Concerns with Network Research Funding

S.Floyd & R. Atkinson, Editors
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.