

IPV6 READINESS SURVEY: THE CASE OF INDONESIAN ORGANIZATIONS

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Abstract

Recently, the Internet has become a crucial part of human life where various sectors depend on the technology. With the significant development of the Internet, the IPv4 as common IP address standard is predicted not able to accommodate the Internet and internet-based technologies growth. Then, the IPv6 was introduced in 1998 as a de facto standard to overcome the problems of IPv4. Although IPv6 technology has been available for decades, however, it has not yet become widely implemented. This empirical study investigates Indonesian organizations readiness for IPv6. Currently, Indonesia is the fourth largest country in the world, and the allocation of IP address to the country is extremely small, compared to the total population and other major countries. Surveying wide range organizations in Indonesia, the result indicates that although there is high awareness among the organizations and they believe IPv6 is important, IPv6 is perceived less urgent to be implemented. Consequently, the organizations don't put a lot of preparation for five readiness criteria, namely training, planning, assessment the current environment, policy and IPv6 deployment.

Dewasa ini, Internet telah menjadi bagian penting dari kehidupan manusia dengan tingginya ketergantungan akan teknologi tersebut. Akibat perkembangan yang significant tersebut telah membuat IPv4 yang umum digunakan saat ini diprediksi tidak mampu mengakomodir pertumbuhan Internet ataupun teknologi lain yang berbasis Internet. IPv6 kemudian diperkenalkan sebagai standard satu-satunya sebagai pengganti untuk mengatasi permasalahan IPv4. Meskipun telah berberapa dekade keberadaannya, IPv6 belum diimplementasikan secara luas. Penelitian ini bertujuan untuk melihat kesiapan organisasi di Indonesia terhadap IPv6. Indonesia merupakan negara terbesar ke 4 di dunia, akan tetapi memiliki alokasi IP yang terbilang kecil (sekitar 18 juta alamat IP) jika dibandingkan dengan jumlah penduduknya dan negara-negara utama lain. Hasil penelitian menunjukkan meskipun tingkat kepedulian cukup tinggi dan organisasi yang berpartisipasi percaya akan pentingnya IPv6, tetapi mereka beranggapan IPv6 tidak mendesak untuk diimplentasikan. Akibatnya, organisasi tersebut minimal atau bahkan tidak melakukan persiapan dalam lima kriteria yang diinvestigasi yaitu pelatihan, perencanaan, evaluasi kondisi terkini, kebijakan dan status penerapan IPv6.

Keywords: IPv6, Indonesia, readiness

1. INTRODUCTION

The number of Internet users reach 3.035 billion by the end of 2014 and penetrate up to 42.3% of the world total population (www.InternetWorldStats.com, 2014). The growth of the Internet tends to continue significantly (OECD, 2014). This is because of many new technologies (e.g. mobile, flexible and always on communication system) requiring the Internet connection to enable their system (Hovav *et al.*, 2004; Tassef *et al.*, 2009), and a fast growth of the Internet in developing countries (Che & Lewis, 2010).

With the significant growth of the Internet, numerous authors (Bohlin, 2002; Colitti *et al.*, 2010; Hain & Huston, 2005; Karpilovsky *et al.*, 2009) have shown their concern to the current Internet Protocol address limitation. Basically, every device connected to the Internet must have an IP address as connection permits (Dell, 2011). Karpilovsky *et al.* (2009) argue that the IPv4 will not be able to provide adequate services for the future Internet. Similarly, other authors (Bohlin, 2002; Colitti *et al.*, 2010) informed that the high demand of the Internet connection has driven to the migration to a much larger address space and the migration becomes a high priority to overcome serious Internet problem in the future (Mueller, 2006).

On 3rd February 2011, ICANN¹ as the IP regulatory body announced that they have allocated the last IPv4 blocks to the five RIRs (Regional Internet Registry). Obviously, it indicates that address shortage has become a real problem where almost entire available IPv4 addresses have been allocated (Dell, 2011). And recently, it is reported that the worldwide number of allocation of IP addresses reached approximately 3.6 billion by the end of 2014 (www.MaxMind.com, 2014). The current protocol can theoretically accommodate up to about 4.3 billion addresses. In the actual implementation, however, the numbers decrease significantly due to several following reasons (Cotton & Vegoda, 2010). Firstly, some addresses are not available to public since they reserve only for private addresses and loopback. Secondly, ICANN allocates several addresses for particular purposes, namely multicast (class D) and future use. The combination of the two previous reasons contributes to nearly 600 million addresses unavailable to the public. Finally, many addresses allocated to the user are not actually used due to the inefficiency of classes' concept on IPv4. However, there is no data reported the precise number of this category.

IPv6 or next generation IP has been almost two decades available as a solution (Shen. *et al.*, 2009) and standardized on 1998 (Deering & Hinden, 1998). It is not necessary only to extend the address space number but to solve other problems introduced by the current IP (Durdagi & Buldu, 2010; Mueller, 2010), such as security and mobility. However, the adoption remains minimal (Che & Lewis, 2010; Limoncelli, 2011). Elmore *et al.* (2008) predicts that it will be about 8 to 22 years to full adoption based on the current trends or even more (Dell, 2010). Mueller (2008) argues that the impact of the address scarcity would be similar with the impact of oil crisis in the era of 1970s. Obviously, where the Internet has become a critical resource and widely used (Wellman & Haythornthwaite, 2008), it will significantly affect many aspects of modern human life, when the development has to stop.

2. RESEARCH METHODOLOGY

This research examines the technology readiness of Indonesian organizations for IPv6. Since the decision to adopt and implement IPv6 is made at an organizational level, this research targeted a wide range of organizations as the end users of Internet Protocol. There is still very little known about IPv6 development in Indonesia, especially to end-user organizations. We define end-user organization as an organization which uses computer networks or Internet in their operations. The research sample was IT policy makers or those who were responsible to manage their computer networks, included middle or senior managers and also other IT-related positions associated with the organization's computer network. We adapt the instrument from previous readiness study for

¹ ICANN (Internet Corporation for Assigned Names and Numbers) is the non-government body that coordinates the Domain Name System (DNS), Internet Protocol (IP) addresses, space allocation, protocol identifier assignment, generic (gTLD) and country code (ccTLD) Top-Level Domain name system management, and root server system management functions

IPv6 by Dell (2011). There are five aspects measured in this study related to organizations readiness along with respondent's opinion about the importance and urgency of IPv6.

An online survey was used to obtain data from respondents. The invitation email was sent to a total of 390 respondents. There were two groups of respondents. The first group consisted of a wide range of organizations were randomly obtained from social media (LinkedIn), supplemented by snowball sampling of further organizations recommended by participants. It was ensured that respondents' organizations utilized computer network technology in their operations. 264 invitations were sent and 47 valid responses were received, giving a response rate for this group of 17.8%. The second group consisted of top 100 universities listed on Webometric. We also surveyed the local node of the Indonesia High Education Network (Inherent) where they were not listed on Webometric. We selected both of these groups since it is likely that they significantly rely on computer network technology on their operations. There were total of 122 invitations sent in this category, resulting in 27 valid responses, giving a response rate of 22%.

In term or respondents position, Policy makers (such as CIO and IT manager) and Network Administrator dominated up to 71% of the total respondents. The 29% of respondents were in other IT professional positions that also have a strong connection to the network environment, such as those who responsible for network security and design. Table 1 indicates the distribution of respondent's industry.

Table 1. Respondent Industries (self-reported)

Industry	Response	Industry	Response
Agriculture	4	Mining	7
Communication/Telecommunication	5	Property	2
Education and Training	27	Retail Trade	5
Finance and Insurance	7	Software Developer	4
Government Administration and	2	Transport and Storage	1
Health and Community Services	2	Vendors (software / hardware)	1
IT Consultant	8	Wholesale Trade	1
Manufacturing	4	Other Organization	8

3. RESULTS AND DISCUSSION

3.1. Awareness, Importance and Urgency

The level of IPv6 awareness was extremely high: only 7% respondents hadn't heard of the technology. Only respondents who had heard of IPv6 continued with the survey. These respondents were asked how important they believed IPv6 to be: 73% believed that IPv6 is important and only 10% believed it is not. Further, respondents were asked to provide reasons for their choice. The most frequently cited reasons for a belief in the importance – or lack of importance – are summarized below:

Table 2. Reason for belief in the Importance of IPv6

Important	Not important
Lack of capacity of IPv4	The issue was not perceived as relevant to the respondent's organization
To anticipate technological development	Minimal need for public address space
To provide better security	Satisfaction with IPv4
Reputational benefit from IPv6 deployment	

In term of urgency to move, only 42% of respondents believe it is an urgent issue and 38% are not. In this question, the numbers of respondents who believe IPv6 is urgent are slightly

different from those who believed it is not. Table 3 summarizes the common reasons for these beliefs.

Table 3. Reason for belief in the urgency of IPv6

Urgent	Not urgent
<ul style="list-style-type: none"> • IPv4 has been fully allocated • NAT prevents end-to-end communication • A significant increase in IP-connected technology • Need to increase network security 	<ul style="list-style-type: none"> • IPv4 is still able to accommodate the Internet connection • NAT solves the problem • The issue was not perceived as relevant to the respondent's organisation • The respondent's organisation has sufficient IPv4 address space

3.2. Level of training

There were six questions about the extent to which organizations had conducted IPv6 training. The results are presented in Figure 1.

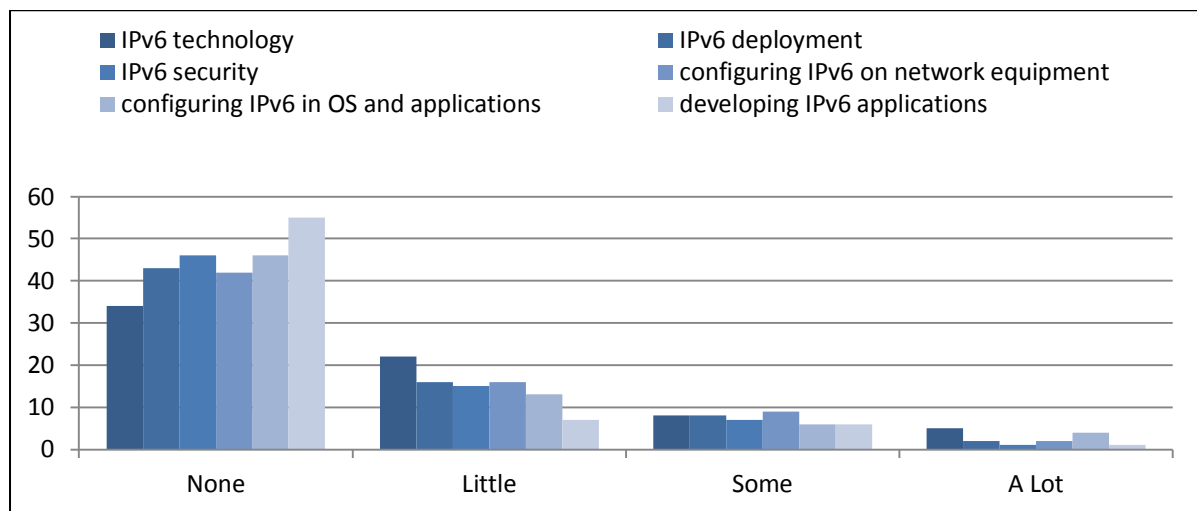


Figure 1. Level of IPv6 training (n = 69)

Very few Indonesian organizations have conducted much IPv6 training. Among the training categories, only general training about IPv6 has been conducted by roughly half the respondents. This low level of training in Indonesian organizations will affect the availability of IPv6 skills among IT people – it will likely not be possible simply to hire people from outside the organization when necessary.

IP is not only about addressing, but it is a foundation technology to allow communication through the Internet or computer network. IPv6 is not backward compatible and is quite different to the previous version; hence organizations should increase IPv6 knowledge among to facilitate a successful IPv6 implementation.

3.3. Planning

Respondent organizations were questioned about the extent to which they had commenced IPv6 planning, developed an IPv6 strategy and created IPv6 projects. The responses are summarized in Figure 2.

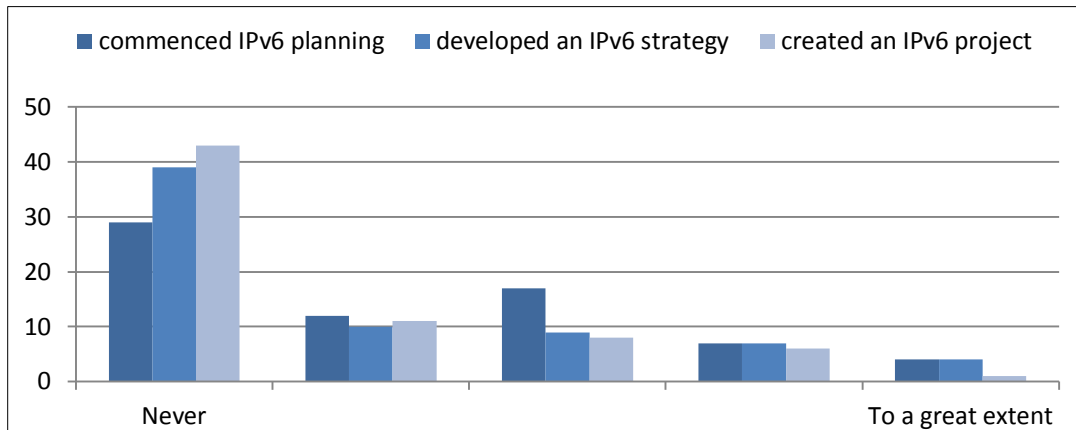


Figure 2. Level of IPv6 Training

Consistent with the perceived importance of IPv6 among most of organizations, approximately half of the respondents indicated that they have already commenced planning for IPv6 at least to a small extent. However, far fewer organizations had developed an IPv6 strategy or created an IPv6 project, indicating that planning in Indonesian organizations has generally been conducted only at a basic level.

In terms of planning, one respondent highlighted the important of planning thus: ‘it will be difficult if we take action in short time’. Indeed, according to Grossetete *et al.* (2008), early planning and having an IPv6 strategy could significantly reduce the switching cost and operational risk. An organization needs a clear direction to implement a new technology when many aspects will involve people, devices, applications and services. Planning is also important to prevent unnecessary work and minimize failure of its implementation.

3.4. Assessment of the IT Environment

Respondents were questioned about the extent to which they had assessed their training needs to implement IPv6, their IT assets and their application portfolio. The responses are summarized in Figure 3.

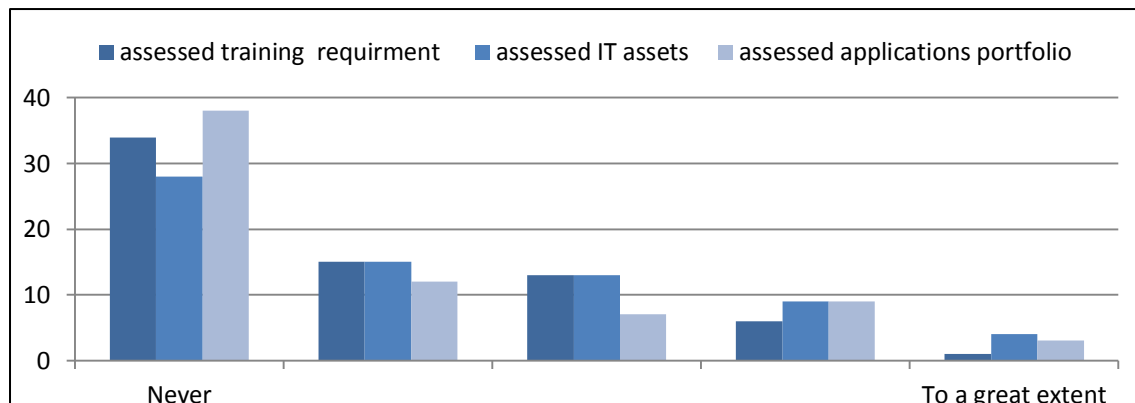


Figure 3. Assessment of the IT environment

It is important to ensure that an organization has sufficient resources for broad deployment of IPv6. The results indicate that very few organizations have made significant steps to determine the potential impact of IPv6.

Vint Cerf², one of the Internet’s founder, argues that IPv4 will not be able to provide the necessary IP addresses, and hence migration to IPv6 is a matter of time. Organizations need to

² McNamara (2010), “Why IPv6? Vint Cerf keeps blaming himself” available on <http://www.networkworld.com/community/blog/why-ipv6-vint-cerf-keeps-blaming-himself>, accessed on September 2012.

assess what resources have to be provided to start IPv6 implementation. This step will lead the organization to introduce a specific policy in order to make a smooth transition.

The results also indicate that, very few respondents have reviewed their application portfolio. In some cases applications do not care which IP version is used in the underlying network. However, ensuring that applications support IPv6 is also important to decrease the cost of upgrade as network-aware applications will likely be affected by the transition to IPv6.

3.5. Policy

The organizations were also questioned about the extent to which they had updated their policy framework to prepare for IPv6. The responses are summarized in Figure 4.

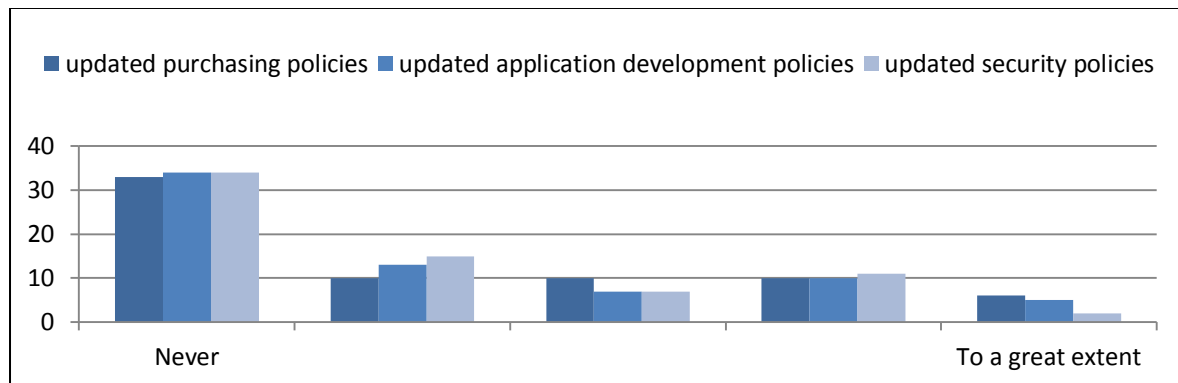


Figure 4. Policy Readiness

Very few organizations have updated relevant policies to prepare for IPv6. Only a small proportion of organizations have updated purchasing policies, although the cost to do so is minimal: almost 50% of organizations have not updated their purchasing policy to ensure the purchasing of IPv6-capable equipment. However, it could potentially cost a lot when they have to implement IPv6 if they have to replace IPv6-incapable equipment.

One of barriers to adoption of a new technology is switching cost, especially with incompatible technologies. However, early anticipation can reduce the costs that may arise, for example set conditions in the procurement of IPv6 ready networking devices.

3.6. Deployment status

Finally, respondents were asked about IPv6 deployment generally and about IPv6 address planning, which is often associated with deployment. The responses are summarized in Figure 5.

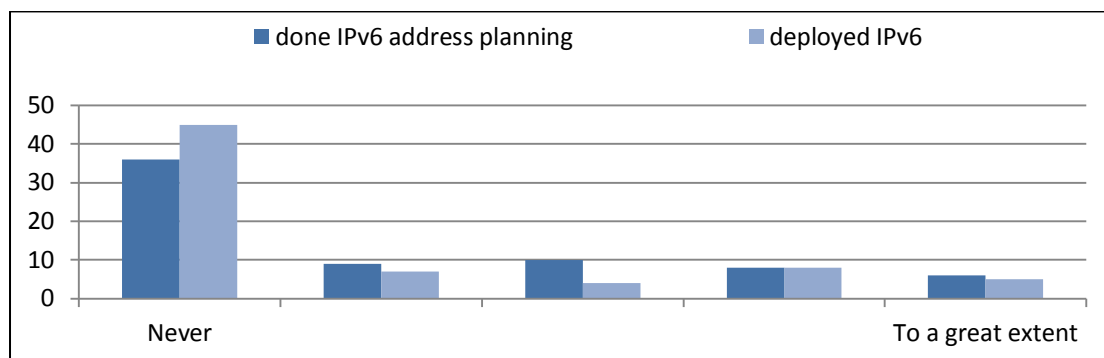


Figure 5. IPv6 Deployment

Very few Indonesian organizations have deployed IPv6. This is not surprising, given the low level of preparation for IPv6 in other areas. Interestingly, a small proportion of respondents have fully deployed IPv6 on their network, mostly from Education and Telecommunication sectors.

4. CONCLUSION

The results from this survey indicate that the level of awareness of IPv6 among Indonesian end-user organizations is extremely high and the majorities believe that IPv6 is important, due to problems imposed by continued use of IPv4 and to cater to increased demand for Internet-connected devices. However, few consider IPv6 as an urgent issue, with many believing that the current technology can still accommodate their needs.

Although IPv4 address space has been fully allocated globally, it seems that many Indonesian organizations have not taken significant steps towards IPv6. Deploying IPv6 takes multidimensional effort and needs a comprehensive approach involving people, devices, applications and services, for which many Indonesian organizations seem ill-prepared. The implications of this lack of readiness could include increases costs, risks and unforeseen difficulties that result from hurried and poorly planned deployment in the future.

Finally, although Indonesia is poorly-served by IPv4 in comparison to many other countries, particularly those in the developed world, the lack of preparation taken by Indonesian organizations suggests they will continue to rely on IPv4 in the foreseeable future. Nevertheless, Indonesia has an opportunity to take a leading role in IPv6 and become a world leader in its deployment; given the increasing reliance on the Internet in a vast range of industries and sectors combined with the state of IPv4 in Indonesia compared to other countries, we must ask whether this is an opportunity that can afford to be missed.

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