



## WTPF Backgrounder Series

# IPv4 and IPv6 issues

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EVERY DEVICE connected to the Internet is identified by a unique [‘IP address’](#) used to route data packets globally across the net. The current addressing system, called IP version 4 or ‘IPv4’, was deployed on 1 January 1983 and uses 32 digital bits to represent addresses, generating a theoretical total limit of 4.3 billion addresses.

IPv4 address space is managed by the [Internet Assigned Numbers Authority](#) (IANA) globally, and by five [Regional Internet Registries](#) (RIRs) responsible in their designated regions for assignment of addresses to end users and [local Internet registries](#), such as [Internet Service Providers](#) (ISPs).

In the early days of the Internet, before the RIR system was in place, some organizations received very large allocations of address space. These addresses became known as ‘legacy address space’, and this now accounts for nearly 40% of all IPv4 addresses. These organizations do not have a contractual relationship with the RIRs, which were established *after* these early allocations.

Because they represent a finite resource, the depletion of IPv4 addresses has been a concern since the late 1980s, when the Internet started to experience dramatic growth. IPv4 allocation policy has evolved significantly, or ‘tightened up’ over time, with the creation of the five RIRs since 1990s, and policy decisions enforced by RIRs – such as using [Classless Inter-Domain Routing](#) (CIDR), payment of membership and per-address fees to RIRs, needs-based assessment, and encouraging the use of [network address translation](#) (NAT), to give just a few examples.

IANA exhausted its global free IPv4 pool in February 2011. RIRs [APNIC](#) and [RIPE-NCC](#) exhausted their regional free IPv4 pools in





April 2011 and September 2012 respectively. The exhaustion of free IPv4 pools in the North America, Africa and Latin-America regions is predicted to occur between 2014 and 2017.

### IPv6 ADDRESSES

[IPv6 \(Internet Protocol, version 6\)](#) was developed to solve the crisis of IPv4 exhaustion. It uses 128 bits to represent addresses, which generates a space of equivalent to some 340 undecillion<sup>1</sup>, or for the mathematically minded, more than  $7.9 \times 10^{28}$  times as many addresses as IPv4. To give a more tangible idea of the scale, some have compared the number of available IPv6 addresses to the number of grains of sand on the planet.

As with IPv4, IPv6 address space is managed by IANA and the RIRs following a similar 'first come, first served' policy, linked to the concept of 'demonstrated need'. Even though IPv6 address are generously allocated in giant blocks, as of March 2013 only a tiny fraction (less than 0.0002%) of the total IPv6 address space is used.

In view of the historical imbalance of worldwide IPv4 address distribution, the 2005 report of the [WSIS](#) Working Group on Internet Governance (WGIG) acknowledged that "the current numbering management is required to ensure equitable distribution of resources and access for all into the future". Some have expressed worries that the policy which led to the occupancy of a substantial portion of the finite pool of IPv4 addresses ('legacy IPv4 addresses') by wealthier 'tech-savvy' entities may once again work against late entrants looking for IPv6 address allocations - especially developing countries.

Others believe that since the IPv6 address space is virtually inexhaustible, this 'quasi-inexhaustibility' means that any past issues regarding imbalances will not arise in the future and that, therefore, the current allocation policies of the RIRs can be maintained unchanged for IPv6. Those supporting this view also note that IPv6 address allocation policies have applied from the very beginning of the allocation, whereas IPv4 policies were developed retrospectively.

### NEEDS OF IPV4 DURING TRANSITION

Because IPv6 was designed without backward compatibility, the transition from IPv4 to IPv6 essentially needs a 'dual stack' phase during which hosts operate with both protocol stacks concurrently, 

<sup>1</sup> A cardinal number represented in the US by 1 followed by 36 zeros, and in Great Britain by 1 followed by 66 zeros.

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using the IPv6 protocol stack to speak to other IPv6 hosts and the IPv4 protocol stack to speak to other IPv4 hosts. The availability (or lack thereof) of IPv4 addresses is therefore a factor which continues to be of importance during the transition period.

For the moment, it is unsure how long the IPv4/IPv6 transition period will last. Some worry that it might last indefinitely.

### **RECLAMATION OF UNUSED IPV4 SPACE**

Some legacy IPv4 addresses are not used or not visible on the Internet. There is a potential possibility to reclaim these address ranges and reissue the addresses in smaller blocks. However, no strict accounting of IP address allocations has been undertaken, and it would take quite a bit of effort to track down which addresses really are unused. It can be expensive in terms of cost and time to renumber a large network, so the current holders of those addresses are likely to object. There is no clear legal basis to force such an address reclamation.

### **IPV4 ADDRESS TRANSFER**

In view of IPv4 scarcity, more and more voluntary redistribution of IPv4 addresses (IPv4 address transfers) has been occurring, with the emergence of new 'IPv4 address broker' businesses advertising online to facilitate these transfers. There is some concern that a growing market in IPv4 addresses has developed, with a significant proportion of transferred IPv4 addresses coming from legacy allocations which are not subject to the relevant policies of the RIRs. The rising market price of such transferred IPv4 addresses is also causing concern about the potential impact on new or fast-growing ISPs in developing countries.

### **AWARENESS RAISING AND CAPACITY BUILDING**

The transition from IPv4 to IPv6 continues to be very slow, even though some relatively significant picking up of pace occurred recently when APNIC and RIPE-NCC exhausted their free IPv4 pools. As of March 2013, only 1% of Google users are using IPv6 and fewer than 16% of all networks comprising the Internet are IPv6 enabled.

Even though many think the deployment of IPv6 should become a clearly-stated priority objective for national policy-makers, some believe it should be the industry's decision on when and how to invest in the transition to IPv6.

ITU has been promoting IPv6 deployment for many years and



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has adopted relevant Internet-related Resolutions since its 1998 Plenipotentiary Conference in Minneapolis. More recently, Resolutions of [WTSA 2008](#), [WTDC-2010](#), and [Plenipotentiary 2010](#) have all stressed the need for human capacity development and training with respect to IPv6 address deployment.

In addition, [an ITU IPv6 Group](#) studied IPv6-related address policy issues in 2010-2012, and at the request of developing countries, started an ITU IPv6 capacity building project to facilitate human and infrastructure capacity development in the developing world, in cooperation with other partner organizations and stakeholders.

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