

ICANN PRIMER

UNDERSTANDING THE TECHNICAL AND BUSINESS
FUNCTIONS OF THE INTERNET CORPORATION FOR
ASSIGNED NAMES AND NUMBERS (ICANN)

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GOVLAB

Introduction & Objectives

ICANN's role in governing the Internet is to coordinate the Internet's unique identifier system to ensure the operability, stability and security of one global Internet. Understanding what this means in practice, however, requires a comprehensive understanding of both the Internet technologies that underlie ICANN's work as well as the Internet's key business operation players and their relationship to ICANN.

This primer, therefore, serves the goal of helping frame ICANN's key responsibilities in the Internet governance space as they relate to Internet technologies and the business operations of the Internet.

Introduction to Internet Technologies

PACKET SWITCHING

The Internet (or "inter-network") is a global network of networks. The fundamental innovation that produced the Internet as we know it, and that makes the Internet run, is packet switching.

Packet switching allows for the delivery of variable-bit-rate data streams over a shared network, which allocates transmission resources (e.g. bandwidth) as needed. The Internet gains its robustness from packet switching in that information does not need to take a determined path from sender to receiver. The way packet switching works is that when a computer sends information, Transmission Control Protocol (TCP) breaks the information into smaller "packets" of data. Each packet is labeled with sender and receiver information using the Internet Protocol (IP) addressing system and is transmitted through the Domain Name System (DNS), with each packet not necessarily traveling the same route. When a packet reaches its specific computer destination, again using TCP, the packet is reassembled with the other packets.

Packet switching means that any machine connected to the Internet can send information to and receive information from any other machine connected to the Internet, regardless of either machine's location.¹

WHAT ARE NETWORKS?

A network is created when two or more machines are linked together with the ability to communicate. There are many kinds of computer networks,² including, for example:

- ▶ Local-area networks (LANs) – connect computers located in proximity to each other.
- ▶ Wide-area networks (WANs) – connect computers located far apart through telephone lines or radio waves.
- ▶ Campus-area networks (CANs) – connect computers within a limited geographic area, such as a campus or military base.
- ▶ Metropolitan-area networks (MANs) – connect computers within a town or a city.
- ▶ Home-area networks (HANs) – connect digital devices contained within a user's home.

The Internet, as described above, operates as one global network,³ linking different types of networks around the world across "a widespread information infrastructure."⁴

¹ "Packet Switching Demo." PBS. Retrieved from http://www.pbs.org/opb/nerds2.0.1/geek_glossary/packet_switching_flash.html; Video: "Circuit Switching and Packet Switching." YouTube. Retrieved from <http://www.youtube.com/watch?v=Dq1zpiDN9k4>.

² Definition: "Network." Webopedia. Retrieved from <http://www.webopedia.com/TERM/N/network.html>.

³ Definition: "Internet." Webopedia. Retrieved from <http://www.webopedia.com/TERM/I/Internet.html>.

⁴ "Brief History of the Internet." Internet Society. Retrieved from <http://www.internetsociety.org/internet/what-internet/history-internet/brief-history-internet>.

PROTOCOL LAYERS

Key to every network is its protocols—the sets of “rules” that guide technical interactions on that network. A network protocol is defined as the “agreed-upon format for transmitting data between two devices.”⁵

Network protocols include everything from the electrical specifications for how a device physically connects to the network infrastructure, to specifications for which methods can be used to control congestion in the network or for how application programs will communicate and exchange data.⁶ Network protocols are often described in terms of two different frameworks:

THE OPEN SYSTEM INTERCONNECTION (OSI) MODEL

The OSI defines a vertical stack of seven layers of protocols for a network.⁷ Control is passed from one layer to the next, starting at the application layer, and proceeding to the bottom-most layer and then back up the hierarchy.⁸ The stack of OSI layers is as follows:

- ▶ **Application Layer (Layer 7)** – This layer includes protocols that enable a “window for users and application processes to access network services.”⁹
- ▶ **Presentation Layer (Layer 6)** – This layer includes protocols that format data for presentation to the application layer. In a way, these protocols serve as “translator” for the network.¹⁰ An example protocol within this layer is HyperText Transfer Protocol (HTTP).
- ▶ **Session Layer (Layer 5)** – This layer focuses on protocols for “setting up, managing and then tearing down sessions between Presentation layer entities.”¹¹ Example protocols within this layer include Network File System (NFS) and Structured Query Language (SQL).
- ▶ **Transport Layer (Layer 4)** – This layer focuses on protocols enabling the process for delivery of data to the appropriate application process on host computers. Key protocols within this layer are the Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).¹²
- ▶ **Network Layer (Layer 3)** – This layer is where the physical path of data is set based on network conditions, priority of service, and other factors.¹³ The most significant protocol at Layer 3 is the Internet Protocol, or IP (described in further detail below).
- ▶ **Data Link Layer (Layer 2)** – This layer provides the protocols or specifications for transferring data between network entities.¹⁴ The foremost data link layer protocol is the Ethernet protocol.
- ▶ **Physical Layer (Layer 1)** – This layer is “concerned with the transmission and reception of the unstructured raw bit stream over a physical medium.”¹⁵ This layer begins at the network interface card (NIC), which is the device within a computer used for connecting the internal data bus of a computer to the external media (cables) of the network.¹⁶

5 Definition: “Protocol.” *Webopedia*. Retrieved from <http://www.webopedia.com/TERM/P/protocol.html>.

6 “Networking Protocols General Information.” *TechFest*. Retrieved from <http://www.techfest.com/networking/prot.htm>.

7 “OSI Model - Open Systems Interconnection model.” *Compnetworking*. Retrieved from http://compnetworking.about.com/cs/designosimodel/g/bldef_osi.htm.

8 “The 7 Layers of the OSI Model.” *Webopedia*. Retrieved from http://www.webopedia.com/quick_ref/OSI_Layers.asp.

9 “The OSI Model’s Seven Layers Defined and Functions Explained.” *Microsoft*. Retrieved from <http://support.microsoft.com/kb/103884>.

10 *Id.*

11 *Id.*

12 “Networking on z/OS.” *IBM z/OS Basic Skills Information Center at 27*. Retrieved from http://publib.boulder.ibm.com/infocenter/zos/basics/topic/com.ibm.zos.znetwork/znetwork_book.pdf.

13 “The OSI Model’s Seven Layers Defined and Functions Explained.” *Microsoft*. Retrieved from <http://support.microsoft.com/kb/103884>.

14 Think of sending mail through the postal system. The data link layer is where the letter is stuffed into the envelope (when data is moving down through the layers) and where the envelope is opened (when passing the contents upward at the receiving end).

15 “The OSI Model’s Seven Layers Defined and Functions Explained.” *Microsoft*. Retrieved from <http://support.microsoft.com/kb/103884>.

16 Tamara Dean. *Network+ Guide to Networks at 9*. Retrieved from http://books.google.com/books?id=UD0h_GqgbHgC&printsec=frontcover&dq=network%2Bguide+to+networks&src=bmrr#v=onepage&q&f=false.

THE TCP/IP MODEL

Combining and generalizing some of the OSI model's protocol layers, this model describes a suite of four layers of protocols for communication over the Internet¹⁷:

- ▶ **The Application Layer (Layer 4)** – This layer includes the protocols specifying how applications get access to networked services. It encapsulates the session, presentation and application layers as described in the OSI framework.
- ▶ **The Transport Layer (Layer 3)** – This layer includes protocols that act as delivery service for the application layer and those that handle error detection and recovery.
- ▶ **The Internet Layer (Layer 2)** – This layer focuses on routing and delivery of data, allows for communication across independent networks, and carries out translations to deal with dissimilar data addressing schemes.
- ▶ **The Link Layer (Layer 1)** – This layer is a combination of the Data Link and Physical layers of the OSI model. It consists of the actual hardware, including wires and NICs.

INTERNET PROTOCOL

Internet Protocol (IP) sits at the third later in the OSI Model, and is the principal communications protocol in the TCP/IP suite. IP specifies the format of packets (also called datagrams) sent and received on the Internet, as well as the standard for routing packets across interconnected networks, i.e., the Internet.

ROUTING

The first key component of IP is the concept of “routing,” the process of moving packets from source to destination on the Internet.¹⁸ The hardware supporting this process is called a router and serves as the core or “centerpiece” of the network from which computers, servers, printers and other devices can be connected to the Internet.¹⁹

IP ADDRESSING

The next key component of IP is the addressing system. Every computer, server, router or other device connected to the Internet has a unique number assigned to it called an IP address, without which communication with other devices, users, and computers on the Internet would prove impossible. An IP address can be analogized to a telephone number, each one providing a unique way to reach you and only you.

Connected devices are assigned IP addresses through the process of IP allocation. Large bundles of IP addresses are allotted to Internet Service Providers (ISPs) from the “Unallocated Address Number Pool,” which is administered by the Internet Assigned Numbers Authority (IANA), now a department of ICANN.²⁰ ISPs then assign IP addresses to every server and every computer that connects to the Internet.

With so many Internet users, ISPs choose to “lend” IP addresses from a pool of numbers, rather than assigning every computer a fixed (or static) IP address. This loaning of IP addresses is known as “dynamic IP addressing.”²¹

17 “4 Layers of the TCP/IP Model.” *Pitt.edu*. Retrieved from http://www.sis.pitt.edu/~icucart/networking_basics/4LayersofTCPIPModel.html.

18 Definition: “Routing.” *Webopedia*. Retrieved from <http://www.webopedia.com/TERM/R/routing.html>.

19 Guy McDowell. “How Does a Router Work?” *Makeuseof*. [October 10, 2009]. Retrieved from <http://www.makeuseof.com/tag/technology-explained-how-does-a-router-work/>.

20 “IPv4 Address Report.” *Potaroo.net*. Retrieved from <http://www.potaroo.net/tools/ipv4/index.html>.

21 “Networks with Dynamic IP Addresses.” *OpenDNS*. Retrieved from <http://www.opendns.com/support/article/61>.

IPV4 VERSUS IPV6

Notably, two versions of this communications protocol are currently in use. Internet Protocol version 4 (IPv4) was the first publicly available IP; it encompasses 32-bit IP addresses, which limits the number of possible unique IP addresses to 4,294,967,296. In 1998, however, in recognition of the impending exhaustion of available addresses within IPv4, a successor Internet Protocol version was developed: IPv6. This version uses 128-bit addresses and offers about 3.4×10^{38} (340 undecillion) possible unique addresses.²²

While the intention is for IPv6 to replace IPv4, this process has not yet been completed. This matters because IPv4 and IPv6 essentially operate as parallel systems, meaning data cannot be exchanged between these protocols without “special gateways” or transition technologies.²³

THE DOMAIN NAME SYSTEM (DNS)

WHAT IS THE DNS?

When Internet users connect to websites or other Internet servers, they do so by typing a domain name into a browser.²⁴ A domain name is a unique, human memorable identifier such as www.icann.org.²⁵ However, connected devices to the Internet do not communicate via domain names, but communicate (as described above) through IP and IP addresses (www.icann.org's IP address, for instance, is 192.0.34.163).

The way that domain names are “resolved” and mapped to their correlating IP addresses is called Domain Name Resolution. These resolutions are performed through the DNS,²⁶ a hierarchical, distributed database operated by millions of different entities around the world.

HOW DOES THE DNS WORK?

Domain Name Resolution occurs in multiple steps.²⁷ First, every time an Internet user enters a domain name into a browser (e.g. [icann.org](http://www.icann.org)), the user's computer's first stop in resolving (or finding the IP address for the server housing [icann.org](http://www.icann.org)'s content) is its own DNS “cache,” which stores information for queries a computer has recently run.

If the IP address is not stored in the DNS cache, the user's computer next queries its ISP's DNS server for the mapped IP address. If the ISP's DNS server does not have this information stored, it redirects the query to one of the core “root name servers” that sit at the top of the DNS hierarchy. The authoritative core root name servers are managed by 12 organizations that use redundant machines around the globe to provide distributed service; in fact, there are core root name servers in over 130 physical locations around the world.²⁸

These core root name servers store authoritative information on all top-level domains (.com, .net, .org, etc.) and their cor-

22 RFC2460: “Internet Protocol, Version 6 (IPv6) Specification.” IETF. Retrieved from <http://tools.ietf.org/html/rfc2460>.

23 Ben Parr. “IPv4 & IPv6: A Short Guide.” Mashable. (February 3, 2011). Retrieved from <http://mashable.com/2011/02/03/ipv4-ipv6-guide/>; see also “IPv6 Transition Mechanisms.” Ripe.net. Retrieved from <http://www.ripe.net/lir-services/training/e-learning/ipv6/transition-mechanisms>.

24 Domain names are read hierarchically from right to left. Take “[icann.org](http://www.icann.org)” for example: the “.org” specifies the top-level domain (TLD), and the word preceding the period constitutes the second-level domain, which is registered by a specific individual or entity, in this case ICANN.

25 Definition: “Domain Name.” Wikipedia. Retrieved from http://www.wikipedia.com/TERM/D/domain_name.html.

26 Paul Mockapetris. RFC 1034: “Domain Names - Concepts and Facilities.” The Internet Society. (November 1987). Retrieved from <http://tools.ietf.org/html/rfc1034>.

27 Chris Gonyea. “DNS: Why it's important and how it works.” DYN. Retrieved from <http://dyn.com/blog/dns-why-its-important-how-it-works/>.

28 “Root Servers.” IANA. Retrieved from <http://www.iana.org/domains/root/servers>; Kim Davies. “There are not 13 root servers.” ICANN Blog. (November 2007). Retrieved from <http://blog.icann.org/2007/11/there-are-not-13-root-servers/>.

relating top-level domain (TLD) name servers. This information is stored in a file called the “root” (also called the “root zone,” “root zone file,” “DNS root zone,” or “root domain”).

While the core root servers will not know the final IP address a computer is looking for, they look at all of the TLDs and will return a list of authoritative TLD name servers who might have the final IP address.

These authoritative TLD name servers are queried next. These servers host information about that specific TLD and the name servers of any domains subordinate to it.

The last part of the resolution process involves a query to the name server for the specific domain sought (so in our example from above, the “ICANN” domain within the .org TLD). These name servers contain a record of information on that specific domain, including the IP address(es) associated with it. The query returns this information back to the ISP’s DNS server, which communicates the correlating IP address to the user’s computer, which can then use the IP address to connect to the particular server storing the sought-after domain’s content.

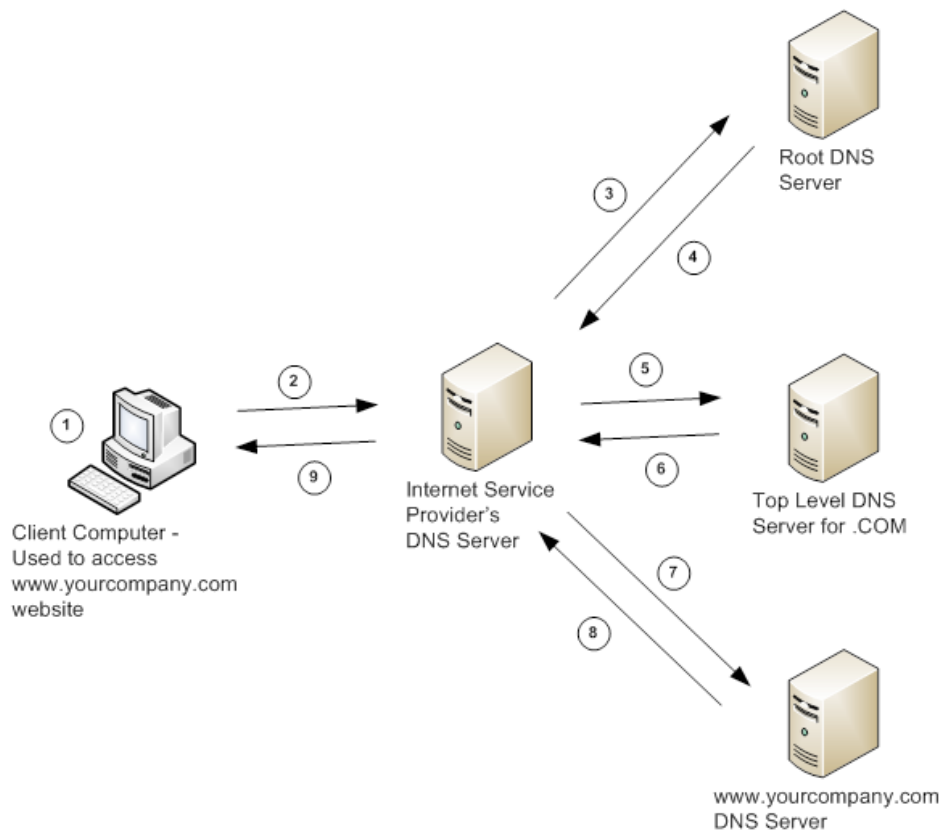


Figure 1.²⁹

29 "Diagram: How the Domain Name System (DNS) Works." UXWorld. Retrieved from <http://ww3.uxworld.com/uncategorized/dns-query-flow/>.

Introduction to the Business Operations of the Internet

In addition to understanding the technologies of IP and the DNS, knowing about the different types of organizations that serve core business operation functions for the Internet proves vital to understanding ICANN's work.

ISPS & WEB HOSTING COMPANIES

Within the network of networks that is the Internet, ISPs serve a number of roles related to Internet access and services. The primary role of an ISP is to serve as access provider, offering users Internet connection through available technologies such as telephone lines, cable, Wi-Fi, and fiber optics.³⁰ For example, Verizon is an ISP company offering Internet connection through fiber optics in New York City; Spectranet is an ISP company offering connection through broadband and WiFi in India.³¹

ISPs may also offer hosting services, such as offering email and/or web hosting services through virtual and/or physical servers, where users can store data and run their own software. For example, many small companies rent servers through ISPs to host their websites.³²

Some ISPs also provide transit services, meaning that they provide an “upstream cascade” of Internet access to other ISPs. These “upstream ISPs” usually have a larger network than the ISP contracting with users and/or is able to provide the “contracting ISP” with access to parts of the Internet the contracting ISP by itself has no access to.³³

REGISTRIES

Registries are organizations that manage the allocation and registration of Internet number resources such as IP addresses and autonomous system numbers (ASNs) for the Internet. Specifically:

- ▶ **Regional Internet Registries (RIRs)** manage the allocation and registration of Internet number resources within a particular region of the world. There are currently five RIRs:
 - African Network Information Center (AfriNIC) for Africa.³⁴
 - American Registry for Internet Numbers (ARIN) for the U.S., Canada, parts of the Caribbean, and Antarctica.³⁵
 - Asia-Pacific Network Information Center (APNIC) for Asia, Australia, New Zealand, and neighboring countries.³⁶
 - Latin America and Caribbean Network Information Center (LACNIC) for Latin America and parts of the Caribbean.³⁷
 - Réseaux IP Européens Network Coordination Centre (RIPE NCC) for Europe, Russia, the Middle East, and Central Asia.³⁸
- ▶ **National Internet Registries (NIRs)** are entities organized under the umbrella of an RIR and coordinate Internet number

30 “What are the different Internet connection methods?” Microsoft. Retrieved from <http://windows.microsoft.com/en-us/windows-vista/what-are-the-different-internet-connection-methods>.

31 “About us.” Spectranet. Retrieved from <http://www.spectranet.in/about-spectranet.php>.

32 “Web Hosting Providers.” w3school. Retrieved from http://www.w3schools.com/hosting/host_providers.asp. Notably, however, not all web-hosting companies are ISPs. Companies like Dreamhost or Hostgater, for example, are dedicated to web hosting and not to providing access. Alan Henry. “5 Best Web Hosting Companies.” Lifehacker. (May 2012). Retrieved from <http://lifehacker.com/5911651/five-best-web-hosting-companies>.

33 Jason Gerson and Partick S. Ryan. “A Primer on Internet Exchange Points for Policymakers and Non-Engineers.” SSRN. (August 11, 2012). Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2128103.

34 [Afrinic.net](http://www.afrinic.net/). Retrieved from <http://www.afrinic.net/>.

35 American Registry for Internet Numbers. [ARIN.net](https://www.arin.net/). Retrieved from <https://www.arin.net/>.

36 [APNIC.net](http://www.apnic.net/). Retrieved from <http://www.apnic.net/>.

37 Latin American and Caribbean Internet Address Registry. Retrieved from <http://www.lacnic.net/en/web/lacnic/inicio>.

38 [RIPE NCC](http://www.ripe.net/). Retrieved from <http://www.ripe.net/>.

resources at a national level.³⁹

- ▶ **Local Internet Registries (LIRs)** are allocated “blocks” of Internet number resources by RIRs or NIRs and assign most parts of these blocks to customers. Most LIRs are also ISPs, whose customers are either end users or other ISPs.⁴⁰

DOMAIN NAME REGISTRY OPERATORS

There are also organizations that serve as registry operators; these companies keep track of authoritative information on which second-level domains exist within a specific TLD, and manage the correlating TLD name server to ensure functionality throughout the DNS. Verisign, Inc., for example, manages the TLD name servers and registry databases for the .com, .net, .name, .tv and .cc TLDs.⁴¹

Domain name registry operators also contract with registrars to enable the sale of second-level domains within the TLD by the registrars.

REGISTRARS

Internet registrars are the entities that provide registration services to the public.⁴² ICANN, for example, registered the “*icann.org*” domain name through the registrar GoDaddy.⁴³

Registration of a domain name requires registrars to keep a set of authoritative records on contact information for registrants and managers via a database called Whois. This database is available and searchable to the public.⁴⁴ A typical Whois entry includes not just registrant and manager contact information, but also up-to-date information on IP addresses and the name servers correlating to a registered domain.⁴⁵

Along with registration services, registrars may also provide hosting services.

39 “Operational policies for National Internet Registries in the APNIC region.” APNIC.net. Retrieved from <http://www.apnic.net/policy/operational-policies-nirs>.

40 “ARIN Number Resource Policy Manual.” ARIN.net. (August 21, 2013). Retrieved from <https://www.arin.net/policy/nrpm.html>.

41 “Domain Names.” Verisign, Inc. Retrieved from http://www.verisigninc.com/en_US/products-and-services/domain-names/index.xhtml.

42 Definition: “Registrar.” Webopedia. Retrieved from http://www.webopedia.com/TERM/D/domain_name_registrar.html.

43 “ICANN.org.” Whois. Retrieved from <http://who.is/whois/icann.org>.

44 See, e.g., Whois. Retrieved from <http://who.is/whois/icann.org>.

45 *Id.*

Understanding ICANN's Role

ICANN'S WORK AS IT RELATES TO BUSINESS OPERATIONS & IP

To ensure the continued interoperability of the Internet's unique identifier systems, ICANN performs a number of functions within the IP space. First, ICANN coordinates policies determined by the five RIRs for allocating and assigning sets of unique numerical identifiers needed to make the IP system work consistently around the world:

- ▶ **IP addresses** (described above);
- ▶ **Autonomous system numbers**—the number that uniquely identifies a specific network on the Internet⁴⁶; and
- ▶ **Protocol port and parameter numbers**—the numbers that, when added to an IP address, signify the unique destination location needed to reach a specific process or application running on a computer.⁴⁷

Specifically regarding IP addresses, ICANN also manages (through the IANA function) the distribution and allocation of IP address “blocks” to the RIRs, which then sub-delegate these blocks to ISPs for distribution within a given region.

ICANN also administers over two thousand registries for protocol parameters, working closely with the Internet Engineering Task Force (IETF). The IETF is an organization that develops protocols to govern the way computers send and receive packets of data over IP-based networks.⁴⁸

ICANN'S WORK AS IT RELATES TO BUSINESS OPERATIONS AND THE DNS

Within the DNS space, ICANN administers the contents of the root zone, the TLDs, and the DNS records associated with them. ICANN also accredits registrars that take domain name registrations from the public. Specifically, this means that ICANN does the following:

REGARDING THE ROOT ZONE

ICANN manages the root zone through IANA, who serves as operator. Specifically, IANA handles the content of the root zone file by maintaining the “Root Zone Database,” a registry of all TLD delegations and their corresponding operators.⁴⁹ ICANN also coordinates operations of one of the core root name servers, the L-ROOT.⁵⁰

⁴⁶ For example, New York University operates a network (an autonomous system) and thus has a unique ASN, which is used to help express routing policies within the NYU network.

⁴⁷ As an analogy, if an IP address is like a telephone number, the protocol port and parameter number is like an extension.

⁴⁸ “About the IETF.” Internet Engineering Task Force. Retrieved from <http://www.ietf.org/about/>.

⁴⁹ “Root Zone Database.” IANA. Retrieved from <http://www.iana.org/domains/root/db>.

⁵⁰ “L-ROOT.” ICANN. Retrieved from <http://dns.icann.org/>.

REGARDING TOP-LEVEL DOMAINS

ICANN manages the proposal process, delegates administrative responsibility, and coordinates registration requirement policies for approving the assignment of new generic TLDs (gTLDs) (including those incorporating non-Latin scripts), such as .com, .org or .net.⁵¹

ICANN also establishes policies that guide the provision of services for sponsored gTLDs (sTLDs), such as .aero, .cat, .coop, .museum. There are a specific number of sTLDs, each having a designated “sponsor” that represents the specific community served by the sTLD.⁵²

ICANN’s remit also involves coordinating policies to ensure maintenance of authoritative records on country-code TLD (ccTLD) delegations, such as .de or .fr for Germany and France.⁵³ Notably, it is a function of IANA to determine an appropriate trustee for each ccTLD; IANA does not, however, determine what constitutes a country. Instead, IANA refers to the International Standards Organization for such information.⁵⁴

The gTLD domain name registry operators, for the most part,⁵⁵ also sign contracts with ICANN, acknowledging that they will be bound by ICANN’s consensus policies existing at the time of signing as well as those approved through ICANN policy development in the future.⁵⁶

REGARDING DNS RECORDS

- ▶ Domain name registry and registrar operators are required under contract with ICANN to maintain domain name registration data within the publicly available Whois databases. Whois is like an address book; it contains the names of websites, their numerical identifiers, and their owners in searchable form.

REGARDING REGISTRARS

- ▶ ICANN lastly accredits gTLD domain name “registrars.” ICANN’s accreditation process means that ICANN identifies and sets minimum standards for the performance of registration functions (including technical, operational and financial components⁵⁷), and then through accreditation agreements, recognizes persons or entities meeting those standards.⁵⁸

51 Notably, in 2011 ICANN “opened up the domain name space” and “democratized” the allocation of TLDs. In addition to existing gTLDs like .com, ICANN invited applications for new domains (available for \$185,000). David Sarno. “ICANN to let thousands of domain names bloom.” *Los Angeles Times*. (June 21, 2011). Retrieved from <http://articles.latimes.com/2011/jun/21/business/la-fi-internet-domain-20110621>.

52 “Status Report on the sTLD Evaluation Process.” ICANN. Retrieved from <http://archive.icann.org/en/tlds/stld-apps-19mar04/stld-status-report.pdf>.

53 Country code TLDs are directly handled by sponsoring organizations “entrusted with operating the domains in the public interest for the community the domain is designated to serve.” See “Understanding the ccTLD Delegation and Redelegation Procedure.” IANA. Retrieved from <http://www.iana.org/domains/root/delegation-guide>.

54 “Procedure for Establishing ccTLDs.” IANA. Retrieved from <http://www.iana.org/procedures/cctld-establishment.html>.

55 Not all registries operate under contract with ICANN, however. For example, the EDUCAUSE registry handles the sale and management of second-level domains within the .edu TLD name, and do not have a contract with ICANN. Similarly, the United States General Services Administration runs the .gov TLD and is not under contract with ICANN.

56 Donna Austin. “Who Are the True Multistakeholders in ICANN.” *CircleID*. (September 17, 2013). Retrieved from http://www.circleid.com/posts/20130917_who_are_the_true_multi_stakeholders_in_icann/.

57 “Registrar Accreditation Application.” ICANN. Retrieved from <http://www.icann.org/en/resources/registrars/accreditation/application>.

58 The list of ICANN-accredited registrars can be found here: “ICANN-Accredited Registrars.” ICANN. Retrieved from <http://www.icann.org/registrar-reports/accredited-list.html>.