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Guide to Administrative Procedures of the Internet Infrastructure

Status of this Memo

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Abstract

This document describes the administrative procedures for networks seeking to connect to the global Internet. This includes the steps and operations necessary for address space allocation and registration, routing database registration, and domain name registration. The document also contains information about the required forms and how to obtain them.

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Who Should Read This Document

This document is intended for system engineers and technical managers of networks who want to make a connection to the Internet. It assumes a basic knowledge of the Internet and networking.

This information is intended to help new or expanding networks understand and follow the Internet administrative procedures, and to provide assistance in filling out the various templates and registration forms. Appendix D is a glossary of acronyms.

Checklist

This document will explain the following procedures:

- o Determine your organization type and current status.
- o Determine your administrative and technical contacts.
- o Determine your budget (and chargeback system) and choice of carriers.
- o Determine to whom you will connect.
- o Predict your current and projected address space needs.
- o Set-up your system to connect.
- o Request and register your address space allocation.
- o Request and register an autonomous system number, if needed.
- o Register with a routing database, if needed.
- o Register your country's domain name, if needed.
- o Request and register your IN-ADDR.ARPA domain name, if needed.

Prerequisites

This document assumes that you have examined different alternatives for physical connectivity and will assist you in navigating the Internet infrastructure so that you can use that connectivity. In choosing your upstream provider, you should consider their ability to deal with the Internet infrastructure.

What will you be doing and what role will you play?

- o If you are interested in connecting yourself (or a small organization), you are an Internet end user. You will probably want to contact an Internet Service Provider (ISP) for most of your needs. Read section I and the first part of section II.
- o If you are interested in connecting your organization and in having address space to distribute within your network, you are an Internet high volume end user. You will need more address space, but still may chose to work with an Internet Service Provider (ISP) for most of your needs. Read sections I and II.
- o If you are interested in connecting your organization, and in distributing addresses to your clients (who are end users), you are an Internet Service Provider (ISP). You will need to contact a Local Internet Registry (if one is available, or your upstream provider). Read section I and continue reading the rest of this document.

- o If you are interested in distributing addresses to your clients and your clients are in turn distributing addresses, you are a Local Internet Registry or large ISP. You will probably need to contact the Regional Internet Registry in your geographical area. Read section I and continue reading the rest of this document.

I. Preparation of Systems and Network Planning

STEP ONE: PREPARE INFORMATION, ORGANIZE HARDWARE, FIGURE OUT TO WHOM YOU WILL CONNECT, AND TEST IN-COUNTRY SYSTEMS.

A. What do I need to connect to the Internet?

You can connect using dial-up or dedicated lines, and you can choose UUCP or IP. It is preferable to be running the UNIX operating system with TCP/IP over a dedicated line, although you can begin by using UUCP over a dial-up line. Although there are alternatives to UNIX, for historical reasons and robustness UNIX is better prepared to handle Internet connectivity. It is best to use TCP/IP inside your network even if you use another method for your external connectivity.

You will need to obtain an Internet Protocol (IP) address, or block of addresses, and a domain name. You may also need an Autonomous System Number (ASN) and an IN-ADDR.ARPA (reverse addressing) domain name. However, you may begin by having dial-up connectivity to another organization that supports one or more mail exchange (MX) record(s) for your site. This would allow you to receive email at your own domain name without requiring you to invest as much initially.

B. What connectivity medium should I choose?

You may be constrained by telecommunications regulations in your country as to your choice of dial-up, digital phone lines, fiber optic cable, or satellite suppliers. If not, cost, bandwidth, and reliability will determine your choice.

C. What else do I need to do?

Before you do anything else:

1. Designate an administrative contact person and a technical contact person.

Choose one person to be the administrative contact and another person to be the technical contact. Write down their full names, email and postal addresses, and telephone and fax numbers (with country

prefixes in the form + country code (e.g., +011), city code, and local telephone number). The administrative contact should be a member of your organization and must reside in the country. The technical contact should be the key network support person and may be represented initially by someone outside of the country. Note that the technical contact must transition to a network support person residing in the country. The Internet Registries will request this information in the form of database entries called objects. For example, on the RIPE template, the administrative contact should be listed in the admin-c field in the database objects, and the technical contact in the tech-c field in the database objects (more information on database objects follows in section II D below).

2. Determine your cost-recovery charging scheme, if needed, so that you can sustain operations.

No form or record will specifically request this, but it is important that you project your costs adequately so that you can assess fees to cover them and ensure stability of operations.

3. Diagram your network topology.

Determine the number of groups and end users. Describe the size and shape of your current network. Design your addressing plan based on this information. It may be helpful to consider your organization chart when doing this, if you anticipate it to be fairly stable.

If you are restricted to using the local telecommunications company's telephone circuit, choose your circuit carrier based on capacity and where it lands geographically. Consider an asymmetric circuit, e.g., 128kbps in and 64kbps out, if you expect to have more incoming traffic than outgoing (e.g., if most of the traffic is expected to originate from web servers outside your network).

4. Determine to whom you will connect.

See the prerequisites section for types of connection providers that might be appropriate for your situation. Determine which ISP or telecommunications company best fits your connectivity needs.

5. Predict your address space and bandwidth requirements from end user needs.

Since address space is finite and must be conserved, end users are not permitted to reserve address space. Address space is based on what your needs are and how you justify those needs. Evaluation of IP address space requests is usually based on the documentation you provide for the following 24 months (as per RFC 2050), as specified

in the address space usage template and in the addressing plan you submit. Once you have used your assigned address space, you can request additional space based on an updated estimate of growth in your network. This usually includes detailed documentation, updating the appropriate regional registry database with details of your end user assignments, and assigning address space both conservatively and efficiently.

You will need to justify your needs for address space by communicating your network design and should be prepared to clearly present your plan for effective use of the request. Determine your current and future user needs. If you are offering virtual web services, it is no longer necessary to assign one IP address per domain. HTTP/1.1 defines the "host" header to allow vanity names without the use of an IP address. Allocations for points of presence (POP) throughout your region should also be determined. Predictions of user behavior can be based on analysis of published rates, interviews with individual and institutional subscribers, and case histories of other countries (see "History of the Internet in Thailand"). For example,

```
Area1
  10 dialup modems
  10 leased lines to organization's LANs (size of the LANs)
Area2
  5 dialup modems
Main POP
  5 servers: mail, WWW, DNS, FTP, etc.
```

When you design your plan, you should design it for what you need now, what you believe you will need six months from now, and then one year and two years from now.

6. Set up, connect, and test your hardware and software.

It is important to ensure that you have enough representative systems set up and their connectivity tested using temporary addresses before contacting the appropriate agency for address space.

D. How do I get the documents referred to in this guide?

See Appendix B for details on obtaining the documents referred to in this guide.

E. Section References

For more information on TCP/IP, see RFC 2151, "A Primer on Internet and TCP/IP Tools and Utilities".

II. Address Space Allocation

STEP TWO: OBTAIN ADDRESS SPACE ALLOCATION AND REGISTRATION FROM THE ISP YOU ARE CONNECTING TO, OR (AS A LAST RESORT) YOUR REGIONAL REGISTRY.

Internet Protocol (IP) addresses (under the current version 4) are 32-bit numbers usually expressed as 4 octets in dotted decimal notation (for example, 128.223.162.27, which is the IP address for the Network Startup Resource Center (NSRC) web server at the time of this writing). Public IP addresses make up the Internet address space. Addresses are allocated in a hierarchical manner and are designed to be unique.

The Internet Assigned Numbers Authority (IANA) allocates large address blocks to the three current Regional Internet Registries (IRs): ARIN, APNIC, and RIPE NCC which, in turn, allocate smaller blocks to Local Internet Registries or large ISPs. Local Internet Registries, which are typically ISPs or collections of ISPs represented at a country level, and large ISPs process the vast majority of address space assignments to ISPs and end users

Contact the Internet service provider from whom you are getting your connectivity services (your upstream provider) with an address allocation request. It is important and required that you contact your upstream provider first, and not the Regional IR automatically. The first question the Regional Registry will ask you is why you cannot get address space from your upstream provider.

A. Who is my upstream provider?

If there is an ISP already functioning in your country, contact them directly. If you are to be the first connection in your country, you may need to contact your Regional IR in your geographic region, but you should always contact your upstream provider first for assistance and guidance. Since address allocation is hierarchical, the administrative organizations and procedures also represent this hierarchical structure. It is important not to skip a step in the hierarchy. Current Regional Registries include ARIN (the Americas, Caribbean, and Africa), RIPE (Europe, Africa, and the Middle East), and APNIC (the Pacific Rim and Asia). Contact information for these organizations is listed in Appendix A.

You should contact your Regional Internet Registry if 1) the ISP you are connecting to is unable or unwilling to provide address space, or 2) your particular connectivity requirements will result in non-local data to your customers possibly taking a different route over the Internet than data destined for your upstream provider's customers,

or 3) you anticipate a quick growth rate that may require changing your current upstream provider to a larger one and you wish to avoid the renumbering that such a move would require.

B. How much address space should I ask for?

Regional IRs typically assign address blocks on the basis of an immediate need and projected utilization rate within one year. (If you are in the ARIN region, it is one year for end user organizations and three months for ISPs.) Calculate your address space request accordingly. It is recommended to include the organization chart and network topology diagram referred to in section I.C, number 3 (above). Note that address space is allocated based on CIDR bit boundaries (see next section). The registries will need to understand your network engineering and deployment plans in significant detail before they can allocate address space. Therefore, the more detailed information you can provide, the more likely your request will be processed quickly.

If you obtain address space from your ISP, it is very likely that you will need to renumber should you decide to change upstream providers and/or if you grow considerably. As this renumbering may affect your customers (and their customers, etc.) if they are using dedicated lines, you should carefully weigh the cost/benefit involved in obtaining address space from your upstream provider.

If you are singly homed, you should obtain your address space from your upstream ISP. If you plan on enlarging but remaining singly homed, you should continue to obtain space this way as it promotes aggregation. If, however, you plan to be multi-homed as part of your growth plan, it would make sense to become a member of an appropriate Regional IR (or, if one exists in your region, a national Network Information Center (NIC) and obtain a /19 or "provider aggregatable" address space.

The minimum routable block is often a /19, so if you plan on enlarging, it is better to pay the fees to the Regional IR now and obtain a /19 block so that you will not have to renumber later. Note that if you are an ISP in the ARIN region, ARIN has special requirements before you can do this in terms of the amount of address space you have previously used, which must be a /21. The current policy is that you must have used a /19 previously from your upstream ISP before going to ARIN, or you must be multi-homed and show you have used a /21 and be willing to renumber and ARIN will issue a /20 from a reserved /19.

As of February 8, 1999, ARIN lowered the minimum allocation size for IP addresses from a /19 to a /20. ARIN will issue initial allocations of prefixes no longer than /20. If allocations smaller than /20 are needed, ISPs and end users should request address space from their upstream provider. ARIN does not guarantee that addresses will be globally routable.

APNIC and RIPE NCC do not have these requirements. For APNIC, new allocations to members will be a /19.

Remember that your upstream provider should route you if you ask them. You are a customer of the ISP, so if the service is not what you need you should change ISPs.

IF YOU ARE CONNECTED TO ONLY ONE PROVIDER, AND ARE NOT VERY LARGE YET, GET AN ADDRESS RANGE FROM YOUR PROVIDER. SKIP THE REST OF THIS SECTION AND ALL OF SECTION V.

C. What is CIDR?

CIDR stands for Classless Inter-Domain Routing. Historically, IP addresses were assigned within classes: Class A (8 bits of network address, 24 bits of host address), Class B (16 bits of network address, 16 bits of host address), or Class C (24 bits of network address, 8 bits of host address). With the advent of CIDR, address space is now allocated and assigned on bit boundaries. Using CIDR means you are able to assign addresses corresponding with the number of hosts on the network, thereby conserving address space.

The following table illustrates this:

Addrs	Bits	Pref	Class	Mask
1	0	/32		255.255.255.255
2	1	/31		255.255.255.254
4	2	/30		255.255.255.252
8	3	/29		255.255.255.248
16	4	/28		255.255.255.240
32	5	/27		255.255.255.224
64	6	/26		255.255.255.192
128	7	/25		255.255.255.128
256	8	/24	1C	255.255.255.0
512	9	/23	2C	255.255.254.0
1K	10	/22	4C	255.255.252.0
2K	11	/21	8C	255.255.248.0
4K	12	/20	16C	255.255.240.0
8K	13	/19	32C	255.255.224.0

Addr

Number of addresses available; note that the number of addressable hosts normally is 2 less than this number because the host parts with all equal bits (all 0s, all 1s) are reserved.

Bits

Size of the allocation/assignment in bits of address space.

Pref

Length of the prefix covering this address space. This is sometimes used to indicate the size of an allocation/assignment.

Class

Size of the address space in terms of class C network numbers.

Mask

The network mask defining the routing prefix in dotted quad notation.

(From <http://www.ibm.net.il/~hank/cidr.html>)

D. How do I request and register address space?

You will need to send a database object to the appropriate registry to request and register address space. The registration databases are composed of records that are a series of fields separated by one or more blank lines; each field consists of two parts, the tag and the value. Do not modify the tags in the templates or errors will occur. Values for particular fields are specified in the templates; be careful to enter appropriate information.

The first line of a template denotes the record type. For example, an IP address template's first line is `inetnum`, therefore the record is known as an `inetnum` object. This first line is also used as the primary key for the record, therefore if you want to modify the first field of the record, the only way to do so is to delete the record entirely and add a new record with the corrected information.

For illustration, here is the RIPE `inetnum` object.

```
inetnum: [IP address range that will be assigned]
netname: Network-Name
descr: Network-Name Communications Company, Town
admin-c: NIC-handle of administrative contact
tech-c: NIC-handle of technical contact
country: ISO 3166-country-code
```

```
rev-srv: ns.someserver.net
rev-srv: ns.otherserver.net
status: assigned pa (provider aggregatable)
       or assigned pi (provider independent)
changed: email@address.net 960731
source: RIPE
```

For Countries in the APNIC Region

In order to obtain services from APNIC, you will need to become a member. APNIC-070 is the APNIC Membership Application. It is located at:

<ftp://ftp.apnic.net/apnic/docs/membership-application>

Send the completed form via email to APNIC at:

member-apply@apnic.net

APNIC Address Allocation Requests:

Once you have become a member, you can request IP address space using one of the three IP address request forms. If you are an organization that will use address space internally only (e.g., large enterprises such as universities, government ministries, large corporations, etc.), choose #1 (End User Address Request). If you are an organization that plans to sub-delegate address space to customers (e.g., you are an ISP), choose #2 (ISP Address Request). If you are a confederation of ISPs (e.g., national NICs, etc.), choose #3 (Confederation Address Request).

1. APNIC-074 is the APNIC End User Internet Address Request Form.

2. APNIC-065 is the APNIC Internet Services Provider Internet Address Request Form.

3. Confederations are a means by which service providers can group together to provide resource allocation and registration services tailored to their specific local language and cultural requirements. For details on how to become an APNIC recognized confederation, please see APNIC Confederation Concepts and Requirements located at:

<ftp://ftp.apnic.net/apnic/docs/confed-requirements>

APNIC-074 is the APNIC Confederation Internet Address Request Form.

Copies of all forms can be found in the following directory:

ftp://ftp.apnic.net/apnic/docs
or
http://www.apnic.net/reg.html

All completed forms should be sent to:

hostmaster@apnic.net

If there are strong reasons why you cannot obtain address space from your upstream ISP, and you require address space as a one-time allocation only, you can obtain address space as a "non member". For more details, see APNIC-071:

http://ftp.apnic.net/apnic/docs/non-member-application

and send the completed form to:

billing@apnic.net

For Countries in the ARIN Region

Membership in ARIN is optional and not a requirement for requesting IP address space from the registry or from your Internet service provider. If you are a large end user organization, choose #1. If you are an ISP, choose #2.

1. The form for network number assignments is located at:

ftp://rs.arin.net/templates/networktemplate.txt
or
http://www.arin.net/templates/networktemplate.txt

2. The form for ISPs to obtain a CIDR block of IP network numbers is located at:

ftp://rs.arin.net/templates/isptemplate.txt
or
http://www.arin.net/templates/isptemplate.txt

Send either completed form via email to ARIN at:

hostmaster@arin.net

with "IP request" (if you chose #1) or "ISP CIDR request" (if you chose #2) in the subject field, as appropriate.

For Countries in the RIPE Region

RIPE NCC provides IP address space allocation only to contributing local Internet registries. For a description of the European Internet Registry policies and procedures, see RIPE-159, "European Internet Registry Policies and Procedures". It is located at:

`ftp://ftp.ripe.net/ripe/docs/ripe-159.txt`

RIPE-160 is Guidelines for Setting up a Local Internet Registry. It is located at:

`ftp://ftp.ripe.net/docs/ripe-160.txt`

If you have questions regarding setting up a new local IR, please contact the RIPE NCC at:

`new-lir@ripe.net`

Once your local IR is established, you will get detailed information on how to submit requests to the RIPE NCC hostmaster.

Send the completed form via email to RIPE NCC at:

`ncc@ripe.net`

If you have general queries, please contact RIPE NCC at:

`ncc@ripe.net`

E. Section References

For more information on IP addresses, see RFC 1518, "An Architecture for IP Address Allocation with CIDR" and RFC 2050, "Internet Registry IP Allocation Guidelines".

III. Autonomous Systems (AS)

STEP THREE: IF NEEDED, OBTAIN AN AUTONOMOUS SYSTEM NUMBER.

A. What is an ASN and do I need one?

Autonomous System Numbers (ASNs) are used to facilitate routing in multi-homed environments. They are allocated when your routing policy is different from your provider's. This generally means your site is multi-homed. In nearly all cases, unless you are multi-homed to more than one ISP, you will not need an ASN. If your routing policy does not differ from your service provider's, you should use

the service provider's ASN. If there is constant traffic between you and a point in another country, you may want to connect to a second ISP in that country. Note that the resultant multi-homing generally makes the system more robust and may also change registry (and therefore request) relationships. It also increases costs greatly.

You may have to reduce traffic on your international lines by choosing to connect to a local exchange point. This allows traffic to stay within your country and off of expensive international links. If you implement this plan, you will be multi-homed and will need to read the autonomous systems and routing sections of this document.

B. How do I register an ASN?

Since the ASN space is quite limited, request only what you really need when you need it.

For Countries in the APNIC Region

APNIC-066 is the ASN Request Form. The form is located at:

<http://ftp.apnic.net/apnic/docs/asn-request>

Send the completed form via email to APNIC at:

hostmaster@apnic.net

For Countries in the ARIN Region

A complete listing of assigned ASNs is located at:

<ftp://rs.arin.net/netinfo/asn.txt>

The ASN registration form is located at:

<ftp://rs.arin.net/templates/asntemplate.txt>

or

<http://www.arin.net/templates/asntemplate.txt>

Send the completed form via email to ARIN at:

hostmaster@arin.net

with "ASN request" in the subject field.

For Countries in the RIPE Region

The European Autonomous System Number Application Form and Supporting Notes form (RIPE-147) is located at:

`ftp://ftp.ripe.net/ripe/docs/ripe-147.txt`

Local IRs can send the completed form via email to RIPE at:

`hostmaster@ripe.net`

C. Section References

For more information on ASNs, see RFC 1930, "Autonomous Systems (AS)".

IV. Routing and Exchange Points

STEP FOUR: IF NEEDED, REGISTER WITH A ROUTING DATABASE.

A. Do I need to register with a routing database?

You do not need to register with a routing database if you are simply carrying default routes to your (single) ISP. If you get your address space from an ISP, the ISP will register you. If you are connected to more than one ISP, then you should register with a routing database.

The more multi-homed you are, the larger your routing tables need to be. If you are connected to public exchange points (see examples below), or to more than one backbone ISP, you need to carry full routing tables and run without a default route.

Example European Exchange Points:

LINX	London Internet Exchange
M9-IX	Moscow Internet Exchange
NIX.CZ	Neutral Internet Exchange, Czech Republic

Example Asia/Pacific Exchange Points:

AUIX	Australia Internet Exchange
HKIX	Hong Kong Internet Exchange
JPIX	Japan Internet Exchange

Example Americas Exchange Points:

MAE-EAST	Metropolitan Area Ethernet - East
MAE-WEST	Metropolitan Area Ethernet - West
PAIX	Palo Alto Internet Exchange

Depending on the requirements of your international ISP, you may be able to have only a default route to them and specific routes to other suppliers if you have an in-country exchange point. Or they may require that you carry a full set of routes, treating your connection to the in-country exchange point as if it were a multi-homed connection.

B. What about CIDR and routing?

All registries use CIDR. All major router vendors (Cisco, 3Com, Nortel, Proteon, IBM, etc.) support CIDR. CIDR Internet routers use only the prefix of the destination address to route traffic to a subnetted environment.

C. How do I choose a routing database?

The Internet Routing Registry (IRR) describes registries maintained by several national and international networking organizations. These currently include the RIPE Network Coordination Centre (NCC), ANS (Advanced Network Solutions, Inc.), Bell Canada (formerly CA*net), Cable and Wireless (CW), and the Routing Arbiter Database (RADB). The IRR is a way for ASNs to publicize their own intended routing policies without having to request a change from a go-between.

"whois" queries to "whois.ra.net" return data that they gather from the entire IRR set of routing registries. Tools such as "peval" and "rtconfig" return data only from the RADB. Thus, when running those tools and desiring data from a set of registries, one must enumerate them as in the following example. "whois" queries to the client configure the precedence of routing databases. For example:

```
@RtConfig set sources = "TEST, RADB, RIPE, ANS, BELL, CW"
```

There are several other registries, such as ALTDB. A list, and other information on RADB, is available at:

```
http://www.radb.net/
```

As of January 1, 2000, the transition to the Routing Policy Specification Language (RSPL) is complete. RIPE-181 object submissions are no longer accepted. For more information, see:

<http://www.merit.edu/radb/announce.html>

With the exception of the Routing Arbiter Database, each registry serves a limited customer base. ANS, Cable and Wireless, and Bell Canada accept routing registrations for their customers alone, and the RIPE NCC oversees European registrations. The Routing Arbiter Database is unique in that it handles registrations for networking organizations not covered by the other routing registries. The Routing Arbiter also provides coordination among all the registries to ensure consistent representation of routing policies.

All Regional IRs need to register with one (only one) of the routing databases in the IRR. If you are announcing routes via BGP4, you need to register your routes in the Routing Registry in only one of the IRR's. Logically, this will be the "closest" IRR to you. However, note that some ISPs do not use the regional registries or RADB.

D. How do I register in the RADB (The Americas)?

You need to submit three types of database records to the RADB: one or more maintainer objects, an AS object, and one or more route objects.

To specify the individuals who are allowed to update your records in the RADB, fill out one or more maintainer objects and send them via email to:

db-admin@radb.net

You need to submit a maintainer object before you can register any AS or route objects.

To describe the autonomous system that announces your routes, fill out an AS object and submit it via email to:

auto-dbm@radb.net

AS objects are also called aut-num objects.

To register your routes, fill out one or more route objects, and send them to RADB via email to:

auto-dbm@radb.net

Note that most of the IRR participants have the auto-dbm@xx.net email address function for accepting updates to the IRR automatically.

E. Section References

For more information on routers, see RFC 1812, "Requirements for IP Version 4 Routers". See also RFC 1786, "Representation of IP Routing Policies in a Routing Registry (ripe-181++)".

For more information on CIDR and routing, see RFC 1817, "CIDR and Classful Routing".

V. Domain Name Registration

STEP FIVE: REGISTER YOUR DOMAIN NAME.

A. What is a country domain?

The Domain Name System (DNS) specifies the naming of computers within a hierarchy. Top-Level Domain (TLD) names include generic TLDs (gTLDs) and two-letter country codes (ccTLDs). Examples of gTLDs include .com (commercial), .net (network), and .org (organization). Examples of two-letter country codes are .ca for Canada, .fr for France, and .id for Indonesia. ISO 3166 is used as a basis for country code top-level domain names. Country codes are assigned by the International Organization for Standardization (ISO) in cooperation with the United Nations. The Internet Assigned Numbers Authority (IANA) directly registers all country-code top-level domains, however it is not involved in the allocation of codes to countries. IANA is a function of the Internet Corporation for Assigned Names and Numbers (ICANN, see Appendix A). See ISO 3166 for more information and a current listing of country codes (Appendix C).

A hierarchy of names may, and normally should be, created under each TLD. There is a wide variation in the structure of country domains. In some countries there is a substantial hierarchy, while in others the structure is flat. In some country domains the second levels are generic categories, while in others they are based on geography, and in still others, organization names are listed directly under the country code. Examples of second level generic categories are ac or edu (academic or education), co or com (corporate or commercial), and go or gov (government).

B. How do I register as a country domain?

First check that: (1) the domain is still available, few are, (2) you have someone in your country as the administrative contact, and (3) your name servers are prepared (see RFC 1912 for information on common errors in preparing name servers).

The whois master database is the authoritative source of information on .com, .net, .org, and .edu domain name registrations. It is currently maintained by Network Solutions, Inc. and holds referral pointers to which whois database contains the record for the domain name.

To apply to manage a country code top-level domain you should:

1. First, if you are on a UNIX host, use the "whois" command to see if the domain is already registered:

```
whois =<domain>
```

2. If the domain does not already have an administrative contact, request a Domain Name Agreement template from IANA by sending email to:

```
iana@iana.org
```

C. What if my country is already registered?

If your country is already registered, contact the country-code administrator to register a new second-level domain name.

Please note that ARIN, RIPE, and APNIC do not handle domain names (other than IN-ADDR.ARPA). If you want to register a domain name directly under a top-level domain (TLD), please contact the appropriate TLD administrator.

D. How do I resolve a country domain name dispute?

See RFC 1591 for domain name dispute information. Note that you will need to resolve the dispute within your country before you contact IANA.

E. Section References

For more information on domain names, see RFC 1591, "Domain Name System Structure and Delegation"; RFC 1713, "Tools for DNS Debugging"; and RFC 1912, "Common DNS Operational and Configuration Errors".

VI. IN-ADDR.ARPA Domain Delegation

STEP SIX: IF NEEDED, REGISTER YOUR IN-ADDR.ARPA DOMAIN.

A. What is an IN-ADDR.ARPA domain and do I need one?

An IN-ADDR.ARPA domain allows for mapping of IP addresses into domain names. This is often referred to as "inverse addressing" because it is the opposite of the domain name to IP address resolution. IN-ADDR domains are represented using the network number in reverse. For example, the IN-ADDR domain for network 123.45.67.0 is represented as 67.45.123.in-addr.arpa.

You almost always need reverse resolution.

B. How do I register an IN-ADDR.ARPA domain?

You should ask your upstream provider about registering your IN-ADDR.ARPA domains. If you are working directly with a regional registry, see below.

For Countries in the APNIC Region

The IN-ADDR.ARPA Delegation Form is APNIC-064 and is located at:

<ftp://ftp.apnic.net/apnic/docs/in-addr-request>

CAUTION: You must set-up your name server to accept the delegation prior to submission of this form.

Send the completed form via email to APNIC at:

domreg@rs.apnic.net

For Countries in the ARIN Region

How IN-ADDR.ARPA is registered is dependent on the registration of the block needing reverse entries. For example, all blocks that have been registered directly from the Regional IR may have IN-ADDR.ARPA delegation established by ARIN. In this case, IN-ADDR.ARPA delegations are registered using the ARIN modify template. This template can be found at:

<ftp://ftp.arin.net/templates/modifytemplate.txt>
or

<http://www.arin.net/templates/modifytemplate.txt>

Instructions for completing the template can be found at the bottom of the template.

CAUTION: Do not list your network number in reverse on the template.

Send the completed form via email to ARIN at:

hostmaster@arin.net

All blocks that have been reassigned to your organization by an ISP will have IN-ADDR.ARPA established by your provider. In this case, contact the ISP that reassigned IP address space to your organization and coordinate IN-ADDR.ARPA delegation.

For Countries in the RIPE Region

The domain object needs to be entered in the RIPE database before requesting reverse delegation.

```
domain: 0.194.in-addr.arpa
descr: Our organization allocation
admin-c: NIC-handle of administrative contact (e.g., JLC-2RIPE)
tech-c: NIC-handle of technical contact
zone-c: NIC-handle of zone contact
nserver: Name server (e.g., ns.someserver.net)
nserver: ns.otherserver.net
nserver: ns.ripe.net
changed: email@address.net 960731
source: RIPE
```

NOTE: One of the name servers has to be ns.ripe.net

The domain object described above should be included in the request, as well as zone file entries for the zone above the one requested. For example, if a reverse delegation is requested for 1.193.in-addr.arpa, the relevant zone file entries should be included for 193.in-addr.arpa; whereas if a reverse delegation is requested for 2.2.193.in-addr.arpa, the zone file entries should be included for 2.193.in-addr.arpa.

Send the completed object(s) via email to RIPE at:

auto-inaddr@ripe.net

VII. Security

A. Is there a way to prevent unauthorized changes to my objects?

Registries provide various security measures to prevent unauthorized changes to your database entries. Contact your regional IR for more information. Note that the contact information you provide in the database object registrations is not private.

VIII. Network Optimization and Management

A. How do I optimize traffic on my network?

Contact the Cooperative Association for Internet Data Analysis (CAIDA). CAIDA is a collaborative undertaking to promote greater cooperation in the engineering and maintenance of a robust, scalable global Internet infrastructure. CAIDA provides a neutral framework to support these cooperative endeavors.

The CAIDA web-site is located at:

<http://www.caida.org/>

Send email with questions or comments to:

info@caida.org

Security Considerations

Security is discussed in section VII.

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References

- [1] Malkin, G., "Internet Users' Glossary", FYI 18, RFC 1983, August 1996.
- [2] Hinden, R., Editor, "Applicability Statement for the Implementation of Classless Inter-Domain Routing (CIDR)", RFC 1517, September 1993.

- [3] Rekhter, Y. and T. Li, "An Architecture for IP Address Allocation with CIDR", RFC 1518, September 1993.
- [4] Fuller, V., Li, T., Yu, J. and K. Varadhan, "Classless Inter-Domain Routing (CIDR): an Address Assignment and Aggregation Strategy", RFC 1519, September 1993.
- [5] Rekhter, Y. and C. Topolcic, "Exchanging Routing Information Across Provider Boundaries in the CIDR Environment", RFC 1520, September 1993.
- [6] Postel, J., "Domain Name System Structure and Delegation", RFC 1591, March 1994.
- [7] Wijnen, B., Carpenter, G., Curran, K., Sehgal, A. and G. Waters, "Simple Network Management Protocol Distributed Protocol Interface Version 2.0", RFC 1592, March 1994.
- [8] Ramao, A., "Tools for DNS debugging", RFC 1713, November 1994.
- [9] Baker, F., "Requirements for IP Version 4 Routers", RFC 1812, June 1995.
- [10] Rekhter, Y., "CIDR and Classful Routing", RFC 1817, August 1995.
- [11] Barr, D., "Common DNS Operational and Configuration Errors", RFC 1912, February 1996.
- [12] Hawkinson, J. and T. Bates, "Guidelines for Creation, Selection, and Registration of an Autonomous System", RFC 1930, March 1996.
- [13] Freed, N. and N. Borenstein, "Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies", RFC 2045, November 1996.
- [14] Hubbard, K., Kusters, M., Conrad, D., Karrenberg, D. and J. Postel, "Internet Registry IP Allocation Guidelines", BCP 12, RFC 2050, November 1996.
- [15] Kessler, G. and S. Shepard, "A Primer On Internet and TCP/IP Tools and Utilities", FYI 30, RFC 2151, June 1997.
- [16] ISO 3166: "Codes for the Representation of Names of Countries"
- [17] Palasri, S., Huter, S., and Wenzel, Z. "The History of the Internet in Thailand", University of Oregon Books, 1999.

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Appendix A: The Internet Agencies

o The Internet Assigned Numbers Authority (IANA)

IANA is the central coordinator for the assignment of unique parameter values for Internet protocols and for all address space and name space used in the Internet. IANA allocates parts of the Internet address space to Regional Internet Registries (IRs) for distribution to Local IRs and ISPs. IANA is also responsible for the coordination and management of the Domain Name System (DNS).

Note that as of 1999, IANA is a function of the Internet Corporation for Assigned Names and Numbers (ICANN), the non-profit corporation that is the top-level administration authority of the global Internet.

Email: iana@iana.org
Postal: 4676 Admiralty Way, Suite 330
 Marina del Rey, CA 90292
 USA
Telephone: +1-310-823-9358
Fax: +1-310-823-8649
Internet: <http://www.iana.org/>

o Internet Corporation for Assigned Names and Numbers (ICANN)

From the ICANN web site:

The Internet Corporation for Assigned Names and Numbers (ICANN) is a technical coordination body for the Internet. Created in October 1998 by a broad coalition of the Internet's business, technical, academic, and user communities, ICANN is assuming responsibility for a set of technical functions previously performed under U.S. Government contract by IANA and other groups.

Specifically, ICANN coordinates the assignment of the following identifiers that must be globally unique for the Internet to function: Internet domain names, IP address numbers, protocol parameter and port numbers. In addition, ICANN coordinates the stable operation of the Internet's root server system.

As a non-profit, private-sector corporation, ICANN is dedicated to preserving the operational stability of the Internet; to promoting competition; to achieving broad representation of global Internet communities; and to developing policy through private-sector, bottom-up, consensus-based means. ICANN welcomes the participation of any interested Internet user, business, or organization.

Email: icann@icann.org
Postal: Internet Corporation for Assigned Names and Numbers
(ICANN)
4676 Admiralty Way, Suite 330
Marina del Rey, CA 90292
USA
Telephone: +1-310-823-9358
Fax: +1-310-823-8649
Internet: <http://www.icann.org/>

o InterNIC

The InterNIC was a cooperative activity between the National Science Foundation, General Atomics, AT&T, and Network Solutions, Inc. The joint activity InterNIC no longer exists.

Currently, Network Solutions runs the central registry according to the shared registry model specified by ICANN for registration of second-level domain names under the generic top-level domains .com, .net, and .org.

For information on accredited registrars for .com, .net, and .org, please see:

<http://www.icann.org/registrars/accredited-list.html>

(note that Network Solutions is an accredited registrar as well as the entity running the registry).

Email: hostmaster@netsol.com
Postal: Network Solutions, Inc.
505 Huntmar Park Dr.
Herndon, VA 20170 US
Telephone: +1-703-742-4777
Fax: +1-703-742-9552
Internet: <http://www.networksolutions.com/>

Regional Internet Registries (IRs)

Regional IRs operate in large geopolitical regions such as continents. Currently, there are three Regional IRs: ARIN for the Americas, the Caribbean, and Africa; RIPE NCC for Europe, Africa, and the Middle East; and APNIC for the Asia Pacific region. The specific duties of the Regional IRs include coordination and representation of all local Internet Registries in their respective region.

- o APNIC

Asia Pacific Network Information Center (APNIC) is a non-profit Internet registry for the Asia Pacific region. APNIC provides IP address allocation, Autonomous System Number (ASN) assignment, and IN-ADDR.ARPA registration.

Email: hostmaster@apnic.net
Postal: APNIC Box 2131
Milton Queensland 4064
Australia
Telephone: +61-7-3367-0490
Fax: +61-7-3367-0482
Internet: <http://www.apnic.net/>

- o ARIN

The American Registry for Internet Numbers (ARIN) is a non-profit Internet registry that was established for the purpose of administration and registration of Internet Protocol (IP) numbers to the geographical areas that were previously managed by Network Solutions, Inc. These areas include, but are not limited to, North America, South America, Africa, and the Caribbean region. ARIN provides IP address allocation, Autonomous System Number (ASN) assignment, and IN-ADDR.ARPA registration.

Email: hostmaster@arin.net
Postal: 4506 Daly Drive
Suite 200
Chantilly, VA 20151
Telephone: +1-703-227-0660
Fax: +1-703-227-0676
Internet: <http://www.arin.net/>

- o RIPE NCC

Reseaux IP Europens Network Coordination Centre (RIPE NCC) is a non-profit Internet registry for the European, North African, and Middle East regions. RIPE NCC provides IP address allocation, Autonomous System Number (ASN) assignment, and IN-ADDR.ARPA registration.

Email: ncc@ripe.net
Postal: Singel 258
1016 AB Amsterdam
The Netherlands
Phone: +31-20-535-4444
Fax: +31-20-535-4445
Internet: <http://www.ripe.net/>

Appendix B: Documentation

Internet Documentation

For general Internet documentation, "ftp" to rfc-editor.org and "cd" to the /rfc subdirectory for Request for Comments documents.

Details on obtaining these documents via ftp or email may be obtained by sending an email message to:

rfc-info@rfc-editor.org

with the message body help: ways_to_get_rfcs. For example:

To: rfc-info@isi.edu
Subject: getting rfcs

help: ways_to_get_rfcs

Documents, Templates, and Forms

The documents, templates, and forms referenced in this guide are available from the document stores in the directories listed in the URLs (Uniform Resource Locators). Organizations without connectivity wishing to obtain copies of the referenced documents should contact their Local IR to arrange postal delivery of one or more of the documents. Note that fees may be associated with the delivery of hardcopy versions of documents.

The document stores can be accessed in two ways:

1. Via anonymous FTP (File Transfer Protocol).

Using your ftp program, connect to the appropriate host computer shown below using your email address as the password. Use the "cd" (change directory) command to connect to the appropriate subdirectory, then use the "get" command to retrieve the specific file. For example:

ftp rs.apnic.net (for countries in the Asia/Pacific region)
ftp rs.arin.net (for countries in the Americas)
ftp rs.ripe.net (for countries in Europe or North Africa)

login: anonymous
password: your_email_address

cd netinfo
get <domain>_info.txt

2. Via electronic mail, ftp, or the World Wide Web.

Send email to the appropriate address shown below with the message body as specified.

APNIC Documentation

For APNIC documents and templates, "ftp" to ftp.apnic.net and "cd" to /apnic/docs. APNIC no longer has an electronic mail method of form retrieval. Many of APNIC's request forms are also available on the web site at:

<http://www.apnic.net/reg.html>

ARIN Documentation

For ARIN templates, "ftp" to rs.arin.net and "cd" to /templates.

You can also obtain templates via the web site at:

<http://www.arin.net/templates.html>

Other ARIN documentation is available at:

<http://www.arin.net/docs.html>

Or send email to:

hostmaster@arin.net

RIPE Documentation

For RIPE documents and forms, "ftp" to ftp.ripe.net/ripe and "cd" to /docs or cd to /forms.

Or send email to:

mail-server@ripe.net

with send help in the body of the message.

Appendix C: Country Codes

The International Organization for Standardization (ISO) 3166 Maintenance Agency and ISO 3166 current list of two-letter country codes is available via:

<http://www.iso.ch/infoe/agency/3166-1.htm>

Appendix D: Acronyms

ANS	Advanced Network Services, Inc.
ASN	Autonomous System Number
APNIC	Asia Pacific Network Information Center
ARIN	American Registry for Internet Numbers
AS	Autonomous System
CANET	Canada Net
CIDR	Classless Inter-Domain Routing
DNS	Domain Name System
gTLD	Generic Top-Level Domain
IANA	Internet Assigned Numbers Authority
InterNIC	Internet Network Information Center
IP	Internet Protocol
IR	Internet Registry
IRR	Internet Routing Registry
ISO	International Organization for Standardization
ISP	Internet Service Provider
LINX	London Internet Exchange
NCC	Network Coordination Centre
NIC	Network Information Center
NSRC	Network Startup Resource Center
POP	Point of Presence
RADB	Routing Arbiter Data Base
RFC	Request for Comments
RIPE	Reseaux IP Europeans
TCP/IP	Transmission Control Protocol/Internet Protocol
TLD	Top-Level Domain

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