

Summary of the responses to the ITU-TSB Questionnaire on IPv6 address allocation and encouraging the deployment of IPv6

ITU-TSB

September 2009

1. Introduction

The World Telecommunication Standardization Assembly ([WTSA-08](#)) (Johannesburg, October 2008 Resolution 64 on 'IP address allocation and encouraging the deployment of IPv6' instructs (inter alia) the Director of TSB to study the question of IPv6 address allocation and registration for interested members and, especially, developing countries and to report to the 2009 session of the ITU Council.

Prior to conducting any studies, in order to assess the awareness and deployment status of IPv6 among ITU Member States, TSB issued [Circular 30](#) in March 2009 - Questionnaire on IPv6 address allocation and encouraging the deployment of IPv6. The questionnaire can be found at:

- <http://www.itu.int/md/T09-TSB-CIR-0030/en>

The first part (questions 1 to 6) of the questionnaire was designed to collect data on the current distribution and the forecasted request of IP address in the near future.

The second part (questions 7 to 13) consists of open-ended questions in order to collect various and open opinions for more efficient promotion of IPv6 deployment. The questions are about perceived requirements/barriers, costs, facilities for promoting IPv6 deployment, and the quantitative and qualitative level of information on IPv6 available in different countries.

As of August 2009, TSB received two responses from Regional Internet Registries and 33 responses from ITU Member States and Sector Members. Individual responses and a summary can be found at:

- <http://www.itu.int/oth/T3B05>

2. Who responded to the Questionnaire

Table-1 and 2 below summarize the respondents:

Table-1 Number of respondents (By type)

RIRs	ITU-T Member States	ITU-T Sector Members
2	30	3

Table-2 Number of respondents (By region)

Africa	Americas	Asia, Middle-East	Europe and Russia	Oceania	Non-regional based entities
3	4	8	17	1	2
Among the above, some stated it is impossible to reply to any question					
1	0	1	2	0	0

Of the 33 respondents from ITU Members, 14 Member States and one Sector Member indicated that it was not difficult to answer the questionnaire. The others felt that it was difficult. For 11

Member States and two Sector Members the data are not easily obtained; for four Member States it is their policy not to collect or provide the data; for four Member States it is difficult to count IP address on a geographical basis. Finally, two Member States lack an entity that could collect the data.

3. Responses to questions

Responses to each individual question are summarized below:

Question 1)-2) What is the number (absolute number, for example 10'000) of IPv4/6 addresses currently available and used in your country?

The Asia-Pacific Network Information Centre (APNIC) and the Numbering Resource Organization (NRO) provided comprehensive data of IPv4/6 address distribution all over the world in their responses¹ which are almost identical. Some respondents provided answers to Question 1)-2), some respondents simply referred to the NRO data².

It is important to note that NRO, APNIC and some other respondents emphasised that it is difficult or impossible to count the number of IP addresses used within each economy³, because the allocated IP addresses may be used beyond the boundary of a given country or economy.

As the NRO response contains more up-to-date data⁴, the NRO data were used in this summary analysis. Chart 1 shows the proportion of allocated IPv4 addresses per economy. The total number of IPv4 addresses so far allocated by RIRs is 2,850,885,432 (about 170 /8s). The United States of America tops the list by holding 51% of the total allocated IPv4 addresses, followed by China (7%), Japan (6%), European Union (4%), the United Kingdom (3%), France (3%), Korea Republic (3%), Germany (2%), Canada (2%), and Australia (1%). These top 10 economies account for 83% of the total allocated IPv4 addresses.

Chart 2 shows the frequency distribution of allocated IPv4 addresses per economy in y axis. The x axis represents IPv4 addresses allocated (as of 15 May 2009) per economy. The scale of the x axis is logarithmic to show the large distribution of allocated IPv4 addresses. This chart shows that about three fourths of economies hold less than 1,000,000 IPv4 addresses (0.06 /8s); their total holdings account for only 0.84% of the total allocated IPv4 address space. The NRO data also show 23 economies appear not to have any IPv4 address, however some of these economies may use in fact addresses allocated by ISPs in other economies.

¹ The NRO response to the TSB Questionnaire is available at <http://www.nro.net/news/nro-response-to-itu.html> ; the APNIC response is available at <http://archive.apnic.net/community/research/ipv6/tsb-ipv6-survey-apnic.pdf>

² ARIN website: <https://www.arin.net/index.html>

RIPE NCC website: <http://www.ripe.net/index.html>

³ RIRs use the term 'economy' whereas ITU use the term 'country'. Currently there are 246 economies recognized by ISO 3166-1. Economy boundary mostly corresponds to the border of a country. However in some cases, a country may have several economies and vice versa.

⁴ NRO data is as of 15 May 2009 and APNIC data is as of 19 April 2009

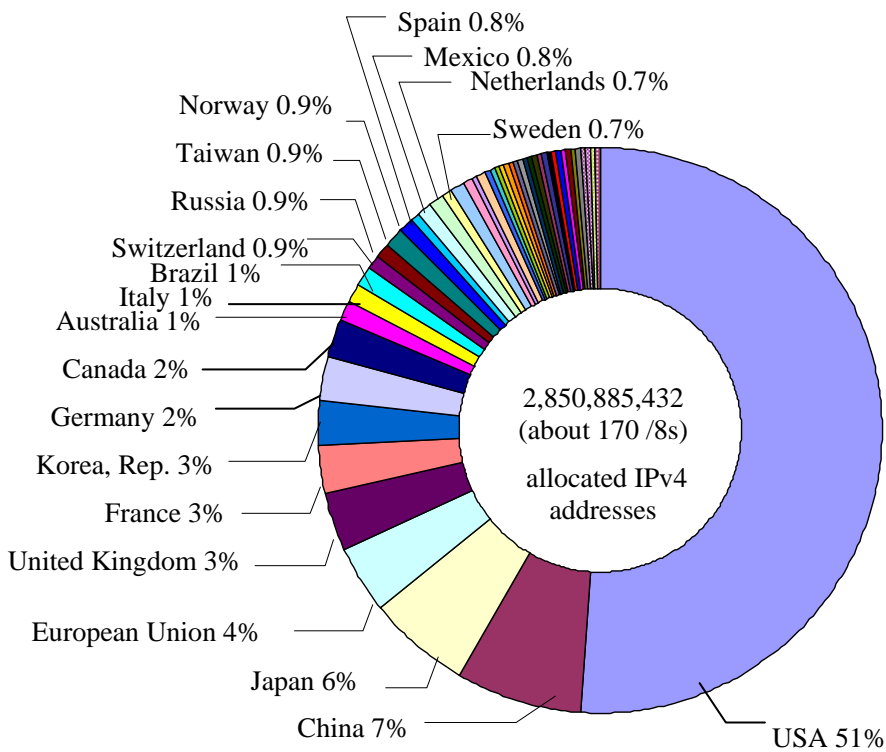


Chart 1: Proportion of allocated IPv4 addresses per economy (as of 15 May 2009)

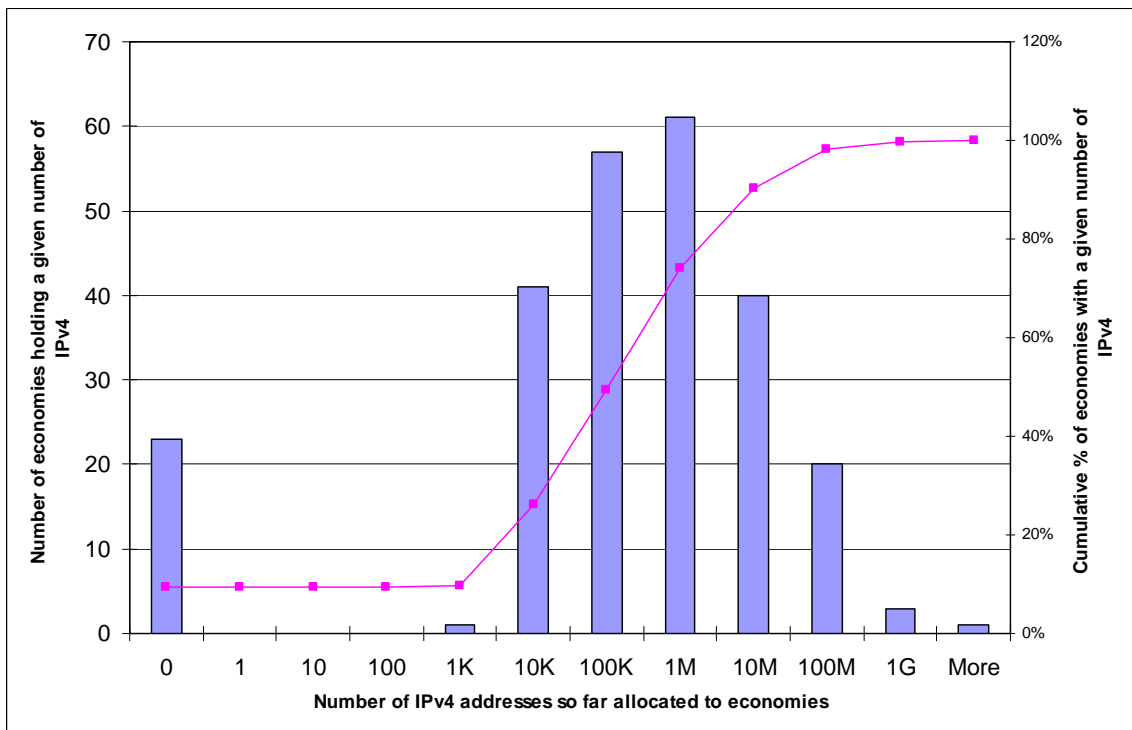


Chart 2: Frequency distribution of IPv4 address per economy (as of 15 May 2009)

Chart 3 shows the proportion of allocated IPv6 addresses per economy. The total number of IPv6 addresses allocated by RIRs is 72,938 /32s. The USA tops the list by holding 20% of the total allocated IPv6 addresses, followed by Germany (13%), Japan (11%), France (11%), Australia (11%), European Union (8%), Korea, Rep (7%), Italy (6%), Taiwan (3%) and Poland (3%). The difference in number of allocated IPv6 addresses among the top economies is relatively smaller compared with in the case of IPv4. However, the proportion of IPv6 addresses allocated to the top 10 economies is 95 % of the total allocated IPv6 addresses, which is significantly higher than in the case of IPv4 (83%).

Chart 4 shows the frequency distribution of allocated IPv6 addresses per economy in y axis. The x axis represents the number of IPv6 addresses allocated (as of 15 May 2009) per economy. The scale of x axis is logarithmic to show the large distribution of allocated IPv6 addresses. As the IPv6 deployment is at an early stage, more than 40% of economies have no IPv6, 17% of economies have only one /32 IPv6 address block.

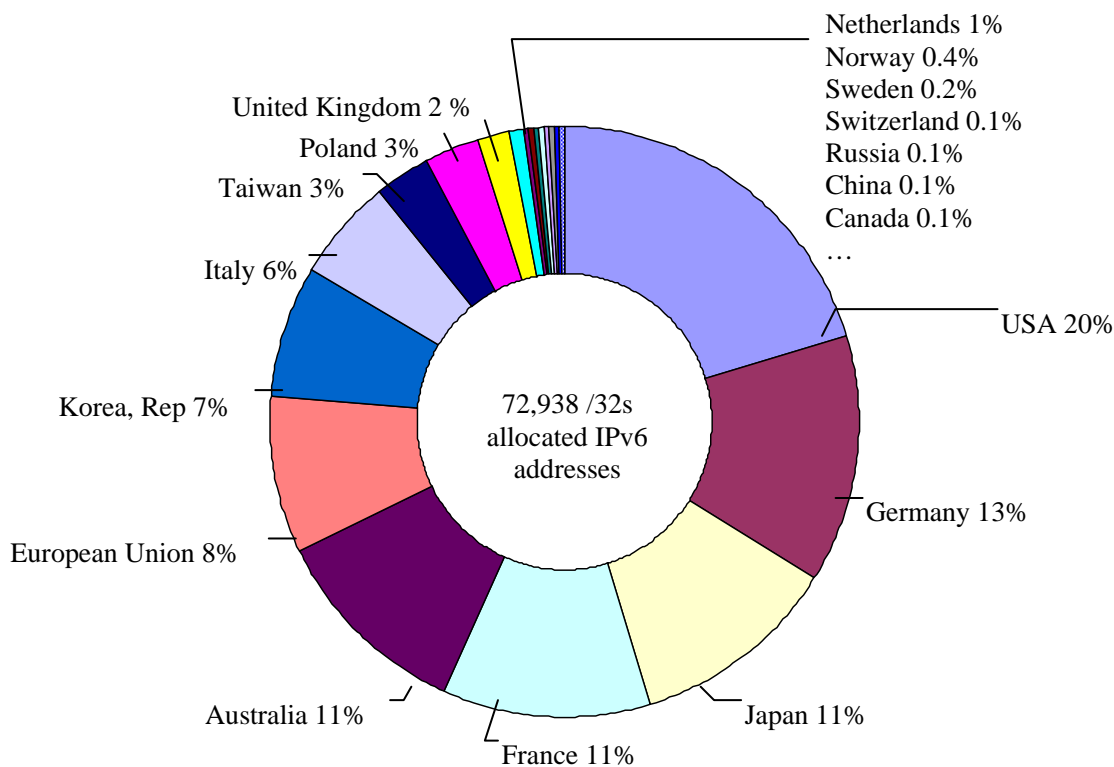


Chart 3: Proportion of allocated IPv6 addresses per economy (as of 15 May 2009)

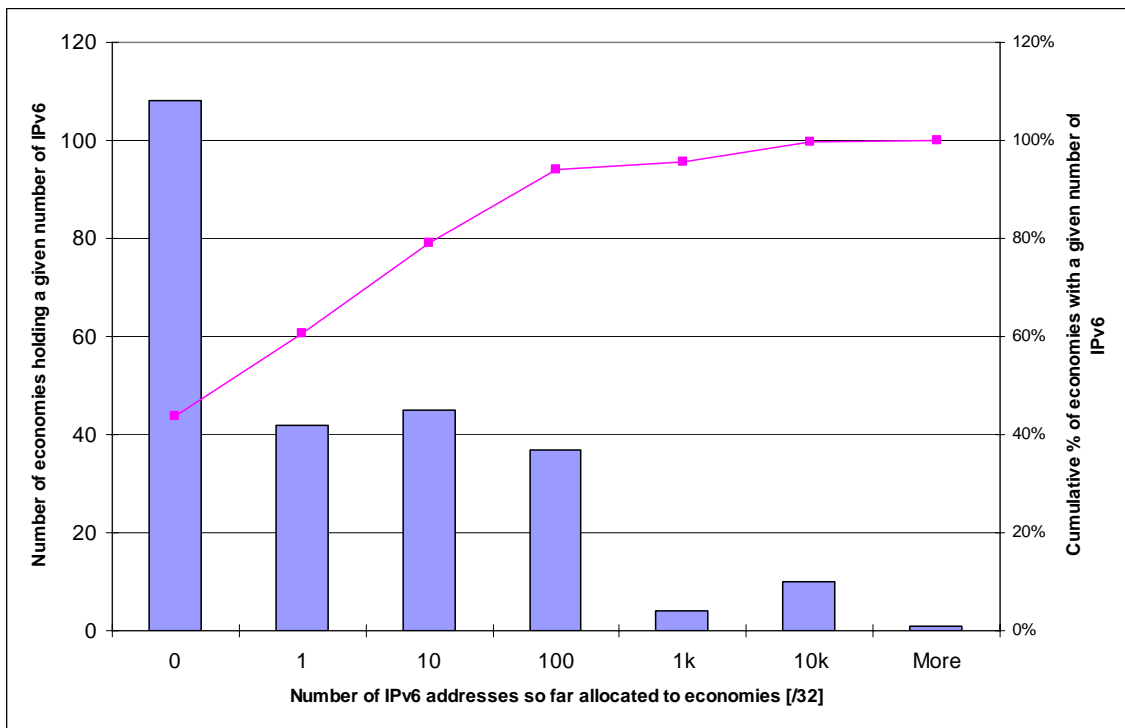


Chart 4: Frequency distribution of IPv6 address per economy (as of 15 May 2009)

Question 3)-4) What is the number (absolute number, for example 100) of organizations in your country that currently have been allocated an IPv4/6 address block from one of the Regional Internet Registries (RIRs)?

The NRO response provides the data of these organizations for each economy, however it doesn't include those who received IPv4 before the RIR system began.

To answer Question 3)-4), about one third of the respondents referred to APNIC/NRO responses or to RIR databases available on the web.

According to the NRO data, the total number of organizations worldwide receiving IPv4 addresses from RIRs is 20,643. The largest number of organizations within one single economy is 4376 (for USA) and the average number is 83.6 organizations per economy. Chart 5 shows a frequency distribution of economies having a given number of organizations on the y axis. The x axis represents the number of organizations with IPv4 addresses from RIR pools per economy. The scale of x axis is logarithmic to show the large distribution of the number of organization.

Table 3 contains the actual data summarized in Chart 5. It shows that 27 economies don't have any organization getting IPv4 from RIRs, 32 economies have only one such organization, more than 50% economies have less than 10, and more than 80% economies have less than 100. 1.2 % of the total number of economies that have the highest density of such organizations account for more than a third of the total number of organizations⁵.

⁵ These economies are: United States of America (4376 organizations), Russian Federation (1594 organizations, and Australia (1028 organizations). These three economies have 6998 organizations in total.

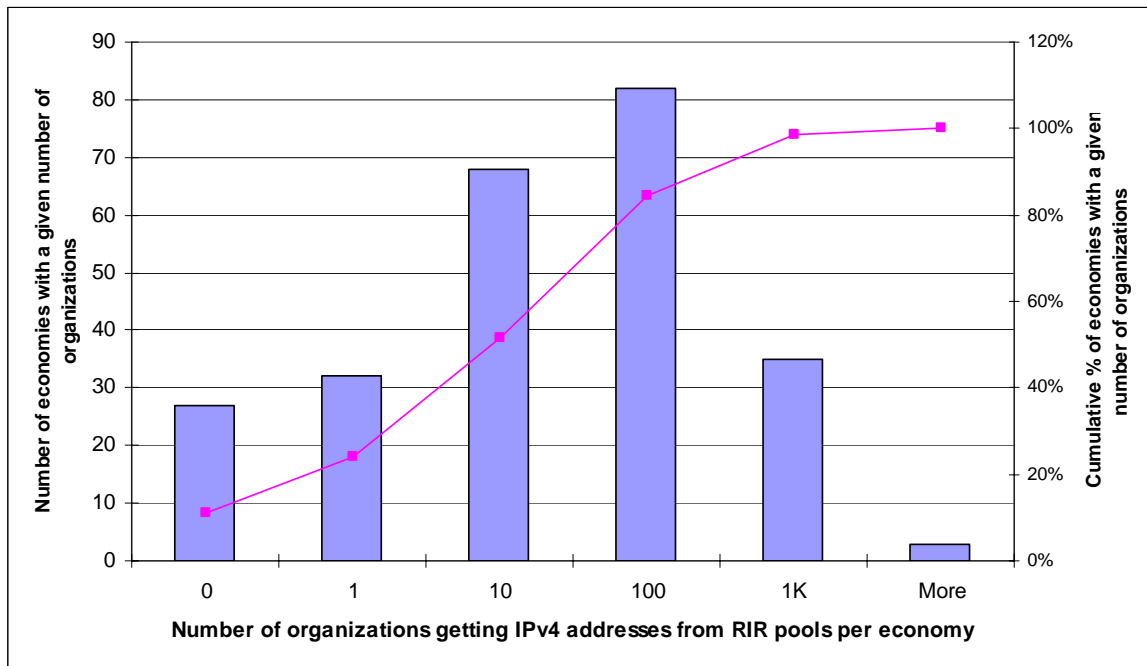


Chart 5: Frequency distribution of the number of organizations getting IPv4 addresses from RIRs (as of 15 May 2009)

Table 3: Organizations getting IPv4 addresses from RIRs (As of 15 May 2009)

Organizations	0	1	2-10	11-100	101-1000	1001-	Total
Economies	27	32	68	82	35	3	247
Frequency[%]	10.9	13.0	27.5	33.2	14.2	1.2	100
Cumulative frequency[%]	10.9	23.9	51.4	84.6	98.8	100	-

As for organizations receiving IPv6 addresses from RIR pools, their total number is 1927, the largest number of organizations within one single economy is 691 (for USA), and the average number is 7.8 organizations per economy. Chart 6 shows a frequency distribution of economies versus number of organizations. Table 4 contains the actual data summarized in Chart 6.

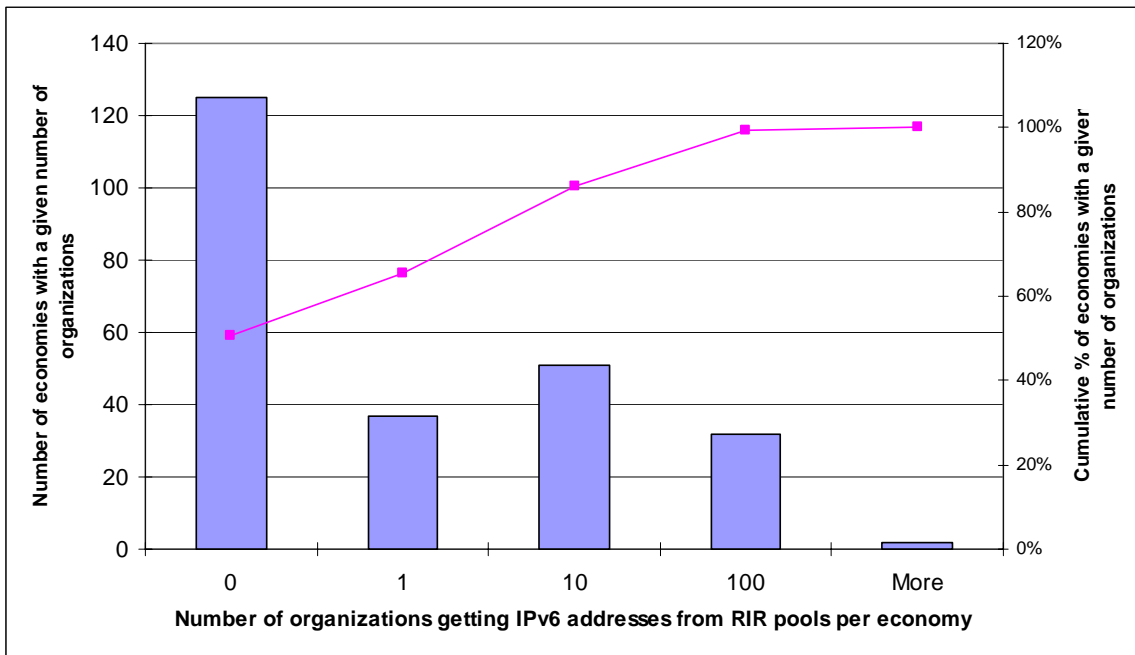


Chart 6: Frequency distribution of the number of organizations getting IPv6 addresses from RIRs (as of 15 May 2009)

Table 4: Organizations with IPv6 addresses from RIRs
(As of 15 May 2009)]

Organizations	0	1	2-10	11-100	101-	Total
Economies	125	37	51	32	2	247
Frequency[%]	50.1	15.0	20.6	13.0	0.81	100
Cumulative frequency[%]	50.1	65.6	86.2	99.2	100	-

The data show that over 50% of economies don't have any organizations getting IPv6 from RIR pools, 0.81 % of the total number of economies that have the highest density of these organizations account for more than 40 % of the total number of organizations⁶.

⁶ These economies are: United States of America (691 organizations) and Japan (128 organizations). These two economies represent a total of 819 organizations.

The organizations that receive IPv4 addresses directly from RIR pools are categorized into NIRs, LIRs, and end-users who request Provider Independent address⁷. Figure 1 illustrates the current IPv4 address distribution hierarchy with the numbers of entities highlighted at each level.

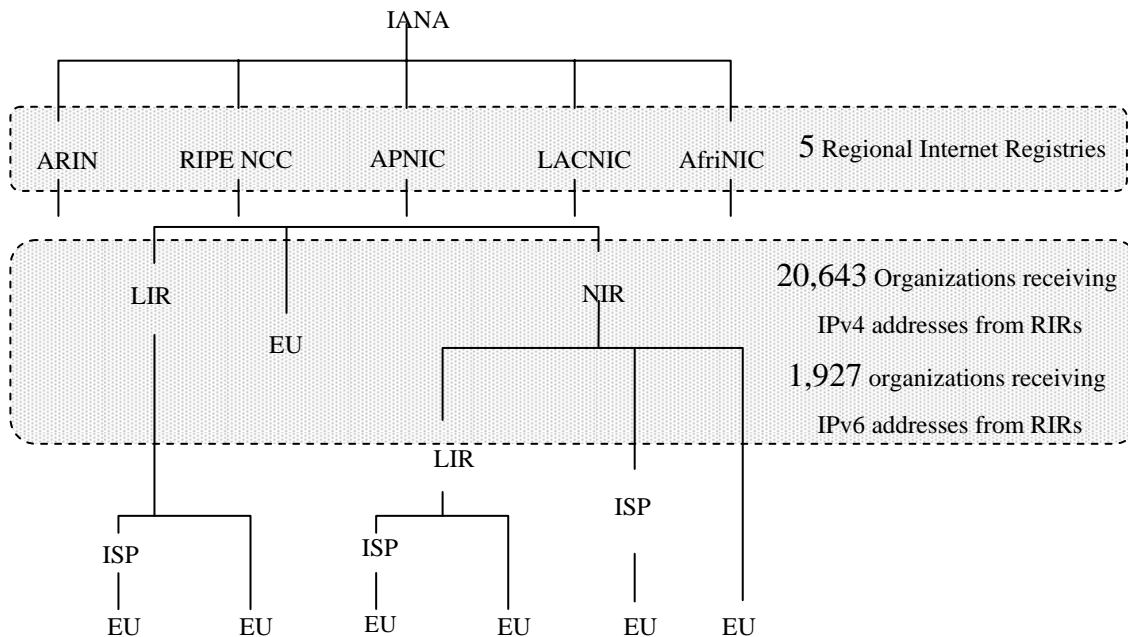


Figure1: IPv4 and IPv6 address distribution hierarchy (As of 15 May 2009)

Question 5)-6) What would you expect your requirements to be in terms of the number (absolute number, for example 10'000) of IPv4 addresses in your country in the future?

The NRO response provided trends in IP address allocation for the 2005-2008 period.

Although it is very difficult to forecast future needs as some respondents noted, because they are not based solely on allocation histories, but many factors (e.g., infrastructure development, competitive business, infrastructure provision, economic conditions and national policies, according to one respondent), past trends in allocation might be one indication reflecting some of the above factors and could allow a prediction of needs in nearly future. Chart 7 shows the relative number IPv4 addresses that were allocated in 2008 per economy. According to the NRO, 203,488,368 IPv4 addresses (about 12 /8s) were allocated in 2008. USA tops the list by acquired 53,840,384 (3.2 /8s) addresses, which account for 26% of the total. It is followed by China (23%), which is experiencing a very rapid Internet growth recently. The top 10 economies in this list account for about three fourths of the total number of allocated IPv4 addresses worldwide in 2008.

⁷ This case is rather unusual, as most end-users who need PI addresses request them from the organizations directly above their upstream providers, normally LIRs or NIRs.

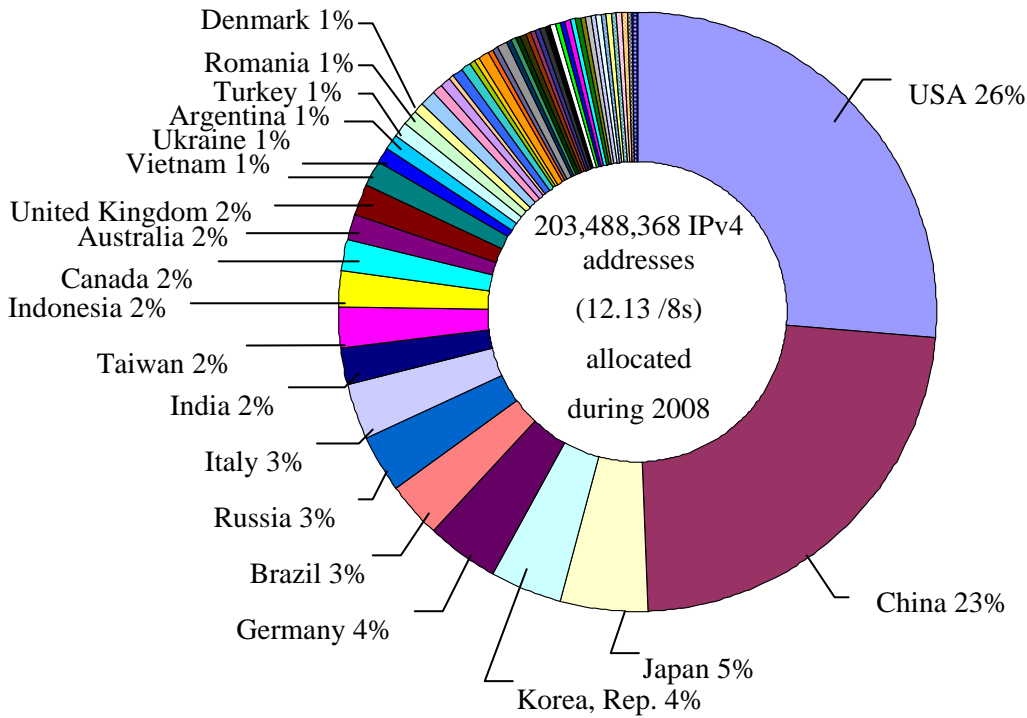


Chart 7: Share of IPv4 addresses allocated during 2008

To better outline the trends during the last three years, charts 8 and 9 were generated with data provided by the NRO. Chart 8 includes all the economies while chart 9 shows without the USA, in order better to see trends in the rest of the world.

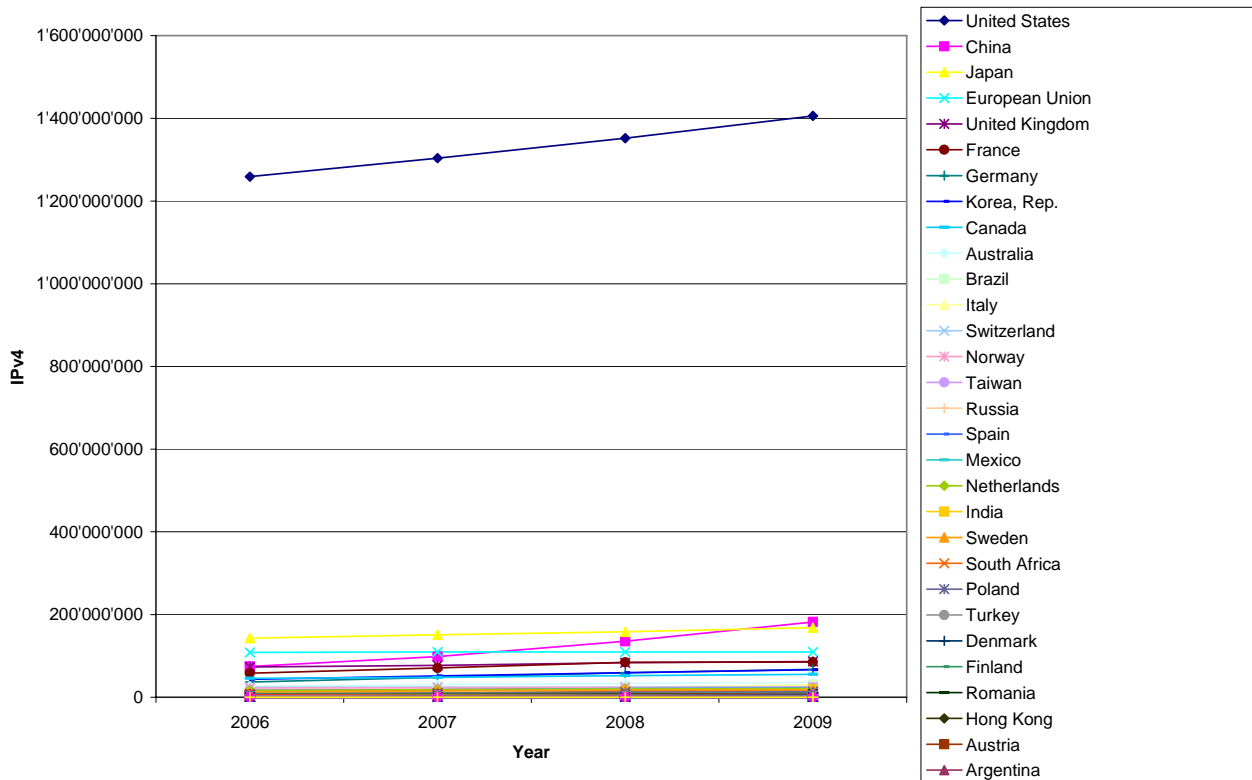


Chart 8: Trends in IPv4 allocations

Chart 9 highlights the remarkable increase in IPv4 allocation in China, which represents almost a 2.5 times increase in the total holdings in the last three years. Table 5 summarizes the trends in IPv4 allocation to the USA, China and worldwide. Table 5 shows continuous growth in IPv4 allocation to the USA: the number of allocations to the USA has constantly been accounting for about a quarter of the total allocation to economies each year.

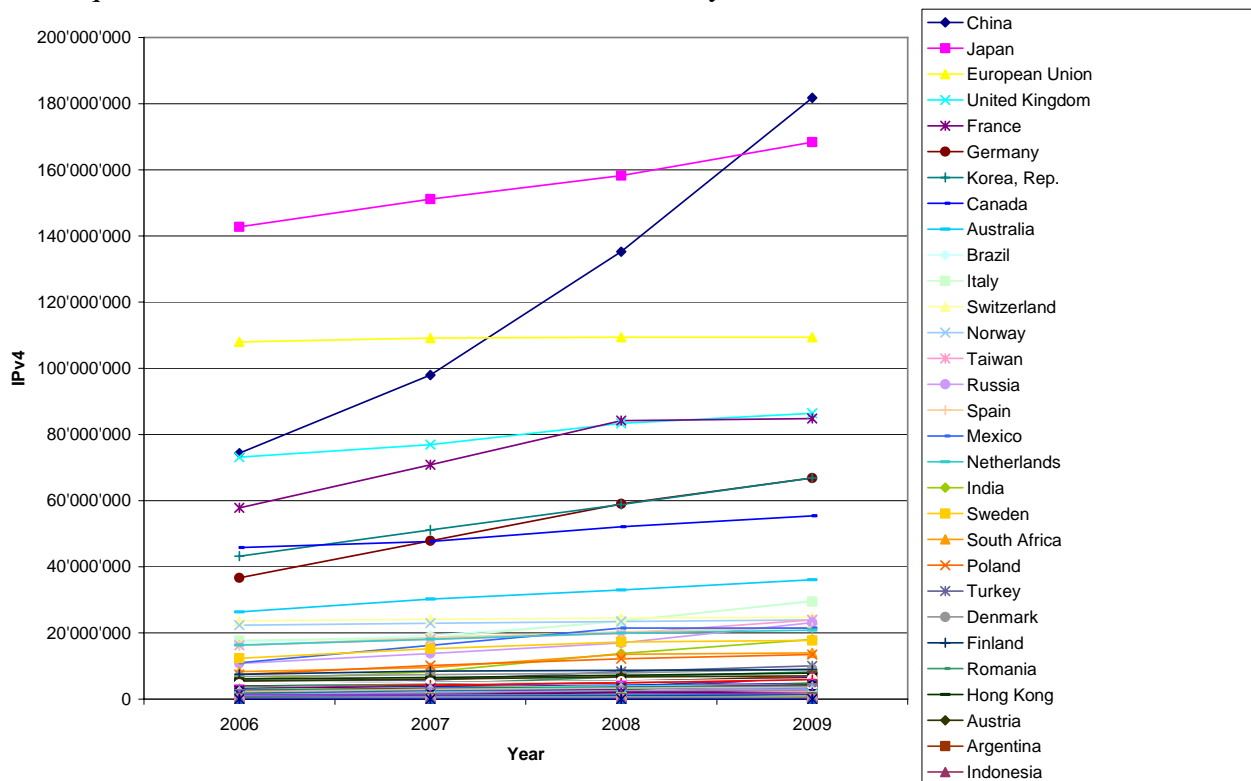


Chart 9: Trends in IPv4 allocations (without USA)

Table 5: Trends in IPv4 Allocation to USA, China and worldwide [/8s]

Year	worldwide	USA	China	USA/worldwide	China/worldwide
2006	10.05	2.664	1.409	26.50 %	14.02%
2007	12.32	2.894	2.223	23.49 %	18.04%
2008	12.13	3.209	2.771	26.45 %	22.84%

Chart 10 shows the relative number IPv6 addresses that were allocated in 2008 per economy. According to NRO, 15,323 /32s IPv6 addresses were allocated in 2008. The USA tops the list by acquired 14,478 /32s IPv6 addresses, which account for 94% of the allocated IPv6 addresses in 2008. It is followed by Sweden (1%), France (0.5%), Germany (0.5%), United Kingdom (0.2%) and Brazil (0.2%).

Chart 11 shows the trends in IPv6 allocations during the last three years. Germany had the largest IPv6 allocation until the end of 2007, until the USA overtook in 2008. As IPv6 initial allocation is

intended to be large so as to avoid frequent subsequent allocations, trends in IPv6 allocations are not represented in smooth line graphs compared with IPv4's.

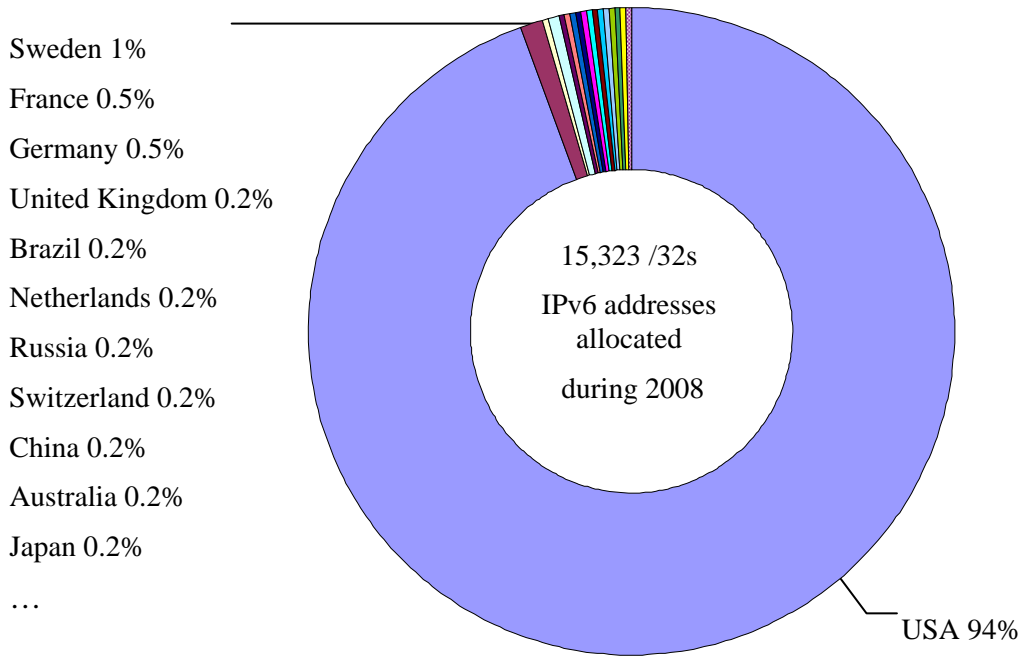


Chart 10: Share of IPv6 addresses allocated during 2008

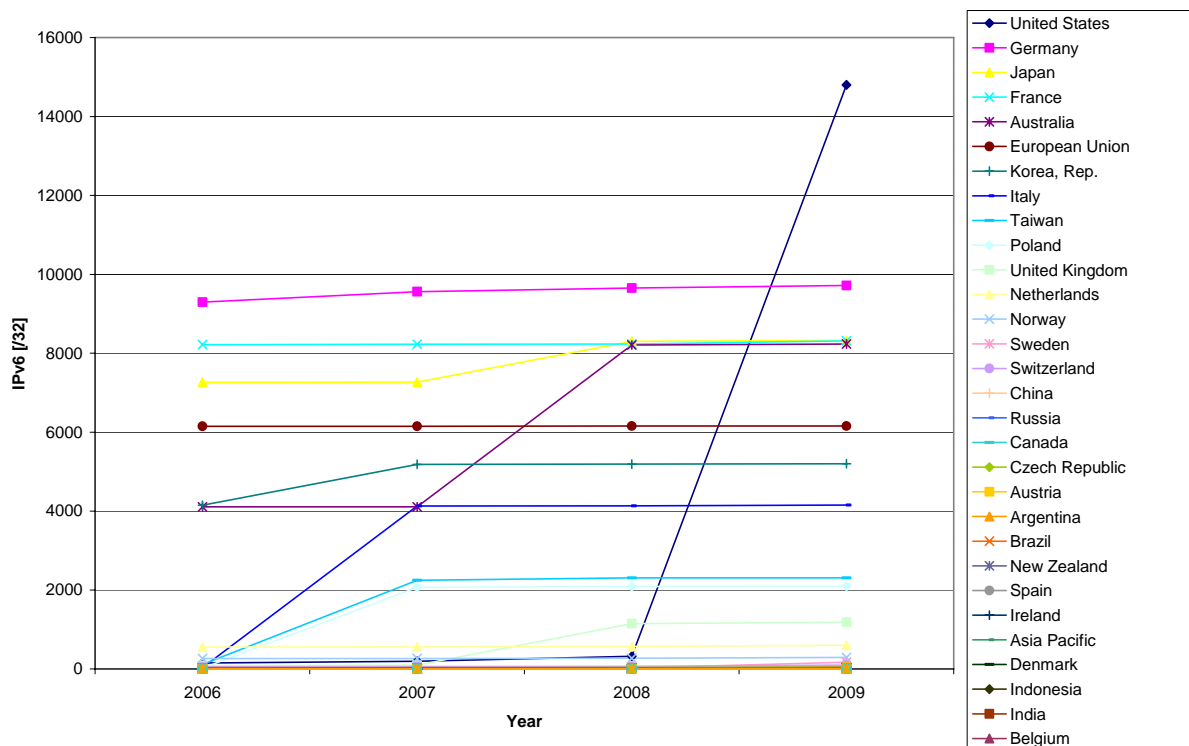


Chart 11: Trends in IPv6 allocations

Question 7) What, if any, facilities are present in your country, to encourage IPv6 deployment?

Several responses informed ITU of various activities being undertaken in their countries. The webpage of ‘links to regional activities’⁸ at ITU IPv6 website was updated accordingly to include these valuable inputs.

Some respondents mentioned that their ccTLDs are already IPv6 capable.

Question 8) What would you expect requirements to be in your country in terms of equipment necessary for the transition from IPv4 to IPv6?

Of the 27 responses to this question, three respondents replied that this question is difficult to answer. The following requirements were mentioned in the 24 valid responses:

- IPv6-capable equipment at the end-user level,
- dual-stack upgrade of each network element (routers, servers and applications),
- translation and tunneling,
- requirements for various access networks,
- training, planning, coordination.

It was noted that requirements may vary according to the types of equipment and the different transition phases from IPv4 to IPv6. Requirements should not be limited to equipment.

One respondent noted that their government issues guidance on utilization of IPv6 in government procurement.

Question 9) What would you expect the cost to be of that equipment?

There were 22 responses to this question. Five Member States and one Sector Member mentioned a concrete sum of money⁹, while the others consider that it is difficult or impossible to give an estimate at this moment as costs will be determined by user choices and market prices. It was mentioned that the sooner IPv6 gets adopted, the sooner equipment and software prices will decrease.

Question 10) Do you consider that you have adequate information on IP address allocation and registration policies and mechanisms?

Question 11) If you answered “no” to Question 10 above, indicate what additional information would be useful for you.

There were 26 responses to Question 10). Twenty-one ITU Member States and one Sector Member replied ‘yes’. Three Member States and one Sector Member answered ‘no’. The additional information requested includes:

- evaluating criteria or methods of IP address usage rate during the subsequent allocation,
- planning of IP address space,
- rules and procedures of IPv6 sub-network allotment to operators and end users,
- information in language other than English.

⁸ See <http://www.itu.int/net/ITU-T/ipv6/regional.aspx>

⁹ Total costs estimated by Member States vary from 50,000 US dollars to 50 million US dollars (minimum estimation for a given state), and the median is 500,000 US dollars.

Question 12) What are, to the best of your knowledge, the real or perceived barriers to IPv6 uptake, (for example, institutional barriers, cost of equipment, cost of training, current allocation policy, etc)?

There were 23 responses to this question.

The most widely perceived barrier is lack of market demand to achieve a profitable business case to deploy IPv6. This point was reflected by various responses mentioning lack of content on IPv6, equipment cost (hardware, software and configuration), training cost, risk of service interruption, risk of early deployment related to immature equipment/supply chain. The second most reported barrier is lack of information, including unawareness of urgency, lack of knowledge regarding how to transition from IPv4 to IPv6, and lack of information on RIR policies and practices on how to obtain IPv6 addresses. Another barrier reported is the resistance to change, either due to satisfaction with the current system, lack of confidence of IPv6 or institutional barriers.

In addition, the importance of government effort to promote the uptake of IPv6 was emphasized in one response to this Question.

Question 13) What specific information would you expect to find on the ITU web site that will be created pursuant to WTSA Resolution 64?

There were 19 responses to this question. Combining the responses, the following information would be expected to be available on the ITU IPv6 website :

- a) Information about trainings and events on IPv6.
- b) Information on IP address allocation and global IPv6 deployment situation.
- c) Case studies of IPv6 deployment.
- d) More detailed information about IPv6 in languages other than English.
- e) News about transition technologies.
- f) Step by step guidelines to setup IPv6 for trial and deployment.
- g) Links to the website of related entities.
- h) A forum where users can discuss various aspects of IPv6 deployment including regulatory approaches.

If you have any additional comments, please write them in below, or in an additional page.

Eleven respondents provided general comments.

Several respondents suggested that additional data should be collected: the IPv6 deployment stage in ISP's infrastructure, DNS, and web contents, etc; cost for end-users and ISPs in IPv6 uptake; and information on user equipments and user operating platforms that are IPv6-capable.

It was also noted that extensive work remains to be done for IPv6 uptake. IPv6 support is not yet comparable to IPv4 support. The main problem with the low degree of IPv6 deployment might be its low priority status in each network/environment.

It was also highlighted that there is neither common policy nor regional plan to encourage the deployment of the IPv6 in certain regions. Knowledge on IPv6 such as the benefits features and migration technologies is not well disseminated in certain regions. The issue related to cost is also highlighted; cost elements for migration such as costs for training, new equipments, configurations and addresses themselves are not available for certain regions.

One Member State noted that the current address allocation system works very well and in that sense it is very important that ITU works in close operation with this system and also supports its activities. Another Member state echoed this comment of the current system and cautioned that creating additional and different policies for IPv6 allocations may create misunderstanding and may lead to

conflicts of responsibility in the future. A third Member State stated their support for the RIR system for IPv4 and IPv6 address allocation.

One respondent acknowledged the importance of awareness-raising for the adoption of IPv6, particularly for developing countries.

Member States from one region requested to identify the needs of the different regions and stated that ITU-T should be invited to become an additional registry for IP addresses and that it should provide the registry function at reasonable costs, leaving freedom to each State Member to address its request to ITU-T or an RIR.
