

Concerns with Network Research Funding

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Internet Architecture Board

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Objectives

- Describe a wide range of open networking research topics
- Advocate increased network research funding

Summary of IAB Concerns

- Ongoing research in networking is important for future Internet health.
- Commercial research funding is necessary and important, but has proven insufficient.
- Non-commercial funding for networking research declined in the mid/late 1990s

Today's Reality

- Industry focus is on applied research
- Longer-term, higher-risk, research significantly less likely to garner industry funding
- Architectural work has had minimal funding for several years
- There are many open Internet research topics

Examples of Open Research Topics

Important Caveats

- IAB is not trying to acquire research funding for itself or IRTF (or IETF).
- IAB is not trying to list each/every open research topic in this document.
- Goal of our list is simply to demonstrate the breadth of the open research topics.

Naming

- Internet has several namespaces at present:
 - IP addresses, Sockets, Domain Names
- Many IRTF NSRG members think additional namespaces desirable
 - NSRG did not reach smooth consensus on details, however
- DNS has various inconvenient limitations and issues
 - What alternative approaches might exist?
 - How can we remove some limitations ?

Unicast Routing

- Concerns about end-to-end BGP convergence times growing as routing table size increases
- Desires for improved, more sophisticated routing metrics
 - Lowest monetary-cost, lowest packet loss, others
- Concerns about site multi-homing
- Desire for additional/improved routing algorithms
 - Something beyond link-state, distance-vector, path-vector
 - Includes work on graph theory applicable to routing

Multicast Routing

- Desires for improved multicast routing architectures
- Desires for new/improved routing algorithms
- Desires for approaches that are easier to deploy
- Desires for approaches that are easier to operate

Mobile & Ad-Hoc Routing

- Current work interesting, but not the final word
- Desire for mobility to be a native property of the Internet
 - rather than mobility via an add-on protocol
- Self-organising and dynamic routing systems create new security challenges
- Desire for alternative approaches to wireless scalability.

Security:

Formal Methods & Key Mgmt

- Formal Methods work:
 - Security Models,
 - Trust Models,
 - Cryptographic Protocols, etc.
- Key Management work:
 - Non-hierarchical key management
 - More general approaches to multicast key mgmt

Security:

Distributed Computing

- Kerberos is great, but...
 - Not easy to initially deploy
 - Has centralised security model
- Desires include:
 - Improved support for ad-hoc computing
 - Easier-to-deploy approaches
 - Better support for inter-domain authentication
 - Better support for grid computing

Security:

Deployment Considerations

- Theoretically perfect security often impractical to deploy
- “Mostly secure” approaches that are easy to deploy might provide greater risk reduction
- Need security mechanisms that are:
 - Easy to implement correctly
 - Easy to deploy correctly
 - Easy to manage

Network Management

- SNMP & MIBs are great, but not the last word
- Monitoring devices has been more successful than managing networks --> need to manage networks
- Funding organisations don't always consider Network Management "legitimate" research
 - Need to change that mindset

Quality of Service

- IETF has several QoS mechanisms:
 - Integrated Services (e.g. RSVP)
 - Differentiated Services (e.g. IP ToS)
- Inter-domain QoS mechanisms available today create easily exploited DDOS vulnerabilities
- Today's de facto QoS deployments rely on over-provisioned network capacity
- IETF lacks an overall QoS architecture
- Need more research on QoS architecture

Congestion Control

- Modifying congestion control for new environments:
 - Streaming media; multicast applications.
 - Wireless; paths with reordering, intermittent connectivity, etc.
 - Very high-bandwidth paths.
- Communication between transport and other layers ?
- Router-based congestion control mechanisms
- Understanding traffic dynamics in large, complex networks.

Evolution of the Internet

- We need to better understand the factors that affect evolution of the Internet:
 - Technical and architectural issues.
 - Changes in the infrastructure over time.
 - The role of standards.
 - Economic and public policy factors.

Obstacles to Evolution

- Need to better understand the obstacles to evolution:
 - Increased complexity
 - Interactions between layers
 - Interventions by middleboxes, etc.
- Need to understand how to accommodate increased complexity without unduly constraining evolution.

Additional Topics

- There are **lots** of good research topics not mentioned in this document.

Conclusions

- Increased research funding, particularly from non-commercial sources is desirable
- Increased support for basic research, including architectural work needed
- Absent additional research funding, future of the Internet might not be as bright

Issues not addressed by the IAB draft:

- Research about topics not related to IETF standards.
- Promising avenues for future research.
- The needs for basic research.