IP numbers – no Address, no Access

Fig. 1. To be connected to the Internet, any computer or other device must have a unique IP address assigned to it.

The Internet Protocol (IP) address system is part of the underlying infrastructure of the Internet. To be connected to the Internet, any computer or other device must have a unique IP address assigned to it.

The debate and open consultations within the scope of the Working Group on Internet Governance (WGIG) have served to underline that the IP address space, like the telephone numbering space, the radio-frequency spectrum or the domain name space, is a virtual, valuable international resource shared by all users in all countries. There are two types of IP addresses in use today: IP version 4 (IPv4) and IP version 6 (IPv6). IPv4 was initially deployed in January 1983 and is still the most commonly used version. IPv6 was introduced in 1999 and is still in its early stages of diffusion.

During the 1980s and early 1990s, adopters of the Internet were able to receive IPv4 addresses under allocation policies that were in place at the time. Those early adopters often still hold many more addresses than they would be allocated under present allocation policies. And so, it is argued that for historical reasons, there is an imbalance in the distribution of IPv4 addresses. Since the creation of Regional Internet Registries (RIR), the allocations made to each region have been made based on real needs and it has

been an efficient way to address the concerns regarding the imbalance in the distribution of those resources. Nevertheless, questions about the future of IP address policy have been raised. In the light of the transition to IPv6, some countries feel that allocation policies for IP addresses should ensure balanced access to resources on a geographical basis.

Main Actors and their Roles

By 1993, two Regional Internet Registries had been established, first in Europe and then in Asia-Pacific. The establishment in November 1998 of the Internet Corporation for Assigned Names and Numbers (ICANN) has given the debate on Internet governance a new focus. ICANN manages the allocation and assignment of IP addresses and autonomous system numbers. IP numbers are allocated or assigned, upon documented requests, in the form of address blocks from the Internet Assigned Numbers Authority (IANA) to Regional Internet Registries. These registries, in turn, assign blocks of addresses to Internet service providers (ISP), who then use them to number downstream customers. The Address Supporting Organisation (ASO), composed of representatives from Regional Internet Registries, advises the ICANN Board on policy issues relating to the

operation, assignment and management of Internet addresses via the Address Council.

There is also the Number Resource Organisation (NRO), which was formed in 2003 by the Regional Internet Registries to act as their coordinator on matters of mutual interest. NRO protects the unallocated number resource pool, promotes and protects the bottom-up policy development process, and acts as a focal point for Internet community input into the RIR system. The Internet Engineering Task Force (IETF), an open international community of network designers, operators, vendors and researchers, is responsible for technical standards-setting with regard to IP addresses.

Regional Internet Registries

There are five Regional Internet Registries today. RIPE NCC (Réseaux IP Européens Network Coordination Centre) handles IP allocation for Europe, the Middle East and Central Asia. ARIN (the Amercian Registry for Internet Numbers) serves North America and parts of the Caribbean. LACNIC (Latin American and Caribbean Internet Addresses Registry) serves Latin America and parts of the Caribbean. APNIC (the Asia-Pacific Network Information Center) serves Asia-Pacific. AfriNIC (the African Network Information Center) serves Africa. AfriNIC is the latest "kid on the block", its application having been formally accepted in 2005.

All Regional Internet Registries are designed to operate as independent and neutral non-profit organizations, based on an industry self-regulation model in which open and transparent, bottom-up processes are used to consider the inputs of all stakeholders in the formulation of address management policies. According to the WGIG paper, Regional Internet Registries have demonstrated their capability to fulfil their tasks and to make their contribution to the functioning of the Internet. For example, they have been able to manage the transfer of functions from ARIN to LACNIC and from ARIN, RIPE NCC and APNIC to AfriNIC, as and when these registries have come on board, without interrupting Internet services and connectivity for end-users.

IP Address Management

The management of IP addresses is primarily in the hands of not-for-profit private sector organizations – that is ICANN/IANA and the five Regional Internet Registries. ITU has a mandate from Member States to work in this area.

Areas of Concern

It is stated in the WGIG paper that there is currently limited involvement of either governments or civil society in the policy-making or practical management of IP addresses, although generally RIRs encourage these stakeholders to participate in its policy development. Some governments take the position that the allocation of IP numbers, or some subset of these numbers, should be under the sovereignty of national governments and should be managed via a national Internet registry (NIR). Note that in some regions there are already NIRs, which respond to regional needs; the allocation of IP addresses from RIRs to NIRs is made on the normal basis of documented needs. Some other governments and stakeholders do not see the need for any change to the existing system. Some consider that making a change in the address allocation mechanisms would result in operational risks, for example, with routing aggregation.

As well, governments have used the channel of ICANN's Governmental Advisory Committee (GAC) to comment on IP address policies, notably with regard to the transition to the IPv6 address space. However, it is argued that they have no decision-making authority in the establishment of policy.

But a comment from Australia states that: "As far as we are aware, both governments and civil society are able – and indeed encouraged – to participate in RIR policy development. Moreover, governments jointly can contribute through the GAC. Lack of government involvement appears to be due to factors other than lack of opportunity. The current model means all interested stakeholders can have a say in IP address management, not just the private sector."

NRO acknowledges that: "Public sector participation in ICANN, particularly as expressed through the Government Advisory Committee, has clearly not operated to the satisfaction of all parties. NRO is supportive of further refinements that could meet the needs of national governments for more meaningful participation in the activities of ICANN.

The Internet Society (ISOC), in a commentary issued in April 2005 on the status of the work of WGIG, underlines

Fig. 2. In Asia-Pacific with a larger share of these Internet users than either North America or Europe, the region has expressed a critical stake in the discussion on Internet governance.
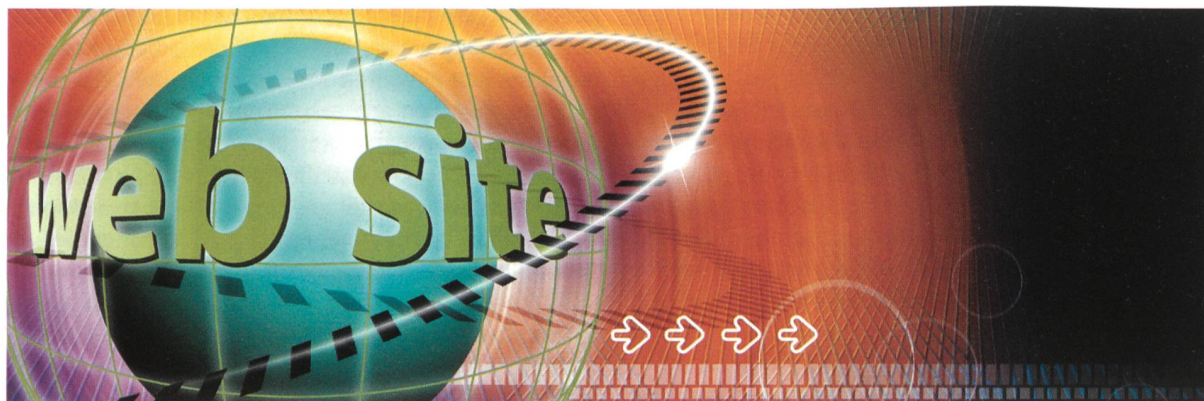
that the best way to extend the reach of the Internet is to build on those aspects that have worked well — for example, the long-established open, distributed, consensus-based processes and many regional forums for the development and administration of the Internet infrastructure.

ISOC points out that: "Decision-making about issues such as resource allocation or IP Address Policy has always been in the hands of the Internet community, in order to be as close to those who require and use the resources as possible. It is this participative model, close to the end-users, that led to the phenomenal, stable growth of the Internet. The Internet community and its bottom-up processes are constantly evolving in response to changes in needs and availability. For example, in response to moves by the African Internet community, the African countries now have their own Regional Internet Registry (AfriNIC) that helps coordinate users' needs and IP Policy in that region. Latin America has the same story to tell."

Some have expressed the view that the current management system and distribution of responsibilities for number allocation has worked well so far, and that realistic projections or requirements indicate that there will not be any problems for the foreseeable future. Others, however, argue that because of the rapid increase of demand and utilization of the Internet, a review of the current numbering management is required to ensure equitable distribution of resources and access for all into the future.

With the number of Internet users expected to surpass 1 billion in 2005, the stakes are high. In Asia-Pacific with a larger share of these Internet users than either North America or Europe, the region has expressed a critical stake in the discussion on Internet governance. Yet, the region's participation in governance mechanisms has not matched its stake in the outcomes, according to a statement presented at WGIG's fourth meeting in mid-June 2005. A survey on Internet governance conducted in twelve major regional languages and attracting some 1200 responses from 37 countries points to a high level of satisfaction with the status quo on the issues of domain name management and IP address allocation (44 and 40%, respectively). However, these topics are also considerably polarised.

In the case of IP address allocation, 40% approve and 32% disapprove of the current system. "In other words, despite relatively high levels of satisfaction as compared to other topics, the results do not really indicate a ringing endorsement of the status quo. This may partly explain the very prominent place that these issues claim in the current debate on Internet governance, often overshadowing most other issues," underlines the statement from the UNDP Asia-Pacific Development Programme that carried out the survey.

The IPv4 Address Space and the Transition to IPv6

India, in its comments on the WGIG paper, argues that the current system "results in non-contiguous allocation of IP addresses to a single service provider, user or country leading to huge routing tables that consume precious resources in the network elements, leaving fewer resources for traffic."

In the transition to IPv6, India proposes that "allocation of IPv6 addresses should be country-based taking into account the country's population, level of development and potential." The proposal recommends that institutions at the national level of countries may take responsibility of allotting contiguous IP addresses to the ISPs/users. This may facilitate simple and efficient routing, monitoring and policy enforcement, according to the proposal.

India reiterates the need for equitable distribution of address space based on needs and future requirements. It underlines that the balancing of skewed distribution of IP addresses should be dealt with explicitly.

Australia in its comments called on WGIG to "get to the bottom of competing claims about the impact of different IP address allocation models impacting on routing tables and thus efficient network operation. "Australia believes that this would allow the World Summit on the Information Society in Tunis in November 2005 to assess the IP allocation issue."

It is recognised in the WGIG paper that the present management system for IP addresses has, so far, provided a stable and secure functioning Internet. It is also noted in the paper that the IPv4 address space is a limited resource. Some argue that while the distribution of IPv4 addresses is unbalanced, there is no discrimination in this unequal distribution, which reflects an unequal need for IP addresses. Others believe that the legacy allocation of large blocks of numbers to early adopters and the imposition of charges for latecomers results in an inequitable distribution of resources. In particular, later adopters point to the somewhat liberal address holdings of the early adopters and ask why they have to bear the brunt of the cost and effort to achieve very high address utilisation rates while the early adopters are still able to deploy relatively simple, but somewhat more extravagant addressing schemes across their networks.

At the time IPv4 was released, the choice of using 32-bit address fields, or potentially over 4 billion unique addresses was either "wild-eyed extravagance on the part of the researchers who designed this protocol or a demonstration of an uncanny level of prescience about the shift in the computing environment from a small number of massive lumbering mainframes into a prolific realm of chattering embedded tiny digital devices," says Geoff Huston, Senior Internet Researcher at APNIC. "I suspect that a strong element of the latter was part of their thinking, and this remarkable choice of address design formed one of the reasons why the Internet protocol was in a position to support the personal computing revolution of a decade later."

There is an interest among some governments in developing and clarifying a role for international organizations and national governments in the policies for the allocation of IP addresses. There is also an operational requirement that the addresses allocated by RIRs remain aggregated in a way that allows for the routing that interconnects the networks of the Internet. WGIG concludes that: "The solution of this issue will require creativity." ■

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