

# Networking Grand Challenges

NSF Future Directions  
Workshop  
April 2003

## Our panelists:

- Ravi Mazumdar, Purdue
- Larry Peterson, Princeton
- Lixia Zhang, UCLA
- Jean Walrand, Berkeley

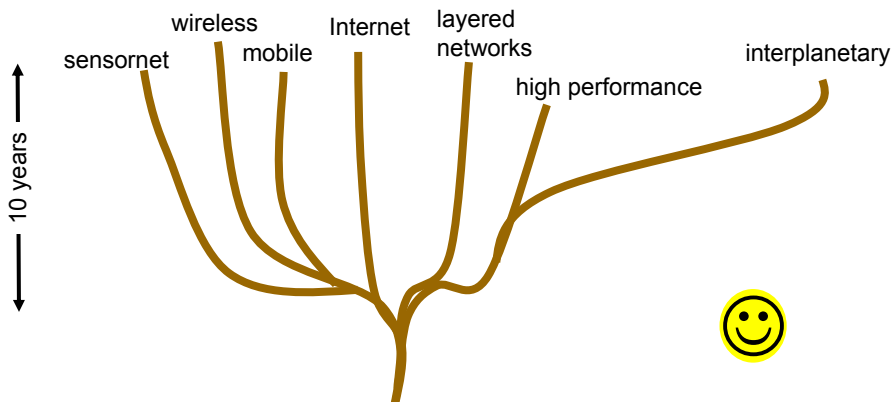
Moderator: Don Towsley, UMass

## Is networking in doldrums?

- ❑ stagnant economy
- ❑ uncertain funding picture
- ❑ world affairs
- ❑ SARS
- ❑ university budget cuts



## These are exciting times!



## Charter of panel

- ❑ what constitutes a grand challenge?
  - *intra area?* e.g., one petabyte transfer in < one second
  - *inter-area?* how to design robust networks independent of technology/application
- ❑ what are some of the grand challenges?

## What *are* the important research challenges?

- ❑ *timeless* (still unsolved) problems?  
*how to build robust networks that scale with technology to handle diverse apps (1965)*
- ❑ what are the *new drivers*:
  - technological?
  - applications?
  - social?
- ❑ short-term versus long term challenges?

## Observation: diversification of community

- 1994 - INFOCOM, SIGCOMM  
portions of Globecom, ICC
- 2003 - INFOCOM, SIGCOMM, ICNP, IMC, MOBICOM, MOBIHOC, MOBISYS, WCNC, web/P2P/CDN conferences, ...  
portions of many other conferences

Are we splintering?

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**Challenge:** how to maintain communication / interactions? NSF role?

## Panel Format:

- panelists (short) presentations  
(8 min each)
- panelist observations/questions
- open discussion

Ravi Mazumdar

Larry Peterson

Lixia Zhang

Jean Walrand

Don Towsley

## A network science?

Goal: to answer questions like

- why do topologies look as they do?
- why do disruptive apps appear? what are their effects?
- a single bottleneck link? multiple bottleneck links? on end2end paths

Components:

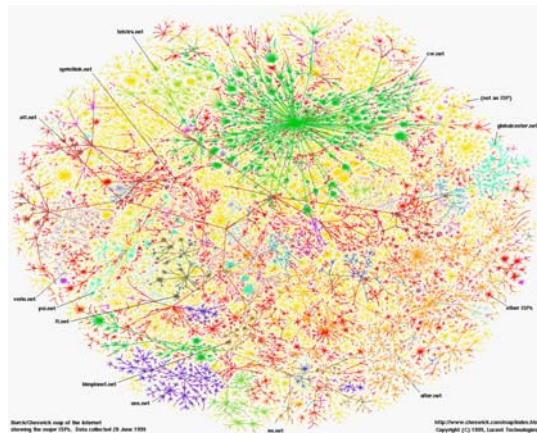
- physical laws, mathematics, algorithms, markets
- components change over time (how?)
- parallel networks (universes)

## A network science?

- multidisciplinary - stat/probability, computer science, nonlinear systems, market economics, communication theory, complex systems, ...
- experimental methods, need for data
- translation into engineering

As challenging/important as physics,  
biology, ...

## Evolution of the Internet



## What have we heard?

- mathematical theories to:
  - understand performance limits
    - compute/communication/sensing tradeoffs with power constraints
  - understand as a complex system
- how to design evolvable networks
- how to design resilient (tolerate *any* fault) networks
- how to design markets and network mechanisms to support future heterogeneous apps