IETF
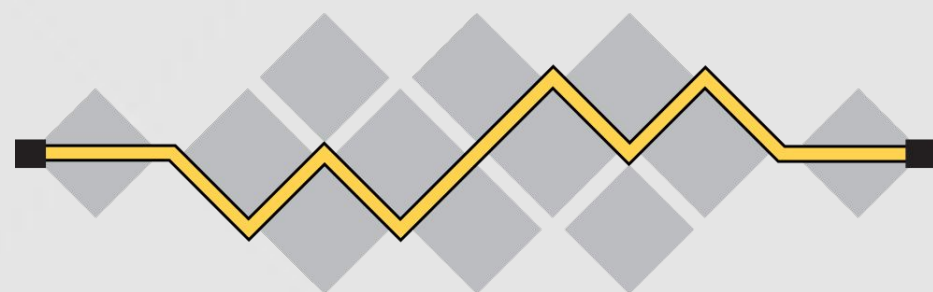
Overview of Technical Work and Hot Topics

Making the Internet work better

RIPE86 - May 2023

IETF®

IAB and IESG members here today - Come talk to us!

Mirja Kühlewind
IAB Chair
ietf@kuehlewind.net

Warren Kumari
OPD Area Director
warren@kumari.net

Éric Vyncke
INT Area Director
evyncke@cisco.com

Jari Arkko
Recent IAB member
jari.arkko@piuha.net

The mission of the IETF is to make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet.
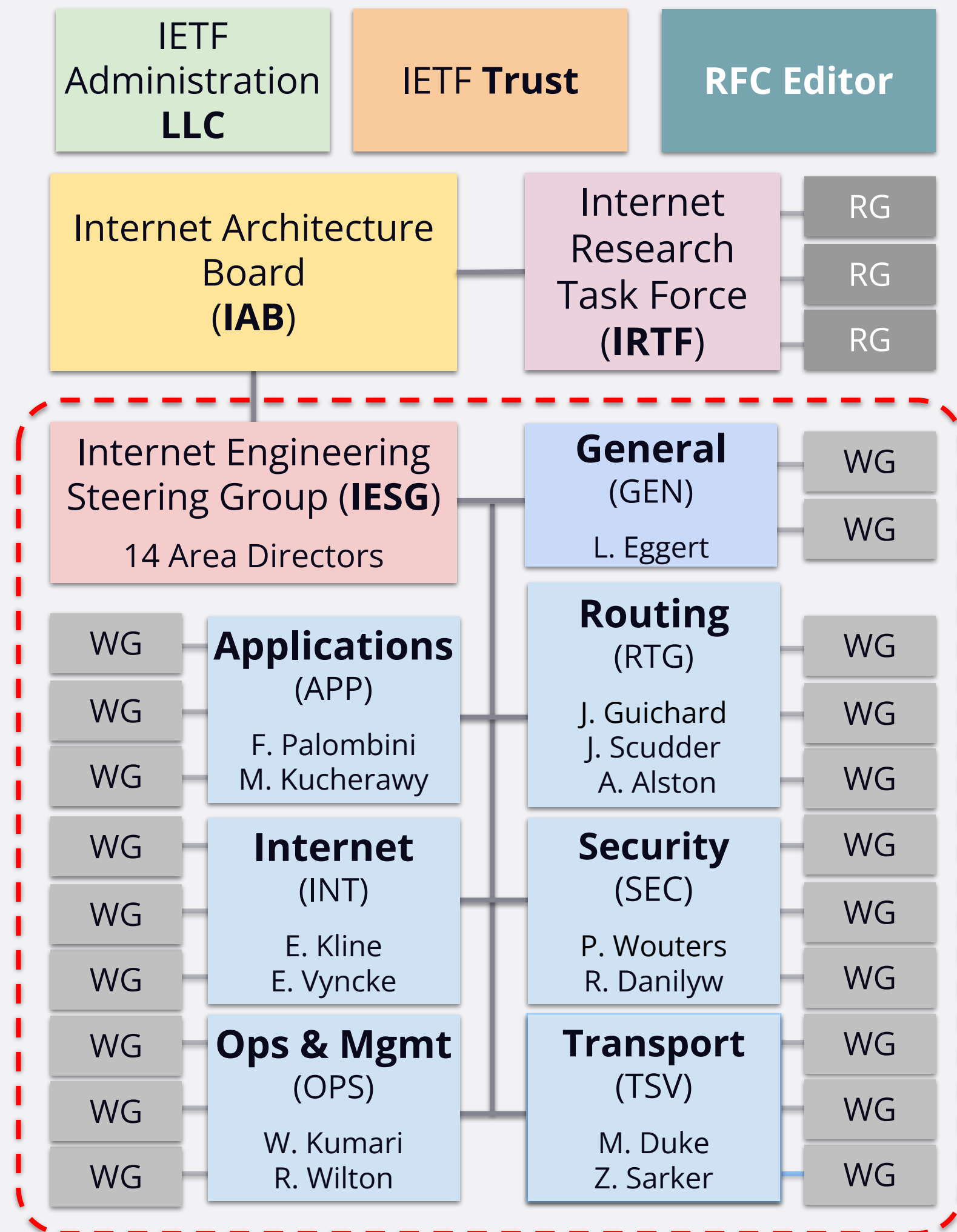
RFC 3935

IETF

Making the Internet work better

Overview of this session

- **Brief Introduction to IETF and IAB**

- **IETF trends and hot topic**

  - **DNS and IPv6**

  - **Environmental impacts**

  - **QUIC and TLS**

  - **Management of encrypted networks**

- **New working groups and recent BoFs**

- **Ways to participate**

IETF
Organizational Structure

- IETF is structured into seven **areas**
- Internet Engineering Steering Group (**IESG**)

  = all area directors (**AD**s)
  - Approves all Internet Standards
  - Starts/Manages/ends technical WGs
- Internet Architecture Board (**IAB**)
  - Architectural oversight
  - Liaison management
- Internet Research Task Force (**IRTF**)
  - Longer term Internet research

Making the Internet work better

I E T F ®

IETF Administration **LLC**

IETF **Trust**

RFC Editor

Internet Architecture Board (**IAB**)

Internet Research Task Force (**IRTF**)

RG

RG

RG

Internet Engineering Steering Group (**IESG**)

14 Area Directors

General (GEN)

L. Eggert

WG

WG

WG

WG

Applications (APP)

F. Palombini
M. Kucherawy

Routing (RTG)

J. Guichard
J. Scudder
A. Alston

WG

WG

WG

WG

WG

WG

Internet (INT)

E. Kline
E. Vyncke

Security (SEC)

P. Wouters
R. Danilyw

WG

WG

WG

WG

WG

WG

Ops & Mgmt (OPS)

W. Kumari
R. Wilton

Transport (TSV)

M. Duke
Z. Sarker

WG

WG

IETF by the numbers in 2022

https://www.ietf.org/blog/ietf-snapshot-2022/

6654 Participants
in all IETF activities (mailing list posters, meeting participants, I-D authors)*

3839 Registered
IETF Meeting participants

Documents

811 Internet-Drafts (I-D) submitted†

2728 I-D authors

194 RFCs published

2407 Unique
meeting participants

104,000 Messages
sent to IETF mailing lists

3604 Individuals
posting to IETF mailing lists

Working groups

126 Active Working groups

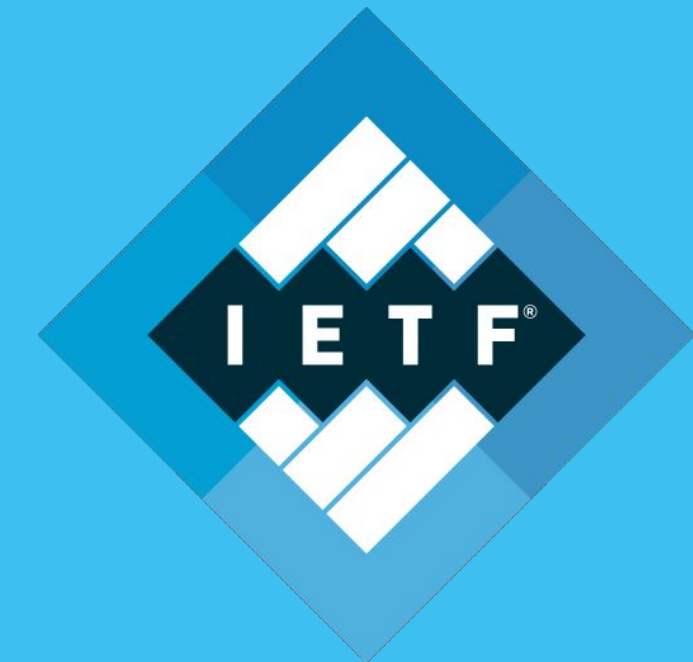**8** new Working Groups chartered during 2022

4 IETF Working Groups concluded during 2022

* based on unique email address used to register for IETF events, submit I-Ds, and post to IETF mailing lists
† Unique I-D names not counting different versions of the same I-D submitted to the IETF I-D archive
All information as of 31 December 2022

IETF Hackathon

We believe in: Rough consensus and running code

David Clark, 1992

Trends and Hot Topics

Current DNS trends

- **Extended DNS Error Deployment**
  - DNS errors are opaque
    - Almost all are SERVFAIL :-)
  - RFC8914 helps solve this
  - Adds **useful error messages** to the DNS
    - Error Code 7 - Signature Expired
    - Error Code 16 - Censored
    - **Deployment already exists! (e.g. CloudFlare)**

- **Improving encrypted DNS**
  - client -> resolver DNS DoT/DoH deployment
  - client -> resolver DNS **DoQ**
    - RFC9250 published in 2022
  - resolver -> auth draft-ietf-dprive-unilateral-probing
    - How do resolvers know **when DoT is available?**

- **Non-DNS resolution reservation**
  - draft-ietf-dnsop-alt-tld: A **.alt** TLD for anchoring alternate name spaces (i.e.: **not the DNS underneath**)
  - SSAC113: A **.internal** (name may change) TLD for private use name spaces (akin to RFC1918 addresses)

- **DNSSEC guidance about NSEC3**
  - RFC9276 discusses when and how to use NSEC3
  - TL;DR #1: **prefer NSEC** for proof of non-existence
  - TL;DR #2: if using NSEC3, use **one hash iteration**

Some IPv6 trends

- **Registering SLAAC Addresses in DHCPv6**
  - Ops people use IPv4 DHCP logs for all sorts of things
    - Finding the CEO's printer
    - Figuring out who had which malware, etc.
  - SLAAC allows each machine to just pick an address
  - Breaks the above uses.
  - Using draft-wkumari-dhc-addr-notification, **hosts inform the DHCPv6 server** that an address is in use.

- **Unique IPv6 Prefix per Device in Broadcast Networks**
  - draft-ietf-v6ops-dhcp-pd-per-device
  - Replacing NDP by DHCP-PD and routing for **scalability and security**

- **Extension Headers Processing**
  - HbH current **operational issues**: draft-ietf-v6ops-hbh
  - Adding limits: draft-ietf-6man-eh-limits
  - More on HbH: draft-ietf-6man-hbh-processing

- **Unintended Operational Issues With ULA**
  - draft-ietf-v6ops-ula
  - RFC 6724 prefers IPv4 to IPv6 ULA, could sound weird

- **Other IPv6 Measurements**
  - **Extension headers** notably

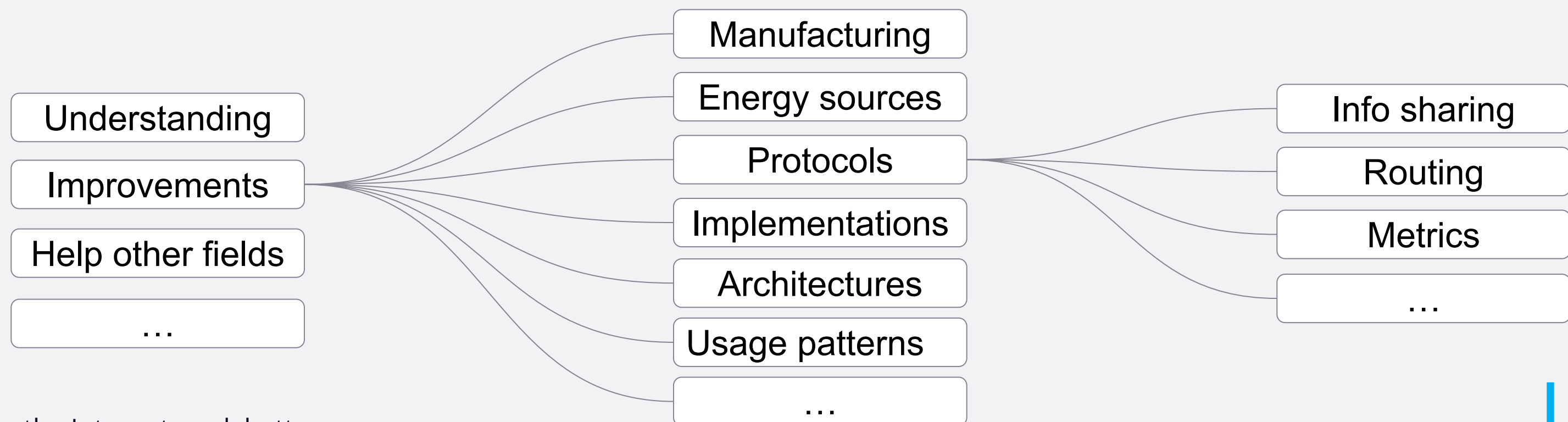# Other Internet Area trends

- **MADINAS WG**
  - MAC Address Device Identification for Network and Application Services
  - About randomized and changing MAC addresses, see IEEE 802.11b[hi]
  - https://datatracker.ietf.org/wg/madinas/

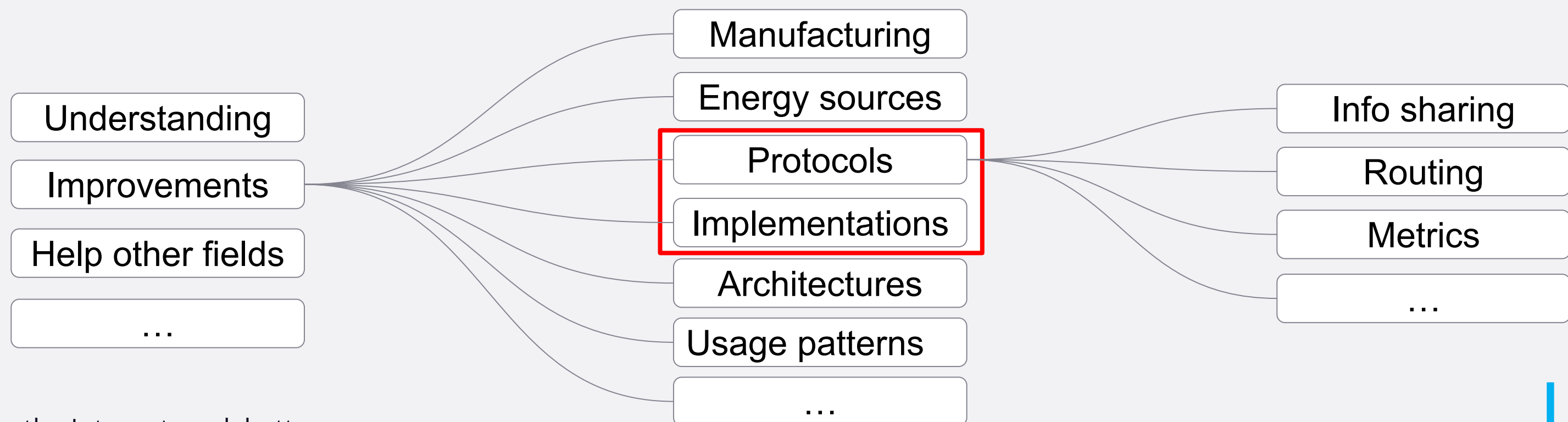**I E T F** Making the Internet work better

Environmental Impacts of the Internet:
Can standards organizations do something?

- IAB held a workshop on the impacts & improvements in December
  - Report, papers, and all information is on the web:

    https://datatracker.ietf.org/doc/draft-iab-ws-environmental-impacts-report/
- Can we help with the costs or benefits or better understanding?
- Standards can be a part of a solution to a bigger puzzle

I E T F® Making the Internet work better

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Understanding
Improvements
Help other fields
…

Manufacturing
Energy sources
Protocols
Implementations
Architectures
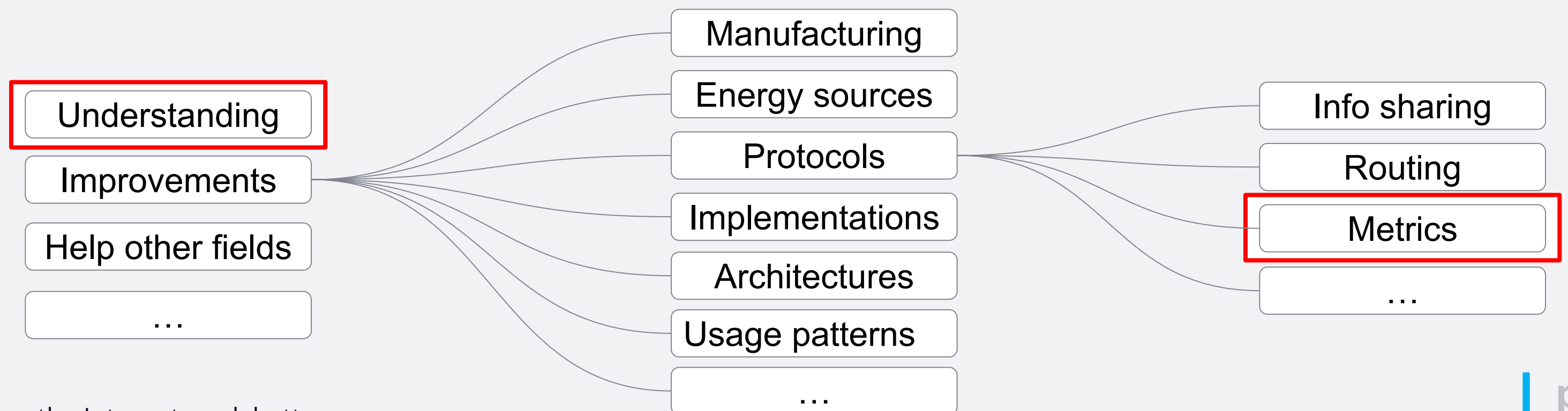Usage patterns
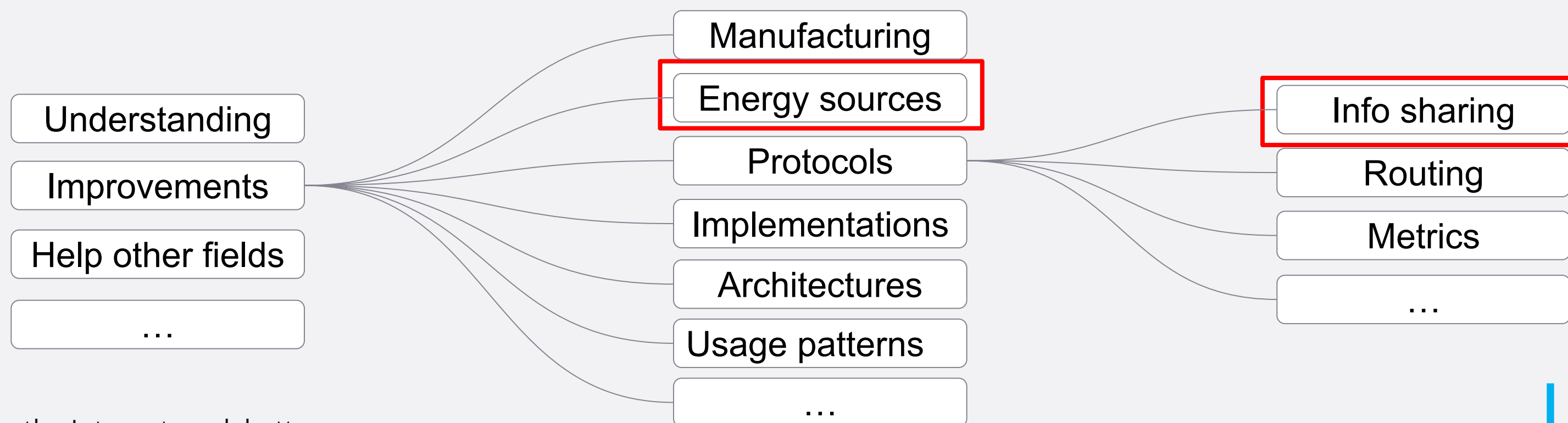…

Info sharing
Routing
Metrics
…

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Making the Internet work better

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```
Understanding          Manufacturing          Info sharing
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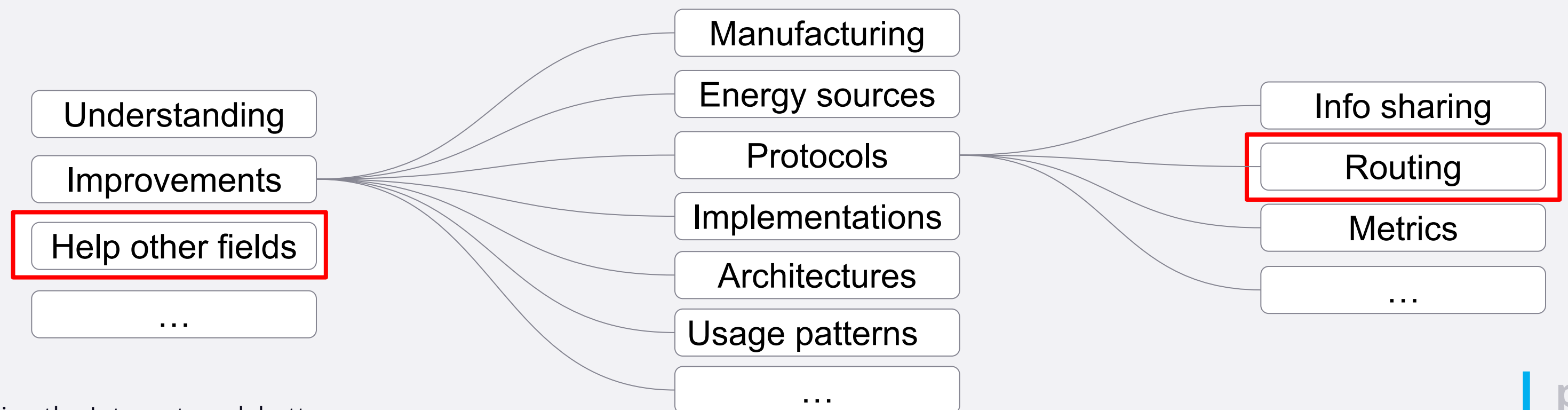
Can standards organizations do something? (cont'd)
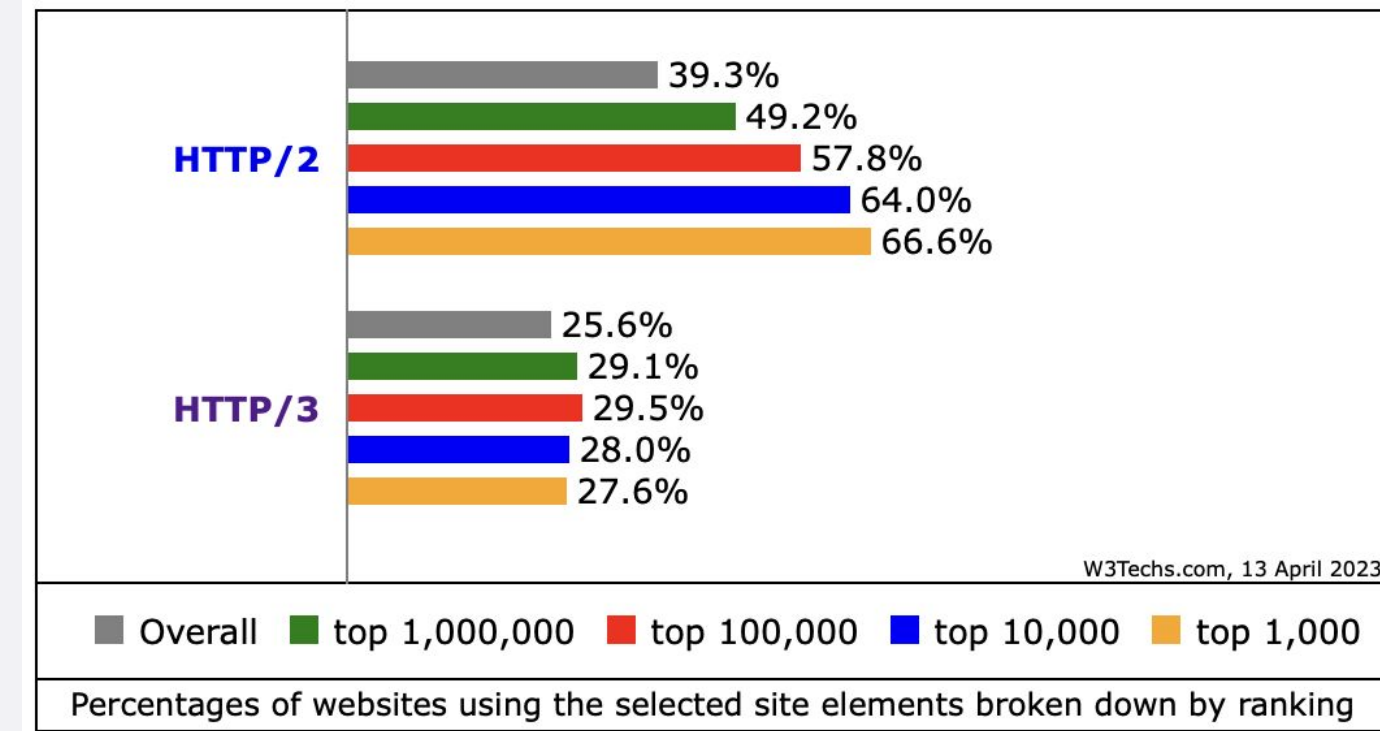
Some short term opportunities:

- Metrics & measurements
- Intra-domain information sharing
- Opportunities to sleep or slow down
- Data format choices for new protocols
- Avoid proof-of-work crypto assets

Where can I join?

- Not fully new (video conferencing etc.)
- General IETF discussion takes place at the e-impact@ietf.org list (subscribe)
- Plus work in specific WGs!

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Secure Transport Protocols

- **QUIC** is a new transport protocol that integrates TLS into the transport layer
  - RFC9000 was published 2021 and deployment is ongoing
  - Active work on extensions in the QUIC WG, e.g. multipath extension for QUIC
- **TLS Encrypted ClientHello** encrypts the TLS handshake to remove visible application metadata from the network (see draft-ietf-tls-esni-16)
  - Aims to prevent ossification of TLS handshake and improve client privacy
- Post-quantum TLS key exchange adds larger key shares to TLS handshakes

Percentages of websites using the selected site elements broken down by ranking

https://w3techs.com/technologies/comparison/ce-http2,ce-http3

Figure 2: Split Mode Topology

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Relay-based privacy enhancements

Secure proxy protocols build on secure transport protocols **relay e2e traffic** to further improve client **IP address privacy** by separating the address info from activity

- **Oblivious HTTP** (OHAI WG) relays encrypted application HTTP messages to cooperating gateways
  - Can be used for transactional application messages (DNS queries, telemetry reporting, etc)
  - Example deployments include Google FLEDGE

- **MASQUE relays** transport arbitrary UDP traffic or IP flows
  - Secure HTTP proxies tunnel unmodified e2e traffic
  - Can be used with unmodified servers using TLS/TCP, QUIC, etc
  - Can be used in multi-hop solutions
  - Example deployments include iCloud Private Relay

Work ongoing to advertise support for OHTTP targets, relays, and MASQUE services, e.g in DNS records (This allows networks to define oblivious DNS resolvers)

IAB workshop on Management Techniques in Encrypted Networks (M-TEN)

- M-TEN workshop goals

  *"This workshop aims to discuss ways to **improve network management techniques** in support of even broader **adoption of encryption on the Internet**."*

- Held 17-19 Oct, 2022 (online), roughly 35 participants
  - See here for more information, proceedings, and recordings: https://datatracker.ietf.org/group/mtenws/about/
  - Workshop report: https://datatracker.ietf.org/doc/draft-iab-m-ten-workshop/
- Topics, presentations and discussions included:
  - How to safely measure/manage encrypted traffic
  - Deployments of real-world datacenter solutions
  - Benefits and motivations for collaboration
  - Multiple proposals for end-point collaboration

IAB M-TEN workshop (cont'd)

- **Main take-away:** Solving the entire problem space with a single approach may not be possible, as such it is more likely that **different use cases will require different solutions**.
  - Different use cases have different requirements on
    - level of collaboration between multiple parties
    - scalability as well as costs of implementation
    - data encryption and trust
    - network management

- **Also:** Education about various solutions will be required in order to ensure operators as well as regulation and policy organizations can understand and thus support the deployment of developed solutions.
  - Each problem space will have different encumbrances of multiple types; for example, technical, legal, data ownership, and regulatory concerns.

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New Work

New Working Groups Overview

- **Time-Variant Routing (tvr)**
  - defines **information and data models for time-based, scheduled changes** to a network. Time-based changes may include changes to links, adjacencies, cost, and - in some cases - traffic volumes.
- **Computing-Aware Traffic Steering (cats)**
  - analyzes the problem in further detail and produce an **architecture to exposing network conditions to endpoints** (notably ALTO) and load balancing/service selection at layers 4 and 7 (for example, related to the selection of SIP servers).
- **Post-Quantum Use In Protocols (pquip)**
  - is a standing venue to **discuss PQC (operational and engineering) transition issues** and experiences to date relevant to work in the IETF.

- **More Instant Messaging Interoperability (mimi)**
  - specifies the minimal set of mechanisms required to make modern **Internet messaging services interoperable** based on one or more identity building block technologies (for example, X.509 certificates or Verifiable Credentials) to establish end-to-end cryptographic identity across messaging services, assuming the use of MLS for key establishment.
- **Secure Asset Transfer Protocol (satp)**
  - work on a **base architecture** that utilizes the gateway paradigm that ensures a **common semantic** understanding to be shared among the modes of asset transfers, data sharing and coordinated asset exchanges, and a **Secure Asset Transfer Protocol** that implements the transfer of a digital asset from one gateway to another, satisfying the ACID properties.

IETF-116 BoFs (new work coming)

- **<u>BPF/eBPF</u>**
  - Run sandboxed programs in a privileged context such as the operating system kernel.
  - Document **existing (e)BPF use** and define processes for future extensions.

- **vCon**
  - Standardize a **container for conversation data** (vCon) contained in transcripts and multi-media files
  - Specify mechanisms to ensure the integrity and privacy of the data.

- **Structured Email (SML)**
  - Adding **machine-readability for the automated transactional email**.
  - Provide a space to discuss requirements, existing solutions, and to identify areas for standardization
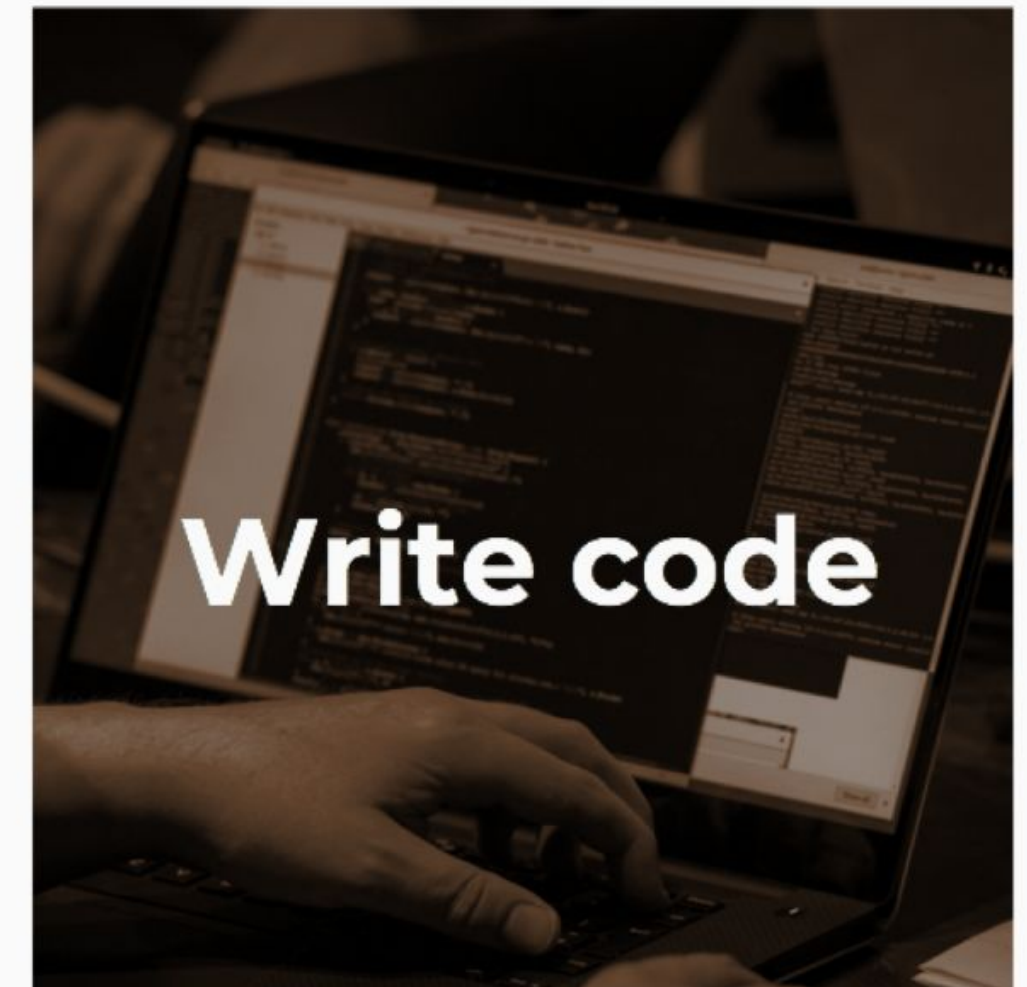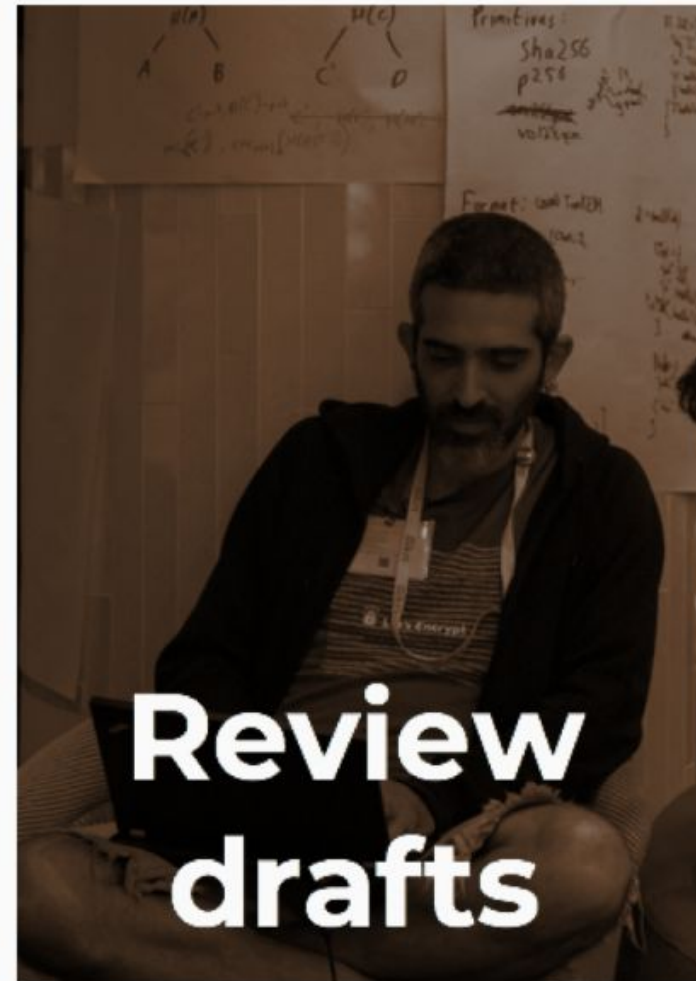
- **Key Transparency (KEYTRANS)**
  - **Distributing the end-user public keys** for E2E encryption in a safe, publicly-auditable way.

IETF Participation

Ways to participate in the IETF

Join mailing lists

Review drafts

Write code

Attend meetings

Author documents
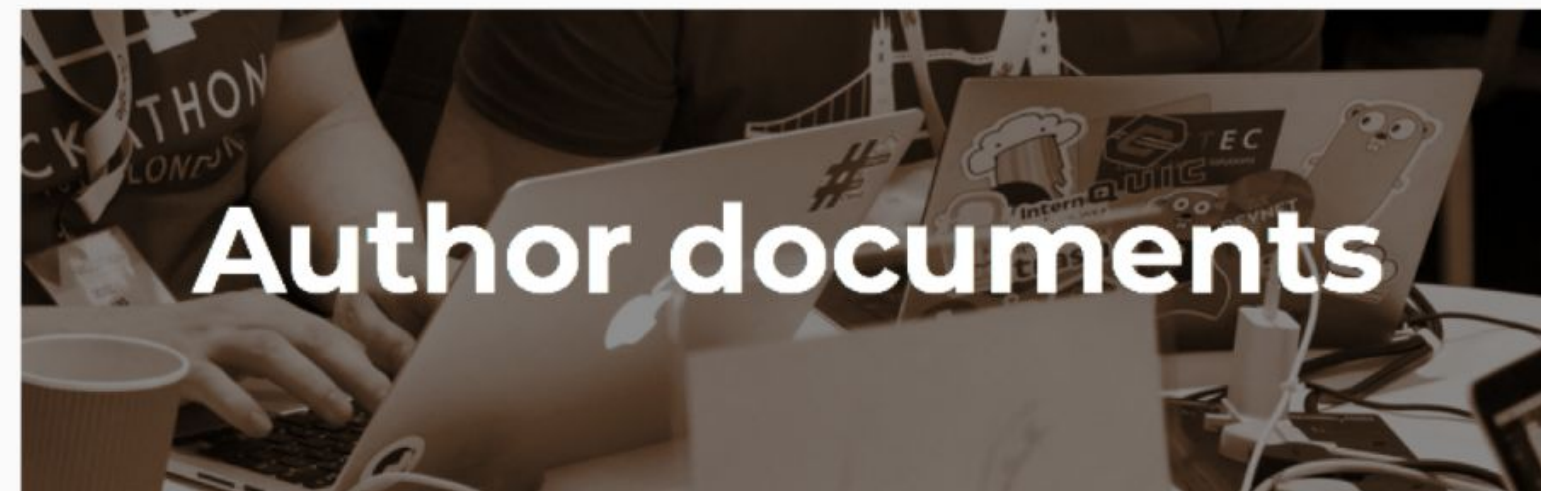
Why might network operators want to participate?

- Be on top of the new internet protocols and extensions
- Lot of work explicitly on Network Operations
  - Input from operators is valuable to keep this work vibrant and relevant
- What we want to know from you:
  - Are these real problems that impact you?
  - Are these real network requirements? What's missing?
  - Are these in sync with operator's reality?
  - Is this going to be easy to deploy?
  - How would I troubleshoot this?

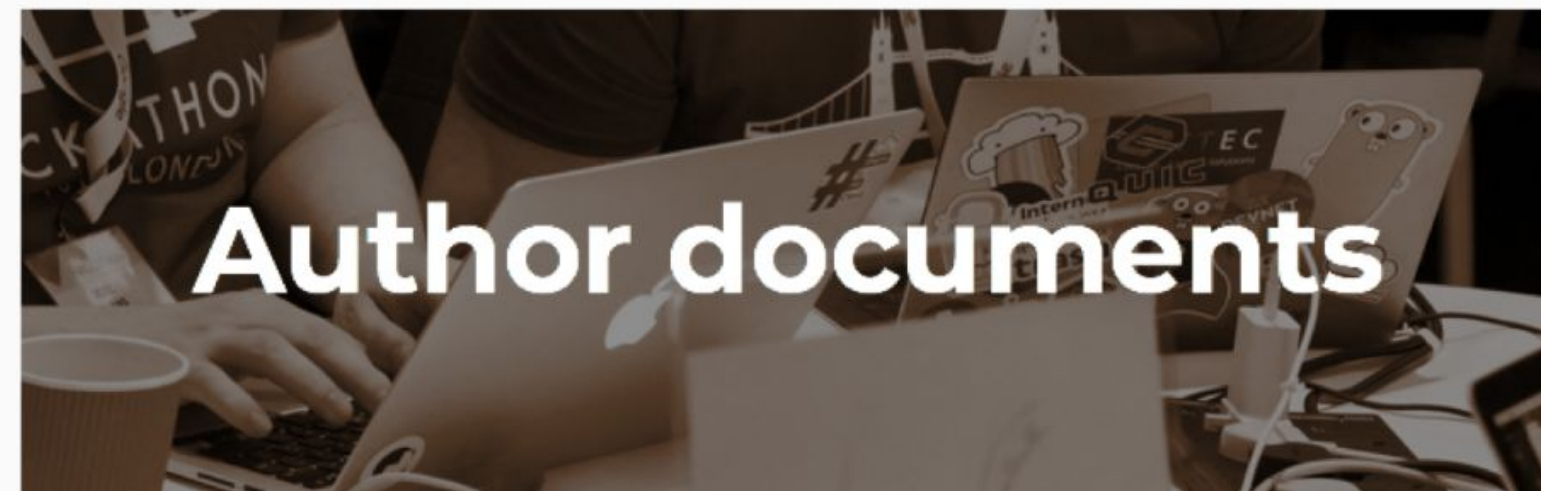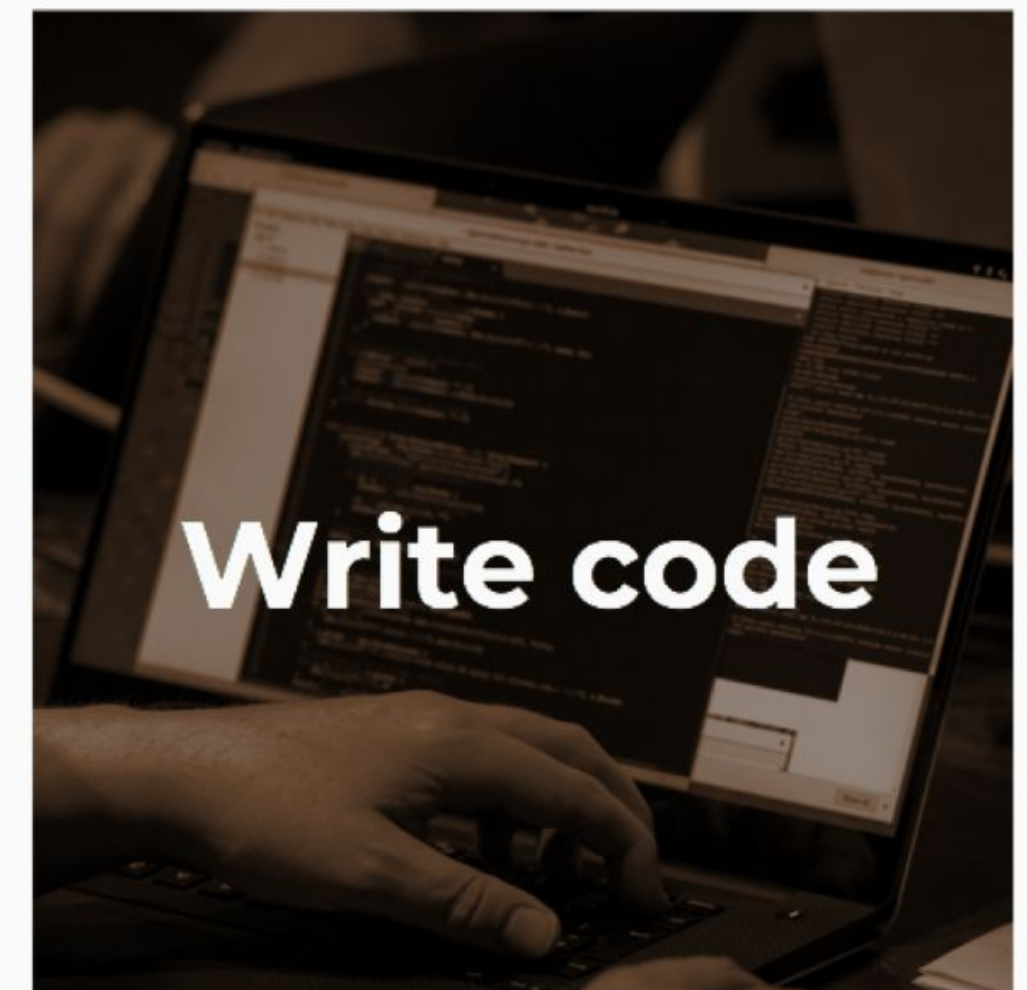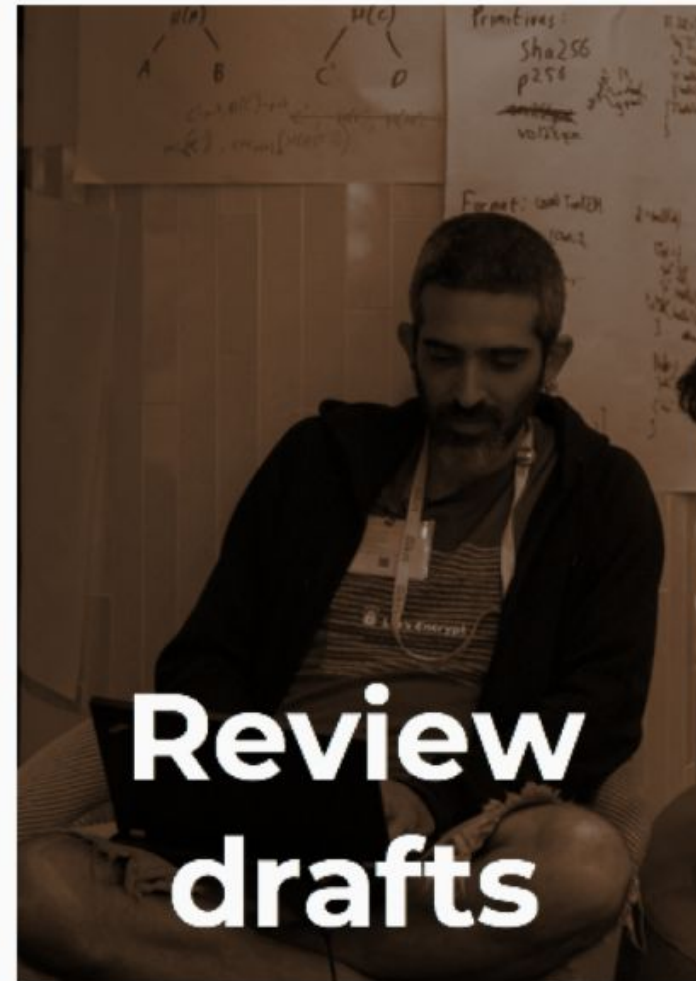# The IETF would benefit from more operator input!

- Early feedback from operators:
  - Ensures developed protocols have **operational relevance**
  - Ensures protocols **are deployable and manageable**

We'd like your help to make the Internet better!

Resources

- IETF web site: https://www.ietf.org/
- Getting started in the IETF: https://www.ietf.org/about/participate/
- Newcomers' tutorials: https://www.ietf.org/about/participate/tutorials/newcomers/
- Next meeting(s): https://datatracker.ietf.org/meeting/upcoming

- RFC and Internet-draft search: https://datatracker.ietf.org/
- Working groups (includes chairs' contact information):
  https://datatracker.ietf.org/wg/

- Author guidance: https://authors.ietf.org/en/getting-started
  - Recommend markdown format tool chain:
    https://authors.ietf.org/drafting-in-markdown

Ways to participate in the IETF

Join mailing lists

Review drafts

Write code

Attend meetings

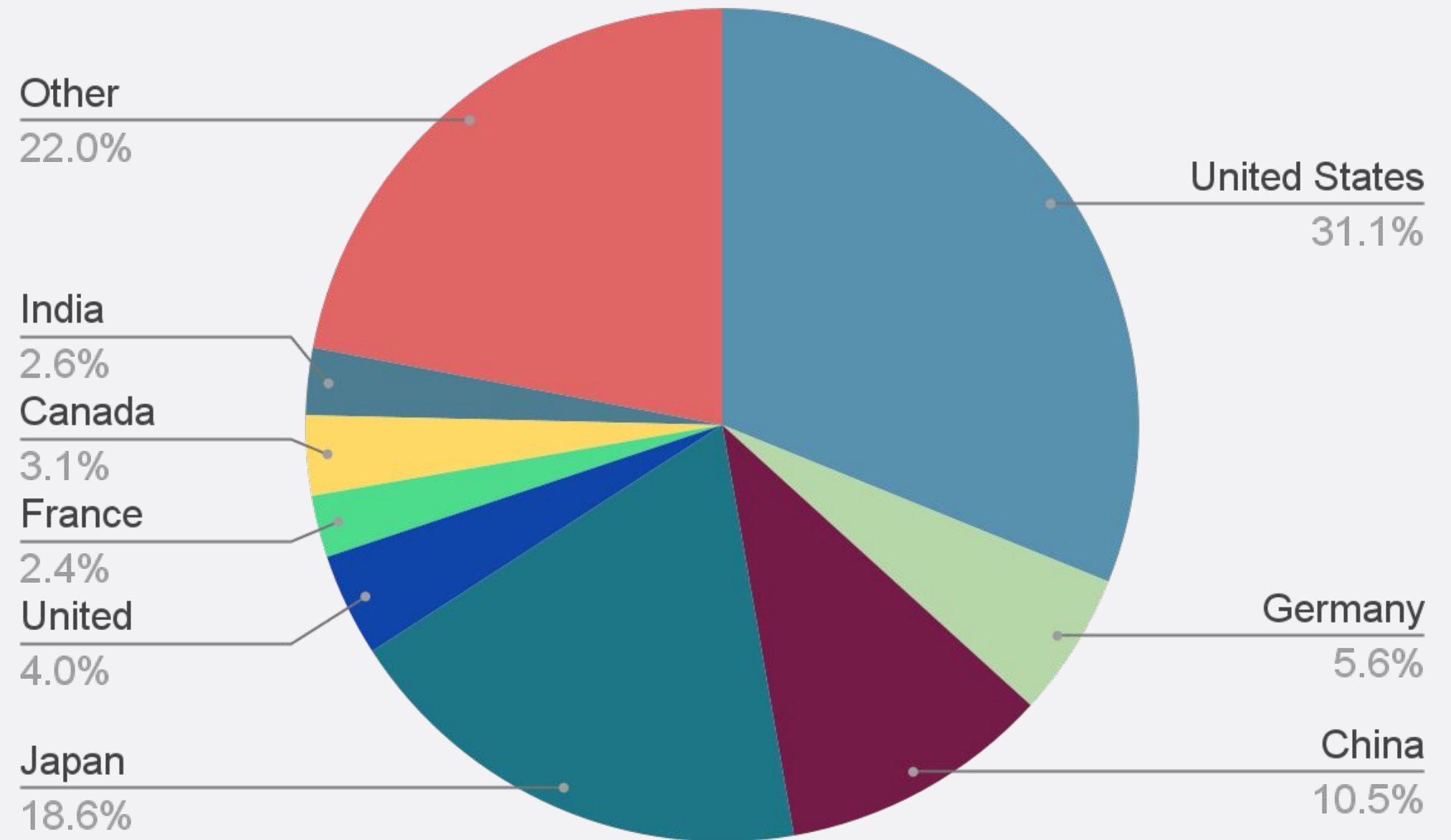Author documents

thank you.

backup

IETF 116 Yokohama, March 2023
1740 onsite and remote participants

- **1740** registrations
  - **1000** on-site
  - **740** remote
- Fee waivers - Remote
  - **382** granted, **251** used
- Fee waivers - Onsite
  - IETF: **2** requests, **1** granted
  - IRTF: **7** requests, **6** granted
- **439** Hackathon registrations
  - **361** on-site, **78** remote
  - **72** Hackathon-only
    (**43** remote, **29** onsite)
  - **29** projects

Other
22.0%

India
2.6%

Canada
3.1%

France
2.4%

United
4.0%

Japan
18.6%

United States
31.1%

Germany
5.6%

China
10.5%

Making the Internet work better
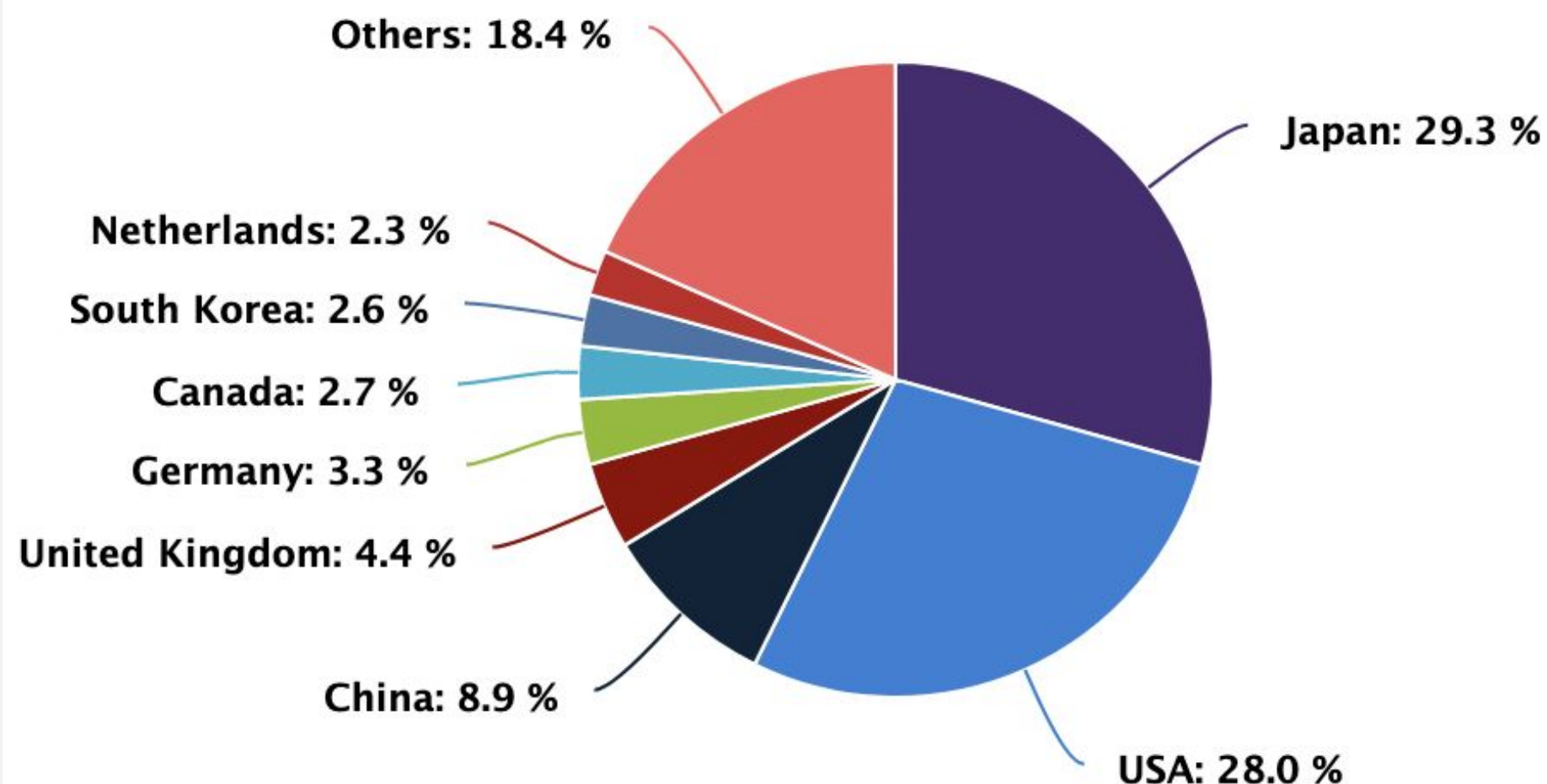
I E T F

IETF 116 Participant Stats as of 2023-03-29

Onsite: 1000

Remote: 740

Participants by Country (Onsite)

- Japan: 29.3 %
- USA: 28.0 %
- China: 8.9 %
- United Kingdom: 4.4 %
- Germany: 3.3 %
- Canada: 2.7 %
- South Korea: 2.6 %
- Netherlands: 2.3 %
- Others: 18.4 %

Participants by Country (Remote)

- USA: 35.2 %
- Others: 24.0 %
- China: 12.6 %
- Germany: 8.8 %
- India: 4.9 %
- Japan: 4.3 %
- Canada: 3.5 %
- United Kingdom: 3.5 %
- France: 3.1 %
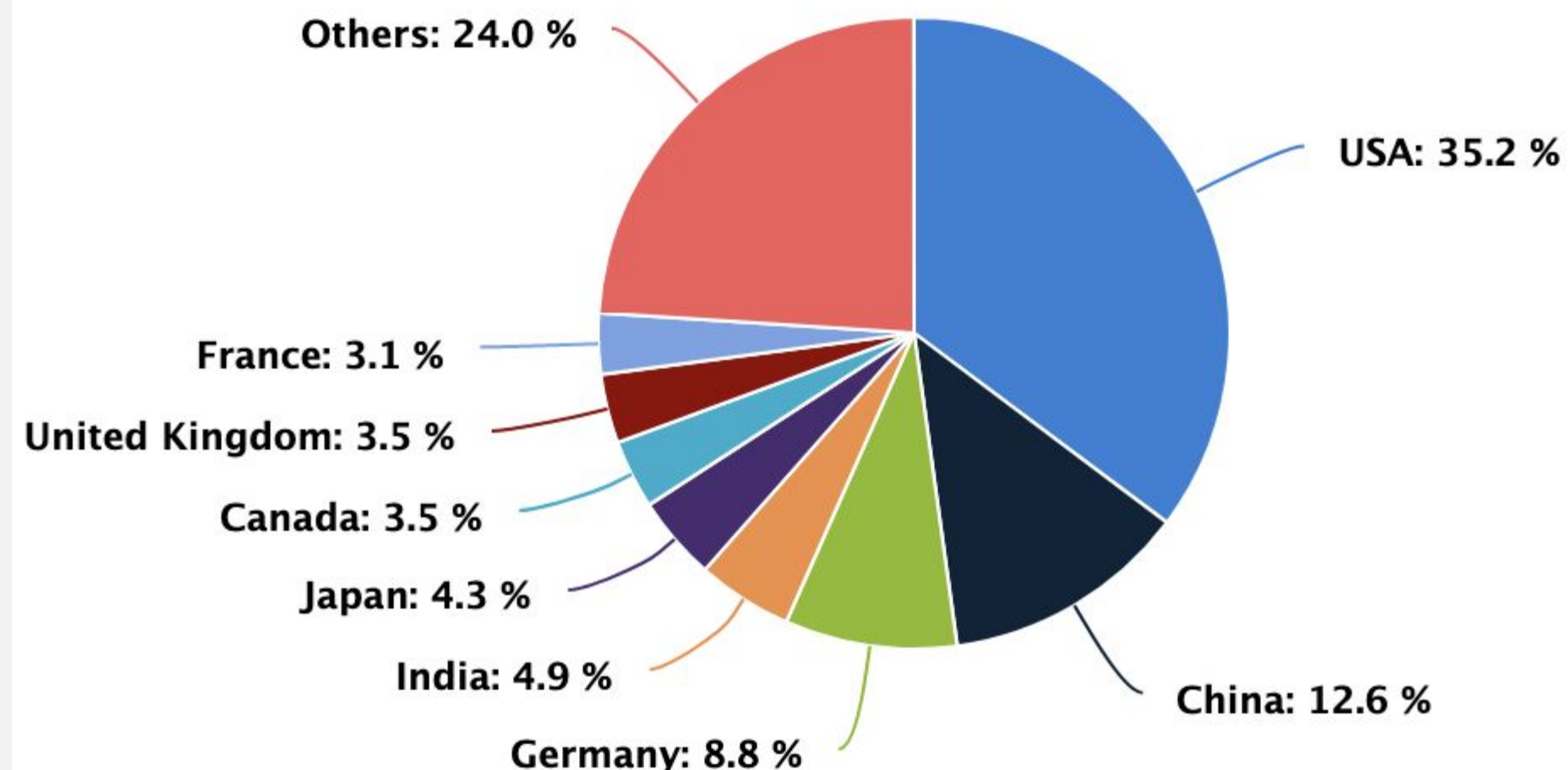
IETF Community by Geography

- **37.7%** North America: US, Canada
- **0.4%** Not answered
- **2.5%** Africa
- **11.6%** Asia
- **40.6%** Europe
- **3.9%** Latin America
- **12.3%** Oceania: Australia, New Zealand, Pacific Islands
- **1.1%** Middle East

IETF Community by Gender

- **5.0%** Prefer Not to Answer
- **0.3%** Other
- **0.9%** Transgender
- **1.4%** Non-binary
- **8.5%** Woman
- **85.4%** Man

From the IETF Community Survey 2022
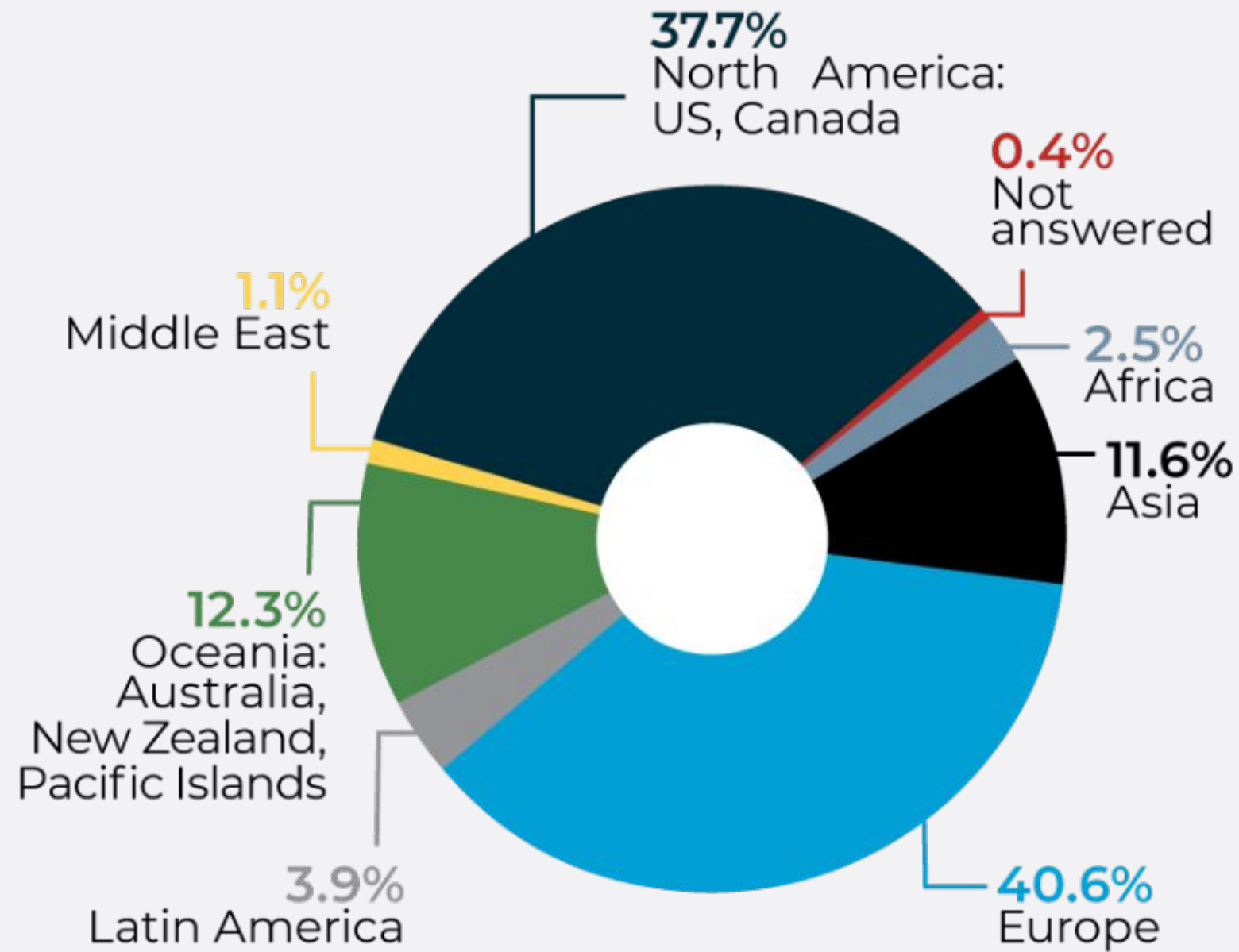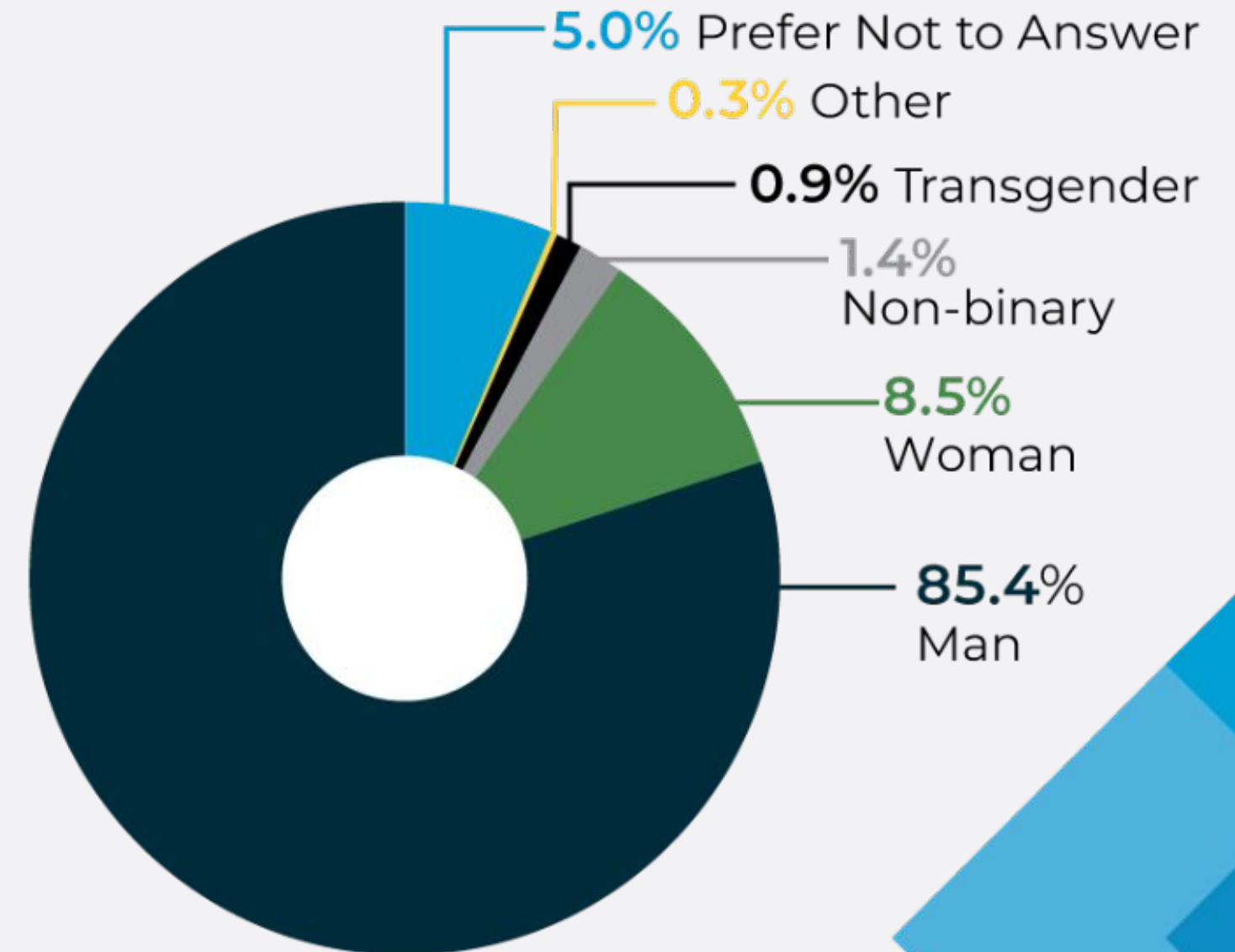
Internet Research Task Force (IRTF)

The IRTF promotes research of importance to the evolution of the Internet protocols, applications, architecture and technology.

- Research Groups
  - Users – human rights and privacy
  - Operations - network management and AI, global access, network measurement
  - Infrastructure - cryptographic primitives, path awareness, congestion control, information-centric networking, computation in the network
  - Futures – quantum internet
- ACM/IRTF Applied Networking Research Workshop (during July IETF meeting)
- Applied Networking Research Prize (2 talks per meeting during IRTF Open session)

New groups since IETF-116

- Research and Analysis of Standard-Setting Processes Research Group (RASPRG)
  - aims to bring together researchers, practitioners, policy makers, standards users, and standards developers to study standardization processes across SDOs, with a particular focus on Internet standard-setting in the IETF.
- Usable Formal Methods Proposed Research Group (UFMRG)
  - brings together the Internet protocol standards community and the academic research community studying formal methods of protocol specifications to share experience and ideas.

IAB Technical discussion topics

IAB technical discussions (~ 1/month)

- 2023-15-03 Universal Broadband
  - Micah Beck (University of Tennessee) "Is Universal Broadband Service Impossible?" (see also Universal Digital Services Through Basic Broadband)
- 2023-03-01 Identity Management
- 2022-12-14 The Challenges of Blockchain-Based Naming Systems for Malware Defenders
- IETF-115 DNS and Alternate Name Spaces
- 2022-11-10 Inter-domain routing security
- 2022-10-26 Limited Domains
- 2022-09-28 Data Privacy
- IETF-114 Internet architecture governance and coordination
- IETF-114 Centralization
- 2022-04-27 Partial Internet Connectivity
  - John Heidemann (University of Southern California/Information Sciences Institute (USC/ISI)) "What Is The Internet? (Considering Partial Connectivity)"

IAB Open meeting

- **116:**
  - Carbon neutral with the Public Core of the Internet (Hiroshi Esaki)
- **115:**
  - OONI Censorship Measurements in Iran (Simone Basso)
  - Iran's Mahsa Amini Revolution: Protest Crises and the Role of Technology (Mahsa Alimardani, Oxford Internet Institute)
- **114:**
  - EU Digital Markets Act (Luis Cabral, Stern School of Business, New York University)

Recent and in-progress IAB documents

Approved for publication

- ### draft-iab-path-signals-collaboration

  Considerations on Application-Network Collaboration Using Path Signals
  - provides guidance for the design of **explicit** path signals, which are encouraged to be **authenticated** and include a **minimal set of parties** to minimize information sharing

- ### draft-iab-protocol-maintenance

  Maintaining Robust Protocols
  - describes **active protocol maintenance** as a means to accomplish **long term interoperability** of protocols by constantly evolving specifications and implementations in order to **reduce ambiguity** over time and create a healthy ecosystem.

Under discussion

- ### draft-iab-privacy-partitioning

  Partitioning as an Architecture for Privacy
  - describes **emerging patterns** in protocols that apply the principle of privacy partitioning, which **selectively spreads data** and communication across multiple parties as a means to improve the **privacy by separating user identity from user data**.

What does attending the IETF look like?

- **Working** groups
  - Detailed discussions about the real issues
  - Very few high-level presentations
  - Reading the current proposed documents is key
- **Who should come?**
  - Protocol engineers
  - Accademic researchers
  - **Operators**
- World-wide **Attendance**
  - Sites try to rotate between Europe, North America, and Asia

WHY participate in IETF?

- IETF mission "make Internet work better" is **everyone's mission**!
- The **quality of the standards** and documents impacts everyone in the industry!
  - It impacts Interoperability
  - It impacts network operations and stability
  - It impacts features and services
- Open process allows for anyone interested in providing technical contributions
  - Standards involve **balancing** various (and sometimes competing) interests! You are likely to be impacted, if your interests are not well represented during deliberations.
  - From consumer of standards become a participant in standard making!

Internet Engineering and Planning Group (IEPG)

- The IEPG is an informal gathering that meets on the Sunday prior to IETF meetings. The intended theme of these meetings is essentially one of operational relevance in some form or fashion.
- As per RFC 1690, IEPG is an **Internet Service Operators' forum**, intended to assist Service Operators to coordinate in operational aspects of managing Internet services.
- Topics of interest include IPv6, BGP, BGPSec, DNS, DNSSEC, Network operations, RPKI, Measurements, Network attacks...
- For example **IETF-116**: presentation on **integrating YANG telemetry into Kafka** to enable an **automated data processing pipeline for operators** which starts with YANG push, consolidates Data Mesh and ends at Network Analytics.
- Join the mailing list - iepg@iepg.org

Network Slicing (TEAS WG)

- The Traffic Engineering Architecture and Signaling (teas) WG in IETF has been working towards defining the IETF network slice within the scope of the IETF networks.
- The E2E 5G network slice would require stitching the IETF and the non-IETF slice (edge RAN and core DC).
- The term "Slice" refers to a set of characteristics and behaviors that differentiate one type of user-traffic from another within a network. An IETF Network Slice is a logical partition of a network that uses IETF technology.
- To realize **IETF network slice**, a Network Resource Partition (NRP) as a collection of resources (bufferage, queuing, scheduling, etc.) in the underlay network is used.
- Framework is in WGLC and YANG model is in active development.
  - draft-ietf-teas-ietf-network-slices
  - draft-ietf-teas-ietf-network-slice-nbi-yang

Recent IAB Statements

- [IAB comments](#) on a notice by the Federal Trade Commission on "[Trade Regulation Rule on Commercial Surveillance and Data Security](#)" (16 CFR Part 464).
- [IAB Response](#) to the call for input from the UN Office of the High Commissioner for Human Rights on "[The relationship between human rights and technical standard-setting processes for new and emerging digital technologies (2023)](#)."
- [IAB Comments on A Notice by the Federal Communications Commission on Secure Internet Routing](#)
  - Reply to FCC's request for comments on Secure Internet Routing.

- [Statement on Mandated Browser Root Certificates in the European Union's eIDAS Regulation on the Internet](#)

- [IAB Statement to OSTP on Privacy-Enhancing Technologies](#)
  - Reply to Office of Science and Technology Policy (OSTP)'s Request for Information on Advancing Privacy-Enhancing Technologie

I E T F®

Make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet.

[RFC 3935]

IETF
Ethos

✓ **Everyone** may participate

✓ Make all work available for **free**

✓ Judge contributions on **technical merits**

✓ Determine success by **voluntary deployment**

IETF
Open Internet Standards

- Open standards are key to allow devices, services, and applications to **interoperate across a interconnected, heterogeneous, and global network of networks**
  - All IETF standards are available **online at no charge**, thus facilitating adoption of them.
  - The IETF determines its success by **technical quality and voluntary deployment**
- The IETF process is **open**, **transparent**, and relies on a **bottom-up consensus-building**
  - **Everybody may participate**, no membership
  - All work like Internet-Drafts and email archives are **publicly available**
  - Decisions are based on **rough consensus**
- **Openness** in both the technical standards itself as well as the standards development process is the basis for **innovation** in and on top of the Internet and **key to its success**.

IETF
Work Areas and Key Protocols

Internet Applications
(W3C, OASIS, etc.)

Operations & Management (OPS)
network management & operational best practices

YANG
NETCONF
SNMP
RADIUS

Applications & Realtime Media (ART)
application protocols over end-to-end transports
HTTP, voice & video, SIP, RTP, email

Transport (TSV)
end-to-end transmission mechanisms over network paths
TCP, UDP, QUIC, congestion control

Routing (RTG)
stable paths across dynamically interconnected networks
BGP, OSPF, IS-IS, MPLS, RSVP, VPNs, SFC, multicast

Internet (INT)
how to carry IP packets over different link layers
IPv6, IPv4, DNS, DHCP, NTP, mobility, multihoming

Security (SEC)
security & privacy at all layers & for all protocols
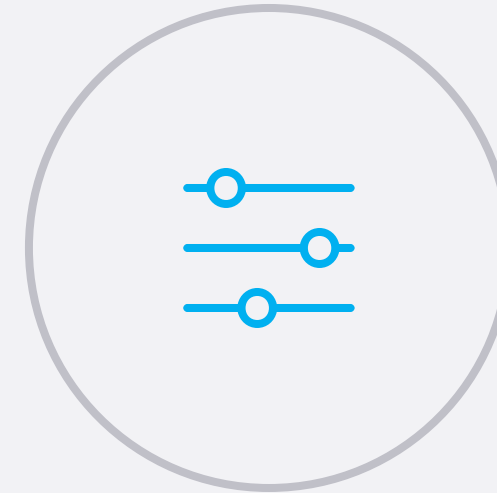
TLS
IPsec
PGP
S/MIME
PKIX
cryptography

Link Layers
(IEEE, 3GPP, etc.)

IETF
Examples of Current Work

Improving security and privacy
to ensure the Internet is trusted as a medium for communications and collaboration

Automating network management
to improve the efficiency of operating networks that are increasingly large and complex

Developing new transport technology
to enhance the ability of applications to send data across a growing and diverse Internet

Enabling the Internet of Things
by infusing connectivity among objects, sensors, and other devices with constrained capabilities

Recent Major Protocol Development Efforts

Standard spotlight: WebRTC

Standards published by the IETF define the core **WebRTC protocol** that enable conferencing services used by billions of people around the world

Code, APIs, and standards has made it simple to add real-time communications functionality to any application.

Work is already underway in the IETF to extend WebRTC.

Image from Monkey Wrench Design on Kickstarter

Global IETF Community

IETF
Processes and Safeguards

- **Open** participation, **transparent** processes, and **distributed** decision-making

- **Rough consensus**, no voting

- Judgments on the basis of **technical merit** and **architectural alignment**
  - Leadership judges consensus rather than offering personal opinions

- Leadership **nominations committee** ("NomCom")
  - Randomized selection of committee members from pool of active IETF volunteers
  - Two-per-organization limit on committee members
  - Decisions on the basis of community feedback

- Leadership **diversity norms**; soft per-company limits

IETF
Document Types

Internet-Draft (I-D)

- Active **working documents**
  - *Not finalized and not stable*
- **Anyone can submit an I-D**
  - draft-*yourname*-...
- Only **some I-Ds are Working Group documents**
  - draft-**ietf**-*wgname*-...

RFC (Request For Comment)

- **Archival** publication series
  - RFCs never change once published
- **Not all RFCs are standards**
  - Also: Informational, Experimental
- **Not all RFCs are IETF documents**
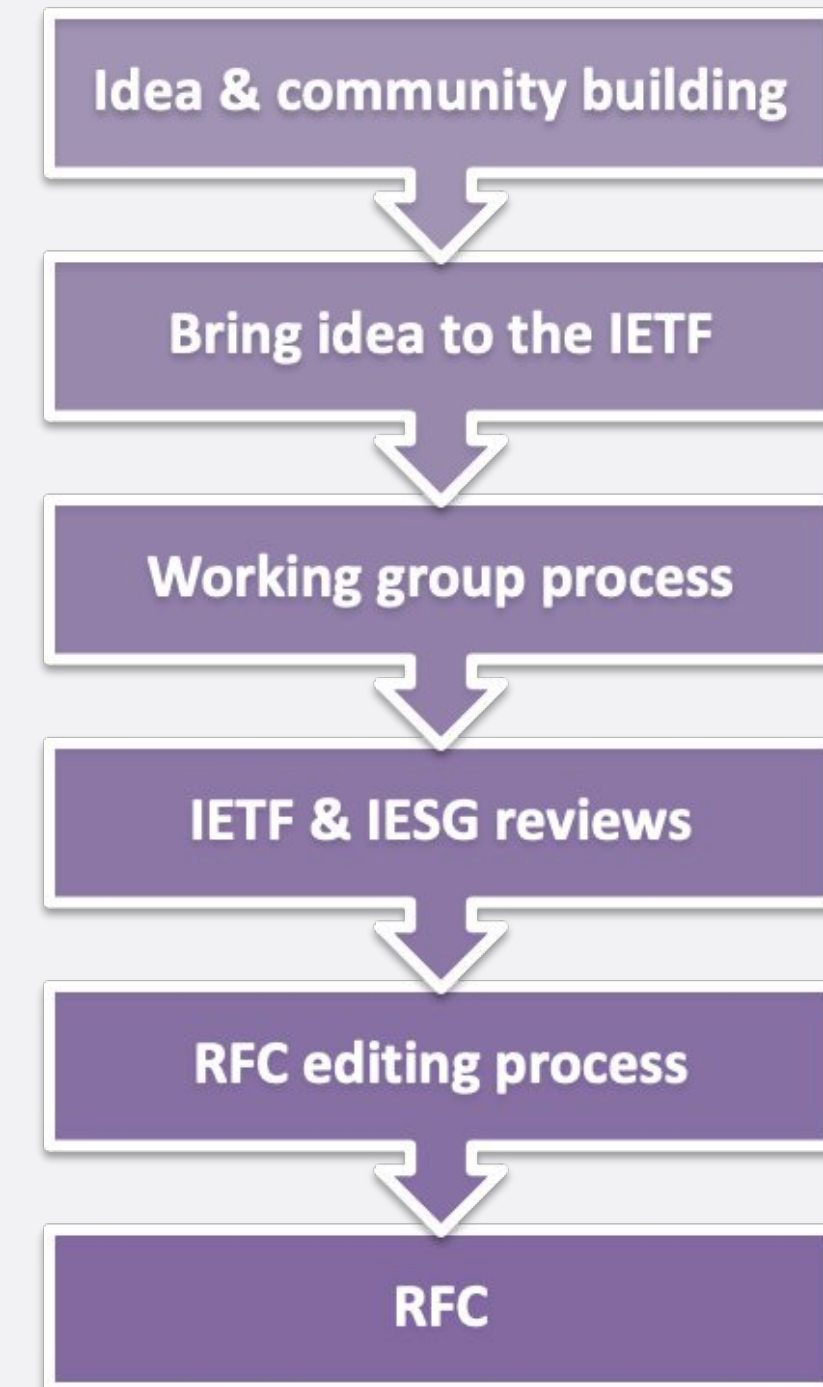 - Also Internet Architecture Board (IAB), Internet Research Task Force (IRTF), others

IETF
How To Engage

- Working groups and materials
  - **All working groups are open to anyone and free to join**
  - All working materials are freely available online
  - Most work is conducted online
- Meetings and events
  - **IETF plenary meetings** are held three times a year (rotating around the globe)
  - Some working groups schedule **interim meetings** at various times and places
  - **Full remote participation** is available for all meetings (since before the pandemic)
  - Open source **IETF Hackathons** are collocated with plenary meetings
- Get started at: **www.ietf.org/participate**

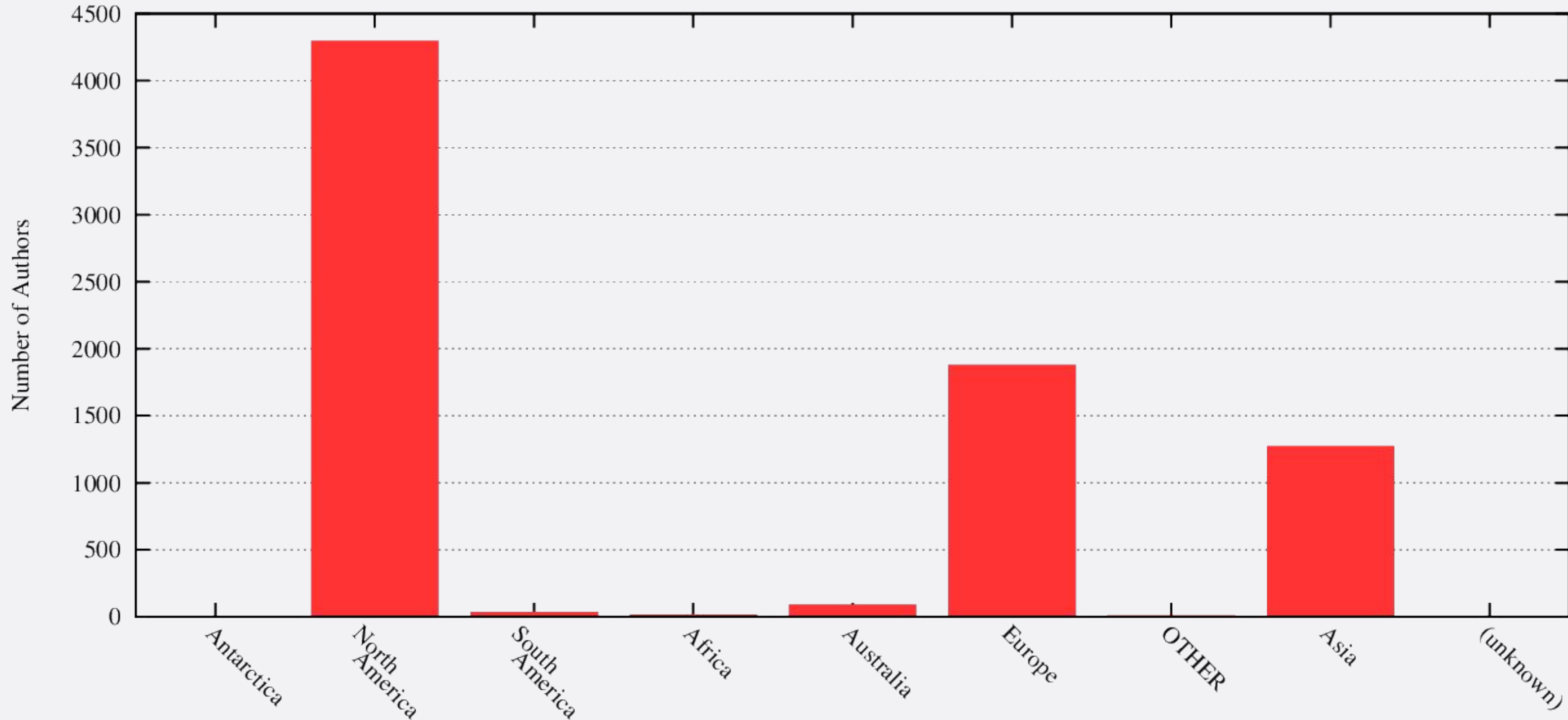Making the Internet work better

IETF
How New Work Starts

- **Contribution-driven**, bottom-up process
  - Participants identify a **problem that needs solving**
- The **problem fits** one of the IETF areas
  - And **aligns with architectural principles** of the Internet
- **Scope is well defined** and understood
  - Research is complete, **engineering work** is needed
  - Agreement on **timetables and milestones**
- **Willing people** to do the work
  - Typically not just initial proponents

Idea & community building

Bring idea to the IETF

Working group process

IETF & IESG reviews

RFC editing process

RFC

IETF – Activities by Regions
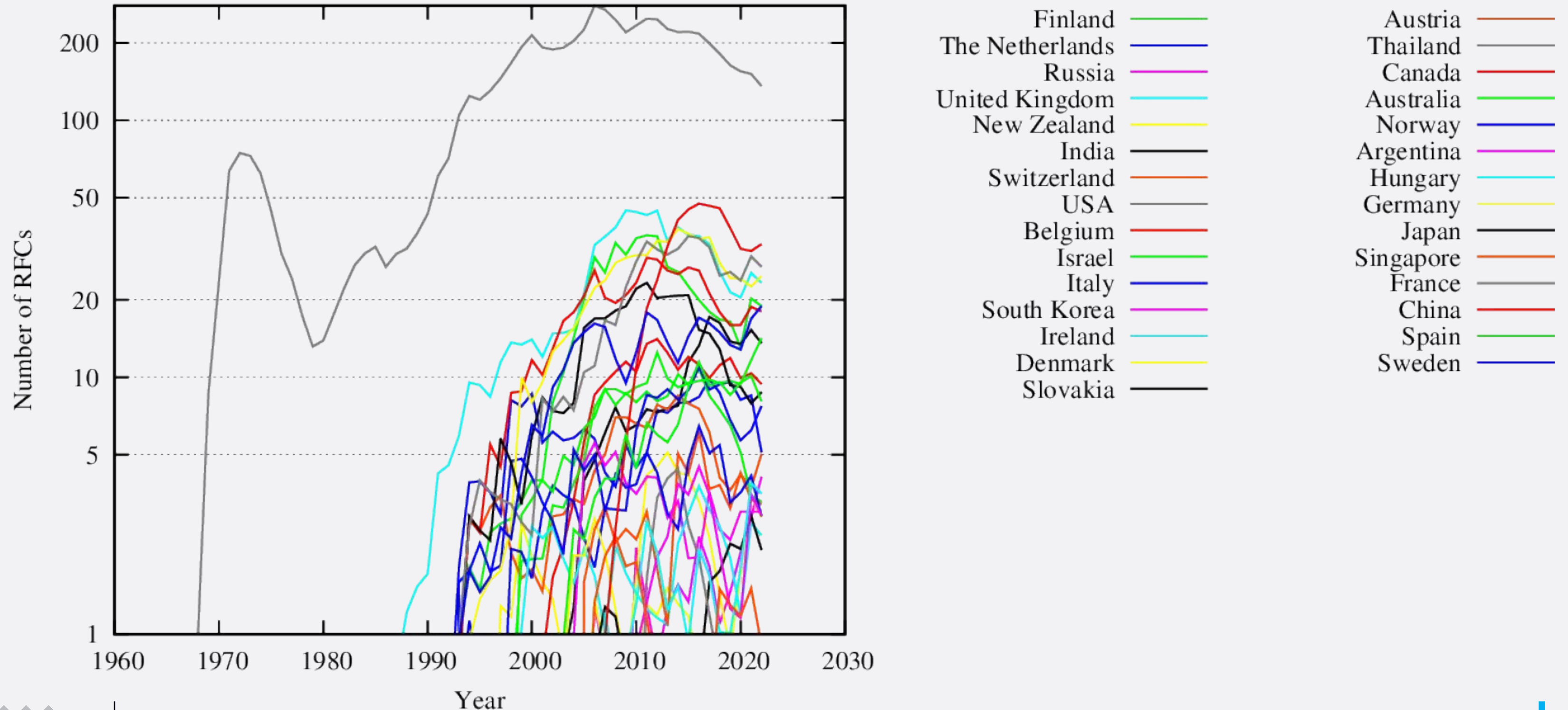## Document (I-Ds and RFCs) authors by continent

IETF – Activities by Regions
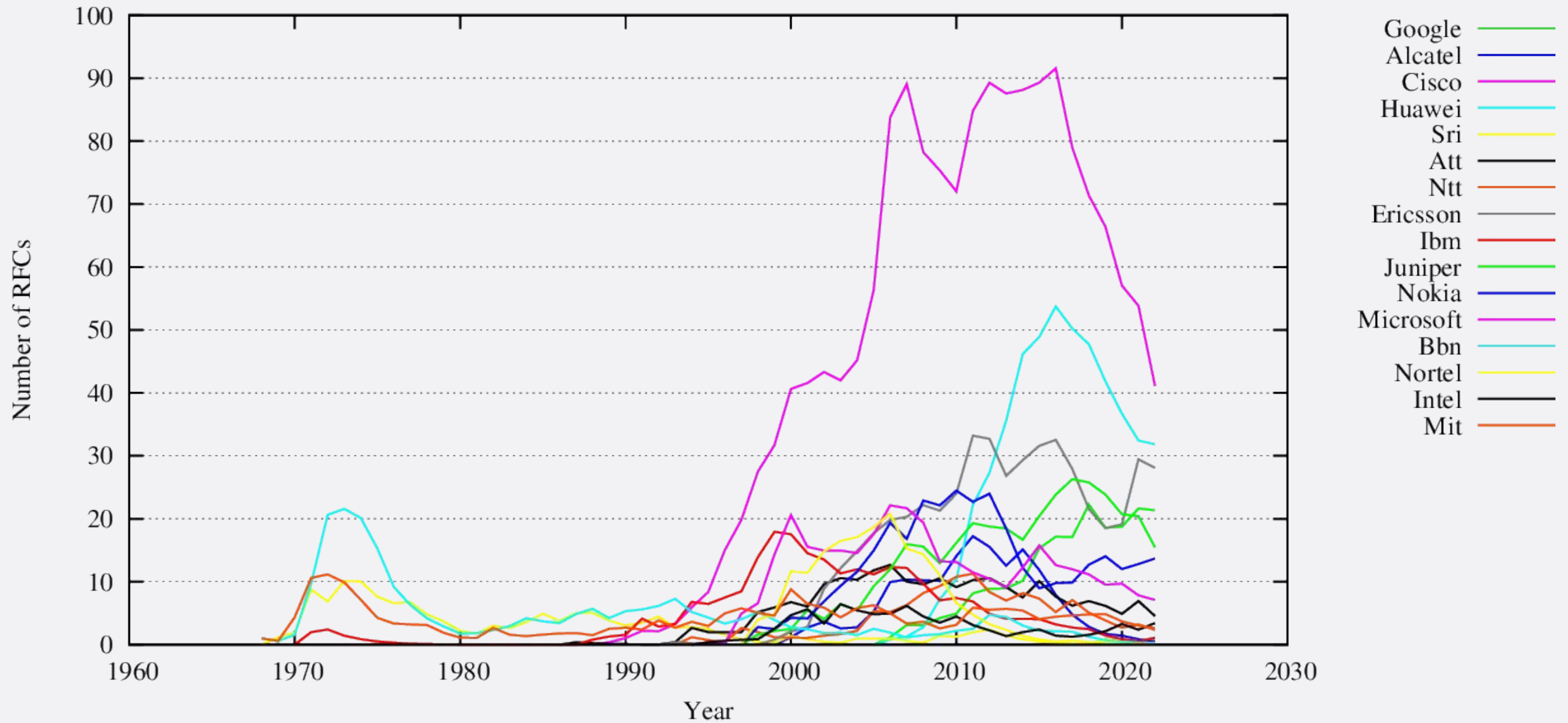## Document authors over time (I-Ds and RFCs)

Source: https://www.arkko.com/tools/rfcstats/countrydistrhist.html October 2022

IETF – Most Active Organizations
By I-Ds in the last 5 years

Source:https://datatracker.ietf.org/stats/document/authors/ October 2022

Hot Topics by Area

- Applications and Real-time (ART)
  - ohai
  - MIMI

- Transport (TSV)
  - masque
  - quic
  - L4S

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Hot Topics by Area

- Internet (INT)
  - BPF BoF
  - 6MAN:
    - trying to improve IPv6 HbH/DO
      - draft-ietf-6man-hbh-processing
      - draft-ietf-6man-eh-limits
  - NTP:
    - v5 in development; feedback pls!
    - roughtime making progress
  - SCHC
    - compress all the thingz

- Routing (RTG)
  - Update to MPLS Header with MPLS Network Actions (MNA)
  - E2E intent-aware paths using colors in BGP
    - 2 experimental drafts are being worked on
  - Scaling of Deterministic Networking (DetNet)
  - Improvements in Source Address Validation

Hot Topics by Area

- Operations and Management (OPS)
  - Network Inventory
  - Attachment Circuit
  - Transaction ID/Path Tracing
  - Green Energy
  - SRv6 IPFIX
  - ACL Extension
  - L3NM/L2NM and extension

- Security (SEC)
  - SCITT
  - RATS
  - SATP
  - JWP

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