The IANA Functions

An Introduction to the Internet Assigned Numbers Authority (IANA) Functions

Contents

Introduction

The IANA functions include the management of protocol parameters, Internet number resources and domain names. The Internet Corporation for Assigned Names and Numbers (ICANN) performs these functions on behalf of the global Internet community.

The IANA Functions

The IANA functions are the coordination of some key elements that keep the Internet running smoothly. These functions are typically divided into three core areas:

PROTOCOL ASSIGNMENTS

Management of protocol parameters involves maintaining many of the codes and numbers used in Internet protocols. This is done in coordination with the Internet Engineering Task Force (IETF). See page 7 for more details.
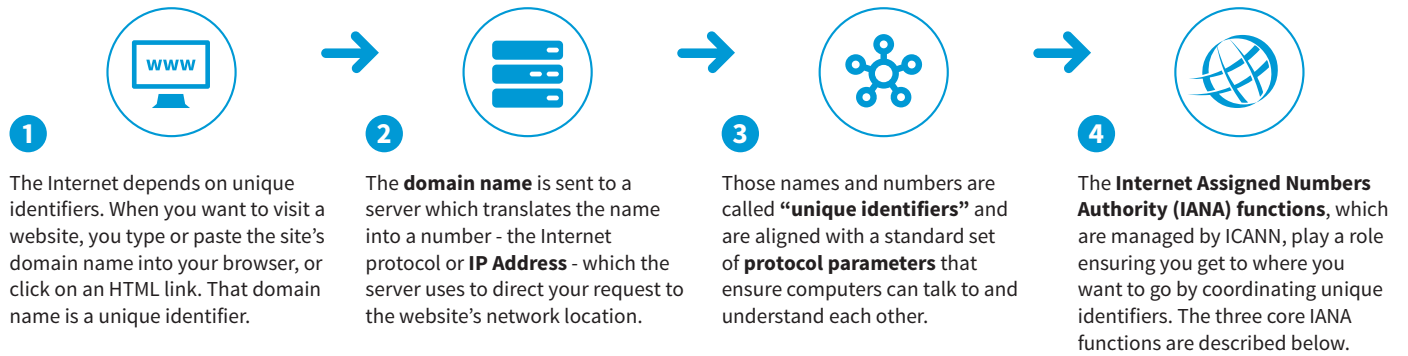
INTERNET NUMBER RESOURCES

Management of Internet number resources involves the global coordination of the Internet Protocol addressing systems, commonly known as IP addresses. The allocation of blocks of autonomous system numbers (ASNs) to regional Internet registries (RIRs) is another part of this function. See page 12 for more details.

ROOT ZONE MANAGEMENT

Management of the root zone involves assigning the operators of top-level domains, such as .uk and .com, and maintaining their technical and administrative details. The root zone contains the authoritative record of all top-level domains (TLDs). See page 14 for more details.

WHAT ARE UNIQUE IDENTIFIERS?

1 The Internet depends on unique identifiers. When you want to visit a website, you type or paste the site's domain name into your browser, or click on an HTML link. That domain name is a unique identifier.

2 The **domain name** is sent to a server which translates the name into a number - the Internet protocol or **IP Address** - which the server uses to direct your request to the website's network location.

3 Those names and numbers are called **"unique identifiers"** and are aligned with a standard set of **protocol parameters** that ensure computers can talk to and understand each other.

4 The **Internet Assigned Numbers Authority (IANA) functions**, which are managed by ICANN, play a role ensuring you get to where you want to go by coordinating unique identifiers. The three core IANA functions are described below.

THE HISTORY

The IANA functions were developed during the administration of the ARPANET, a US goverment-funded Department of Defense network. Originally, just one person - Jon Postel - performed the functions. Since then, the Internet has grown tremendously and the IANA functions are now managed by ICANN.

UNDERLYING PRINCIPLES

The actual maintenance requirements and administrative actions necessary to perform each of the IANA functions differ, but all involve the same basic principles:

- **All activities are performed in a professional, fair and neutral manner according to the policies and guidelines developed by the applicable IANA functions' stakeholders.**
- **Accurate and authoritative registries are maintained and made available to the public without cost.**

THE IANA FUNCTIONS OPERATOR DOES	THE IANA FUNCTIONS OPERATOR DOES NOT
✔ **Create registries based on policies from the community**	✖ **Determine what can be a domain name**
✔ **Maintain existing registries**	✖ **Create nor interpret policy**
✔ **Allocate Internet number resources**	✖ **Choose TLD managers**
✔ **Publish all registries for general public use**	

More details about what ICANN does and does not do in its performance of the IANA functions can be found in the following sections: Protocol Parameters on page 7, Internet number resources on page 12 and domain names on page 14.

Defining the Policies Governing How the IANA Functions are Performed

The policies for protocol parameters, Internet number resources and domain names are defined by organizations representing the global Internet community. These organizations use various forums provided by ICANN or use other well-established policy development processes to develop consensus-based policy. More details about how policy is defined for each of the IANA functions can be found in the following three sections. Participation in these organizations and all others that develop policy that may impact or be impacted by these services is encouraged.

More information: **icann.org/policy**

IANA Functions Stakeholders

The United States Department of Commerce's National Telecommunication and Information Administration (NTIA) currently, pursuant to a contract, plays a role as steward of ICANN's performance of the IANA functions. Various other stakeholder organizations also play important roles with respect to ICANN's performance of the IANA functions, some through written agreements with ICANN. More details about these roles and relationships can be found in the following three sections.
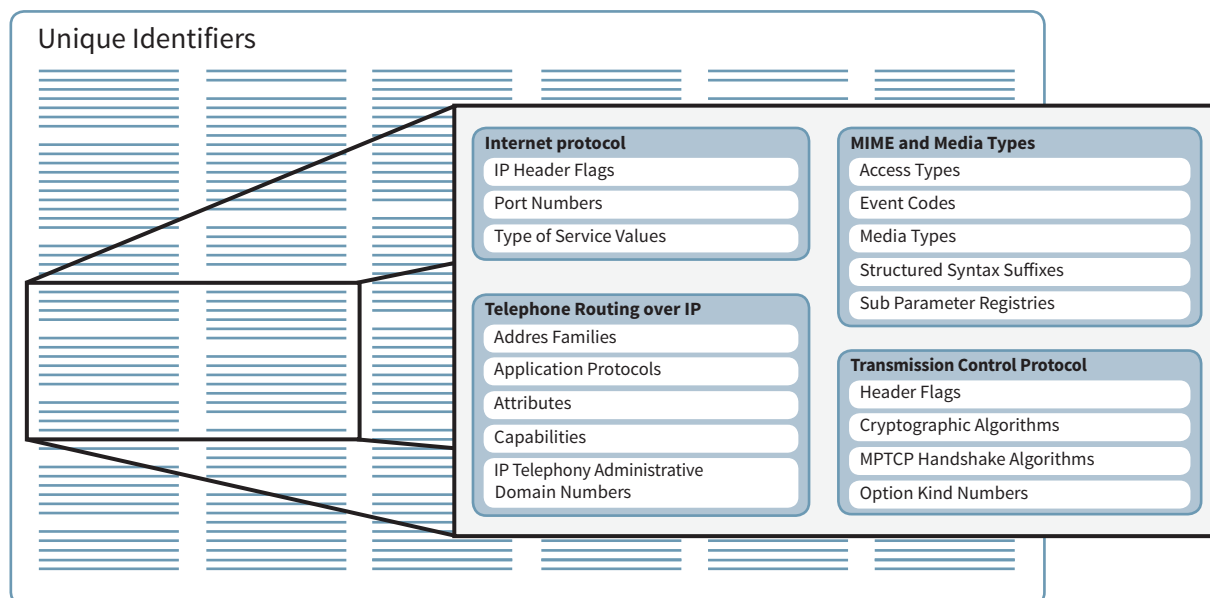
The IANA Functions: Protocol Parameters

- The Internet Engineering Task Force (IETF) develops Internet protocols and policy for those protocols.
- The Internet Architecture Board (IAB) reviews ICANN's performance of the protocol parameter function as delineated in the MoU between ICANN and the IAB and the IETF.
- ICANN creates and maintains the tables containing protocol parameters, and coordinates the requests for assignments of parameters.

What are Protocol Parameters?

Protocols are sets of agreed forms of communication. Standardization of Internet protocols is essential for ensuring the Internet continues to work and enables those using equipment or software from different vendors to communicate effectively. While domain names and Internet number resources are specialized forms of protocol parameters, there are many more Internet protocols that require coordination. All Internet protocols have values or parameters that must be globally unique.

All Internet protocols have values or parameters that need to be globally unique.

These Internet protocols and their parameters define a common language by which devices can communicate with each other in an understandable way. Typically, each protocol defined by the IETF will have one or more protocol parameter registries that allow independent implementers of the protocols to select the right values to enable those implementations to interoperate.

Some common types of protocol parameters are:

- Port numbers: e.g. port number "80" is used for web page transmission, i.e. "HTTP".
- Private Enterprise Numbers (PENs): unique identifiers typically used in network management systems to uniquely identify network components.
- Language tags: used to mark content on the Internet based on which language it contains, e.g. "fr" for French or "en" for English.
- HTTP Status Codes: e.g. status code "404" meaning "Page Not Found".
- Media Types: used to mark the file format of content transferred over the Internet, such as "video/h264" for video streaming. See diagram below.

One protocol parameter is the type of content attached to emails or embedded in web pages. For example, if you wanted to find out more about the MPEG 4 audio "media type", this is what you'd see in the IANA registry:

ICANN maintains over 2,800 protocol parameter registries and sub registries.

SAMPLE EXTRACT OF MEDIA TYPE REGISTRY		
NAME	**TYPE**	**REFERENCE**
mosskey-request	**application/mosskey-request**	**RFC1848**
mp4	**application/mp4**	**RFC 1848, RFC6381**
mpeg4-generic	**application/mpeg4-generic**	**RFC3640**
mpeg4-iod	**application/mpeg4-iod**	**RFC4337**
mpeg4-iod-xmt	**application/mpeg4-iod-xmt**	**RFC4337**
mrb-consumer+xml	**application/mrb-consumer+xml**	**RFC6917**
mrb-publish+xml	**application/mrb-publish+xml**	**RFC6917**
msc-ivr+xml	**application/msc-ivr+xml**	**RFC6231**
msc-mixer+xml	**application/msc-mixer+xml**	**RFC6505**

The user can click to see more information about how each protocol parameter should be used. Read more about RFCs below.

📄 More information: **iana.org/protocols**

Who Creates Internet Protocol Parameters?

The IETF is an inclusive technical forum open to anyone that develops Internet technical standards and protocols. It does this by using a defined standards-drafting process and consensus-based approval process. The IETF's standards-drafting process results in the creation of documents called 'Requests for Comments' (RFCs). RFCs describe the communication mechanism in use, or proposed for use, for Internet protocols.

📄 Find out more about the IETF at **ietf.org**

Who Determines the Policies?

It is up to the IETF community to determine the policies for the protocol parameter registries maintained by ICANN. All IETF protocol parameter registries are created through the publication of RFCs. In those RFCs the policy for the registration procedures that ICANN implements for each registry are defined.

Non-IETF registries may be created by other processes. For example, the "IPv4 Recovered Address Space" registry was created to implement a community-developed policy (see page 13). A public comment period was opened and the results led to the creation of this registry. No RFC relating to this registry was published.

📄 More information about the registration procedures used by the IETF can be found in RFC 5226: **iana.org/go/rfc5226**

PUBLIC COMMENT IS AN OPPORTUNITY FOR ALL STAKEHOLDERS TO PROVIDE INPUT AND FEEDBACK ON ALL AREAS OF ICANN'S WORK. FIND OUT MORE ABOUT THE PROCESS AT ICANN.ORG/PUBLIC-COMMENTS

ⓘ

Administration of the .ARPA Domain

The .ARPA domain, the management of which is an IANA function, is used for protocols that require some form of operational infrastructure in the domain name system, for example, a way of translating an IP address into a domain name.

The .ARPA top-level domain houses various sub-domains that are used for Internet infrastructure purposes. ICANN administers the .ARPA domain in line with the policy outlined in RFC 3172 and in close liaison with the Internet Architecture Board (IAB). The IAB is charged with the technical and engineering development of the Internet and is responsible for managing and developing the policies associated with .ARPA.

📄 Read more about the policy at **iana.org/go/rfc3172**

📄 More information: **iana.org/domains/arpa**

What Review is Involved?

ICANN implements the protocol parameter function pursuant to agreements with the IAB and IETF. ICANN and the IETF entered into a memorandum of understanding in 2000 concerning the technical work of the IANA functions (see **iana.org/go/rfc2860**). Every year since 2007, ICANN and the IETF have reviewed the supplemental service level agreement that includes annual deliverables and performance goals for the protocol parameter work. Service Level Agreements can be found at **icann.org/resources/pages/agreements-en**

📄 More information: **iana.org/protocols**

ICANN's Role in Performing the Protocol Parameter Function

As Internet protocols are used globally, there must be a publicly available record of the authoritative answer to the following question: What value should be used in a particular situation for each protocol used on the Internet? ICANN, in accordance with policy established by the IETF and pursuant to agreements with the IETF and the IAB, maintains the definitive repository of the protocol parameter registries used in most Internet protocols documented in the RFC series.

REVIEW AND IMPLEMENTATION OF IANA CONSIDERATIONS

As a draft RFC nears its approval stage, ICANN's IANA specialists participate in the RFC review process, identifying where protocol assignments should be located within the registries that ICANN maintains. Most RFCs include a section called 'IANA Considerations' which describes the protocol parameter-related actions to be implemented by ICANN upon approval of the draft document. These actions include, as applicable, creating new registries and/or modifying existing registries to add or modify protocol parameter entries.

Once a protocol parameter registry has been published, subsequent updates to the protocol or new features within that protocol may require updates to that relevant registry. In many cases, it is ICANN's IANA specialists' task to evaluate any requests for additions and modifications and ensure all records are updated correctly. In other cases, the IANA specialists will consult with community experts to make protocol parameter registry modifications. Some protocols allow for updates to be made directly by ICANN's IANA specialists rather than requiring a new RFC to be published.

The IANA Functions: Internet Number Resources

- The five regional Internet registries (RIRs) and their communities develop global policy.
- The ICANN Address Supporting Organization Address Council is responsible for reviewing the execution of the global policy development process.
- The five RIRs monitor and review ICANN's performance of the numbers function.
- ICANN maintains the number registries and is responsible for allocation of Internet Protocol addresses (IPv4 and IPv6) and autonomous system numbers to the RIRs.
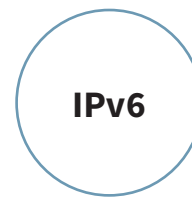
IP Addresses: IPv4 and IPv6

THERE ARE AROUND 4.3 BILLION IPv4 ADDRESSES AND AROUND 340 UNDECILLION (3.4 X 10^{38}) IPv6 ADDRESSES. AS OF 2014, 99% OF IPv4 SPACE AND LESS THAN 1% OF IPv6 SPACE HAS BEEN ALLOCATED.

At its core, the Internet works by passing data between devices using a system of unique identifiers called IP addresses. Today, there are two types of IP addresses in use:

IPv4

192.0.2.53

IPv6

2001:db8:582::ae33

Autonomous System Numbers (ASNs)

ASNs are used to uniquely identify a routing domain controlled by a single administration. In order for traffic to flow from a source Internet address to a destination, network operators need to "announce" the addresses for which they provide connectivity to other network operators. Network operators often want to define certain policies for subsets of their addresses, for example, to favor one of their neighbor network operators for cost or performance reasons. ASNs allow network operators to group subsets of their Internet addresses to apply these different policies.

The Role of the RIRs

The five RIRs are not-for-profit, membership-based organizations that operate in distinct regions.

Each RIR distributes the Internet number resources allocated to it to network operators in its region according to the allocation and assignment policies defined by its own regional community. These regional policies are developed using the RIRs' individual open, bottom-up, consensus-based policy development processes. Each RIR community is open to all and anyone can take part in the policy development process.

ARIN   RIPE NCC
LACNIC   APNIC
AFRINIC

Map showing each of the five RIRs' service regions.

Who Develops the Global Policies?

Global policies are developed collectively by all five of the RIR communities. An identical version of a global policy proposal must have consensus from all five of the RIR communities before it can be recommended for ratification, and then implemented by ICANN.

Who Ensures that the Global Policies are Implemented?

The ICANN ASO Address Council is responsible for ensuring that the documented global policy development process has been followed correctly in each of the five RIR communities.

Other supporting organizations and advisory committees in the ICANN structure are invited to comment on a proposed global policy before it is forwarded to the ICANN Board for ratification.

The five RIRs, working collectively as the Number Resource Organization (NRO), monitor and review ICANN's performance of the IANA functions relating to Internet number resources.

ICANN's Role in Performing the Numbers Function

ICANN is responsible for maintaining the record of allocated and unallocated blocks of IPv4 addresses, IPv6 addresses and ASNs; and is responsible for allocating large blocks of IP addresses and ASNs to the five RIRs according to global policies.

PREFIX	DESIGNATION	DATE	STATUS
5F00::/8	IANA	2008-04	Reserved
3FFE::/16	IANA	2008-04	Reserved
2C00:0000::/12	AFRINIC	2006-10	Allocated
2A00:0000::/12	RIPE NCC	2006-10	Allocated
2800:0000::/12	LACNIC	2006-10	Allocated
2600:0000::/12	ARIN	2006-10	Allocated
2400:0000::/12	APNIC	2006-10	Allocated
2620:0000::/12	ARIN	2006-09	Allocated
2001:B000::/12	APNIC	2006-03	Allocated

A sample list of the reserved and allocated IPv6 address space maintained by ICANN.

📄 More information: **iana.org/numbers**

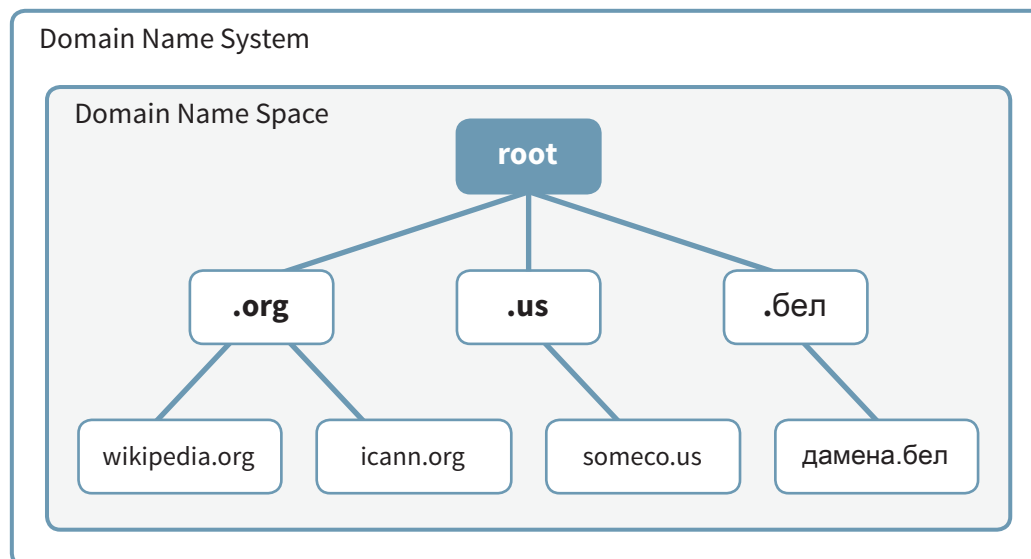# The IANA Functions: Root Zone Management of the Domain Name System

- ICANN's Generic Names Supporting Organization (GNSO) and Country Code Names Supporting Organization (ccNSO) develop policy relating to most top-level domains.
- ICANN is responsible for processing change requests for the Root Zone File and Root Zone Database. It evaluates, coordinates and reports on requested changes, as well as managing the Root DNSSEC Key Signing Key (KSK).
- Verisign maintains and distributes the Root Zone File, and also manages the Root DNSSEC Zone Signing Key (ZSK).
- The U.S. Department of Commerce's National Telecommunication and Information Administration (NTIA) provides general stewardship of ICANN's performance of the root zone management function. NTIA also verifies that ICANN followed established process in requesting changes to the authoritative root zone and authorizes Verisign to implement changes in the root zone.

DOMAIN NAMES

The Internet depends on domain names as a key type of unique identifier used to access resources online. When you want to visit a website, such as http://www.icann.org/, you type or paste the site's domain name www.icann.org into your browser, or click on an HTML link. That domain name is a unique identifier

THE DOMAIN NAME SYSTEM (DNS)

The DNS is divided into a hierarchy. Each 'dot' in a domain name represents a new level in the hierarchy.

Domain Name System

Domain Name Space

root

.org   .us   .бел

wikipedia.org   icann.org   someco.us   дамена.бел

At the top of this hierarchy is the root. The root contains information about top-level domains:

- Generic Top-Level Domains (gTLDs)
  General purpose domain names are those such as .com, .org, .click, .info or .公益 , or ones that are related to specific fields of interest, such as .coop, .museum, or .cat. There are also generic top-level domains for use by a single entity or brand.
- Country Code Top-Level Domains (ccTLDs)
  These domains are designated to represent a country or territory, and are eligible for delegation based on the ISO 3166-1 standard. ccTLDs may be represented in Latin or other scripts. Examples of ccTLDs include .br, .fr .mx and .рф.

ROOT NAME SERVERS

For the DNS to work, there must be servers that respond to the queries that initiate the translation between domain names and the values associated with those names. These servers, called 'root servers', form an important part of the DNS. Many root server instances are located all over the world, and are operated by 12 different organizations.

> THERE WERE AN AVERAGE OF 62 CHANGES TO THE ROOT ZONE FILE PER MONTH IN 2014. SEE PAGE 17 FOR MORE DETAILS.

WHO DEFINES THE POLICIES?

Multiple bodies within the ICANN policy development framework provide input into the policies used to manage the root of the DNS. For TLDs, the ccNSO and GNSO provide global-level policy recommendations to be applied to the management of ccTLDs and gTLDs in the root, respectively. These policies are created using open policy development processes.

Advice on the technical management and configuration of the root is provided by a variety of different communities, including the ICANN Root Server System Advisory Committee (RSSAC) and the ICANN Security and Stability Advisory Committee (SSAC). ICANN's other two Advisory Committees (the At-Large Advisory Committee and the Governmental Advisory Committee) consider and provide advice to the ICANN Board on

policy matters. Open consultation is also used to engage industry experts and operators in activities such as developing the parameters by which Domain Name System Security Extensions (DNSSEC) were implemented in the root.

WHAT REVIEW IS INVOLVED?

When a request is made to change any information contained within the root, the details of the request are transmitted by ICANN to NTIA as a recommendation for implementation in the root. NTIA verifies that ICANN followed established procedure and policy in processing the change request; and then authorizes Verisign and ICANN to implement the change in the authoritative root zone file and root zone database, respectively.

When requests for delegations or redelegations of ccTLDs are made, the ICANN Board of Directors is also called upon to check that ICANN staff correctly followed and applied all procedures in evaluating the requests.

ICANN'S ROLE IN PERFORMING THE DOMAIN NAMES FUNCTION

Based on established policies and procedures, ICANN acts as the global coordinator of the DNS root. It is responsible for:

- Evaluating, and recommending for approval, creation of, or changes to, TLDs in the root.
- Reviewing the requested changes to the root zone are implemented and the implementation communicated to the requester.
- Evaluating requests for changes to the root zone to ensure that they comply with current policies and procedures.
- Updating the details in the root zone database (including details published in the "WHOIS" service) to reflect changes in the information associated with TLDs.
- Managing the Key Signing Key (KSK) for the root zone, which is central to implementing security of the DNS using the DNSSEC protocol enhancements.

More information: **iana.org/domains**

FIND OUT MORE ABOUT DNSSEC, KEY SIGNING KEYS AND KEY SIGNING CEREMONIES AT: iana.org/dnssec

The IANA Functions: Other Services

- .INT, a Top Level Domain designed for intergovernmental treaty organizations, is managed by ICANN as part of the IANA functions.

THE INT DOMAIN

Domain names within .INT are available for registration by intergovernmental organizations. The .INT domain is used by organizations established by international treaties between or among national governments.

📄 For more information about the .INT domain, please see: **iana.org/domains/int**

ICANN and the IANA Functions

ICANN, a private not-for-profit public benefit corporation, has performed the IANA functions on behalf of the global Internet community since the organization's creation in 1998. The primary governing framework for these functions is a series of contracts commencing in 2000 with the United States Government. Some other key agreements, with the various stakeholders groups include:

- A Memorandum of Understanding (MOU) with the IETF, described in RFC 2860: **iana.org/go/rfc2860**
- An MOU and Exchange of Letters with the ICANN ASO: **archive.icann.org/en/aso/aso-mou-29oct04.htm**
- Documented relationships with some root server operators: **https://www.icann.org/resources/pages/root-server-operators-2015-06-01-en**
- Contracts, MOUs and other accountability framework documents with some of the ccTLD administrators: **https://www.icann.org/resources/pages/cctlds/cctlds-en**
- Contracts with gTLD registry operators: **https://www.icann.org/resources/pages/registries/registries-agreements-en**

📄 The current IANA functions contract can be found at:
  icann.org/en/system/files/files/contract-01oct12-en.pdf

OUTREACH

Liaisons from ICANN's IANA Department maintain strong working relationships with the IANA functions' stakeholders and engage in discussions about technical implementation issues that require community coordination. ICANN also provides a helpdesk at the IETF Meetings to encourage interaction with one of its largest communities of users — protocol developers (see page 7).

FEES

ICANN does not charge fees for any services related to the performance of the IANA functions. All of the registries maintained by ICANN as part of the IANA functions are

available to everyone free of charge. Funding for operational costs associated with performing the IANA functions is provided for in ICANN's budget.

REPORTING AND FEEDBACK

Reports on performance standards and various other metrics of the IANA functions are published online on a monthly basis. The procedures are periodically reviewed and consultations with stakeholders are held regularly to optimize performance.

ICANN also performs annual customer satisfaction surveys to get feedback from its stakeholders and to make continual improvements to the services it provides.

More information on statistics and performance metrics can be found at:
iana.org/performance

> THE RESULTS OF THE 2014 IANA FUNCTIONS CUSTOMER SERVICE SURVEY ARE AVAILABLE AT: https://www.iana.org/reports/2014/customer-survey-20141217.pdf

LINKS

Internet Architecture Board (IAB): **iab.org**
ICANN Address Supporting Organization Address Council (ASO AC): **aso.icann.org**
ICANN At Large Advisory Committee: **atlarge.icann.org/alac**
ICANN Country Code Names Supporting Organization (ccNSO): **ccnso.icann.org**
ICANN Governmental Advisory Committee (GAC): **gacweb.icann.org**
ICANN Generic Name Supporting Organization (GNSO): **gnso.icann.org**
ICANN's IANA Website: **iana.org**
Internet Engineering Task Force (IETF): **ietf.org**
The Number Resource Organization (representing the five RIRs): **nro.net**

One World, One Internet