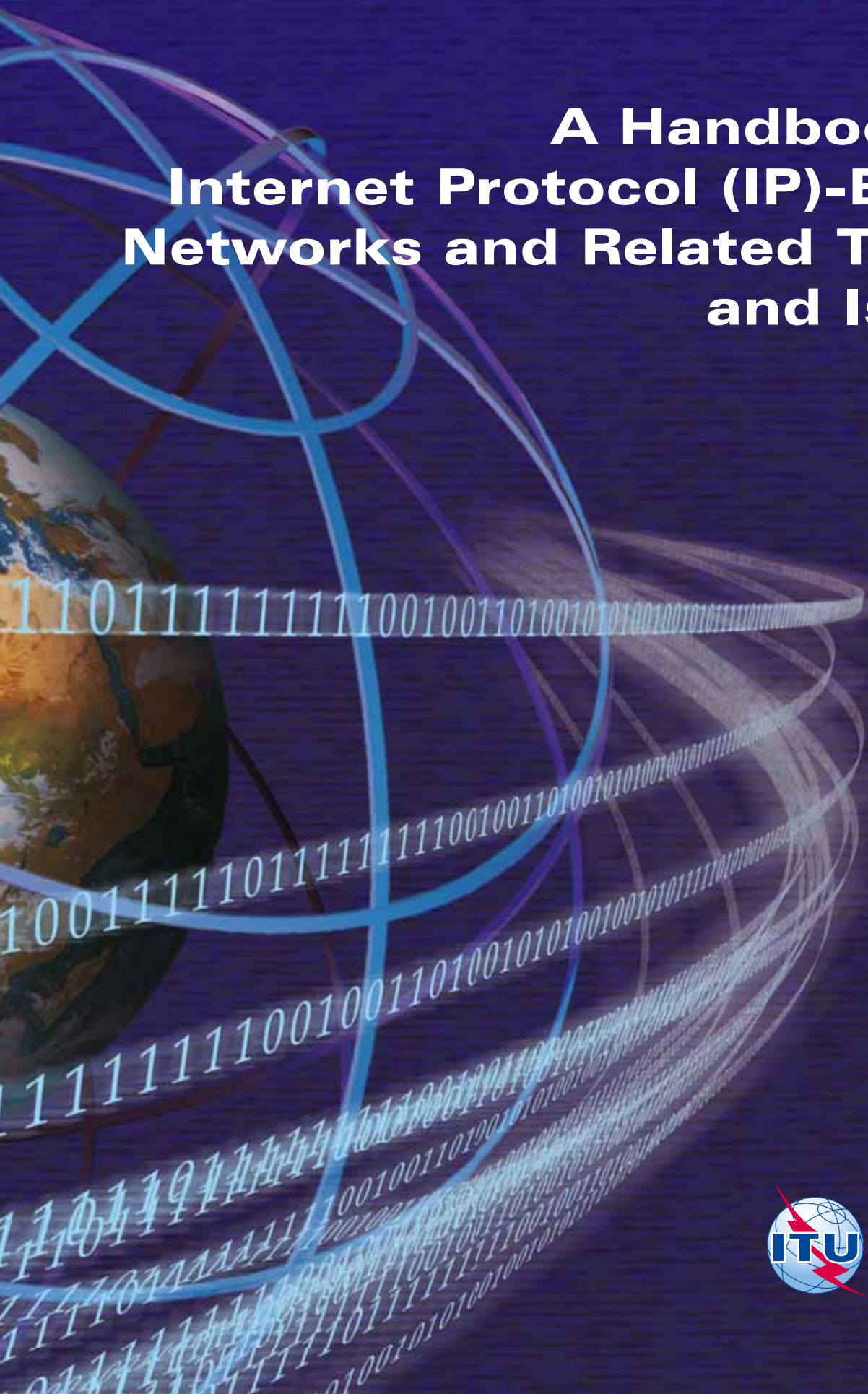
International Telecommunication Union

A Handbook on Internet Protocol (IP)-Based Networks and Related Topics and Issues



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Preface

The use of Internet Protocol (IP)-based technologies is now a strategic element in the design, development and use of telecommunication networks. Consequently, there is a growing interest by ITU members in the policy and regulatory issues related to the growth of IP-based networks, such as the Internet, and their convergence with other networks. One example is the rapid uptake of Voice over IP (VoIP), which has given rise to a number of recent national regulatory proceedings and decisions. We are also witnessing a growing interest in the policy and regulatory implications of next-generation networks (NGNs), a key standardization activity in ITU. Convergence across media platforms, such as delivery of television over broadband networks, is also forcing national policy and regulatory reviews spanning what were previously different sectors. This clearly will result in new challenges for national policy makers and regulators and there appears to be a need to build international dialogue on these issues, including the sharing of national experiences and approaches as well as assistance in capacity building for developing economies. There is much opportunity not only to find common technical approaches, as in ITU's standards work on NGNs, but also to discuss and share common policy and regulatory approaches to convergence and network security.

At its session from 5 to 16 May 2003, the ITU Council discussed and endorsed a proposal by several countries for ITU-T, in collaboration with ITU-D, to develop an IP policy handbook to advise Member States, especially developing countries, on the management of Internet domain names and related issues.

A project team was duly created and worked by correspondence. Numerous contributions were received from entities that are key players in IP-based network development, including both members and non-members of ITU.

The result of the project team's work was presented to the ITU Council in 2005 and approved for publication.

We wish sincerely to thank the co-chairmen, Ms Fiona Alexander of the United States and Mr Nabil Kisrawi of the Syrian Arab Republic, the members of the project team, the contributors to the work and Mr Richard Hill and Mr Désiré Karyabwite who provided secretariat support, as well as Ms Maite Comas Barnes and Ms Martine Métral who assisted the secretariat.

Hamadoun I. Touré
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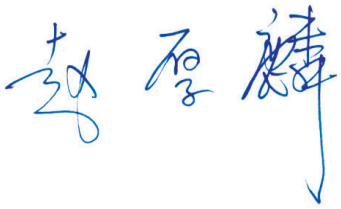

Foreword

As the use of IP-based networks, including the Internet, continues to grow around the world, global dialogue on the roles and responsibilities of all stakeholders involved in the dissemination, innovation and use of these networks intensifies. The Internet and the applications it supports have become of crucial importance to the economic, social and political development of all countries, in particular developing countries, as the global community seeks to use the Internet and other ICTs as a way to help provide digital opportunities for all. As a result, issues of Internet coordination, management, standardization and governance represent some of the most contentious debates in a variety of international, regional and national forums, including the United Nations World Summit on the Information Society (WSIS). The results of these debates are likely to have an impact on the contents of this handbook and readers of this handbook are invited to follow the debates on these issues.

With this in mind, the project team worked diligently to provide a factual, unbiased account of how IP-based networks, including the Internet, work today, as well as some of the key policy issues associated with the proliferation of these networks. We hope that ITU Member States and Sector Members as well as the larger global community find this handbook useful as international, regional and national deliberations continue.

Additionally, we would like to express our most sincere thanks to the members of the project team who contributed to the success of this effort. Special thanks are owed to Richard Hill, representing the ITU-T secretariat, and Désiré Karyabwite, representing the ITU-D secretariat, without whose dedication and expertise the completion of this handbook would not have been possible.

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1 Introduction

1.1 Purpose and scope

The purpose of this handbook is to inform Member States, especially developing countries, about issues related to Internet Protocol (IP)-based networks, including the management of Internet domain names and related issues.

The information presented is based on existing ITU material and input from the members of a project team created to produce the handbook. The material presented does not represent the views of ITU members or the ITU as an institution, but instead attempts to portray a factual representation of some of the relevant current structures, institutions and issues associated with the use of IP-based networks.

The intended audience is policy makers at the national level, mainly in developing countries, who are or may be called upon to influence or to decide national policies with repercussions on international policies with respect to the use of IP-based networks and/or IP-based applications.

The main text of the handbook has been kept short, consisting essentially of summaries with references to more detailed material contained in separate, attached documents. This format has been chosen in order to enhance the completeness of the handbook.

The structure and methodology of the subsequent sections are:

1) General background: provides a description of today's information and communication technologies (ICT) sector well as some of the key actors in this area.
2) Public interest issues associated with the use of IP-based networks: provides a discussion of the issues that may be relevant at the national level in order to develop national policies that will enable an environment in which IP-based networks and services can be deployed effectively at national and international levels and in the public interest.
3) Technical management and coordination: provides a discussion of the technical coordination issues that may be relevant at the national level as well as their repercussions at the international level.
4) Convergence issues: provides a discussion of the issues that may arise from the convergence of voice and data technologies.
5) Use of IP-enabled applications: provides information on the actual or potential future use of IP-based networks.
6) Conclusions.
7) Sources of additional information.

It should be stressed that this handbook serves as a snapshot in time of technologies that are rapidly advancing to meet the world's needs. Thus, this version of the handbook reflects the situation at the time it was in preparation, i.e. mid-2005.

This handbook should be viewed as an additional resource to those that already exist or become available relevant to the purpose and scope of this handbook, or as technology evolves. It should not be viewed as a definitive work on the topics concerned and may need to be revisited in the light of the results of the United Nations World Summit on the Information Society (WSIS) and other ITU activities.

2 General background

This is a general background section that provides the reader with a baseline level of understanding of the Internet Protocol (IP)-based networks used as a vehicle for ICT requirements, and identifies some of the organizations that are key global and/or regional actors in this arena.

Some general data on how different countries have approached certain issues can be found in the responses to a survey conducted specifically for this handbook: see TSB Circular 168 and the responses to it at:

- http://www.itu.int/itudoc/itu-t/ip-polic/question/

2.1 Snapshot of today's telecommunications environment

It is widely believed that telecommunication infrastructure and networks have constituted an engine of economic growth and social development for many decades and will continue to do so. The telecommunications environment, however, is currently, and has been for the past 20 years, in a state of change induced by technology advances, deregulation, privatization and increasing global competition. Changes have occurred and continue to occur from both the policy and technological points of view. From the policy point of view, we have moved from a system based mainly on State-controlled monopolies to a system based mainly on competitive, privately-owned companies supervised for some of their activities by national regulators. From the technological point of view, we have moved from a system in which most revenues were derived from long-term investments in slowly-evolving voice services based on fixed lines, to a system in which future revenues will be derived mostly from fast-changing telecommunication services and applications using mobile and IP-based technologies.

Despite these perpetual changes, general agreement exists amongst ITU members with respect to the role of an enabling environment for ICT development. Readers may be interested in consulting the Final Report of ITU-D Study Group 1 on the Promotion of Infrastructure and Use of the Internet in Developing Countries which can be found at:

- http://www.itu.int/ITU-D/study_groups/SGP_1998-2002/SG1/StudyQuestions/Question_13/QIndex.html

Global trends in reform have been well summarized and discussed in detail in the ITU annual reports on "Trends in Telecommunication Reform". See:

- http://www.itu.int/ITU-D/treg/

2.2 Internet Protocol (IP)-based networks

There are many ways to characterize networks: on the basis of their logical topology (point-to-point versus broadcast); physical topology (hub-and-spoke; bus; ring); transmission medium (wired, wireless, fixed, mobile); speed; transmission protocol; etc.

The Internet is often characterized as being a packet-switched network. Using this type of characterization, it should be noted that there are fundamentally three types of networks: circuit-switched (of which telephony is an example); connection-oriented packet-switched (of which X.25 and X.75 are examples) and connectionless packet-switched (of which Signalling System 7 and IP-based networks are examples).

The Internet may also be characterized as a logical architecture that is independent of any particular network, but which permits multiple different networks to be interconnected in such a way that computers and people can communicate without the need to know which network they are using or how to route information to them. In other words, the Internet is a conceptual creation consisting of protocols and procedures, which are then used by the constituent networks to interconnect. This

notion was captured in a definition by the United States Federal Networking Council (Resolution 1995), as submitted to the United Nations Working Group on Internet Governance[1] with a proposed amendment to reflect the evolving nature of the Internet[2].

The connectionless packet-switched nature of IP-based networks is certainly a distinguishing feature with merits and disadvantages, but it is a less important distinguishing feature than two other historical features, which were:

a) Intelligence at the edges (also known as the "hourglass" architecture). As the United States National Research Council's *The Internet's Coming of Age* (National Academy Press, 2001) puts the matter: "As a consequence of this hourglass-shaped architectural design, innovation takes place at the edge of the network, through software running on devices connected to the network and using open interfaces. By contrast, the PSTN [traditional telephone network] was designed for very unintelligent edge devices – telephones – and functions by means of a sophisticated core that provides what are termed "intelligent facilities". This was historically true, but is now becoming less the case and the ultimate goal of NGN, which is by definition a packet-based network, is to combine both intelligence at the edges and in the core.

b) Dynamic routing, known as the robustness principle. As the same work states: "The robustness principle is arguably the single most important enabling characteristic of the Internet. It was initially adopted for the ARPANET in order to accommodate the unpredictably changing topologies anticipated for defense applications (i.e. dynamic network reconfiguration) and then for the Internet in order to accommodate interconnecting a diverse set of networks built by multiple implementers out of components using multiple implementations (i.e. heterogeneity of devices and technologies). In accommodating both requirements, the Internet accommodates decentralized management, growth, and – accordingly – evolution."

Furthermore, it should be noted that certain IP-based applications (in particular e-mail and the worldwide web) make extensive use of name resolution services provided by the Domain Name System (DNS). The DNS is a highly distributed hierarchical database, relying on a system of redundant main authoritative servers to provide details of individual domain names. In particular, the DNS relies on "root servers" at the top of the naming hierarchy; these root servers are considered to be critical central resources for the DNS. From an operational point of view the computers providing the DNS are decentralized (the root servers are distributed) but the authoritative sourcing of the DNS is centralized from a data management point of view (all the root servers contain identical copies of data obtained from a unique central source). The critical role of the root server system (albeit only for the specific purpose of host naming) is unique to the Internet. There is no equivalent for most other network technologies.

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1 The topic of Internet governance was discussed and debated in Phase 1 of the United Nations World Summit on the Information Society (WSIS). As no agreement on Internet governance could be reached, the WSIS documents called on the Secretary General of the United Nations to create a Working Group on Internet Governance (WGIG) to: develop a working definition of Internet governance; identify the public policy issues that are relevant to Internet governance; develop a common understanding of the respective roles and responsibilities of governments, existing intergovernmental and international organizations and other forums as well as the private sector and civil society from both developing and developed countries; and prepare a report on the results of this activity to be presented for consideration and appropriate action for the second phase of WSIS in Tunis in 2005. The group terminated its work on 18 July 2005 and its report with the proposals is available at: http://www.wgig.org/

2 http://www.wgig.org/docs/CNRInovember.pdf

According to the features described above, IP-based networks were described in the past as "dumb networks", in which innovation can take place "at the edges" without any need to modify the central network.

Historically, this approach made sense, since it would have been difficult to implement the Internet architecture if many different networks all had to be modified to support the concept of Internetworking. The notion of layering was introduced to describe the introduction of added services over and above the actual communications capabilities. Indeed, the use of routers between individual networks was another example of this approach, since no changes to any given network were required to participate (via a router) in the nascent Internet. More recently, the possibility was raised that applications could be developed in a more integrated fashion within one or more of the underlying networks. These integrated applications may still be considered part of the Internet, if not embedded in NGNs, provided that the applications could interoperate with other networks that support the end application.

2.2.1 Public versus private networks

A public network is one that can be accessed by any user, while a private network is a network that can only be accessed by some restricted group of people, typically employees of a particular private company.

Most countries distinguish public networks from private networks and apply very different regulatory provisions to the two, in the sense that few, if any, regulatory provisions apply to private networks and then only in the case of use of part of these networks by the public.

IP-based networks can be public or private. What is usually referred to as "the Internet" is in fact a complex collection of public and private networks, in which portions of the private networks are partially accessible to the public (for example, to access a private group's website, or to send e-mail to such a group).

2.3 What is "the Internet"?

There are many descriptions that seek to answer the question: "What is the Internet?". The following technical definition has been adopted by ITU-T Study Group 13 in Recommendation Y.101 on Global Information Infrastructure terminology:

> "A collection of interconnected networks using the Internet Protocol which allows them to function as a single, large virtual network."

As a result of Phase 1 of the United Nations World Summit on the Information Society (WSIS), a Working Group on Internet Governance (WGIG) was created and mandated a series of specific tasks, including a working definition of Internet governance.

2.4 Some of the relevant organizations

There are a variety of organizations involved in the standardization and development of IP-based networks. Some are based on intergovernmental treaties, for example ITU, some are primarily non-governmental, such as the Internet Engineering Task Force (IETF), including the Internet Architecture Board (IAB), and others are a blend of government, private sector, civil society and academic interests, for example the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC) and Internet Corporation for Assigned Names and Numbers (ICANN). Each has a role to play today with respect to the development of IP-based networks, including the Internet. Below is a description of a few of these organizations.

2.4.1 International Telecommunication Union (ITU)

The International Telecommunication Union (ITU), established in 1865, making it the oldest intergovernmental organization responsible for telegraphy, became later the specialized agency of the United Nations system for telecommunication services[3, 4]. It serves as an impartial, international organization within which governments and the private sector work together to meet the purpose of the Union as embedded in the ITU Constitution, Article 1, provisions 2 to 19A. The three Sectors of the Union – Radiocommunication (ITU-R), Telecommunication Standardization (ITU-T), and Telecommunication Development (ITU-D) – work today to build and shape tomorrow's telecommunication networks and services. They are supported in that task by the General Secretariat, which includes a Strategy and Policy Unit (SPU). The activities of ITU cover all aspects of telecommunication, including treaties on radio spectrum issues (the Radio Regulations) and on international telecommunications (the International Telecommunication Regulations), as well as the approval of recommendations in order to ensure the seamless interworking of telecommunication equipment and systems on a global basis, the adoption of operational procedures for the vast and growing array of wired and wireless services, and the design of programmes to improve telecommunication infrastructure in the developing world.

The ITU Radiocommunication Sector has the following functions and structure:

> "The functions of the Radiocommunication Sector shall be, bearing in mind the particular concerns of developing countries, to fulfil the purposes of the Union, as stated in Article 1 of this Constitution, relating to radiocommunication: by ensuring the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using the geostationary-satellite or other satellite orbits, subject to the provisions of Article 44 of this Constitution; and by carrying out studies without limit of frequency range and adopting recommendations on radiocommunication matters."

The ITU Telecommunication Standardization Sector has the following functions and structure:

> "The functions of the Telecommunication Standardization Sector shall be, bearing in mind the particular concerns of the developing countries, to fulfil the purposes of the Union relating to telecommunication standardization, as stated in Article 1 of this Constitution, by studying technical, operating and tariff questions and adopting recommendations on them with a view to standardizing telecommunications on a worldwide basis."

The ITU Telecommunication Development Sector has the following functions and structure:

> "The functions of the Telecommunication Development Sector shall be to fulfil the purposes of the Union as stated in Article 1 of this Constitution and to discharge, within its specific sphere of competence, the Union's dual responsibility as a United Nations specialized agency and executing agency for implementing projects under the United Nations development system or other funding arrangements so as to facilitate and enhance telecommunications development by offering, organizing and coordinating technical cooperation and assistance activities."

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3 Telecommunication is defined in the ITU's Constitution and Convention 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."

4 International telecommunication service is defined in the ITU Constitution and Convention as "the offering of a telecommunication capability between telecommunication offices or stations of any nature that are in or belong to different countries."

> "The activities of the Radiocommunication, Telecommunication Standardization and Telecommunication Development Sectors shall be the subject of close cooperation with regard to matters relating to development, in accordance with the relevant provisions of this Constitution."

Within the foregoing framework, the specific functions of the Telecommunication Development Sector shall be to:

> "a) raise the level of awareness of decision-makers concerning the important role of telecommunications in the national economic and social development programme, and provide information and advice on possible policy and structural options; b) promote, especially by means of partnership, the development, expansion and operation of telecommunication networks and services, particularly in developing countries, taking into account the activities of other relevant bodies, by reinforcing capabilities for human resources development, planning, management, resource mobilization, and research and development; c) enhance the growth of telecommunications through cooperation with regional telecommunications organizations and with global and regional development financing institutions, monitoring the status of projects included in its development programme to ensure that they are properly executed; d) activate the mobilization of resources to provide assistance in the field of telecommunications to developing countries by promoting the establishment of preferential and favourable lines of credit and cooperating with international and regional financial and development institutions; e) promote and coordinate programmes to accelerate the transfer of appropriate technologies to the developing countries in the light of changes and developments in the networks of the developed countries; f) encourage participation by industry in telecommunication development in developing countries, and offer advice on the choice and transfer of appropriate technology; g) offer advice, carry out or sponsor studies, as necessary, on technical, economic, financial, managerial, regulatory and policy issues, including studies of specific projects in the field of telecommunications; h) collaborate with the other Sectors, the General Secretariat and other concerned bodies in developing a general plan for international and regional telecommunication networks so as to facilitate the coordination of their development with a view to the provision of telecommunication services."

The work of ITU promotes and coordinates the development and evolution of most telecommunication infrastructures, including those over which IP-based networks run. A description of ITU's work with respect to IP-based networks can be found at:

- http://www.itu.int/osg/spu/ip/index.phtml

For more information on ITU in general, see:

- http://www.itu.int

2.4.2 Internet Architecture Board (IAB) and Internet Engineering Task Force (IETF)

The Internet Engineering Task Force (IETF) is a large, open, non-governmental international community of network designers, operators, vendors and researchers mainly from industrial countries concerned with the evolution of the Internet architecture and the smooth operation of the Internet. It is open to anyone, and interested individuals participate in their personal capacity.

The actual technical work of IETF, which includes the development of Internet standards, is done in its working groups, which are divided up by topic into several areas (e.g. routing, transport, security, etc.). Much of the work is handled via mailing lists. IETF holds meetings three times a year.

The IETF working groups are grouped into areas, and managed by area directors (ADs). The ADs are members of the Internet Engineering Steering Group (IESG). Providing architectural oversight is the Internet Architecture Board (IAB). IAB also adjudicates appeals when someone complains against IESG. IAB and IESG are chartered by the Internet Society (ISOC) for these purposes. The General Area Director also serves as the chair of IESG and IETF, and is an ex officio member of IAB.

For more information, see:

- http://www.ietf.org

There is good collaboration between both ITU-T and ITU-R on one hand and IETF on the other; in particular, relevant IETF outputs are referenced in ITU recommendations. This is also the case with other standards development organizations (SDOs).

2.4.3 International Organization for Standardization (ISO)

The International Organization for Standardization develops a wide range of standards, of which a well-known example related to IP-based networks is ISO 3166, which defines the country codes used in country code top level domain names (ccTLDs); see:

- http://www.iso.org/iso/en/prods-services/iso3166ma/index.html

There is close collaboration between ITU and ISO/IEC in many domains.

2.4.4 Internet Corporation for Assigned Names and Numbers (ICANN)

The Internet Corporation for Assigned Names and Numbers (ICANN) is a non-profit organization, headquartered in the United States, that performs functions with respect to Internet names and addresses, under a memorandum of understanding (MoU) with the United States Department of Commerce.[5] Specifically, ICANN deals with issues related to IP address space allocation, protocol identifier assignment, generic (gTLD) and country code (ccTLD) top-level domain name system management, and root server system management functions. ICANN, managed by an internationally diverse Board of Directors named by a Nominating Committee which is itself named by the ICANN constituencies described below, is responsible for coordinating the management of the technical elements of the Domain Name System (DNS) to ensure universal resolvability so that all users of the Internet can find all valid addresses, as well as certain policy and commercial aspects of the domain name business.

ICANN's structure consists of three supporting organizations and five advisory committees, which propose policies for consideration by the ICANN Board of Directors. These groups include:

The Address Supporting Organization (ASO). ASO comprises the five regional Internet registries (RIRs), that collectively share a global responsibility delegated to them for distributing IP addresses to those in need of one. Through ASO, the RIRs propose global addressing policy to the ICANN Board.

The Generic Names Supporting Organization (GNSO). GNSO is the policy development body responsible for developing and recommending to the ICANN Board substantive policies relating to gTLDs such as .com, .org, .biz, .info, or .museum.

The country code Names Supporting Organization (ccNSO). ccNSO is responsible for developing appropriate global policy regarding ccTLD management at global level.

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5 The current MoU expires in September 2006.

The Governmental Advisory Committee (GAC). GAC is a forum, open to governments and distinct economies, through which their representatives provide non-binding advice to the ICANN Board on public policy issues related to the technical management of the DNS. Some intergovernmental organizations currently participate as observers, for example ITU, WIPO and OECD.

The Root Server System Advisory Committee (RSSAC). RSSAC is responsible for advising the ICANN Board about the operation of the DNS root name servers. They consider and provide advice on a variety of topics including the operational requirements of the root name servers such as host hardware capacities, operating systems and name server software versions, network connectivity and physical environment.

The Security and Stability Advisory Committee (SSAC). The role of SSAC is to advise the ICANN community and Board on matters relating to the security and integrity of the Internet's naming and address allocation systems. Among other things, SSAC gathers and articulates requirements to offer to those engaged in the technical revision of the protocols related to the DNS and address allocation and those in engaged in operations planning.

The At-Large Advisory Committee (ALAC). ALAC is responsible for promoting the structured involvement and informed participation in ICANN of the global individual Internet user community and to provide an end-user perspective on ICANN activities that affect individual users.

It should be noted that in addition to a memorandum of understanding with the United States Department of Commerce (DOC), ICANN performs the Internet Assigned Names Authority (IANA) functions under a separate contract with DOC. These functions include performance of the administrative functions associated with root management, coordination of the assignment of technical protocol parameters, and allocation of Internet numbering resources. As a part of the IANA functions contract, ICANN receives change requests and makes recommendations to DOC, which has the operational oversight and policy responsibility for the authoritative root zone file. DOC then directs VeriSign to make changes to the authoritative root zone file based on a cooperative agreement between DOC and VeriSign. The management of the authoritative root zone file has no connection with the routing of Internet traffic.

For more information, see:

- www.icann.org
- www.iana.org/root-managment.htm

2.4.5 Regional Internet registries (RIRs)

The regional Internet registries (RIRs) are non-governmental organizations responsible for allocating Internet number resources such as globally unique IP addresses (IPv4 and IPv6) and routing identifiers (namely, border gateway protocol (BGP) autonomous system numbers). Each RIR allocates resources to Internet service providers (sometimes referred to as local Internet registries, or LIRs) and other organizations within a given geographical area, and generally without reference to country.

The establishment and evolution of the RIR system was not simply the result of Internet growth and the natural need to refine and decentralize a growing administrative task. Rather, it arose from, and closely tracked, the technical evolution of the Internet Protocol, in particular the development of today's IP addressing and routing architecture. According to legend, the task of maintaining a list of assigned network addresses was carried out voluntarily by Jon Postel, using a paper notebook. As the Internet grew, and with it the Internet Registry, the task of maintaining the assigned network addresses outgrew Postel's notebook. It was eventually passed to the Stanford Research Institute (SRI) International in Menlo Park, California, under a National Science Foundation contract.

Today, there are five RIRs providing technical coordination with respect to administrative functions necessary for addressing and routing. They are structured as not-for-profit, open membership-based organizations, operating as neutral and impartial bodies of industry self-regulation. With the establishment of ICANN and in particular the adoption of ICANN document ICP-2 (http://www.icann.org/icp/icp-2.htm), ICANN has accepted the role of accrediting (recognizing) these RIRs.

There are currently five RIRs:

- APNIC, established in 1993, serving the Asia-Pacific region (http://www.apnic.net);
- ARIN, established as InterNIC in 1993, serving Northern America and portions of the Caribbean (http://www.arin.net);
- LACNIC, formally recognized by ICANN in 2002, serving Central and South America, and portions of the Caribbean (http://www.lacnic.net/en);
- RIPE NCC, established 1992, serving Europe and the Middle East (http://www.ripe.net); and
- AfriNIC, established in 2005, serving Africa (http://www.afrinic.net).

Each of the RIRs is incorporated in a specific country as a private, non-profit company or organization. Each has a membership structure which is open to all interested parties, although members are most typically LIRs or ISPs that require address space services. In certain instances, most particularly in the case of APNIC, intermediate registries exist which provide service at the level of individual countries or economic regions (generally as defined by ISO-3166 codes). These "national" registries are autonomous, but act as agents of their respective RIR in terms of address management responsibilities, providing allocation services according to regional policies.

For more information about RIRs, please consult the RIR websites listed above.

2.4.5.1 RIR policy process

Another function of the RIRs is to facilitate the development of policies needed to guide the management of Internet resources regionally and globally. This is done in a consensus-based, bottom-up, industry self-regulating manner, in response to the requirements of the many and varied stakeholders in the respective RIR communities. Importantly, these policy development processes are open to anybody, and often include the active participation of both public and private sector bodies as well as civil society.

Each RIR hosts regular, open, public policy meetings, at least twice annually, which form the primary focal point for policy development in each region. These meetings are open to all interested parties, regardless of membership status, who can participate in discussing IP-related issues and in developing number resource management policies. Formal policy development processes, along with publicly available, open mailing lists, ensure that address management policies take into account broad perspectives on the issues that impact the community. The role of the RIRs is to facilitate these processes and help their communities build consensus-based policies; and then to ensure that these policies are applied fairly and consistently.

Due to the natural regional differences, the RIRs may take different approaches in supporting the development and implementation of policies. Furthermore, owing to differing priorities among RIR communities, as well as timing and participation in policy processes, specific policies may vary between regions at any one time. RIR staff and community members are generally active, however, in the exchange of information about developments in other regions, including the results of respective policy processes, and there is a strong tendency towards the convergence of any significant policy differences or new policy developments.

Regardless of the specific policy process or outcomes in each region, the RIRs share a common goal: ensuring the fair distribution and responsible stewardship of number resources, in order to best maintain the stability and continued growth of the Internet. The managerial, administrative and technical activities of the RIRs form an integral part of the infrastructure needed to keep the Internet operating efficiently.

It may be noted that a set of global guidelines for the allocation of IP addresses was set out in IETF RFC 2050, published in 1996. However, this document is fairly general and now largely historical, as it has been effectively replaced by the more refined policies developed within each RIR region.

All RIR policies are available on the website of each organization, along with supporting documents such as a common "policy comparison matrix" developed by the RIRs themselves.

2.4.5.2 The Number Resource Organization (NRO)

Although existing as separate entities that meet the needs of their respective communities, the RIRs must also work closely together, coordinating activities that support policies that are common to all.

In October 2003, the four RIRs – APNIC, ARIN, LACNIC and RIPE NCC – entered into a memorandum of understanding (MoU) to form the Number Resource Organization (NRO): http://www.nro.net/documents/nro1.html.

The purpose of NRO is to ensure the global coherence of certain RIR activities, and to provide a single common interface to all the RIRs where this is necessary. NRO also undertakes joint RIR activities, including technical projects and liaison activities. NRO does not replace or interfere with the regional policy-development processes of the RIRs, nor with any of the RIRs' operational activities.

In October 2004, NRO signed an MoU with ICANN re-establishing the Address Supporting Organization (ASO). ASO was originally formed in 1999 by an MoU between the RIRs and ICANN, and has been reformed as a consequence of the ICANN reform processes of the past two years. The purpose of ASO is to review and develop recommendations on number resource policy and to advise the ICANN Board on these matters. The new ASO MoU stipulates how NRO will fulfil the role, responsibilities and functions of ASO as outlined in the ICANN Bylaws.

For more information, see:

- http://www.nro.net
- http://www.nro.net/documents/nro1.html
- http://www.nro.net/documents/aso-mou.html

2.4.5.3 Provider-based addressing

As described in § 2.2, the Internet enables and relies on a dynamic routing environment in which network topology changes can be accommodated automatically and at reasonable speed. It must be noted, however, that today's routing technology will allow changes at the level of networks rather than individual users, and that such changes cannot be processed in real time. In today's Internet an ISP's global routing table will contain some 180 000 entries, and while that number is growing at a steady rate, it is generally felt that major increases in routing table size would degrade dynamic routing on many routers, to the extent that smaller ISPs would lose global visibility of the Internet, resulting in unpredictable service and/or the need to select manually the routes that they were able to carry.

That management of IP addresses therefore involves not only the conservation of address space, but also the conservation of "routing space" through the avoidance of excessive address space fragmentation. Accordingly, the principle of "provider-based" addressing has been generally

applied, in which the recipients of IP addresses are the ISPs who are able to utilize large blocks of address space and allow those address ranges to be reached through a minimal number of routing announcements. From the addressing point of view, it has been said that the "geography" of the Internet involves the ISP as the primary subdivision, with frontiers corresponding to interconnections across which global routing information is exchanged.

A further consequence is that RIRs must make allocations not only in accordance with demonstrated needs of ISPs, but also in such a way as to limit the number of discrete, independent allocations that are made. The value of the resource is due not only to the relative scarcity of IPv4 addresses, but also to the need to maximize aggregation and limit routing table growth. Thus, there will be a need to carefully manage the assignment of IPv6 addresses also.

2.4.6 Root server operators

The root server operators are 12 organizations, one public (the United States Government, which operates three servers), the rest private entities, which operate the system used to publish the root zone file that is administered through the Internet Assigned Numbers Authority (IANA) functions process. As a result of historical developments, 10 of the 13 original root servers reside in the United States; however, to facilitate geographic diversity and build in network security through redundancy, some of the root server operators have recently deployed mirror copies of existing root servers throughout the world. Today, the 13 root servers, together with mirrored data, are based in more than 80 locations in 34 countries. They provide the authoritative top-level information for the Internet Domain Name System (DNS). The role of root servers is sometimes confused with that of the servers that route Internet traffic. Root servers do not in fact route traffic but instead perform the function described above. More information on root servers can be found at:

- http://www.root-servers.org
- http://www.rssac.icann.org
- http://www.isoc.org/briefings/016/index/shtml

It is important to distinguish these root servers, which provide information for the DNS, from the servers that route actual traffic, i.e. that route the packets. These are completely different functions provided by different servers.

2.4.7 Internet service providers (ISPs)

Internet service providers (ISPs) are companies (usually private, but publicly-owned in some countries) that provide basic Internet connectivity and/or access and interconnection for consumers (individual users or corporations that wish to access the Internet). Depending on their size and business objectives, ISPs may provide all or some of the following services:

1) Facilities for access to the public Internet (dial-in, leased line, cable, ADSL, etc.)
2) Fixed or dynamic IP addresses, in conjunction with access facilities
3) E-mail accounts
4) Acting as an agent for domain name registration
5) Storage and other facilities for web hosting (hosting of webpages)
6) Support in case of problems
7) Consulting services
8) Additional features such as spam prevention

All ISPs interconnect to one or more other ISPs, in order to provide connectivity to the public Internet. Smaller ISPs connect to larger ISPs, and the largest ISPs interconnect with each other. The two most predominant kinds of agreement for ISP connection are charging and peering. Charging

agreements provide access to the full Internet, while peering is limited to only access to the ISPs' customers.

3 Key policy questions associated with the general use of IP-based networks[6]

As mentioned previously, the one constant with respect to communication technology is perpetual change. The technological changes have driven, and have been driven by, policy changes. Governments around the world are faced with the issues arising from these fundamental changes, in particular that of how to manage the policy issues that are typical of any "network product". By "network product" we mean any product whose utility or value increases more than linearly with the number of users. Network products include roads, railroads, air traffic systems, postal systems and, of course, telecommunication networks. The policy issues that are typical of such "network products", and that may apply to the general use of IP-based networks, include:

1) Universal access/service provisions
2) Consumer protection
3) Supervision of dominant market players
4) Emergency services
5) Access for disabled persons
6) Security (e.g. law enforcement, cybercrime, legal intercept) and privacy protection
7) Allocation of scare resources
8) Dispute resolution

Each of these areas is discussed briefly in subsequent sections.

Some approaches to the issues raised above have been contributed by Member States specifically for this handbook, and can be found at:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach01.doc (Attachment 1)
- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach02.doc (Attachment 2)
- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach03.doc (Attachment 3)
- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach05.zip (Attachment 5)

3.1 Universal access/service provisions

Universal access/service provisions refer to many methods used to ensure that telecommunication users located in areas where implementation costs are higher are offered telecommunication services of a quality and price comparable to users located in areas where implementation costs are lower. One well-known method is to impose, by regulation, low prices for high-cost areas, which usually results in somewhat higher prices in low-cost areas. Another method consists of a collecting a special tax to be used for telecommunication development in high-cost areas (for example, isolated or rural).

Not all countries have universal access/service provisions, and, in countries that do have provisions, not all countries apply similar provisions uniformly to all applications. For example, a country might choose a policy that imposes a certain universal access provision for one technology, but not for another technology.

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6 For a more detailed discussion on aspects of IP telephony that may not be covered in this section, please see relevant ITU publications including § 5.5 of this document and the ITU-D Essential Report on IP Telephony.

The methods used to implement universal access/service provisions vary from country to country; examples include cross-subsidy by users in high-density areas to users in low-density areas, government subsidies, taxation, etc.

The choice of a particular regime of universal access/service provision, if any, is a complex matter that depends on the overall information and communication technology (ICT) policy of the country; the state of its current telecommunications environment; its general stance with respect to regulation, subsidies and taxation.

Most countries have (or have had) universal access provisions for what are considered basic services provided by the circuit switched telephony model. With the advent of convergence, an emerging question is whether access to IP-based networks, in particular via high-speed links, should also be subject to universal access/service provisions.

3.2 Consumer protection

A description of what constitutes consumer protection varies from country to country and even possibly, within countries, from issue to issue. In order to achieve some degree of consumer protection, some countries have either relied on general consumer protection law as applied to IP-based networks and IP-based applications, or updated and strengthened existing laws so that they are better able to protect consumers. The approaches vary widely depending on national legal traditions and regimes as well as the state of a country's overall development. In most developing countries, issues related to consumer protection have yet to be addressed, in particular those related to spam prevention.

A key policy question is whether, and if so to what extent and how, provisions relevant to consumer protection should apply to the use of IP-based networks or the provision of IP-based applications, taking into account the traditional differences in the treatment of public and private networks.

3.3 Supervision of dominant market player(s)

In some countries there may be dominant players in a national telecommunications environment, while in others there may be a single monopolistic provider. In both situations, the risk of a player or group of players with significant market power and the ability to dictate prices with little reference to competitive forces exists. This situation may be due to historical factors (there was a monopoly regime prior to liberalization) or because the national environment is such that a natural monopoly exists (the market is too small to support true competition).

Regardless of levels of development, supervision of dominant market players to ensure effective competition and a level playing field could be left to a generic competition-law enforcement agency, but most countries have established a special-purpose telecommunications regulator, with a decision-making process independent from the parties it regulates.

Such supervision in certain countries has taken the form of mandatory interconnect prices, i.e. mandatory prices at which the dominant player must rent its infrastructure to its competitors.

A key policy question is whether, and if so to what extent and how, the telecommunications regulator should be mandated to supervise suppliers of IP-based networks or IP-based applications, taking into account the traditional differences in the treatment of public and private networks.

3.4 Emergency services

For those telecommunication services that are considered to be "basic", it is customary to mandate special provisions to deal with emergencies (traditionally built-in facilities in the network). These provisions have the goal of, on one hand, allowing emergency calls to be placed easily and at all times (special emergency number, priority scheme for emergency services, etc., with possible extension to the international domain) and, on the other hand, of allowing services to be restored

quickly in case of massive destruction, for example due to storms (mobile facilities, satellite-based facilities).

A key policy question is whether, and if so to what extent and how, emergency service provisions should apply to IP-based networks or IP-based applications. In this context, various ITU-T recommendations, in particular Y.1271 "Framework(s) on network requirements and capabilities to support emergency telecommunications over evolving circuit-switched and packet-switched networks" provide guidelines for the offer and acquisition of such services from a technical perspective.

3.5 Access for disabled persons

Many developed countries have provisions designed to facilitate access to basic telecommunication services for handicapped people while the majority of developing countries have yet to address the issue. A key policy question is whether, and if so to what extent and how, provisions providing access for disabled persons should apply to IP-based networks or IP-based applications, taking into account the traditional differences in the treatment of public and private networks.

3.6 Security and privacy

With our increasing dependence on computer networks, the importance of network security, including appropriate provisions for law enforcement concerns and privacy, needs to be addressed. The explosive growth in the use of computers has increased the dependence of organizations and individuals on the information stored and communicated using these systems. This has led to a heightened awareness of the need to protect data and resources, provide law enforcement officials with effective tools to combat cybercrime, develop a global culture of cybersecurity, and find effective means to combat spam.

Some developed countries have provisions designed to facilitate tracking and eavesdropping by law enforcement authorities, legal frameworks to combat spam, as well as provisions to protect the identities of users of communication services and the content of those communications. In many such countries, privacy and security provisions are very general and apply to any medium, not just to telecommunications. All developing countries should address these issues urgently.

For more information see:

- http://www.itu.int/ITU-T/edh/files/security-manual.pdf
- http://www.itu.int/ITU-D/e-strategy/e-security/
- http://www.itu.int/osg/spu/spam/index.phtml
- Council 2005 Document C05/EP/10 (report on SPAM as per WTSA Resolution 51)

A major policy question is whether, and if so to what extent and how, provisions related to security and privacy should apply to IP-based networks or IP-based applications, taking into account the traditional differences in the treatment of public and private networks. In particular, to what extent, if any, should there be provisions for IP-based networks to ensure the identification and traceability of packet-originators and/or recipients?

3.7 Allocation of scarce resources

All countries have provisions for the allocation of scarce resources, such as electromagnetic spectrum, and numbering resources, including naming and addressing. Naming and addressing resources for IP-based networks are typically allocated at a supra-national level, so a key policy question here is whether, and if so to what extent and how, national governments should participate in those allocation processes to ensure appropriate distribution of these resources.

3.8 Dispute resolution

IP-based networks can be used to facilitate conventional dispute resolution processes, including conventional national court proceedings. Discussion of these topics can be found at:

- http://www.odr.info/

In addition, many countries have implemented specific dispute resolution systems for the resolution of disputes involving trademarks and Internet domain names. The best-known system of this type is the Uniform Dispute Resolution Procedure (UDRP) developed by WIPO and adopted by ICANN; a number of parties serve as providers of UDRP services. For more information on that system see:

- http://www.icann.org/udrp/udrp.htm
- section IV.v.1 of Attachment 4 at http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach04.doc

Finally, there are many recent developments related to dispute resolution for disputes arising in telecommunication sectors. Many of those developments may apply equally to IP-based networks. For an overview of those recent developments see:

- http://www.itu.int/ITU-D/treg/Events/Seminars/2003/GSR/Documents/DRS_Final_GSR_5.pdf
- http://www.itu.int/ITU-D/treg/Case_Studies/Disp-Resolution/ITU_WB_Dispute_Res-E.pdf

4 Technical management and coordination of ICT resources and other related issues

No one entity or organization governs or controls ICT resources. As was mentioned in § 2 in the description of relevant organizations, these resources are managed or coordinated by a variety of organizations, both public and private. The remainder of this section describes the current management and allocation systems of the current environment.

4.1 E.164 numbering

ITU-T Recommendation E.164 provides the number structure and functionality for the three categories of numbers used for international public telecommunication in the public switched telephone network – i.e. the geographical areas, global services and networks. For each of the categories, it details the components of the numbering structure and the digit analysis required to successfully route the calls. Specific E.164-based applications which differ in usage are defined in separate recommendations, while E.164.1 specifies the procedures and rules for reservation and assignment of E.164 numbering resources.

There has recently been increasing interest in interfacing, or interconnecting, certain IP-based applications with the public switched telephone network, by mapping E.164 numbers on to IP addresses. For a discussion of that topic, see § 5.4 below on ENUM. See also the thorough discussion in:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach06.doc (Attachment 6)

Note: other numbering schemes exist in ITU-T, for telex, data transmission, mobile services, signalling nodes (SANCs), network management numbering, etc.

4.2 IP addressing

Numbers called "IP addresses" are required for the functioning of IP-based networks. Such networks are commonly referred to as "the Internet".

The format of IP addresses is defined in standards published by the Internet Engineering Task Force (IETF). See in particular Request for Comment (RFC) 791 and 2460.

There are currently two types of IP address: the original type, which is 32-bits long, and is called "IPv4", and the new type, which is 128-bits long, and is called "IPv6". IPv4 addresses are prevalently used today with some limitations which have resulted in starting a migration towards IPv6. The issues related to those IP addresses and the migration to IPv6 have been explored in a number of papers, including:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach08.doc (Attachment 8)
- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach09.doc (Attachment 9)
- http://www.potaroo.net/ispcolumn/2003-07-v4-address-lifetime/ale.html
- http://bgp.potaroo.net/ipv4/
- http://www.potaroo.net/ispcol/2004-12-isp.htm
- http://www.ntia.doc.gov/ntiahome/ntiageneral/ipv6/index.html
- http://www.itu.int/ITU-T/worksem/ipv6/200506/index.html

4.3 Internet domain names and addressing

The Internet Domain Name System (DNS) is a distributed hierarchical look-up service. It is primarily used on the Internet to translate between domain names and IP addresses. A description of the DNS can be found at:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach07.doc (Attachment 7)
- http://www.isoc.org/briefings/016/index.shtml

Issues associated with the DNS are one of the many topics currently being discussed by the Working Group on Internet Governance (WGIG).

4.3.1 Internet top level domain names

Internet top level domain names (TLDs) are those domain names that appear at the extreme right of a uniform resource identifier (URI), for example "int" in "www.itu.int". Such TLDs may be country code TLDs (ccTLDs), or they may be generic (gTLDs) or sponsored (sTLDs). Sponsored TLDs are top level domain names used only by a specific industry (for example ".aero") or for a specific purpose (for example ".museum").

4.3.2 Country code top level domains (ccTLDs)

A country code top level domain name (ccTLD) is a TLD used in the Internet DNS to identify a country, for example ".ch" for Switzerland. As mentioned previously, the two letters chosen for each country are derived from the ISO 3166 standard. Currently there are 243 ccTLDs. The rules and policies for registering domain names in the ccTLDs vary significantly by country.

In some cases, domain names come under the provisions of a general telecommunications law and the government exercises its formal powers, or its informal influence, through the ministry of telecommunications or the telecommunications regulator, or other government ministries or agencies. The appropriate government authority may supervise the activities of the ccTLD operator and approve their pricing policy if there is not a competitive registry-registrar model.

In other cases, previous informal arrangements are being clarified and/or formalized, under the sponsorship of the government, and in consultation with all concerned parties, because it is held that matters related to the administration and operation of the ccTLD are of public interest. The public interest arises from the growth of the Internet and its use to facilitate electronic commerce and the information society.

In other cases, the government maintains a hands-off approach to ccTLD operations, which are left to the private or academic sector, to either not-for-profit or for-profit entities.

Some ccTLDs are reserved for use by citizens or entities of the concerned country or territory, while others are operated in an open and completely unrestricted manner.

Generally speaking, the ccTLD managers (called registries) are entities that are legally (and often operationally) resident in the concerned country or territory. In the early days of the Internet, the registries were often academic or research institutions. Today they are more often commercial or special-purpose non-profit organizations, or government-owned or licensed entities. Governments have become involved in accordance with local legal frameworks and traditions. Government involvement ranges from formal (via laws and regulations) through informal.

A key question facing national policy-makers is how best to ensure that identified public-policy goals are met by a ccTLD manager given the various models of ccTLD management used.

As noted above, in some countries, the ccTLD operator is entirely free from government supervision. In other countries, there is informal influence from the government, while in yet other countries there is a formal link between the government and the ccTLD operator. Such a formal link can take several different forms: contract between the government and the operator, legislation defining the roles and responsibilities of the operator, or regulations.

For background information on ccTLDs, see:

- IETF RFC 1591 "Domain Name System Structure and Delegation" at http://www.ietf.org/rfc/rfc1591.txt?number=1591, which provides the basic principles and rules that have been used to implement the Internet Domain Name System and to delegate to ccTLD operators
- The ICANN webpages containing "ccTLD Resource Materials" at http://www.icann.org/cctlds/
- In February 2002, ICANN's Governmental Advisory Committee (GAC) published "Principles for Delegation and Administration of ccTLDs" at http://www.icann.org/committees/gac/gac-cctldprinciples-23feb00.htm
- Further information on ccTLD can be accessed through regional ccTLD organizations: APTLD for Asia Pacific (http://www.aptld.org), AFTLD for Africa (http://www.aftld.org), CENTR for Europe (http://www.centr.org), NATLD for North America, LACTLD for Latin America and the Caribbean (http://www.lactld.org)
- The list of current ccTLD contact information for each country code can be found at http://www.iana.org/cctld/cctld-whois.htm
- Information on national practices for certain countries can be found at: http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach10.doc (Attachment 10)
- Websites of particular ccTLDs accessed from http://www.iana.org/cctld/cctld-whois.htm
- ITU-T Workshop on Member States' experiences with ccTLDs, at http://www.itu.int/ITU-T/worksem/cctld/index.html
- TSB Circular 160, Addendum 2, which summarizes responses to a questionnaire on Member States' experiences with ccTLDs
- The best practices developed by a forum of ccTLD operators can be found at: http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach11.doc (Attachment 11)
- One particular generic ccTLD model can be found at: http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach12.doc (Attachment 12)

4.3.3 Generic and sponsored top level domains (gTLDs and sTLDs)

The best-known gTLDs are "com", "org", and "net", but there are several others. More recently introduced gTLDs include "sponsored" names such as ".aero" and ".museum" where the sponsor is responsible for developing policies to govern the TLD policy, aside from consensus policies that are required of all gTLDs. For current information on TLDs see:

- http://www.iana.org/gtld/gtld.htm

4.3.4 Internationalized domain names (IDN)

The Internet Engineering Task Force (IETF) has approved three documents which, taken together, provide a technical foundation for handling domain names with Unicode characters (that is, domain names which contain non-ASCII characters). These documents are:

- RFC 3490 "Internationalizing Domain Names in Applications (IDNA)"
- RFC 3491 "Nameprep: A Stringprep Profile for Internationalized Domain Names"
- RFC 3492 "Punycode: A Bootstring encoding of Unicode for Internationalized Domain Names in Applications (IDNA)"

A discussion of IDN can be found at:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach13.doc (Attachment 13)

Implementation of IDN raises some very complex issues. In particular, before accepting IDN-based domain names, registries should define a policy for what scripts they accept, that is, a policy for which subset of Unicode they accept. These issues are discussed in the IETF RFC 3743 "Joint Engineering Team (JET) Guidelines for Internationalized Domain Names (IDN) Registration and Administration for Chinese, Japanese, and Korean" and also in the Internet Draft" Registration of Internationalized Domain Names: Overview and Method", available at http://www.ietf.org/internet-drafts/draft-klensin-reg-guidelines-04.txt (this document has not been approved by IETF and has been offered for discussion).

ICANN has also published several reports and papers which discuss various aspects of IDN. See "IDN Committee Final Report to the ICANN Board" at http://www.icann.org/committees/idn/final-report-27jun02.htm and the presentations referenced at the bottom of http://www.icann.org/committees/idn/.

Information on recent (as of 2004) developments with respect to IDN can be found at:

- http://www.aptsec.org/meetings/2003/workshop/default.htm
- http://www.itu.int/osg/spu/newslog/categories/enum/2004/05/28.html#a656
- http://www.icann.org/meetings/kualalumpur/idn-workshop-08jul04.htm

In addition, by its Resolution 48 – Internationalized domain names, the World Telecommunication Standardization Assembly (Florianópolis, 2004) instructed ITU-T Study Group 17 to study internationalized domain names, and to continue to liaise and cooperate with appropriate entities in this area.

At present, one of the main unresolved issues is the handling of language tables, i.e. the particular set of characters that should be allowed to be used for a particular domain name, in order to allow use of national languages. The handling of languages and scripts for domain names is a major concern of countries that do no use Latin characters.

4.4 International Internet connectivity

4.4.1 International traffic exchange

There are several key concepts related to the international exchange of Internet traffic. These include international traffic flows, accounting regimes and peering. A full explanation of these concepts, and current international Internet traffic exchange settlement models, can be found at:

- http://www.potaroo.net/ispcol/2005-01-isp.htm

4.4.2 ITU-T Study Group 3 work

ITU-T Study Group 3 (SG3) started examining the international Internet connectivity (IIC) issue in 1998. The objectives of the study were, at that time, to identify the differences between the Internet and the public switched telephone network (PSTN) costing models. SG3 agreed that it was inappropriate to apply the existing PSTN costing model to the Internet, but disagreement persisted regarding whether the existing private leased-line model results in equitable cost compensation between providers.

In early 2000, the regional tariff groups of SG3 developed a set of basic principles which they believed would provide the basis for a more detailed set of principles in the future. The draft recommendation developed by the regional groups called for respect for the principle of fair trade.

In June 2000, SG3 attempted to gain global agreement on the proposal made by the regional tariff groups but failed owing to the resistance of a few Member States. The Chairman of SG3 therefore decided to submit the draft recommendation directly to the Sector's governing body, the World Telecommunication Standardization Assembly (WTSA-2000) where it was adopted, with reservations made by some countries, and labelled as Recommendation D.50.

The purpose of the recommendation was to set out the *principle* for negotiating agreements to transmit international Internet traffic. The possible need for compensation between the providers carrying the traffic was also recognized in the recommendation. When providers install Internet circuits, they generally have a choice between the "sender-keeps-all" or peering system of bilateral connections when traffic is more or less balanced, or the asymmetrical system whereby the initiating provider pays for the whole connection with the other country (full-circuit cost), which is the case today for some developing countries.

The recommendation called for arrangements to be negotiated and agreed upon on a commercial basis when direct Internet links are established internationally. It required only that the two providers involved reach a mutual agreement.

Recommendation D.50 also said that the parties involved could take into account the possible need for compensation for elements such as traffic flow, number of routes, geographical coverage and the cost of international transmission when negotiating such commercial arrangements.

The full text of the Recommendation D.50 can be found at:

- http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=T-REC-D.50

The WTSA also decided that while international Internet connections remain subject to commercial agreements between operating agencies, there was a need for ongoing studies in this area. In the subsequent study period 2000-2004, SG3 continued to study the technical and economic developments related to international Internet connectivity and it considered the need to provide further guidance on the general principles that may be relevant to bilateral commercial agreements in this area. Accordingly, after extensive debate and deliberations during the four-year period 2000-2004, SG3 adopted an annex to Recommendation D.50 which contains additional guidelines. SG3 also agreed to continue to study Internet traffic flow methodologies for use in commercial agreements.

SG3 also recognized that the costs of the international link for Internet connectivity between developing countries and the Internet backbone networks can be a serious problem for these countries in regions where the necessary infrastructure is not in place and the market for Internet access is not yet functioning fully.

Some believe however that the global market is changing and many of the arguments put forward in 1998 in support of a comprehensive settlement regime for international Internet connectivity no longer wholly apply, and other possible solutions have emerged. Competition is increasing in Internet backbone markets and it is no longer the case that most Internet traffic is routed via North America. Crucially, this increased competitiveness, combined with the impact of liberalization in the local market in reducing leased line costs, is helping to reduce the cost of Internet access and improve the ability of purchasers of international connectivity to negotiate improved contract terms.

Another important contributing factor has been the development of Internet exchange points (IXPs). These provide means of reducing costs of access to Internet backbones in other regions, by allowing ISPs to deliver Internet traffic without connecting the local or regional ISPs via distant hubs in other regions, as is the case in some developing countries, as well as to aggregate local and regional traffic for transmission to the Internet backbones. This also serves to stimulate the development of traffic with regional and local content which in turn provides incentives for more investment in infrastructure and increased interconnectivity.

A number of IXPs have been established in developing countries with the assistance of foreign aid programmes. For example, the United Kingdom's Department for International Development (DFID) has helped to fund the establishment of IXPs in Uganda, Tanzania, and Mozambique. The continuing provision of bilateral and multilateral aid for establishing regional IXPs has been characterized by some as a means to facilitate the expansion of cheaper Internet connectivity in developing countries.

Global backbone network providers meanwhile are continuing to extend their networks to meet this increased demand for Internet connectivity and provide connectivity via local points of presence, or IXPs, around the world.

In the new study period 2005-2008, SG3 will continue to study how these various market developments and shifts in international Internet traffic flows are influencing the increased availability, efficiency and cost of Internet connectivity around the world, which remains an important issue for developing countries as repeatedly voiced in the WSIS process. The issue of international Internet connectivity is one of the topics be considered by the Working Group on Internet Governance. Additional information can be found at:

The European Commission site:

- http://www.europa.eu.int/information_society/topics/telecoms/international/news/index_en.htm#editorial

The ITU site at:

- http://www.itu.int/osg/spu/ni/ipdc/index.html
- http://www.itu.int/osg/spu/casestudies/
- http://www.itu.int/ITU-D/treg/publications/AfricaIXPRep.pdf

A more detailed summary of ITU work in this area, the role of IXPs and the discussions on this topic in the United Nations Working Group on Internet Governance (WGIG) can be found in the April 2005 edition of ITU News:

- http://www.itu.int/itunews/manager/main.asp?lang=en&iYear=2005&iNumber=03

Some believe that traffic flows are influenced by the historical distribution of IP addresses.

5 Convergence issues, including technical and policy relationships between the converging networks

Technological innovations are beginning to link traditional telephony technologies with advanced IP-based networks. This technological convergence raises technical and policy questions for ITU members. Examples of such new technology capabilities include ENUM (see § 5.4 below) and IP Telephony/Voice over IP (VoIP) (see § 5.5 below).

5.1 National sovereignty and international interoperability

It is axiomatic that nations are sovereign, that is, that they have the right to implement whatever national policies, laws, rules, and regulations they see fit, within the framework of agreed international law and international treaties.

It is equally axiomatic that international interoperability is an essential feature of telecommunications, and that such international interoperability can be achieved only if national operators conform to agreed international standards, including internationally agreed numbering, naming and addressing schemes.

While international standards are not binding, they are typically followed in order to achieve appropriate international interoperability. See § 5.3 below.

5.2 Technological neutrality of policies

As noted earlier, national approaches to the regulation (or not) of IP-based networks and IP-based technologies vary widely. While some Member States have signalled a move towards a more technology-neutral approach to the regulation of telecommunication services, this is not the case with all Member States. Indeed, the issues involved are complex. What is meant by technology-neutral regulatory frameworks are frameworks in which regulations that apply to a particular service (such as voice transmission) apply uniformly no matter what technology is used to implement the service. For information on trends in this respect, see:

- http://www.itu.int/ITU-T/worksem/conreg/index.html

5.3 Interoperability

Interoperability of IP-based networks and IP-based applications requires compliance with a large number of standards, developed and published by a wide range of organizations, of which the most important are (in alphabetical order) IETF, ITU and W3C. For further information, see:

- www.ietf.org
- www.itu.int
- www.w3c.org

A description of ITU's work with respect to IP-based networks can be found at:

- http://www.itu.int/osg/spu/ip/index.phtml

5.4 ENUM

The ENUM protocol maps in one direction parts or all of the ITU-T Recommendation E.164 international public telecommunication numbering plan into the Internet Domain Name System (DNS). At first glance a simple protocol, ENUM nevertheless raises a number of regulatory and policy issues. For a summary, see:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach14.doc (Attachment 14)
- ITU-T Recommendation E.164 Supplement 3
- ITU-T Recommendation E.164 Supplement 4

5.5 "IP telephony"[7]

"IP telephony" consists in using IP-based networks to provide voice transmission services that are more-or-less equivalent to traditional public switched telephone services. "IP telephony" may be considered to be simply an application provided over existing services; indeed, at present there is no formal definition of it as a service in ITU-T. Although "IP telephony" does not yet constitute a substantial percentage of the global worldwide telephony traffic volume, it is expanding rapidly as a result of the following technical motivations:

- The circuit-switched network was designed and optimized to provide a single product – full duplex 4 kHz switchable voice channels between points (64 kbit/s digital channels).
- Data, in general, are characterized by bursts of information rather than the constant bit rate flows typically associated with speech.
- Data burst can be most efficiently transported using packets of information that can be interleaved in time within a network with other packets being carried between other sources and destinations.
- For more than 40 years, voice has been digitally encoded into 64 kbit/s streams that can be transported over the 64 kbit/s channels. However, advances in voice coding permit a wide range of options, e.g. from 5-8 kbit/s to higher quality audio at 64 kbit/s. Multiplexing voice at a rate other than 64 kbit/s is difficult over the 64 kbit/s circuit-switched network. However, IP telephony subscribers need to interconnect with the approximately 2 billion worldwide classical telephony subscribers, and implementation of a transcoding mechanism makes it necessary to transform their lower bit-rate to the legacy 64 kbit/s encoding (much like what happened when the low-rate encoding of mobile networks was connected to fixed PSTN networks).
- Significant work has been performed in IETF, ITU and elsewhere to provide real-time capabilities using IP that permit voice to be transported over IP using the range of voice coding. Carrier-grade products that integrate those protocols are being introduced in the field to produce quality of service that satisfies customers. IETF and ITU are currently working on protocols that ensure that QoS constraints are met in a consistent manner in real time over a set of traversed networks.
- This flexibility to transport a variety of user information streams, i.e. constant and variable bit rate, different speeds, etc., allows packet-switching networks to evolve towards the objective of one integrated network for a wide range of applications.
- A single integrated network (packet-switching) can mean less operational and maintenance costs compared with multiple overlay networks. However, in the short term there may be additional expenses.

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7 This section is largely based on ITU-D's The Essential Report on IP Telephony (2003).

- In addition, the flexibility of packet-switched networks to accommodate new information streams, with a wide range of characteristics and based on IP and the host of open, standardized interfaces and languages available to it, allows the introduction of new applications providing new revenue streams. In some cases those capabilities should be the driver for the introduction of IP transport within telecommunication networks rather than the "reproduction" of existing telephony services.
- IP-based networks can use the same underlying lower layer transport facilities, i.e. twisted metallic pairs, cable, wireless, optical fibre, satellite. The evolution to IP-based networks can be accomplished economically by deploying IP-based packet switches/routers that can be connected by existing transport facilities. This was a tremendous vehicle for offering Internet access to mass markets in developed countries owing to the availability and ubiquity of those transport facilities; but this is not the case for developing countries, and provides them with good reason to increase their transport facilities towards developed countries in order to offer Internet access. However, in The Essential Report on IP Telephony, developing countries were advised to consider a checklist of factors which would help them in accelerating the introduction of IP networks at national level and for international connections. This is the checklist:

  1) Does the growth of telecommunication traffic and the relative proportions of voice and data support the introduction of "IP telephony"?
  2) Consider the need for know-how and training to deploy rapidly skilled personnel who are able to meet the technical, operational, management and policy challenges stemming from the new "IP telephony" environment.
  3) Universal service: Role of an "IP telephony" system in the provision of universal access/service.
  4) Affordable prices: What parameters should be taken into account for:
     - Prices of proposed "IP telephony" to be considered as being at a level to make the applications as widely utilized as possible,
     - Costs that affect the affordability of the service such as:
       - Interconnection charges
       - Reasonable transit charges, if applicable
       - Government charges (if any).
  5) Interconnection matters: Are there technical and/or operational limitations that would prevent interconnection, and what steps must be taken to resolve them?
  6) Numbering: What steps may need to be taken to implement the international numbering scheme for telephony systems (E.164 and/or ENUM).
  7) Consider the extent to which a system may prevent and/or identify unauthorized uses, means for identifying them, their impact on PSTN and other telecommunication service providers.
  8) Consider the impact of the operation of "IP telephony" on existing telecommunication networks and services and on their revenues, while weighing the overall benefit that may be derived from the introduction of "IP telephony".
  9) Consider those competition matters between IP-based systems and existing telecommunication networks and services to ensure a competitive environment.
  10) Consider the extent to which IP-based systems are able to provide for privacy and security of communications.

11) Consider the extent to which "IP telephony" is responsive to telecommunications requirements in cases of emergency.

12) Consider broad-based investment sources, including private-public partnerships and domestic and foreign sources, for the introduction of IP-based networks and services.

13) Consider non-discriminatory, transparent and efficient rulemaking processes which are consistent with the sustainability of new technologies.

Discussion and a publication of these topics can be found at:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach15.zip (Attachment 15)
- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach16.doc (Attachment 16)
- http://www.itu.int/ITU-D/e-strategy/publications-articles/pdf/IP-tel_report.pdf

6 Use of IP-enabled applications

The actual services provided to end users through the Internet are defined not through the routing mechanisms of Transmission Control Protocol/Internet protocol (TCP/IP), but depend instead on higher-level application protocols, such as hypertext transport protocol (HTTP); file transfer protocol (FTP); network news transport protocol (NNTP) and simple mail transfer protocol (SMTP). Because these protocols are not embedded in the Internet itself, a new application-layer protocol can be operated over the Internet through as little as one server computer that transmits the protocol data in the proper format, and one client computer that can receive and interpret the protocol data. The utility of a service to users, however, increases as the number of servers that provide that service increases.

By the late 1980s, the primary Internet services included electronic mail or "e-mail", Telnet, FTP, and Usenet news. E-mail, which is probably the most widely-used Internet application, allows users to send text-based messages to each other using a common addressing system. Telnet allows Internet users to "log into" other proprietary networks, such as library card catalogues, through the Internet, and to retrieve data as though they were directly accessing those networks. FTP allows users to "download" files from a remote host computer on to their own system. Usenet "newsgroups" enable users to post and review messages on specific topics.

Despite the continued popularity of some of these applications, in particular news and e-mail, the service that has catalyzed the recent explosion in Internet usage is the worldwide web (WWW). The web has two primary features that make it a powerful, "full service" method of accessing information through the Internet. First, web clients, or "browsers", can combine text and graphical material, and can incorporate all of the other major Internet applications such as FTP, e-mail, and news into one standard interface. Second, the web incorporates a "hypertext" system that allows individual web "pages" to provide direct "links" to other webpages, files and other types of information. Thus, full-scale user interfaces and complex services such as online shopping, continuously-updated news information and interactive games can be provided through the Internet over a non-proprietary system. The web thus plays an important role in many of the new Internet-based applications that are now being developed.

New technologies have at their core a new set of applications that they can provide to consumer, business and government users. The introduction of these new applications necessitates consideration of various public policy issues. As noted earlier, national policies will vary depending on various factors, including state of development, tradition, legal regimes, equitable access, etc.

This section identifies and describes some of these new applications and provides some case studies of implementation. Case studies and information on implemented projects can be found at:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach03.doc (Attachment 3)
- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach04.doc (Attachment 4)
- http://www.itu.int/ITU-D/e-strategy/e-applications/

6.1 E-learning and other uses of Internet in education

Distance learning is a topic that has been high on the agenda of governments for years. More recently, the growth of the Internet and the penetration of broadband have allowed cheaper and content-richer delivery of educational content (already available but not within reach): whereas before, distance learning was based on television broadcasts or the use of leased lines or ISDN videoconferencing, distance learning over the Internet offer governments, companies, institutions and individuals new possibilities. These possibilities go beyond simply imitating the one-way delivery of content of the past, but allow the creation of truly interactive and multimedia approaches to distance learning.

E-learning covers a wide set of applications and processes which use all available electronic media to deliver vocational education and training. The term covers computer-based learning, web-based learning, and the use of mobile technologies; it includes virtual classrooms and digital collaboration and uses. There are many identifiable drivers for information and communication technologies (ICT)-enabled and more recently information and learning technologies (ILT)-enabled instruction, and these may be classified as technical innovation, organizational and business developments, or the characteristics of the needs and demands of the individual learner.

Online or web-based learning (learning via the Internet, intranets and extranets) is increasingly understood to be a subset of e-learning (technology-supported learning).

E-learning is becoming an integrated and critical component of corporate knowledge management and performance enhancement, and return on investment is measured in that context. The success of e-learning can be electronically related to business successes, and more businesses will recognize e-learning's ability to build knowledge and develop skills while reducing training-related costs. Within corporate training, there is a sound understanding of how to exploit these linkages.

The term "e-learning" is used also in further and higher education to describe the use of the web and other Internet technologies to enhance the teaching and learning experience.

The e-learning solutions are:

- Simple informational solutions (http://www.e-learningcentre.co.uk/guide2elearning/2-1/index.htm)
- e-books and e-textbooks (http://www.e-learningcentre.co.uk/guide2elearning/2-2/)
- Streaming media and presentations (http://www.e-learningcentre.co.uk/guide2elearning/2-3/index.htm)
- Live e-learning events (http://www.e-learningcentre.co.uk/guide2elearning/2-4/index.htm)
- Interactivity and testing (http://www.e-learningcentre.co.uk/guide2elearning/2-5/)
- Games and simulations (http://www.e-learningcentre.co.uk/guide2elearning/2-6/index.htm)
- Online courses and tutorials (http://www.e-learningcentre.co.uk/guide2elearning/2-7/index.htm)
- Learning by e-mail (http://www.e-learningcentre.co.uk/guide2elearning/2-8/index.htm)
- Collaborative learning (http://www.e-learningcentre.co.uk/guide2elearning/2-9/index.htm)

6.2 E-government[8]

It is widely accepted that public administrations should use ICT tools to enhance transparency, democracy, accountability and efficiency – at all levels of government, and in particular at the local level:

- In the delivery of public services to citizens and enterprises.
- In the design of online services, adapted to the needs of citizens and businesses.
- In the better management of financial, human and public resources and goods.

Provision of information and services via the Internet (in particular, via the worldwide web) will increase the use of Internet by citizens in each country and should, as a consequence, stimulate demand for private companies to provide information and services via the Internet. Thus, if the governments of developing countries play a leading and model role in the use of the Internet, this could create a "virtuous circle" in which other components of society are motivated to increase their use of the Internet, for the benefit of all citizens. ITU-D has implemented a number of e-government projects (e.g. Azerbaijan, Bhutan, Bosnia Herzegovina, Bulgaria, Georgia, Mongolia, Paraguay and Uzbekistan) aimed at increasing efficiencies in the way governments work and in delivering online services to citizens and businesses. Further information can be found at: http://www.itu.int/ITU-D/e-strategy/e-applications/.

6.3 E-health

E-health can be defined as the use of information and communication technologies (ICT) and in particular the Internet to improve or enable health and healthcare. Indeed, e-health represents the combined use in the health sector of electronic communication and information technology (digital data transmitted, stored and retrieved electronically) for clinical, educational and administrative purposes, both on site and remote. This is a complex subject that has important cultural, technical and regulatory components and whose relevance increases as cheaper information technology (IT) resources become available and integrated into society. In particular, the faster penetration of broadband and the deployment of local area networks (LANs) inside the hospital, combined with smart instrumentation and powerful IT equipment, has opened up the potential for integration between point-of-care devices and databases defining a treatment, the implementation of alarm systems used by the nurses running a facility, the integration and consolidation of laboratory results and patients' records, associated billing, etc., irrespective of distance or geography. The basis of this revolution in-the-making is the popularization of IP technologies.

E-health resources can help:

- *Improve health status* by supporting healthy lifestyles, improving health decisions and enhancing healthcare quality;
- *Reduce healthcare costs* by improving efficiencies in the healthcare system and prevention;
- *Empower people* to take greater control of their health by supporting better-informed health decisions and self-care;
- *Enhance clinical care and public health services* by facilitating health professional practice and communication; and
- *Reduce health disparities* by applying new approaches to improve the health of underserved populations.

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8 This section is based on the input papers and conclusions of the 5-6 June 2003 ITU-T Workshop on Challenges, Perspectives and Issues in E-Government Standardization, see http://www.itu.int/ITU-T/worksem/e-government/index.html.

Ensuring access to and quality of e-health resources will be central to realizing and maintaining health in the future.

The concept of e-health is widely adopted to describe the application of ICTs across the whole range of functions which, in one way or another, affect the health of citizens and patients. Such an activity can be summarized in three main "streams" of actions:

- Delivery of care to patients by healthcare professionals
- Health-related information
- Trading health products

6.3.1 E-health applications

A wide range of potential applications of ICTs are now available in the health field and have been implemented to varying degrees within many developed countries. These include systems ranging from the purely administrative to those for care delivery.

6.3.2 Retrieval of health and medical information by citizens and institutions

Another new but important trend is the retrieval of health and medical information by citizens. The Internet also provides a useful medium not only for commercial information providers such as publishers, but also for official bodies seeking innovative ways to support public health education campaigns.

6.3.3 Case studies and current standardization work

Some case studies highlight experiences with the implementation of pilot e-health projects; see http://www.itu.int/ITU-D/fg7/case_library/Categories.asp#3.

The recently created e-Health Standardization Coordination Group (eHSCG) has been discussing how to further foster standardization in e-health and has collected information in this area; for more information, see http://www.ehscg.org/.

6.4 E-commerce

E-commerce is the use of electronic systems to engage in commercial activities. Businesses use e-commerce to buy and sell goods and services, create greater corporate awareness and provide customer service. A detailed tutorial of issues and developments is given at:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach04.doc (Attachment 4)
- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach17.doc (Attachment 17)

6.5 E-agriculture

The electronic medium has now begun to assume an important role in every economic activity.

Emphasis has always been on electronic business/e-commerce, with the focus on trade in manufactures; but increasingly other productive sectors have begun to benefit from the use of ICT, and effective applications can certainly produce significant increases in efficiency and productivity.

ICT can be utilized to optimize and assist in decision making. The potential of ICT can be fully exploited and benefited from only if the necessary infrastructure is well in place in order to enable its productive application and ensure that, as a tool, it is appropriately and efficiently utilized.

The e-market in a global market means trust entities working in the trust domain. Agencies and governments have to "create" the infrastructure required to certify entities and products, from the farm producer to the market.

ICTs for product-tracking have already been used successfully; see: http://www.ipv6style.jp/en/action/20030328/index.shtml.

ITU-D successfully launched an IP-based e-agriculture project in rural Kyrgyzstan. For more information please visit: http://www.itu.int/ITU-D/e-strategy/e-applications/Kyrgyz/index.html.

In addition, governments are involved in building wireless network backbone infrastructures able to provide connectivity among national and international communities. This is one of the main targets in regions and in least developed countries. With increased information flow, intraregional and interregional trade has led to partial improvement in the quality of life of the people of poor regions.

6.6 E-broadcasting: broadcasting over the Internet

The Internet is a natural medium for broadcasting, given its architecture. Information on the broadcasting of digital multimedia content can be found in:

- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach18.zip (Attachment 18)

6.6.1 Broadcasting of radio programmes

It all started with music CDs: they started delivering pristine quality music for the mass consumer market. With the advancement of audio compression techniques, the most popular being "MP3" files (the popular designation for the Moving Picture Expert Group (MPEG) MPEG2/Layer 3 audio compression scheme), digital audio came into everyday parlance. The advancement of digital signal processing devices, allowing the creation of cheap real-time encoders, together with the availability of extensive MP3 content, has stimulated the creation of the "digital age short-wave radio", able to provide listening round the globe. As the bandwidth required for audio transmission is much lower than for video (a V.90 PCM modem dial-up connection can suffice), Internet radio broadcasts were an early entrant in the suite of Internet applications explored by the Internet users. Of course this use of the Internet raises intellectual property issues that are being studied at the national and international levels.

6.6.2 Video streaming

TV broadcasting used to be a monopoly for over-the-air or cable TV networks, because of the sheer bandwidth that video signals required for a quality transmission – be it analogue or digital. However, the penetration of the broadband Internet and more importantly the development of new image compression techniques such as ITU-T H.264 | MPEG4/AVC have allowed the delivery of broadcast-quality content using ADSL links or other bandwidth-richer copper access network technologies. In several countries, traditional telephone companies are considering, planning or experimenting with offering services that are similar to, or even richer than, those offered by traditional cable TV operators.

With streaming media, you can offer video and audio over the Internet or over a variety of LANs (local area networks) and WANs (wide area networks). The streaming video can be a live broadcast of an event or presentation, or an 'on-demand' playback of a pre-recorded video.

Streaming video is becoming increasingly popular in the corporate world. It has become the most popular way to communicate over a company Intranet to employees and over the Internet to customers. The most common uses of streaming content are in:

- Product demos, launches and updates or service demos
- Communication with the branch offices in a company
- Sales updates
- Online training programmes

- Company presentations
- Board meetings
- Conferences with the clients
- News and entertainment

6.6.2.1 How does streaming work?

Suppose you are interested in keeping your sales force up-to-date with a new product and your sales force is distributed across the seven seas. Getting them across to your place is not an option because the time and expenditure involved in travelling are not worth the cost of the product at this stage. One of the options is to send the product details in the form of a product demo across to each person over the web. But this product demo involves heavy files and multimedia applications that take time to download over the web. What is the solution here?

Content that is streamed in the form of packets and is downloaded while the viewer looks at a small section of an already downloaded part may be one way to avoid those long waits. This in technological parlance is called streaming.

6.6.2.2 How can streaming help?

In general, the best way of presenting the product or service to a client is by talking to him in person and presenting your product. You can add the same features on your website by offering more interactivity and personalized services to your customers. After all, we do know that a website that makes its visitors linger on and read and study it more tends to make loyal customers.

One of the most promising areas for corporate streaming is in web conferencing. This has the capacity to fundamentally change the way people communicate and work together in the workplace. It enables knowledge sharing and collaboration between people who have not met each other. See:

- http://www.multibandofdm.org/presentations.html

6.6.3 Web/netcasting

Web/netcasting is difficult to define precisely. People understand different things under the same title. In § 6 we have presented almost all techniques concerning the Internet and/or web. Webcasting is included in those technologies. However, to try to extract some specifics about webcasting, we propose to rename it "videoconferencing". This classification is seen rather from a strategic point of view than from a technological point of view because, in the end, all the different technologies associated with an "e-broadcasting" system are mixed together and used (sometimes misused) to provide solutions in different Internet application fields.

The success of projects and initiatives can depend on how we access and share the latest news, ideas and information. The video system allows the sharing of information with other groups, individuals and communities across the globe as if people were meeting in the same room, helping them to get the most out of their education and business communications.

6.6.3.1 What is videoconferencing?

Videoconferencing is an interactive form of real-time telecommunication that uses screens, in addition to a sound link. This TV-style linking allows you to hold meetings, and discussions and give presentations without having to leave your place of work, thus helping you to save time and money.

6.6.3.2 Uses of videoconferencing

One-to-one communication

This is the simplest form and is the type of conferencing most commonly associated with desktop PC conferencing. This is simply one person talking to another.

One-to-many communication

This may take the form of a broadcast from one site that is then transmitted to several other sites. A good example of this may be a presentation or educational lecture to a number of students.

Many-to-many communication

This is the most complex form of videoconferencing and is mostly associated with room-based videoconferencing technology. In this case several parties (more than 2) are involved in the conference, and all can be seen and heard.

6.6.3.3 Why use videoconferencing

There are many benefits to using videoconferencing:

- one can communicate more regularly with people in other districts or countries, which would usually be costly or impossible if somebody had to travel
- it is possible to videoconference with many more people than would fit into a single meeting room because each party will be using their own facilities
- videoconference communication and meetings are often much shorter in total as no travel is involved. A meeting that may take people away from work for four hours (due to travel) may take only one or two hours using a videoconference
- using videoconferencing saves money as it can lower expenses – there is no need for all the costs involved with travelling, such as meals and tickets
- a telephone call or e-mail is not always the best way to communicate with another person. Interactive meetings can help to generate ideas, and enable people to read and react to others' sensitivities
- videoconferencing allows for collaboration by document sharing. Many people in different areas can work on the same project and make contributions
- many institutions can receive the same broadcast simultaneously, and thus a much greater level of participation can be gained. For example, a lecture being broadcast to students at many different educational institutions.

Some wider benefits of videoconferencing:

Videoconferencing can also help to:

- enhance the distance-learning experience and support by putting people in touch with other learners in different geographical regions and/or with lectures in the university and other governmental institutions
- create and develop a useful dialogue with governmental and institutional education providers
- collaborate more with worldwide experts on various projects
- sustain and develop existing e-projects, designed by and for third-world countries.

Some references:

- http://www.strategiccomm.com/videoconf.html
- http://www.abiresearch.com/reports/ASBB42.html

6.6.4 Narrowcasting

6.6.4.1 What is narrowcasting?

To send data to a specific list of recipients. Cable television is an example of narrowcasting since the cable TV signals are sent only to homes that have subscribed to the cable service. In contrast, network TV uses a broadcast model in which the signals are transmitted everywhere and anyone with an antenna can receive them.

The Internet uses both a broadcast and a narrowcast model. Most websites use a broadcast model since anyone with Internet access can view the sites. However, sites that require you to log-in before viewing content are based more on the narrowcast model. The various push technologies are another form of narrowcasting. Perhaps the best examples of narrowcasting are e-mail lists where messages are sent only to individuals who subscribe to the list.

The terms *multicast* and narrowcast are often used interchangeably, although narrowcast usually refers to the business model whereas multicast refers to the actual technology used to transmit the data for all.

6.6.4.2 Some properties of narrowcasting:

- Like the telephone, it allows interactive dialogue, but in the form of local to worldwide real-time many-to-many dialogue
- Unlike radio and TV it is more than monologue
- Like the telephone, its reach may be local, regional, national or worldwide
- Created and maintained "correctly", a narrowcasting channel will remain community-owned and -operated

For further information, see:

- www.8mg.jp/en/sice2004/SICE2004Presentation.pdf
- Narrowcasting market analysis by Norman McLeod (http://www.digitalsignagedirectory.com/articles/article.asp?name=narrowcasting)

6.6.5 Some general remarks

The widespread adoption of broadband access over the last few years has made the provision of telecommunication broadband-based added value services economically viable. The authoritative report weblinked below examines the growing market opportunity for these services and how each of the key areas will develop. It provides a detailed analysis of both the business and residential sectors, and includes market sizing and forecasting for seven key applications across six geographic regions:

- Business – hosting; storage; VoIP; VPNs
- Residential – games; music; video services; VoIP
- Packed with market data, case studies and mature analysis, this report provides a high-quality guide to where the sector stands today, and how it will develop over the next five years. (See more at http://www.juniperresearch.com/)

Finding the right partner that delivers IP telephony without sacrificing flexibility, reliability, security and interoperability – all while leveraging existing investments – is the key.

6.6.6 How to chose the right network capacity

As enterprises grow and change, their network becomes increasingly more important in helping them to handle more users, meet heavier demands, address possible security issues and respond to their customers in a timely way. The days of simple network changes and upgrades are long gone. Today's enterprises have an increasingly integrated, multi-vendor approach to communications infrastructure and technology.

Networks become more complex every time new network applications are added. For example, converged voice and data systems offer tremendous business benefits, but they are much more complex than standard data networks to get up and running. And multiple vendors can multiply the complexity. In today's economy, our customers seek to leverage existing investments they have already made on their networks – with a minimum of additional costs. They also want to realize the full value of new investments to contribute to their business success, but that becomes complicated as new features are introduced to a network, such as IP telephony. All of these factors can be addressed with a comprehensive consulting and integration process, beginning with an IP network readiness assessment.

6.6.7 How to ensure the successful implementation of a given telecommunication solution without over-committing internal resources

In the words of Dr Jim Metzler, president of Ashton Metzler & Associates, "Enterprises that are content with an 'on-the-fly' approach to installation and integration should prepare themselves for the inevitable – budget over-runs due to costly rework, big misses on the Consulting and Integration schedule, and worst of all – deteriorated end-customer support." Programme management expertise, as an onsite interface, is essential for large-project planning, controls and documentation, in order to deliver coordinated consistency in complex network implementations across a multi-site network.

The broadcasting system provider should have network experts who can augment the customer's own technical resources allowing him to keep his resources focused on supporting his enterprise's critical functions. Upon completion of the project and final hand-over, the broadcasting system provider experts provide the appropriate level of knowledge transfer to the customer resources, teaching them the industry best practices employed to ensure the success of the customer communications solution.

6.7 Other e-applications

Further information can be found at:

- http://www.itu.int/ITU-D/e-strategy/e-applications
- http://www.itu.int/ITU-T/special-projects/ip-policy/final/Attach19.zip (Attachment 19)

7 Conclusion

As mentioned at the beginning, the purpose of this handbook is to inform Member States, especially developing countries, on issues related to IP-based networks. The material presented does not represent the opinions or views of ITU members or the ITU as an institution but instead attempts to portray a factual representation of today's environment. There are differing views amongst ITU members regarding support for the current structures and institutions associated with IP-based networks.

8 Sources of further information: suggested reading and useful online resources[9]

As the handbook will be one of a variety of existing global resources on the subject, a section that provides information for further reading and online resources would be helpful to the reader.

8.1 Reports (with URLs) to be visited

Advanced Telecommunications in Rural America: The Challenge of Bringing Broadband Service to All Americans. United States Department of Commerce, National Telecommunications and Information Administration and United States Department of Agriculture, Rural Utilities Service: http://www.digitaldivide.gov/reports.htm

Connecting the Globe: A Regulator's Guide to Building a Global Information Community. United States Federal Communications Commission: http://www.fcc.gov/connectglobe/

Internet Economic Toolkit for African Policy Makers. World Bank: http://www.infodev.org/projects/finafcon.htm

The Information for Development Program: Encouraging the Use of ICTs in Developing Countries. World Bank: http://www.infodev.org/library/dalywp.pdf

The Right to Communicate: At What Price? Economic Constraints to the Effective Use of Telecommunications in Education, Science, Culture and in the Circulation of Information. ITU and UNESCO: http://unesdoc.unesco.org/images/0010/001008/100803e.pdf

The Networking Revolution: Opportunities and Challenges for Developing Countries: Are Poor Countries Losing the Information Revolution? World Bank: http://www.infodev.org/library/working.htm

World Development Report 1998/1999: Knowledge for Development. World Bank: http://www.worldbank.org/wdr/wdr98/contents.htm

World Telecommunication Development Report 1998. ITU: http://www.itu.int/ti/publications/WTDR_98/index.htm

World Trade Organization Reference Paper on Basic Telecommunications. World Trade Organization (WTO): http://www.wto.org

ITU-D Question 16/2 – Handbook on New Technologies and New Services: http://www.itu.int/publibase/catalog/index.asp

8.2 Websites to be visited

APEC Telecommunications & Information Working Group's Development and Financial Resources Information website: http://www.apectelwg.org

Global Connectivity for Africa: http://www.worldbank.org/html/fpd/telecoms/gca.htm

Global Internet Policy Initiative (GIPI): http://www.gipiproject.org

ITU Development Sector (ITU-D): http://www.itu.int/ITU-D/index.html

ITU Development Sector (ITU-D), Study Group 2, Rural Applications Focus Group, Case Library: http://www.itu.int/itudfg7

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9 Website addresses valid when this handbook was prepared.

ITU Development Symposium for Regulators:
http://www7.itu.int/treg/Events/Seminars/2000/Symposium/English/documents.html

ITU Internet Case Studies: http://www.itu.int/ti/casestudies/index.htm

ITU World Telecommunication Policy Forum: IP Telephony: http://www.itu.int/osg/spu/wtpf

The Internet Society: http://www.isoc.org

The Internet Corporation for Assigned Names and Numbers (ICANN): http://www.icann.org

The National Telecommunications Cooperative Association, International Department
http://www.ntca.org/intlconf/report_main.html

United States Government's Closing the Digital Divide Website: http://www.digitaldivide.gov

World Bank's Information for Development Program: http://www.infodev.org

World Bank's Investment Promotion Network: http://www.ipanet.net

NOTE:

Electronic versions of "A Handbook on Internet Protocol (IP)-Based Networks and Related Topics and Issues" and its 19 attachments (in English) are available at
http://www.itu.int/ITU-T/special-projects/ipe-policy/final/

A Handbook on Internet Protocol (IP)-Based Networks and Related Topics and Issues

Attachment 1 – The Main Issues Surrounding The Internet

Attachment 2 – IP Policy Manual – Contribution from France

Attachment 3 – IP Policy Manual – Contribution from Estonia (010)

Attachment 4 – A Guide to Global E-commerce Law

Attachment 5 – White Paper – Internet Korea 2004

Attachment 6 – IP Policy Manual – Contribution from ECC of CEPT (009)

Attachment 7 – Internet domain names and addressing

Attachment 8 – Pv6

Attachment 9 – IPv6 Contribution at WTDC 2002 – Internet for everyone IPv6 2005 Roadmap Recommendations

Attachment 10 – Additional information on ccTLDs

Attachment 11 – IP Policy Manual – Contribution by Richard Francis

Attachment 12 – Model regulation or law for ccTLDs

Attachment 13 – Internationalized domain names (IDN)

Attachment 14 – ENUM

Attachment 15 – IP Telephony and Voice over IP (VoIP)

Attachment 16 – ITU-D: E-Strategies – Activities and Progress Report

Attachment 17 – Enabling E-Commerce

Attachment 18 – E-Broadcasting: Broadcasting over the Internet

Attachment 19 – The Essential Report on IP Telephony

International Telecommunication Union
Place des Nations, CH-1211, GENEVA 20
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