



I E T F[®]

IETF Annual Report 2021

A summary of Internet Engineering Task Force,
Internet Architecture Board,
Internet Research Task Force, and
RFC Editor activities

Snapshot

IETF by the numbers 2021

6561 Participants in all IETF activities*

122 Active IETF Working Groups

109,861 Messages sent to IETF mailing lists in 2021†

208 Interim meetings

1017 Internet-Drafts (I-Ds) submitted‡

220 RFCs published

4087 Registered IETF Meeting participants

* based on unique email address used to register for IETF events, submit I-Ds, and post to IETF mailing lists

† Courtesy of the [sodestream project](#)

‡ Unique I-D names not counting different versions of the same I-D submitted to the IETF I-D archive

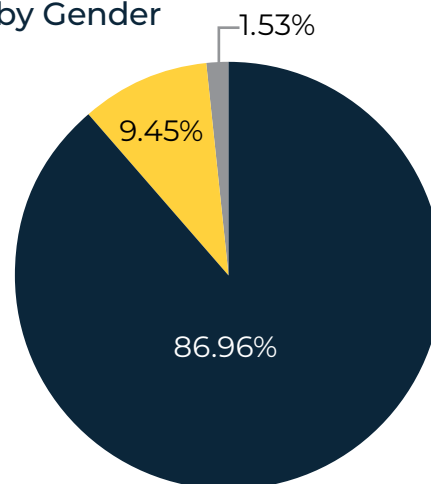
IETF Community

by Geography

39.7%	US, Canada
38%	Europe
12.3%	Asia
3.1%	Australia, New Zealand, Oceania
2.8%	Latin America
2.2%	Africa
1.5%	Middle East
0.4%	Not answered

SOURCE: IETF community survey 2021; Categories do not sum to 100% as some respondents did not answer these questions.

by Gender



● Male: 86.96%
 ● Female: 9.45%
 ● Non-binary/third gender: 1.53%

Internet Engineering Task Force Activities

The Internet Engineering Task Force ([IETF](#)) is the premier Internet standards organization, providing a neutral venue for developing open standards through open processes. The IETF brings together a large international community of network designers, operators, vendors, and researchers to work on the evolution of the Internet architecture and the smooth operation of the Internet. The IETF pursues its mission by adhering to cardinal principles of open processes, technical competence, volunteer participation and leadership, rough consensus and running code, and by taking responsibility for all aspects of its protocols.

IETF Working Groups

Working Groups ([WGs](#)) are the primary mechanism for developing IETF specifications and guidelines, many of which are intended to be standards or recommendations. Working Groups submit these specifications and guidelines for publication as RFCs. The RFC document series, which includes documents produced by the Internet Architecture Board ([IAB](#)), the Internet Research Task Force ([IRTF](#)), and the IETF—as well as individual submissions—contain technical and organizational notes about the Internet.

As of 31 December 2021, there were 7 active Areas containing a total of 122 active IETF Working Groups. The Internet Engineering Steering Group ([IESG](#)), consisting of the 14 Area Directors and the IAB Chair, is responsible for technical management of IETF activities and the Internet standards process. The active areas are:

Applications and Real-Time (ART) Area

Develops application protocols and architectures in the IETF. The work in the area falls into roughly three categories: delay-sensitive applications, delay-tolerant applications, and building blocks for general use.

General (GEN) Area

Consists of WGs and other activities focused on supporting, updating, and maintaining the IETF standards development process.

Internet (INT) Area

Technical topics covered include IP layer (both IPv4 and IPv6), implications of IPv4 address depletion, co-existence between the IP versions, DNS, DHCP, host and router configuration, mobility, and how IP will run over new link layer protocols.

Operations and Management (OPS) Area

Includes Network Management protocols such as NETCONF and YANG; autonomic networking; and various operational issues facing the Internet such as DNS operations, IPv6 operations, multicast operations, IoT-operations, operational security, (secure) routing operations, and benchmarking.

Routing (RTG) Area

Maintains the scalability and stability characteristics of the existing routing protocols, as well as developing new protocols, extensions, and bug fixes to ensure continuous operation of the Internet routing system.

Security (SEC) Area

Develops specifications to enable secure and privacy-preserving communications with confidentiality and integrity protection; improve the security of network end-points; standardize watch-and-warning information in security operations; and provide mechanisms for protocols and applications to handle the authentication, authorization, and accounting of users, applications, and devices.

Transport and Services (TSV) Area

Works on mechanisms related to end-to-end data transport to support Internet applications and services that exchange potentially large volumes of traffic at potentially high bandwidths. A key focus are mechanisms to detect and react to congestion in the Internet, such as the congestion control algorithms in Internet transport control protocols including TCP, Stream Control Transmission Protocol (SCTP), Multipath TCP, Datagram Congestion Control Protocol (DCCP), and QUIC.

New IETF Working Groups

The following new Working Groups were chartered during 2022:

- WebRTC Ingest Signaling over HTTPS (wish)
- IOT Operations (iotops)
- Real-Time Communication in WEB-browsers (rtcweb)
- Serialising Extended Data About Times and Events (sedate)
- Media Type Maintenance (mediaman)
- MAC Address Device Identification for Network and Application Services (madinas)
- DANE Authentication for Network Clients Everywhere (dance)
- Oblivious HTTP Application Intermediation (ohai)
- System for Cross-domain Identity Management (scim)

Concluded IETF Working Groups

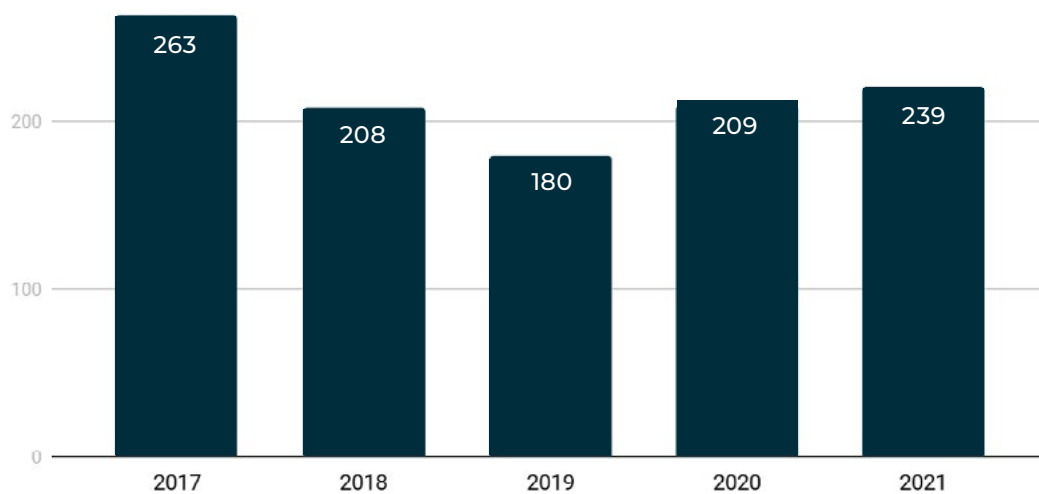
The following Working Groups were concluded during 2021:

- Binary Floor Control Protocol Bis (bfcpbis)
- SIP Best-practice Recommendations Against Network Dangers to privacy (sipbrandy)
- Interface to the Routing System (i2rs)
- Token Binding (tokbind)
- Host Identity Protocol (hip)
- Public Notary Transparency (trans)
- TURN Revised and Modernized (tram)

RFCs

The final form of the work undertaken in the IETF is captured in RFCs. RFCs are also published by the IAB, IRTF, and through independent submissions. In 2021, 239 RFCs with 6,387 total pages were published.

RFCs published in the past 5 years



Internet-Drafts

Internet-Drafts (I-Ds) are working documents of the IETF, its Areas, and its Working Groups, as well as groups such as IRTF Research Groups. While only some I-Ds eventually become RFCs, I-Ds are the focal points for much of the day-to-day work and discussion of the IETF. During 2021, I-Ds posted to IETF I-D repository included:

- **1107** I-Ds of all types*
- **704** I-Ds authored by individuals
- **1154** Different I-D authors
- **290** I-Ds adopted by working groups

*This is a count of unique I-D names, not counting different versions of the same I-D.



IETF Tech Spotlight: WebRTC

The publication in 2021 of the standards that provide a foundation for Web Real-Time Communications (WebRTC) marked a milestone in the development of conferencing services used by billions of people around the world. WebRTC is arguably the most important set of technologies used during the COVID-19 pandemic. All web-based videoconferencing services make use of WebRTC, a large set of technologies that allow web browsers to make voice, video, and real-time data calls.

More than a decade ago, when rich web applications were in their infancy, engineers from across the web and real-time communications industries came together to tackle a challenging problem: could modern voice and video over IP technology be brought to the ubiquitous platform of the Web?

The task was daunting. Real-time communications involved complicated protocol mechanics and network traversal machinery, while the Web lacked the APIs and security model needed to safely effectuate two-way real-time communications. But the idea of being able to make a video call in your browser at the click of a button presented nearly limitless possibilities for collaboration, connection, and productivity.

That idea has become a reality for billions of users around the world thanks to years of intensive work to standardize WebRTC in the IETF and the World Wide Web Consortium (W3C). The availability of WebRTC code, APIs, and standards has made it simple to add real-time communications functionality to any application. And that widespread availability has been a true lifeline during the COVID-19 pandemic.

There is already work underway to extend WebRTC. The IETF WebTransport (WEBTRANS) work is aiming to make it easier for applications to get better networking performance from a variety of transport properties and protocols. The WebRTC Ingest Signaling over HTTPS (WISH) working group is focusing on the development of a protocol to support one-way WebRTC-based audiovisual sessions between broadcasting tools and real-time media streaming networks. Similar work to expand the use cases of WebRTC is ongoing in the W3C.

Finishing the core WebRTC standards required tremendous effort from dozens of IETF and W3C participants over many years. The end result is a hugely popular technology suite that fulfills the Internet's central promise—connecting people—on a global scale every day. It will be exciting to see what the future holds as the IETF community continues to build on this success.

WebRTC has grown into a thriving ecosystem of applications and services, thanks to the web and the innovation enabled by open standards and open source.

Justin Uberti
Distinguished Engineer
Google

Video conferencing is a critically important method of communication, especially right now and WebRTC brings it to everyone instantly using only their Web browser. It's a powerful demonstration of the true power of the Web.

Eric Rescorla
Mozilla CTO

The creation of the WebRTC standards and their implementation across all major browsers provides developers with a common set of protocols to add video conferencing to a range of applications.

Cullen Jennings
CTO for Security & Applications
Cisco

WebRTC plays an important role in aligning user experience and improving interoperability of rich collaboration services to provide better communication capabilities for people, which is more important than ever.

Mikael Prytz
Research Director
Ericsson

IETF Meetings

While the work of the IETF is largely conducted over mailing lists, the IETF community holds a variety of online and in-person meetings to make progress. All IETF meetings in 2021 were held online due to the COVID-19 global pandemic.



[IETF 110 Online](#)

23-27 March 2021
Hosted by Google
1329 participants
Proceedings



[IETF 111 Online](#)

26-30 July 2021
Hosted by Juniper
1411 participants
Proceedings



[IETF 112 Online](#)

8-12 November 2021
Hosted by Ericsson
1347 participants
Proceedings

Interim Meetings

Complementing the online IETF meetings during 2021, working groups held additional virtual interim meetings. Over the year, IETF working groups held more than 250 interim meetings, more than double the number held in 2019. More details, including agendas, minutes, and materials for each interim meeting can be found via the IETF Interim Meetings webpage.

IETF Global Hosts and Sponsors

Work in the IETF is supported by contributions from dozens of sponsors each year. Significant ongoing support is provided by IETF Global Hosts and Global Supporters who have made sustained commitments to ensure the standards that power the Internet remain open for permissionless innovation. See the IETF website for more information about IETF sponsors and how they support the IETF.



Diversity and Inclusivity Sponsors

Anyone can participate in the open processes used by the IETF, and the technical standards they produce are improved with broader participation. A variety of programs help realize these ideals by providing a path to sustained engagement for those who would otherwise face difficulties participating in the IETF. The IETF's Diversity and Inclusivity sponsorship supports fee waivers to lower economic barriers to meeting participation, and the IETF Systems program which offers women participants the opportunity to connect, share, and learn with each other.

GOLD

Akamai
Cisco

SILVER

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BRONZE

Comcast
Donuts
ICANN
Verisign

Running Code Sponsors

We believe in rough consensus and running code" is an unofficial mantra of the IETF and underscores the value the community puts on getting work done in the real world. Running Code sponsors are front and center for some of the IETF's most attended events, such as IETF Hackathons, while supporting essential technology to support the work of the IETF.

BRONZE CNNIC | ICANN

Equipment and Services Sponsors

Equipment and Services Sponsors provide in-kind support for IETF meetings and other activities that bring the community together across the year, fostering vital communication and collaboration.

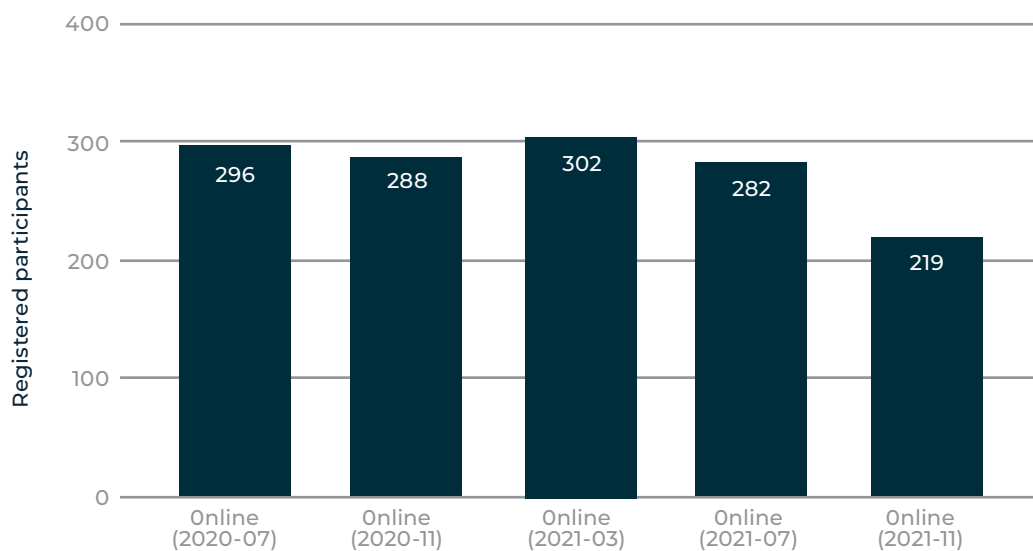
Cisco | Juniper Networks | Webex Meetings | Cisco DevNet

IETF Hackathons

IETF Hackathons encourage developers to collaborate and develop utilities, ideas, sample code and solutions that show practical implementations of IETF standards. IETF Hackathons are collaborative events, not competitions. Past IETF Hackathons have covered a range of topics, including: DNS, HTTP 2.0, NETVC, OpenDaylight, ONOS, VPP/FD.io, RiOT, SFC, TLS 1.3, WebRTC, YANG/NETCONF/RESTCONF.

Since beginning in 2015 with approximately 50 participations, IETF Hackathons have grown dramatically. Even with participation entirely online during 2021, hackathons enjoyed strong participation with an average of more than 260 and a peak of 302 registered participants. Support for IETF Hackathons is provided by Cisco DevNet.

IETF Hackathons 2020-2021



IETF Administration LLC Updates

Established in 2018 after an extensive community process to update the administrative arrangements supporting the work of the IETF, the IETF Administration LLC (IETF LLC) completed its third full year of operation in 2021.

The IETF LLC provides the corporate legal home for the IETF, the IAB, and the IRTF. It is responsible for supporting ongoing operations, managing finances and budget, raising money, and establishing and enforcing policies to ensure compliance with applicable laws, regulations, and rules. Key principles guiding the IETF LLC include trust, responsiveness, and transparency. To that end, board meetings are open to observers except for items such as legal, contracts, and personnel matters, with meeting agendas published prior to the meeting and minutes published afterwards.

Noteworthy accomplishments and developments during 2021 include:

First-ever community survey

In May 2021, the IETF Administration LLC (IETF LLC) on behalf of the IESG and in collaboration with the IAB distributed the first annual IETF community survey to all 56,000 addresses subscribed to IETF mailing lists. The responses help better understand our community and its makeup, and gather views on the IETF and how well it works for participants.

IASA2 Retrospective

After three years of operation, the IETF LLC undertook a broad consultation with the community throughout 2021 to conduct a complete assessment of the structure, processes, and operation of the IETF Administrative Support Activity (IASA 2.0) established in 1998. The assessment identified areas where work is completed, where work is continuing, and made several recommendations for future work, including that further assessments be performed every three years.

Director of Development engagement

Lee-Berkeley Shaw joined the IETF Administration LLC as Director of Development, focused on designing and delivering the strategy to achieve the IETF's goals for financial sustainability, with specific emphasis on growing the IETF Endowment.

IETF Endowment relaunch

Building on the significant financial commitment made by the Internet Society in 2020, a renewed effort to build the IETF Endowment was launched in 2021 with the goal of ensuring the long-term sustainability and financial independence of the IETF. Over \$250,000 was raised in 2021, which when matched by the Internet Society 2:1, will result in over \$750,000 going into the IETF Endowment to support financial stability and future works of the IETF.

IETF Tools investment

Our 2021 budget included significant new investment to support strategic transformations related to tools. The total tools budget increased \$505,212 from \$937,910 invested in 2020. During the year two new developers were employed and several tools-related RFPs issued and awarded.

IETF meetings

Due to the COVID pandemic all IETF meetings in 2021 were held fully online. To support the online experience, we invested further with our remote participation services provider, Meetecho and implemented multiple recommendations from participants, as expressed in our post-meeting surveys. Participant satisfaction, as measured in these surveys showed an ongoing improvement, reflecting this investment.

IETF ADMINISTRATION LLC 2021 FINANCIALS

The audited Statement of Activity for the 2021 year

	Actual	Budget
NON-MEETING REVENUE		
Contributions	\$152,701	\$6,750,000
ISOC Contribution Cash	-	\$6,250,000
Endowment Contributions	\$152,701	\$500,000
Administrative In-Kind Contribution	\$58,050	\$9,000
Other (including investment interest)	\$1,812,461	\$730,940
TOTAL NON-MEETING REVENUE	\$2,023,211	\$7,489,940
MEETING REVENUE		
Registration Fees	\$ 659,886	\$ 1,510,625
Sponsorship	\$ 1,045,351	\$ 1,045,833
Hotel Commissions	-	\$114,501
Rebates & Comps	-	\$ 406,978
Misc	\$ 438,355	\$ 26,500
TOTAL MEETING REVENUE	\$ 2,143,592	\$ 3,104,437
TOTAL REVENUE	\$ 4,166,804	\$ 10,594,377

Notes for 2021 Financials

1. Changes to the schedule for recognizing multi-year Internet Society contribution based on auditor review have resulted in a variance of 2021 actuals to budget; the overall contribution commitment of the Internet Society has not changed.
2. The ongoing effects of the global COVID pandemic led to significant variances in meeting registration fee revenue and expenses during 2021.

IETF ADMINISTRATION LLC 2021 FINANCIALS

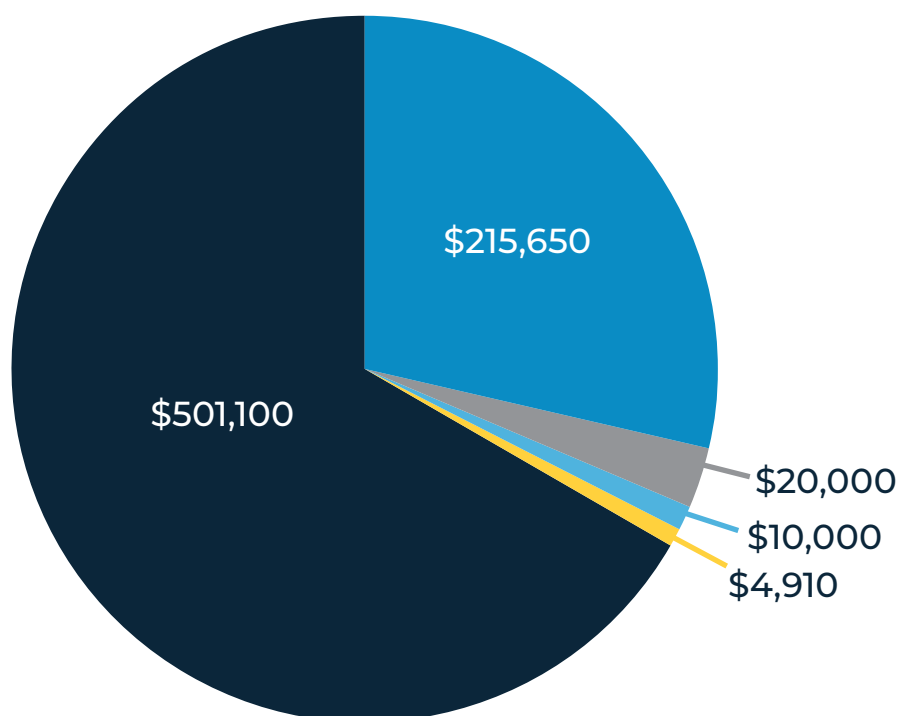
continued

	Actual	Budget
MEETING MEETING EXPENSES		
Venue Costs	\$ 26,864	\$ 1,111,088
Travel and Expenses	\$ 10,507	\$ 349,800
Meeting Support	\$ 888,302	\$ 1,006,480
NOC Support	\$ 572,437	\$ 701,387
Other	\$ 118,324	\$ 153,538
Site Visits (formerly Future Meetings)	-	\$ 25,500
TOTAL MEETING EXPENSES	\$ 1,616,435	\$ 3,347,792
OPERATING EXPENSES		
Administration	\$2,026,733	\$1,994,729
Staff Costs	\$1,013,067	\$855,437
Operations	\$331,334	\$388,032
Board Costs	\$5,266	\$84,580
Secretariat - Admin	\$336,000	\$332,280
CPA Services	\$180,905	\$155,000
Legal Services	\$160,161	\$179,400
RFC Services	\$1,413,763	\$1,482,744
RFC Production Center	\$1,338,163	\$1,313,944
RFC Series Editor	\$75,600	\$159,800
Independent Submissions Editor	-	\$9,000
Community Leadership	\$607,800	\$682,660
Secretariat - Community leadership	\$553,800	\$553,800
IESG Support	-	\$22,240
IAB Support	-	\$37,440
IRTF Support	-	\$17,650
NomCom Support	-	\$1,530
Community Leadership Training	\$54,000	\$50,000
IETF Trust Contribution	\$80,850	\$80,850
Standard Budget	\$80,850	\$80,850
Special Projects	-	\$100,000
Tools	\$1,176,469	\$1,301,052
Secretariat - IT	\$1,312,944	\$1,252,144
Management/Planning	\$123,756	\$123,756
Research/Analysis/Design	\$ 123,756	\$223,756
Software Development	\$309,080	\$281,375
Infrastructure Development	-	\$20,000
Operations (non-Secretariat)	\$ 176,838	\$ 109,125
Review/Audit	-	\$ 100,000
TOTAL OPERATING EXPENSES	\$5,305,616	\$5,642,035
TOTAL EXPENSES	\$6,922,050	\$8,989,827
Net Income	\$ (2,755,247)	\$1,604,550
Capital Investment	\$ 207,048	\$585,000
NET INCOME (AFTER CAPITAL EXPENDITURE)	\$(2,962,295)	\$1,019,550

IETF Endowment

The IETF Endowment is a designated investment fund created in support of IETF and its activities. Its purpose is to ensure the long-term financial sustainability for the work of the IETF. Contributions to the IETF Endowment are bolstered through a generous 2:1 matching program by the Internet Society.

Sources of IETF Endowment Support



- Internet Society Matching Funds - \$501,100
- Internet Registries - \$215,650
- Corporations - \$20,000
- Foundations - \$10,000
- Individuals - \$4,910



Internet Architecture Board Activities

The Internet Architecture Board (IAB) provides long-range technical direction for Internet development, ensuring the Internet continues to grow and evolve as a platform for global communication and innovation. The IAB provided reports to the community throughout 2021:

IAB report to the community for IETF 110

This report included the announcement of a new Liaison Coordinator position to provide a clear contact point for liaison managers appointed by the IAB, and for the community more broadly to handle any liaison-related requests directed to the IAB.

IAB report to the community at IETF 111

This report highlighted publication of RFC 9075: Report from the IAB COVID-19 Network Impacts Workshop 2020 and provided the usual updates on IAB appointments, liaison activities, programs, and workshops.

IAB Statement on Inclusive Language in IAB Stream Documents

The IAB concurred with the IESG statement on Inclusive Language, noting that clear, precise, and widely accessible language is equally valuable in contributions to the IAB stream, announcing that the all IAB stream documents and RFCs will follow the same guidance, and encouraging all contributors to do the same.

IAB report to the community for IETF 112

This report provided on liaison statements and relationships and noted the publication of RFC 9120: Nameservers for the Address and Routing Parameter Area (“arpa”).

The IAB publishes a list of documents on its website, with active Internet-Drafts and published RFCs available via the IETF Datatracker.

IAB Technical Programs and Administrative Support Groups

Active Technical Programs

- [Evolvability, Deployability, & Maintainability \(EDM\) Program](#)
- [Internet Thread Model \(model-t\) Program](#)

Administrative Support Groups

- [IANA Program](#)
- [Plenary Planning Program](#)

RFC Editor related activities (under reorganization)

- [RFC Editor Future Development Program](#)

IAB Workshops

Workshops provide a way to bring together experts on a focused topic of interest to the work of the IAB. In 2021, the IAB held online workshops on analyzing data about IETF participation and measuring network quality for end-users.

Measuring Network Quality for End-Users

(14-16 September)

Interested researchers, network operators, and Internet technologists convened to share their experiences and to collaborate on the steps needed to define properties and metrics with the goal of improving Internet access for all users.

Show me the numbers: Workshop on Analyzing IETF Data

(29 November - 2 December)

Engineers and researchers gathered to explore trends and derive insights into the standardization process, participation, and governance through the analysis of IETF data such as email archives, I-Ds, RFCs, and the IETF Datatracker.



Internet Research Task Force Activities

The Internet Research Task Force ([IRTF](#)) promotes research of importance to the evolution of the Internet protocols, applications, architecture, and technology.

The IRTF is managed by the IRTF Chair in consultation with the Internet Research Steering Group ([IRSG](#)).

Research Groups

The IRTF consists of a number of focused and long-term Research Groups (RGs) working on topics related to Internet protocols, applications, architecture, and technology. Research Groups have the stable long-term membership needed to promote the development of research collaboration and teamwork in exploring research issues. Participation is by individual contributors, rather than by representatives of organizations. Research Groups active as of 31 December 2021 were:

- Crypto Forum Research Group (cfrg)
- Computing in the Network Research Group (coinrg)
- Decentralized Internet Infrastructure (dinrg)
- Global Access to the Internet for All (gaia)
- Human Rights Protocol Considerations (hrpc)
- Internet Congestion Control (iccr)
- Information-Centric Networking (icnrg)
- Measurement and Analysis for Protocols (maprg)
- Network Management (nmrg)
- NetWork Coding for efficient Network Communications Research Group (nwcrg)
- Path Aware Networking RG (panrg)
- Privacy Enhancements and Assessments Research Group (pearg)
- Quantum Internet Research Group (qirg)
- Thing-to-Thing (t2trg)

Applied Network Research Prize

The Applied Networking Research Prize (ANRP) is awarded for recent results in applied networking research that are of potential interest to the Internet standards community. Researchers with relevant, recent results are encouraged to apply for this prize, which offers the opportunity to present and discuss their work with the engineers, network operators, policy makers, and scientists that participate in the IETF and the IRTF. From the 76 nominations received for the 2021 edition of the ANRP, six awards were presented to: Francis Y. Yan, Audrey Randall, Rüdiger Birkner, Thomas Wirtgen, Aqsa Kashaf, and Kevin Bock.

Applied Network Research Workshop

The ACM/IRTF Applied Networking Research Workshop (ANRW) provides a forum for researchers, vendors, network operators, and the Internet standards community to present and discuss emerging results in applied networking research. The workshop offers an opportunity for academics to transition research back into IETF standards and protocols, and to find inspiration from topics and open problems discussed at the IETF. To foster this cross-community collaboration, the workshops are co-located with IETF meetings once a year and organized in a way that allows ample time for discussion and interaction.

The ANRW 2021 was held in conjunction with the IETF 111 Online meeting. The workshop consisted of a mix of invited talks, submitted talks, and submitted short papers. Video recordings from the workshop are available from the IRTF website. Workshop proceedings have been published by the ACM.

The ANRW series receives financial support from Akamai and Comcast.

2021 IETF Donors

Global Hosts and Global Supporters



Endowment Flagship Donors



2021 IETF Donors

We recognize everyone who has contributed financial support to the IETF in 2021.

\$100,000+

Cisco * Ericsson * Google * Juniper * LACNIC * RIPE

\$10,000 - \$99,999

Akamai * Comcast * Donuts * Fenner Family Fund * Huawei * ICANN * Verisign

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For a complete list of IETF Donors, please visit the IETF website.

Information Resources

Internet Architecture Board (IAB)

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