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
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 “siloi”-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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