

Whither Network Science?



A cross-cultural approach

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3/5/2008

Does Network Science Exist?

Yes

- History: About 40 years since the creation of ARPANET, long history of achievements
- Specific impacts: Teletraffic theory, network optimization, switching theory, multiple access networks, protocols research,...

No

- Not a coherent science
- Not associated with a single academic discipline or department
- No agreed upon component subjects
- No widely agreed upon name
- In spite of specific impacts, limited overall impact

Crisis in Networks Research 1

- *Decline of industrial R&D Labs*
 - These bridged the divide between theory and implementation
 - Theoretical researchers in industry R&D units worked with implementers to design new products and services
 - Academic researchers took cues from them for further research to gain new insights and results.
 - Academic research also created brand new paradigms which were picked up by industry
 - Start-ups as a solution? Yes and No

Crisis in Networks Research 2

- *Decline in academic research*
 - Supply side:
 - Shrinking worldwide supply of grad students
 - Competition from new “hot” areas
 - Residue of burst bubble
 - Demand side:
 - Decline of demand for industry researchers (except in China and India)
 - Saturation of positions in academic research
 - Symptom: Rise in the number of candidate’s in post-doctoral positions before an academic job becomes available

Crisis in Networks Research 3

- *Fragmentation because of “silo”-based research*
 - Theorists: Applied mathematicians (operations research, applied probability, graph theory, theory of algorithms, ...)
 - Experimentalists/Designers: hardware, software, system implementations ...
 - These two “cultures” are also present in other scientific disciplines, e.g., physics, computer science.
 - Symptoms
 - Different flavors of conferences, e.g., SIGCOMM versus INFOCOM
 - NSF panels
 - Funding initiatives – GENI
 - Textbooks
 - Flawed research

How Do We Fix It?

□ Educational:

- Creation of comprehensive and integrated educational programs - Is it time to create Communication Network Science and Engineering (CNSE) departments?
- This will create the need for a common “core” program and a new generation of textbooks
- Courses will focus both on theory and implementation/design

How Do We Fix It?

- Research:
 - Need to keep best features of centralized industrial R&D model, e.g., Bell Labs
 - Bring theorists and implementers/experimenters together on long term projects
 - Continue silo-based research, but also encourage collaboration
 - Positive example: cross-layer optimization

Desired Outcome

- The fragmentation issue will be greatly ameliorated
- This will lead to a cadre of better trained graduate students with a well rounded education *at an earlier stage of their careers*
- A new generation of researchers who will help further define the science of networks
- Will also help in arresting (somewhat) the decline in academic research and (to a lesser extent) industry.

Let the debate begin!

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