ARIN

American Registry for Internet Numbers

GUIDE TO:

INTERNET NUMBER RESOURCES

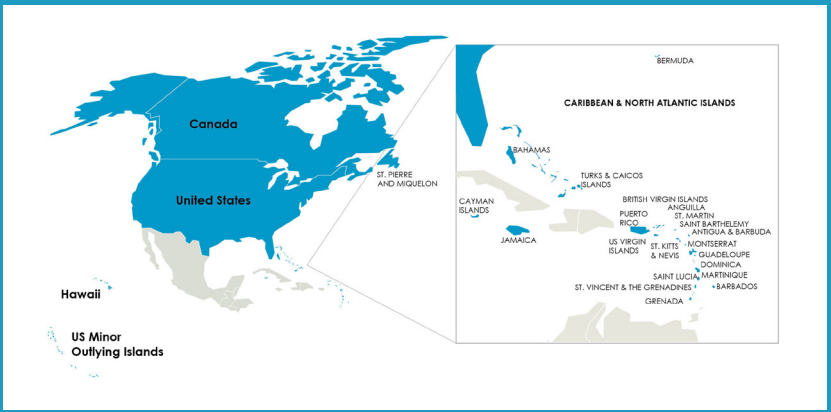
What exactly are IP addresses and ASNs?

How are they used and distributed?

What is routing, and what does ARIN have to do with it?

Read on for answers to all these questions and more.

ARIN's core service is the management and distribution of Internet number resources: Internet Protocol (IP) addresses and Autonomous System Numbers (ASNs). ARIN manages these resources within Canada, the United States, and many Caribbean and North Atlantic islands.



What are IP addresses?

An Internet Protocol (IP) is a set of technical rules that defines how computers communicate over a network. An IP address is a number that identifies each computer or device on the Internet. Much like mailing a letter requires an address for the postal service, or a phone call requires a unique number, IP addresses uniquely identify each device so that information can be sent directly to and from it.

IP addresses come in two versions:

IP version 4 (IPv4) and IP version 6 (IPv6)

Why are there two different versions of IP addresses?

The Internet Protocol (IP) was originally designed to package data with the Transmission Control Protocol (TCP) to handle sending that data to its destination. After several versions, IPv4 was developed in 1981 and became the first widely-used Internet Protocol. It's held up well, considering it still accounts for most of today's Internet traffic. An IPv4 address may look like:

198.51.100.132

Unfortunately, the relatively small length of IPv4 addresses limits the protocol to around **4.3 billion** combinations, which suited the number of connected devices in 1981, but was never meant to accommodate a global Internet. In September 2015, ARIN officially depleted its pool of free IPv4 addresses.

When it became clear that the IPv4 address pool could not meet all the future needs of the rapidly growing Internet, a new protocol was developed that offered a far greater number of unique addresses, called IPv6.

IPv6 was deployed in 1999, and uses hexadecimal notation to allow for far more combinations. An IPv6 address may look like:

2001:0DB8:0234:AB00:0123:ABCD:34EF:0001

This longer format allows for about **340 undecillion** combinations. The technical functionality of the Internet remains the same with both types of addresses, but to keep the Internet growing, organizations will need to transition to IPv6. IPv4 and IPv6 will likely coexist for many years, but organizations must start deploying IPv6 now to ensure they can grow and continue to communicate with everyone on the Internet.

What are Autonomous System Numbers?

An Autonomous System (AS) is a group of one or more IP prefixes (lists of IP addresses accessible on a network) run by one or more network operators that maintain a single, clearly defined routing policy. Network operators need Autonomous System Numbers (ASNs) to control routing within their networks and to exchange routing information with other Internet Service Providers (ISPs).

There are two different formats to represent ASNs: **2-byte** and **4-byte**. A 2-byte ASN is a 16-bit number. This format provides for 65,536 ASNs (0 to 65535). From these ASNs, the Internet Assigned Numbers Authority (IANA) reserved 1,023 of them (64512 to 65534) for private use.

A 4-byte ASN is a 32-bit number. This format provides for 2^{32} or 4,294,967,296 ASNs (0 to 4294967295). Unlike 2-byte ASNs, IANA did not reserve any 4-byte ASNs for private use.

Up until the Internet Engineering Task Force (IETF) proposed a gradual transition to 4-byte ASNs in 2007, all ASNs were 2-byte. There is no longer a distinction between a 2-byte and 4-byte ASN, and all ASNs should be considered 4-byte.

For more information about specifications for ASNs, see the following Requests for Comments (RFCs):

RFC 1930 – Guidelines for creation, selection, and registration of an Autonomous System (AS)

RFC 4893 – BGP Support for Four-octet AS Number Space

RFC 5396 – Textual Representation of Autonomous System (AS) Numbers

What are the different types of Autonomous Systems?

There are three different kinds of AS:

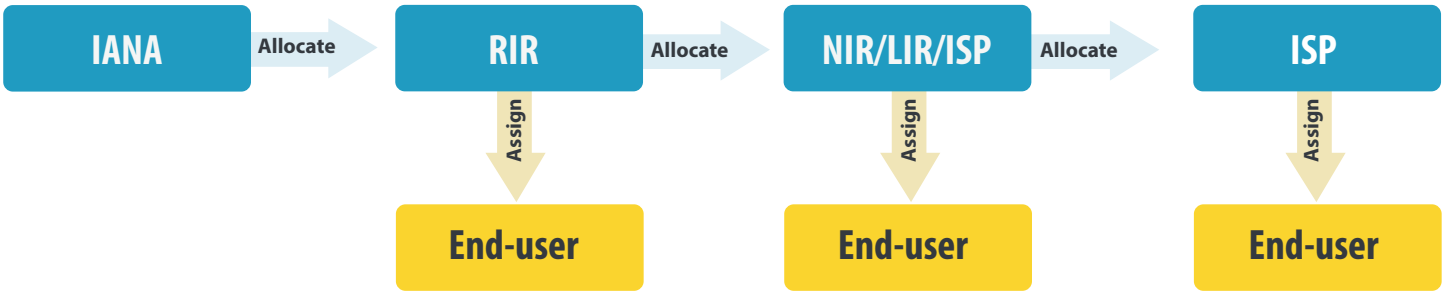
1. **A multi-homed AS** connects to two or more AS's so it can maintain its Internet connection should one AS connection fail.

2. **A stub AS** connects to only one other AS, though it may have its own private connections not visible to the rest of the Internet.

3. **A transit AS** acts as a link between two or more other AS's, allowing for data to pass through it, even data from unassociated networks. ISPs, for example, offer their customers and their customers' networks access to other networks and the Internet via transit AS.

How are Internet number resources distributed?

IP addresses and ASNs are distributed on a global level from IANA. IANA distributes large blocks to ARIN and the other four Regional Internet Registries (RIRs), who in turn assign ASNs and allocate smaller IP address blocks to National Internet Registries (NIRs), Local Internet Registries (LIRs), and Internet Services Providers (ISPs) in their regions. IP addresses can then be reassigned to customers until reaching end users.



What is routing?

Routing is the act of moving information through a computer network. On the Internet, information is split into "packets," each individually labeled with its ultimate destination, an IP address. Specialized devices called routers pass packets from the source computer to its destination by analyzing a routing table to determine the best path. Each packet can take a different path, with all packets reassembling upon arrival at their destination.

What is a routing table?

A routing table is a list of networks stored in a router's memory, used to forward packets to the right destination. Routers have a finite amount of memory and processing power, so the smaller the size of the routing table, the faster and more often packets will get to their destinations. The recent increase in Internet-enabled devices has lead to a larger routing table size, creating an ongoing challenge for router manufacturers and network administrators.

What does ARIN have to do with routing?

While ARIN doesn't directly route IP address blocks, we play a key role in helping to keep the routing table at a manageable size. The ARIN community has directed ARIN to allocate large blocks of IP addresses that result in fewer routing table entries to help keep the routing table at a manageable size. Organizations manage their large blocks, further allocating smaller blocks from inside their networks. This allows many entities to use a single large block, rather than each network having its own allocation, and further reduces routing table growth. Resources allocated by ARIN are not guaranteed to be globally routable on the Internet.

Who makes up the Internet technical community?

Many independent organizations work together to coordinate certain technical parts of the Internet, including:

AFRINIC- African Network Information Center (RIR)

APNIC- Asia Pacific Network Information Centre (RIR)

ARIN- American Registry for Internet Numbers (RIR)

IANA - Internet Assigned Numbers Authority

ICANN - Internet Corporation for Assigned Names and Numbers

IETF - Internet Engineering Task Force

ISOC - Internet Society

LACNIC - Latin American and Caribbean Internet Addresses Registry (RIR)

NANOG - North American Network Operators Group

NRO - Number Resource Organization

RIPE NCC - RIPE Network Coordination Centre (RIR)

These organizations help with:

- Technical protocols and standards
- Internet number resource distribution and management
- Connectivity
- Policy development and implementation
- Education and training

The technologies, resources, and services used to run the Internet are highly interdependent and require a significant amount of coordination, administration, and day-to-day management. Each organization has a specific role and provides fundamental value to the Internet's operation.

These organizations have contributed to the incredible growth and stability of the Internet today. There are well-established mechanisms, including meetings, mailing lists, and bottom-up policy development processes that enable direct participation by any interested party. This ensures that policies are defined by those most affected by them, and are flexible enough to adapt to changing community needs.

Additional ARIN Resources

Request Internet number resources at **www.arin.net/resources/request.html**

ARIN is consistently supporting the deployment of IPv6 through education and outreach. Learn about IPv6 at **www.arin.net/knowledge/ipv6_info_center.html**

Find IPv6 DNS and hosting providers, as well as other helpful information at **https://getipv6.info**

Learn how you can get involved in ARIN's community-driven Policy Development Process (PDP) by attending a meeting at **www.arin.net/participate/meetings**

Keep in touch with ARIN and see what we're up to!

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