Internet Systems Consortium, Inc.

2020 Annual Report

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INTERNET SYSTEMS CONSORTIUM, INC.
ANNUAL REPORT 2020

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(Internet Systems Consortium consists of Internet Systems Consortium, Inc. (a not-for-profit company) and its wholly owned subsidiary Internet Systems Corporation, both incorporated in Delaware with headquarters in New Hampshire, USA.)

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LETTER FROM THE PRESIDENT

The many pandemic faces of Jeff Osborn

2020 was a terrible year for the world at large, but overall a good year for ISC. We saw some big changes internally as we moved from our long-time headquarters in Redwood City, California to our new, much smaller digs in Newmarket, New Hampshire. Our office presence is virtual for the most part, but fortunately the Internet keeps us connected. We had more turnover than is usual for ISC, much of it move-related, and ended the year with a staff that is majority-European for the first time.

We shipped versions 9.11.15-9.11.26 and 9.16.0-9.16.10 of the stable branches of BIND 9, as well as monthly development releases on other branches. BIND is still the leading global DNS implementation and we expect that to be the case well into the future. We released stable versions 1.6.2-1.6.3 and 1.8.0-1.8.2 of Kea DHCP, which is being broadly implemented on networks around the world. We have also released early versions of Stork, a new graphical dashboard, which promises to improve provisioning, monitoring, and support of Kea, and eventually, BIND 9.

As I write this, we are in the vaccination phase of a global pandemic, which has complicated our lives in ways and to a degree that was difficult to imagine a year ago. Several ISC staff members, as well as many close friends and family members, have contracted and recovered from COVID. While we are still preparing for the recession that economic history promises us roughly once a decade, things are going very well for ISC on the financial front, and we are in a very strong revenue and cash position.

We effectively broke even in 2020 with a $50,000 loss on a consolidated basis with the for-profit and non-profit organizations combined, which keeps the tax burden on our for-profit subsidiary at a minimum. New team members in New Hampshire, USA; London, UK; Bucharest, Romania; and Kharkiv, Ukraine joined the rest of our staff scattered around the world. ISC is truly a global company.

We are grateful to our support customers, sponsors, and contributors as they help us continue to develop and maintain open source software, and operate and maintain the F-Root DNS root server.

It has been another good year at ISC, although a complicated one, and we look forward to protecting and promoting a free and open Internet for many more.

Regards,

Jeff Osborn
April 2021

THE IMPORTANCE OF CONNECTIVITY

If we have learned anything over the past year – dealing with a global pandemic, social unrest, climate disasters, and more – it is that we are all connected. No man is an island, as the saying goes, and it is truer now than ever. No matter where we are, we cannot isolate ourselves from the rest of the world and tell ourselves that what happens in other places does not affect us. Nor should we want to.

The Internet, at its heart, is a global mesh of interconnectivity that ties every one of its users to every other. Of course, it is also a tool for commerce, a military resource, an educational asset, a recreational device, and much more. It is also, unfortunately, a means to spread hatred and division.

But fundamentally, the Internet is the way the world communicates today and the way we stay connected to each other. And throughout 2020 we were reminded again and again of just how critical the Internet's infrastructure is.

According to the Pew Research Center, 90% of Americans use the Internet at least occasionally, as of April 2020. That's probably not a big surprise, as the Internet was originally invented in the US. 94% of Canadians and the same percentage of Australians use the Internet, and 91% of people in the UK – also probably not too surprising. But how about 59% of people in Lebanon, 76% in Brazil, 85% in Turkey, 68% in South Africa, or 54% in Nigeria? In those countries and others, which are not among the world's wealthiest, Internet usage is increasingly vital.

A report from The New York Times in April 2020 noted that usage of the Zoom videoconferencing platform more than tripled from late February to mid-March of last year, and other video platforms also saw huge jumps as many offices and schools around the world went remote.

We all observed holidays, celebrated weddings, mourned at funerals, and took part in other lifecycle events via Internet video in 2020, and video, texting, chat, and email were lifelines for many who were isolated and unable to see their friends and family. In a separate Pew Research Center study, 87% of US adults surveyed said that the Internet has been essential or important to them during the coronavirus outbreak. Of course, this is not merely a US-centric trend.

So what's the point? The point is that the Internet is critical infrastructure around the world these days, as important as roads and bridges. We need to keep this critical infrastructure safe and secure and to make sure that it can continue to grow to meet the world's demands. ISC is proud that its DNS and DHCP software plays an important role as part of this infrastructure, and we are grateful to our customers who demonstrate their belief in ISC's mission by purchasing support contracts. We are all connected.

LOOKING BACK AND LOOKING AHEAD

2020 Highlights

When the pandemic broke out in the spring of 2020, we had no idea what the likely economic adjustment might mean for ISC. We are a small organization and have limited options for increasing revenue if our support business drops off, so we are vulnerable in a recession and needed to be conservative. Worried about the prospect of a worldwide economic slowdown, we cancelled all travel, instituted a hiring freeze, applied for a special small-business loan, and postponed staff raises.

Luckily for ISC, Internet usage increased significantly during the pandemic and our support business has been strong. Unfortunately, we lost a couple of support customers due to the impacts of the pandemic on their industries, but overall we have not seen any significant disruption in our support business. ISC gained a net of 12 new support customers in 2020, with a significant increase in demand for Kea support.

Our biggest single change in 2020 was closing our headquarters at 950 Charter Street in Redwood City, California. This was already going to be a big job, and it was further complicated by COVID-19. Moving meant shutting down ISC's datacenter in the back of the old warehouse we had occupied for over 20 years.

The project required sunsetting the last remaining hosting and secondary name services we provided for impecunious countries and nonprofits, and relocating ISC's own equipment to professionally managed data centers at the PaloAlto IX and Hurricane Electric in Fremont. With some sadness we realized we could no longer maintain a Stratum-0 GPS clock and so we decommissioned clock.isc.org, referring our users to nwtime.org. We returned the massive trailer with our backup power supply that had sat in our parking lot for years. Our wonderful facilities manager, Rory Doolin, who had been with ISC since the beginning, found new homes for old equipment, and he recycled and donated lightly-used furniture.

ISC's former headquarters at 950 Charter Street in Redwood City, California. We didn't even get to say a proper goodbye.

We had hoped to have an open house to mourn the passing of this gathering place and landmark, but that too was a casualty of the pandemic. Although giving up our historic building was emotional for many of us, we realized our resources could be better allocated elsewhere, and moving out has allowed us to direct funds to more effectively pursue our software development and deployment objectives.

All remaining paper documents were packed and shipped to the new headquarters and business office in Newmarket, NH, and our "offices" became 100% virtual, although that wasn't a huge pivot for us since the majority of staff already worked from home.

ISC's new HQ sits at 53 Main Street in Newmarket, New Hampshire. Only three current staff members have been there so far.

Closing our datacenter accelerated some of our projects to migrate to modern cloud-based applications for some of our non-core functions, including sales and finance. For self-hosted applications, we continue to rely on open source solutions, including GitLab, Mattermost, and Jenkins.

2020 brought more staff changes than we have had in years. Seven ISC employees moved on, including one who retired after ten years with ISC and two people whose jobs were tied to our building. We hired four new full-time staff members: a developer for the BIND team, a DHCP developer/Support Engineer, a Director of Finance and Accounting, and an Accounting Manager. We also recruited a part-time General Counsel with extensive experience in open source and cyber security. We tried to reach out to a diverse pool of applicants as part of our search process: we placed recruitment ads on Indeed, GlassDoor, LinkedIn, Flexjobs, Fossjobs.net, Twitter, Facebook, GitHub, Ada's List, Women in Technology, and BlackJobs.com, and considered a total of 188 applicants.

Other 2020 Activities

ISC as a whole made a significant investment in producing pre-compiled images for BIND and Kea in 2020. There seems to be a general trend towards ready-to-use software, and we received a number of requests to add packages. We added new Kea packages to support ARM architectures and Alpine Linux, and we expect Stork users to rely primarily on packages rather than building from source. We also added a package for the Kea Migration utility, which is based on ISC DHCP. The BIND team published an official Docker image for BIND, and we have requests for the same for Kea. While many of our traditional BIND support customers prefer the control of building their own software, we are seeing new customers - Kea users in particular - who are sold on containerization.

In 2020 we implemented a Code of Conduct for communications in ISC-sponsored fora, including our user mailing lists and GitLab discussions. We are grateful for the users on our mailing lists who have spoken up kindly when they saw a message that was unduly harsh or unhelpful. ISC welcomes new users, and encourages users who might feel intimidated to participate actively in the open source and Internet communities.

We have struggled to find the resources to support Outreachy or Google Summer of Code interns, but we welcome any ideas and suggestions about how we could engage with new or discouraged open source users. We believe enabling wide engagement in and "control" over the Internet is an important part of our mission.

We missed getting to travel and see each other and the rest of the Internet community this year. To

make up for that loss, we produced and shared two ISC Pandemic Cookbooks (Original and Holiday), which were fun projects to maintain connections among our team and social media followers.

In 2020, the total number of native languages spoken at ISC rose to twelve (English [American, British, AND Australian], Polish, Czech, French, Romanian, Welsh, German, Dutch, Portuguese, and Ukrainian). We love being such a multicultural bunch.

Rory Doolin (left) and Jason Lasky share a socially distanced moment outside of ISC's longtime headquarters in Redwood City, California.

2021 Goals

In 2021, we are hard at work on some ambitious plans for the year. These include:

- Growing our support team as our customer base continues to grow. We are adding escalation engineers to both the BIND and Kea development teams and bringing two new support engineers on board in early 2021.
- Completing the refactoring of the BIND 9 network code, which will allow us to become more competitive on performance and to reduce code complexity.
- Extending the multithreading work in Kea to cover High Availability deployment models.
- Adding new Kea security features, including native TLS support, granular access controls, and better user-credentials management, as our support customer base expands from mostly service providers to an increasing proportion of enterprise users with corporate application security standards.
- Load-testing more realistic customer scenarios for both BIND and Kea, to enable us to give our customers better advice on what throughput to expect and how to achieve the best results in their deployments.
- Improving our customer support ticketing system to aid engineer productivity and customer satisfaction, as we increase our support customer base.
- Continuing to produce and publish useful, quality technical documentation and training without paywalls.

2020 FINANCIAL OVERVIEW

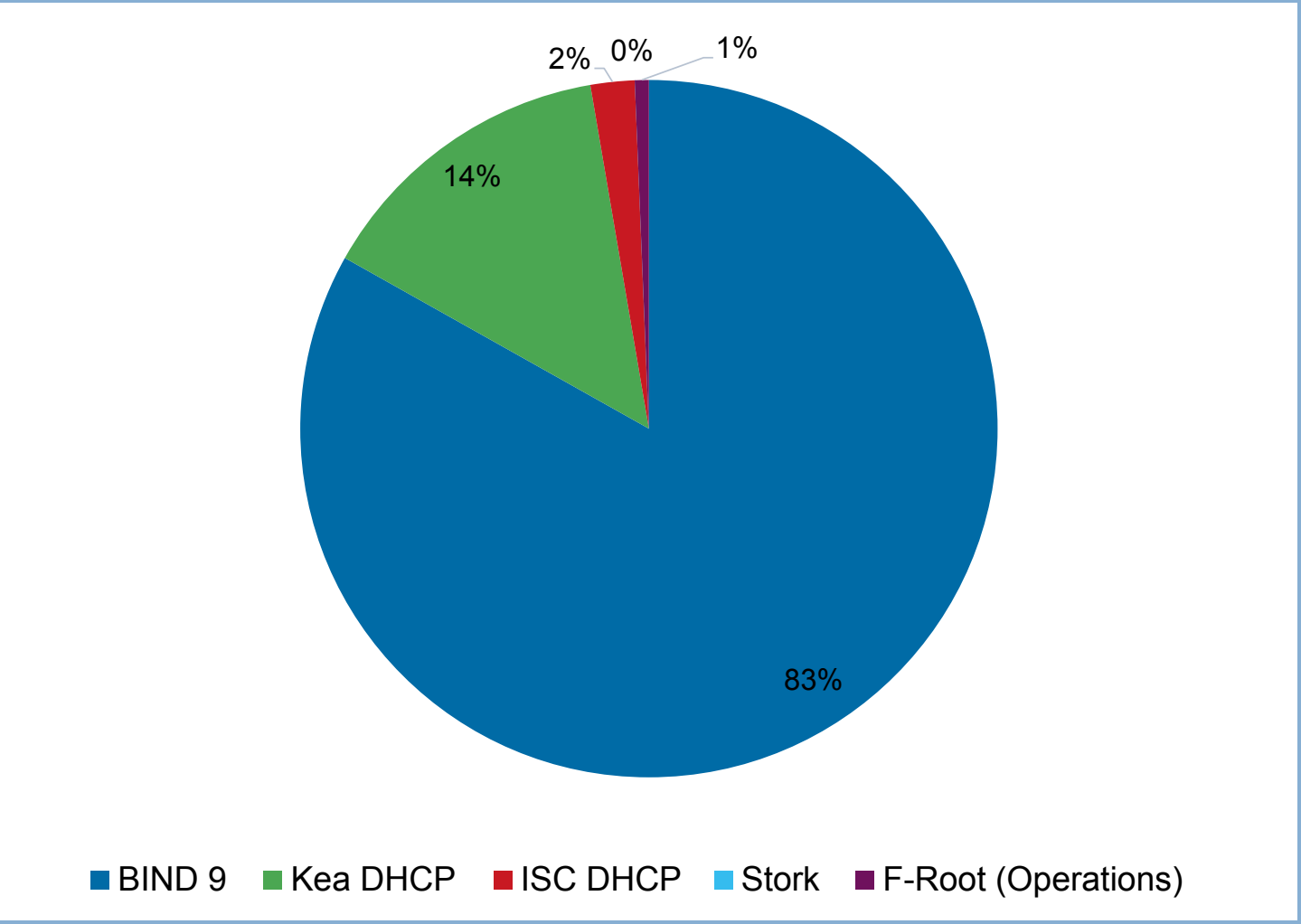
Revenues

ISC's open source software is available for free download; we fund our operations with paid support contracts for our software, which also include special software features. In 2020, 83% of our revenues came from our flagship product, BIND 9. Another 16% came from our DHCP offerings, ISC DHCP and Kea DHCP. Kea's future is solid, with revenues beginning in 2017 and growing strongly.

The remaining 1% of the company's 2020 revenues came from F-Root and donations.

We gained 22 new support contracts in 2020; as a result, ISC was able to add several new staff members in late 2020 and early 2021. ISC is on a steady footing.

2020 Revenues by Service (Unaudited)

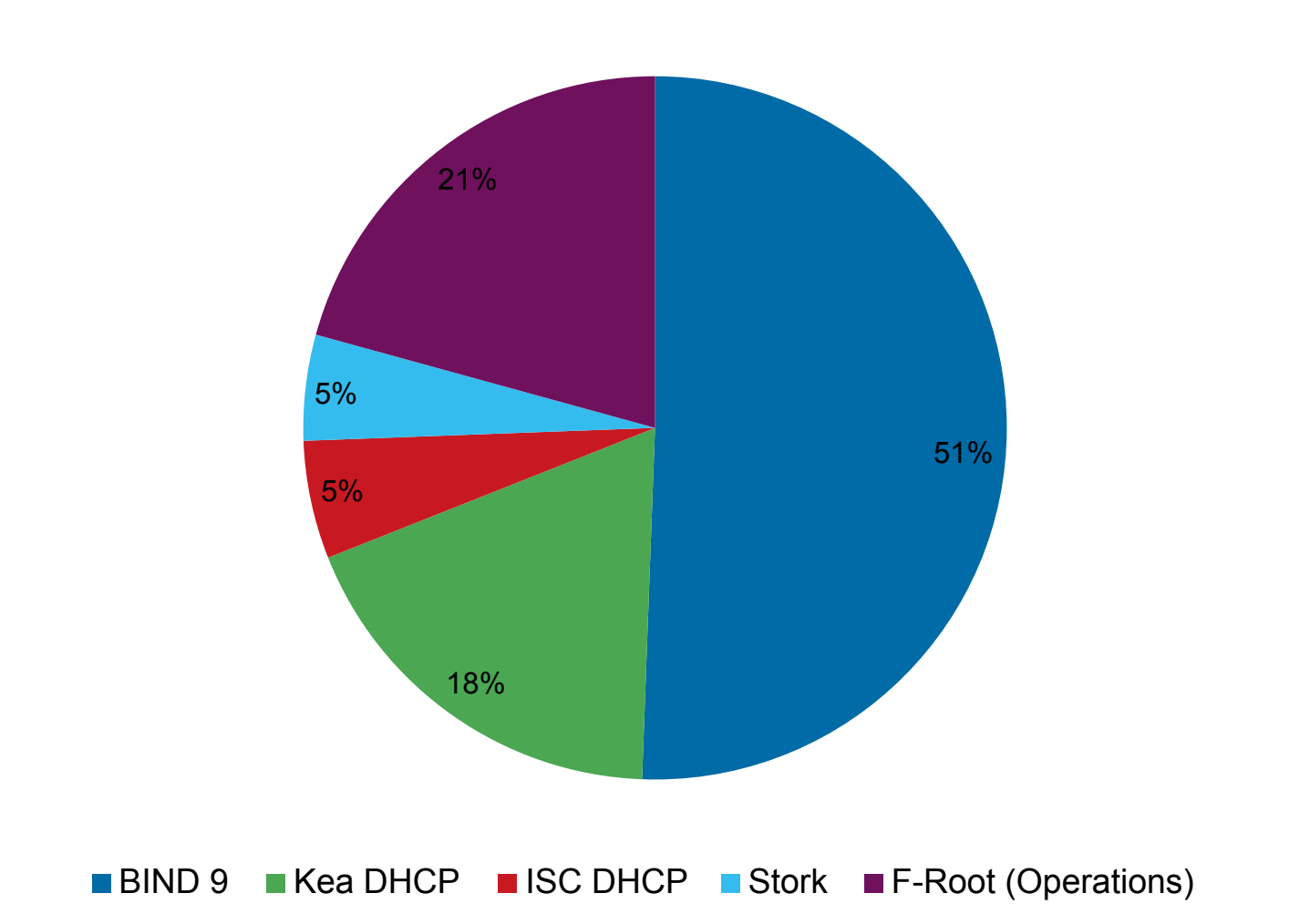


Expenses

ISC's staff are leaders in the Internet industry and represent the majority of the company's costs. Other than personnel, ISC's expenses include bandwidth, network and equipment depreciation, travel (although there wasn't much of that in 2020), taxes, utilities, and maintenance – and very little else. We are proud of the efficiency and cost-effectiveness of our operations.

At the end of 2020, we had 33 staff members in 12 countries (the US, Brazil, the UK, France, Austria, Denmark, Poland, Romania, Czechia, Australia, the Netherlands, and Ukraine). There were 16 people working in Software Engineering and Quality Assurance; four in Support; five in Sales and Marketing; four in Finance and Executive Operations; and four in F-Root and Technical Operations.

2020 Expenses by Service (Unaudited)



2020 CONSOLIDATED FINANCIAL INFORMATION (unaudited)

Numbers in thousands of dollars	2020 Q1	2020 Q2	2020 Q3	2020 Q4	2020 Total
Actual					
Revenue	1,306	1,382	1,322	1,435	5,445
Expense	1,197	1,450	1,562	1,286	5,495
Net Income	109	(68)	(240)	149	(50)
Budget					
Revenue	1,350	1,350	1,350	1,350	5,400
Expense*	1,360	1,360	1,360	1,320	5,400
Net Income	(10)	(10)	(10)	30	-
Delta of Actuals to Budget					
Revenue	(44)	32	(28)	85	45
Expense	(163)	90	202	(34)	95
Net Income	119	(58)	(230)	119	(50)

* Excludes depreciation expense

	2020 Q1	2020 Q2	2020 Q3	2020 Q4
Headcount**				
Actual – Total	38	36	34	33
Budget – Total	38	38	38	38

** At end of quarter

THE ISC STORY

Since the company's founding in 1994, ISC's employees have pursued the goal of "open source for an open Internet."

An open Internet, not controlled by a few for-profit mega-corporations, keeps communication open for everyone and fosters innovation by reducing the cost of entry.

ISC's open source software offers commercial-grade, rigorously vetted code with professional support for our customers' mission-critical Internet infrastructure. Our business model of paid subscriptions for open source works well for us. It aligns our incentives appropriately as we work for the success of our stakeholders: our subscription customers, and by extension all users.

In 2020 we continued development work on our three open source Internet networking software packages: BIND 9, ISC DHCP, and Kea DHCP. BIND 9, ISC's Domain Name System (DNS) software program, is widely used on the Internet by enterprises and service providers, offering a robust and stable platform on top of which organizations can build distributed computing systems. ISC DHCP is our classic implemention of the Dynamic Host Configuration Protocol for connection to an IP network, offering a complete solution for implementing DHCP servers, relay agents, and clients. ISC DHCP is a mature program with many features, but the software is cumbersome to maintain and update. Kea DHCP, in conjunction with the Stork management platform, is ISC's intended replacement for ISC DHCP. Kea offers a modular design with database management for easy dynamic reconfiguration, while Stork provides a web-based graphical dashboard.

ISC's staff contribute to various Internet governance and community initiatives, and ISC engineers have written or co-authored more than 85 of the technical standards (RFCs) that are essential to interoperability on the Internet.

Internet Systems Consortium, Inc. (ISC) is dedicated to developing software and offering services in support of the Internet infrastructure.

Our Thanks

Our greatest thanks go to the loyal open source users who continue to support ISC, many of whom have been paid customers of ours for more than a decade. These include some of the most capable independent operators and enterprises in the world.

We also owe a debt to all the wonderful open source users who have submitted feedback and patches, and the open source packagers who maintain distributions for our users. We regard many of these collaborators as our friends.

In 2020 we received generous unrestricted donations from the craigslist Charitable Fund (CCF), Verisign, SWITCH, and Deteque.

ISC SOFTWARE

BIND 9

Back in 2019, we embarked on our most ambitious refactoring project ever, replacing the original native socket layer in BIND with a new open source component, libuv. This is a project we had put off for several years because of the complexity and risk of changing such a fundamental and, frankly, ancient part of BIND. Unlike the OSI-layer slideware we have all seen, the socket "layer" in BIND is not a neatly defined layer in the named daemon. Instead, it is - or was - fairly closely integrated into functions that manage tasks which have to be parked while waiting for responses expected over the network.

The 2019 work on the new network manager was not complete when we created the new 9.16 stable branch, and some users discovered problems. For a while the TCP performance on FreeBSD was much worse than on Linux, and performance on platforms without load-balanced sockets performance was abysmal. Additional refactoring and rewritten TCPDNS support improved both stability and performance, but in 2020 we still did not complete the transition to the new network manager. Some operations still rely on the old BIND sockets.

Partly as a result of this, in 2020 we decided to modify our BIND release model again, to lengthen the time between major branches and provide extended support for every stable branch. This longer release cycle will enable us to continue to tackle complex refactoring projects. The next such project we have in mind is the rbtdb: BIND's Red-Black Tree Database, a critical data structure that is ripe for an overhaul.

The new network manager was a precondition for adding native support for the new encrypted transports DNS-over-HTTPS (DoH) and DNS-over-TLS (DoT) to BIND, so delays in completing the network manager caused us to miss our goal of shipping DoH support in 2020. However, we were pleased to release DoT in December; we see potential applications for DoT, particularly in the enterprise. We plan to follow this up with further work on Zone Transfer-over-TLS (XoT), and of course finish and release DoH.

Our technical support team encountered some issues related to BIND 9's cache management and memory usage, reported by a few large and observant operators. We think we addressed some of these with improvements in our serve-stale implementation, but others may remain. It can be complicated to discover the root causes of cache problems. In particular, it is difficult to capture and recreate the conditions that triggered the problem in the lab. One of our major initiatives for 2021 is building better test capabilities to realistically simulate a heavily loaded resolver.

We made a lot of improvements in BIND quality assurance in 2020, which enabled us to maintain a predictable monthly release cadence while adding more test tools and more platform coverage to our GitLab continuous integration system. Automating the testing of the RPMs we have been producing also helped us keep up with the monthly updates. We published the GitLab Runner scripts we are using for BIND as open source, and our QA Manager even found time to contribute a feature to git.

Significant BIND Accomplishments in 2020

- BIND's Key and Signing Policy tool, which automated DNSSEC maintenance, was improved several times in 2020, leading to a very nice assessment by Daniel Stirnimann of SWITCH that "BIND 9.16 has improved DNSSEC support to the point where it can (finally) be called simple to use."

- DNS over TLS (DoT) was released in 9.17.7 for early adopters.

- ISC joined the Google OSS-Fuzz project, adding to our in-house fuzzing. We also implemented new thread-sanitizer checks and addressed many issues found with their help.

- We reformatted all our documentation, migrating it from DocBook to reStructuredText. The BIND Administrator Reference Manual (ARM) is now generated using Sphinx and published on Read the Docs.

- We updated the BIND DNSSEC Guide, moved it from GitHub to GitLab, reformatted it to reStructuredText, and have added it as an appendix to the ARM on Read the Docs, making it easier for us to maintain and for our users to find.

- We added an official BIND 9 Docker image to the collection of ISC-maintained operating system packages.

We issued nine BIND CVEs in 2020, from 2020-8616 through 2020-8624. Details can be found in the BIND 9 Security Vulnerability Matrix in our Knowledgebase. This is the same number of CVEs we had in 2019.

CVE-2020-25705 on SADDNS was announced by researchers; it's a way of exploiting ICMP implementations to make it feasible to mount a DNS poisoning attack on vulnerable resolvers. The fix is in the operating system, but this CVE prompted ISC to "tighten up" the application of DNS cookies to help prevent more spoofing-type attacks in the future.

We welcomed one new developer to the BIND team in 2020, with another joining on January 1, 2021. One of these new team members implemented the improvements to serve-stale and the other has already taken over work on DNS over HTTPS (DoH), so we are expecting a strong 2021.

Kea DHCP

The DHCP team had two major accomplishments in 2020: we released the first multithreaded version of Kea, and we developed a new graphical dashboard called Stork. We also added another software engineer to the team, specifically focused on reproducing, documenting, and addressing software issues reported by support customers.

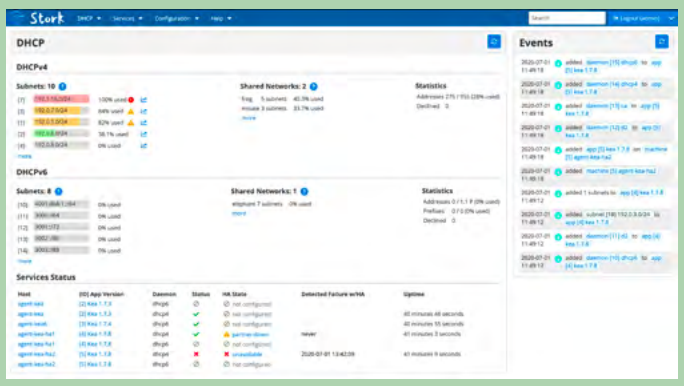
Multithreading

Transforming Kea into a multithreaded application took nearly a year of focused effort, as we had to modify both Kea itself and a number of hooks. We also put effort into various benchmarking tests, to ensure that the result was much faster than the single-threaded version. Our motivation for this project was to push Kea to a significantly higher throughput, something our service provider customers were asking for. We achieved dramatic performance gains, which we shared in a webinar and KB article. Our High Availability hook is now the limiting factor in Kea throughput in most scenarios, and addressing this is one of our top priorities in 2021.

Stork

The second big accomplishment was the development of our first project with a graphical user interface, Stork. While we plan to make Stork a management dashboard for both BIND and Kea, Kea was the clear priority.

A number of greenfield carriers, mostly providing local fiber access networks, are using Kea. They have no incumbent management tools, and they wanted something like the Anterius dashboard we did as a Google Summer of Code project two years ago. We set out to build a monitoring dashboard that could also eventually serve as a platform for configuration management. The result was Stork, which was built with resources from the DHCP development team using Go and Angular, both new technologies for ISC. We are not "reinventing the wheel" but rather integrating with powerful open source management utilities, such as Prometheus and Grafana. Stork is still considered experimental, but is already quite useful and is approaching a 1.0 version by the end of 2021. Before we declare it to be production-ready, we would like to finish implementing automated testing for the UI, and add the ability to view and search lease files.



Stork, the new graphical management platform for Kea.

Stork provides a quick view of Kea server status, and is particularly useful for monitoring High Availability status and pool utilization. Stork consists of an agent running on the application server, which discovers which ISC daemons are running, and a web server which displays current status of the machines and applications being monitored. This enables us to provide an integrated view of system

resource usage and application activity, to support troubleshooting.

Other Kea Accomplishments

In addition to these two main activities, the DHCP team has added many new features and tweaks to accommodate the rapidly growing number of enterprise ISC DHCP users migrating to Kea. Several of these fall into the category of features we have made more flexible to accommodate additional operational requirements: we added support for

bootp and leasequery; expanded our DDNS, client classification, and host reservations support; added support for multiple IP addresses per reservation; and made improvements to our High Availability hook. We are also continuing to track IETF work on DHCP, including RFC 8925, although standards work on DHCP has dropped off considerably vs. prior years. We maintained a regular schedule of monthly Kea maintenance releases while supporting a growing support customer base. As we did with BIND, we reformatted our Kea Administrative Reference Manual to reStructuredText format and posted it on Read the Docs. Finally, we sponsored a series of free technical webinars to train new Kea users, developed and delivered by Carsten Strotmann.

Towards the end of 2020 we started work on making Kea more secure, adding basic HTTP authentication and access controls on the remote management interface. Kea was designed to be run on a protected internal management network, so previously we recommended running a local HTTPS proxy in front of Kea to secure access, but we are seeing more users deploying large numbers of Kea servers, where this becomes impractical. We are planning to continue working on Kea security and on more granular access controls in 2021, as our support customer base expands from mostly service providers to include an increasing proportion of enterprise users, many of whom have enterprise-wide application security standards.

ISC DHCP

We released versions 4.4.2 and 4.1-ESV-R16 of ISC DHCP. The software is now in minimal-maintenance mode, but we are still receiving and responding to pull requests and issues from open source users for ISC DHCP, particularly the client and relay. We did add one new feature: support for the new RFC 8925. We have also addressed a number of issues submitted by users, with patches that are published in our GitLab repo.

In 2021 and beyond, ISC plans to decrease its involvement in the maintenance of dhclient and dhcrelay.

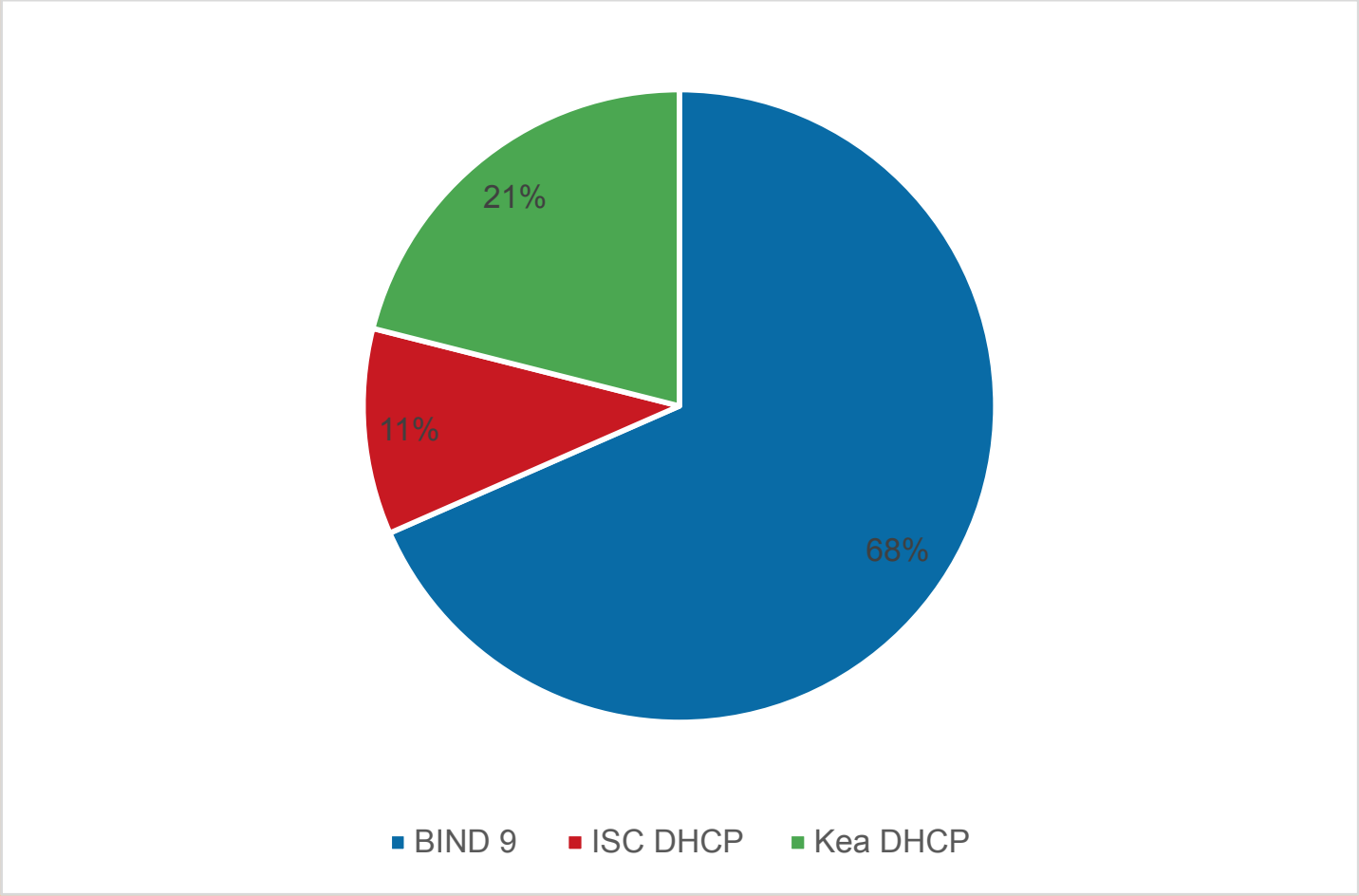
Although we are no longer performing active development work on this legacy software, ISC DHCP is still widely used throughout the Internet and remains important to ISC's support customer base.

SOFTWARE SUPPORT

ISC's revenues come primarily from support services for our software products; our technical support business has been growing modestly for several years. At the end of 2020, ISC had 152 customer support contracts representing 133 distinct customers; this was an increase of 11 customers and 22 contracts compared to 2019. Some of our customers purchase support contracts for more than one ISC software package.

BIND 9 support is our most popular product, but in 2020 we continued to see strong growth in the number of support contracts for the Kea DHCP server.

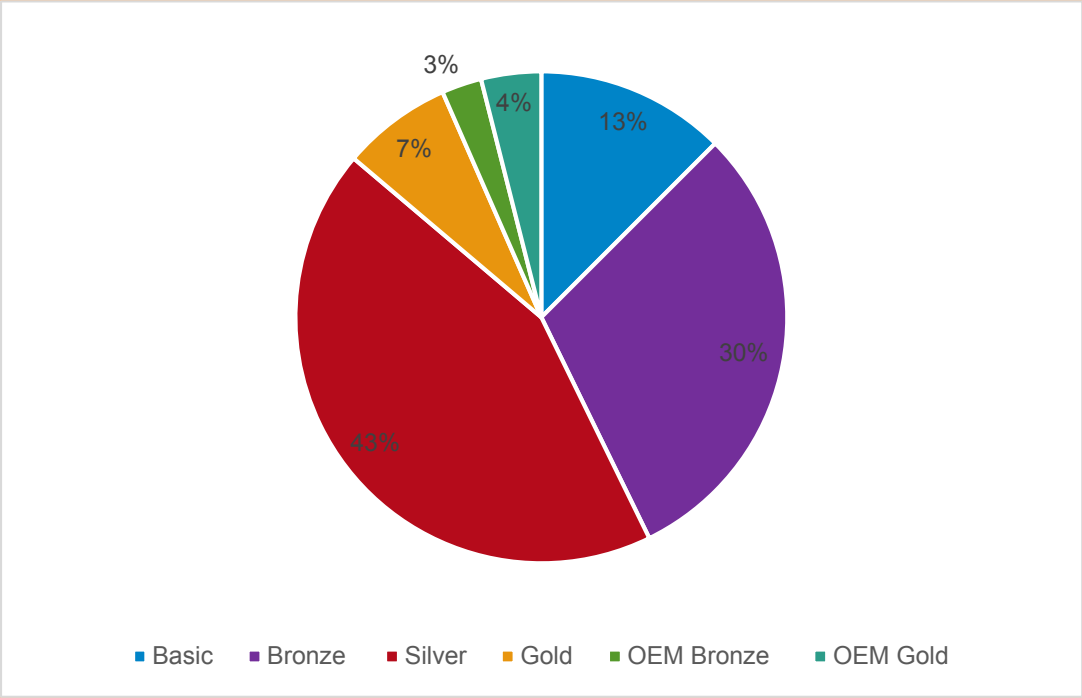
Support Contracts by Product (as of 12/31/2020)



More than half of our customers opt for the Silver or Gold support level, which includes 24x7 response to critical issues and premium software for BIND 9 subscribers.

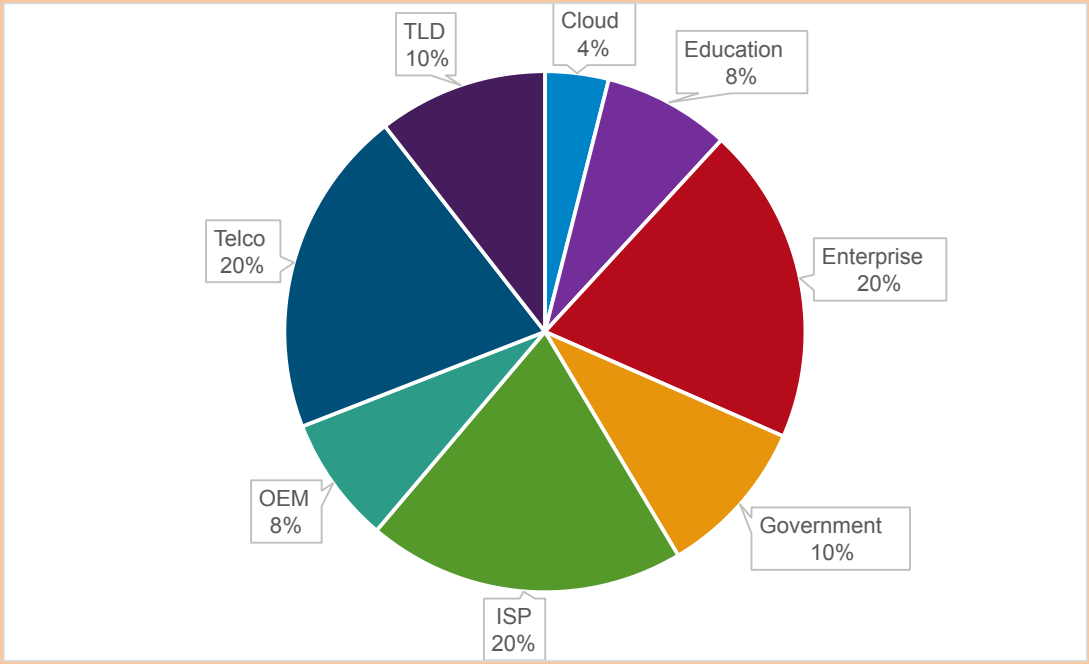
Many open source users tell us that they need the option of premium software to justify paying for technical support; more than half of our BIND customers choose a support level that provides it. All Kea support subscribers also get access to premium software.

Support Contracts by Service Level, All Products (as of 12/31/2020)



Most of our customers are Internet service providers, carriers, or large enterprises.

Support Customers by Industry (as of 12/31/2020)



Support Issues and Trends

To a great extent, the support team is the communications center at ISC. Our engineers hear from our users and support customers about things that are not working as expected or desired, and often they receive the first reports of particular requirements or use cases. The support staff write or review nearly all of the articles in our Knowledgebase, and many of those documents evolve from support problems we work on with our customers.

Our support customers range from organizations that want us to provide them with a certified, ideally containerized, image and a "standard configuration" template, to large service providers who are running a modified version of our software in a product or service they have created. Some of these providers integrate multiple components, including some we know nothing about. While some of our customers are very comfortable with building and modifying their own software to accomplish tasks we never envisioned, others want ISC to give specific configuration instructions.

One of ISC's primary engineering goals is to implement customer-requested enhancements, as identified by the support team. In 2020, the BIND development team's work was focused on completing the network manager refactoring and the encrypted DNS transports that rely on that, which meant that some features our customers are anticipating had to wait, but the Kea development team added new customer-requested changes to every monthly release in 2020. Both groups have a healthy list of good projects to tackle in 2021.

With both our ISC packaged software versions and in our test environment, we try to control the number of platforms we explicitly support so we are not overwhelmed with platform-specific issues, but we are constantly asked to support both older and newer operating systems. In 2020, we added support for Alpine Linux for both BIND and Kea, and ceased supporting both the long-lived Red Hat version 6 and 32-bit Windows (BIND only). Our dependency on other open source software, such as OpenSSL and Libuv, also sometimes limits the OS versions we can support. The current list of supported platforms is available in both the BIND (https://gitlab.isc.org/isc-projects/bind9/-/blob/main/PLATFORMS.md) and Kea (https://gitlab.isc.org/isc-projects/kea/-/blob/master/platforms.rst) GitLab repositories.

In 2020 we saw several clusters of issues with BIND:

- We had reports of performance problems with 9.16, through which we discovered anew that resolver performance testing is an art form. In some of these cases we did detailed analysis of the cache contents of customer resolvers and discovered troubling numbers of NXDOMAIN answers in cache. Our plan to address the resolver issue was to hire an expert in resolver testing to help develop a new, more realistic performance test to help us optimize performance in real-world deployments.

- We also had some reports of problems with hardware service module (HSM) integration from some of our ccTLD customers. As a virtual organization, testing a specific bit of hardware is a challenge for ISC; we very much appreciate the folks at Utimaco who have published an HSM simulator (https://support.hsm.utimaco.com/hsm-simulator).

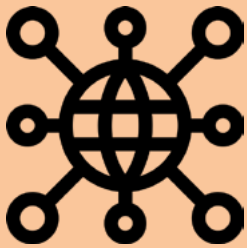
- Some BIND Subscription-Edition users who hoped to leverage EDNS Client-Subnet Identifier

(ECS) for various proprietary service-creation purposes struggled with the way the client-subnet ID was handled as it passed through load-balancers and forwarders.

We saw a significant increase in the number of Kea support customers in 2020. Most of our Kea support tickets in 2020 fell into two categories:

- Service providers, typically access providers, sought advice on scalability, high availability, and features such as client classification and host reservations for greenfield services.
- ISC DHCP users contacted us for advice on migrating to Kea, often looking for equivalent functionality in both packages.

In addition to customer-initiated support tickets, the monthly releases of BIND and Kea and the necessary Advance Security Notifications kept the support team busy in 2020, with communications and updates to our customers. We are fully up-to-speed on providing special access tokens for our support customers to access the private ISC package repositories on Cloudsmith, although relatively few users avail themselves of these packages at this point.



ISC's Customers, in Their Own Words

I just wanted to say how much I appreciate you [...]. This is a thank-you because so many vendors do so badly [with explanations] and ISC.org does so consistently well. A boon to DNS operators everywhere!

[Customer] has been a happy customer of ISC for many years [...]. We have gotten excellent value from the relationship, and I am glad [Customer] has been able to help support the important work the ISC does.

F-ROOT AND TECHNICAL OPERATIONS

The F-Root operations team made significant upgrades in 2020.

- The F-Root management infrastructure was logically and physically separated from ISC's corporate infrastructure, to improve security and allow for better cost accounting of the F-Root function. We also added multiple new management tools for F-Root.
- The team audited the configuration and stability of the systems and network connectivity at all the F-Root sites, which are located in IXes in many underserved areas around the world. We noted that IPv6 connectivity is improving.
- We began taking steps to automate the peering management of the 3300+ active BGP peering sessions in the F-Root Anycast network.
- We migrated from Quagga to BIRD and centralized BGP route collectors for a global view of our transit and peering. We published many more RPKI "ROAs" to help secure our IP space against BGP hijacks.
- Ray Bellis produced a new Root System visualizer and announced it to the RSSAC Caucus list.
- ISC participated in the annual Day In the Life (DITL) data collection for OARC.

In 2020 we added these new nodes to the F-Root system:

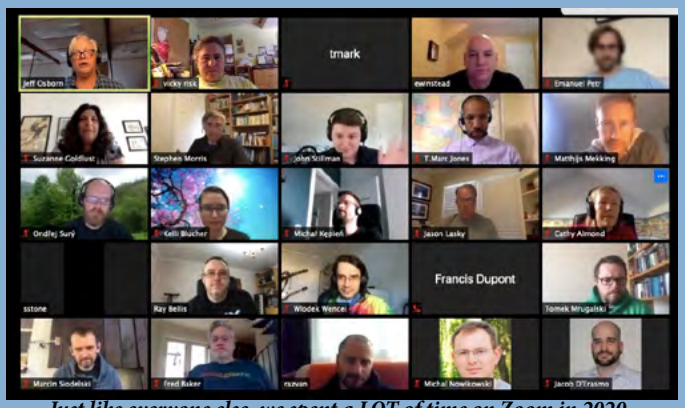
- Chongqing, China, with local sponsor CAICT
- Qinghai, China, sponsored by CNNIC
- Hanoi and Ho Chi Minh, Vietnam, both sponsored by VNNIC
- Kaunas, Lithuania, sponsored by Kaunas University of Technology
- Riyadh, Saudi Arabia, sponsored by SAIX
- Moscow, Russia, sponsored by MSK-IX
- A second node in Chicago, US, sponsored by Chicago IX

With the help and support of our local partners we were able to bring online refreshed hardware in Port-au-Prince, Haiti; Podgorica, Montenegro; Philipsburg, St. Maarten; and Turin, Italy (all ISC-funded); Hong Kong, China (sponsored by HKIX); Osaka, Japan (sponsored by NTT); Kuala Lumpur, Malaysia (thanks to PPIM); and Suva, Fiji (thanks to APNIC).

As of the end of 2020, F-Root consists of three "global" sites, 16 "classic" sites, and 42 "F-single" sites, in addition to over 200 F-Root instances hosted by Cloudflare. The global sites host 2x F-Root servers and F-Root management infrastructure. A classic site comprises 2x F-Root servers, a console server, routers, and switches. An F-single is our current configuration, which relies on a single 1U server to provide both the F-Root service and BGP Anycast. The classic sites are all expected to be phased out and upgraded to the F-single configuration by the end of 2022.

ISC'S PEOPLE

Internet Systems Consortium consists of Internet Systems Consortium, Inc. (a not-for-profit company) and its wholly owned subsidiary Internet Systems Corporation, both incorporated in Delaware with headquarters in New Hampshire, USA. Internet Systems Consortium, Inc. is a nonprofit corporation under US IRC 501(c)(3) with the status of public charity under IRC 509(a)(1) and 170(b)(1)(A)(vi). Our US Federal EIN is 20-0141248.



Just like everyone else, we spent a LOT of time on Zoom in 2020. Beards and long hair were popular this year.

Board of Directors

ISC's Board of Directors is currently made up of four members, each with a long and significant history of involvement with the Internet: Rick Adams (Chairman of the Board), Fred Baker (Director), David J. Farber (Director), and Stephen Wolff (Director).

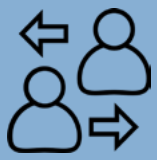
Management

ISC is currently managed by Jeff Osborn (President), Ondřej Surý (Director of DNS Development), Tomek Mrugalski (Director of DHCP Development), Ray Bellis (Director of DNS Operations), Vicky Risk (Director of Marketing and Product Marketing), T. Marc Jones (Director of Sales), and Jacob D'Erasmo (Director of Finance). Robert Carolina is our General Counsel.

Professional Affiliations

ISC staff continue to participate vigorously in DNS community events and organizations.

In 2019, Ondřej Surý was re-elected to another two-year term on the Board of Directors of the DNS Operations, Analysis, and Research Center (DNS-OARC), of which ISC is a "Silver" member.



ISC participates in the Internet Corporation for Assigned Names and Numbers (ICANN) Root Server System Advisory Committee (RSSAC). Ondřej Surý is one of the seven Recovery Key Share Holders for Root Zone DNSSEC Keys, a member of The Registry Services Technical Evaluation Panel (RSTEP), and a member of the RSSAC. Jeff Osborn and Fred Baker have served on the RSSAC since 2017; Fred has been co-chair since 2018, and Jeff is the chair of the RSSAC Caucus Membership Committee. Ray Bellis and Dan Mahoney are also members of the RSSAC Caucus.

The Internet Society (ISOC) promotes the open development, evolution, and use of the Internet for the benefit of all people throughout the world. The work is mainly focused on influencing policy and education, and ISOC is the umbrella organization for the Internet Engineering Task Force (IETF). In

2015, Jeff Osborn became the ISC delegate to the Organization Members Advisory Council (OMAC) and continued in that role through 2020; David Farber, one of ISC's directors, served as a trustee of the Internet Society.

ISC sends developers to every IETF meeting and our engineers participate vigorously in the development of new standards. Fred Baker serves as chair of the IPv6 Operations (v6ops) group; Tomek Mrugalski was co-chair of the DHC working group until mid-2020.

Réseaux IP Européens (RIPE, French for "European IP Networks") is the RIR responsible for Europe and the Middle East. RIPE is also a Root System Operators peer, as they operate K-Root. ISC hosts a RIPE Atlas Anchor at its datacenter in Palo Alto, and ISC technical staff participate in RIPE community meetings.

Cathy Almond continues her role as vice chair of the Programme Committee for the UK Network Operators Forum (UKNOF), while Ray Bellis serves on its Advisory Council. He took the seat previously held by Stephen Morris, who retired in June 2020 after ten years at ISC.

Eddy Winstead is a member of the North American Network Operators' Group (NANOG) program committee, and co-chair of its Outreach program.

Staff Contributions to Other Projects

- Francis Dupont wrote and contributed the BSD kernel implementation of ILNP, the Identifier Locator Network Protocol. This is an IETF draft that has significant potential in an IPv6-only environment, such as a datacenter, to simplify the creation of overlay networks.

- Dan Mahoney performs release engineering and wrangles tickets for the Trusted Domain Project's OpenDMARC software.

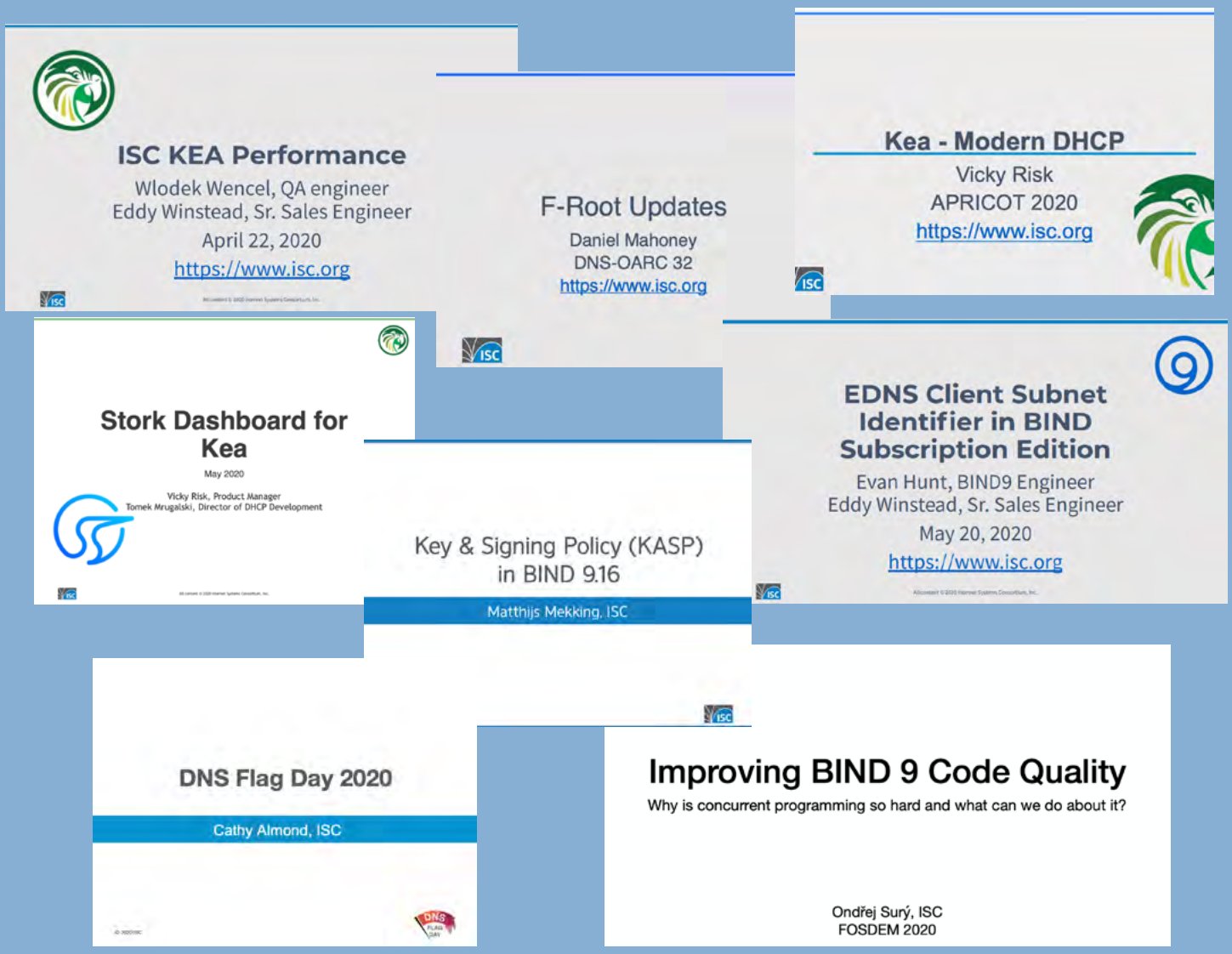
- Ondřej Surý has been providing Debian packages for PHP for many years; he also commits improvements to libuv.

- Michał Kępień contributed a new diff option for Git.

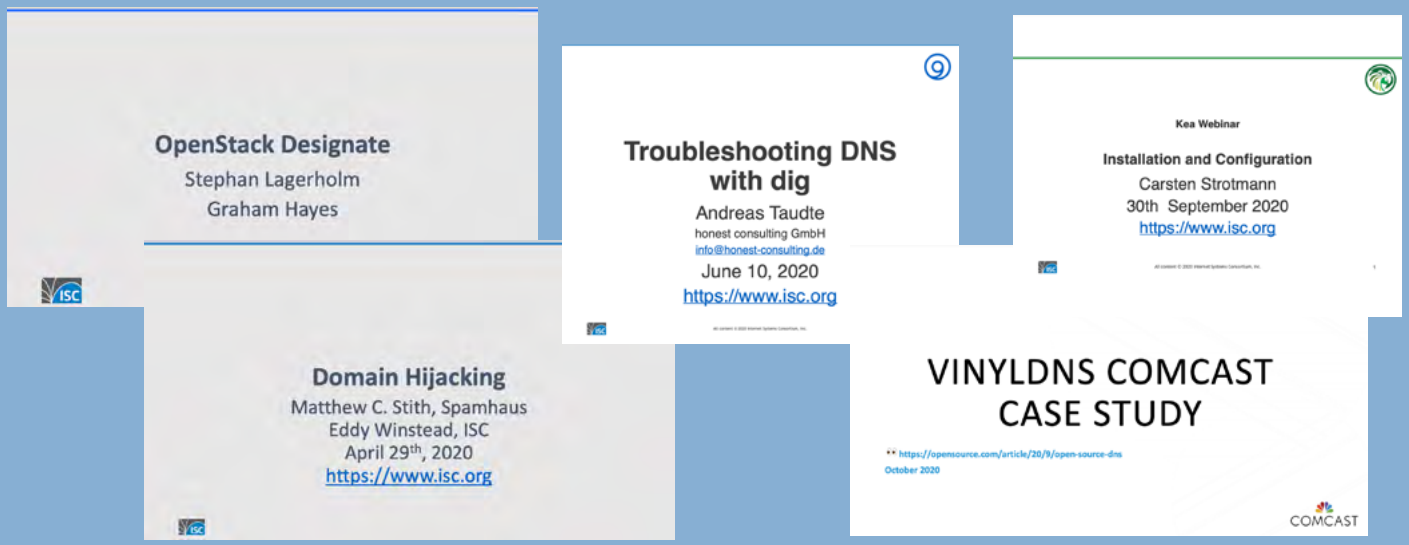
- Jake D'Erasmo created a new accounting system for the Newmarket Fire Department.

Public Presentations

We gave 33 public webinars and conference talks, all of which are archived on ISC's website.



We had a record number of non-ISC guest presenters: Andreas Taudte, Joe Crowe and Paul Cleary, Stephan Lagerholm and Graham Hayes, Matt Stith, and Carsten Strotmann.



OUR CONTRIBUTORS

Many, many thanks to the significant technical contributors from our user community.

BIND 9

- Emanuel Almeida of Cisco Systems, Inc., who reported the BIND vulnerability that became CVE-2020-8620.
- Joseph Gullo, who reported the BIND vulnerability that became CVE-2020-8621.
- Dave Feldman, Jeff Warren, and Joel Cunningham of Oracle, who reported BIND CVE-2020-8622.
- Lyu Chiy, who reported BIND CVE-2020-8623.
- Joop Boonen of credativ GmbH, for reporting BIND CVE-2020-8624.
- Tony Finch, who helped us fix a subtle bug in the KASP feature in BIND.
- Aaron Thompson, who upgraded our native PKCS#11 EdDSA implementation to PKCS#11 v3.0 and added EdDSA support for OpenSSL.
- Paul Frieden of Verizon Media, who exported the BIND zone timers to the statistics channel.
- Graham Clinch, who reported a problem with named-checkconf.
- Alberto Fernández, who found a problem with adding zones with double quotation marks.
- Tobias Klein, who found and reported that DNS rebinding protection was ineffective when BIND 9 was configured as a forwarding DNS server.

Kea DHCP

- Niclas Rozenvik, who reported an issue in Kea and proposed a fix.
- Alexander Pyhalov, who submitted a fix for KeaMA on Illumos.

ISC DHCP

- Frederic Bor, who submitted a patch for ISC DHCP virtual interface support.
- Tim McLaughlin, who pointed out some spots we missed when we added support for SHA 256/512 in ISC DHCP 4.4.3.

Other Contributors

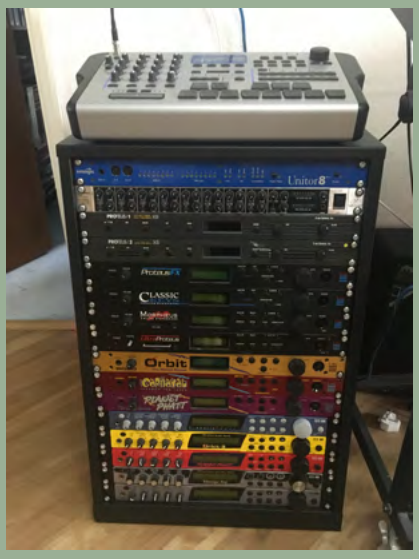
We also offer our thanks to:

- Andreas Taudte, Joe Crowe and Paul Cleary, Stephan Lagerholm and Graham Hayes, and Matt Stith, all of whom took the time to prepare and present webinars for our open source users.
- Our stalwart ISC DHCP community experts, Simon Hobson, Sten Carlsen, Bill Shirley, Bob Harold, Niall O'Reilly, Glen Satchell, and Gregory Sloop, who are helping a whole new generation of users with their ISC DHCP issues via the dhcp-users mailing list.

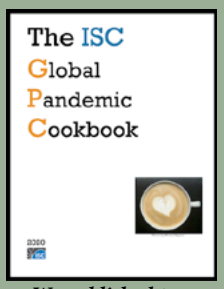
- Numerous other BIND, Kea, and ISC DHCP users, who provided expert advice to others on our user mailing lists. ISC staff could not possibly answer all these questions ourselves, not only because of the number of questions but because we don't have the depth and variety of operational experience our users have. We are grateful for these contributions of technical expertise.

How We Spent Our 2020

Fred Baker spent time outdoors with his grandkids!



Ray Bellis worked on his large collection of E-mu synths and samplers!



We published two employee cookbooks!

We had lots of fun playing with the backgrounds and filters on Zoom – and we know you did too.

Thank you for reading our 2020 Annual Report, and for being part of the open source community. We look forward to continuing to serve you for many years to come.

Does your company or organization use ISC's software products? If you're not already a customer, please consider purchasing a support subscription! Find out more at https://www.isc.org/support.

Or you can show your love for open source by purchasing merchandise from our swag store! Check it out at https://shop.isc.org.