



Asia Pacific Network Information Centre

Policy Aspects of the Transition to IPv6

Geoff Huston
Chief Scientist, APNIC



The Situation

- Within five years the global pool of available IPv4 addresses will show signs of exhaustion
- The Internet will continue to function and grow but the framework for IPv4 distribution will change
- The general expectation is that the industry will adopt IPv6 as a replacement for IPv4 but there are important issues to be resolved

Detailed analysis and modeling of the address distribution function for IPv4 addresses over the past decade predicts that the current framework of supply of IPv4 addresses to the global Internet will show signs of exhaustion in around three years from today. The uncertainty factor with this prediction appears to be around plus or minus 18 months.

This does not imply that the Internet will cease to function at that time, nor does it imply that all network growth will cease at that time. This is simply not the case, of course.

What this does imply is that the current framework of IPv4 address distribution, including the source of further addresses, their cost and any associated conditions, will change at that time. On the other hand, the distribution function for IPv6 addresses is not expected to change in any form.

The general expectation is that the reaction to this situation is that industry will adopt IPv6 as a replacement for IPv4, as a reaction to this scarcity. However there are some open issues with the nature of this transition which merit further examination.

Aspects of Transition

- IPv6 is not a simple replacement for IPv4
- Networks, service systems and users will need to access both IPv4 and IPv6 simultaneously across the entire period of the transition
- The transition will take longer than the time remaining for the continued operation of the current IPv4 address distribution framework
- Industry demand for IPv4 addresses will continue beyond the projected date of IPv4 address pool exhaustion

The Internet has expanded rapidly in the past decade. It is now a truly massive network, spanning almost all parts of our world. There are many thousands of Internet Service Providers providing services to, by latest estimates, some 19% of the world's population. By any metric this is an astounding success story of rapid deployment. But a large and diverse industry tends to lose some elements of agility as it grows, and if IPv6 is to be clearly written in the Internet's future it will be only as an outcome of many individual decisions on the part of vendors, service providers, application providers, and ultimately users.

This transition is not expected to happen quickly, nor cheaply. Transition to IPv6 is not a simple switch to turn on that will instantly obviate any further need for IPv4, as IPv6 is not a backward compatible technology, and an IPv6 host cannot directly communicate with an IPv4 host. As a result, IPv6 is not a simple replacement for IPv4, and networks, service systems and users will need to access both IPv4 and IPv6 simultaneously across the entire period of the transition, in some form or another. Networks will require continued access to IPv4 addresses in order to communicate with other IPv4 networks and services for as long as such networks and services continue to exist in sufficiently large volumes.

There is an expectation that this transition will take longer than the time remaining for the continued operation of the current IPv4 address distribution framework, and a related expectation that industry demand for IPv4 addresses will continue beyond these projections of IPv4 address pool exhaustion.



Principles of IP address Distribution

- The system of IP address distribution for the Internet is based on the principle of demonstrated need using an industry self-regulatory structure to determine the appropriate policies and practices at regional levels
- Internet metrics over the past decade prove the efficacy of this arrangement in sustaining a practical and efficient distribution framework for IP addresses

The system of address distribution for the Internet is based on the the principle of availability to meet needs. Addresses have been made available to those with requirements for addresses, using a principle of demonstrated need. The address distribution function uses a industry self-regulatory structure in order to determine the appropriate policies and practices at regional levels.

The metrics of the expansion of the Internet in the past decade, including the number and diversity of service providers and their pace of deployment of Internet services bears testament to the efficacy of this arrangement in sustaining a practical and efficient distribution framework for addresses that has managed to address the requirements of the Internet at large.



Potential Responses to the Transition to Ipv6

- IPv6 deployment is currently at a low level when compared to the extent of the IPv4 network
- There is a concern that the longer this investment in transition to IPv6 is deferred, the greater the risk of negative outcomes and cost escalation as a result of IPv4 address exhaustion
- While these risks may suggest the need for a regulatory initiative, such action would go against the deregulation that has driven the Internet's success and innovation and could stifle future Internet growth

These arrangements for address distribution will experience some stress during this transition phase, as the demand for IPv4 addresses is currently expected to continue beyond the anticipated lifetime of the existing distribution framework. We are facing a hiatus over IPv4 address supply and a period of realignment of objectives, timelines and costs for the associated IPv4 address distribution framework as part of the longer term transition.

To date we've seen relatively subdued levels of deployment of IPv6 when compared to the extent of the IPv4 network. The cost and opportunity signals that normally accompany advance investments in new technology are not as overt in this situation, and while the longer term risks of continued use of IPv4 are clearly and widely recognised, there still remains few overt market signals in the day-to-day operation of this industry to motivate industry actors to commence investment in an IPv6 transition at present.

There is a concern that the longer this investment in transition to IPv6 is deferred, the greater the risk of negative outcomes for some or many of the actors. In turn, this poses an increased risk of a resultant cost escalation being borne by consumers, particularly if the industry experiences a disruptive hiatus at the point of IPv4 address exhaustion. This risks posed by situation could be interpreted as a precursor for a call for some form of regulatory initiative. Such an intervention could phrase the longer term of objective of technology transition in a set of constraints on the existing actors that would either incent or compel existing actors to undertake such a transition far earlier than would otherwise occur.

There are, however, some serious caveats with such a call for regulatory initiative, based on experience of our previous failures and successes in this industry. The Internet is the most prominent product of the wave of progressive industry deregulation in the communications sector over the past quarter century, and deregulation has encouraged significant levels of private investment in new technologies and services, created new markets, and turned innovation into ubiquitous services. The Internet continues to evolve, and continues to generate novel outcomes the further stimulate investment in innovation within a vibrant competitive market for internet-based services. Imposing external constraints in the form of regulatory impositions poses a risk of stifling such activity in those regulatory regimes where such measure are adopted, with consequent implications in terms of where further innovation takes place and where the rewards of such innovation may be realized. In many places, and in many ways the decision to deregulate this industry was a brave, and even a courageous decision. It represented a significant step away from a known, if staid and inefficient, industry structure into an entirely new world full of unknowns. And in times of uncertainty it often requires a similar level of commitment to believe that the deregulated environment to maintain the stance that the common expression of will in a deregulated market will provide appropriate solutions at the appropriate time.

Asia Pacific Network Information Centre

APNIC

The Challenge

- Industry, regulators and public policy makers need to develop a coherent strategy to sustain the transitional framework between IPv4 and IPv6
- This strategy needs to acknowledge the continuing contribution of the institutions and frameworks that have sustained the Internet through its short but phenomenal history as a deregulated industry
- This strategy should position the various stakeholders and actors in mutually supportive roles while preserving the innovative, vital characteristics of the Internet

The challenge we face, as an industry, as consumers, as regulators, and as public policy makers is to phrase coherent responses to this situation that are capable of sustaining the innovative lifeblood of the Internet, fostering its creativity, efficiency, and agility. At the same time we need to acknowledge the continuing contribution of the the institutions and frameworks that have sustained the Internet through its short but truly phenomenal history so far, and their critical role with the rather unique set of dynamics that exist within this deregulated industry.

Such a response should position the various stakeholders and actors into mutually supportive roles. The critical attribute is that the measures taken by actors within the context of this transition should be capable of instilling confidence that while the future of such a vibrant activity as the Internet is not precisely scripted, and while the outcomes are not capable of being comprehensively defined in advance, that we can create and sustain transitional frameworks within this deregulated industry that will resolve this matter in ways that will preserve the vital characteristics of the Internet.

We should ensure that however various sectors and actors choose to respond here, and whatever approaches are adopted to resolve this matter of realigning the basic elements of addressing in the low level infrastructure of the network in the coming years, that we can maintain a firm hold on an Internet that continues to serve our needs, continues to innovate, and, perhaps above all, continues to excite our imagination with possibilities.

