At the Intersection of Research and Standards: an Introduction to the IRTF

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Research and Standards: Different Worlds?
Why Should Researchers Contribute to Standards?

To help make the network work better

Because your research might be useful – and could change systems people actually use

Because you might learn something – making contacts with industry is a great way to find the real problems!

To keep industry honest – a neutral point of view to evaluate the technology, with no business agenda to promote
How to contribute?
Internet Standards

• The Internet Engineering Task Force (IETF) is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet.

• The mission of the IETF is to make the Internet work better by producing high quality, relevant technical documents (“RFCs”) that influence the way people design, use, and manage the Internet.

• The Internet Research Task Force (IRTF) promotes the evolution of the Internet through applied, longer-term, research on Internet protocols, applications, architecture and technology.
IETF Standards Activities

- About 130 working groups in 7 areas: general, operations and management, applications and real-time, transport services, security, routing, and internetworking
When to Bring Work to the IETF?

- When you’ve identified a problem that needs solving, that matches one of the IETF’s work areas, and is aligned with architectural principles of the Internet
- The scope is well defined and the problem understood; the research is largely complete, engineering needed
- A fix or enhancement to an existing protocol, or a proposal for a new protocol standard, a recommendation to change in operational practice, …
- You’ve done enough research to know your idea is sound – and want to get it used
- There is agreement on the specific deliverables, some expectation they can be completed in a timely manner, and there are people willing to do the work
How to IETF? (1/3)

- Read Tao of IETF: [https://www.ietf.org/tao.html](https://www.ietf.org/tao.html)
- The IETF designs network protocol specifications in working groups → eventually publish as RFCs
  - Don’t submit a research paper – submit a protocol specification, and explain what problem it solves
  - Write for engineers who will implement your protocol, not researchers – most participants are engineers or network operators
    - There will be other academic and industry researchers in the group, but the main focus is engineering, not research
- Discuss and iteratively develop the design
  - Consensus, discussion-based, working group review
  - Multiple rounds of iterative review – your idea will be developed, modified, changed beyond expectation as it progresses through the process, and as you begin to understand real deployment constraints
How to IETF? (2/3)

- Does your idea fit within the charter of an existing working group?
- Maybe you want to extend, update, or improve some existing protocol → you want to extend/modify TCP, QUIC, BGP, IPv6, …
- Write-up the changes you propose, then talk to the chairs of the working group developing that protocol and ask their advice how to proceed
- Not sure where the work fits?
- Join the working group email lists, watch the meeting recordings, read the drafts – see how they work, then participate
  - No formal membership, and anyone can join a group with no permission or approval needed
  - No fee to join a working group – attendance at IETF meetings is paid, but no-questions-asked waivers available if the fee is a barrier to participation

https://www.ietf.org/how/wgs/
How to IETF? (3/3)

- If there is no suitable working group, does your idea fit in the scope of an existing IETF area?
  - e.g., you want to standardise a new protocol
  - Talk to the relevant Area Director → they’ll help you start a new working group, or direct you to an area working group that handles new work

- No suitable IETF area?
  - Is the IETF the right standards organisation for you?
  - Is your idea maybe still research → talk to the IRTF

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What About Research?

• The Internet Research Task Force (IRTF) promotes evolution of the Internet through applied, longer-term, research on Internet protocols, applications, architectures, and technology
IRTF Activities

• Organised around longer-term research groups

• A forum where researchers and engineers can explore the feasibility of research ideas

• You have a good idea, and it works in simulations and in a lab testbed – will it work in the real-world Internet? Is it deployable? Implementable on real hardware?

• How does the network really work? How does that affect your research?

• A venue where researchers can learn from the engineers who build and operate the Internet – and where the standards, implementation, and operations community can learn from research
Security, Privacy, and Human Rights

• Begin to understand how Internet protocols and standards impact human rights and privacy – at the Internet infrastructure level

• Discuss interplay between security mechanisms, privacy, and human rights; seek to raise awareness of broader societal and policy issues to the IETF community
Computation in the Network

• Speculative new architectures for an internet, emphasising named data or named functions
• Generalisation of content distribution networks and web caching infrastructure – mature work, with competing experimental implementations
• Generalisation of lambda functions and “server-less” computation – early stage research
• Long-term replacements for the Internet?

• Does it make sense to re-architect the network around content or computation?
• Implications for the content provider/consumer relationship – democratisation or ossification of current roles?
Path Aware Networking

• Can we benefit from making applications and transport protocols aware of the network path taken – or by making the network path aware of the application or transport?

• Introduces a new control point for operators; questions around trust, privacy, and network neutrality are poorly understood

• IETF community seems determined to enter a standardisation phase: SRv6, APN, ...

• IRTF considering broader questions around privacy, security, path definitions, incentives

Current Open Questions in Path Aware Networking
https://datatracker.ietf.org/doc/draft-irtf-panrg-questions/

Path Aware Networking: Obstacles to Deployment (A Bestiary of Roads Not Taken)
Designing the Quantum Internet

• How to establish and control inter-domain paths that can distribute entangled quantum state?
  • Quantum key distribution for security
  • Distributed quantum computation
  • **Quantum entanglement as a service**

• Architecture and approach generally well defined
  • Classical control plane
  • Managed distribution of entangled quantum state

• Entering a phase of experimentation to validate the architecture, develop prototypes

![Entanglement for everyone](source)

Source: Axel Dahlberg, presentation at IETF 103 QIRG meeting

**QIRG**

Architectural Principles for a Quantum Internet
https://datatracker.ietf.org/doc/draft-irtf-qirg-principles/

Applications and Use Cases for the Quantum Internet
Global Access and Sustainability

- How to address the global digital divide?
- To share experiences and best practices, foster collaboration, in building, deploying and making effective use of the Internet in rural, remote, or under-developed regions
- To create increased visibility and interest among the wider community on the challenges and opportunities in enabling global Internet access, in terms of technology as well as the social and economic drivers for its adoption
- To create a shared vision among practitioners, researchers, corporations, non governmental and governmental organisations on the challenges and opportunities
- Sharing expertise, raising awareness of global access challenges

Advanced Protocol Development

- Measuring and understanding network behaviour
- Interfacing between research and standards community to help:
  - Develop and validate congestion control and network coding algorithms in the real world
  - Develop intent-based and AI-based approaches to network management
  - Understand issues of trust- and identity- management, name resolution, resource/asset ownership, and resource discovery in decentralised infrastructure
  - Understand research challenges in IoT based on initial real-world deployment experience
- Fostering collaboration and interaction between industry and research
Supporting Applied Networking Research

- ACM/IRTF Applied Networking Research Workshop
  - A forum for researchers, vendors, network operators and Internet standards community to present and discuss emerging results in applied networking research
  - Peer-reviewed academic workshop – papers in ACM Digital Library
  - Co-locates with IETF meeting in July – travel grants available (when travel resumes, post-COVID)
  - https://irtf.org/anrw/
Supporting Applied Networking Research

• **Applied Networking Research Prize** is “awarded to recognise the best recent results in applied networking, interesting new research ideas of potential relevance to the Internet standards community, and upcoming people that are likely to have an impact on Internet standards and technologies, with a particular focus on cases where these people or ideas would not otherwise get much exposure or be able to participate in the discussion.”

• Nomination deadline: 22 November 2020

• [https://irtf.org/anrp/](https://irtf.org/anrp/)
Why should network researchers care about protocol standards?

• To improve the network, while learning about real-world constraints
• To build contacts with industry and keep your research grounded in what’s possible
• IRTF provides a pathway from research to standards

• Further questions? irtf-chair@irtf.org