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H. Zhao, Director of TSB/ITU

ITU AND INTERNET GOVERNANCE

Note: Following the ITU Council Working Group on WSIS discussion of this paper, some changes have been introduced into the original text, mainly to change the expressions concerning the author's proposals/positions by an expression of "one possible option" (or a similar expression of this kind), and to add additional annexes containing additional comments received after the first version was posted.

1. Background

1.1 Internet Governance is one of the two hot issues that emerged during the first phase of WSIS, requiring further work during the second phase. While Financial Mechanisms is being handled by a Task Force (TFFM), Internet Governance is being addressed through a Working Group on Internet Governance (WGIG) established by Mr. Kofi Annan, UN Secretary-General. In line with the decision of Tunis PrepCom-1, it is expected that the WGIG will present a preliminary report to PrepCom-2 (17-24 February 2005) and a final report to PrepCom-3 (August/September 2005), for consideration of appropriate action during the second phase of WSIS, which will be held in Tunis, 16-18 November 2005.

1.2 ITU has some formal statements such as Resolutions 101, 102, 133 etc., concerning Internet-related issues, covering both technical and policy-related aspects. ITU Council approved its own Resolutions and Decisions on WSIS, and an ITU Council Working Group on WSIS (WG-WSIS) established in 2002 made a tremendous contribution to the success of Phase 1 of WSIS. It will continue its work for Phase 2. The ITU elected officials are requested to make their own contributions, through WG-WSIS, to the WSIS process.

In reply to the request by the ITU Council-2004, I promised during my informal consultation with ITU Members during the last TSAG meeting held on 15 July 2004 that I would prepare an input to assist the discussion on this issue. This document fulfills that promise.

A first draft of this paper was prepared on 26 September 2004 and informally sent to those who were aware of my intention and who asked for a copy. I note that that draft was circulated more widely than I had imagined. Based on comments received, a new version was prepared and posted on the ITU-T web site on 23 October 2004, with an invitation for comments to be sent by 15 November 2004. The present version is based on comments received. As the earlier version has received wide attention, I did not want to make big changes to this document, but comments received have been reflected.

I take this opportunity to express my sincere thanks for all comments received. Many comments have been incorporated into the text of the paper. Some other comments were too complex and long to be incorporated in the text, those comments are reproduced verbatim in the Annexes to this paper.

1.3 Let me start by discussing the question of scope. In accordance with ITU's Constitution, the ITU is concerned with the transmission, emission, and reception of information[1], not with the content of the information. Questions related to content are outside the scope of ITU.

Furthermore, let me note that, in recent years, ITU has been directly involved in important issues related to Internet, such as VoIP, ENUM, MPLS, cable modems, ADSL, etc. These issues have resulted in stronger collaboration with other Internet standardization bodies and have confirmed that ITU has an important role to play with respect to the key issues related to the continuing evolution of the global telecommunication system.

2. Internet governance issues

2.1 Debates

During the debates on Internet governance, many issues and questions were raised that touched upon sovereignty, security, stability, privacy, international coordination, intellectual property rights (IPR), who does what, etc. In my opinion, the debates reflected the reality that Internet governance is not limited to technical issues, nor to policy issues only. It has increasingly included important social, economic, and national security issues. In addition, people were troubled by the fact that there is no consensus on areas of responsibility (who should do what).

2.2 Internet, a large-scale public critical infrastructure and commercial service

IP-based networks and IP-based services (commonly referred to as "the Internet") have become today a large-scale publicly available and commercial infrastructure that is critical to the national security and economic well-being of many countries[2]. Although in a few places it is still debated whether Internet and IP-based services should be considered new telecommunication services or not, it appears to me, except in a few cases, that it is widely agreed that these large-scale Internet offerings to the public can no longer be considered as an academic trial, or an educational network, or a closed private network/service. Indeed, they are rapidly becoming integrated with other existing public telecommunication infrastructure to constitute the Next Generation Network (NGN). Given the Internet's importance for the global economy, its stability, the availability and quality of the services and applications that it enables, and its security have become subjects of interest for public authorities, at the national and international levels.

In addition, the financial aspects of Internet are becoming more important. Indeed, Internet has become a significant source of revenue, and also a significant system for transferring funds (for example, by individual consumer transactions). ITU has undertaken studies on certain aspects of the financial flows related to Internet traffic, and work is ongoing on economic models. However, more work, and broader work, is probably needed.

2.2.1 At the national level, Internet governance varies from one country to another, notably with respect to the roles of government, civil society, and the private sector. In those countries where the

[1] Article 1, paragraph 1(a) of the ITU Constitution states that the purposes of the ITU are "to maintain and extend international cooperation among all its Member States for the improvement and rational use of telecommunications of all kinds". And telecommunication is defined at 1012 in the Annex to the Constitution as "Any transmission, emission or reception of signs, signals, writing, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems". See http://www.itu.int/aboutitu/Basic_Text_ITU-e.pdf

[2] The WSIS Declaration of Principles states: "The Internet has evolved into a global facility available to the public and its governance should constitute a core issue of the Information Society agenda" (par. 48)

management of Internet at the national level is still in the hands of the private sector, the private sector, in most countries, normally has established relations with governments. I have noted that governments all over the world support the development and deployment of the Internet in their country; indeed, I find it difficult to believe that Internet would be available in a country if that country's government opposed it.

As far as government engagement is concerned, the situation today is rather diverse: the government functions are carried out, or influenced by, Telecommunications Ministry, Telecommunications Regulator, Science and Technology Ministry, Education Ministry, Information Ministry, Justice, Security, or Commercial Ministry, etc. The word "Ministry" here implies the authority of government, which could be indeed a Ministry in some countries, or a "Department" of a government in other countries.

On possible option for the future is that as Internet and IP-based services become widely deployed and accepted as a publicly available infrastructure and commercial service of national importance, national oversight responsibility will be eventually handed over to the national authority, although the national authority might delegate some of its powers to the private sector, for example through industry self-regulatory mechanisms (although the reserve regulatory power for critical public infrastructures would, normally, be retained by the government).

Some believe that there is a tendency such that Ministries responsible for scientific and academic matters will eventually hand over their responsibility for the national management of public Internet and IP-based services matters to an authority established to deal with the public policy issues that arise with respect to telecommunications infrastructure, namely the Telecommunications, Information Technology, or Commercial Ministries/Departments of government, noting that some countries have renamed their telecommunication authorities to "information" authorities or "communication and information" authorities, or similar designations.

2.2.2 At the international level, there is no single international (intergovernmental or private) organization that coordinates all the issues related to the Internet and IP-based services. Currently, a wide range of organizations are involved. Some of those organizations are private sector, some are intergovernmental, some are multilateral arrangements such as the Cybercrime Convention. Each has unique strengths and contributes in its own way to the success of the global Internet. It might be an option to consider a more coordinated approach at the international level, which might be beneficial for everybody.

2.2.3 There is unanimous agreement in WSIS, as per the two output documents "Declaration of Principles" and "Plan of Action", that Internet Governance should be "multilateral, transparent and democratic, with the full involvement of governments, the private sector, civil society and international organizations". It is therefore clear, as agreed by all, that governments should play an appropriate role in Internet governance, at the international and national levels.

Although some governments have tried to strengthen their engagement in Internet governance, many believe that the operational issues, and in particular those issues with commercial implications, should be better left to the private sector. This is certainly an option to consider for the future.

The questions that now arise are:

a) how can governments play their role nationally? And

b) what (if any) intergovernmental activities are necessary at the international level?

I would like to explore options related to question b) above.

3. ITU's role in coordinating public telecommunications infrastructure and services and its work on Internet and IP-based services

3.1 About ITU

ITU is a well respected intergovernmental organization, a specialized agency within the UN family. Government representatives at ITU may come from Foreign Affairs Ministries, Telecommunication Ministries, Telecommunications Regulators, or other government entities, depending on the particular Member State. ITU does not choose the country representatives. It is the Member State which decides to nominate an appropriate government entity to represent them in ITU. Participation in a national delegation may be open to anyone recognized by the national government, whether government employee or not, at the government's discretion. Similarly, membership in Sector Member delegations is determined by the Sector Member itself.

ITU is the only intergovernmental organization within the UN system that has had a special partnership between governments and industry members ever since it was created in 1865 to coordinate public telecommunication infrastructure and services. Today, ITU still enjoys and profits from this public-private partnership: it has 189 Member States and around 700 industry Sector Members, which covers almost all major industry players in the ICT field. In ITU, there are three Sectors: ITU Telecommunication Standardization Sector (ITU-T), ITU Radiocommunication Sector (ITU-R), and ITU Development Sector (ITU-D). Industry members (the private sector) have played a key role in all Sectors of the ITU, particularly in ITU-T.

ITU has always worked with the consent of Member States. It has never recommended anything which is against the legal or regulatory provisions of its Member States. In case of disputes between Member States, ITU encourages them to engage in discussions to find a solution. ITU does not intervene in any commercial disputes nor in any bilateral disputes.

As a member-oriented organization, ITU work is always driven by contributions (input documents) from its members (both Member States and Sector Members), that is, it works in a bottom-up manner. The strength of ITU is its Member-driven approach, with a well-established open (for its members) and transparent working environment, which is an open secret shared with many successful organizations.

Except for small and medium-sized Internet Service Providers (ISPs) and ccTLD operators, most industry players who are active in Internet-related activities are ITU Sector Members. Greater participation in ITU by civil society and the academic world would be welcome and, in my opinion, ITU should take some steps to encourage this.

3.2 ITU's technical contributions

It is widely recognized that ITU's standardization work has assured the success of worldwide public telecommunication services and advanced new telecommunication technologies. Some think that the ITU has no role in Internet standardization. But this is not correct. It is true that the core transport and routing protocols for IP-based networks have been developed by the Internet Engineering Task Force (IETF). But ITU standards and other ITU activities have contributed, and continue to contribute, to the development and deployment of Internet in many ways. Indeed, convergent technologies such as VoIP and ENUM have induced a high level of cooperation amongst the various standardization bodies and have raised issues directly related to sovereignty, stability, and quality of service of telecommunication networks. In my opinion, it is not far-fetched to say that many now recognize that ITU's activities are among the key major contributors to Internet's wide-spread adoption.

As a matter of fact, ITU has been engaged with the technical development of packet-switched and connectionless technologies (which form the basis of the Internet) since very early, including during their inception period. In the early 1970s, as pioneers like Larry Roberts and Jim White sought to

commercialize and globalize packet switched data networks and services, they created and led CCITT (now called ITU-T) Study Group activities.

ITU-T's standardization work touches almost all aspects of the world-wide infrastructure that provides IP-based services and forms the basis for the Internet: from multimedia terminals, access, transmission, inter-working, quality of service (QoS), security, tariff models, IP telephony; to technology-related policy studies, as well as end-user needs. But ITU is not concerned with issues related to content.

Five particularly successful areas of integration of various Internet developments occurred in the 1990s. One was in the security area which included extensive use of ITU-T X.509 (1988) digital certificates for authentication. Another was in the area of network management where ITU's network management protocol, ITU-T's X.500 directory, and X.600-series ASN.1 syntax expressions were adapted as the Simple Network Management Protocol (SNMP) that is used to manage the Internet's operation. The CCITT (now ITU-T) OSI X.500 "domain name system" is still used extensively within today's IP-based networks in the form of object identifiers for object code modules for SNMP. For that purpose, IANA manages a portion of the OSI DNS domain name space[3]. A third was the joint IEC/ISO SGML standard which was adapted by researchers at the nearby CERN research facility in a lightweight form known as HTML—which as served as the underlying language of the World Wide Web (WWW), and the entire XML information exchange industry. A fourth was the multimedia session initiation and management standard ITU-T H.323 which serves as the basis today for managing many of the Internet's multimedia applications. A fifth comprises the standards used by end-users to access their Internet Service Providers (ISPs), whether through conventional modems, cable modems, digital subscriber lines (DSL), or fiber to the home (FTTH). All of these initiatives were highly successful in the marketplace and became the basis for a significant part of the network security, network management, WWW, and multimedia products for the Internet, telecommunications, and computer information exchange industries.

In particular, ITU-T has not only followed all stages of Internet technical developments by contributing its own standards for facilitating the development of Internet, but also spares no efforts to seek an efficient and effective international cooperation with all partners concerned, particularly those involved in Internet developments such as ISOC/IETF, IEEE, W3C, as well as ISO, IEC, ETSI, and many SDOs/forums.

Through its standardization work, ITU has assured the past success of global telecommunication services, and ITU continues to contribute to the successful development and deployment of the Internet and other new services today. Furthermore, ITU is now leading the study on Next Generation Networks (NGN) for tomorrow.

3.3 ITU's policy contributions

For the past 20 years, ITU has supported the liberalization of telecommunications markets. In the late 1980s, new technical developments (including the emergence of packet-switched connectionless networks that form the basis of Internet) were central to the policy dialogue which resulted in the revision of the International Telecommunication Regulations (ITR), an intergovernmental treaty developed and adopted at the 1988 World Administrative Telegraph and Telephone Conference (WATTC-88). Four key provisions turn out, in retrospect, to have significantly facilitated the development of the Internet. Article 9 of the ITR allowed, for the first time, the use of private

[3] itu-iso (root)
iso(1)
identified-organization(3)
dod(6)
internet(1)

international leased lines for the purposes of constructing data network capabilities available to the public. This article—which legitimized the existence of shared international data networks—subsequently became a mechanism for forcing the availability of reasonably priced international private leased lines for constructing the global Internet market. Article 4 allowed data and related services to flourish by adopting a broad definition of what constitutes public telecommunication services but a very narrow definition of the possible restrictions on access and service (e.g., quality of service). Section 4.2 provided a compelling (but not mandatory) suggestion that global standards should be used for data networks and related services. There was also a provision foretelling of misuse and vulnerability problems arising today, namely Section 9.1(b)—which requires a signatory country implementing data networking capabilities to avoid "technical harm" to facilities of third countries. I have been told that this last provision was inserted as a result of the famous Morris Internet worm incident that occurred in 1988.

As ITU activities have, directly or indirectly, supported the technical development of Internet from the very beginning, logically, ITU has also contributed to the policy-related studies. These began during the 1980s with User and Legal Symposia. They increased in the 1990s. During the last several years, ITU successfully organized global symposiums such as the Internet Policy Symposium in 2001 and various workshops on Internet issues. Started in 2002, the Global Symposium of Regulators, with a purpose to exchange views on liberalization of ICT markets and promotion of Internet applications, is another ITU initiative, which is widely supported and appreciated by the international community.

In my opinion, the fundamental policy issues related to Internet are very similar to those related to other telecommunication applications and technologies. While the Internet is different in certain technical ways, it is not that different for what concerns public policy, although, of course, the specific policies adopted for Internet might be different, both at the national and international level, from those adopted for other technologies. Indeed, there is no reason to suppose that the policies adopted for Internet would be the same as those adopted in the past for other technologies (telephony or whatever), particularly when considering that the policies for older technologies are being revisited and revised in many countries. Some countries are even moving towards “technology-neutral” policies, which might well be different from previous policies.

Recognizing this, the ITU has many policy-related activities, some specifically related to the question of the ways in which existing regulatory regimes should be modified or adapted to encourage further development of the Internet. This includes issues such as tariffing, cost sharing, quality of service, service definitions, and security.

4. Proposed options regarding issues

4.1 Definitions

ITU-T Study Group 2 received some inputs on definitions. Based on those inputs and other considerations, following definitions could be options to be further considered.

a) Definition of Internet

Internet is the publicly accessible global packet switched network of networks that are interconnected through the use of the common network protocol IP. It encompasses protocols; names and addresses; facilities; arrangements; and services and applications. IP-based services consist both of applications made available to the public on a large scale such as VoIP using E.164 identifiers, as well as signaling and directory services critical to providing infrastructure protection and meeting national public policy (including security and safety) mandates.

b) Definition of Internet Governance

Internet Governance consists of the collective rules, procedures, processes, and related programs that shape social actors' shared expectations, practices, and interactions and result in practices and operations that are consistent with the sovereign rights of states and the social and market interests of end-users and operators. It includes agreements about standards, policies, rules, and enforcement and dispute resolution procedures.

4.2 Sovereignty

Sovereignty is an issue that often arises, implicitly or explicitly, in debates on Internet Governance. My understanding and proposals in this area cover several aspects as follows:

a) Authority to establish rules for critical signaling and directory network elements and identifiers such as telephone country codes and Internet country code domain names.

Both telephone country codes and Internet country code domain names are public resources that fall within the scope of national sovereignty. In principle, a particular country code or a particular domain name associated with a particular country are the national resources of that country. The ultimate authority for these resources should be a national authority, although the operational work related to their management could be carried out by the authority itself or by a designated agency to which it could choose to delegate authority. There should be no question about this responsibility. I note the complicated situation for the management of country code domain names in some countries, largely because of historical reasons. To address these issues, one option would be to suggest respecting the fundamental principle of national sovereignty, as well as finding pragmatic solutions to maintain the stability of the service and to protect the interests of the concerned operators. Concretely, a possible option that might be further considered is to study the possibility of ITU's maintaining and publishing the authoritative list of country code domain name delegations, at the request of those countries who wish ITU to undertake this task (with other countries free to continue present arrangements if they wish). There should be no inconsistency between lists maintained by ITU or others. Consideration could also be given to the development in ITU-T, in cooperation with all concerned parties, of a Recommendation on the issue of re-delegation of country code Domain Names.

The Council of European National Top Level Domain Registries (CENTR) has commented on this proposal, their comments are attached as Annex B of this paper.

b) Management of Internet Protocol (IP) addresses

The early allocation of IPv4 addresses resulted in geographic imbalances and an excessive possession of the address space by early adopters. This situation was recognized and addressed by the Regional Internet Registries (RIRs). However, despite their best efforts, and even though a very large portion of the IPv4 space has not been assigned, some believe that there is a shortage of IPv4 addresses and voice concerns regarding the principles and managements of the current system. Some developing countries have raised issues regarding IP address allocation. It is important to ensure that similar concerns do not arise with respect to IPv6. One option for possible future consideration, discussed with some industry experts, is the idea that, in addition to the current arrangements for allocation of IPv6 address by the RIRs, one could reserve a portion of the large IPv6 space for country-based assignments, that is, assign a block to a country at no cost, and let the country itself manage this kind of address in IPv6. By assigning addresses to countries, we will enable any particular user to choose their preferred source of addresses: either the country-assigned ones or the region/international-assigned ones. A competition between the country registration agency and the regional registration agencies will exist, but people will have a good choice. Sovereignty connected to the registration of addresses will be safeguarded. The details and constraints, in particular the very important issues related to routing table size (it is

essential that address allocation continue to be consistent with the need of ISPs to continue aggregating routes), could be further discussed if this proposal encounters favor.

However, I note that the Number Resource Organization (NRO) has commented on version 1 of this proposal. Although their comments seem to be based on the incorrect assumption that I was proposing to allocate all IPv6 addresses through national authorities, I find the NRO comments valuable and I attach them verbatim as Annex A of this paper together with my response to those comments, and the NRO response to my response. Annex E contains a further, more detailed, comment by APNIC on this topic.

c) Country/Geographic Area Codes

- ITU is the global authority for the assignment and management of telephone country/geographic area codes (E.164), for example "41" for Switzerland.
- ITU is also a member of the ISO committee that agrees the ISO-3166 codes used for Country Code Domain Names (for example, "ch" for Switzerland), and it provides input concerning UN recognition of Member States.

4.3 ITU and developing countries

Developing countries, or governments of developing countries, have consistently expressed their concerns over their roles and their interests in Internet governance. Quite often, ITU has been requested to defend the interests of developing countries in the development of new technologies and new services. ITU's role in protecting the interests of all countries implies that it deals with the issues that arise when developing countries are not in a position to make use of certain new technologies in the same timeframes as when they are deployed in developed countries.

The ITU Development Sector was established to work mainly to support developing countries. ITU provides, by itself or in cooperation with others, training courses for capacity building, consultation on policy issues, assistance on projects, case studies, global data collection, benchmarking, etc. ITU, particularly its Development Sector and the ITU regional/area offices, has strong connections with developing countries for ICT matters.

ITU is trusted to take care of the interests of the developing countries and to continue doing so. ITU will do its best to meet this expectation. Indeed, at the request of its members, ITU protects the interests of the developing. This however does not mean that ITU will take a biased position against the developed countries. ITU's mission is to promote telecommunications-related development by its member countries, including developed and developing countries, economies in transition, and least developed countries.

4.4 ITU and IPv6

ITU supports the implementation of IPv6. ITU has worked with external SDOs, particularly with IETF, IPv6 forums, and the RIRs for the development of IPv6. Instructed by ITU Resolution 102, ITU commits itself to this important work. ITU organized several IPv6 workshops, ITU expressed its support for IPv6 at various international conferences, etc. In its latest efforts on standardization of NGN (Next Generation Network), reference to IPv6 is included.

ITU encourages its members, Member States and Sector Members, to actively participate in the management of IPv6 addresses, trials of deployment of IPv6 systems, strategy of transition from the current system into IPv6 systems

And ITU has worked with the European Union (EU) Task Force responsible for creating roadmaps for the deployment of IPv6 in all business sectors within the EU.

4.5 ITU and IDN

The matter of Internationalized Domain Names (IDN) raises complex policy and technical issues that can benefit from discussion in formal government processes. One option would be for ITU to work with all concerned organizations, whether private or intergovernmental, to survey the issues and agree solutions, in order to facilitate and accelerate the continued adoption of Internet by all the world's peoples.

ITU has been engaged with telecommunication of human languages from the very early stage. The first was the Morse coding in the 19th century, and the latest was its successful work in 1980s for standardization of languages in its CCITT (now "ITU-T") Recommendations T.50-series, including Latin-based languages, and non-Latin based languages such as Arabic, Cyrillic, Chinese, Greek, Hebrew, Japanese (-Katakana, and –Kanji), and Russian.

ITU Resolution 102 and Resolution 133 specify the ITU's work on IDN. ITU organized several workshops on the IDN. It is expected, particularly by developing countries, that increased ITU involvement could facilitate and accelerate the deployment of IDN.

4.6 ITU and Security

ITU has always put security high on its standardization agenda. Over 70 ITU-T Recommendations are published in the field. One of the best known is ITU-T Recommendation X.509, which was first developed in 1988 and still provides the basis for public key infrastructures (PKI) used, for example, in the secure HTTPS protocol. Another is ITU-T Recommendation X.805, recently developed, which deals with security architecture for end-to-end communications.

Guided by ITU Plenipotentiary Resolution 130, "Strengthening the role of ITU in information and communication network security", ITU organized several workshops and symposiums on security during the recent years, including the Cybersecurity Symposium associated with WTSA-04 (World Telecommunication Standardization Assembly, Brazil, 5-14 October 2004), and this constitutes an ITU action to implement the WSIS "Plan of Action".

A handbook on security, which provides an overview of ITU-T Recommendations related to security, was published prior to the first phase of WSIS in December 2003, and ITU-T work in this area continues.

4.7 ITU and national security needs, including spam

ITU organized the first WSIS Thematic Meeting on Countering spam in Geneva, 7-9 July 2004. Over the past several months, strong linkages between spam and other forms of cybercrime and critical infrastructure protection have emerged. Countering spam is just one of many elements of protecting the Internet that include availability during emergencies, and supporting public safety and law enforcement officials.

4.8 Intellectual Property Rights (IPR)

ITU has worked on IPR for more than two decades. In the mid-1980s, a "Code of Practice for Patents" was created to guide the standardization work with patents. This "Code of Practice" was later updated and three options were identified:

1) patent holder waives its rights,
2) license granted on a reasonable terms and on a non discriminatory basis, or

3) not willing to follow either 1) or 2)

In case (3), no Recommendation will be developed. In case (2), the commercial negotiation on licensing and royalty terms takes place outside ITU.

ITU is still working on the various patent issues. ITU has started to study two other aspects of IPR: software copyright and trademarks. There is no policy yet approved for the latter two items. However, guidelines in line with the patent policy are under development.

4.9 Other areas

In addition, ITU, in accordance with its mandate, would take care of other work, such as: work on Internet exchange points, Internet interconnection charging regimes, and methods to provide authenticated directories that meet national privacy regimes. ITU will study any new items for the Next Generation Networks (NGN) and services.

4.10 International cooperation

It is sometimes said that because of the intrinsic constraints of their processes, inter-governmental institutions like ITU should not be trusted to coordinate Internet governance. Despite these views, one option is to consider the matter. There could be a division of labor. For example, wherever possible, the management of operations on a commercial basis should be done by the private sector, but for those issues normally taking a long time, like policy issues, cross-boundary issues, an intergovernmental organization (IGO) is perhaps better placed (and ITU in particular is well placed). It is important to recognize that in today's environment, one option is that no single body alone should take care of everything. That is, a grand collaboration between all concerned bodies would be an option.

ITU has enjoyed long-standing good cooperation with IGOs such as UNESCO, UPU, WIPO, etc. and bodies such as IEC, ISO, etc.

The relation between ITU, an intergovernmental organization, and other Internet standards bodies (such as IETF) is, in my opinion, an excellent example of cooperation between ITU and external SDOs. Increasingly, as Internet infrastructure and the services it enables become integrated into the NGN, the long-established regional and national SDOs will be assuming significant roles.

In its long history, ITU has tried very hard to find ways to accommodate opinions and contributions by non-Members. ITU will continue its efforts to work with external bodies in the interest of the public for ICT matters, particularly with civil society, NGOs, RIRs, ccTLDs, forums, international/regional organizations. ITU will continue its cooperation with UN and its specialized agencies UNESCO; WIPO, and others.

As a further option for discussion, it might be appropriate for ITU to consider how it could encourage greater participation from NGOs, civil society, and universities and research institutions. I would particularly welcome suggestions in that respect.

4.11 ITU and ICANN

As a new organization started in 1998, ICANN has had significant success in many areas under its competence, particularly in its operational and administrative work in encouraging new gTLDs, promoting competition, and implementing dispute resolution procedures.

Having read the paper issued by Dr. Lynn, then President of ICANN, who called for a reform of ICANN in February 2002, I was impressed with his recognition of the fact that ICANN had not succeeded in obtaining support from all governments around the world. He particularly indicated that early attempts to keep governments away from Internet matters proved wrong, and he asked for increased engagement by governments.

We noted that ICANN has made great efforts to reform itself. Many positive changes, such as internationalizing its board, are widely recognized. Surely there is still a lot of work to be done for this young organization. We have to give it more time to change.

The US government has played a unique role in the development of ICANN. In the early days of Internet development, the issues were in the hands of a few US experts, later on with a few competing US organizations. Realizing in 1997 the significance of the issues related to Internet governance, the US government initiated the concept of ICANN and provided its support to ICANN in the form of a Memorandum of Understanding (MoU) between the US Department of Commerce and ICANN, which assumed some of the functions that had previously been performed by a contractor (IANA) of the US Department of Defense. The US government has always encouraged ICANN be develop into an internationally accepted organization. Keeping in mind its responsibility to maintain stability of the global Internet service, the US government carefully choose not to relinquish its own role up to now. I have noted a statement by US authorities to the effect that the US government will not extend its MoU with ICANN after the expiration of the current MoU in 2006.

I share the same concerns as the US government concerning the stability of Internet and the role of the private sector. ICANN served a need that existed in 1998 while the Internet and IP-based services were emerging as a large-scale public infrastructure and offerings. As there is no a better solution so far, in my opinion, we ought to recognize and appreciate the efforts made by the US government.

As a matter of fact, since the creation of ICANN in 1998, ITU has supported and cooperated with ICANN. In July 1999, ITU signed an MoU on “Protocol Supporting Organization (PSO)” with ICANN, ISOC/IETF, W3C and ETSI. After ICANN reform, ITU continues its role in the Technical Liaison Group (TLG). ITU supported the nomination of candidates by PSO to the ICANN Board since 1999. ITU also committed to the work of ICANN Independent Review Panel Nomination Committee before 2002. ITU was one of founding member of ICANN’s Governement Advisory Committee (GAC). In reply to the public call for ICANN Reform launched by the then President of ICANN, I prepared a paper, after intensive informal consultations with ITU members, which was submitted to ICANN in April 2002, and which was unanimously supported by the ITU Council-2002. And ICANN and ITU have worked together to organize workshops on ccTLDs and on the top level domain “.int”.

While we appreciate the changes ICANN has introduced into its own process, we have to address another important issues: its own legitimacy and its role with respect to intergovernmental coordination. The latter cannot be easily achieved, in my opinion, within ICANN’s current structure.

During recent years, particularly during the WSIS debates, ICANN has been under challenge for various issues. It would be fair to say that not all criticisms were justified. Some issues were in fact beyond ICANN’s competences. However, some ambiguity in, or misunderstanding of, ICANNs plans and actions, not necessarily as expressed by its staff or its members, but as perceived by external people, led to some criticisms.

It would be necessary and useful if the mission of ICANN were further clarified, and restricted to its areas of technical competence. The WGIG provides a good opportunity for ICANN to establish a different image.

One option is that ITU should support ICANN to continue wherever it has successfully managed its tasks so far. That is, to support ICANN as an organization to deal with technical and operational matters of Internet domain names and addresses, in particular IANA functions that are unrelated to intergovernmental cooperation and coordination for public infrastructure and services. In this option, ITU would welcome and support ICANN’s contribution to all policy discussions wherever appropriate.

4.12 The role of governments at the international level

In my opinion, it is very important to recognize that the success of any ICT technology or service, and of the Internet in particular, depends on the collaboration of all parties, and in particular of governments and the private sector. Indeed, I think it is not seriously disputed that governments should set appropriate frameworks for public policy issues such as security, allocation of scarce resources, etc.

It is very difficult, from a structural and legal point of view, for a private organization to obtain formal advice directly from worldwide governments—other than its own national government—because, by definition, a private organization works under, and is bound by, the laws of one jurisdiction, and many sovereign states find it difficult to waive sovereignty and to give advice that could be overridden by another government, which would make them subject, de facto, to the laws of a different state.

There is of course no difficulty for some governments to participate informally in the work of a private organization, but not all governments have that flexibility. And, in any case, there is a big difference between the legitimacy that comes from formal participation, as compared to informal participation.

The usual solution to this difficult problem is to charge an intergovernmental organization with the task of developing internationally agreed public policies (that is, advice to private organizations), which policies are then transposed as appropriate into national laws and apply to private organizations as appropriate.

Therefore, one option for future discussion that would appear to me practical would be to build on the long and successful tradition in which private sector operators have obtained guidance from their national governments for national matters, and from the ITU or other appropriate bodies such as WIPO, WTO, etc. for international matters. That is, to recognize the respective competencies of the private sector and of governments, whether at the national or international levels.

Concretely, one option that might be helpful could be to build on ITU's unique position as an intergovernmental organization that has private sector members—especially since those active ITU members are also major players in providing Internet infrastructure—and to consider relying on ITU (and other IGOs as appropriate) to provide appropriate public policy frameworks at the international level for what concerns Internet matters. According to this option, it would be better to exploit already existing organizations, mechanisms and task owners as appropriate, before a new entity (if any) is established.

The details could be further discussed if this proposal is considered worth pursuing.

4.13 The results of the 2004 World Telecommunication Standardization Assembly (WTSA)

I noted that an early draft of this paper had been circulated informally before the 5-14 October 2004 WTSA. It seems appropriate to mention in this paper some of the key results of WTSA-2004 with respect to Internet. These include:

a) New Resolution 46 [G]: ITU-T contribution to Council Working Group on WSIS.

b) New Resolution 47 [M]: Country Code Top Level Domain Names.

c) New Resolution 48 [N]: Internationalized Domain Names.

d) New Resolution 50 [L]: Cybersecurity.

e) New Resolution 51 [P]: Combating spam.

The text of the Resolutions can be found at:

http://www.itu.int/ITU-T/wtsa/resolutions.html

5. Options for future discussion

As there is lack of consensus within ITU regarding many of the topics covered above, I would like to offer here some options that could be further discussed, if the membership wishes to conduct such discussions.

As Internet governance covers a very wide range of topics, including technical issues, one option would be to have existing inter-governmental organizations under the UN system to take care of issues, if any, that require inter-governmental coordination, while recognizing the role of existing international and private sector organizations with respect to technical and operating matters. It would be cost-effective to charge existing UN family organizations with this task.

As discussed above, ITU is involved in the key areas of Internet governance that are subject to international coordination, at a different level of engagement depending on the topics. One option to consider is that Internet governance should work the same way the Internet does, decentralized where possible and highly networked. Thus, one option is that no existing or future organization should have a preponderant role in Internet Governance.

Regarding future discussions, one option is that ITU should study the issues and look for new ways to create a proper environment to meet the challenges.

The WGIG provides an excellent opportunity to find way of improving the current situation at the global level. One option is for WGIG to establish a matrix to identify who could do what and to provide guidelines on efficient and effective international cooperation of all stakeholders.

Possible options for possible future discussion could include a role for ITU-T maintaining and publishing the authoritative list of country code domain name delegations, at the request of those countries who wish ITU to undertake this task; in allocating a block of IPv6 addresses to countries; in promoting the implementation of Internationalized Domain Names (IDN); in security initiatives, including countering SPAM; in work on Internet exchange points and Internet interconnection charging regimes; and in methods to provide authenticated directories that meet national privacy regimes.

It is also an option that ITU could actively participate in the work of WGIG and, given its history and mandate, it might be an option that ITU could have a significant role to play in any outcomes.

I wish the great success of WGIG and WSIS on Internet governance issues, and all other issues, as part of the ongoing activities to forge appropriate intergovernmental coordination and to foster international cooperation.

Annex A:
Response from the Numbering Resource Organization (NRO) and further communications with NRO

NRO Response to ITU Comments on the Management of Internet Protocol (IP) Addresses

15 November 2004

On 21 October 2004, the Director of ITU TSB published a memorandum, "ITU and Internet Governance" for public comment. The Number Resource Organization (NRO) respectfully offers this public response on behalf of the Regional Internet Registries: APNIC, ARIN, LACNIC and RIPE NCC.

This response is limited to section 4.2(b), titled "Management of Internet Protocol (IP) addresses". This focus is consistent with the purview of the RIRs, and should not be interpreted as agreement with the remainder of the ITU memorandum.
Note: Throughout this memo the terms "number" and "address" will be used interchangeably to denote network layer addresses. In particular the term "Internet address" does not refer to a domain name, URL, URI or mailbox name.

Summary
The ITU memorandum has proposed a new IPv6 address space distribution process, based solely on national authorities. This proposal appears to be based on certain assumptions about the history and status of IPv4 address space and the current allocation principles for allocating IPv6 address space, and an attempt to safeguard what the memorandum terms the "sovereignty connected to the registration of addresses".
It also appears that behind the proposal is an assertion of primacy of public sector interest in the administration of address resources for the Internet. Since the inception of the Regional Internet Registry (RIR) system in the early 1990s, the RIRs have recognized not only the legitimacy of this public sector interest but also that of the private sector. The RIRs believe that the balance of these two interests requires careful consideration. The RIRs work within a broad spectrum of stakeholders in Internet address administration, and have developed open regional policy development processes that include the active participation of both public and private sector bodies as well as civil society.
The IPv6 address space distribution proposal in the ITU memorandum overlooks the success of the RIRs in including public and private sector considerations in open regional policy development processes. It also disregards the widely accepted and long-held views that IP addresses are endpoint network identifiers that intrinsically have no national attributes, and that allocation principles regarding their distribution must be guided primarily by technical considerations relating to the viability of the operation of the Internet.

In addition, the memorandum makes assertions about IPv4 and IPv6 address space which are inconsistent both with authoritative statistics about IP address space and with the established consensus-based allocation principles developed by the global Internet community.

Rather than addressing the diversity of requirements of the global Internet community or the body of experience already gained in the operation of the global IP address distribution function, the ITU memorandum proposes a uniform model of Internet address distribution as a public sector activity

within autonomous national boundaries. The memorandum ignores any consideration of the technical impacts of its proposal on the global Internet (specifically on address space routability) and simply suggests that considerations of "details and constraints, in particular issues related to routing table size" should be postponed until an unspecified time in the future.

This proposal, if adopted, would disrupt the stable, proven mechanisms for IP address space distribution on which the success of the Internet has been founded and on which the global Internet community relies for future operational stability and continued growth.

Internet Number Resource Distribution

Internet number resource distribution is an engineering function co-ordinated between Internet operators under consensus agreements. The development and execution of address allocation principles are organised on a regional level by four (shortly to be five) RIRs: APNIC, serving the Asia-Pacific region; ARIN, serving Northern America, parts of the Caribbean, and continental Africa south of the equator; LACNIC, serving Latin America and portions of the Caribbean; and RIPE NCC, serving Europe, the Middle East, Central Asia, and continental Africa north of the equator. AfriNIC will soon be formally recognised as the fifth RIR, to manage Internet number resources in Africa under an autonomous self-governing framework.

These RIRs are funded and governed by over 8000 organisations worldwide, representing the users of the Internet number resources. Allocation principles and procedures are developed in regional fora which are open not only to the RIR members, but to all interested parties including Government.

This long standing, open policy-making structure has been implemented since the early 1990s and has been a tremendous success. The fairness and efficiency of Internet number distribution is very widely recognised, as is the openness and accessibility of the associated allocation principles. In particular this structure has demonstrated repeatedly that it can adapt quickly to the rapid changes that take place in the Internet environment.

Diversity

The RIRs recognise that today different national environments feature a wide variety of models of regulation, public sector activity, private sector investment profiles, participatory frameworks, cultural considerations and technology deployment models. Such a broad diversity of profile across national communities does not readily lend itself to the uniform imposition of a particular administrative model for network infrastructure elements. The current RIR system can and does accommodate this diversity, while avoiding the inherent shortcomings of a uniformly imposed public sector approach, based solely on national address distribution models. It also avoids pitting the public and private sector in direct competition at a regional or national level. Coordination functions such as these are not enhanced by allowing the operation of competitive markets to dictate polices and services. Where there is a strong coordination component of the activity, in order to ensure address routability, aggregation, fairness of access and ultimately considerations of viability of the Internet itself, competitive supply practices tend to undermine the orderly operation of responsible administration of such infrastructure elements.

The RIR system encompasses both private and public sectors within its global framework. The RIR system as a whole has specifically not mandated one model or the other, but has allowed regional and national communities to determine what is in their best interests in terms of structure of participation. For example, in several nations there are National Internet Registries with direct public sector involvement. In some cases this is a public sector activity, while in other cases this is a private sector activity within a national context.

Therefore, there is no valid reason to impose a single uniform administrative model upon each regional community that implicitly scripts a leadership role to either the public or private sector. To impose a level of uniformity to this sector at an international level by asserting the primacy of participation of either the public or private sector is not an accurate or helpful characterization of the Internet as a truly international facility. Nor are there grounds to set up public and private sector activities that engage in openly competitive frameworks for infrastructure administrative services. The RIRs accurately reflect the diversity of the international environment, and the outcome of their framework is a stable administrative service that is performed efficiently and effectively, and in which diversity is a strength and asset. The RIR system, with its diversity of models for national community participation, is one of the more eloquent expressions of today's richly diverse environment.

IPv4 Address Space: Allocated Globally According to Regional Needs

It is important to understand the issue of historical allocation of IPv4 address space. The ITU memorandum refers to "geographic imbalances and an excessive possession of the address space by early adopters", but recognises correctly that the current Regional Internet Registry system has successfully addressed that problem. However since the historical imbalance is sometimes described as a failing of the current system, this issue will be addressed specifically.

During the 1980s and early 1990s, early adopters of the Internet were able to receive IPv4 address space under the allocation policies that existed at the time. These early adopter organisations were allocated and often still hold many more addresses than they would be allocated under present allocation principles, placing them in a relatively advantaged position today. This enduring imbalance is not a result of the current principles but rather a reflection that different allocation principles were in place in the past. Those principles reflected certain technological constraints of the time, and assumptions about the limited function and future of the Internet itself, which together promoted a relatively lax approach to address consumption.

Fortunately, technology has improved since the early days of the Internet, as have the systems under which addresses are allocated. Indeed, today's Regional Internet Registry system was proposed in 1992 specifically to address the administrative problems evident at that time, and is recognised widely as an outstandingly successful solution.

Today, it is clear that sufficient IPv4 addresses are available to be allocated on a fair and equal basis to all users for many years to come. Through the current system of IP address administration, IP addresses are allocated according to immediate need wherever that need is demonstrated, in accordance with well-known allocation principles. The distribution of this global resource is organised in an efficient and very widely accepted manner.

While there are many issues in the management of IP address space, the transformation of IP addresses into a nationalised management regime has never emerged as a relevant solution. On the contrary, such a move is widely regarded as a significant step towards stockpiling and unfair distribution of Internet number resources. Under the current system, sufficient IPv4 addresses are available to all network users, on a fair and equal basis. The distribution of this resource is organised in an efficient and very widely accepted manner.

IPv6 Address Space Distribution

The ITU proposal is founded on the premise that transforming IP addresses to a national resource will ensure that IPv6 distribution would somehow avoid the problems that are allegedly experienced with IPv4 distribution.

Under the current distribution scheme IPv6 service providers receive address space following current allocation principles, established through open self-regulatory industry processes. These principles have been developed not in isolation, but by building on the extensive experience of developing the IPv4 system. They use the already established and globally recognised framework of the Regional Internet Registries for developing and executing the associated allocation principles. The distribution of IPv6 address space is not only building on what has been already developed, but is starting with a playing field which is level from the outset. In addition, there is also allowance for future changes in allocation principles.

The ITU memorandum proposes a new, independent and unproven process for IPv6 address space distribution, based solely on national authorities. This disregards the fact that IP addresses have no national attributes and that there is no compelling reason for specific national policies regarding their distribution. Unlike other number spaces such as E.164, IP addresses are not structured along national boundaries. IP addresses are also invisible to the Internet user, unlike E.164 numbers that are visible to the user and thus also serve as "names". Naming, addressing and routing are separate functions in the Internet. Languages are visible in Internet domain names and a large part of the domain name space is indeed structured along national boundaries. This has led to the development and implementation of national policies through appropriate local mechanisms. This works well because separate parts of the Internet domain name space can be administered and operated totally independently from each other. However this model does not apply to IP addresses, which are useful because of their uniqueness and require global coordination, which would be disrupted, not aided, by competition. While competition is a good mechanism in many areas, it is hard to see how different systems can compete meaningfully in the distribution of a global resource.

Conclusion

The RIRs observe that the ITU is proposing a model of IP address space distribution that is based on a limited set of considerations and has not adequately considered the need to ensure stable, fair and consistent distribution of a global resource. The ITU proposal has no means to guarantee stable mechanisms for IP address space distribution, and for the benefit of the Internet (including the ITU’s own constituency), we urge the ITU to carefully reconsider this proposal.

There are many issues within the area of what has come to be known as "Internet Governance", particularly issues of fairness and a level playing field on a global level that accommodates public and private sector interests The Regional Internet Registry system has evolved over more than a decade to become one of the successes in this area. Internet number resource distribution is fair and accessible to all. Its policy development process is open and transparent.

The NRO welcomes the opportunity to contribute to this memorandum, and looks forward to further discussion with the ITU TSB on these important matters.

Signed
NUMBER RESOURCE ORGANIZATION

Houlin Zhao's Response to NRO Statement: "NRO Response to ITU Comments on the Management of Internet Protocol (IP) Addresses"

19 November 2004

Dear Paul,

Having read your document, I find many valuable information and opinions, which I share with you without hesitation and reservation. However, I also find some misunderstandings to my proposals on IPv6. To avoid further confusions and unnecessary reactions, I would like to provide you with the following clarifications on my positions:

1) My draft text in question is in fact a draft input to an internal ITU Working Group on WSIS, which will meet in December 2004. In reply to the request of this Group, I prepared this draft input. To save time and for the sake of transparency, I posted it on ITU-T web site for public comments. My targeted public is the ITU-T Members. As indicated in the paper, I will prepare an "official" input to that Group after 15 November. I am very pleased to advice you that by the deadline of 15 November, I received a number of comments from the ITU-T Members, as well as a few from non-Members including your document. I will take care all comments from ITU-T Members and non-Members to prepare my "official" input to the ITU Council Working Group on WSIS.

2) In your paper, there are plenty of historical events and explanations on the development of IPv6/IPv4 and on the work done by RIRs. I found those information and opinions very important and very relevant to the ICT society. I share those views with you. As you might have noted, I have supported RIRs from the very beginning when I started my role of TSB Director in 1999, and I have been working to strengthen the cooperation between ITU and RIRs since then. One example, the IPv6 workshop ITU-T organized in 2002 received a lot of useful information from RIRs. ITU highly appreciated the presence of RIRs at that workshop. Another good example of our cooperation would be the ENUM trials, which I always referred as a model of cooperation between ITU and a private sector member. If you could agree, I would be pleased to invite RIRs to provide tutorial sessions on their competences to the ITU Members. I believe such tutorial sessions would be welcomed by the ITU Members.

On the other hand, the problems I mentioned in my paper on the assignments of IPv4 addresses should be considered as a historical lesson. Whether you and I would share the same views on the problems is another issue. However, I would like to remind you a fact that in my draft paper, I do not present any criticism to the work of RIRs. Ï am very pleased to note that in the part of "IPv4 Address Space:..." of your paper, you indicate that ITU refers to...(problems), BUT RECOGNISES CORRECTLY that the current RIR system has successfully addressed that problem". I would like to reconfirm to you that we will continue to support RIRs on its handling the allocations of IPv4 addresses as well as IPv6 addresses. We are also looking forward to strengthening our cooperation wherever possible.

3) I got an impression that the rest of your paper was based on a misunderstanding on my proposals. Please allow me to refer to some of those statements in your paper. The first sentence of your "Summary" starts with "The ITU memorandum has proposed a new IPv6 address space distribution process, based solely on national authorities." At its fifth para, the paper accused ITU "Rather than addressing ..., the ITU memorandum proposes a uniform model of Internet address distribution as a public activity within autonomous national boundaries." In the part "Diversity", the first para again refer to "avoiding the ...of a uniformly imposed public sector approach, based solely on national

address distribution models" and further down to its third para, the paper says "there is no valid reason to impose a single uniform administrative model upon each regional community... In the part "IPv6 Address space Distribution", your paper accuses my proposal "based on the premise that transforming IP addresses to a national resource will ensure ...IPv6 ... avoid the problems that are allegedly experiences with IPv4 distribution." and in its third para, your paper again accuses "The ITU memorandum proposes a new independent and unproven process for IPv6 address space distribution, based on solely on national authorities."

I would accept your arguments as listed above if I did "propose a uniform model...within autonomous national boundaries" or "a new IPv6 address space distribution process, based solely on national authorities" (both quoted above). However, if I argue with you that the base of your comments is not true, what you would tell me? How would you explain to me your understanding on my sentence in 4.2 (b): "By assigning addresses to countries, we will enable any particular user to choose their preferred source of address: either the country-assigned ones or the region/international-assigned ones. A competition between the country registration agency and the regional registration agencies will exist, but people will have a good choice." Here, do you see any sign that I have proposed a new system "based solely on national authorities"? A few words before this sentence, I put my idea as "to reserve a block of IPv6 address for allocation by authorities of countries, that is, assigning a block to a country at no cost and letting the country itself manage this kind of address in IPv6". I draw your attention to those words "to reserve a block of IPv6 address". Do you understand these words as "the whole set of IPv6 addresses"?

As ITU has received from time to time some voices from developing countries to have IP addresses free of charge, the sovereignty related to internet governance often referred to the address issues, the very huge amount of IPv6 addresses capability, and technical feasibility to assign a block (not clear about the size) to countries for their own management as one of possible arrangements, etc.. all these have driven me to make my proposal as shown in 4.2 (b) of my paper. I would like to confirm to you that I have not proposed a uniform system based solely on national authorities in my paper, and I will not propose such a system as the only system in the future. What I have proposed in my paper is to offer one system, as one of many systems, including national ones, regional ones, multinational ones, and international ones. I do not expect that "my system" will avoid all problems we have learnt from the IPv4 processes. I thought "my system" could help address the sovereignty issue. I would agree with you that it is not proved yet. It might fail in the end. We do not know the result and we will have to wait to see. However, I have not expected such a system can address all problems, particularly technical problems, we learnt from the IPv4. I am fully aware of the technical problems, the administrative problems, the implementation problems, etc. which are associated with the deployment of IPv6 systems, so that I conclude my short para of 4.2 (b) by the following sentence: "The details and constraints, in particular issues related to routing table size, could be further discussed if this proposal encounters favor." Do you see my ignorance on those problems from this sentence? If yes, I would be glad to modify it if you could provide me a better sentence.

I do not believe I have to remind you another fact that ITU-T Rec. E.164 provides a base not only for a worldwide public telephone numbering scheme based on national territories, but also for a set of numberings for global usage, ie. 800-series numberings, which are not limited to the national boundaries.

4) Having explained my views on your comments, I would once again re-emphasize my sincere thanks to you all for your attention to my paper, and for your efforts to provide me with your comments, although I do not share with them completely. I am particularly pleased with the last part of your paper

"conclusion", which provides your desire to discuss with ITU on this important issue under a friendly term. I would like to assure you that ITU would welcome any comments from you, no matter whether they are positive or negative. A fair and open dialogue between RIRs and ITU will bring benefits to the whole family and the public. I will keep you informed with future development on my paper and I would be glad to continue to receive your comments.

5) I appreciated your advice that you have put your comments on your web. I would be pleased if you could add my reply to the same web site where you have posted your document.

Best regards,

Houlin

Clarification on NRO statement: "NRO Response to ITU Comments on the Management of Internet Protocol (IP) Addresses"

19 November 2004

In the NRO response to the ITU Memorandum "ITU and Internet Governance" we said, "The ITU memorandum has proposed a new IPv6 address space distribution process, based solely on national authorities." We understand that some parties have expressed concern that we may have overstated this point and should clarify our position. While we acknowledge that the ITU proposal is not exclusive to national authorities, we still maintain that this does not undermine the issues we have raised in our response to the ITU memorandum. We will shortly post three items to the NRO website regarding this discussion. First, a revised response to the ITU memorandum reflecting the clarification mentioned above; this revised response document will be posted alongside the original NRO document and the original ITU Memorandum. Second, we will post a copy of the ITU response to the NRO statement. Third, as soon as it becomes available to us from the ITU, we will provide pointer links to our statements on the ITU website for the convenience of those who would prefer to view the dialogue on the ITU website.
We thank Houlin Zhao for the comments he has sent regarding the NRO statement "NRO Response to ITU Comments on the Management of Internet Protocol (IP) Addresses". The NRO has read these comments with interest and is looking forward to further discussion with the ITU on these important issues. We are also pleased to accept the invitation to provide tutorial sessions to ITU members. We welcome any further comments or questions so as to promote the open and constructive dialogue to which we are committed.

Axel Pawlik
Secretary
Number Resource Organization

Annex B:
Comments by the Council of European National Top Level Domain Name Registries (CENTR)

Brussels, 23 November 2004

Dear Mr. Zhao,

With reference to the document on Internet governance published on October 21, the Council of European National Top Level Domain - CENTR would like to draw your attention to some considerations that were discussed at the 24th General Assembly in Zurich last week.

We do understand there is a plethora of opinion from many different stakeholder's visions and concerns regarding the definition of Internet governance and the way we should look at the Internet management future.

Our purpose is to participate actively and constructively in the discussion where the benefit we should look at is the one of the worldwide Internet users.

As a regional organisation, CENTR takes advantage of the membership of over 50 country code Top Level Domains of developed and developing countries. We believe that the dialogue we have established with all different parties is the most valuable means for any decision.

Consequently, we look forward to interacting with you and others in the ITU, WSIS and WGIG processes in the spirit of mutual cooperation and growth.

Yours faithfully,

Paul Kane
CENTR Chairman

Council of European National Top Level Domain Registries (CENTR)
comments on Mr. Zhao's draft paper
on "ITU and Internet Governance"

Executive Summary

- CENTR recognises the value of the inputs of Mr. Zhao in the Internet governance debate as well as the historical role of the ITU in the international telecommunication sector. However, we have noted that these inputs do not match with the opinions expressed by other representatives of ITU.
- CENTR members believe that the present discussion on this subject should be based on a core message that Mr. Zhao has clearly expressed: "Internet governance should work the same way the Internet does, decentralized where possible and highly networked".
- As the WSIS process has acknowledged, "Internet Governance should be multilateral, transparent and democratic, with the full involvement of governments, the private sector, civil society and international organisations".
- CENTR is one of the many actors that play in the Internet arena. Representing over 50 ccTLDs both from the developed and developing countries, it has gained a considerable experience in perceiving its members needs and wishes at all the Internet governance levels. Therefore, it is delighted to make it available for a better coordination of the Internet.
- CENTR recognises the importance of technical aspects and supports all those actions that can contribute to improve the Internet functioning.
- CENTR is aware that there have been difficulties and criticism for the way Internet is currently managed. Nevertheless, it believes that any future action in the Internet governance context should be focused to improve the present status in the maximum interest of the Internet users.

Introduction

Based in Europe, the Council of European National Top Level Domains Registries (CENTR) is an association of country code Top Level Domain registries which includes government agencies and private sector members from countries all around the world. Around half of CENTR's members are from developing or emerging economies. CENTR outreach programme offers training days, giving pro-bono software and computer equipment to members and interested parties in various regions. CENTR's mission is to empower learned decision making at a decentralised local level, via informed debates, workshops and training sessions on policy, operational aspects and management procedures.

In the past CENTR and its members have been active participants in ITU ccTLD workshops in 2003 and earlier this year. We do hope this exchange of information will continue in the future. CENTR sponsors and participates in numerous events designed specifically to facilitate information sharing and Internet management awareness and techniques.

CENTR and its members do believe that we need to pay attention to the reasons why decentralised decision making is flourishing and proving so successful today. CENTR members stands ready to work with the ITU to identify common areas of interest to stimulate the development of the Internet to the benefit of local Internet users in both the developed and emerging Internet communities. By empowering decentralised, informed decision making and resolving issues in a timely manner we are confident the Internet will contribute to the societal and economic well-being of all its users.

In response to Mr. Zhao's draft paper on "ITU and Internet Governance", CENTR would like to submit few comments and seek clarification on certain assumptions and proposals to stimulate a constructive, informed debate.

Internet governance issues

First of all, the debate on Internet governance has broadened in the last period. This process reflects both the involvement of many entities at international level and the concerns of some governments, especially those of developing countries.

Wherever the discussion leads us to, we urge those who are involved in the process not to forget that at present Internet functions although it has grown exponentially in the last decade at commercial and social level; that all national, regional and international entities that have managed the net so far have provided the Internet user communities with great value and have achieved important goals for the benefit of all stakeholders.

CENTR believes that, thanks to the historical expertise of the ITU and other intergovernmental organizations, Internet governance can be enriched by providing all stakeholders with the inputs for a fruitful coordination of the net.

However, CENTR expresses its concerns for all those actions and opinions that aim to create an organisation with all the competency to adequately deal with the diverse policy mandates. It is our view that this will not solve any Internet problem, but it will imprison the Internet spirit and organisation and thus impair the necessary flexibility to cope with the rapid pace of development of the Internet, the constantly changing technology and interests of stakeholders.

Internet and the governments

The report alludes in very general and broad terms to a march toward so-called "authorities", presumably governmental, operating the "national oversight responsibility". More specifically, it sees the role of management of public Internet matters moving toward governmental telecommunications and commerce ministries and in some cases delegating some of its powers to the private sector for instance through industry-self regulatory mechanisms.

CENTR believes that any general assumption like this should be carefully considered. It should be based on case by case evidence and take explicitly into consideration the particulars of national arrangements. Based on the evidence, the trend noted in the paper can be supported only in a limited number of cases.

Consequently, governments roles should be ultimately limited to the national scope for which they are responsible – and that there is no need for a preponderance of intergovernmental activity in areas where issues can be handled locally. Local authorities have demonstrated to be fully capable and competent in managing Internet policy at national levels. The principle of subsidiarity, in its EU conception, should be fully applied.

Importance of technical aspects

IANA database

The draft paper calls for ITU to operate the IANA function for countries that wish to use it, with others continuing to use ICANN.

A distinction is made between the gTLD and ccTLD space. The proposal put forward in the paper only addresses the ccTLD name space. From a technological and overall consistency in the DNS usage and the Internet perspective we do not share this vision. The DNS and therefore the Internet as it functions today relies on universally accepted protocols by all registries both the ccTLD and gTLD's, registrars, Internet service providers and domain name users. All comply to the same set of RFC's, which lies at the core of the DNS.

The DNS is hierarchical and foresees distributed responsibilities: this was and is the strength of the DNS and the Internet. At the heart of this system is the IANA function, which is based on a single, coherent and authoritative database.

Therefore, on one hand, it is hard to see how competing distinct databases (one for the gTLD's, one for ccTLD's which will remain with IANA and one for those ccTLD that wish to use the ITU) could operate, other than by introducing new, bureaucratic procedures and new unprecedented legal arrangements, and at the same time remain to be effective and efficient.

On the other hand, we do appreciate the concerns which underlie the proposal, as we also understand the concerns of non-governmental stakeholders in developing countries, not effectively represented in ITU structure or WSIS process. However, dividing the IANA database into two distinct administrations can create potential confusion rather than help in sorting out the expressed concerns. On the contrary, CENTR believes that ITU can help and support the entire process through its active and effective involvement in GAC.

IPv6 addresses

CENTR nor its members are experts on the allocation of IP-addresses. Allocation of IP-addresses is done by the Regional Internet Registries. Therefore we are not in a position to comment on this section. However, we note the discussion on IPv6 addresses in the paper is based on the perception by some of scarcity of IPv4 addresses. We also note the statement in the paper that this perception is not based on facts. Actually, as is adequately put in the paper, a very large portion of the IPv4 space has not been assigned.

An informed and constructive discussion is in our view only possible if it is based on facts and not on perceptions. With regard to the allocation of IP-addresses and for that matter the discussion on ccTLD's, CENTR is available to inform other stakeholders and participate in for instance the workshops organized by the ITU.

Conclusion: a roadmap for future Internet governance

CENTR has experienced that the dialogue on Internet governance is greatly assisted by having different parties express their future vision.

CENTR expresses its gratitude to Mr. Zhao for having made his thoughts available to the Internet community, so that they can be shared and enriched by further contributions.

CENTR vision of the Internet governance scenario can be summarised as follows:

- Nowadays, Internet functions. As any technology, it has its pro and contras, its advantages and its problems.
- At present, the domain names are over 64 millions and there is a continuously growing number of Internet users: their interest should be our only goal.
- The presence of ccTLDs during the preparatory phases of the World Summit of Internet Society, increasing participation of governments within ICANN GAC, specific meetings organized by governments of the European Union are all good examples of what has already been achieved as a result of the collaboration between public and private sector, and CENTR truly believes those efforts must be maintained and where possible intensified.
- CENTR agrees that “no single body alone can take care of everything. That is, a grand collaboration between all concerned bodies is needed” and stands ready to work with the ITU and other organization and stakeholders to identify key areas of interest to the benefit of all Internet users.

Annex C:
Comments by Eurolinc

ADAPTIVE INTERNET GOVERNANCE - BASICS

PRESENT SITUATION

A single government decides what is good for itself, thus for the others. As this practice is not acceptable by the entire world, it is predictable that various countries will organize the internet governance (IG) in their own way, like China already did.

FUNDAMENTAL PRINCIPLES

The IG shall be organized in a framework designed to last longer than the time frame needed to make it operational, that is a minimum of ten years.

Differences in development level, languages, cultures, jurisdictions, political systems, and morever conflicts of interests frequently resorting to wars, make unviable a monolithic and centralized structure.

The IG framework can only be multilateral, and rooted to subsidiarity.

IMPLICATIONS

The worldwide internet is composed of millions of autonomous systems. Consistency and interoperability are achieved by using common standards, and by the orderly allocation of common resources.

Standards shall be defined for the needs of users of the whole world. Standardization structures shall adjust to regional and local needs. Some standards are necessary at world level, while others should address more localized uses.

The allocation of common non material resources (e.g. identifiers) shall be defined by legitimate institutions belonging to the United Nations (UN) system.

The stable operation of the internet shall result from the interconnection of a multiplicity of autonomous cooperating systems (as is the case of telephony), and shall not depend on a unique and centralized system (as is the case of DNS).

MODELS

By necessity there will be a plurality of IG models. A matrix of scenarii has already been proposed [1]. Roles distribution between the public sector, the civil society and the private sector lends itself to a diversity of blendings pertaining to national choices.

The worldwide IG model is basically a system of cooperation and interoperability between diverse IG models chosen by UN member States, with the involvement of other stakeholders.

Excessive model diversity would certainly be too complex for being efficient. It would be desirable to achieve interests aggregation so as to make up one or two dozens models at most.

ORGANIZATION

In a first phase, and taking account of the UN organization, a certain number of member States adopting the same model constitute an IG domain (IGD). There is no reason to introduce constraints of geographical proximity, which may make no sense in the present world.

The IG organization in an IGD pertains to constituent States. Hence, it shall not be addressed in this document.

In a second phase, it would be interesting to explore the creation of stateless IGD's, composed of non profit, industrial, academic, trade, or other structures. Some experience is needed to insure the coexistence of States and stateless IGD's.

INTEROPERABILITY

Basic technical interoperability, defined by numerous documents (RFC), is a necessary common platform, but it is restrictive and lacking with regard to many needs perceived by users and operators. Some examples:

- use of alphabets other than the ASCII subset,
- peer-to-peer communications,
- traffic instrumentation,
- mobility of users, contents, network elements,
- identification and authentication of partners,
- spam elimination,
- protection against software attacks.

The implementation of trusted domains, as it had been announced for dot EU, implies the IGD concept, in which technical and jurisdictional arrangements may be deployed to achieve specific objectives.

Technical aspects, as complex as they may be, are only a minor component of interoperability. Other aspects, which may be little or non technical, are just as essential. Some examples:

- tariff agreements for user and transit traffic,
- jurisdictional agreements for spam, illicit contents, advertising and sale of dangerous materials (weapons, drugs, medicine), information theft, misuse of personal data, defamation,
- monitoring of some sensitive traffic, alarm criteria,
- coordination of police interventions or others.

These issues are not new in the telephone system context, and acquired experience would be very helpful for transposition in the IG context. Furthermore, telephony evolves unavoidably toward voice over IP (VoIP), which in time will make rather thin a distinction between internet and telephony.

COMMON RESOURCES

Internet common resources are:
- IP addresses,
- domain names.

Only IP addresses are technically bounded. Their allocation at world level could be delegated to ITU, which already allocates diverse common resources for radio and telephony. Address blocks could be allocated by ITU to IGD's or to countries. These two options are not exclusive. The procedure is to be agreed between ITU and IGD's.

Domain names belong to two types: ccTLD and gTLD.

ccTLD's (ch, fr, uk, etc.) are domain names corresponding to country names. They are defined by the UN and the ISO 3166 standard. The WSIS Declaration of Principles assigns to States the sovereign right of managing these domains.

Generic gTLD's (com, edu, biz, info, etc.) are a resource artificially limited for reasons of merchandising, and their management is under ICANN control. It may be impractical to change substantially the existing status. However, IGD's can introduce new gTLD's in their domain, as well as multi-IGD gTLD's by mutual agreement.

At world level the management of this type of common resource, the value of which is essentially a brand name, should be handled in the framework of an institution in the UN system dealing primarily with commerce.

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REFERENCE

[1] - An Analysis of Internet Governance Aspects, Feb. 2004, by Loïc Damilaville & Louis Pouzin
http://www.itu.int/osg/spu/forum/intgov04/contributions/govern_analysis_1.4.pdf

ACRONYMS

ASCII	American Standard Code for Information Interchange
ccTLD	country code Top Level Domain
DNS	Domain Name System
EU	European Union
gTLD	generic Top Level Domain
ICANN	Internet Corporation for Assigned Names and Numbers
IG	Internet Gouvernance
IGD	IG Domain
IP	Internet Protocol
ISO	International Organization for Standardization
ITU	International Telecommunications Union
RFC	Request For Comment
UN	United Nations
VoIP	Voice over IP

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Eurolinc is a non-profit organization founded for the promotion of **multilingualism** in the internet. It is accredited to WSIS.

Annex D:
Comments by Internet Governance Task Force of Japan (IGTF-J)

Comment on the Proposal to allocate IPv6 address by nation states

Internet Governance Task Force of Japan (IGTF-J)
November 24, 2004

This paper is a work in progress and we welcome your comments for further revision.

Summary
This Memo provides IGTF-J's comment on the new proposed scheme to allocate IPv6 address by nation states and managed by their governments as a dual system operating concurrently with the current IP address system operated by the Regional Internet Registries, suggested in the paper written by Mr. Zhao of ITU Telecommunications Standard Bureau.

1 Technical requirements to allocate IPv6 Address

Internet Protocol (IP) has two distinct characteristics in terms of addressing:
1) Fixed address length, and
2) Every packet has an embedded address, which is required for connectionless communication.
This means, as is seen in the case of transition from IPv4 to IPv6, that in order to change the address system the protocols must also be changed fundamentally. Therefore, in order to use a protocol as long as possible, maximum care should be taken to guarantee availability of IP addresses indefinitely for all users who want to communicate.

Since IPv6 has a vast address space of 128 bits, many people tend to forget the importance of conservation of address resources. However, IPv6 is not different from IPv4 in terms of fixed address length. It should be noted that IPv6 address resources are vast but *not infinite*, and also that their practical availability is far lower than the theoretical maximum. For instance, address segments are simply divided such that the lower 64 bits of the 128 bits of IPv6 is used for addressing within a single LAN segment, while the address length for individual sites is only 48 bits. These factors immediately lower the address availability dramatically.

In addition to the care for the quantity of address allocation, care should also be taken for preservation of an operational routing system. Even if quantitative conservation is fully taken care of, routing aggregation is essential in order to ensure global routability for all IP addresses. Excessive fragmentation of Ipv6 address space will cause a failure of the routing system resulting in discontinuation of services to many part of the Internet. This would affect many network providers, and especially small operators who will suffer unsustainable cost increase due to increasingly expensive routers required to operate in this environment.

2. Management scheme requirements to satisfy technical requirements

Currently, IP address management and allocation is carried out by four Regional Internet Registries (RIRs) under the central management by IANA (Internet Assigned Numbers Authority). The RIR

framework has operated for over 10 years and is the only IP Address space allocation mechanism with a successful proven record. Should a new and different management scheme be introduced in the future, that new scheme must satisfy the technical requirements mentioned in 1. above as much as the current RIR framework, and any method that has the potential to undermine these requirements *must* be avoided.

The most important policy in allocation of IP address space is *fairness*. Allocation standards must be kept globally uniform, regardless of the region or property of user organizations. In case there are plural bodies that provide address allocation services, the difference in allocation standards must not become elements of competition. To guarantee this it is essential to maintain uniform allocation policies achieved through coordination activities between parallel allocation bodies and education mechanisms from upstream allocation bodies to downstream bodies (which is currently maintained by assignment window with autonomous size judgment) such as currently exercised by RIR-NIR-LIR[4] scheme.

It is also very desirable to develop address allocation policies by open meeting process that is open to all interested parties including users which is also currently exercised by RIRs and their constituencies.

3. Perceived characters of Nation-state based addressing

Let's assume that IP addresses are allocated by nation states. This will enable easy recognition of some users' nationality/locale by reading the first several bits of addresses, and enable attractive services such as automatic traffic segmentations, prioritized processing and statistical processing, but it will also enable questionable applications such as easy censorship, tracking or restriction of communication content.

In any case, existing addresses already allocated (both IPv4 and IPv6) have not been allocated on a national basis, and if only some addresses are allocated in this manner, then not all IP addresses will have the same characteristics or support the above services

4. Concerns toward managing IP address by nation-states

We believe that fulfilling both 1. Technical requirements and 2. Management scheme requirements are essential for IP address allocation and management even in case of the existing arrangements by RIRs. Therefore, we should not accept any risk of not meeting these conditions.

Mr. Zhao's paper discusses about installing the IP address management by nation-states with the current RIR scheme continuing to operate in parallel. We are, however, much worried that we may not be able to keep consistent allocation standards in those parallel systems, including a worse case that these two systems will compete as IP address allocation service providers and result in compromise to existing essential standards of address management.

We do understand that national governments have much interest in Internet governance issues including IP address allocations and that they want to protect these resources under national sovereignty perspectives, as Internet is becoming a kind of social infrastructure these days. However,

[4] RIR (Regional Internet Registry), NIR (National Internet Registry) and LIR (Local Internet Registry)

we strongly believe that the conditions required for address management as mentioned above should not be constrained or limited by the interests of national sovereignties, but they should be kept in order to preserve the functions of Internet to be used among all the people of the world for their distribution of information and communication.

* * *

Internet Governance Task Force of Japan is a joint group established in August 2004 by individuals and organizations from the Japanese Internet Community and Internet Industry to engage in the activities of the Working Group on Internet Governance（WGIG）to achieve safe and trusted global framework of Internet operation and application through maintaining and further developing private sector-led management.

This memo was drafted by IGTF Working Group on Internet Resources, including* Takashi Arano *(Member of the Board, IPv6 Forum) and* Akinori Maemura *(Chair, Executive Council of APNIC); they worked in their individual capacity and not representing the organization they are affiliated with.

Internet Governance Task Force of Japan
www.igtf.jp/e

Chairman: Prof. Shumpei Kumon (University of Tama)

Full Member:
Japan Internet Providers Association (JAIPA)
Japan Network Information Center (JPNIC)
Japan Registry Services (JPRS)
Internet Association Japan (IA Japan)
Associate member:
Internet Users Network
New Institute for Social Knowledge and Collaboration, University of Tama
Institute for HyperNetwork Society

For more information, please contact:
Izumi Aizu
Internet Governance Task Force Secretariat
Tel: +81-3-3402-8180 E-mail: sec@igtf.jp www.igtf.jp/e

Annex E:
Comments by APNIC

A Commentary on IPv6 Address Distribution Policies

In November 2004 the Director of ITU/TSB, Houlin Zhao, proposed consideration of an address distribution function using country-based address assignments. This was proposed as a parallel service function to that managed by the Regional Internet Registry (RIR) system [1]. A merit of this proposal was suggested to be that "people will have a good choice", implying a positive benefit from the establishment of competitive parallel distribution systems. The document indicated that details and constraints associated with such a proposal were yet to be investigated.

This document will examine some of these details and constraints, related to the established address distribution models, and the model suggested by Mr Zhao.

1. The Theory and Practice of IP Addresses

Any identity scheme for a communications network must achieve three quite fundamental functional objectives: identity, location and reachability. In more informal terms the network's identity scheme must be able to identify who is attached to the network, where they are located and how to pass a communication element from one location to another.

There are a number of approaches to this three part objective in terms of the architecture of identity schemes.

One approach is to use distinct identity sets for each of these three functional requirements. This is similar to a human use system, where my name identifies myself, but not my location, and a description my location does not reveal my identity, and a set of instructions to travel between two locations does not reveal the identity of the individual at either location. In such a multi-part system there is a requirement for a set of mapping functions to allow an identity to be mapped to a location, and a pair of locations to be mapped to a path specification.

A simplifying approach is to combine identity and location into a single identity scheme, so that a token drawn from this space not only uniquely identifies a communication endpoint, but also has semantic content which can be used to locate the endpoint within the network. This approach has the advantage of not requiring a mapping system between endpoint identity and current network location, so that with knowledge of an endpoint's identity a communication can be initiated without requiring any additional information. This simplifying assumption that binds endpoint identity with network location has been used in a number of communications systems, including the Internet. In the architecture of IP, an IP address is used as the unique identifier of the attachment point to the network as well as a location identifier for packet transmission.

1.1. Geographic and Provider-based Address Distribution Systems

With any addressing system, there are a number of approaches to the mechanisms of address token distribution. One approach is to divide the token space into a set of distinct token sets, assign each grouping of address token values to geographically distinct administrative entities and then allow the use of local policies to further distribute these token values to those endpoints located within the defined region. A somewhat different approach is to divide the token space in such a way that the token sets are distinguished by service provider, with a consequent objective of distribution of identity tokens in a manner that is quite precisely aligned to the network's reachability topology.

The first approach is evident in parts of the distribution of identity tokens in the context of the public switched telephone network (PSTN), and the ITU-T's Recommendation E.164. Here the established numbering plan distributes this token space among a collection of (approximately) national administrative entity. Sets o token values with a common prefix value are associated with a specific geographic locale.

The objectives of such a geo-political number plan include the desire to ensure uniform access to the token space, and to allow national policies to be determined and implemented without undue disruption to other national domains. The essential assumption behind a geographic-based numbering plan is that the addressed entity remains within the confines of the associated geographic region, and that the topology of the network has some basic relationship with such geographical boundaries.

The other approach is to distribute token sets that are aligned by communication service provider. This is evident in the distribution of public address tokens in the context of the Internet in both IPv4 and IPv6. In this address realm address tokens are assigned to individual entities by the service provider, and the address token value used is drawn in every case from the provider's own token set. Here a set of token values with a common prefix are associated with a common provider, and the common prefix is functionally synonymous with a provider's identity

Of course neither the PSTN nor the Internet exclusively uses one form of addressing system, or numbering plan. The inclusion of deregulation and competition in the PSTN domain, plus the introduction of mobility and various forms of special purpose number blocks has resulted in numbering plans that also have provider-based address blocks (such as, for example, codes +882 and +881 in the ITU-T's Recommendation E.164, which is further delegated on a provider-by-provider).

Some evidence of geographic-based address schemes can be found in the Internet environment. The address distribution structure used in the Internet uses a single original allocation authority, the Internet Assigned Numbers Authority (IANA). IANA allocates blocks of addresses to each of the RIRs as required, and each RIR operates exclusively in servicing a regional of the globe. At this level it could be asserted that there is a form of geographic-based address distribution, although on an extremely coarse scale of international regions. RIRs then allocate addresses generally on a per-provider basis, and providers then undertake further allocations on the basis of their internal topology rather than any common geographic system.

2. Constraints on Address Distribution

There are some significant propositions and considerations that lie behind the widespread current use of provider-based address distribution systems within the Internet in preference to the use of various forms of geographic-based addresses.

2.1 The Necessity of Aggregation

The first proposition is that in the global Internet some form of abstraction through aggregation of address sets is necessary in order to maintain network integrity, and to ensure the viability of the network's routing and forwarding subsystems.

Within the architecture of the Internet each router has to maintain a set of current reachable addresses. The local forwarding decision for each packet switched by the router is based on a best match between the packet's destination address and the set of addresses held in the router's forwarding table. In the absence of a matching entry, the packet is discarded.

Without any form of aggregation of address sets each router would need to maintain a comprehensive collection of each current end entity's address, and the routing protocol would need to provide comprehensive distribution of updated switching decisions for each end entity following any change in network topology. While this may be theoretically feasible, it is entirely impractical. Today (late 2004) a reasonable estimate of the number of discrete host routes in the IPv4 Internet would be of the order of 10**8 to 10**9 entries. The related memory requirements to support routing and forwarding tables would imply high speed forwarding memory of some 10**9 to 10**10 bytes, and a routing database which would consume 10**10 to 10**11 bytes, configured across some 10**8 routers. In addition to the hardware consideration is the further consideration of the load on the routing protocol when the full routing table is some 10**10 to 10**11 bytes in size. Real time operation of a routing protocol with performance parameters in terms of global propagation of state change in the order of tens of seconds would consume significant network resources well beyond the capacity of much, if not all, of current transmission infrastructure.

The Internet's routing and forwarding systems use one basic tool to reduce the size of their databases to supportable proportions. This tool is the aggregation of addresses, where blocks of addresses with a common prefix are manipulated as a group through the manipulation of the single prefix. In geographic address distribution systems it is intended that the common prefix spans multiple providers operating within a single geographic domain. In provider-based addresses the common prefix may span one or more local, national or multi national geographic regions, but is associated with the customers of a single service provider.

2.2 Internet Inter-Provider Interaction

The second proposition is that inter-provider relationships within the Internet are generally constrained to the extent that they are based either upon a customer / provider relationship or a mutual peering relationship where neither party is a provider or customer of the other. To date there have no effective mechanisms devised that would create other inter- provider relationships that rely on some form of calculated financial settlement derived from the inter-provider traffic profile or any other form of net value transfer calculation.

This topic has been the subject of considerable study over the past decade. The basic observation is that with the transmission of an Internet packet from one provider to another it is not evident from the packet itself that there is an associated net value transfer from the sending provider to the receiving provider, or in the other direction, nor what the quantity of any such value transfer may be. Behind this is the further observation that users of the Internet services do not explicitly fund entire complex

transactions (such as a "call", or a mail delivery request) from end to end as a unit of a network service transaction. [2]

The typical starting point for carrier-to-carrier settlements is that the retail offering of the provider is one of a comprehensive, end-to-end service, in which the originating service provider utilizes the services of other providers to complete the delivery of the service. The originating provider then settles with those other providers who have taken some kind of role in providing the service. With such cost-distribution, both small and large providers are able to operate with some degree of financial stability, which in turn allows a competitive market to exist. However, the retail model of the Internet is not necessarily one of end-to-end service, but one of partial path service. And there is no price component that covers the complete path. The Internet can be viewed as a collection of bilaterally funded path pairs, where the sender funds the initial path component and the receiver funds the second terminating component.

The corollary of this observation is visible in the inter-domain routing table, namely that the overall majority of inter-provider connections can be characterized as either peer-to-peer or provider-to-customer. The implication is that any inter-provider path between two providers can be seen as a sequence of 0, 1 or more customer / provider relationships, following by 0 or 1 peer-to-peer provider relationship, followed by 0, 1 or more provider / customer relationships.

A second corollary is that from the perspective of a single provider all external relationships can be characterized as a collection of relationships with customers, providers, and peers. 2.3 The Provider Business Model and Inter-Provider Routing Policies

The third proposition is that in a stable set of inter-provider relationships no provider permits transit traffic without some identifiable funding source.

This proposition is best illustrated by example. Suppose a provider A peers with provider B at one location and provider C at a different location. Provider A will learn both B's routes and C's routes. What routes should provider A announce to each of B and C? In particular, should A announce B's routes to C, and C's routes to B? In both cases the answer is no. Neither B or C are paying A for the peering connections, so the costs associated with the transit across A are unfunded.

Furthermore, suppose provider A uses provider T as an upstream transit provider. A is now a customer of T. Should A announce T's routes to either of the peer providers B or C? Again the answer is no. T is A's provider, and is not funding A for any form of transit service. Neither B nor C are paying A for transit services, so A has no funding to provide transit between B or C and T.

The more general characterization of the inter-provider relationships is that in general a provider has three sets of relationship: customers, peers and upstreams. In order to avoid being used as an unfunded transit provider the routing policies used by providers have a consistent set of constraints such that routes learned from customers are announced to all other customers, to peers and to upstreams, while routes learned from peers are only announced to customers, and routes learned from upstreams are only announced to customers.

3. Geographically Aggregated Address Schemes

It is now possible to analyse geographically aggregated address schemes and their viability within the context of the Internet. The assumption used here is that geographic address distribution schemes are aggregateable by geographic region, but are not aggregateable by provider.

Any provider providing services into a geographically aggregated service domain can choose either to announce the geographic address prefix as part of its announced routes, or announce the enumerated set of individual explicit customer routes of its customers.

The latter course of action is little different from fully enumerated host routing outlined previously, and suffers from the same issues of inability to scale to any meaningful extent.

The former course of action has the provider announcing a single aggregate prefix to its peers and upstreams. Within that single prefix are routes associated with the service provider's customers and routes associated with customers of other service providers. As long as all other service providers are also customers of this service provider (a geographic monopoly model) then this is a viable structure in terms of routing policies. But where the other providers within the region are peers of this provider, then within the current Internet inter-provider framework, this creates a situation where the provider assumes a role of unfunded transit service provider for certain traffic. As per the previous section, this situation is analogous to a provider announcing a peer's routes to its upstream, and incurring unfunded transit traffic as a consequence. This is an untenable business proposition for the service provider.

Where other providers within the geographic region that do not peer or interconnect directly with each other, then there is a consequent situation of split routing. For example, if providers A and B both provide services to the same geographic region, announce the geographic address aggregate, but do not interconnect, then when A receives a packet from its upstream destined to a customer of B, then A has no option but to discard the packet as it has no more specific information as to how to reach B.

Geographic addressing schemes as a means of address aggregation in the routing table are only a viable approach when adopted concurrently with a service provider model of geographic monopoly providers. This could be also be stated as the proposition that in order for geographic address aggregation to be viable the network's topology must match geography, and the provider-based aggregation is then synonymous with geographic aggregation. The inference here is that within the constraints of this model two providers cannot provide service to the same geographic area.

In a more conventional multi-provider competitive model of service provision geographic address aggregation is not supportable in terms of inter-provider interaction within the Internet environment. Such a model of address aggregation is sustainable only when, at a minimum, each provider's service quality is directly substitutable with any other, and there is an objective, uniform and fair form of incremental financial inter-provider settlement structure that can provide each provider with the assurance of funding for all forms of transit service provision. Such preconditions are not evident in the Internet today.

4. Provider-Based Address Aggregation

In concluding that geographic address aggregation is not a practical approach as a tool for scaling routing and forwarding in the Internet, this does not imply that the current methodology of provider-based addressing is flawless in practice. As has been commonly observed, the issues with provider-based addressing concern the customer's portability between providers and the capability for a customer to simultaneously obtain service from 2 or more service providers. In the first case the provider is ultimately forced to renumber the devices that are part of their local network from addresses drawn from one provider's address block to addresses drawn from the other provider. For large end sites this is a complex and expensive task [3]. IPv6 has improved this situation to some extent, but there remain issues with the synchronization of the domain name system, the fate of long-held sessions and the logistics of triggering a renumbering event on each end point within the site. Connecting to more than one provider, or multi-homing, presents significant complexities if provider- based aggregation is to be honoured. In this case each local entity has as many alternate addresses as there are providers, and in order to support the desired resiliency that motivates multi-homing, the host must be able to be agile across multiple addresses within a single end-to-end session.

With the IETF Multi-Homing in IPv6 Working Group continues to develop approaches in this space the overall observation is that multi-homing support and provider- aggregation present a significant challenge to the architecture of the Internet itself, and the solution space invariably explores a quite basic shift in the architecture of attempting to decouple endpoint identification (who am I talking to) from provider-based endpoint location identification (where are you).

Such an evolution of the Internet architecture would address these noted issues with provider-based addressing scheme, as both renumbering and multi-homing can be seen as presenting similar functional requirements to the protocol's architecture. However such work would do nothing in terms of addressing the shortcomings of geographical-based addresses.

5. Country-Based Address Distribution Structures

In terms of the details and constraints of a country-based address distribution scheme, each national address administration would still need to be constrained to be aligned to provider-based addressing.

This then raises the issue that if the address distribution function is one that is constrained to be aligned to provider-based network topologies and the RIR model is attuned to undertaking this function along such lines, then what would be the role, function and value of a parallel national- based address distribution function?

A related uncertainty within this proposition is how could we ensure that a national administration would adhere to such a constraint? The issue here is one similar to the tragedy of the commons in that the aberrant actions of an individual national administration in operating a non-aggregateable address distribution system may not necessarily imperil the viability of the Internet's routing system. It is, however, a more certain prediction that if every national administration followed the same path then the cumulative outcome would be failure of Internet routing and failure of the Internet itself. The mechanism of recommendations adopted by the ITU provides no reasonable level of assurance of adherence to the common constraint of effective aggregatibility of addresses.

Given that such a parallel function would also have its costs of operation, then what benefits would the end consumer, who ultimately bears such costs, derive from this duplication of function? If the end user is the intended beneficiary of the function, the competitive supply of a commodity is one possible remedial measure when there is the situation of a sole incumbent operator operating the distribution function with the inclusion of monopoly rentals added to the price of the goods and services. However competition is not a panacea for all possible markets associated with the distribution of all forms of goods and services. The RIRs structure is based on the form of a mutual membership association where the function itself is operated on the basis of the cost of the service, rather than as a for-profit enterprise. A 'competitive' national enterprise would not be able to operate at the same economies of scale of operation, but would have to fulfil the same set of functions and operations as the RIR. If this function were operated on the same basis as the RIRs then there would appear to be no particular cost advantage to be derived at all. If it were to be operated at a cost to the public purse, then the national constituency would inevitably have to bear the incremental cost of operation of this duplication of function.

This should be contrasted to the way in which national administrative entities already operate within the RIR framework. The national entity operates in the local time zone, using local staff and local languages. The address distribution framework is identical to that to the RIR itself: one of provider based address allocation and provider-based aggregation of addresses in the routing system. Within this model the national entity operates under the same set of constraints as policies as all other RIR-serviced entities, ensuring a common outcome of viability of the Internet's routing system and a uniformity of distribution practices. This ensures that there is very limited opportunity for 'registry shopping" for an entity to obtained advantaged outcomes by using a particular registry, and allows the underlying address system to be fully portable in terms of their deployment across the provider's network. One characterization of this model is that of an 'agency' function, where the national entity presents a functionally equivalent interface to providers as that of the RIR.

6. Conclusions

Within the current constraints of the Internet's architecture and deployed hardware and systems, the Internet uses provider-based address aggregation as a means of ensuring that the Internet continues to operate in a viable and cost-effective manner. Other forms of address aggregation, in particular geographic-based address aggregation, cannot provide similar leverage due to limitations in the flexibility of the inter-provider interconnection models available to industry players.

Address distribution functions need to be aligned to this constraint of provider-based address aggregation, and this model is one that forms the basis of the RIR function.

Nationally based address distribution functions are used in some regions within the RIR model, but in this framework there are some critical features that are at variance with the ITU proposal. The national entities do not have absolute policy autonomy and cannot determine to use radically different mechanisms of address distribution. This ensures that the overall constraint of address aggregation is achieved with a uniformity of outcome in terms of address aggregation and routing viability, without creating imbalanced and untenable pressures on the routing system. It is also the case that such national operations are not in direct competition with the RIR mechanisms, and are structured, like RIRs, as industry service entities.

The overall objective of the RIR system is to ensure that the address distribution function operates in the service of a working network, is efficient, accessible, fair and balanced, and operates impartially in terms of the application of its policies.

The proposed introduction of a second mechanism of address distribution to national entities, which could then operate autonomously with neither collaboration with the Internet community nor adherence to a common outcome, introduces significant elements of risk to the future of a viable and operational Internet. In this respect it would be appropriate to offer the advice to the ITU-T to reconsider its proposal and, with those communities that already have had considerable experience in this area of activity, undertake further careful investigation into effective address distribution mechanisms for the Internet.

References

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