TELECOM REGULATORY AUTHORITY OF INDIA

Draft Recommendations

On

Issues Relating to Transition from IPv4 To IPv6 in India

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Executive Summary

With the increased Internet penetration in the country, newer devices, applications and services are likely to be deployed. This will generate a greater demand of IP addresses by the Internet users in the country. In addition, Internet users are also aspiring for better quality of service, mobility and security while using the Internet. The existing version of Internet protocol, IPv4 seems to be lagging behind in catering to these newer challenges. The next generation Internet protocol, IPv6 has been developed to address these challenges and various steps towards migration to IPv6 has been initiated by different countries worldwide, specially in Asia Pacific region where the shortage of IPv4 addresses is likely to be more acute. In India also Government (Department of IT) has taken major initiatives in this direction by setting up Interagency IPv6 Implementation Group (IPIG) and also a pilot project for IPv6 test bed through ERNET and Academicia.

To augment the Government's efforts, the Authority issued a consultation paper on "Issues relating to Transition from IPv4 to IPv6 in India" during August, 2005 highlighting the need for migration to IPv6, Regulatory issues related to migration, Creation of National Internet Registry (NIR) and Setting up of IPv6 test bed. In addition Open House Discussions at Bangalore and New Delhi were also held. The Authority has come out with draft recommendations, which are based on the

written responses received and deliberations made by stakeholders during OHDs in addition to the consideration of best practices in Asia Pacific Region. It has been concluded that migration to IPv6 should not be mandated but facilitated by the Govt. Also, no fiscal incentives are recommended, as the cost involved in IPv6 migration is insignificant. Major thrust of recommendations is in setting up of test beds for experimentation in IPv6 technologies, creation of a National Internet Registry in the country and bringing awareness about IPv6 through the Govt. machinery.

The gist of major recommendations is following:

1. Regulatory issues related to transition from IPv4 to IPv6.

(i) Definition of IP address mentioned in ISP licence to be amended to enable 128 bits to be used as needed for IPv6 based addressing.

2. Encouragement by Govt. for IPv6 migration

(i) Usage of IPv6 in the platforms/applications pertaining to e-governance should be mandated. The Govt. should also mandate IPv6 compatibility in its own procurement of IT systems and networks.

(ii) Workshops and seminars, to bring awareness about IPv6 among service providers and end-users community should be conducted through Govt. agencies.

3. Creation of Internet Registry in Country

(i) National Internet Registry (NIR) in the country should be established within the framework of APNIC, the Regional Internet Registry.

4. Setting up IPV6 test Bed

(i) Enlargement of the existing IPv6 test bed of ERNET to make it countrywide and accessible to all interested parties.

(ii) Upgradation of NIXI as a national testbed for IPv6 & interconnection among its various nodes to provide access to all ISPs.

(iii) Encouragement to TEC, CDOT, CDAC to set up the IPv6 test beds through Govt.'s funding.

The detailed draft recommendations are available on TRAI website (www.trai.gov.in). Comments of stakeholders are solicited on the above for finalising these recommendations. For any further clarification on the matter, Shri S.N.Gupta, Advisor (Converged Network) may be contacted at Ph No.**:** 011-26167914, Fax: 011-26191998, e-mail **:** trai09@bol.net.in .

1. Background

1.1 The Indian Internet scenario is changing very rapidly as more and more individuals and Institutions have started utilizing Internet for their day-to-day activities. In addition the demand for quality of service and security on Internet is also catching up. The enormous success of the Internet came as a surprise to all of its early users and for the developers of IPv4. No one expected that the 32-bit IPv4 address space might become insufficient to accommodate the future needs of users of what was then a small research network. But by the mid-1990s the steadily increasing demand for IP addresses pressurised the remaining supply. Many experts have started predicting that the available IPv4 addresses would last for only a few years more.

1.2 Short-term workaround solutions were developed to slow the rate of IPv4 address depletion until the work on IPv6 (Next Generation Internet Protocol) could be completed. One short-term solution was Network Address Translation (NAT). Also known as Port Address Translation (PAT), NAT resides between the Internet and a group of hosts on a server, firewall, or router. Through a manipulation of port numbers, NAT allows a large number of hosts to share a single unique IPv4 address. However, NAT was never intended as a long-

term solution as it creates a number of problems in modern networks. Most significantly, NAT affects a key benefit of the Internet as a network of 'Always-on, Equally-connected, Easily-reachable' peers. Peer-to-Peer capability provides a powerful tool, empowering users to become active contributors to the Internet, rather than just users. Peer-to-Peer systems assume that a user can find and connect to another user, but if a user is hidden behind a NAT device this assumption may not be valid. As a result, present peer-to-peer systems utilize an extra level of complexity made necessary only to circumvent NAT related obstacles.

1.3 Another method, Classless Inter-Domain Routing (CIDR), sometimes known as Supernetting is a way to allocate and specify the Internet addresses used in inter-domain routing more flexibly than the original system of IP address classes. As a result, the increased number of Internet addresses become available. CIDR is the routing system used by virtually all gateway hosts on the Internet's backbone network. However, CIDR is also supposed to have its associated problems, as it does not guarantee an efficient and scalable hierarchy.

1.4 The methodologies like NAT and CIDR were utilised to overcome the shortage of IP addresses. However, these were

supposed to be only short-term remedy to IP address shortage. The long-term solution to the IP address depletion problem was to create a new version of IP with an expanded address space. Originally called IPng for IP next generation, this proposed version eventually became to be known as IPv6. It makes use of 128 bits in place of 32 bits used in IPv4 and therefore provides enormous addressing capabilities.

1.5 The primary motivation for the deployment of IPv6 is to expand the available address space on the Internet, thereby enabling millions of new devices, viz. Personal Digital Assistants (PDAs), cellular phones, home appliances in addition to computers/ PC to be made always connected to Internet. In addition being an advanced technology it brings many additional advantages to the users.

1.6 Following are the important features of IPv6 protocol, which could play a catalytic role in the growth of Internet in the country due to its advance capabilities:

- **(i) Enormously large Address Space**
- **(ii) Enhanced Support for QOS and Mobility**
- **(iii) Efficient and Hierarchical Addressing**
- **(iv) Faster Routing capabilities**
- **(v) Built-in Security**

1.7 IPv6 is gaining momentum globally, with a lot of developments in Europe, Japan, China and Korea through Governments participation. Many more developing countries from Asia are also joining this movement and participating in various test and trial programmes.

1.8 Department of IT, Govt. of India has taken main initiatives to facilitate the efforts of stakeholders regarding the adoption of IPv6 by constituting a multi-agency IPv6 Implementation Group (IPIG), by creating test bed and supporting R&D activities. Some of the Universities/ R&D institutions have also been contributing towards the developmental aspects of IPv6 in India. However the industry has not moved forward to engage in large-scale deployment of IPv6 as in some South East Asian countries like Japan, Korea, Taiwan, China and EU nations and that is why enabling steps for increasing its usage in the countries are to be found out. TRAI's recommendations on this subject through a consultative process with various stakeholders are mainly focused towards this objective.

1.9 The recommendations discussed in the subsequent sections cover the following main issues: -

(i) Regulatory issues related to transition from IPv4 to IPv6.

(ii) Encouragement by Govt. for IPv6 migration.

(iii) Creation of National Internet Registry (NIR).

(iv) Setting up of IPv6 test bed.

2. Regulatory issues related to transition from IPv4 to IPv6

2.1 Need for Mandating IPv6

2.1.1 Introduction

IPv6, which is next generation Internet protocol, has capacity to expand the available address space on the Internet enormously, using 128 bits vis-à-vis 32 bits of IPv4 as well as having the capability to provide better QoS. In addition IPv6 is designed to promote higher flexibility, better functionality and enhanced security & mobility support. Because of these advantages, the service providers generally should be inclined to migrate to this newer version of Internet technology. But the uptake of IPv6 in the country does not appear to be satisfactory and that is why enabling policy initiatives need to be deliberated upon.

2.1.2 Summary of Stakeholders' Comments

(i) It was pointed out by some ISPs that IPv6 would not only provide solution for IP addresses but also provides certain other benefits like faster routing, better security and geographical addressing. It was also mentioned that it is possible to provide seamless mobility, as an IP device will have same IP address while roaming in

different networks. Also IPv6 provides end-to-end QoS, which supports real-time applications like VoIP and Gaming better than IPv4.

(ii) It was also mentioned that Internet Engineering Task Force (IETF), which is the industry's technical body for Internet development, has almost stopped working on the development of IPv4 and the priority for developing new applications and software is being given only for IPv6. 3GPP2, a partnership framework for 3G & Internet Protocol technologies, has also mandated the deployment of IPv6 for 3G services & beyond. It was also mentioned that the applications, which need end-to-end QoS would be assisted by IPv6 where QoS is a built-in feature.

(iii) Some of the ISPs opined that alternative methods like NAT, CIDR are only interim solutions to address the shortage of IP addresses and IPv6 is the long-term remedy for IP address shortage. Also technologies like NAT put obstacle to VoIP deployment & IPv6 will support VoIP without any obstruction.

(iv) APNIC, the Asia Pacific Network Information Centre, which is the Regional Internet Registry suggested that

the most successful Internet industry environments are the ones which will transition most readily to IPv6, and which will do so spontaneously when the need arises and as the business case dictates. The focus of Internet regulation should be to encourage the development of a competitive and dynamic environment in a light-handed manner, by ensuring the minimum necessary barriers to development and deployment of Internet services.

(v) Many ISPs including ISPAI opined that the adaptation of IPv6 should be left to Industry as a technology option and Licensor/Regulator should not mandate this. It was suggested that the Govt./Regulator should create awareness about IPv6 and provide education to service providers and other stakeholders on various issues pertaining to IPv6.

2.1.3 Analysis of Stakeholders' Comments

(i) From the above it is observed that most of the ISPs are of the opinion that though it is preferable to deploy IPv6, but it should not be mandated. On the other hand many other stakeholders agreed that the development of newer technologies like 3G & beyond and applications

requiring end-to-end QoS and the imminent shortage of IPv4 address would necessitate the adoption of IPv6, in future.

(ii) For the present, the major part of global Internet still comprises of IPv4-based hardware and software and many of enhanced capabilities attributed to IPv6 have also been made available in IPv4 as add-on features. As a result, service providers and consumers may like to continue to use IPv4 for some period of time till the address space shortage in the current system is faced, to defer the costs involved in upgrading to IPv6.

(iii) With respect to choice for the protocols to transport the Radio and Signalling bearers over IP in 3G networks, 3GPP Release 5 mentions that IPv6 is mandatory and IPv4 is optional, although a dualstack (both IPv4 & IPv6) is recommended. This means in all mobile networks providing 3G services in future, IPv6 capability will be a built-in feature compulsorily.

(iv) It is also observed from International practices that IPv6 migration is not forced on the existing ISPs through a mandate but its deployment is facilitated by the

Governments by setting up IPv6 testbeds, backbones and also conducting training & awareness programmes.

(v) It is therefore concluded that the regulator/licensor should adopt technology-neutral, light-handed approach rather than mandating use of any particular technology. However, to facilitate the transition to IPv6 for future, it is necessary that Govt. should provide initial form of catalyst by creating awareness and providing education about IPv6. Additionally, it should encourage its usage in e-governance projects and also its own IT systems procurements, in addition to setting up of national test facilities for IPv6. These issues are discussed in subsequent chapters and enabling recommendations framed up.

2.2 Amendment required in existing ISP licence

2.2.1 Provision in ISP licence

The existing ISP licence stipulates that Internet is a global information system that is logically linked together by a globally unique address system, based on Internet Protocol (IP) or its subsequent enhancements/ upgradations. Therefore there appears to be no restriction

on the use of any version of Internet Protocol (IP) including IPv6. IPv6, which is the next generation Internet protocol, is an upgraded version of IP.

However, Part I of Schedule C of ISP Licence stipulates the definition of IP Address as:

"*Operation of Internet Service requires IP addresses which is at present a 32 bit binary address. This address is required for each permanent connection on Internet. Typically, it is required for ports of routers and other ISP equipment and also for leased line connections to be provided to end users.*"

The above definition may require amendment to enable usage of 128 bits in the address space, as IPv6 address has the length of 128 bits.

2.2.2 Summary of Stakeholders' Comments & Analysis

Some of the ISPs pointed out that Regulator/ Licensor should look into the definition of IP address mentioned in the existing ISP license, which stipulates the IP Address to have 32-bits. It was suggested that the above definition needs to be amended, as IPv6 address will have 128 bits.

This suggestion is very relevant and therefore enabling change in the clause related to address definition is required to be recommended to licensor.

2.2.3 Recommendation:

In view of the above it is recommended that definition of IP address vide Part I of Schedule C of ISP licence to be amended as follows:

> **"*Operation of Internet Service requires IP addresses which can have upto 128 bits or higher in future. This address is required for each permanent connection on Internet. Typically, it is required for ports of routers and other ISP equipment and also for leased line connections to be provided to end users.*"**

2.3 Allocation of permanent IP addresses for Broadband

2.3.3 Introduction

With the anticipated increase in broadband penetration as per the Broadband policy targets (20 millions by 2010), number of IP access devices and other customer premises terminals is likely to increase manifold. Such devices will also require some kind of identification like telephone

number in telecom networks and allocating permanent IP address to such devices can provide a mean for such identification. IPv6 has been designed to provide a simple, high-performance solution for configuring terminals and a basic mechanism to enable “plug and play,” type of environment, wherein a system auto configuration facility enables a user to access the network without need for any configuration. Allocation of permanent IP address is supposed to provide an easy solution to the need for mobility without interrupting running communication sessions while moving a terminal from one IP network to another IP network, though the purpose can be served by other mechanisms in IPv6 also. Therefore it needs to be deliberated as to whether allocating permanent IP addresses to a broadband user is a must or not.

2.3.2 Summary of Stakeholders' Comments

(i) Many ISPs mentioned that an “Always on” Broadband connection with static IP address will provide several benefits like better security, mobility and location based services. However, it was also mentioned that proper monitoring of such connection is required otherwise it may lead to security hazards.

(ii) Some of the ISPs were of the view that need for a permanent IP address allocation depends on the applications used by end users and therefore it should be the prerogative of the user whether the permanent IP address is required or not.

(iii) It was also opined that there is a cost associated with permanent IP addresses and tariff charged for the same by a service provider should also be reported to TRAI in a transparent manner like reporting of tariff in case of other services.

(iv) APNIC was of the view that assigning static or dynamic IP addresses to end users is an operational decision based on issues such as overhead incurred when assigning static addresses, customer requirements, and many technical concerns based on the network infrastructure and applications being used. Therefore, it would be inappropriate for a regulator to mandate a single solution i.e. static IP address, when that solution may not necessarily technically feasible for all, and may not be the best solution.

2.3.3 Analysis of Stakeholders' Comments

(i) It can be observed from above that for Broadband connection, permanent IP address is not a `must' requirement though it is desirable for some applications. On the other hand, a permanent IP address allocation may lead to increased security risk for the users as once its address is intercepted it will remain exposed. As per most of the stakeholders the choice of IP address should be left to the end users who can opt for the same in accordance with their applications needs. Also in case a user opts for a permanent IP address, he should have choice to change it like a telephone number.

(ii) In case of IPv4 based networks, whenever any device changes its network, its IP address also changes. However, when the address changes, the existing connection of the mobile device that is using the address assigned from the previously connected link cannot be maintained and might be abruptly terminated. There are mechanisms to allow for the change in addresses when moving to a different network. For that purpose end-users will require

multiple fixed IP addresses allocated on different networks. In case of IPv6 networks, in case a mobile node changes location and address, the existing connection through which the mobile node is communicating is maintained due to inbuilt mobility feature of IPv6. This feature provides Transport layer connection survivability when a device moves from one link to another by performing mapping of address for mobile device. That means connectivity can be maintained in a network even without a permanent IP address allocation. Therefore, there appears to be no need for a permanent IP address allocation for `Always On' connection, except for some specific applications like subscribers own client-based websites, which can enable two way Internet.

(iii) In addition, at present there seems to be lack of transparency on the part of ISPs while charging their customers for permanent IP addresses as the tariff for Internet and Broadband services are forborne and market driven. In case of leased line, it is a part of the leased line rental, but in case of broadband access the charges for permanent IP addresses are not clearly mentioned. A customer should be

informed about all such charges at the time of subscribing for an Internet connection and permanent address should be allocated only in case it is opted for by the customer.

(iv) In view of the above, it is concluded that there is no need of mandating allocation of a permanent IP address to a Broadband subscriber and this option to be left to the user, as is the practice at present.

3. Encouragement by Govt. for IPv6 Migration

3.1 Introduction

For making a transition from IPv4 to IPv6, ISPs have to upgrade their networks, provide training to their system administrators and related staff and also have to conduct trial on their network before commercially deploying IPv6. This may involve certain amount of capital and operational cost. Presently ISPs are reluctant to invest in transition to IPv6 as they are not finding any compelling business case and feel that deploying a dual stack IPv4-IPv6 infrastructure, which is required for smooth transition and coexistence of IPv4 & IPv6, will increase the costs initially till IPv6 based operation becomes streamlined and financially viable.

3.2 Summary of Stakeholders' Comments

(i) It was mentioned by some ISPs that there is a cost associated with the IPv6 enablement/upgradation, which could go approximately upto 30% of equipment cost in many cases, major part being in software upgradation. Training and education of manpower,

which play the major role in the IPv6 transition, will also have some operational costs for the service providers.

(ii) The representative of IPv6 Forum mentioned that a medium tier ISP need to experiment with IPv6 to get hands on experience for 6 months before it deploys it in their networks. In this process he may invest in one server for web, one server for mail and DNS for experimentation. If it is assumed that relatively low cost x86 based Linux servers is used then the Total Cost of Ownership of new servers to the service providers could be about Rs. 2 lakhs. If the system administrator is to spend full time 6 months to learn this and experiment, then cost of experimentation could be another Rs. 2 lakhs, making it a total of Rs. 4 lakhs for the ISP.

(iii) It was also mentioned that System administrators need at least one-week hands on training and this may cost per person per week around $3000 USD. In addition there is also some cost associated with the upgradation of equipments and software at the customer premises and education of end users.

(iv) Internet Service Providers Association of India (ISPAI) suggested that as an encouragement for IPv6

deployment all the e-governance applications developed through Govt. initiative should be IPv6 ready so as to ensure that the subsequent developmental migration does not put any strain on the outflow of the exchequer and more service providers are motivated to migrate towards IPv6.

(v) It was also opined by some ISPs that the operational readiness of the service provider is most important for the IPv6 transition. The networking equipments manufactured within last two years are already IPv6 enabled and only there is need to upgrade the software part, which is freely downloadable. Also for new ISP who wants to setup its Internet infrastructure now, there is no cost difference between IPv4 and IPv6 infrastructure. Therefore not much cost implications are there.

(vi) Some ISPs mentioned that Government has to come forward and establish an Agency or a body to address various issues related to transition to IPv6. The Govt. may ensure that additional cost required to migrate from Ipv4 to Ipv6 should be partially offset by reducing/waiving off customs and other duties on

software and hardware required for this migration, which might help ISPs and other stakeholders.

(vii) Some ISP's mentioned that to encourage the IPv6 deployments, it should be included in the syllabi of technical institutes that teach and/or conduct research in ICT sector to increase the awareness level and technical competency.

(viii) APNIC mentioned that readiness is the key to an IPv6 transition in India. This involves developing a detailed knowledge and understanding of IPv6 within the Internet industry in India, in order that transition can be planned and implemented by the industry itself, as and when the need and opportunity arises. It seems that human resource development is key to ensuring that Industry is well positioned to make such decisions.

3.2 Analysis of Stakeholders' Comments

(i) It can be observed from above that cost implications for IPv6 migration for the ISP's are not very significant but most of the service providers are not motivated enough to migrate to IPv6 apparently in

the absence of viable business case. Therefore, in order to encourage the service providers for migration to IPv6, it is necessary to identify possibilities of some motivations for the usage of this new technology. This aspect was also brought out in the previous section on need for mandating IPv6. One of the commonly used methods for such facilitation is encouragements provided by govt. to enable the service providers and ultimately the end-users to reap the advantages of advancements in technology. In addition there also appears to be an urgent need to create more awareness about IPv6 within the user community.

(ii) It is observed from International practices as mentioned in Annex A (chapter 6) that the governments world-over are providing various incentives for deploying IPv6 like creating tax credit programs that exempt the purchase of IPv6-capable routers from taxes and providing no-interest/ low-interest loans to service providers migrating to IPv6. As the upgradation costs involved per ISP node are not very significant, it is not considered necessary to

make any recommendations for differential duty structure based on a type of technology.

(iii) It has also been observed that in some countries like China, Japan, Korea and EU, multiple IPv6 backbones are established by interconnecting regional administrative offices, universities, research centers and engineering colleges and some Governments have taken initiatives to deploy IPv6 in their departments and organisations. Various agencies have also been established to promote IPv6 Ready Logo program and to monitor the IPv6 research & development and deployment. Similar steps can also be initiated by govt. as the cost differential between IPv6 and IPv4 based systems is negligible and also the upgradation costs per node from IPv4 to IPv6 is also insignificant. Similarly, govt. as a central agency can also take up the task of bringing awareness about IPv6 among the masses and user community at large.

3.3 Recommendations:

In view of the above it is recommended that:

(i) The Govt. should mandate the usage of IPv6 in the platforms/applications pertaining to e-governance, so that headstart is taken for IPv6 deployments. The Govt. should also mandate IPv6 compatibility in its own procurement of IT systems and networks.

(ii) Department of Information Technology, Govt. of India should conduct workshops and seminars to bring awareness about IPv6 and its benefits for service providers and end-users community.

4. Creation of National Internet Registry (NIR)

4.1 Introduction

In order to procure IP addresses from Asia Pacific Network Information Center (APNIC] which is a regional Internet Registry as a representative of central body, Internet Assigned Numbering Agency (IANA), ISPs either need to take membership of APNIC or approach upstream ISP. Each member of APNIC is required to pay annual membership fee of the order of US$5000.

Smaller ISPs generally are not familiar with the APNIC procedures and also are not aware of the operational processes and therefore prefer to source the IP addresses from their upstream ISP from whom they procure the International Internet Connectivity. While the APNIC does not refuse a non-member, however, it requires a strong justification in case an applicant does not source its IP address requirement from its upstream ISP.

A National Internet Registry (NIR) is a national resource allocation agency that provides domain name, IP registration and other supporting services like PKI services to the service providers. Such an agency typically has resource allocation

policies that are either derived from similar policies that exist across registries in the world (best current practices) adapted to the local requirements or defined exclusively for the sub region in accordance with the general guidelines of the regional registry such as APNIC. In addition to specifying policies for resource allocation, such agency is expected to arbitrate claims and/or disputes arising out of resource allocations to the service providers and users community.

4.2 Summary of Stakeholders' Comments

(i) Some stakeholders mentioned that there is need to have a national agency to manage the allocation of IP addresses at the national level, as is done for any other national resource. It will not only reduce the cost but also make the process of obtaining IP address for end users and small service providers simpler and efficient. They suggested for this purpose an independent national agency similar to NIXI could be created. Representative from DIT also supported the idea of a National Internet Registry.

(ii) It was also mentioned that smaller ISPs have the option to contact the upstream ISPs or the regional

agency (APNIC) to obtain IPv4 addresses. Being a long and tedious process, it leads to a lot of procedural systematic problems and delays and hence is very inefficient.

(iii) Many large ISPs mentioned that there is no procedural problem in obtaining the addresses from the APNIC. They mentioned that APNIC charges a fee of US$ 5000 per annum from the ISPs, who want to obtain addresses from them and there is no bulk discount kind of thing while obtaining more addresses in bulk.

(iv) It was also mentioned that there should be a system of temporary allocation of IPv6 addresses to various service providers on trial basis. For example NIXI may obtain these addresses from APNIC and may allocate these to whosoever needs them on a trial basis without any financial implications. It was also mentioned that it could help allocation of IP addresses in contiguous manner within the nation.

(v) APNIC stated that there is no necessary correlation between the presence of an NIR and more effective transition to IPv6. Transition to IPv6 should not be seen as an impetus for the establishment of an NIR in

India. This issue should be addressed directly by the Internet community rather than by the licensor or regulator. It was also pointed out by APNIC that a national agency dedicated to the coordination of such activities might provide benefits if it is adequately funded, properly managed and able to operate in a stable, neutral and independent manner.

4.2 Analysis of Stakeholders' Comments

(i) It can be observed from above that IP addresses like Country Code, Domain Names should be considered as a national resource procured from Regional Internet Registry and there is a need to localise their allocation function according to local conditions. For this purpose a neutral, not for profit, autonomous agency needs to be created in line with framework for NIRs by APNIC, who has the responsibility of address allocation at regional level. Establishment of such bodies is relevant for IPv4 as well as IPv6 addresses & hence it can play a very important role in the overall development of Internet the Country.

(ii) Such entity will be in a position to provide better services to local ISP's requiring Internet resources and implement operational procedures which suite local environment and culture. Such procedures can be devised in line with the APNIC's operational policies for NIRs (6.Annex B). If a National Internet Registry (NIR) is created then ISPs will deal with a local agency rather than a distant one for their resource requirements. This will not only reduce the costs they incur in operationalising their Internet infrastructure, smaller ISPs will also benefit through better understanding of Internet operational policies. Such national agency could also represent ISPs of the country in APNIC for their address needs as well as any other issues on collective basis in more effectively manner.

(iii) It is observed from international experiences that in many countries of Asia Pacific region like China, Japan, Taiwan, Korea and Indonesia; NIRs have already been established. Such Registries were established these countries through the government's initiatives by their associated agencies with industries participation, in line with APNIC guidelines & are performing functions analogous to RIR (APNIC) [Refer -

Annex-A 6.3]. Therefore, it is considered necessary that similar local body should be established in India also.

4.3. Recommendation:

In view of above it is recommended that

(i) Government (DIT) should initiate the necessary process for establishment of National Internet Registry (NIR) in the country in accordance with framework for NIRs by APNIC, the Regional Internet Registry (RIR) for Asia Pacific Region.

(ii) To start with NIXI, National Internet Exchange of India can be considered to be entrusted with this activity as it is already dealing with .IN domain name and is also a Not-for-profit, autonomous body with industry participation.

5. Setting up of IPv6 Test bed

5.1 Introduction

ISPs need to experiment with IPv6 and conduct trials to get hands on experience before deploying this technology in their networks. For this purpose an IPv6 test bed/ platform is required to which such ISPs can connect to conduct the trials for their traffic flow. In addition, for developing IPv6 applications, Vendors and software development companies also require some IPv6 test bed for testing of such applications.

DIT has already initiated a pilot project within ERNET (Education & research Network) in association with IIT Kanpur and IISc Bangalore. This network has IPv6 enabled routers and DNS infrastructure with access at Delhi, Kanpur and Bangalore.

The results obtained through this project include:

- Configuration of IPv6 server at 9 ERNET centres.
- Configuration of mail and DNS services at each centre.
- Testing of mail transactions.

- Testing for auto-configuration and multicasting features.

It is given to understand that this is yet to be made available to ISPs/vendors for testing their networks and applications. Additionally, this appears to be one of the isolated test facilities without a countrywide access provision. Therefore, a national level facility for IPv6 trials with access facilities in all the major cities does not appear to be available in the country at present.

5.2 Summary of Stakeholders' Comments

(i) Many ISP's mentioned that National test bed would help the ISPs in evaluation and testing of their network for transition to IPv6. This test bed should be used to test the functionality of various applications, protocols over IPV6 to analyse their stability. It should be comprehensive test bed where enterprises and service providers can test there business / network application like Web, Email, ERP, VOIP, DNS etc., and chart out a clear migration plan.

(ii) Few stakeholders mentioned that infrastructure required to set up a test bed needs certain amount of investment in terms of equipment and connectivity (Bandwidth). It was mentioned that this should be funded by a Govt. agency and created with participation from technology research institutions, Govt. and other stakeholders. This test bed should be connected to other national and global pilot networks like Moonv6 in US and networks similar to 6Bone and Freenet6 should be made available at national level, say at Bangalore, New Delhi and other metros. Such arrangement will cost the ISP's less to trial.

(iii) IPv6 Forum mentioned that the scope of testbed need not to be national in nature, right from the beginning. There is a need to encourage metro wide networks, initially, that would primarily serve as network and networked applications interoperability testbeds for IPv6 and then evolve into nationwide testbed, either by using existing infrastructure such as the ERNET IPv6 backbone, for a limited period, or by chartering IPv6 into other nationwide network projects and using them.

(iv) ISPAI mentioned that a single test bed with homogenous hardware, software, applications and routing policy couldn't be useful. It is desirable to have a plurality of test beds so that communication across heterogenous environment can be simulated and analysed. It was also mentioned that a non-profit and independent entity like NIXI may be considered to be one such test bed. NIXI already has four nodes and these may be interconnected exclusively for the purpose of sending IPv6 traffic while also ensuring that such connectivity is not used for transit of normal Internet traffic.

5.3 Analysis of Stakeholders' Comments

(i) It can be observed from above that there is an urgent need for creating a national test bed for IPv6 on the lines similar to the ones in China, Japan, Korea, Taiwan and Europe. Such test bed will help identify large-scale deployment issues and transition mechanisms, evaluate various technologies and develop applications and solutions, in addition to competence building in the country.

(ii) It has been observed from the international practices that several Governments like China, Japan, Korea and several countries of EU are promoting and funding the establishment of testbeds for development and testing of IPv6. Interconnection of nationwide testbeds of research institutes and service providers is also being facilitated in some countries so as to provide an impetus to testing and development of newer IPv6 applications and interoperability.

(iii) In India, the Govt. has already taken a lead to have a start up test bed for IPv6 through ERNET, though it is not available at all the major cities and does not provide access to all the ISPs. Therefore, its scope needs to be enlarged. In addition, the platform for National Internet Exchange (NIXI), which is also handling .IN domain name allocations, can be used as an IPv6 test bed. For this purpose, all the 4 nodes of NIXI need to be interconnected, their routers upgraded to IPv6 and also .IN server to be upgraded to be capable of handling IPv6.

(iv) In addition, various technical agencies of Ministry of Communications & IT like Telecom Engineering Centre (TEC), Centre for Development of Telematics (C-DOT)

and Centre for Development of Advance Computing (C-DAC) are known to be possessing the requisite expertise and are involved in various developmental activities in the field of advance IT & telecom technologies. These agencies can also be a natural choice to develop and establish the platforms and test beds for IPv6 research and development. The capital expenditure involved for such projects can be provided by the central govt.

5.4 Recommendation:

In view of the above it is recommended that:

(i) The existing IPv6 test bed of ERNET should be expanded in association with academic institutions to make its nodes available in all major cities for access to all the interested parties.

(ii) Setup of NIXI should be upgraded to IPv6 and its various nodes interconnected so that it can be utilised as a test bed by the ISP's by providing access to all the ISPs.

(iii) Other technical wings/ agencies of Govt. like Telecom Engineering Centre (TEC), Centre for

Development of Telematics (C-DOT) and Centre for Development of Advance Computing (C-DAC) should also be encouraged to setup test beds for IPv6 trials which could be further integrated in the ERNETs test bed for IPv6.

6. Annexes

6.1 International Experience

Many countries around the world like Japan, Korea, China, European Union, USA have set up national IPv6 networks to enable the network operators/ service providers and software developers to get a hands-on feel of this technology. Some of the important cases are described below:

6.1.1 Europe

The European Commission (EC) initiated an IPv6 Task Force in April 2001 to design an "IPv6 Roadmap 2005" and delivered its recommendations in January 2002, which were endorsed by the EC.A phase II IPv6 Deployment Task Force was enacted in Sep, 2002 with a dual mandate of initiating country/regional IPv6 Task Forces across the European states and seeking global cooperation around the world.

For its part, the European Commission (EC) funded a joint program between two major Internet projects—6NET and Euro6IX—to foster IPv6 deployment in Europe. The Commission committed the financial support to enable the partners to conduct interoperability testing, interconnect both networks, and deploy advanced network services, including support to some 40 IPv6 research projects on the continent.

The EC IPv6 Task Force and the Japanese IPv6 Promotion council forged a strategic alliance to foster IPv6 deployment worldwide.

6.1.2 Japan

Japan took political leadership in the design of a roadmap for IPv6 in the fall of 2000 in a policy speech by Prime Minister. The Japanese government mandated the incorporation of IPv6 and set a deadline of 2005 to upgrade existing systems in every business and public sector. Japan sees IPv6 as one of the ways of helping them leverage the Internet to rejuvenate the Japanese economy. The IPv6 Promotion Council was created to address, in a comprehensive way, all issues related to the deployment and rollout of IPv6. In 2002–2003, the Japanese government created a tax credit program that exempted the purchase of IPv6-capable routers from corporate and property taxes. Under the framework of the Japanese government's e-Japan initiative, the Ministry of Public Management, Home Affairs, Post and Telecommunications has sponsored an "IPv6 promotion council," which, among other things, has established and promoted an IPv6 Ready

Logo program and allocated the equivalent of $70 million for IPv6 research and development.

6.1.3 <u>South Korea:</u>

In 2001, the South Korean Ministry of Information and Communication announced its intention to implement IPv6 within the country. In September 2003, the Ministry adopted an IPv6 Promotion Plan with commitment for funding IPv6 routers, digital home services, applications, and other activities.

6.1.4 <u>China:</u>

In December 2003, the Chinese government issued licenses and allocated budget for the construction of the China Next Generation Internet (CGNI). The goal is to have that network fully operational by the end of 2005. China and Japan have declared jointly in the 7th Japan-China regular bilateral consultation toward further promotion of Japan-China cooperation that IPv6 is an important matter in the area of info-communications field.

6.1.4 <u>North America:</u>

A North American IPv6 Task Force was initiated in 2001. The mission of the networks have begun and

IPv6 is part of emerging production programs NAv6TF is to engage the North American markets to adopt IPv6. The first significant government interest in this effort comes from the U S government defence community, where trial IPv6. This program is currently working with government agencies, ISP's, and application vendors to develop an aggressive campaign to deploy IPv6 in North America.

6.2 Research Projects / Testbeds for IPv6:

Since the formulation of basic IPv6 specifications in mid 1990's, a number of research projects and testbeds have been developed and operated to test and improve the different functionalities of IPv6. Some of the important ones of them include :

6.2.1 6Bone:

The 6bone is an independent outgrowth of the IETF IPng project that resulted in the creation of the IPv6 protocols. The 6bone is currently an informal collaborative project covering North America, Europe, and Japan. One essential part in the IPv4 to IPv6

transition is the development of an Internet-wide IPv6 backbone infrastructure that can transport IPv6 packets.

The 6bone is a virtual network layered on top of portions of the physical IPv4-based Internet to support routing of IPv6 packets, as that function has not yet been integrated into many routers. The network is composed of islands that can directly support IPv6 packets, linked by virtual point-to-point links called "tunnels". The tunnel endpoints are typically workstation-class machines having operating system support for Ipv6. Over time, as confidence builds to allow routers to carry native IPv6 packets, it is expected that the 6bone would disappear by agreement of all parties. It would be replaced in a transparent way by ISP routers and user network based on IPv6 Internet-wide transport.

The 6bone is thus focused on providing the early policy and procedures necessary to provide IPv6 transport in a reasonable fashion so testing and experience can be carried out. It would not attempt to provide new network interconnect architectures,

procedures and policies that are clearly the purview of ISP and user network operators. In fact, it is the desire to include as many ISP and user network operators in the 6bone process as possible to guarantee a seamless transition to IPv6.

6.2.2 IPv6 Implementation on GEANT Network:

The GÉANT project is a collaboration between 26 National Research and Education Networks (NRENs) across Europe, the European Commission, and DANTE. DANTE is the project's co-ordinating partner. The project began in November 2000.

An important objective during the third year of the GÉANT project was the development and implementation of IPv6 services on the GÉANT network.GÉANT now offers a dual stack core IPv6 backbone. The development of IPv6 services means that, together with several of its counterparts in other regions of the world, GÉANT now forms part of the world's first next-generation Internet network with global reach.

The introduction of IPv6 services on GÉANT began with a 6-month pilot phase, which started in April

2003. During this time GÉANT was capable of delivering IPv6 service. NRENs and projects were connected to the IPv6 service as and when they were ready to do so. The network's stability and reliability were carefully monitored during the pilot phase using dedicated IPv6 monitoring tools, with any necessary debugging being performed. The pilot phase also served to define the operating procedures required for production service. GÉANT entered operational IPv6 service in October 2003. In February 2004, tests also began with a view to developing an IPv6 multicast service.

It is expected in future that work will be done on extending IPv6 connections outside the GÉANT core and towards international networks, as well as on advanced features such as multicast, advanced monitoring and more sophisticated security measures.

6.2.3 China Next Generation Internet (CNGI):

Chinese people have started a large-scale IPv6 trial called CNGI (China Next Generation Internet), with strong government initiative. The first aim is to build a CNGI core network with more than 30 nodes covering

more than 20 provinces. Plans are in place to conduct various trials on core networking capabilities including next generation security and QoS. The focus is on applications such as mobile IPv6, 3G, Grid Computing and Sensor networking. Simultaneously, efforts are on to promote hardware, software and middleware developed in China through CNGI project.

CNGI will be composed of 6 networks operated by different service providers. Each operator will implement different QoS technologies. End-to-end QoS is the ultimate goal, but CNGI will be continued beyond 2005. CNGI has also focused on mobile IPv6 to cater to the mobile Internet subscribers.

6.2.4 NTT Communications Corp. – Commercial IPv6 Network

NTT Laboratories started one of the largest global IPv6 research networks in 1996. Trials of their global IPv6 network, using official IPv6 addresses, began in December 1999. Since spring 2001, NTT Communications has offered commercial IPv6 services.

6.3 National Internet Registries (NIR) in Asia Pacific Region

(i) China Internet Network Information Center (CINIC).

(ii) Korea Network Information Center (KRNIC).

(iii) Japan Network Information Center (JNIC).

(iv) Taiwan Network Information Center (TNIC).

(v) Indonesia Network Information Center (INIC).

The Agencies associated with the setting up & operation of some of such registries are detailed below:

China Education and Research Network (CERNET)

China Education and Research Network (CERNET) project was started in 1994. It is the first nation-wide education and research computer network in China. The CERNET project is funded by the Chinese government and directly managed by the Chinese Ministry of Education. CERNET will connect all the universities and institutes in China and will connect middle schools, primary schools and other education and research entities. CERNET is one of the four NSPs in mainland China.

Taiwan Network Information Center

TWNIC is a country NIC of Taiwan, founded by Computer Center,Ministry of Education in March 1994.The members of TWNIC are from non-profit societies, Internet Service Providers, commercial companies,governments, universities, and research organizations. Currently, TWNIC has 56 members. TWNIC is run by a steering committee comprised of 19 commissars elected among 47 members. Under the steering committee are 6 subcommittees: XRegistration, Service, Promotion, CIX, Technology and Secretariat.

National Internet Development Agency of Korea (NIDA)

Korea Network Information Center (KRNIC) of National Internet Development Agency (NIDA) of Korea serves as the registration center for .KR domain name registration and IP address allocation for Internet users in Korea. It is the main centre for information to expand the usage and maintain the function of the Internet. In addition, KRNIC represents the official Internet organization in Korea internationally and exchanges information and techniques with APNIC and other countries and also works co-operatively with them.

Japan Network Information Center

Japan Network Information Center was established in 1992 for IP address allocation and domain name registration. In 1997, JPNIC became an official organization admitted by three governmental departments and an agency. Now JPNIC has approximately 250 ISPs and other companies as members

Annex - B

Operational policies for National Internet Registries in the APNIC region

Table of contents

1. Introduction

1.1 General

To improve allocation and registration services for the Asia Pacific Internet community, APNIC provides for the establishment of National Internet Registries (NIRs) within economies of the region. This structure enables registry services to be provided in the local language and culture, allowing better services to ISPs requiring Internet resources.

Historically, the creation of NIRs added complexity to APNIC's ability to carry out its delegated responsibility to ensure efficient Internet resource utilisation in the Asia Pacific. The added layer of administration placed demands on APNIC that were disproportionate to the demands of other members. Because there is a need to ensure that NIRs do not negatively impact resource management in this region, a clearer, simpler framework for the operations of the NIR system has been developed.

This document describes the operational procedures for resource allocation by APNIC to NIRs and their members.

This document does not describe address management policies, which are documented elsewhere, and which NIRs are expected to comply with. NIRs may implement additional local policies, provided these do not conflict with regional or global policies. Any substantial policy change proposed within an NIR's community should be brought to the APNIC community for approval through existing open policy-making mechanisms.

Any questions regarding this document should be referred to the APNIC Secretariat.

1.2 NIR establishment

The recognition of NIRs in the APNIC region is the responsibility of the APNIC Executive Council. The criteria for establishment and recognition of NIRs are not discussed in this document, but are detailed in the APNIC document "Criteria for the Recognition of NIRs in the APNIC Region".

1.3 NIR fees

APNIC charges fees for providing NIR services. These fees are set at a level that ensures that other APNIC members do not subsidise NIR members and that NIRs provide sufficient funding to cover the cost of providing the services they require. Details of the NIR fees are described in the APNIC document "APNIC Fee Schedule: Membership Tiers, Fees, and Descriptions", within the provisions describing the 'per address fee' for confederations.

2. Definitions

2.1 Internet Registry (IR)

An Internet Registry (IR) is an organisation that is responsible for distributing IP address space to its members or customers and for registering those distributions. IRs are classified according to their primary function and territorial scope within the hierarchical structure.

IRs include:

- APNIC and other Regional Internet Registries (RIRs);
- National Internet Registries (NIRs); and
- Local Internet Registries (LIRs).

2.2 Regional Internet Registry (RIR)

Regional Internet Registries (RIRs) are established under the authority of IANA to serve and represent large geographical regions. Their primary role is to manage, distribute, and register public Internet address space within their respective regions. Currently, there are three RIRs: APNIC, RIPE NCC, and ARIN, although a small number of additional RIRs may be established in the future.

2.3 National Internet Registry (NIR)

A National Internet Registry (NIR) primarily allocates address space to its members or constituents, which are generally LIRs organised at a national or distinct economy level. NIRs are expected to apply their policies and procedures fairly and equitably to all members of their constituency.

2.4 Local Internet Registry (LIR)

A Local Internet Registry (LIR) is generally an Internet Service Provider (ISP), and may assign address space to its own network infrastructure and to users of its network services. LIR customers may be other "downstream" ISPs, which further assign address space to their own customers.

2.5 NIR-LIR member

An NIR-LIR member is an LIR that is a member of an NIR.

2.6 Address space

In this document, address space means public IPv4 and IPv6 address ranges, excluding multicast addresses, private addresses defined by RFC1918 and addresses designated for experimental use.

2.7 Internet resources

Internet resources are those resources administered by the Internet registry system including address space, autonomous system numbers, and in-addr.arpa domains associated with the address space administered by the registry.

3. APNIC address allocations to NIRs

3.1 General

As members of APNIC and of the Asia Pacific Internet community, NIRs are required to fully implement all applicable APNIC address management policies. As NIRs, they also take responsibility for ensuring policy compliance with respect to all Internet resources which are under their management.

It should be noted that APNIC cannot delegate to an NIR sole responsibility for managing all address space within its country or economy. APNIC must remain able to accept direct membership from any organisation in the Asia Pacific

region, both to promote maximum Internet routability and to meet its obligations as an open membership organisation.

3.2 Request process

For each NIR, APNIC will maintain an "allocation window" which specifies the maximum allocation, which the NIR may make without seeking a "second opinion" from APNIC.

3.2.1 Allocation request

When the NIR approves an allocation, which is smaller than, or equal in size to, its allocation window, the NIR will send APNIC an "allocation request". When APNIC receives an allocation request, it will allocate the amount of address space specified to the NIR. The NIR will then allocate that address space to its NIR-LIR member.

An allocation request must include all information required to register the allocation and create the applicable whois database objects. In particular, the allocation request must include a unique identifier for the NIR-LIR member for whom the allocation is being requested. These identifiers are used to ensure aggregation of subsequent allocations to each NIR-LIR member.

In the allocation request, the NIR is not required to provide information justifying the allocation; however, the NIR must maintain such information permanently in its own records.

3.2.2 Second opinion request

For requests than are larger that the NIR's allocation window, the NIR must send APNIC a "second opinion request". A second opinion request includes the same information as the allocation request, as well as information, which fully justifies the proposed allocation. The second opinion request should also include a summary of the NIR's evaluation of the request and proposed allocation size.

When APNIC receives a second opinion request, it will evaluate the proposed allocation size. If APNIC agrees that the request is properly justified, it will allocate the address space to the NIR for re-allocation to the NIR-LIR member. If APNIC does not agree that the request is properly justified, it will request further information as required from the NIR, and possibly request that more information be collected by the NIR from the applicant.

The second opinion request procedure for allocations is very similar to the procedure used by APNIC and NIRs with respect to assignments by LIRs.

3.3 Database registration

An NIR may choose to operate a whois database to locally register the allocations it makes. Requirements for operating such a database are provided in the document "Criteria for the Recognition of NIRs in the APNIC Region".

Whether or not an NIR does operate a whois database, the NIR is responsible for maintaining all registration records for address space under its management. This maintenance includes adding new records when allocations are made, updating records when details change, and transferring records to or from APNIC.

In all cases, it is important that the APNIC database server is able to answer queries for all address space that is in use by the NIR, and also that the "source" of those responses should clearly reflect the specific NIR providing the data.

3.4 Delegating reverse zones in in-addr.arpa

Each NIR may choose one of the following options for the managing the reverse DNS zones:

3.4.1 Option 1

In this option, reverse DNS zones may be managed as follows:

- Each NIR will generate a flat file view of the zone, and place it in a publicly visible area on web, ftp, or ssh/rsync servers. A description of the required "flat file" view is included in the Appendix to this document.
- On a regular cycle, APNIC will fetch this file, parse it, and include its zone information in the parent /8 zonefile.
- Where duplicates exist, any APNIC object that results in a zonefile entry will override any

matching NIR-asserted object. The NIR will be notified of any such overrides.

- Any NIR-asserted object that lies outside the ranges allocated to the NIR will be ignored. The NIR will be notified if this occurs.

3.4.2 Option 2

In this option, APNIC will manage reverse DNS zones by an automated process, which uses 'domain' objects in the APNIC Whois Database. Changes to domain objects are synchronised to the external DNS every two hours.

APNIC will create the 'inetnum' and 'domain' objects for the NIR-LIR member on the /16 and /24 boundaries. The 'mnt-by' attributes will reflect the relevant NIR, ensuring that responsibility for managing these objects remains with that NIR. The domain objects will be inactive and will include a dummy value for the 'nserver' (nameserver) attribute, as shown in the following example:

domain: 28.12.202.in-addr.arpa
descr: in-addr.arpa zone fro 28.12.202.in-addr.arpa
admin-c: DNS3-AP
tech-c: DNS3-AP
zone-c: DNS3-AP
nserver:
remove.this.nserver.to.enable.zone.at.apnic.net
mnt-by: MAINT-APNIC-AP

changed: inaddr@apnic.net 20020810
source: APNIC

If an NIR chooses to use the APNIC system of managing reverse domain objects, the NIR must update the domain object in the APNIC Whois Database by inserting correct nameserver information in the nserver attribute.

Alternatively, if the NIR wishes to use their own reverse DNS management systems for their members, the NIR must delete the relevant dummy domain object in the APNIC Whois Database. In this case, the update cycle for synchronising changes to the external DNS will be dependant on the mirroring cycle of the particular NIR.

Where the allocations of address space are smaller than /16, it will be necessary to make delegations for each /24.

3.5 Address space held by NIRs

Under the previous 'confederation' model, NIRs were able to hold allocations of resources for further allocation to ISPs in their economy. This document describes a new model whereby all allocations approved by NIRs will be made from the regional address pool managed by the APNIC Secretariat.

Existing address pools held by NIRs should be further allocated as appropriate, under current address management policies.

3.6 Service levels

APNIC will attempt to respond to all NIR requests within its standard response time (currently two working days). In the case of allocation requests (as opposed to second-opinion requests), APNIC will attempt to respond with a specific allocation within one working day.

4. Transfer of members between APNIC and an NIR

4.1 Transfer of membership from APNIC to an NIR

If an LIR transfers membership from APNIC to an NIR, the following provisions apply. These provisions assume that the LIR will transfer all resources to the NIR and cancel its existing APNIC membership; however, as noted below, there may exceptions.

A. APNIC should freely allow member LIRs to join NIRs in their country and to receive address registry services from that NIR (including resource allocation and registration), wherever this is preferred.
B. In these cases, management responsibility for the LIR's address space and registration records will be transferred from APNIC to the NIR. The LIR will no longer receive any service from APNIC in relation to the address space received from APNIC.
C. The existing address space holdings of the LIR will be transferred to the management of the NIR. This address space will be included in the assessment of the NIR's membership category in the next membership renewal.

D. APNIC will not impose a per-address fee for the transfer. Likewise, APNIC will not impose any further charges on the LIR in relation to Internet resources previously allocated to that LIR.

If the LIR chooses to maintain its membership with APNIC while receiving new allocations from an NIR, the LIR may choose whether and when resources are transferred (and may opt for them to be transferred gradually over time).

It should be noted that although an LIR may be a member of both an NIR and APNIC, it may only obtain resource services from one source.

4.2 Transfer of membership from NIR to APNIC

If an LIR transfers membership from an NIR to APNIC, to receive services from APNIC, the following conditions apply.

A. NIRs should freely allow NIR-LIR members to join APNIC and to receive all address registry services from APNIC (including resource allocation and registration), wherever this is preferred.
B. Responsibility for managing the NIR-LIR member's address space, reverse DNS, and registration records will be transferred from the NIR to APNIC. The NIR-LIR member will no longer receive any service from the NIR in relation to the address space received from the NIR.
C. The NIR-LIR member will become an APNIC member. Their APNIC membership tier will be assessed at the

next membership renewal, based on all of their APNIC-managed address space (including both the transferred address space and any other address space they have received from APNIC).

D. The NIR will not impose any further charges on the LIR in relation to Internet resources previously allocated to that LIR.

As in section 4.1 above, the transition of address space management from NIR to APNIC may take place over time, with the LIR maintaining membership of both registries. Again it should be noted in such cases that an LIR may be a member of both NIR and APNIC, but can only obtain resource services from one source.