

Briefing Paper:

IPv6 deployment: State of play and the way forward

The Internet Society's Briefing Papers are intended to act as an orientation paper for members of the Internet Society on a given topic. They provide background, outline current issues, challenges and opportunities, and provide suggestions as to ways forward. The Internet Society welcomes your comments on this topic. Please send your comments to pubpol-briefing@isoc.org.

Introduction

Issues related to global addressing, and particularly the depletion of Internet Protocol version 4 (IPv4) and the deployment of IPv6, affect and involve all stakeholders – including the private sector, the public sector, the technical community, civil society, the research community, and academia. In this particular Briefing Paper, the Internet Society looks at one sub-set of stakeholders – those entities that have central roles in IPv6 deployment at the infrastructure and application layers, including but not limited to network operators, hardware manufacturers, and application developers.

A short introduction to the global addressing challenge of IPv4 depletion and IPv6 take-up is included at the end of this Briefing Paper.

Opportunities and challenges

While there is a growing recognition, certainly among network operators and hardware manufacturers, that moving to IPv6 is an inevitability in the longer term, there is considerable reluctance to move faster than is absolutely necessary despite the impending depletion of IPv4 addresses that looms large on the not so distant horizon (this reluctance is born of a number of factors that will be reviewed below). The challenge with this approach is that piecemeal approaches and tardy deployment could impact the seamless addressing that users take for granted and, as a result, deteriorate their Internet experience. The Internet Society believes there are a number of compelling strategic reasons for this set of key stakeholders to take-up IPv6 sooner than later – whether through enabling networks or building suites of IPv6-ready applications – that more than justify tackling immediate-term implementation challenges head-on.

The reasons for moving to IPv6 vary from community to community. For example, IPv6 will unlock a range of opportunities for network operators, in terms of service provision continuity, growth, and innovation on one hand, and network management efficiencies and savings on the other. For hardware manufacturers IPv6 is key enabler of smart grids, intelligent buildings, sensor networks, and other hardware- (and application-) dependent innovations. As IPv6 is deployed, demand for new hardware will grow. For application developers the promise of a virtually unlimited address space is expected to spur innovation in monitoring, tracking and remote management software and applications, to touch on but a few. More generally, IPv6 offers simpler and more resource efficient infrastructure management and routing, for example removing the need for "work-arounds" (such as Network Address Translation (NATs)) that add costs and complexity to the network; better scaling of networks and services; and more a flexible platform for the delivery of new services, all of which should encourage innovation and new product offerings.

The opportunity outlined above is impossible without increased IPv6 take-up, given the threat that the imminent depletion of IPv4 poses to service continuity and growth. IPv6 is a key element in mitigating this threat through allowing for an unimpeded growth in addressing as the Internet evolves. Exploiting the opportunity presented by IPv6's unlimited address space will also likely become a competitive advantage vis-à-vis players. As the "always on, always connected" communications world evolves, IPv6-related innovation in product offerings and applications will drive increased demand for bandwidth and services.

There are two oft-mentioned impediments to IPv6, both of which relate to the issue of demand and both of which may be more perceived than real. On the one hand there is the supposed need for a "killer application" to drive demand. On the other hand is the issue of "who goes first" – in other words, the circular discussion about whether networks need to be IPv6 enabled to encourage application development or whether applications incorporating IPv6 need to be developed to encourage network deployment. While one cannot rule out the possibility of a "killer application" or applications helping to drive IPv6 take-up, we believe that focusing on such a panacea detracts from the real rationale for IPv6, that of business continuity and growth. Furthermore, the Internet Society believes that is vitally important to move beyond "chicken and egg" type discussions between the various players and start ensuring that not only that the underlying communications infrastructure is IPv6 ready, but that hardware, devices, and applications are too.

Finally, business service continuity, growth, and competitive advantage could be threatened if a timely transition is not undertaken. While consumers and enterprise customers may not need to know whether networks, devices, or applications are IPv6 ready, any service degradation due to an inability to enjoy seamless connectivity across networks and the Internet will quickly make IPv6 a competitive advantage.

The way forward

Some network operators, hardware and device manufacturers, and others are in the process of taking up IPv6, through deploying it in their networks or building it into their products. However many players are sitting on the sidelines, adopting a wait and see approach. While deployment is underway, it is not progressing fast enough.

In addition to the issue of demand discussed above, one of the most common concerns related to the up-take of IPv6 is the cost of implementation, staff training, and so on. For example, some players are deferring IPv6 take-up in order to avoid near term costs and implementation complexities. While this may make sense given the current economic climate, it is an untenable approach in the longer term as it could well be detrimental to future network management and growth, and adds further network costs. Further, in a survey of the Internet Society's organizational membership on IPv6 issues, respondents indicated that implementing IPv6 within their networks turned out to be more straightforward than had been anticipated.¹

IPv6 related challenges can be avoided by methodically and incrementally incorporating the protocol into ongoing business planning. This minimizes the likelihood of any business risks occurring during IPv4 run-out and IPv6 take-up, ensures that hardware, services and applications continue to operate smoothly, and allows for the ability to benefit from the increased addressing space and all the innovation and growth that will ensue. Those that have implemented IPv6 have done so typically through a measured and phased approach that lends itself well to existing refresh and development cycles, encourages proper integration into existing platforms, and lowers costs.

The Internet Society does not believe that players should delay the transition. An investment now in IPv6 is an investment in business continuity – it is effectively mitigating any future business risk when IPv4 is depleted. It is also an investment in future growth and opportunity – the vast addressing space that IPv6 offers will undoubtedly unlock new hardware, device, services, and software and application innovation in the communications and media industries in ways unforeseen.

Conclusion

IPv4 depletion and IPv6 deployment are multi-stakeholder issues with significant import at national and global levels. In this Briefing Paper we have chosen to focus on a set of key stakeholders. We recognize that there are many others, including, for example governments², users, content providers, and others. However, the infrastructure, device, and application level players are central to

¹ <http://www.isoc.org/pubs/2009-IPv6-OrgMember-Report.pdf>

² <http://www.isoc.org/pubpolpillar/docs/ipv6-government-role.pdf>

the success of the new addressing protocol. If the networks, routers, customer premises equipment, devices, and the applications that run on them are not IPv6 ready then not only will business continuity suffer but so to will economic opportunity and the stability and viability of the Internet.

The Internet Society does not believe that stakeholders have the luxury of taking a wait and see approach or indulging in circular "who goes first" discussions. IPv4 depletion is imminent and the time for moving to IPv6 is nigh. The Internet Society appreciates that a many players – such as network operators, hardware manufacturers, handset manufacturers – have made great strides in engaging on this important issue, but, as most would agree, much more needs to be done by all stakeholders. Much greater preparedness for IPv6 – across networks, hardware, and applications is needed. Business continuity and opportunity, and therefore national competitiveness, depend upon it.

Background

The global Internet addressing system – the means by which packets of information are delivered to the intended location and/or recipient across the breadth of the Internet – is running out of addresses.

The current addressing protocol (Internet Protocol version 4, or IPv4) created approximately 4 billion addresses, and due to the Internet's enormous success, the pool of remaining addresses is expected to be depleted in the next 18 to 36 months. The new address protocol, IPv6, offers an address space that is some 340 trillion trillion addresses large, dwarfing the number of IPv4 addresses. With this expanded address space, IPv6 brings a number of advantages in terms of stability, flexibility, and simplicity in network management. The IPv6 era is also likely to bring a new wave of innovation in applications and service offerings as it removes the need for shared addresses and network hiding in many instances.

IPv6 is being slowly implemented across networks and will coexist with IPv4 until a transition to IPv6 occurs (a transition that is likely to take many years). While the technical work related to the protocol has been largely accomplished³, what remains is deployment. Unfortunately this is not occurring fast enough and could become a significant challenge to continued seamless global addressing.

While awareness and implementation of IPv6 is growing, many organizations, whether in the public or private sector, are adopting a "wait and see" approach, sometimes along with tactical "work-arounds" (such as Network Address Translation (NATs)) designed to prolong the viability of the existing pool of IPv4 resources. The Internet Society does not believe that these approaches are viable in the longer term: ultimately IPv6 is necessary for the continuity, stability, and evolution of the Internet.

³ The Internet technical community, particularly the IETF, has spearheaded the development of IPv6; the work program is now largely completed – in IETF parlance the IPv6 work is now in "maintenance mode" (fixing bugs as they arise) and in "new features mode" (looking at how new applications and services can be supported).