University of Glasgow

Defining Network Protocol standards

Colin Perkins

Colin Perkins | https://csperkins.org/ | Copyright © 2020 University of Glasgow | This work is licensed under the Creative Commons Attribution-NoDerivatives 4.0 International License.
To view a copy of this license, visit http://creativecommons.org/licenses/by-nd/4.0/ or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.

Defining Network Protocol standards

What is the process for defining Internet protocol standards?

What's happening in the research world that might affect Internet standards?

Colin Perkins | https://csperkins.org/ | Copyright © 2020 University of Glasgow

- Why might you care about protocol standards?
- How are Internet standards developed?

Colin Perkins | https://csperkins.org/ | Copyright © 2020 University of Glasgow

Why Should You Care About Internet Standards?

Because you might learn something

To improve the systems you use – help meet your needs

To make the network better, improve interoperability, and for the common good

To keep industry honest – a neutral point of view to evaluate technology, with no business agenda?

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Internet Standards

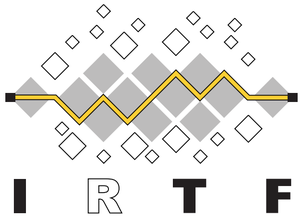
- The Internet Engineering Task Force (IETF) is a large open international community of protocol designers, network operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet.
- The mission of the IETF is to make the Internet work better by producing high quality, relevant technical documents (“RFCs”) that influence the way people design, use, and manage the Internet.

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

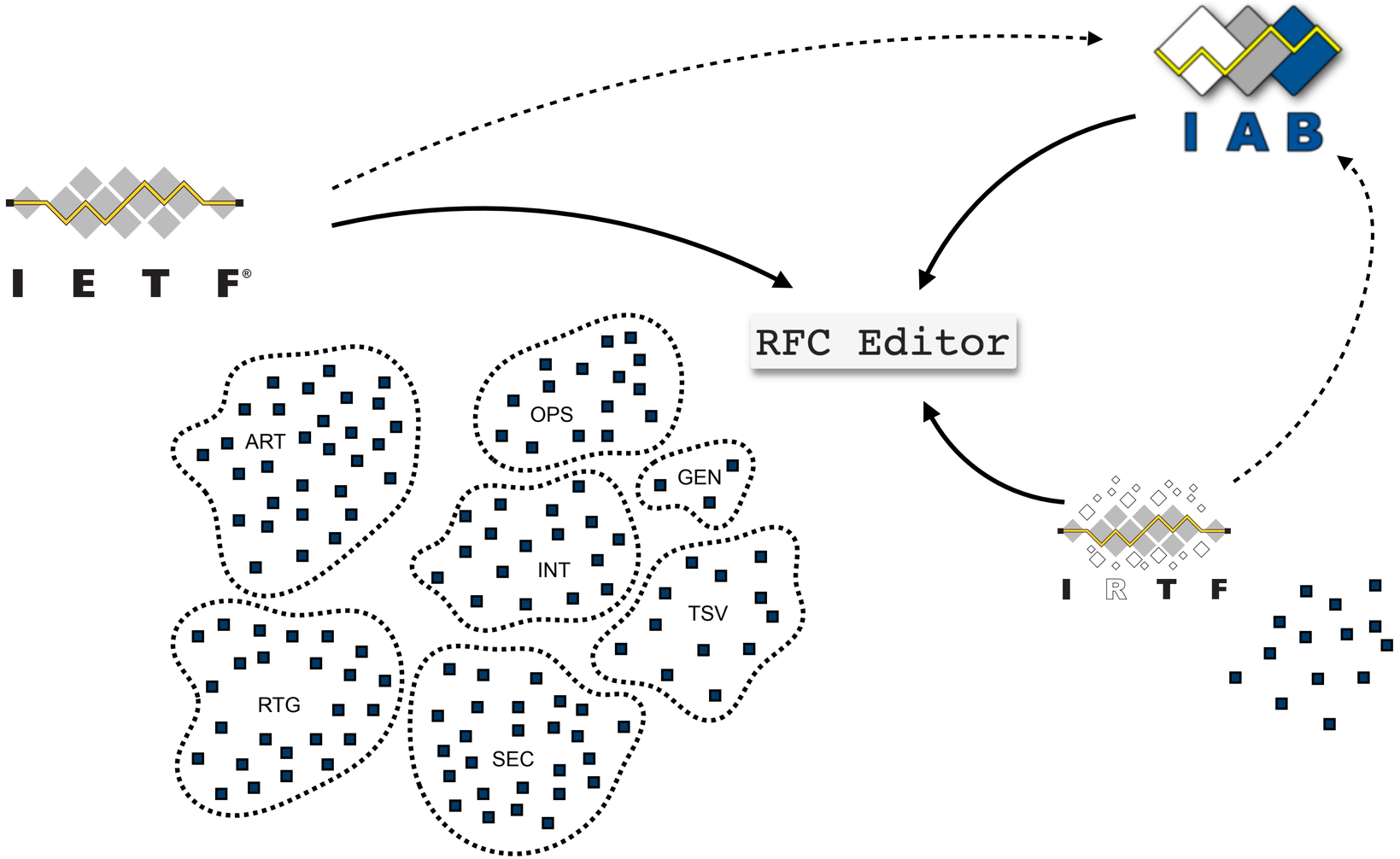
Internet Standards

- The Internet Engineering Task Force (IETF) is a large open international community of protocol designers, network 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.

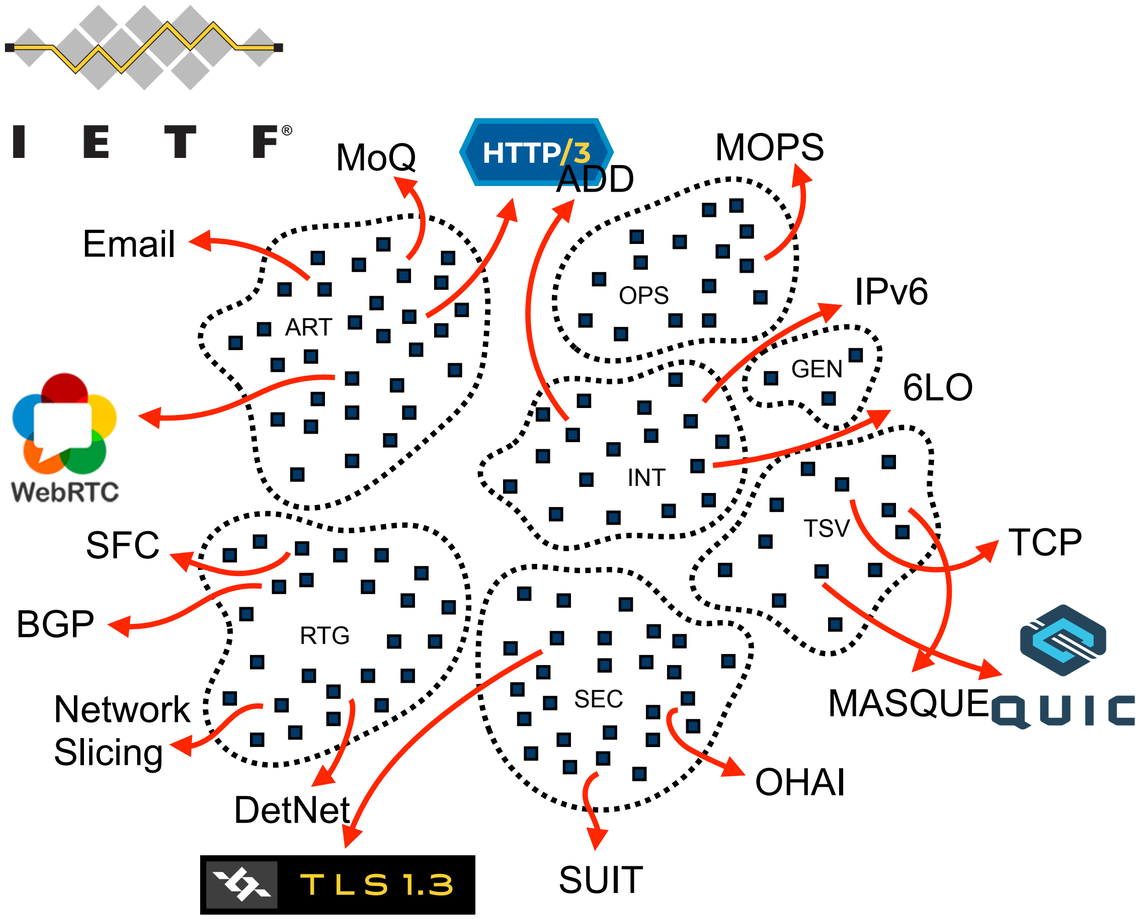
- The Internet Research Task Force (IRTF) promotes the evolution of the Internet through applied, longer-term, research on Internet protocols, applications, architecture and technology



Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow



Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow



~130 working groups in 7 areas

general
operations and management
applications and real-time
transport services
security
routing
internetworking

Open and volunteer-driven

Publishes Internet standards RFCs

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

How to IETF?

Problem

- Identify a problem of relevance to the standards community

Community

- Check if the IETF is interested in your work

Working Group

- Develop your ideas in an IETF working group

Review

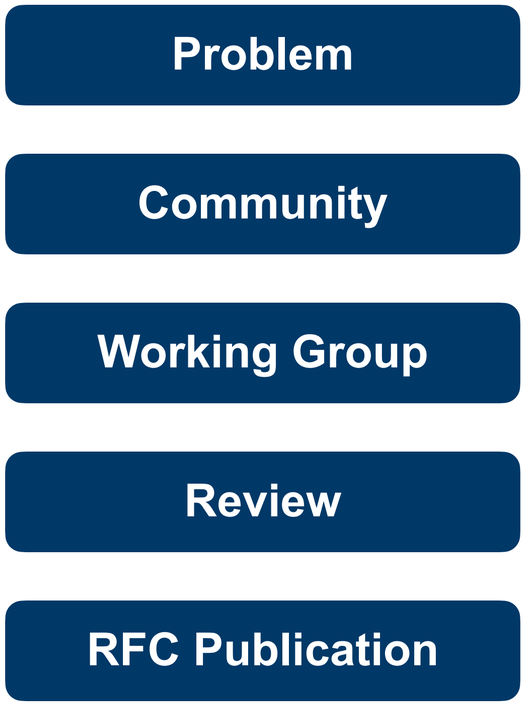
- …

RFC Publication

- Profit…?

BY ND

When to Bring Work to the IETF?

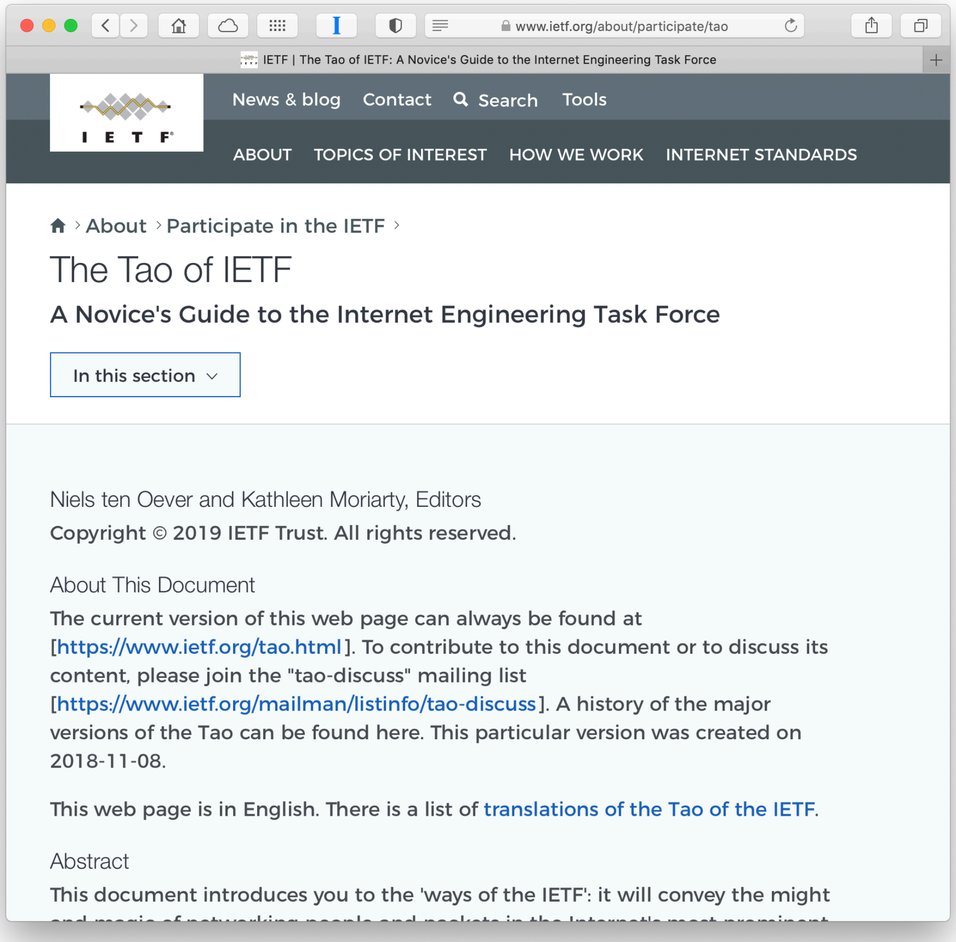


- Don’t start too early – **IETF is not a place to do research**

- Once you think you’ve identified a problem that fits one of the IETF’s work areas, and built a prototype to demonstrate utility, **only then** bring the work to IETF
  - When the scope is well defined and the problem understood
  - When the research is largely complete, and engineering is needed
  - When you know your idea is sound, and want to see it used

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Find your home in the IETF community (1/3)



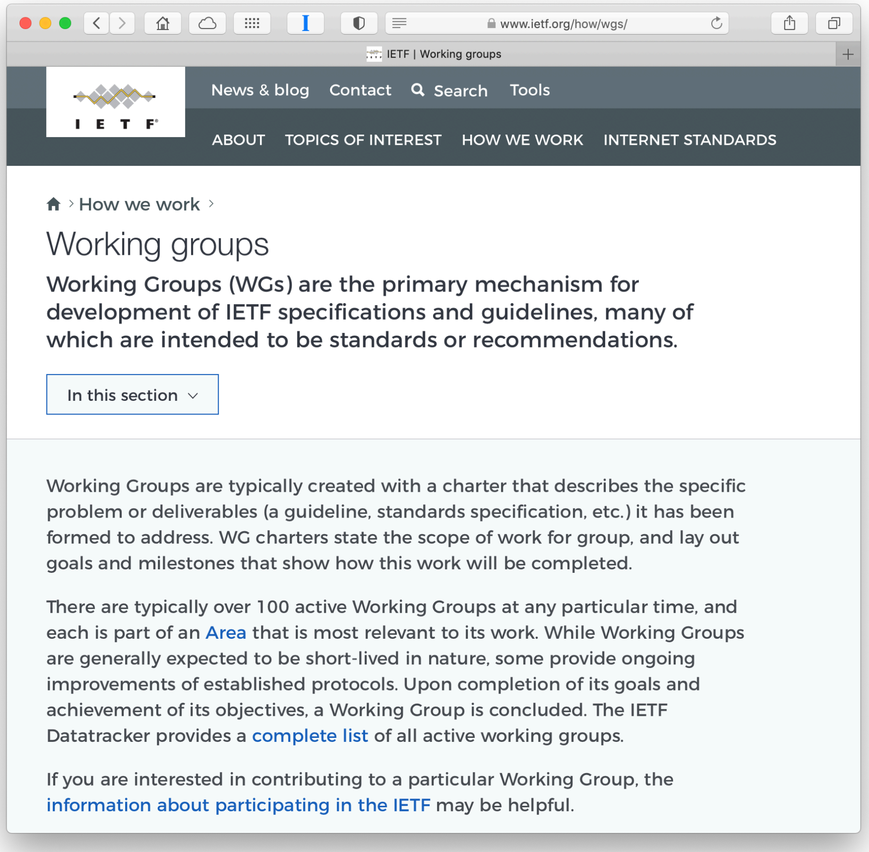
- Read **Tao of IETF**: https://www.ietf.org/tao.html

- IETF is a large organisation, with its own rituals, culture, and process
- Don’t worry about all the details, but it helps to have an idea

CC BY ND

Find your home in the IETF community (2/3)

- Does your idea fit into the charter of an existing group?
  - Do you want to extend, update, or improve an existing protocol?
  - Talk to the chairs of the working group developing that protocol
- 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

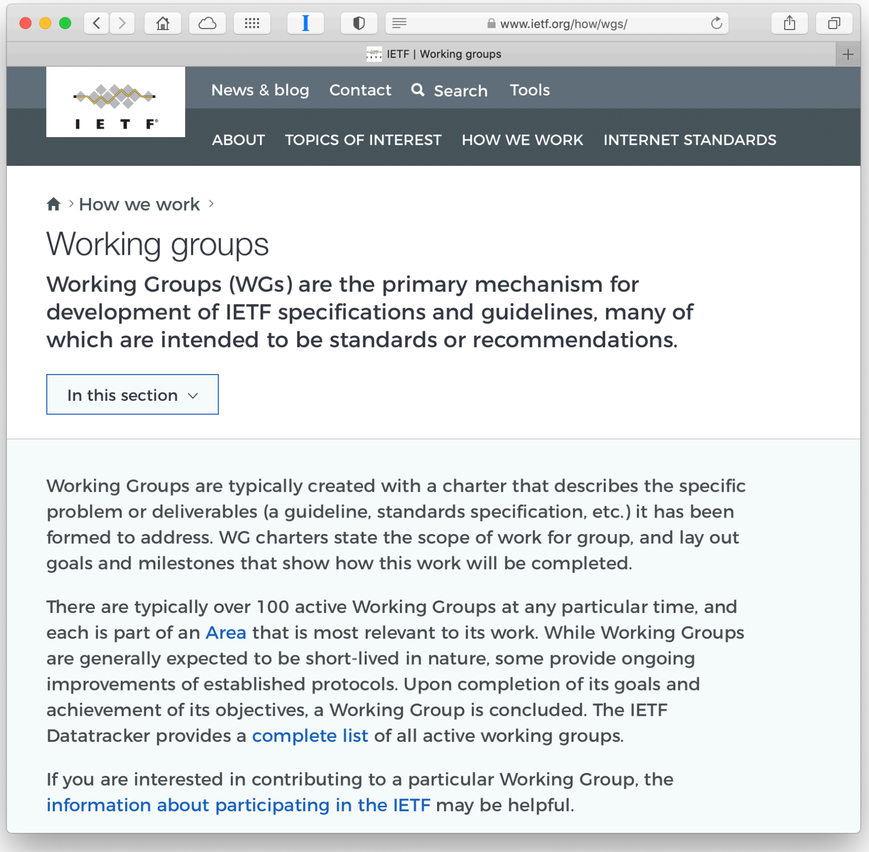


Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Find your home in the IETF community (3/3)

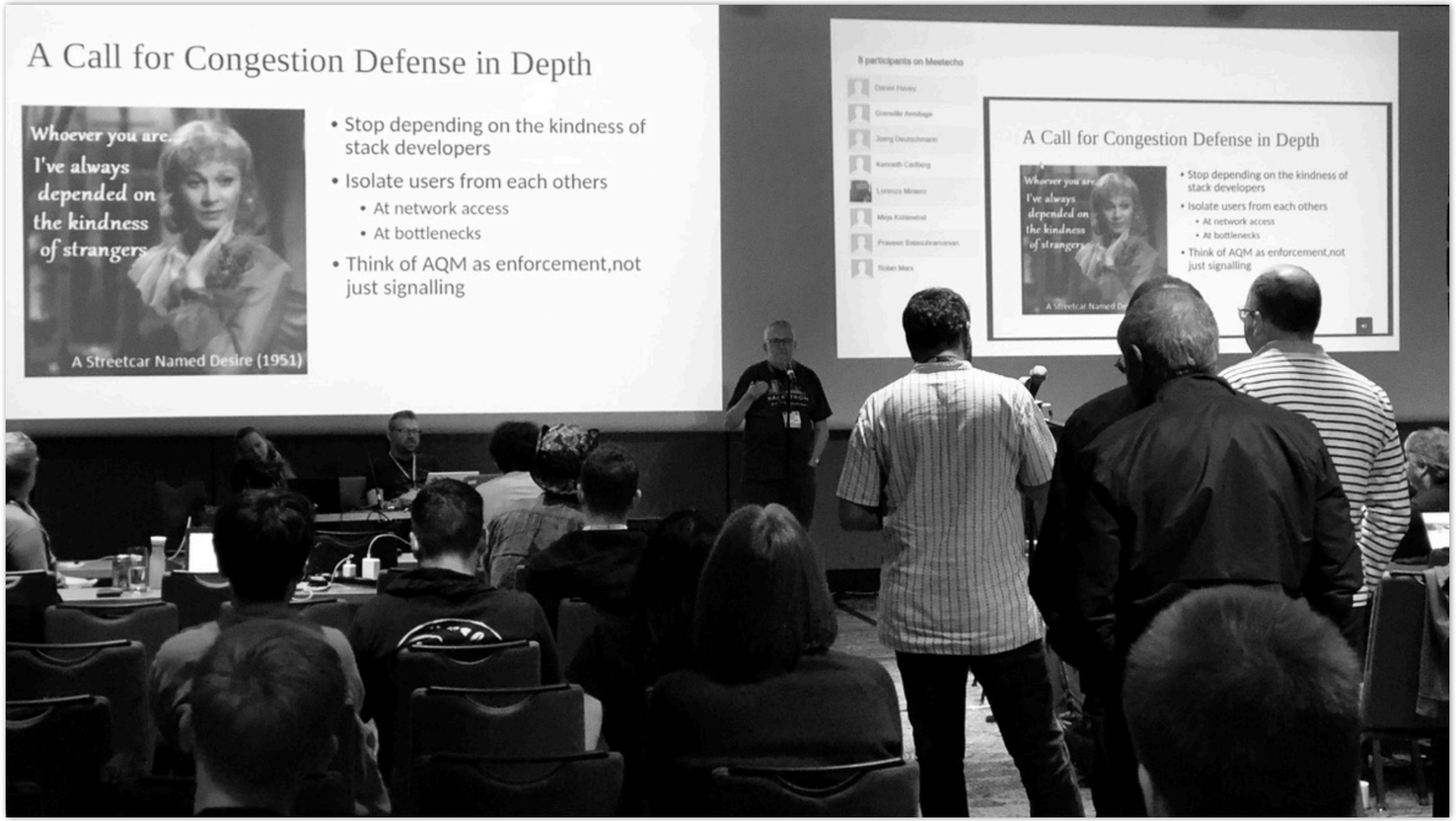
- If there is no suitable working group, does your idea fit in the scope of an existing IETF area?
  - e.g., you want to standardise a new protocol
  - Talk to the relevant **Area Director** – they'll help you start a new working group, or direct you to an **area working group** that handles new work

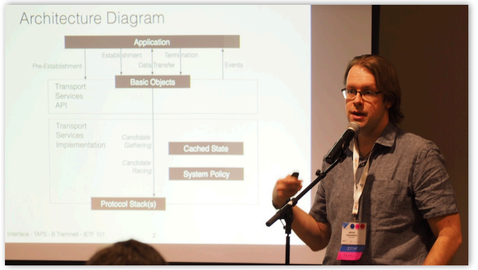
- No suitable IETF area?
  - Is the IETF the right standards organisation for you?
  - Is your idea maybe still research? → talk to the IRTF



Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

The Working Group Process (1/2)

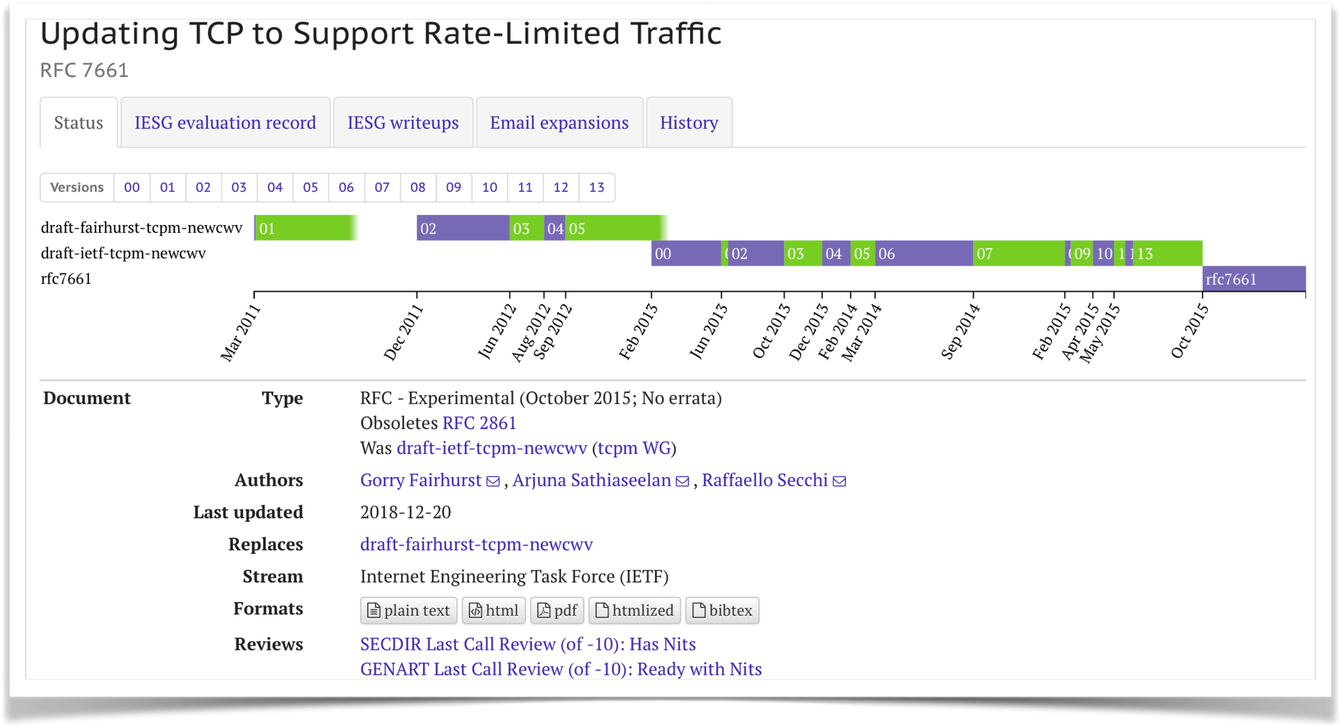




Iterative, multi-stage, review process until **rough consensus and running code**

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

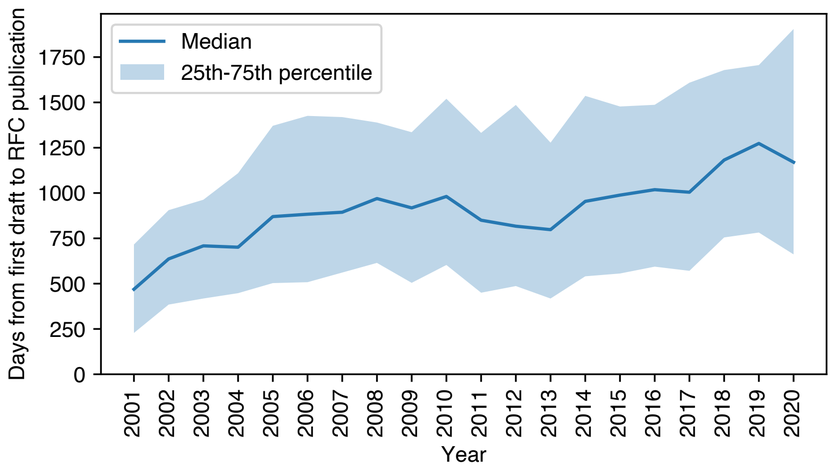
The Working Group Process (2/2)

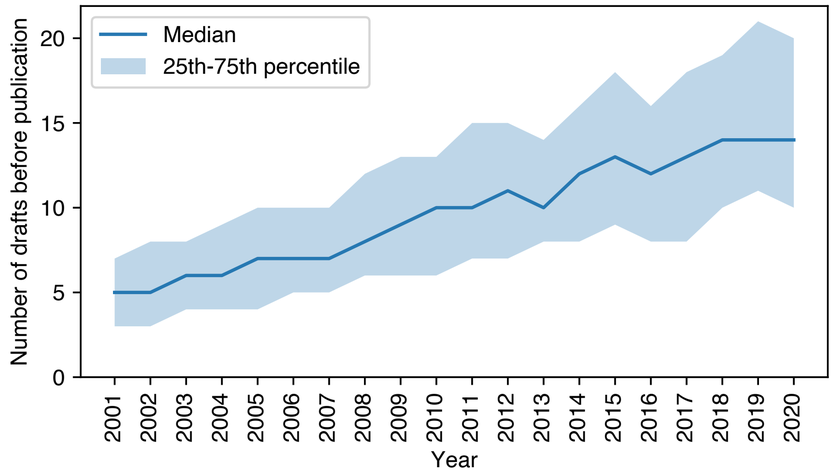


- Consensus can be slow, with multiple rounds of review
- Your idea will be developed, modified, changed beyond expectation as it progresses through the process
- Few ideas survive contact with deployment reality unscathed

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

How Long Does It Take?



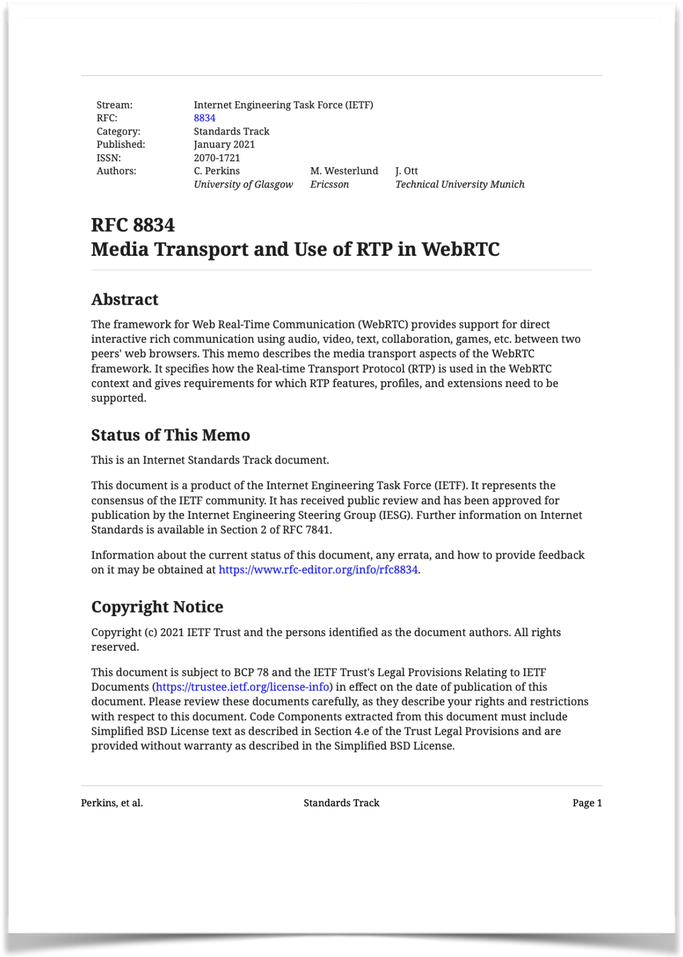


Figures from S. McQuistin *et al.*, "Characterising the IETF through the lens of RFC deployment", ACM IMC 2021

- The consensus process is slow: standards take around 3 years, and 12 revisions, before publication
- It's getting slower over time – the network is becoming more complex, more interdependencies
- Successful protocols are generally deployed as they're being developed

Colin Perkins | https://csperkins.org/ | Copyright © 2020 University of Glasgow

RFC Publication



Stream: Internet Engineering Task Force (IETF)
RFC: 8834
Category: Standards Track
Published: January 2021
ISSN: 2070-1721
Authors: C. Perkins, *University of Glasgow*; M. Westerlund, *Ericsson*; J. Ott, *Technical University Munich*

RFC 8834
Media Transport and Use of RTP in WebRTC

Abstract

The framework for Web Real-Time Communication (WebRTC) provides support for direct interactive rich communication using audio, video, text, collaboration, games, etc. between two peers' web browsers. This memo describes the media transport aspects of the WebRTC framework. It specifies how the Real-time Transport Protocol (RTP) is used in the WebRTC context and gives requirements for which RTP features, profiles, and extensions need to be supported.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc8834.

Copyright Notice

Copyright (c) 2021 IETF Trust and the persons identified as the document authors. All rights reserved.

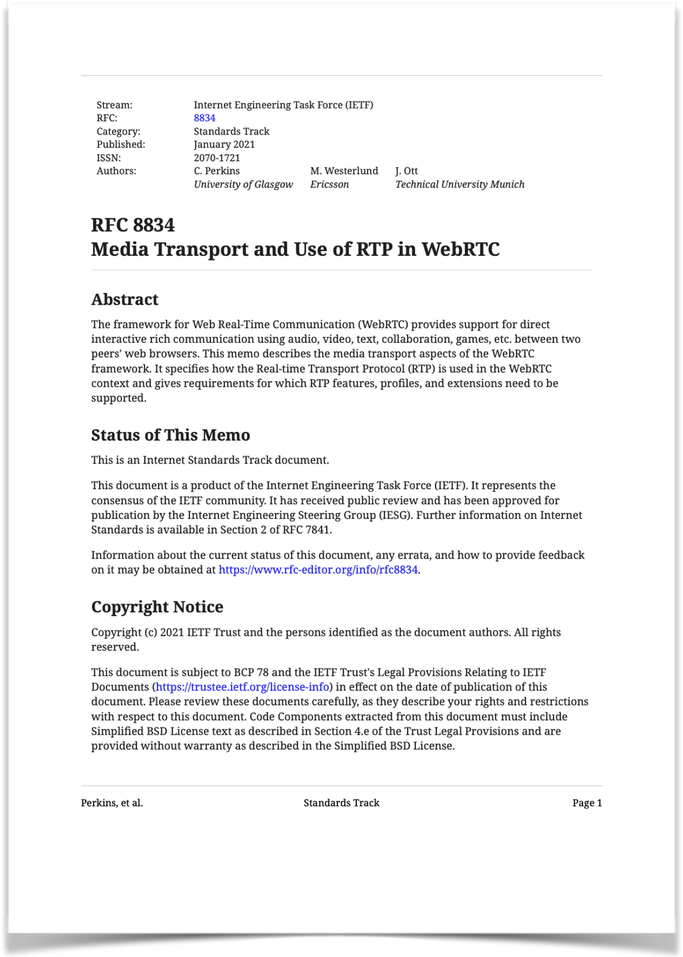
This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (https://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Perkins, et al. Standards Track Page 1

- Eventually, an RFC is published – your idea is now an Internet Standard

CC BY ND

RFC Publication



Stream: Internet Engineering Task Force (IETF)
RFC: 8834
Category: Standards Track
Published: January 2021
ISSN: 2070-1721
Authors: C. Perkins, *University of Glasgow*; M. Westerlund, *Ericsson*; J. Ott, *Technical University Munich*

RFC 8834
Media Transport and Use of RTP in WebRTC

Abstract

The framework for Web Real-Time Communication (WebRTC) provides support for direct interactive rich communication using audio, video, text, collaboration, games, etc. between two peers' web browsers. This memo describes the media transport aspects of the WebRTC framework. It specifies how the Real-time Transport Protocol (RTP) is used in the WebRTC context and gives requirements for which RTP features, profiles, and extensions need to be supported.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc8834.

Copyright Notice

Copyright (c) 2021 IETF Trust and the persons identified as the document authors. All rights reserved.

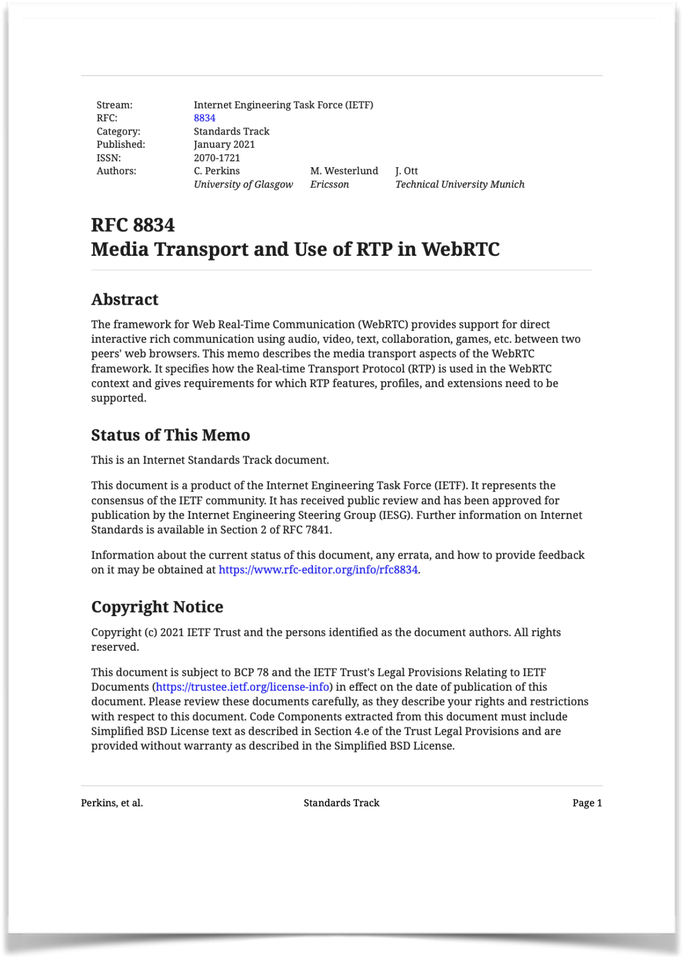
This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (https://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Perkins, et al. Standards Track Page 1

- Eventually, an RFC is published – your idea is now an Internet Standard
- Was it worth it?

CC BY ND

RFC Publication



Stream: Internet Engineering Task Force (IETF)
RFC: 8834
Category: Standards Track
Published: January 2021
ISSN: 2070-1721
Authors: C. Perkins, *University of Glasgow*; M. Westerlund, *Ericsson*; J. Ott, *Technical University Munich*

RFC 8834
Media Transport and Use of RTP in WebRTC

Abstract

The framework for Web Real-Time Communication (WebRTC) provides support for direct interactive rich communication using audio, video, text, collaboration, games, etc. between two peers' web browsers. This memo describes the media transport aspects of the WebRTC framework. It specifies how the Real-time Transport Protocol (RTP) is used in the WebRTC context and gives requirements for which RTP features, profiles, and extensions need to be supported.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc8834.

Copyright Notice

Copyright (c) 2021 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (https://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Perkins, et al. Standards Track Page 1

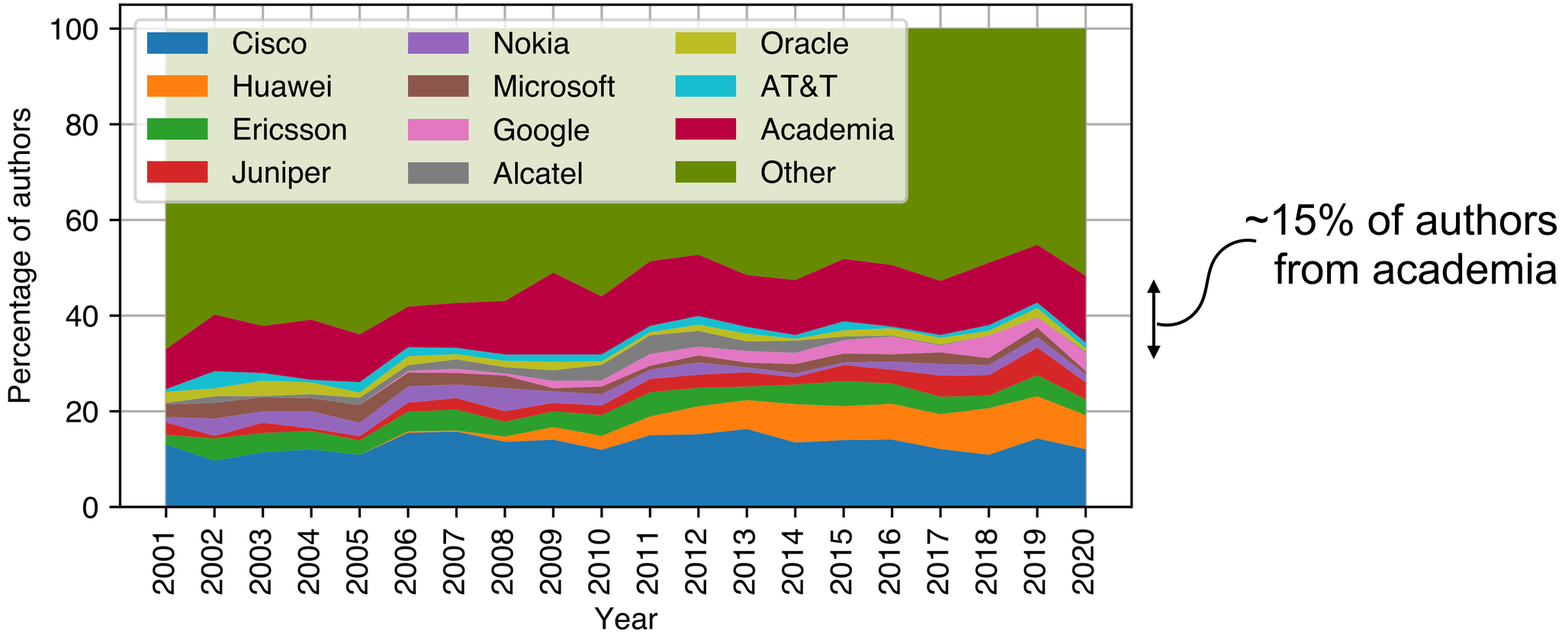
- Eventually, an RFC is published – your idea is now an Internet Standard

- Was it worth it?
  - If your goal was to improve the network, or better understand, the network – yes!
  - If your goal was develop a new protocol, build momentum for deployment, encourage multiple implementations – yes!
  - As a way to get industry contacts – yes!

- As a research publication? No

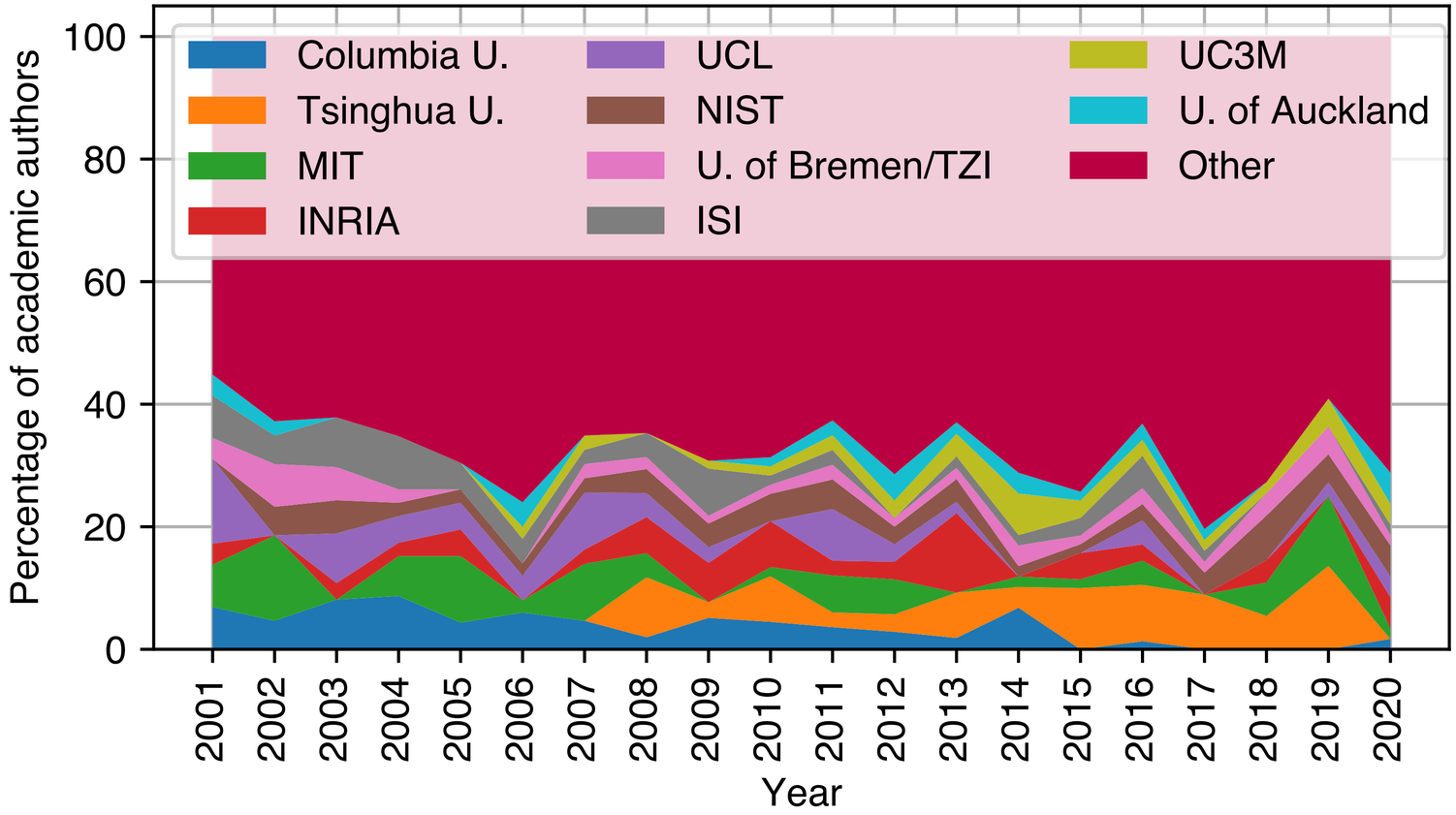
CC BY ND

Who writes IETF standards? (1/3)



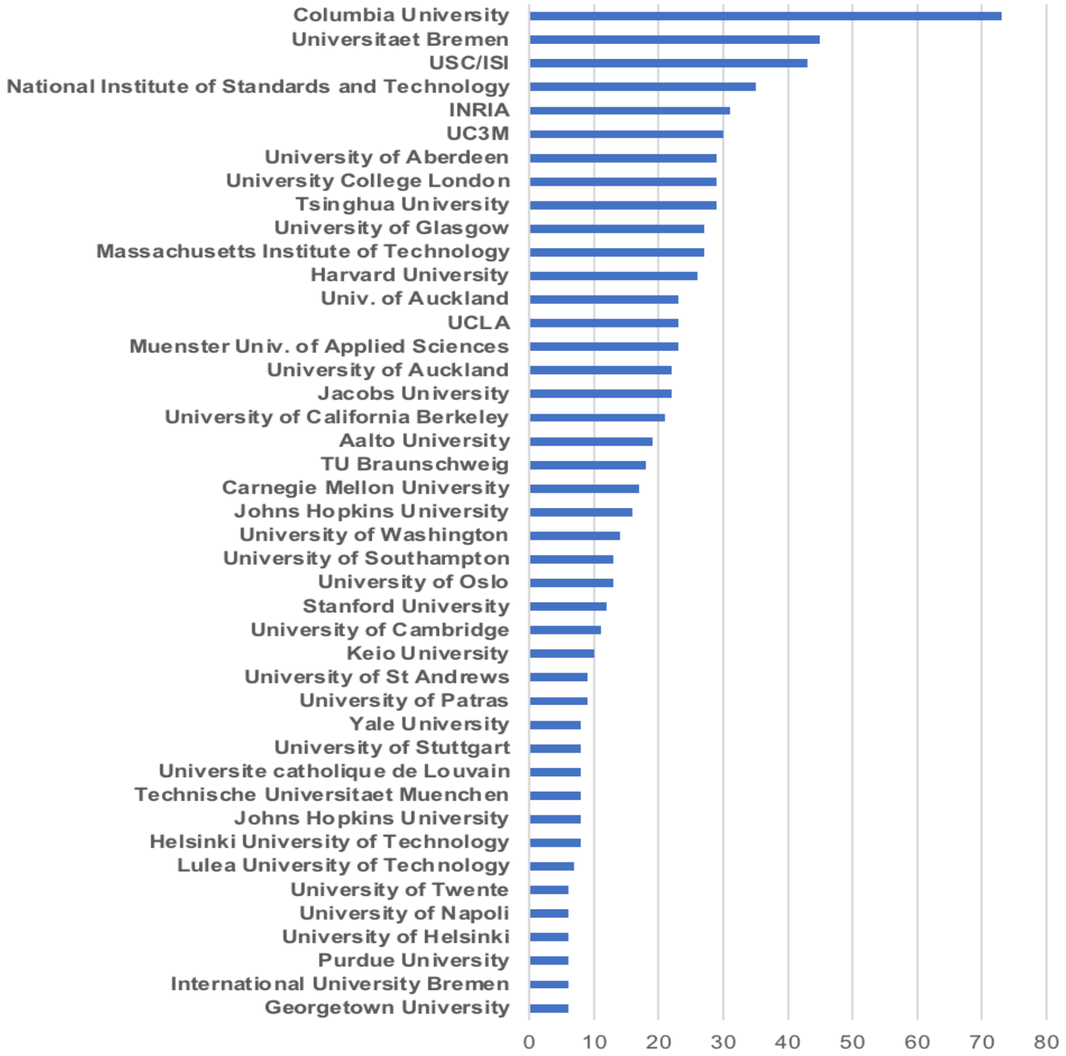
Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Who writes IETF standards? (2/3)



Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

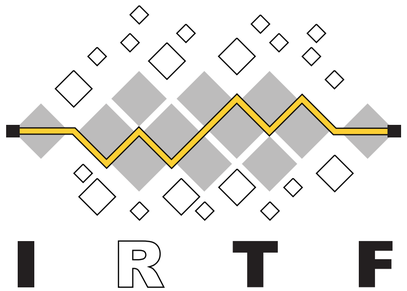
Who writes IETF standards? (3/3)



- Small, but determined, research groups can have outsized impact
- Strong contributions from diverse range of institutions – not all standards are driven by large technology companies
- The process rewards participants that can commit to long-term engagement

Academic RFC authorship from IETF datatracker records;
data mostly complete since early 2000s, preliminary analysis

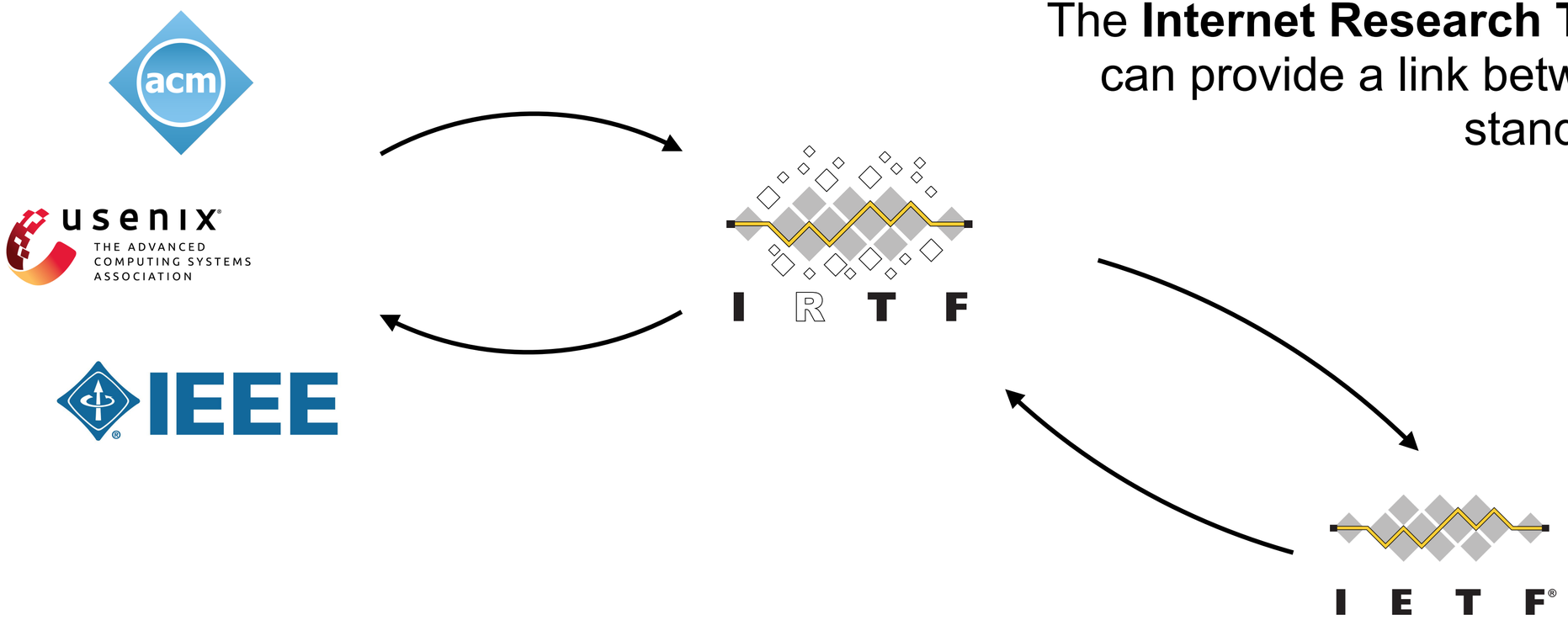
Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow



- What networking research topics might develop into the basis for future standards?
- How might they affect the Internet we use?

Colin Perkins | https://csperkins.org/ | Copyright © 2020 University of Glasgow

What About Pre-Standards Research?



The **Internet Research Task Force** (IRTF) can provide a link between research and standards communities

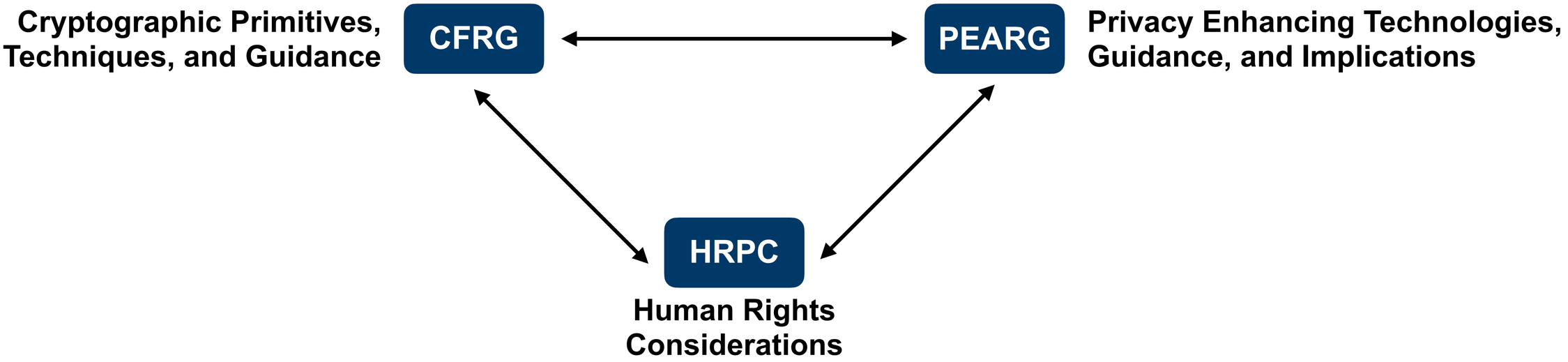
Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

IRTF Activities

- Organised around longer-term **research groups**, meeting co-located with IETF
- Open **discussion forums** where researchers and industry standards makers can explore feasibility of research ideas
- 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

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Security, Privacy, and Human Rights

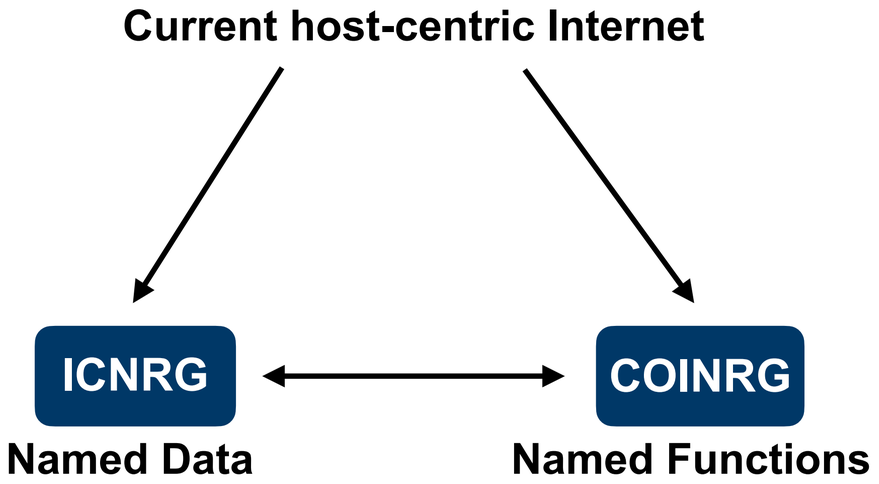


- Begin to understand how Internet protocols and standards impact human rights and privacy – at the Internet infrastructure level
- Discuss interplay between security mechanisms, privacy, and human rights; seek to raise awareness of broader societal and policy issues to the IETF community

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Content-Aware Networking and Computation

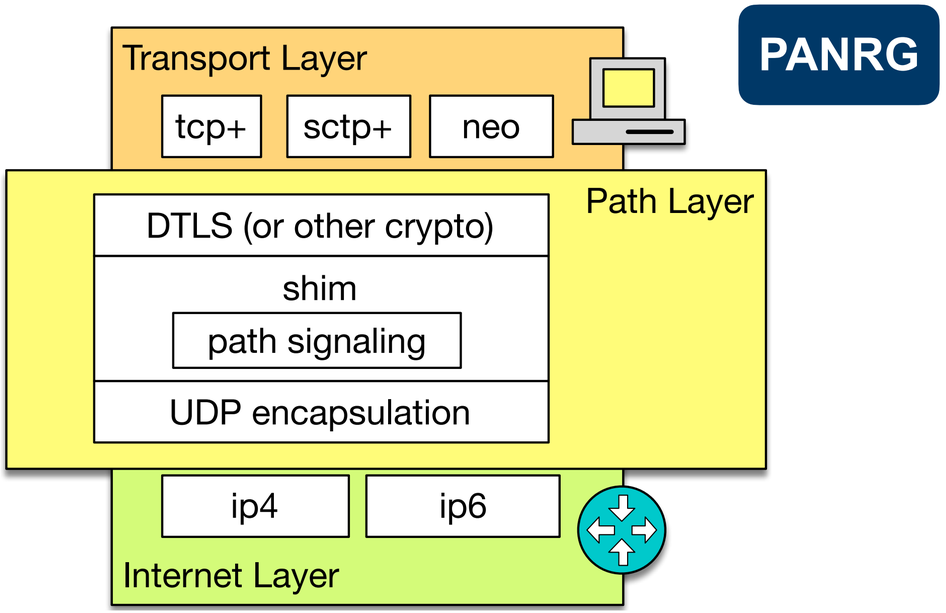
- Alternative internet architectures that emphasise content-aware and programmable infrastructure
  - Programmable, content-aware, routing and forwarding
  - Pervasive in-network caching and computation
  - **Focus on data and computation** rather than devices
  - What does internetworking mean in a content-aware software-defined network?



- Can we/should we re-structure the network around data and computation?

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Path Aware Networking



Source: Brian Trammell, presentation at IETF 96 PLUS BoF

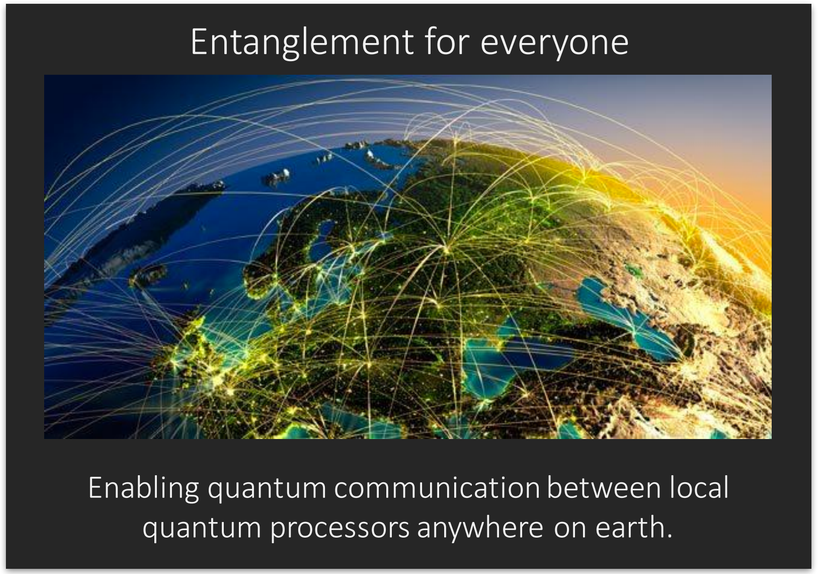
- Can we benefit from making applications and transport protocols aware of the network path taken – or by making the network path aware of the application or transport?
- Introduces a new control point for operators; questions around trust, privacy, and network neutrality are poorly understood
- But – potentially improves performance and gives precise control over routing/forwarding

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

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** – how can we build distributed quantum computers?

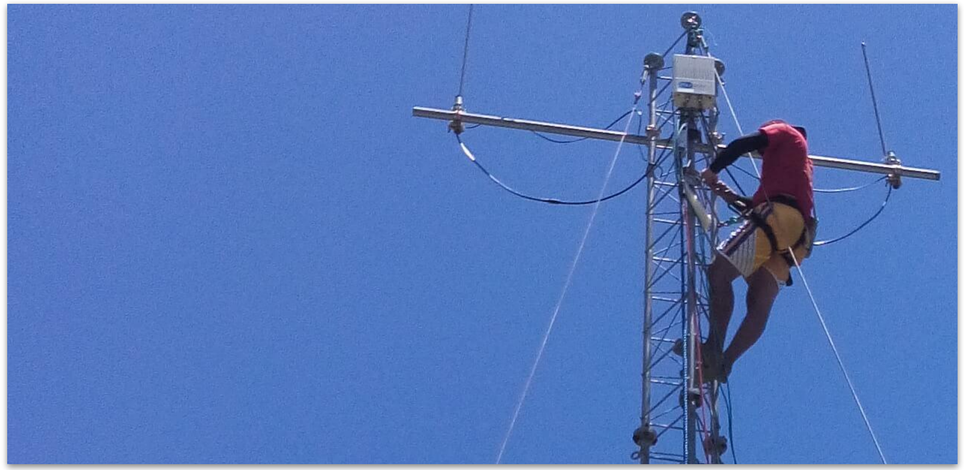
QIRG



Source: Axel Dahlberg, presentation at IETF 103 QIRG meeting

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Global Access and Sustainability



Source: Maria Theresa Perez, “Community Cellular Networks in the Philippines: Experiences from the VBTS project”, Presentation to IRTF GAIA RG, November 2019, https://www.ietf.org/proceedings/106/slides/slides-106-gaia-up-vbts-philippines-00

- How to address the global digital divide?
- Sharing expertise, raising awareness of global access challenges

GAIA

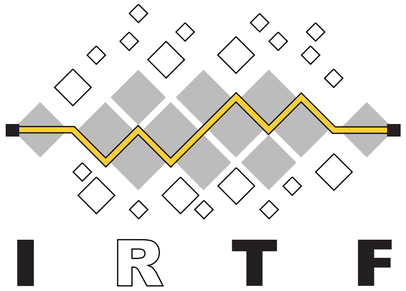
Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Advanced Protocol Development

- Measuring and understanding network behaviour
- Linking research and standards community to help:
  - Develop new **congestion control** and **network coding** algorithms; **measure and understand performance**
  - 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

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow

Why should you care about protocol standards?



- The network is **not finished** – existing standards are evolving; many speculative new research ideas under discussion close to the standards world
- The standards process is perhaps more open than you think – **you can change the network** to reflect your needs and your vision

Colin Perkins | https://csperkins.org/ | Copyright © 2021 University of Glasgow