



# An introduction to IANA

Presentation Notes

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While the Internet is renowned for being a worldwide network free from central coordination, there is a technical need for some key parts to be globally coordinated – and the *Internet Assigned Numbers Authority* (IANA) fulfills this coordination role.

Specifically, IANA allocates and maintains unique codes and numbering systems used in the technical standards (“protocols”) that allow computers and other devices to talk to each other over the Internet.

The maintenance requirements of different protocols vary in nature, but in essence all involve ensuring the numbers and codes used to implement Internet standards are unique and are used consistently worldwide. This consistency is key to ensuring that the Internet retains its interoperability.

IANA is operated by a small team of experts who process requests for IANA’s different areas of responsibility. The team maintains close relationships with the communities that develop Internet standards and operate Internet infrastructure.

The various activities of IANA can be grouped broadly into three categories:

**Number Resources.** IANA coordinates the global pool of Internet Protocol and Autonomous System numbers, providing them to Regional Internet Registries.

**Domain Names.** IANA manages the domain name system root, the .int and .arpa domains, and some internationalised domain name resources.

**Protocol Assignments.** IANA manages Internet protocol numbering systems in conjunction with relevant standards bodies.

## Number Resources

At its core, the Internet works by passing data between different computers using a system of unique computer identifiers called IP addresses. These addresses, which can take forms like 208.77.188.102 or 2620:0:2d0:5:218::78e0, direct data sent over the Internet to the correct destination. This works in much the same way as a full address on an envelope guides postal mail to the correct destination.

As the number of computers in the Internet is vast, another system of numbers is used to aggregate large groups of computers into single networks — such as that of a specific Internet provider or organisation. These groups are called autonomous systems, and each is given a unique AS number. It is like using a postal code to direct mail to the correct area for delivery.

For IP addresses and AS numbers, IANA's responsibility is to maintain the global pool of numbers, and to supply them to the Regional Internet Registries. There are five of these registries, or RIRs, representing the African, Asia-Pacific, European, Latin America & Caribbean, and North American regions.

The RIRs are in turn responsible for evaluating requests from network operators, such as Internet providers and large companies, and for identifying what number resources they need. Ultimately, these network operators will take blocks of IP addresses, and allocate one individually to each computer connected to the Internet through their network. In order to direct Internet data to the correct location, these operators use routing protocols and their allocated AS number to work out the most efficient way to pass traffic between computers.

IANA's role in this area is closely coordinated with the RIRs. The global allocation policies for these number resources are developed through a bottom-up consensus process. Special care is taken to allocate numbers in a particular manner that tries to optimise Internet routing efficiency. As numbers are in limited supply due to protocol limitations, care is also taken to ensure the conservation of available resources.

## Domain Name System

The Domain Name System provides a method of identifying resources on the Internet using easy-to-remember names. At a technical level, devices on the Internet are reached using IP numbers. As these numbers are difficult to remember, domain names such as "iana.org" provide more useful labels for connecting to these computers. The Domain Name System provides the technical tools to convert these memorable names into the IP addresses, as well as other information that helps guide computers to make the right connections.

The DNS is divided into a hierarchy. Each "dot" in a domain name represents a new level in the hierarchy, as shown in the diagram. For example, iana.org is allocated by the operator of .org. The operation of .org is allocated by the operator of what is known as the DNS "root". Each level of administrative responsibility is referred to as a zone.

IANA's predominant responsibility in the Domain Name System is to administer the data in the DNS root zone. IANA also manages a number of other aspects of the DNS.

### The DNS Root

As operator of the DNS root, IANA is tasked with delegating administrative responsibility of "top-level domains", which is the last segment of a domain name. These operators in turn delegate responsibility for domains further down the hierarchy.

Administration of the root revolves around two main classes of top-level domains:

**Generic Top-Level Domains (gTLDs).** These domains are global domains either designated for general use (e.g., .com, .org and .info), or for specific fields of interest (e.g., .museum and .pro). ICANN decides the policy for these domains,

and designates their operators through a public process involving all interested parties.

**Country Code Top-Level Domains (ccTLDs).** These two-letter domains, such as .mx and .fr, are allocated to operators representing specific countries. Each country has its own two-letter code, which is based upon the ISO 3166-1 standard. IANA delegates operation of these domains to operators that have been agreed upon within countries. In contrast with gTLDs policy, policies for these domains are developed locally by their Internet communities, under local law.

IANA is particularly involved in the assignment and reassignment of country-code top-level domains. Its role is to perform due diligence on requests to change the operator to ensure it meets with a number of principles. These principles revolve around ensuring that it is operated in the interests of the local Internet community.

### **The “.int” Domain**

The .int top-level domain is designed for the sole use of intergovernmental treaty organisations. These organisations are not based in a specific country, and therefore do not fit in the ccTLD system. For example, the World Health Organisation uses “who.int”, while NATO uses “nato.int”. IANA operates the .int domain registry. Organisations that meet the criteria for this domain can apply directly to IANA for registration of their domain. IANA also provides ongoing service to existing .int domain holders.

### **The “.arpa” Domain**

The .arpa top-level domain is used for internal Internet protocol purposes — its domains are not intended for direct use by end users of the Internet. The most prevalent use of the domain is “reverse mapping” of IP addresses to domain names. Another use of this domain is for ENUM — a mechanism to convert telephone numbers into Internet resources. IANA administers the .arpa domain in close liaison with the Internet Architecture Board — a committee established by the Internet engineering community to advise on the overall technical architecture of the Internet.

### **Internationalised Domain Names**

With the recent invention of technology to allow domain names that go beyond the restriction of purely Latin-based writing systems, IANA also provides a number of services relating to Internationalised Domain Names, or IDNs.

In order to allow domain registries to share their implementation practices, particularly the tables describing which characters are used for expressing different languages, IANA maintains a register of IDN practices adopted by registries worldwide.

IANA is also responsible for managing a number of test top-level domains that allow for experimentation in preparation for full deployment of top-level IDNs. These domains, such as “. テスト” and “. δοκιμή”, are operated in accordance with ICANN’s IDN test and evaluation programmes.

IANA is directly involved in developing the systems and procedures for implementing IDN top-level domains into production in the near future.

## Protocol Parameters

While Domain Names and IP number resources are two high profile areas managed by IANA, numerous other protocols require global coordination of their numbering systems.

Generally speaking, the Internet standardisation process involves the creation of a document which is part of the “Request for Comments”, or RFC series. These RFC documents describe the technical standards used on the Internet.

As the development of an RFC nears its conclusion, IANA participates in the editorial process, identifying where protocol assignments should be located within IANA’s registry. This usually occurs when unique number systems are used within a protocol, and when there are elements that must be shared across multiple protocols.

Every RFC document includes a section titled “IANA Considerations”. This becomes a starting point for analysis of the protocol’s registry requirements and ongoing maintenance needs.

IANA facilitates protocol registry management through close cooperation with the Internet Engineering Task Force (IETF) and the RFC Editor.

### Example Protocol Registries

The protocol registries cover many different fields, but some of the most common assignments made by IANA — in addition to IP addresses and domain names — are:

**Port Numbers.** Many services on the Internet use a port number to differentiate between multiple applications running on the same computer. For example, web pages are delivered by the HTTP protocol, which is assigned to port number 80. The same computer can deliver email using the port assigned for that purpose, number 25. IANA maintains the master list of which protocols use which port numbers.

**Private Enterprise Numbers.** Some protocols, notably the network management protocol SNMP, require individual organisations to have a unique number called a private enterprise number, or PEN. IANA is responsible for allocating PENs. Current demand is approximately 200 PEN allocations per month.

A small sampling of the hundreds of registries maintained by IANA include *Character Set Names*, *HTTP Status Codes*, *Kerberos Checksum Type Numbers*, *Media Types* used in email attachments and web traffic, *PPP Data Link Layer Numbers*, *SMTP Service Extensions*, and *XML Namespaces*.

### Protocol Registry Maintenance

Once a protocol registry has been devised and published, often subsequent protocols — or new features that are developed within the protocol — will require the registries maintained by IANA to be updated. IANA's task is to identify when it is appropriate to make modifications, evaluate the merit of requests to do so, and maintain the records within a particular protocol registry.

Some protocols allow the protocol registries to be updated independently of the Internet standardisation process. In these cases, IANA receives change requests directly, evaluates the justification for the request — consulting field-specific technical experts if necessary — and allocates resources based upon the requirements of the protocol.

## **A brief history of IANA**

With its services dating back to the early 1970s, IANA is one of the oldest Internet institutions.

IANA as it exists today is an amalgam of roles that have been carried out by a number of parties over the history of the Internet. IANA's protocol assignments role was performed for many years within academia. The costs were met through United States Government grants.

In 1992, the US Government reduced its funding of the day-to-day management of the Internet. A cooperative agreement was established to operate the "InterNIC" amongst a number of parties. InterNIC encompassed IP address registration services, the domain name registry for domains such as .com and .net, and a number of other functions.

Following the explosion of Internet usage in the mid-1990s, it was recognised that a more suitable multistakeholder structure was needed to carry out the Internet management functions. The Internet community participated in a process that resulted in the creation of ICANN for this task.

In 1998, ICANN assumed the IANA role from the University of Southern California's Information Sciences Institute, as well as assuming some of the top-level functions performed by InterNIC. The gTLD registry operations of InterNIC were converted into a competitive domain name registration environment coordinated by ICANN.

### **US Government and IANA**

Today, the IANA is administered under the terms of a contract between ICANN and the US Government. IANA is not a legal entity itself, rather a set of functions performed by the IANA department within ICANN. The contract stipulates the scope of the IANA services, as well as defines reporting requirements for ICANN on how it administers the IANA functions.

ICANN is required to report on a monthly basis to the US Government on how it is administering requests relating to all of the contract-related facets of IANA.

With respect to operation of the DNS Root Zone, the US Government has a more direct role in authorising all changes before they are implemented. In practice, this means that once IANA has completed processing of a change request to the root zone, it is sent to

the US Government to review. After this review, and their authorisation is received, it is then implemented in the DNS root zone.

## Current projects at IANA

IANA is constantly evaluating the way it performs all its services, with an eye to ensure they are conducted as accurately and efficiently as possible. The general thrust of much of its work over the past few years has been to introduce increased automation and clarity to its processes.

IANA has been conducting trials on signing the DNS root zone for over a year now. ICANN has sought approval for signing the root zone from the US Department of Commerce. In the mean time, at the request of various technical communities, ICANN is developing an interim trust anchor repository which will not sign the zone, but provide a useful stop-gap until that is achieved. In light of the recent security issues with the DNS, however, it is considered more important than ever to introduce protocol security to the DNS.

With respect to the imminent expansion of the root zone, to cater for both new generic top-level domains, as well as country-codes expressed in non-Latin scripts, IANA is involved in developing new processes and procedures; as well as scaling operations to cope with the anticipated demand. In particular, IANA is responsible for the intensive evaluation of prospective ccTLD operators, and the new IDN-based ccTLD procedure is anticipated to be a superset of those existing practices.

A general challenge faced by the whole Internet community is the exhaustion of the IPv4 address space. IANA continues to inform the community on the status of the issue, helping educate and inform where possible, as well as migrating its own services to IPv6.

## Resources

IANA's website <http://www.iana.org>

IANA functions contract <http://www.icann.org/en/general/iana-contract-14aug06.pdf>

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