Intellectual Space
(not to scale)

Goal: Networks with adaptable behavior
(“better networks”)

- Network Design
- Network Science
- Theoretical CS
- Economics (Behavior) and Networks
- Societal Values

[Are we missing anything?]
Workshops

• **Science of Network Design**
  - John Doyle, CalTech/NSF
  - John Wroclawski, ISI
  - July 29 and 30, southern CA

• **Behavior, Computation and Networks**
  - Mike Kearns, U Penn
  - Colin Camerer, CalTech
  - July 31 and August 1, La Jolla

• **Network Design and Societal Values**
  - David Clark, MIT
  - Helen Nissenbaum, NYU
  - September 24-26, Washington DC
Meetings

• Smaller than workshops
• Extract/expand on more well trod areas
• Theory and Network Design
  – John Byers (BU), Joan Feigenbaum (Yale), Ellen Zegura (GT)
  – June 11, Boston
• Network Engineering and Network Design
  – TBD, e.g., Nick Feamster (GT), Amin Vahdat (UCSD), David Andersen (CMU), Mike Dahlin (UT Austin), Jen Rexford (Princeton)
  – Likely with SIGCOMM (August)
Food for Thought
(courtesy John Wroclawski)

Electricity: 1800...

Electricity: Today...

\[ \oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0} \]

\[ \oint \vec{B} \cdot d\vec{A} = 0 \]

\[ \oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi_B}{dt} \]

\[ \oint \vec{B} \cdot d\vec{s} = \mu_0 i + \frac{1}{c^2} \frac{\partial}{\partial t} \oint \vec{E} \cdot d\vec{A} \]

What are the analogies...
... for Network Architecture and Design?
Example: Understanding

High Space/Time Paths

High Mobility

Hybrid Environments

Low "Mobility"

Low Node Density

Space Paths

No (Space/Time) Paths
Food for Thought

• (Where) does the current Internet embed assumptions of plenty?

Does TCP work here? (Hint: no!)
What about GENI?

Virtuous cycle of agenda setting, demands for experimentation, identification of infrastructure needs, building, learning, building, learning, ...

Research Agenda

Infrastructure

Experiments

Sometimes one part gets a little ahead...that's ok
Research enterprise is incredibly robust
Likely scenario

• Agenda effort identifies 1 or more (probably more) facilities that would be useful in advancing research

• Members of a facility requirements group are “spies” at each workshop to help extract requirements

• Some of prototyping work funded currently by GPO is useful in future facilities
How can you help

• Already are: Many, many thanks to Ed and Susan for their involvement. It has made a BIG difference

• Spread the word that NetSE replaces GENI

• Spread the word to relevant parts of communities around Network Design
Lessons (so far!)

• Leadership and vision
  - Ed: “elevator pitch worked too well”
  - refinement: must have elevator pitch that works for experts
• Cart before horse
• Right-sizing
• Who’s driving
• Communication
Questions/Discussion