

IPv4 markets

With IPv4 depletion, there is increasing interest in the transfer of IPv4 addresses from organizations holding more addresses than they need, to organizations that are unable to satisfy their needs from the Regional Internet Registry (RIR) free pools.

It is often early address holders that have the extra address space and they usually seek some financial incentive before transferring their right to use the addresses to another organization. Such financial transactions are beyond the scope of the RIRs' remit, as defined by community-developed policies, which focus on ensuring the transfer of address holding is properly recorded. However, as the exchange for money or other assets is a frequent feature of these transfers, this is often referred to as an "IPv4 market".

This approach marks a significant change in how the right to use IP addresses is managed. The administration of IP addresses is governed by community-developed policies. Policies allowing transfers, both within and between RIR service regions, are now in place in some RIR communities and are under consideration in others.

The role of the RIRs

As the transfer of IPv4 address rights becomes more common, the role of RIRs in maintaining accurate, up-to-date public registries of who is registered to use what address space becomes even more important. From a technical perspective, the Internet's resilience relies on network operators being able to contact each other and troubleshoot network issues. Legal and business authorities also have a strong interest in the maintenance of public registration records.

It is therefore important that the policies, procedures, and market practices evolving to facilitate the transfer of address space, properly reflect and incorporate the need for registration of these transfers with the appropriate RIR.

The RIRs are working on, or have already implemented, the policies and processes required to enable transfers within and between regions. To find out more about RIR policies please visit: www.nro.net/policies

IPv6

Despite the development of a transfer market, the NRO believes that IPv6, the newer Internet Protocol, is critical to the future growth and sustainability of the Internet. In the foreseeable future it will be necessary for organizations to run IPv4 and IPv6 networks in parallel, or "dual-stacked" in order to access the entire Internet.

IPv6 is not directly compatible with IPv4. The primary difference between IPv4 and IPv6 is the expanded addressing capability – while IPv4 is based on 32-bit numbers, IPv6 employs 128-bit numbers, resulting in an astronomically large number of unique addresses. This difference means that deployment of IPv6 on the Internet requires updating a wide range of legacy networking hardware and software.

Raising awareness about the need for IPv6 adoption and the challenges this can pose has been a priority for many in the Internet technical community, including the RIRs, for many years. IPv6 adoption is the solution to exhaustion of the IPv4 address pool.

More information on IPv6, including transition technologies and remaining challenges for industry and government, can be found at: www.nro.net/ipv6.



IPv4: Where are we now?

About IPv4

All devices directly connected to the Internet today are identified using Internet Protocol (IP) addresses, which are unique numbers that are used to route data between different points on the network. Most of the IP addresses used today are IP Version 4 (IPv4), a protocol developed in the late 1970s and based on 32-bit numbers. Today, IPv4 addresses are distributed for use by network operators around the world, by RIRs which operate in five defined geographic regions.

The use of 32-bit numbers means that the pool of unique IPv4 addresses is limited to roughly 4.3 billion (2^{32}) – a large number, but unfortunately nowhere near large enough to provide for all the devices that will connect to the Internet in the future. Today, this pool of resources is nearly exhausted. As a result, in some regions it is no longer possible for network operators to meet their demand for IPv4 addresses from the RIR pools.

Principles of distribution

IP addresses are allocated on the basis of demonstrated need, as defined by policies developed by the Internet community and implemented by the RIRs. Essentially, if a network operator can demonstrate, in accordance with local policy, that they have a need for the addresses, they will receive the exclusive right to use them from the appropriate RIR.

IP address space is regarded as a managed common resource. RIRs charge service fees for registration and administration of Internet number resources, but network operators do not buy IP address space from an RIR. Rather, they are registered as having "right of use" over a specific block of addresses.

What is a "/8"?

/8 of IPv4 address space
= 2^{24}
= 16,777,216 IPv4 addresses
= 1/256 of IPv4 total address pool

Historical milestones

In the 1980s, IPv4 address space was handed out to organizations in very large blocks that exceeded their immediate need for the addresses. The majority of these organizations were based in the United States and Europe, and the generous distribution policy was based on the premise that IP addresses were in plentiful supply.

As the Internet grew in the 1990s, it appeared that the Internet would soon outgrow both the IPv4's 32-bit address pool, and the existing centralized distribution system. For these reasons, the responsibility for IP address distribution was shifted to the RIRs, which receive blocks of addresses from a central pool that is managed by the Internet Assigned Numbers Authority (IANA). Working in RIR communities, Internet stakeholders developed more conservative distribution policies, and measures such as the introduction of Classless Inter-Domain Routing (CIDR), which slowed the consumption of IPv4 address space.

IPv4 depletion

Final IANA allocations and "last /8" policies

In 2009, the five RIR communities agreed on a Global Policy instructing that when IANA's central pool of IPv4 addresses reached five remaining /8 blocks, each RIR would receive one final /8 allocation. In February 2011, the central pool reached five /8s, triggering this policy and depleting the central pool of IPv4 address space. Further allocation of these last IPv4 addresses is the responsibility of each RIR, acting in accordance with policies developed by their respective communities.

Some RIR communities have developed specific policies regarding the distribution of their "final /8". These policies, which limit how much address space an individual organization can receive, are designed to "ration" the remaining space and ensure that small blocks of IPv4 are still available to new network operators, allowing them to connect their (primarily IPv6-based) networks to the existing IPv4-based Internet.

STATUS OF 256 /8S IPv4 ADDRESS SPACE

