Snowbird Conference

Keynote Address

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Snowbird Talk

- Context and Background for the Talk
- Concerns for the Research Community
- Specific Challenges
  - Cognitive Systems, Information Management, Networking Focus
- Conclusions

Context for the Talk

- Evolution of Information Technology (personal experience)
  - Computing - Early IBM with console programming, IBM 704/709/7090, calculators have more power than room-sized machines back then
  - Memory – Carry GB on keyring (<$1K) vs. $M for a MB in 1970s which also was room sized. Million to one reduction in cost (plus size and power reductions)
  - Software – batch and overnight delivery to interactive, real-time, and symbolic – design/development still a major limitation and bottleneck
  - Networking – 300 bps dial-up, 50 Kbps ARPANET, 1.5/45 Mbps NSFNET, Giga/Tera

DARPA Experience

- In 1960s, every development was new, no industrial base, no serious constraints
- In 1980s, transfer of ideas to industry emerged, transfer from industry to defense was the goal
- By 2000, was getting increasingly near-term, demonstration/delivery/transfer oriented
- Industry coupled vs. Contrarian
- Breaking out of the mold – getting there
- Can participate in addressing infrastructure concerns – no longer take the lead

Current Observations

- Infrastructure investments of the past are getting in the way of real innovation
- Mindset that we can't do big infrastructure any more – so focus on smaller scale efforts
- Everything needs to use DNS and/or the Web
- Reminiscent of the telco infrastructure situation before the ARPANET, NSFNET and Internet

Crisis for the Community

- Wonderful way we used to do business is in jeopardy of being held hostage to legacy investments – marginalizing ourselves
- Used to be industry that held us hostage, but now it is the research establishment itself
- Need to find new ways of doing business, of working together, of collaborating

Unintended Consequences

- PITAC funding enabled NSF, overloaded NSF – too many proposals
- PITAC funding for DARPA produced no net new money – reduced flexibility, added constraints
- Hard to quantify the effects, measure added progress

Bureaucratic Overload

- Program managers barely had time to read proposals (too many), time spent in managing review committees
- Short Term Stints
  - Heavy on Administration
  - Resulting eagerness to return to academia/industry
- Loss of memory of what came before
- Duplication of efforts over time, reinvention
- Needs to rethink public service to make it more attractive – CRA, ACM, IEEE, etc. can help

Opportunity

- Dot Com bubble hurt, may also help
- Problem with PITAC was how to retain best researchers in light of commercial (money) opportunities that were abundant
- Now academic and government opportunities should be much more attractive
- How to leverage – make this a priority
- Create the intellectual and organizational capital for the future.

The role of the Research Community

- Research Community help in planning and running government initiatives
- Make public service a goal for best researchers at some point in their career
- Think out of the box
- Allow for false starts, failure
- Encourage publication of negative results where significant

Cognitive Systems

- Today's systems are generally very brittle
- CS Properties – reactive, perceptive, reflective
- Knows about itself, external world
- Acts on its knowledge + built in functions
- Metaknowledge includes:
  - Knows about its design, design goals, constraints
  - Can tell when its performance is affected
  - Can tell about external variations about quiescent
  - Can plan and react accordingly, with & w/o help

System Issues

- How to build such systems?
- What are the architectural principles, common standards, reusable functions
- How to characterize/measure system cognition? (other than qualitatively)
- How can individual systems learn to cooperate/collaborate with others

Cognitive System Targets

- Each target for cognition has its own concerns, ontologies – what is sharable?
- Each application may choose to express itself differently! – How to communicate?
- Examples: Networks, User Interfaces, functional applications
- How to avoid each group separately researching cognitive functionality?

Appreciating Information Management

- Sounds pretty mundane and administrative
  - like logistics, and maintenance
- Critical to many of the advanced capabilities we seek in the future
- Trusting your information to “electrons, photons and Networks”
  - It can get lost in the thicket of invisibility and technology evolution

Handling Abstraction

- What is the Internet?
  - Not the collection of networks, routers, computers, switches, lines
  - Conceptual Architecture for global connectivity
  - And, increasingly, a global information system
- What is a Book?
  - Not the “paper and ink”
  - Logical structuring of a literary work
  - An example of a digital object

Understanding Patent & Copyright in Network Context

- Building bridges to Legal Establishment
- Copyright Rights in Works
- Different Legal Systems around the world
- Distinguishing Mass and Energy
- Patents in Systems and Methods
- Legal alternatives to enable progress
- Finding workable compromises

“Google-like” Systems

- Deals with openly accessible information
- Can’t access protected information
- IP concerns often leave critical information off the net
- Places fundamental limitations in spanning the public and private information worlds
- Encryption and Persistence also at odds

Identifier & Resolution Systems

- Multiple identifier systems will continue to exist, be separately administered
- There needs to be a common trusted resolution mechanism
- Needs Government Imprimatur to achieve
- Similar set of issues as Internet in 1970s
- Handle System on Internet since 1994 in public interest – software downloadable.net

Networking

- Principal challenges:
  - Scaling for Growth, meaningful applications
  - Workstations at speed – chicken and egg
  - High speed local access – last mile
  - Don’t be constrained by ITU, ISO, IETF, W3C, ICANN, etc.
- Emerging Role for Wireless everywhere
  - Emphasizes mobility, security, and power
  - Copyright concerns will grow – 802.11b

Conclusions

- Move beyond “Business as usual” – reinvent the means of conducting research to adapt to current needs!
- Insure real innovation is enabled – wherever!
- Both Government and Research Community need to break out of the mold – don’t stay locked in
- Think out of the box – process and proposal

Conclusions

- Let industry do what industry does best – short term developmental projects – be vigilant to get ahead and stay ahead of the power curve
- Pursue unique opportunities
  - Leverage the Dot Com fallout
  - Meld research and advanced applications in national interest post 9/11 – requires care – glad to see NSF taking a lead here
- Encourage the best technical minds to undertake public service for a part of their career; reduce bureaucratic limitations on them wherever possible