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OECD INPUT TO THE UNITED NATIONS WORKING GROUP ON INTERNET GOVERNANCE (WGIG)

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FOREWORD

This report was prepared as an input by the OECD to the United Nations Working Group on Internet Governance (WGIG), in the context of activities by the WGIG "to investigate and make proposals for action, as appropriate, on the governance of Internet" for consideration and appropriate action at the second phase of the World Summit on the Information Society (WSIS) in Tunis on 16-18 November 2005. This report was presented to the OECD Committee for Information, Computer and Communications Policy (ICCP) in March 2005, which agreed to its declassification through a written procedure in April 2005. It was prepared by Ms. Karine Perset of the OECD's Directorate for Science, Technology and Industry, with the participation of Mr. Dimitri Ypsilanti of the OECD's Directorate for Science, Technology and Industry. This report is published on the responsibility of the Secretary-General of the OECD.

As a complement to this report, the OECD has created an online resource, www.oecd.org/internetgovernance, linking to relevant work conducted by the OECD on public policy issues related to Internet governance.

MAIN POINTS

1. This document *i)* presents an overview of the major benefits that the developments of the Internet and ICTs provide to both OECD economies and non-OECD countries' economies; *ii)* briefly reviews the evolution of the Internet and the parallel evolution of Internet governance from the 1960s until today; *iii)* provides the OECD's perspective on the factors that were instrumental to the successful development of the Internet; and *iv)* finally, provides information on the relevant work conducted by the OECD on policy issues related to Internet governance as per the "Internet governance" public policy areas identified by the U.N. Working Group on Internet Governance.

2. The Internet is the publicly available worldwide system of interconnected computer networks that transmit data by packet-switching using a standardised interconnection and transport protocol and many other protocols; by extension, it is considered as the "network of networks". Its neutrality enables the network's intelligence to reside fully at the networks' ends through applications in computers, servers, mobile and other devices. Vibrant developments around the Internet have been a breeding ground for a wide range of new ICT activities, industries and services "at the ends." Hence, the Internet's many benefits should be considered within the wider context of the impact of the Information and Communication Technology (ICT) sector on economies and society.

3. The Internet and the wider ICT sector provide the platform for societies to evolve towards the Information Society. In the OECD countries, ICTs have had, and continue to have, a significant and wide-ranging beneficial impact on economies and societies. ICTs are mainstreamed throughout OECD economies as a whole and contribute to social goals and to economic growth in terms of the impact of ICT investment on productivity. Non-OECD countries are increasingly benefiting from connection to the Internet and increasingly participating in the information society: in terms of users, non-OECD countries have nearly as many users as OECD ones, albeit less active, and often connected at lower speeds. With competition, international bandwidth prices have been decreasing significantly everywhere. Developing countries can take advantage of innovation and economies of scale in infrastructure and technology to leap-frog into the information society. Liberalising their telecommunications and ICT markets is key to facilitating new investments, stimulating new services and creating more efficient markets. ICTs can also contribute to development goals: for example, by reducing transaction costs and helping to deliver information services to health or education providers, or to citizens.

4. A historical lens is useful to appreciate the transformation of the Internet from a research project to a widespread commercial infrastructure, as well as the associated evolution of mechanisms to coordinate Internet resources. The Internet is the result of a collaborative effort by computer scientists from the 1960s onwards. It originated from the concept of open architecture networking formulated in 1972 which created a more versatile protocol than that of the first network launched in the 1960s by the US Department of Defence, ARPANET. In the 1980s the current version of the Internet protocol was developed and rolled out, and the current architecture defined. In the 1990s, the National Science Foundation pursued a strategy to commercialise the Internet backbone. With the advent of the World-Wide Web and commercial browsers, growth in Internet use and domain name registrations was impressive. Combined with large-scale infrastructure deployments triggered by the liberalisation of telecommunications markets as of the mid-1990s, competition in new software, PCs and Internet Service Providers enabled the Internet to become a considerable commercial success. The end of the 1990s and early 2000s saw global widespread use of Internet, with close to one billion Internet users connected in 2004[1] and increasingly pervasive IP-based supporting infrastructure, including mobile phones. Evolving domain name protocols and management of internet resources supported this impressive growth.

5. Management of the domain names system and Internet addressing, synchronised since 1998 largely by the Internet Corporation for Assigned Names and Numbers (ICANN) and by several institutions previously, has succeeded in maintaining security, innovation and stability of the Internet, while enabling its scalability to support high growth rates and meet increasing security threats. ICANN has been instrumental in establishing a dynamic registrar market, introduced some level of competition among registries, and adopted a dispute resolution process which applies to some top-level domain names. Furthermore, ICANN's organisation and institutions seem to be evolving to represent more stake-holders. At the same time, ICANN's Governmental Advisory Committee (GAC) is evolving to represent more governments, including governments of developing countries, and develop its role as an advisor for issues of public policy concern that might have an impact on the coordination of Internet naming and numbering.

6. Several factors emerge as having enabled the widespread success of the Internet:

- **Private sector competition and innovation enabled by liberalising markets**: Private sector initiatives driven by market demand and competition have by-and-large enabled the widespread development of the Internet, as the private sector has largely built, operated, and maintained Internet infrastructure, products, content, and services. Developed in a competitive environment, the Internet has spurred innovations and entrepreneurship in applications, technologies and in services. For businesses and consumers, innovations and competition among suppliers have served to increase service offerings, affordability and accessibility. Non-governmental bodies, often private-sector led, were created to manage the co-ordination of the Internet's technical framework. These include standards bodies and industry associations, as well as voluntary associations.

- **Lightweight governmental and intergovernmental oversight**: The Internet has flourished essentially because most countries have recognised the need to avoid introducing unnecessary regulatory burdens on the Internet. However, interventions by governments and regulatory agencies, such as the liberalisation of telecommunications, the liberalisation of value-added information services using telecommunications facilities, or obligations requiring network interconnection, have enabled competition and growth in access to Internet based services.

- **Decentralised and collaborative process of underlying technological development and core resource management**: Co-ordination and co-operation across a broad range of stake-holders has enabled the current open network in which different components of the Internet can interoperate. Overall, the governance and decision-making processes of the Internet have been multi-stakeholder, mostly bottom-up, participatory and transparent, with limited government intervention. No single person, organisation or country manages the Internet. Instead, the Internet's technological management is handled by many entities, which work within a co-ordinated and overall open framework. This co-operation has helped to ensure the security and stability of the network and avoid the bottlenecks inherent to centralised network architectures. The technological development and administration of the Internet is involved in ensuring that the network is interoperable, functional, stable, secure, efficient, as well as scalable in the long run.

- **A distributed/decentralised, open architecture**: The Internet is made up of tens of thousands of interconnected networks run by Internet Service Providers, individual companies, universities, governments, and others, which can communicate together. The key underlying technical idea is that of open architecture networking in which any type of network anywhere can be included. There is a clear separation between the underlying physical medium, the network transport and interconnection (Internet protocols), and the application technology, which is processed by devices connected at the ends of the network. Many view it as important that the Internet remain open and publicly available.

- **Open, non-proprietary nature of the core Internet standards**: Most of the protocols at the core of the Internet are protocols based on open standards that are efficient, trusted, and open to global implementation with little or no licensing restrictions. The protocol specifications are available to anyone, at no cost, thus considerably reducing barriers to entry, and enabling interoperability. Organisations, such as the Internet Engineering Task Force and the related Internet Architecture Board or the World Wide Web consortium, which administer Internet and WWW standards, have operated independently, in an open, participatory and consensus-driven manner.

7. In public policy areas, governmental and intergovernmental intervention has taken place in order to deal with specific issues that might hinder access or use of the Internet. Among others, the OECD has made strong contributions in several critical public policy areas related to the Internet, such as security, privacy, telecommunication policy, universal access, consumer protection, e-commerce, and broader information economy issues. Web links to OECD publicly available reports and their findings are available at www.oecd.org/internetgovernance.

8. Internet governance has recently raised significant interest around the world, triggered by discussions at the 2003 World Summit on the Information Society (WSIS) around the "international management of the Internet" and the role of all stakeholders in the process. The discussions led to the creation of a Working Group on Internet Governance (WGIG), and offer the opportunity for including new, informed actors in the dialogue on Internet governance processes and priorities. They also hold promise to trigger better co-ordination amongst all stake-holders in areas such as helping to ensure a culture of security, preventing crime, and ensuring the development of education and skills for people to engage in the information society.

ICT/INTERNET-INDUCED BENEFITS

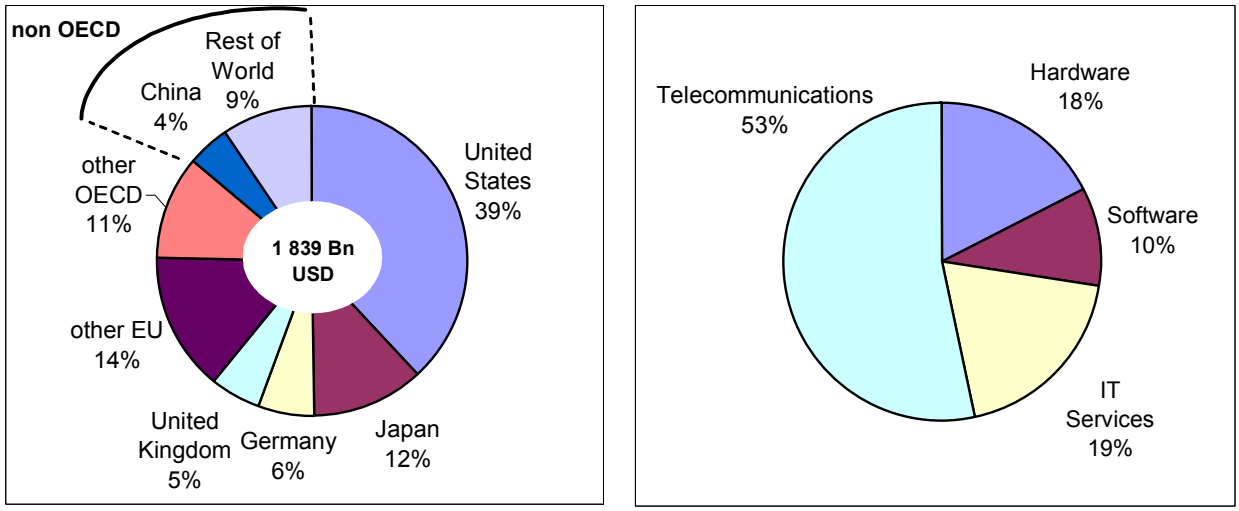
9. The Internet is now a general purpose network communication system which benefits economies and societies across OECD and non-OECD countries. Many ICTs (information technology, telecommunications technologies, and networking technologies) are converging on the Internet, using Internet Protocols, and becoming part of the "network of networks." The Internet's decentralised, distributed, packet-based mode of transportation facilitates this interconnection with other technologies.

10. Advancement of ICT, including the Internet, has benefited the OECD countries the most, with increased productivity as a long-term outcome of ICT investment as their most significant impact on economic growth. In 2003, the worldwide ICT market was worth over 1.8 trillion USD worldwide, of which OECD countries accounted for 87%, as shown in Figure 1.

11. Nonetheless, non-OECD countries are set to benefit increasingly from ICTs and the Internet as countries such as China, India, Russia, and Brazil are driving the greatest growth in Internet markets[2].

Figure 1. Worldwide ICT market*, 2003

By country/region (left-hand side) and by segment (right-hand side)



*. Expressed in 2002 USD.

Source: OECD (2004), "Information and Technology Outlook 2004", Chapter 1: Recent Developments and Outlook, based on International Data Corporation (IDC), 2004.

Leveraging ICT/the Internet in OECD countries

Growth in Internet usage in OECD countries

12. The numerous possibilities offered by the Internet are benefiting individuals, businesses, the health and education sectors, social and public interest organisations, as well as governments. As mentioned above, the Internet is an enabling technology which has facilitated the inter-working of many ICT products and services. It is difficult to isolate the direct economic impact of the Internet, however, as an important part of ICT, the findings given below are relevant.

Box 1. Salient figures of Internet growth in OECD Member countries

Internet subscribers

By 2003, on average 23 per 100 inhabitants across OECD countries had a fixed Internet subscription, up from 9.5 per 100 inhabitants in 1999. Annual growth in the number of subscribers to fixed Internet connections in OECD countries has averaged 26% from 1999 to 2003: there were around 264 million subscribers at the end of 2003, up from around 106 million in 1999[3].

High-speed and broadband

In particular, the number of broadband connections is increasing rapidly, with average annual growth of 77% per annum from 2000 to 2003: at the end of 2003, almost 84 million subscribers connected to the Internet via broadband connections and, by the end of August 2004 broadband subscribers had passed 100 million.[4] Broadband, and its "always on" capacity, is driving new economic models and tariffs, as well as new behaviour by users, including access to entertainment services.

Mobile and portable Internet access[5]

Mobile Internet access is now also becoming increasingly common. As an indication, there were almost 44 million i-mode subscribers in OECD countries by mid-2004 and, with the growth in 3G (IMTS-2000, UMTS) during 2003 and 2004, mobile internet access is expected to increase.

On the operator side, mobile data revenues now regularly account for over 20% of all revenue from mobile services, in particular due to SMS and MMS. Mobile Internet connections and portable Internet access, including wireless (Wi-Fi) hotspots, also play an important part.

Growth in Internet hosts

A host is a domain name that has an Internet protocol address record associated with it and would include computers connected to the public Internet. The number of hosts, or domain names with an associated IP address, is indicative of the minimum size of Internet since a number of host devices cannot be accessed by automated surveying techniques because of security firewalls. In January 2004, there were 233 million hosts connected to the Internet worldwide, up from less than 30 million in January 1998 [6]. The total number of hosts worldwide increased 41% per annum between 1998 and 2004, with those under gTLDs increasing 49% per annum and those under OECD related ccTLDs increasing 28% per annum.

E-commerce becoming an important part of OECD member countries' economies

In July 2004, Netcraft's SSL survey found 324 816 secure servers worldwide, of which 94% (305 939) were in OECD countries. With the number of secure servers located in OECD countries increasing by 58% per annum between July 1998 and July 2004, there were almost 27 secure servers per 100 000 inhabitants across OECD countries in July 2004, up from 1.8 per 100 000 in July 1998[7]. Netcraft's SSL surveys provide one of the best indicators of the growth and diffusion of a major platform used for e-commerce since the most common use of Secure Socket Layer (SSL) protocol, developed by Netscape for encrypted transmission over TCP/IP networks, is to provide a secure end-to-end link for e-commerce transactions. Indeed, major e-commerce uses of secure server software include encrypted credit card transactions in payment applications and restricted access to privileged information both within and between organisations.

Domain name registrations

The registration of domain names indicates interest in adopting a web presence, and is one indicator of the development of the Internet. The number of domain name registrations under major gTLDs and the ccTLDs of the OECD member countries have increased rapidly over recent years. In mid-2004, there were more than 64 million domain names registered worldwide, of which 40 million were registered under major gTLDs and 21 million under OECD related country code top level domains (ccTLDs). From mid-2000 to mid-2004, the number of registered domain names has increased by around 19% per annum, with faster growth in registrations of OECD related ccTLD than in gTLD registrations.

Productivity impact and contribution to economic growth[8]

13. OECD research has identified three areas where ICT has impacted on economic growth in OECD countries.

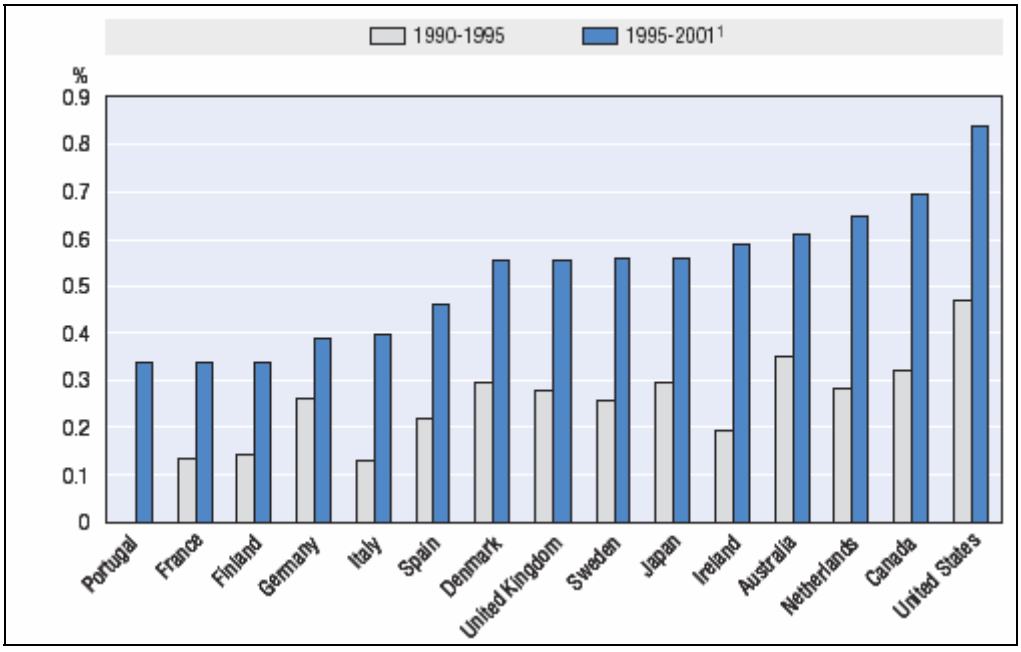
14. First, investment in ICT adds to the capital stock that is available for workers and thus helps raise labour productivity. ICT investment accounted for between 0.3 and 0.8 percentage point of growth in GDP per capita over the 1995-2001 period, with the United States, Canada, the Netherlands and Australia receiving the largest boost (Figure 2). Investment in software accounted for up to a third of the contribution of ICT capital.

15. Second, the ICT-producing sector plays an important role in some OECD countries, although it is small in most countries. Having an ICT-producing sector can be important, since it has been characterised by rapid technological progress and very strong demand. In Finland, Ireland and Korea, close to 1 percentage point of aggregate labour productivity growth in the 1995-2001 period was due to ICT manufacturing.

16. Third, evidence from an OECD-led consortium of researchers in 13 OECD countries demonstrates that the use of ICT throughout the value chain contributes to improved firm performance. The smart use of ICT can help firms increase their overall efficiency in combining labour and capital, or multi-factor productivity (MFP). ICT use can also contribute to network effects, such as lower transaction costs and more rapid innovation, which can improve MFP. In some countries, notably the United States and Australia, there is evidence that sectors that have invested most in ICT, such as wholesale and retail trade, have experienced more rapid MFP growth[9].

Figure 2. The contribution of investment in ICT capital to GDP growth

Percentage points contribution to annual average GDP growth, total economy



1. Or latest available year, i.e. 1995-2000 for Denmark, Finland, Ireland, Japan, Netherlands, Portugal and Sweden.

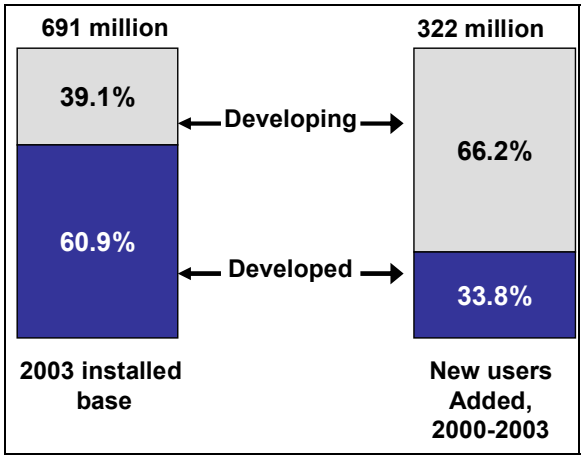
Source: OECD (2003), "ICT and Economic Growth. Evidence from OECD Countries, Industries and Firms". Estimates based on Database on Capital Services. See Schreyer et al. (2003) for methodological details.

Benefits of ICT/the Internet in non-OECD countries

17. Developing countries are already accounting for a large part of Internet users. Between 2000 and 2003, two thirds of the new Internet users were in developing countries, as shown in Figure 3, and this trend is predicted to intensify. The Internet is progressing rapidly in many developing markets, as illustrated in Figure 4 which shows the quasi-totality of countries now connected to the Internet. Nonetheless, developing countries are made up of extremely heterogeneous economies[10], and are at very different levels of ICT/Internet diffusion, as illustrated in Figure 5.

Figure 3. Internet Market Size and Growth

Number of Internet users 2003, and new Internet users added between 2000 and 2003 (right) in developed and developing economies worldwide

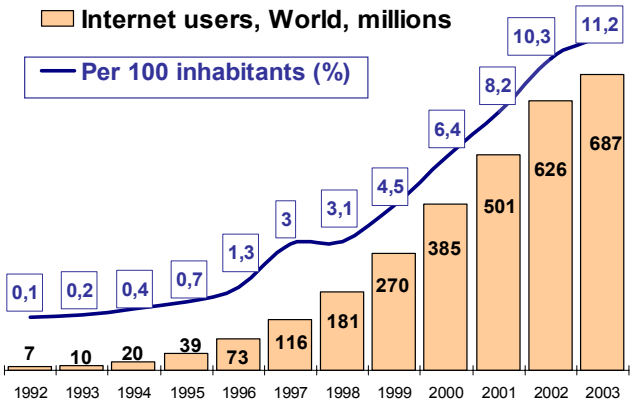


Note: For definitions of developed and developing economies, see note [11]

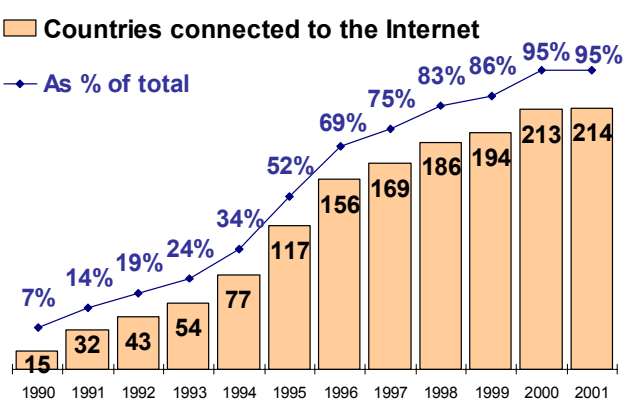
Source: ITU (2005), ITU World Telecommunication Indicators Database and ITU estimates.

Figure 4. Numbers of Internet users and number of countries connected to the Internet

Internet users in millions and Internet users per 100 inhabitants



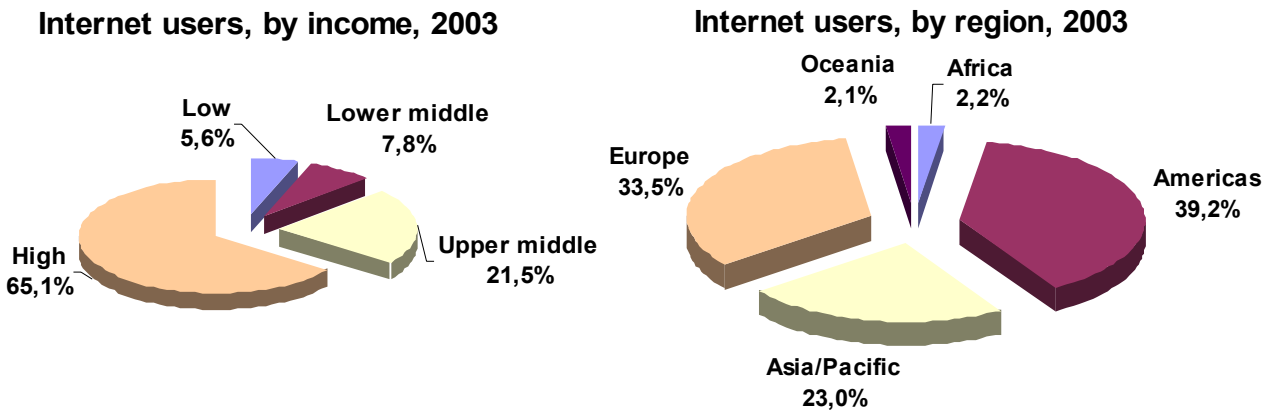
Number of countries connected to the Internet and as a percentage of total countries



Note: In the chart on the right, "countries" refers to 225 known countries or territories; "connected" refers to the establishment of a direct link to the Internet, enabling access via a local telephone call.

Source: Based on ITU World Telecommunication Indicators Database 2004 and 2003[12].

Figure 5. Number of Internet users, by income and by region, 2003



Source: International Telecommunication Union (ITU) indicators, 2004.

ICTs and development goals

18. ICTs, and in particular the Internet, can contribute to achieving internationally agreed-to development goals, including those contained in the Millennium Declaration [13], as they can help to achieve goals of employment and entrepreneurship, poverty reduction, health, education, gender equality, and good governance. The development community has focused on ICT impacts on development objectives such as health, education, e-governance, information-exchange, livelihoods and empowerment. For instance, Internet-based applications have been used to deliver information-related services to citizens, and to health and social service providers.

19. Moreover, an adequate ICT infrastructure is viewed as a key ingredient to decrease transaction costs and reinforce economies of scale in other sectors. Investors in all economic sectors increasingly view an adequate telecommunication/ICT infrastructure as a pre-requisite to investment.

20. In addition to participating in productive capital accumulation by providing services that participate in productive activity (information, communication, management, etc.), ICTs generate positive network externalities by facilitating connection between individuals and markets, thus facilitating the creation of more efficient markets.

Necessary enabling policies and regulatory environment

21. A fundamental requirement for widespread national Internet access is an efficient telecommunications sector. Experience from OECD countries as well as non-OECD countries has shown that this is best achieved through vibrant competition, strongly affected by the necessary presence of policies and regulatory environments that enable market-based operators to develop access infrastructure.

22. Step-by-step approaches to the Internet and advanced ICT services have shown their potential to contribute to the sector's development in a sustainable way.

23. Government awareness and support of telecommunications and ICT sector initiatives are essential, in order to mobilise the resources necessary to define ICT policy and objectives, in particular. Countries seem to be taking action: over 90 countries have or are in the process of developing national ICT for development strategies, establishing national multi-stakeholder ownership and priority areas for

intervention. Along with policy, effective pro-competitive regulation and the creation of a credible independent regulator are key to enable market-based development.

24. In parallel, removing domestic obstacles to the growth and development of Internet is valuable. Policies have in many countries enabled market growth by removing barriers and removing restrictions on competitive entry by ICT companies. These have included allowing IP telephony, liberalising VSAT ground stations to connect with communications satellites, setting up nation-wide local call tariffs or flat rate local calling for Internet dial-up, providing easy market entry and interconnection for ISPs, or enabling direct access to international bandwidth. In many countries, these initial steps have enabled private entrepreneurs to start offering public Internet services. Conversely, unfair provisioning practices or local call and leased line rates that are artificially high in markets with insufficient competition often keep Internet rates high.

25. Moreover, experience has shown that subsidising basic infrastructure, content and skills that facilitate Internet access and use can benefit the sector's development. Basic infrastructure, content and skills include national Internet eXchange Points (IXPs), Internet points-of-presence (POPs), relevant local applications and content, as well as education and training in the use of information technology. However, using public subsidies to offer Internet services such as telecenters has often proven both unsustainable and potentially market-distorting, even hindering the development of market-based entrepreneurial activities, such as the setting-up of cyber-café businesses by local entrepreneurs who have strong incentives to make the enterprise successful.

Increased international network connectivity

26. Internet access depends on telecommunication connectivity that underpins the network. The viability and prices of Internet Service Providers depend not only on enabling domestic policies, but also on the structure and competitiveness of the international bandwidth markets. Competitive forces, when permitted, have driven prices down.

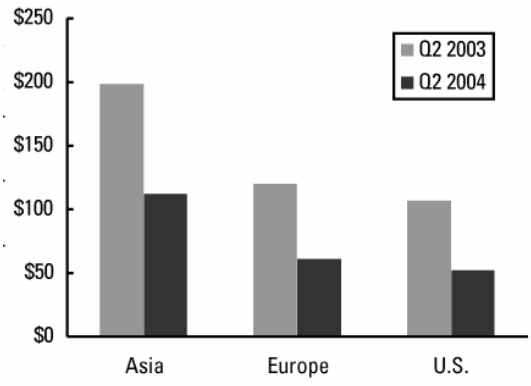
27. Indeed, as Internet traffic has increased, significant changes have taken place in the routing of traffic. Originally, Internet traffic was very US-centric, but since the end of the 1990's, widespread liberalisation of telecommunications in the OECD countries enabled operators to build international end-to-end networks (instead of the half-circuits that characterises countries in monopoly systems).

28. As increased competition emerged in backbone markets, commercial networks diversified and entire regions are now better connected[14]. Whole areas of Asia, as well as some in Africa, now benefit from increased direct connectivity reducing costs significantly. Intra-regional links between Asian networks are growing much faster than any other region's. In Africa, the new SAT3/WASC/SAFE submarine fibre cable extending from Spain and Portugal, down the west coast of Africa, around the Cape and over to the west coast of India means that coastal countries in Africa can tap into the fibre, while landlocked countries can establish connections via coastal countries[15].

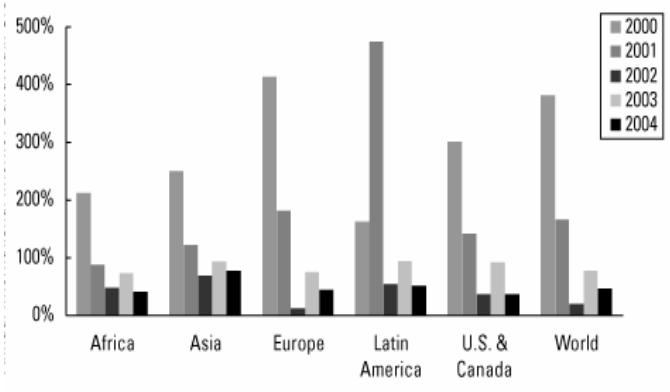
29. In the process, competition between international backbone providers triggered increasingly numerous commercial solutions for the development and exchange of bandwidth between telecommunication bandwidth providers (for example by partnering with carriers in other regions or by swapping capacity). As a result, the Internet's global structure is increasingly distributed, and the Internet is replicating itself within regions. In addition, prices for IP transit services have fallen sharply, as shown in Figure 6[16]. Prices in Asia have declined at a comparable rate, though they still remain much higher than European and U.S. prices.

Figure 6. Monthly Price for international bandwidth and bandwidth growth

Monthly Price per Mbps (USD)



Annual international Internet bandwidth Growth



Source: PriMetrica, 2004.

Box 2. New entrants with regional strategies

The OECD *Communications Outlook 2003* documented the sale of assets, in the post bubble environment, as firms restructured or exited the industry. In many cases these sales were realised at a fraction of the original investment. Some of the examples given were the sale of assets by PSInet, 360Networks, KPN-Qwest, Exodus, Global Crossing, Asia Global Crossing. Others included the sale of assets of Flag Telecom and Dynegy's European network. Since that time further sales have occurred as firms such as MCI, AT&T and Bell South sold properties in Latin America and Level3 sold its Asia/Pacific network. Most recently Tyco sold its undersea cable network.

Significantly, many of these sales have brought new players with their own facilities into international markets for the first time. Some of the 'new entrants', in that sense, include China Netcom, Singapore Telemedia, Tata and Reliance. In other cases companies such as Telmex and Telefonica purchased assets to complement their regional strategies. As a result the international market for telecommunications continues to be extremely competitive.

Another success story of increased international connectivity is that of Dishnet, a leading ISP in India that contracted Tycom to construct an undersea cable to connect India, Singapore, Guam, Indonesia and the United States.

The current situation is very different from the monopoly environment where leased lines and half circuits were available only from one point to another.

Source: OECD (2005), *Communications Outlook*, forthcoming.

30. The options for Internet Service Providers (ISPs) in developing countries are the following:

1. At each interconnection point on the network, Internet service providers of similar sizes (local, national or regional) **peer** with one another, that is, they exchange traffic (for free) through a leased line.
2. ISPs that are too small to peer use **transit** services, whereby they pay backbone providers for network access charges ("port charges"), as well as capacity. For this reason it is beneficial for ISPs in developing countries that transit prices have been decreasing significantly in competitive markets.
3. Another option successfully used by ISPs in many regions involves the setting-up of **Internet eXchange Point**s (IXPs). When policy permits, Internet Service Providers (ISPs) have started purchasing their own domestic and regional Internet eXchange Points, as opposed to pursuing transit agreements with international Internet backbone networks. An IXP interconnects Internet

service providers in a region or country, allowing them to exchange domestic Internet traffic locally without having to send data across multiple international networks to reach its destination. For instance, in Egypt, investments in IXPs have typically had a return on investment of six months[17].

Box 3. Kenya's Internet eXchange Point, set-up in 2002

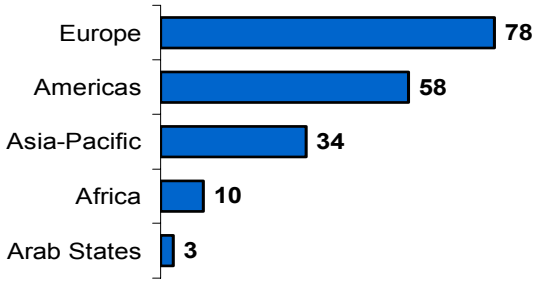
Kenya introduced its IXP in 2002, and ten ISPs are currently exchanging traffic on it. Before the establishment of the KIXP, all traffic between ISPs in Kenya was exchanged internationally whereas 80% of the traffic by Kenyan ISPs was between ISPs. During the initial time KIXP was in operation the latency was reduced from on average 800 to 900 milli-seconds previously, to 60 to 80 milli-seconds.

The creation of KIXP allowed member ISPs to benefit from substantial savings. For a 64 kbit/s circuit the difference in price was USD 200 for a domestic leased line compared to USD 3375 for the same speed international link. For a 512 kbit/s circuit, the difference in price was USD 650 for the domestic circuits as against USD 9546 for the international circuit[18].

Source: OECD (2002), "Internet Traffic Exchange and the Development of End-to-End International Telecommunication Competition".

Figure 7. Internet Exchange Points (IXPs) around the world

Number of IXPs per region as of 20 September 2004



Source: ITU (2005), Trends 2004/2005

Technological leapfrogging

31. ICTs offer many developing countries opportunities for technological leapfrogging in connectivity. For example, large geographic areas can avoid the heavy investment in copper-based infrastructure and invest directly in wireless technology-based communication systems. For example, in Africa, there are more cellular subscribers than fixed subscribers, with operators such as MTN extending GSM[19] cellular phone networks in South Africa, Uganda, Nigeria, Cameroon, Rwanda or Swaziland. The GSM base station towers are potential hubs for broadband wireless systems[20].

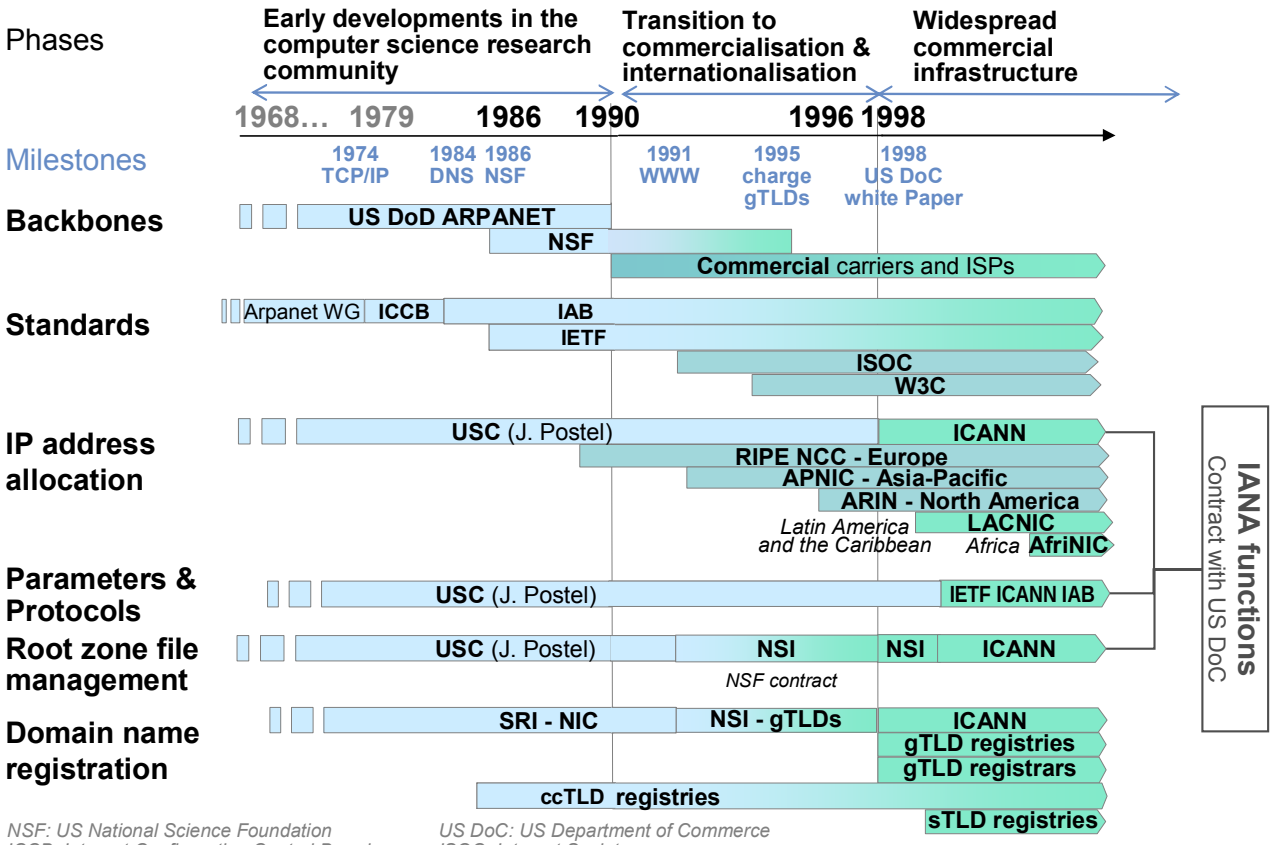
32. Technology developments open new possibilities for regions with poor connectivity to leapfrog stages of development, by, for example, entering the broadband phase via wireless solutions. Wireless local area networks (WLAN), commonly referred to as Wi-Fi, are a good example of a low-cost, robust technology for broadband (enabling telephony and high-speed Internet) that provides an opportunity to leapfrog expensive, wireline broadband (cable or DSL), in places such as the remote villages of Nepal[21].

33. To extend incumbent infrastructure, (traditionally wireline telecommunications infrastructures), new wireless technologies can, if policy permits, enable infrastructure extension at a significantly lower cost (compared, for example, to that of building out expensive copper-lines). For instance, Wireless Local Loop (WLL) technology is a very low deployment cost technology that employs standardised cellular or low-mobility infrastructure and terminals.

COMMERCIALISATION OF THE INTERNET

34. The purpose of this section is to show that the Internet has undergone significant transformation from its early developments to its present stage of commercialisation where market-based rules dominate. The Internet started in the 1960s as the creation of a small group of dedicated researchers and has grown to be a widespread commercial information infrastructure with tremendous influence on economies and societies. The Internet's evolution has been characterised by rapid development and flexibility enabled by little governmental interference and by significant investment and innovation by the private sector. Technical coordination structures were created in parallel to address issues relative to the Internet's operation.

Figure 8. Simplified chronology of Internet technical coordination structures



Source: OECD, 2005

Phase 1: Early developments (until the 1990s)

The origins of the Internet

35. The technical foundations for the Internet were developed by computer science researchers that collaborated closely from the late 1960s onwards. In the early days, they were subsidised by ARPA, the U.S. Department of Defence's (DoD) Advanced Research Project Agency and later, by NSF, the American National Science Foundation. ARPA first demonstrated the viability of packet switching for computer-to-computer communication in its flagship network, the ARPANET, which linked several dozen sites, mainly universities, into a national network for computer science research. The major initial motivation for the ARPANET was to share resources, that is, share expensive time-sharing systems, but when electronic mail applications were developed in 1972[22], electronic mail took off as the largest network application for years, and as a harbinger of numerous "people-to-people" activities that characterise today's Internet.

36. The actual Internet finds its origin in Robert Kahn's 1972 idea of open-architecture networking, or "Internetting". His idea was that an open architecture would be able to connect multiple independent networks, each network itself having a different operating system and design. Such an open-architecture network required a new communication protocol which was designed in 1973-74 by Robert Kahn and Vinton Cerf (later called TCP/IP).

37. The new protocol was used to connect the original ARPANET, with a packet satellite network (SATNET) linking the US and Europe[23], and with a ground-based packet radio network, into the **first Internet**. Initially, implementing TCP/IP was complex and engineering-intensive, even though the detailed specifications of the protocols were open to anyone: computer engineers had to custom-configure routers and develop TCP/IP software for their computers. To facilitate diffusion, in 1979, ARPA[24] established a small Internet Configuration Control Board (ICCB), to help computer engineers from different types of networks configure routers and develop TCP/IP software for computers. Consequently, TCP/IP was implemented on different systems by different research communities, so the Internet grew to incorporate not only different types of networks, but an accompanying broad-based research and development community. Desktop computers could be connected using a compact and simple implementation of TCP, which was fully interoperable with other TCPs. Local Area Networks (LANs), which proliferated at the end of the 1970s after Robert Metcalfe's development of the Ethernet network technology, were also connecting to the Internet.

Managing the Internet's strong growth

38. New technologies and management structures were needed, as the original ARPANET model of a few networks with a small number of time-shared hosts expanded into having many networks constituting the Internet (LANs, workstations, and personal computers).

39. In the early 1980s, the existing Internet protocol supported a very limited number of IP addresses. Such a limitation was a key motivating factor in the development of IP Version 4 (IPV4 addresses are 32-bit numbers). The technology cutover date of all the hosts and equipment on the network was 1 January 1983 and, although less than 500 hosts made up the Internet, several years of planning and development were required in order to simultaneously convert all the machines and equipment on the network[25].

Box 4. Internet Resource Management

(1) Internet Protocol (IP) addresses: Each device connected to the Internet has a numeric identifier: its IP address. IP addresses need to be attributed to each network on the Internet (for network managers to in turn allocate to each device), in function of the network's size. Jon Postel, at the Information Sciences Institute (ISI) of the University of Southern California (USC) managed the allocation of blocks of IP addresses to networks and to Regional Internet Registries (RIRs) from the late 1960's until 1998, under contract with the Department of Defence's Advanced Research Project (ARPA) and then the Defence Communications Agency (DCA).

(2) The Domain Name System (DNS): In 1984, the distributed and dynamic Domain Name System (DNS) was published by Paul Mockapetris. The increase in scale of the Internet and the large number of independently managed networks, including LANs, was making it increasingly difficult to maintain a centralised table to translate user-friendly host names into numeric IP addresses. The DNS was conceived as a scalable distributed mechanism to resolve user-friendly host names (e.g. www.organisation.com) into a numeric Internet (IP) address. Hierarchical DNS names are supported by the "dot" in the name, and structured from right to left. The data in the DNS is stored in hierarchical and widely distributed sets of machines known as "name servers", which are queried by "resolvers"[26].

Invisible to users, the top of the hierarchy is the "root", and the root servers that mirror this root. Root servers replicate the root, and provide information enabling resolvers to find details of the level below, known as the Top Level Domains (TLDs) which are the last label on the right hand-side of the domain name (.org, .com, .jp or .fr).

In 1985 when the DNS started to be implemented, the Defence Communications Agency (DCA) left the responsibility for new generic Top Level Domains (gTLD, such as .com or .org)[27] registrations with the Stanford Research Institute (SRI International), later to be performed by the InterNIC/Network Solutions.

Moreover, responsibilities for maintaining the DNS became dispersed among a large and heterogeneous group of "administrative contacts," in particular DNS country code Top Level Domain (ccTLD, such as .jp or .fr) operations in countries around the world.

The DCA gave ISI at USC the responsibility for DNS root management. The technical coordination functions of IP allocation, protocol parameter coordination and DNS root management came to be known as the Internet Assigned Numbers Authority (IANA) functions, after Jon Postel named his group at USC the "Internet Assigned Number Authority" or "IANA". In addition to these, Jon Postel at USC managed the functions of RFC Editor and US Domain registrar.

40. In 1984, ARPA replaced the ICCB with the Internet Advisory Board (**IAB**) to define the Internet's overall architecture. The IAB was set up similarly to the old ICCB, but increasingly numerous issues of network evolution were delegated to task forces chartered by and reporting to the IAB. ARPA also delegated to the IAB the responsibility for the standards-setting process. Beginning in 1985, the IAB arranged workshops for equipment vendors and the initial research community to exchange knowledge. These exchanges yielded increasingly interoperable equipment on the market.

41. In 1986, the **Internet Engineering Task Force** (**IETF**) was established from one of the IAB[28]'s existing task forces on standards-setting process, and equipment vendors were active participants in IETF meetings.

From ARPA to the National Science Foundation, and to a widespread infrastructure with NSFNET

42. By the mid 1980s, Internet was well established as a technology amongst computer researchers and developers. Industry began offering commercial gateways and routers and started to make available TCP/IP software for some workstations, minicomputers and mainframes. However, many alternate networks and networking technologies were being pursued, in the public sector, and also in the commercial sector.[29] At the time, these networks were largely incompatible.

43. A key milestone of the Internet's development was the National Science Foundation's (NSF) 1986 choice of TCP/IP to provide interoperability when it created the NSFNET backbone to connect American universities. NSF also identified the need for Wide Area Network *infrastructure* to support the general academic and research community, and, importantly, the need to develop a strategy to grow this infrastructure ultimately *independently of direct federal funding*.

Phase 2: Transition to commercialisation and internationalisation (1990s-98)

44. In the early 1990s, the NSF pursued a strategy to commercialise the **Internet backbone**. On the one hand, it encouraged commercial traffic at the local and regional level by enabling the *regional* networks of the NSFNET to take on commercial customers, and thereby lower subscription costs for all. On the other hand, the NSF stimulated the development of private, competitive, long-haul networks for commercial use such as UUNet, ANS CO+RE or PSI, by denying commercial access to *national*-scale transport on the NSFNET backbone. This selective access was carried out through NSF's "Acceptable Use Policy" (AUP) which prohibited backbone use for purposes "not in support of Research and Education".

45. In parallel to NSF's efforts to commercialise the backbone, the IETF's members felt that it should broaden sources of funding beyond the US government, by including the private sector and other institutions, and moreover, on an international level. Hence, the Internet Society (ISOC) was founded in 1992 as an international professional membership organisation of Internet experts that comments on policies and practices for global coordination and co-operation on the Internet.

46. As the Internet expanded, increasing portions of the administrative responsibilities were moved from the DoD to the NSF, which created the InterNIC in 1992 to consolidate existing practices for domain name registration and publication of information. The InterNIC sub-contracted registration services of gTLDs at no charge to public at large to a US-based private-sector company, Network Solutions Inc (NSI) in 1993.

47. In 1995, the NSF also ended its 'acceptable use' policy, withdrawing funding from the NSFNET academic national backbone as the Internet entered the mainstream and became a truly commercial network.

48. This period was typified by the emergence of Internet Service Providers (ISPs)[30], such as the dial-up systems of CompuServe, America Online, Prodigy**.** In 1995, many commercial ISPs throughout the world starting purchasing their own domestic and regional Internet eXchange Points (IXPs)[31] to connect to the Internet. Before 1995, it had been more advantageous for the early ISPs to link to the commercial Internet backbone networks in the USA. This was in part because the US-centric Internet backbones were developed earlier and had more content and services. In addition, it was often cheaper for ISPs to exchange traffic via dedicated lines to the US because of the reticence and rents imposed by incumbent telecommunication monopolies in many countries. Since then, as increased competition has emerged in backbone markets, commercial networks have diversified and entire regions are better connected[32].

Box 5. Impacts of the WWW

In 1991, the World-Wide Web (WWW) was developed by Tim Berners-Lee at the European research centre CERN. The World Wide Web Consortium (W3C) was created in 1994 as an international industry consortium to develop common protocols that promote the evolution of the World-Wide Web and ensure its interoperability.

Browsers: Developments on the WWW were particularly dynamic as of 1993, when the first Web browsers became generally available, such as the popular commercial browser "Mosaic", enabling users to search the Web for information and data. The dynamism was enhanced by a number of structural factors, including: continuous development of higher speed, lower-cost computers; related increases in the power of virtually all electronic devices; rapid expansion of networks; and accelerated distribution of digital applications over a broadening range of economic sectors[33]. The WWW browser war, fought primarily between Netscape and Microsoft at the time, triggered significant software developments.

Charging for domain names: The development of commercial browsers also led to an explosive growth in the demand for .com, .net and .org domain names (at that time free of charge and subsidised by the NSF). In late 1995, responding to the quantity of Web-motivated and sometimes speculative domain name registrations, the National Science Foundation (NSF) authorised the private company in charge of registering domain names, Network Solutions, Inc. (NSI), to charge annual fees[34] for registering generic Top Level Domain names (gTLDs). Meanwhile, most ccTLD registries in other countries had already instituted charges for domain names. Thus, NSI, as the sole private registry and registrar for gTLDs, was in a monopoly position until 1998. Registration of domain names within a few top-level domains (.com, .net, .org) increased from approximately 400 per month in 1993 to as many as 70 000 per month in 1996, the overwhelming majority in the .com category[35].

Phase 3: Commercialisation, Globalisation, Convergence (end of 1990s)

49. Since 1998, rapid adoption of new technology has occurred in societies across the world, although this slowed down when the "Internet bubble" burst in 2000-2002. After the proliferation of PCs and the Internet at the end of the 1990s, the current decade is evolving towards converged platforms supporting broadband Internet, voice and entertainment content and increasingly, mobile and wireless networking. This section provides an overview of market developments since 1998 at different levels of the industry: *i)* at the supporting infrastructure level; *ii)* at the supporting protocol level; and *iii)* at the internet resource management level.

i) Increasingly widespread IP-based supporting infrastructure

50. The telecommunication industry's infrastructure and services provide the fundamental underpinning for information Internet-based economies. As of 1998, liberalisation of the telecommunication markets in the USA and in Europe triggered large investments in new communications infrastructure (in particular digital switches, servers, fibre, and radio networks): operators sought new income drivers as competition in voice services ─ especially mobile ─ increased. Incumbents digitalised telecommunication networks and diversified into long distance, Internet services, and backbone network provision. Globally, telecommunication operators in liberalised markets have begun a process of converting their networks and infrastructures from circuit-switched architectures to IP-based architectures, to support new data and communications applications such as VoIP.

51. The "dot-com bubble" saw exaggerated expectations that resulted in over-investment, excess capacity, and unsustainably large debts in the telecommunications sector. The subsequent "burst" in 2000 caused changes and restructuring in the ICT sector, although telecommunication services and IT services generally continued to grow. There is now an expanding upturn, particularly in the United States and in hard-hit segments[36].

Ongoing convergence, including wireless

52. The transition to 'next generation networks' is resulting in new fixed wireless networks, the development of 3G, and the upgrading of existing fixed access networks to provide broadband access. The digitisation of communications enables ICT infrastructure operators to provide voice, data and broadcasting over several different types of networks. Telecommunication operators, wireless operators, and cable providers have been pursuing the same triple play bundling strategy for consumers — bundling fixed voice, television services, and broadband Internet access. A large group of carriers, and Internet Service Providers, already offer television services over DSL[37]. More recently, wireless, both fixed and mobile, is being integrated into this bundle.

ii) Supporting protocols coordination

The current status of the Internet's underlying technology: IPV4 and IPV6

53. IP version 6, the current version of IP, was developed by the IETF in 1995 and is now a decade old. The compelling reason behind the formation of IPv6 was lack of address space, and increasing the number of IP addresses[38] to 128-bit addresses. Since the introduction of Classless Inter-domain Routing (CIDR)[39] or Network Address Translators (NATs)[40], IP address space scarcity is less of an immediate concern, and other drivers for IPv6 adoption include its better support for new uses such as real-time applications (mobility, quality of service), and enhanced security features — including authentication and privacy. Given the scale of the transition, IPV6 is only partially implemented due to the cost in hardware and software, and especially, the time worldwide transition takes. A reality in Japan and Korea, the transition is underway in Europe, the US, and China. Global implementation is dependant on IPV6 adoption by the entire worldwide pool of networks, computers and equipment since in the meantime, networks that implement IPV6 have to coexist with IPV4 networks.

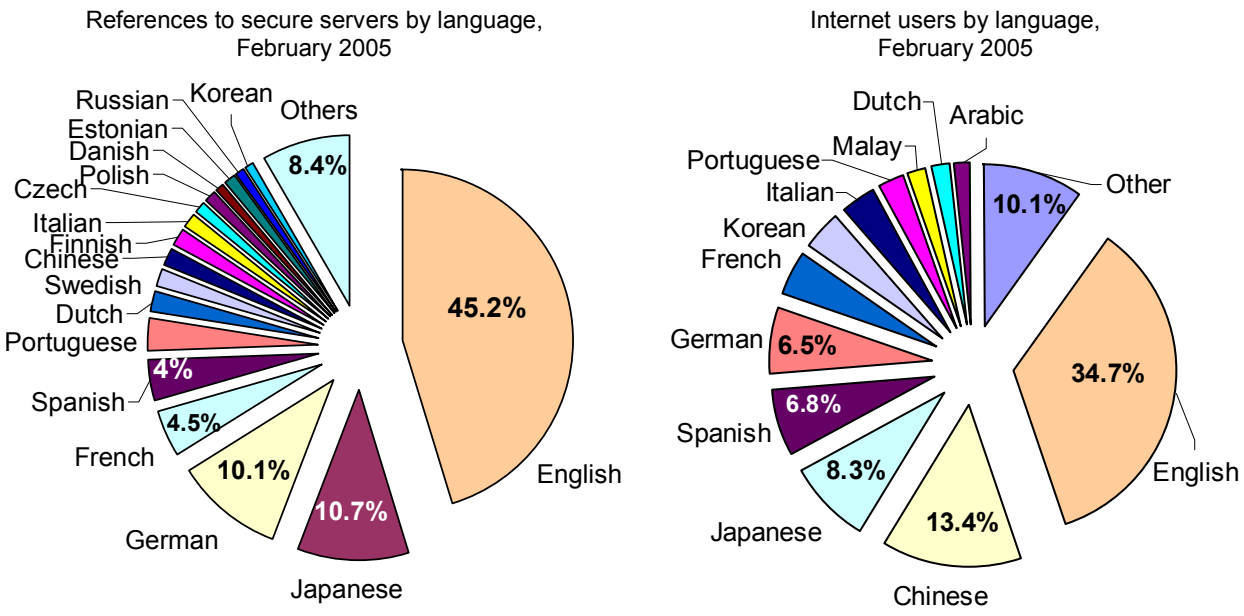
ENUM

54. Standards work is underway in standards bodies including the ITU and the IETF to further the integration and interoperability of IP-based networks with the public switched telephone and mobile networks. ENUM[41], published in 2000, is the protocol which deals with the convergence of the Public Switched Telephone Network (PSTN) and the IP network; it takes a complete, international telephone number (telephone numbers according to ITU-T Recommendation E.164) and resolves it to a series of URLs using a Domain Name System (DNS)-based distributed architecture, *i.e.* it maps a telephone number from the PSTN to Internet services. ENUM was developed to enable users to find services on the Internet using only a telephone number, and for telephones, which have an input mechanism limited to twelve keys on a keypad, to be used to access Internet services.

Internationalisation of Internet use and the use of Internationalised Domain Names (IDN)

55. While English remains the leading language of e-commerce (Figure 9, left), there is increasing development of content and e-commerce capabilities in other languages to support the large non-English language populations that are coming online (Figure 9, right). In this context, for the widespread growth of the Internet, many deem it crucial that non-English language populations be able to use domain names in their own languages.

Figure 9. Language of e-commerce, and language populations on the Internet



Source: OECD, based on secure sites referenced in the Google search-engine's database[42].

Source: OECD, based on Internet World Statistics internetworldstats.com/ and Global Reach statistics, http://glreach.com/

56. The technical standard for Internationalized Domain Names (IDN)[43] creates a norm to translate non-ASCII symbols and languages in the Second Level Domain so that they can be resolved by the existing domain name system. IDN resolution is based on the distribution of client software and does not modify the server side operation. The current IDN standard has been implemented by several registries so far, including ccTLD registries in China, Japan, Korea, Taiwan, Poland, Switzerland, Germany, or Austria, and by the gTLDs registries for .net, .org, and .info. Current barriers to development include the preservation of protocol names (http://) and top-level domains (.jp or .com) in ASCII characters; lack of IDN support in software (Microsoft's Internet Explorer in particular); and the fact not all minority language scripts are encoded. Deploying IDN and developing improved multilingual standards will require significant global coordination.

iii) Internet resource management

57. The management of Internet resources is, as the network itself, spread out with a number of different organisations handling different aspects.

58. In the mid-1990s, the continued growth of demand for domain names placed strains on the Domain Name System (DNS) management, as what had been primarily technical issues became political, legal, and economic problems that attracted high-level official attention. In particular, as attractive domain names in .com became rare, disputes arose over attractive names, and pressure mounted for the creation of new generic Top Level Domains (TLDs) such as .shop. These proposals were countered by intellectual property rights holders that were already facing cybersquatters who had registered domain names corresponding to trademarks. Some governments began to express concern about the United States' control of a critical element of a global communication and commercial resource on which their economies and

societies were becoming increasingly dependent. Meanwhile, from a small company in 1993, NSI, the monopoly registrar and registry for gTLDs, had quickly become a multibillion dollar company.

Setting up ICANN

59. Concerns about the DNS system and NSI's monopoly led the US Department of Commerce (DoC) to conduct a consultation process in July 1997 and issue a White Paper[44] in June 1998 that contained a policy statement of its intent to privatise the management and coordination of the DNS. In addition, it articulated four guiding principles that would be used during this transition process, namely stability, competition, representation and bottom-up policy-making. DoC has stated that the stability and security of this important global resource can best be achieved through privatisation of the technical management of the DNS and continued global co-operation, via appropriate public-private partnerships that reflect the international nature of the Internet.

60. The responses to this paper from the private sector were several proposals[45], including one shepherded by Jon Postel from the newly created Internet Corporation for Assigned Names and Numbers (ICANN) – a private non-profit corporation, incorporated in California. In November 1998 the US Department of Commerce entered into a Memorandum of Understanding with ICANN, to establish a process for transitioning the Domain Name System (DNS) from the US Government to the private sector[46].

61. In a separate agreement, the DoC contracted ICANN to perform the Internet Assigned Numbers Authority (IANA) functions previously performed by other entities under US Government contracts. Under this contract[47], ICANN allocates blocks of IP addresses to Regional Internet Number Registries (RIRs) that serve geographical regions. Regional Internet Registries include RIPE NCC for Europe (1989), APNIC for Asia-Pacific (1993), ARIN for the USA (1997), Canada and a portion of the Caribbean, and LACNIC for Latin America and the Caribbean (2002). More recently, AfriNIC has begun a transition plan to become the operational RIR for the African region in 2005. Regional entities redistribute IP addresses to Local Internet Registries (LIRs), most often Internet Service Providers (ISPs), who in turn provide IP addresses to their customers.

62. As a part of the IANA functions contract, ICANN receives change requests and makes recommendations regarding them to the DoC, which has the operational oversight responsibility for the authoritative root zone file, All top level domain delegations, redelegations, and name server change requests require the final approval of the U.S. Government. The Department of Commerce directs VeriSign to make changes to the authoritative root zone file pursuant to Amendment 11 of their cooperative agreement upon recommendation of ICANN.

63. ICANN's legitimacy, processes, structure, and handling of a number of issues have been questioned by various stake-holders. ICANN underwent structural reforms during 2002/2003, with the declared aim that ICANN should primarily focus on technical matters and leave public policy issues to be decided in the appropriate forums, especially its supporting organisations.

- ICANN's current three supporting organisations consist of: *i)* the Address Supporting Organization (ASO), to coordinate IP address policies for Regional Internet Registries (RIRs); *ii)* the Country Code Names Supporting Organization (ccNSO), to represent countries and regions, and; *iii)* the Generic Names Supporting Organization (gNSO) representing the interests of registrars, individuals and Intellectual Property and trademark interests.

- In addition, advisory committees to ICANN include: *i)* the Governmental Advisory Committee (GAC) for national governments[48] to advise ICANN on issues related to DNS management and coordination of potential impact on national public policy; *ii)* the Root Server System Advisory

Committee (RSSAC) to advise ICANN on the operation of the root name servers of the domain name system; *iii)* the Security and Stability Advisory Committee (SSAC) to provide advice on matters relating to the security and integrity of the Internet's naming and address allocation systems; *iv)* The Technical Liaison Group (TLG) to provide technical advice; *v)* the At Large Advisory Committee (ALAC) represents individual Internet users and finally; *vi)* the Internet Engineering Task Force (IETF).

- Members of ICANN's Board of Directors are selected by the supporting organisations and by a nominating committee which aims to represent all of ICANN's constituencies.

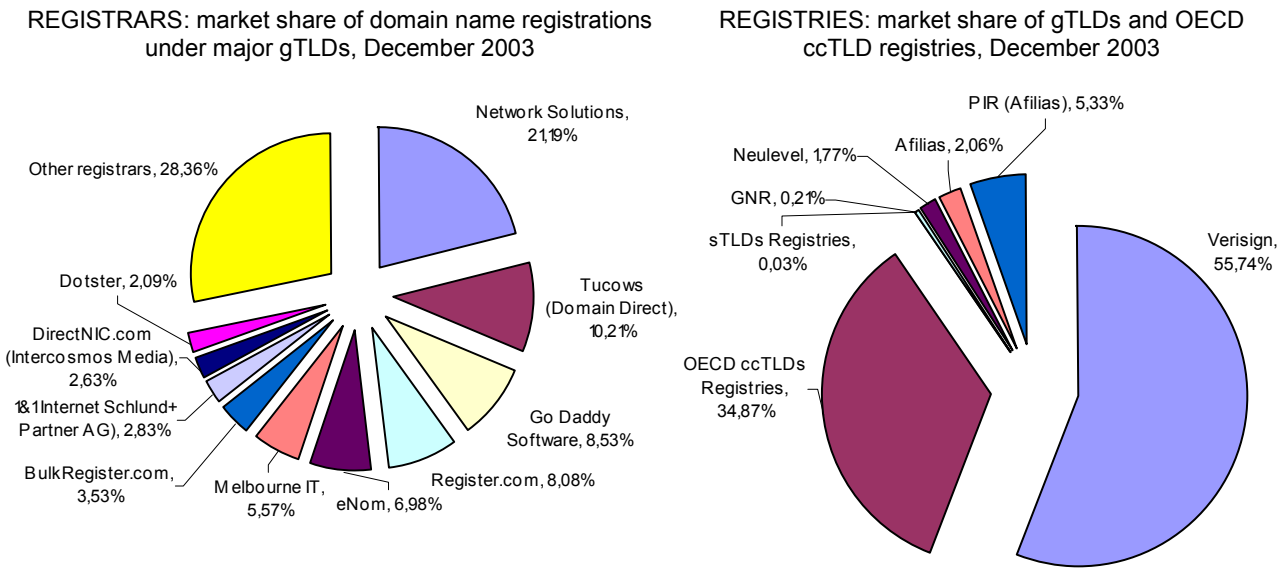
Achievements since the creation of ICANN

64. As a result of the joint partnership agreement between DoC and ICANN, the registry and registrar functions for generic Top-Level Domain names were separated in 1999. Registries perform back-office functions and provide services to Registrars. In particular, they maintain a centralised registry database for each Top-Level Domain (TLD). Registrars, in turn, provide services to users ─ or registrants ─ with whom they have contractual agreements. The registrar market was opened to competition for generic Top-Level Domain names (gTLDs). The Department of Commerce and NSI agreed in 1999 that NSI could charge registrars no more than USD 9 per domain name per year and no more than USD 6 as of early 2000[49]. Verisign purchased the registry and registrar business from Network Solutions Inc. (NSI) in 2000 for the .com, .net and .org TLDs, and retained the NSI brand name for its registrar activities. New entrants in the registrar market rapidly gained market shares and NSI, that previously had the monopoly over generic domain name registrations, saw its market share fall from 100% to around 21%[50] in December 2003. ICANN's registrar-accreditation policy enabled robust competition among more than 160 registrars, while maintaining the stability of top-level domains. (OECD, 2004, "*Generic Top Level Domain Names: Market Development and Allocation Issues*" discusses this).

65. Registries, responsible for operating each TLD, have a monopoly over registration in the TLD over which they exercise responsibility with a relatively concentrated market, for the length of their contract (OECD, 2004, "*Generic Top Level Domain Names: Market Development and Allocation Issues*" discusses this). In 1999, the .edu TLD was shifted from NSI to a not-for-profit entity. ICANN introduced some competition into the registry function in 2000, by launching seven new Top-Level Domains (TLDs) (.info, .biz, .coop, .pro, .name, .museum, .aero) and assigning each to a registry. In 2003, ICANN transferred .org, the fifth-largest domain, to Public Interest Registry. In 2005, ICANN approved the .jobs and .travel new sponsored TLDs[51], and is currently in negotiations with additional candidate registries for .cat, .post, and .mobi. ICANN is currently launching an initiative to ensure stable, transparent procedures for the introduction of further sponsored top-level domains[52]. In addition to increased competition between gTLDs, competition takes place between gTLDs and ccTLDs.

66. There is also new competition in 2005 to provide registry services for .net, after Verisign's contract terminates 30 June 2005. ICANN received five applications to operate .net for six years. Interestingly, with five bids, the prices for registrations will decrease significantly from the previously USD 6 charged by Verisign per domain name.[53] Afilias[54] (which runs the registry of .info addresses and some operations for .org) offered to charge USD 4 for existing names and USD 1 for new registrations the first year. VeriSign (the incumbent registry, which also operates .com), would lower its price to USD 4.25. CORE++ (a non-profit organisation that operates .museum and .aero) and DeNIC (a non-profit organisation that operates Germany's .de domain, the second-largest behind .com) have proposed sliding scales. The fifth applicant is Sentan (a joint partnership between NeuLevel and Japan Registry Services).

Figure 10. A Market share of gTLDs and OECD ccTLD registries, December 2003



Source: OECD (2004), "Generic Top Level Domain Names: Market Development and Allocation Issues", based on Registry Monthly Reports

67. ICANN also adopted a Uniform domain name Dispute Resolution Policy (UDRP)[55], developed by the World Intellectual Property Organisation's (WIPO), to resolve domain names disputes before a registrar cancels, suspends, or transfers a domain name. The reason behind this was that the speed of judicial review was inconsistent with the rate of growth of the Internet: UDRP provides a "fast-track" resolution process whereby parties can also if they wish invoke a standard judicial review process. The UDRP is applied by ICANN-accredited registrars in the .aero, .biz, .com, .coop, .info, .museum, .name, .net, and .org top-level domains, and by some managers of country-code top-level domains.

FACTORS THE OECD VIEWS AS IMPORTANT TO THE INTERNET'S SUCCESSFUL DEVELOPMENT TO-DATE

Private sector competition and innovation enabled by liberalising markets

68. Private sector initiatives have by-and-large driven the widespread development of the Internet. The private sector has largely built, the Internet infrastructure, it operates and maintains the infrastructure and develops and provides the content, applications and services on the Internet.

69. Developed in a competitive environment, the Internet has spurred innovations and entrepreneurship in applications and technologies, and in services range.

70. These innovations in turn helped to provide network operators, equipment suppliers and service providers with low-cost, sophisticated, and high quality solutions to expand their networks, products and service offering. For businesses and consumers, innovations and competition among suppliers have served to increase service offering, affordability and accessibility.

71. In 2001, the ICT sector accounted for more than one-quarter of total business research & development expenditures in most OECD countries[56]. The research and development effort was particularly high in the communications equipment and software sectors, and the ratio of R&D expenditure to total sales was maintained after the Internet bubble 'burst."

72. Non-governmental bodies, often private-sector led, were created to manage the coordination of the Internet's technical framework. These include standards bodies and industry associations, as well as voluntary associations.

73. In addition to its involvement in technical standards bodies and industry associations, the private sector has intervened on a number of issues, through organisations such as the International Chamber of Commerce (ICC) or the World Information Technology and Services Alliance (WITSA). Other private sector actors include TRUSTe (Internet Content Rating Association).

74. The ICT private sector has also been heavily involved in the process of developing predictable, transparent rules, including rules relative to interconnection between Internet backbone providers and Internet service providers, through peering or through transit agreements, for example through network operators' groups such as APRICOT or RIPE.

Role of governmental and intergovernmental oversight

75. In a number of areas, governments and regulatory agencies have been involved in policy areas related to "Internet governance" (See public policy issues associated with Internet governance in the next section). As shown in box 6, regulatory interventions in a number of areas have been instrumental to promote effective competition and growth in Internet markets.

76. International organisations, including the OECD, have also been active in many policy areas. As shown in Table 1, the OECD has made strong contributions in several critical public policy areas related to the Internet, including privacy, spam, consumer protection, security of network and information systems, peering and interconnection, e-commerce, telecommunications infrastructure and broadband, and universal access.

77. Governments are encouraged to help identify issues of public policy concern that might have an impact on the coordination of Internet naming and numbering. ICANN's Governmental Advisory Committee (GAC), through its liaison with the ICANN board as well as with ICANN's supporting organisations, is a forum for raising these issues and has been involved in discussions on new gTLDs, the implications of IDNs and the introduction of IPv6, issues associated with Whois in an international framework, and the relationship between, national governments, their ccTLD and ICANN. The GAC membership is widening steadily to include more developing countries.

Box 6. Regulatory interventions that were instrumental to effective competition and growth in Internet markets

- **Liberalisation of Telecommunications**: The Telecommunications liberalisations from the mid-1990s and especially since 1998 meant that telecommunication carriers were able to provide infrastructure and services on an end-to-end basis. It opened the way for new competitive behaviour and agreements (peering or transit) in the telecommunications markets, and decreased the prices for connectivity for Internet service provider (ISPs), business users and retail users.
- **Interconnection of networks**[57] : Efficient traffic exchange and interconnection between Internet service providers (ISPs) is vital, and competitive environments enforced by governments have helped realise this aim. For example, the European regulatory framework, adopted in February 2002, applies to the markets for Internet network services, including the provision of access to global Internet backbone networks. This means that an ISP can obtain the right of access to a local network access provider (in order to connect end-users to the Internet backbone network of services and thus to offer global Internet connectivity), if the network access provider has significant market power in this particular access market. At the same time, ISPs who are providers of Internet backbone network services also have regulatory interconnection obligations if these ISPs are deemed to possess significant market power in the market or markets for such services[58].
- **Internet service providers**[59]. Markets in which regulation enables effective competition in the ISP (Internet Service Provider) market often have higher penetration rates than can be explained by population income differentials, since competition lowers prices and enables pricing innovation. For example, in 2004, Latvia had an impressive 195 ISP licenses. Latvia's Internet penetration rate of 40.6 Internet users per 100 inhabitants in 2003 was higher than Chinese-Taipei, France, Switzerland, Italy and Belgium despite the country having a GDP per capita of only USD 3 600 per year.
- **Value-added information services**: Liberalising the provision of "value-added" information services using telecommunications facilities enabled the Internet's rapid international diffusion in 1990s. Domestic policies and trade agreements made this possible, and were later extended and institutionalised by the WTO's basic telecommunications services agreement.
- **Dominant position**: Competition policies have had a great impact on the development of the Internet. For example, the European Commission, before clearing the merger of MCI and WorldCom in 1998, required MCI to divest its Internet service provider business to prevent it having a dominant market position.
- **Domain name registration**: Increased market competition in the domain name registration market was largely beneficial for the expansion and evolution of services. For instance, the division between registry and registrar functions created a competitive registrar market that lowered prices and encouraged innovation. The initial experiences with competition at the registry level, in association with a successful process to introduce new gTLDs, have also shown positive results[60] and decreased the rents imposed by monopolistic registries.

Decentralised and collaborative process of underlying technological development and core resource management

78. Overall, the governance and decision-making processes of the Internet have been multi-stakeholder, mostly bottom-up, participatory and transparent, with limited government interference.

79. The Internet's technological development, as well as its administration (the operations and management aspects of its underlying technology), grew overall with little government *regulatory intervention*. Since the early days of the Internet, the coordination and management of core resources, though in some cases under contract with the US government, were developed in a bottom-up manner, mainly by technical developers, providers and users. This model contrasts with that of the telecommunication and broadcasting industries, where in many cases, top-down national government regulation historically guided and structured the design of the media. The technological development and administration of the Internet is involved in ensuring that the network is interoperable, functional, stable, secure, efficient, as well as scalable in the long run. No single person, organisation or country manages the Internet. Instead, the Internet's technological management is handled by many entities which work within a coordinated and overall open framework. Today, the Internet enables new competition which was previously impossible due to the limited resources of other communications media or to the way they were managed. Indeed, convergence entails a need to rethink and adapt regulatory frameworks.

80. Technical standards for the Internet are consensus-driven and bottom-up. Organisations, such as the Internet Engineering Task Force (IETF) and the related Internet Architecture Board (IAB) or the World Wide Web consortium (W3C), which administer Internet and WWW standards, have operated independently, in an open, participatory and consensus-driven manner, since the early days of the Internet.

Box 7. The IETF's standardisation processes focus on "what works"

The Requests for Comments (RFC) document series is a set of technical and organisational notes about the Internet (originally the ARPANET), beginning in 1969. Memos in the RFC series discuss many aspects of computer networking, including protocols, procedures, programs, and new concepts, as well as meeting notes and opinions.

The official specification documents of the Internet Protocol suite that are defined by the Internet Engineering Task Force (IETF) and the related Internet Engineering Steering Group (IESG) are recorded and published as *standards track* RFCs. While few RFCs are standards, almost all Internet standards are recorded in RFCs.

The IETF's processes had existed and evolved informally since the first Request for Comments (RFC) in 1969. The IETF, created in 1986, is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. Its bottom-up standardisation process, collaborative and consensus-driven, focuses on standards that are operational (i.e., that work) through two main rules:

i) For a RFC to be published there need to be two independent and interoperable implementations from different code bases of the proposed specification. This model is different for example from the ISO or the ITU, where specifications can exist only on paper/in theory and subsequent implementation is not necessarily successful.

ii) If someone owns a license that is necessary to implement an RFC, the license-owner must accept to provide it on a compulsory, royalty-free, unlimited and non-discriminatory basis.

Co-optation between technical experts determines whether a RFC becomes a standard.

Source: IETF RFC 3160, http://www.ietf.org/rfc/rfc3160.txt

81. Allocating IP resources and disseminating new standards such as IPV6 also requires wide-spread, collaboration, including by the Regional Internet Registries (RIRs) and their newly-formed Number Resource Organisation, by ICANN, by root server operators, and by country code Top Level Domain (ccTLD) associations such as the particularly active, European-focused association, CENTR[61].

82. The management of the **domain name system**, is distributed geographically – for instance with the participation of RIRs, ccTLDs, root server operators– and organisationally – which include voluntary organisations, industry associations and governmental institutions– yet coordinated. Coordination and sharing of information and ideas allows the participants to ensure stable operation without introducing a single point of failure. The DNS, and therefore the Internet, as it functions today relies on protocols and RFCs which are generally accepted by root server operators, by registries of both ccTLDs and gTLDs, by registrars, by Internet service providers and by domain name users. These protocols and RFCs provide a foundation for each root-server, ccTLD, gTLD, RIR to implement different solutions within the general parameters defined, allowing for competition, robustness and diversity. The DNS is hierarchical and foresees distributed responsibilities, which is a major strength of the DNS and the Internet. At the core of the current system is the IANA function, which is based on a single, coherent and authoritative database. ICANN occupies a key role in that it provides central coordination at the global level of the addressing functions that allow it to operate. The fact that the Internet was born as a project that depended on the US Government resulted in several of the Internet's operational functions being performed by organisations under US government contracts[62].

Open, non-proprietary nature of the core Internet standards

83. Most of the protocols at the core of the Internet are protocols based on open standards that are efficient, trusted, and open to global implementation with little or no licensing restrictions. They are available to anyone, at no cost, on the Internet[63].

84. Core standards that the Internet Engineering Task Force (IETF) developed and diffused (via the IETF's Internet Standards Process mechanism) include the Internet Protocol (IP), Transmission Control Protocol (TCP), File Transfer Protocol (FTP), internet email with Simple Mail Transfer Protocol (SMTP), or the Domain Name System (DNS) protocol[64]. The initial research community has developed into a very broad and international research and development community which cooperates for the development of standards that are operational and interoperable. Other key standards[65] include Hyper Text Markup Language (HTML), initially created by the World-Wide Web Consortium (W3C) in 1989 as a vehicle through which all Internet users can develop and share input[66].

85. It is also noteworthy that many of the core infrastructure standards have a reference open implementation, that is, an implementation which is open-source and redistributable. For instance, BIND (Berkeley Internet Name Domain) is an open implementation of the above-mentioned Domain Name System (DNS) protocols and is used by over 80% of DNS servers. Apache, with nearly 70% market share, is the most common world-wide web server used[67]. Sendmail, with over 50% market share, and qmail, with over 10% market share, are frequently-used implementations of Simple Mail Transfer Protocol (SMTP).

A distributed/decentralised, open architecture

86. The Internet is a made up of tens of thousands of interconnected networks run by Internet Service Providers, individual companies, universities, governments, and others, which can communicate together.

87. The key underlying technical idea is that of open architecture networking in which any type of network anywhere can be included. There is a clear separation between the underlying physical medium, the network transport and interconnection (Internet protocols), and the application technology.

Box 8. Developing TCP/IP

In a well-known joint effort, Robert Kahn, at ARPA, and Vinton Cerf, at Stanford, developed a detailed design of the Network Control Protocol (NCP), later known as TCP/IP (Transmission Control Protocol / Internet Protocol) in 1973-74, to allow packet networks of different kinds to interconnect, and machines to communicate across the array of interconnected networks:

- The Internet Protocol (IP), serving simply to address and forward individual packets of data, and
- TCP (which was separated from IP in 1978), to deal with service features such as flow control from one host to the other, and recovery from lost packets. Some applications do not need TCP in order to use the basic service of IP.

A key feature of the TCP/IP for "Internetting" is that it was designed as a means rather than an end: it was not designed for specific applications, but just as an infrastructure, on which new applications could be developed, as exemplified later by the World Wide Web amongst many others.

Source: Based on Internet Society, "A Brief History of the Internet", http://www.isoc.org/internet/history/brief.shtml.

88. Any communications network, wired or wireless, that can carry two-way digital data can carry Internet traffic. Thus, Internet packets flow through wired networks like copper wire, coaxial cable, and fibre optic, and through wireless networks like Wi-Fi.

89. The application technology is processed by devices connected at the ends of the network. In other words, the intelligence does not lie in the network, which is neutral, but in the end devices carrying applications. For this reason, the network can serve as a neutral and transparent platform for many applications and services that were not necessarily planned-for: each individual network may be separately designed and developed and each may have its own unique interface designed for a specific environment and for specific user requirements. Instances of additional layers of applications developed over the basic Internet Protocol include the World Wide Web, email, Voice over IP (VoIP), and more recently, television over IP (IPTV).

THE ROLE OF THE OECD IN INTERNET-RELATED PUBLIC POLICY AREAS

90. The purpose of this section is to identify the existing role and work of the OECD in policy areas covered under the term Internet governance. As shown in tables 2 to 5, the OECD has made strong contributions in several critical public policy areas related to the Internet, including telecommunications infrastructure and broadband, peering and interconnection, security of network and information systems, privacy, spam, consumer protection, e-commerce, and universal access. Web links to the publicly available reports and their findings are also available at www.oecd.org/internetgovernance.

Background

91. At the outset, it needs to be stressed that many political, economic and regulatory issues normally associated with the Internet usually reflect the catalyst role of the Internet and other technologies in increasing the global and interdependent nature of the world economy. As the previous chapters have mentioned, various institutions at various levels have intervened in order to deal with specific issues created by the Internet. Many of these issues have been ongoing public policy issues which often need to be reviewed in the context of Internet developments. As such they should not necessarily be viewed as "Internet governance" issues. Box 9 shows some of the types of institutions that were adapted or created to address a number of emerging Internet governance issues.

Box 9. Institutions that currently address some Internet governance issues

Non-governmental bodies, often private-sector lead, were created to manage the coordination of the Internet's technical framework. These include standards bodies, industry associations, as well as voluntary associations.

Inter-governmental organisations that have addressed some emerging Internet governance issues include, *inter alia*, the International Telecommunication Union (ITU), the Organisation for Economic Co-operation and Development (OECD), the World Trade Organization (WTO), the World Intellectual Property Organization (WIPO), or the European Union (EU).

National institutions also play a role in a number of issues, as countries have applied or adapted national legislation to address emerging Internet-related issues.

Civil society has also been playing a role. Examples include Privacy International and the Association for Progressive Communications.

92. Discussions in the 2003 World Summit on the Information Society (WSIS) on the international management of the Internet and the role of all stakeholders triggered increased attention on Internet governance and led to the creation of a Working Group on Internet Governance (WGIG) by the United Nations Secretary-General. The main activity of the Working Group on Internet Governance is "to investigate and make proposals for action, as appropriate, on the governance of Internet by 2005." The WGIG is asked to present the result of its work in a report "for consideration and appropriate action for the second phase of the WSIS in Tunis 2005,"[68] which will take place in November.

93. The mandate of the WGIG includes developing a working definition of "Internet governance." The issues related to Internet governance are broad, and involve national sovereignty (country domain names for example), security, stability, privacy, intellectual property rights, etc. These issues are not limited to technical or policy areas, but also have potentially wide-ranging social, economic, and national security implications.

94. It is worth noting that the rapid evolution and convergence of information and communication technologies (including the Internet) and accompanying evolution of markets, heighten both the potential benefits and the risks of, intended or unintended, technological, social, or economic consequences of intervention. For instance, a senior official from the International Telecommunication Union (ITU)[69] proposed creating a new Internet address distribution process for IPV6 based on national authorities. The existing regional Internet registry system (RIRs) opposed this, stating that their own efficient work would be undermined and that national authorities would be less objective in their allocation of addresses[70]. Evidence of the RIRs managing IPv4 numbers have shown that they have performed well and ensured that there has been no shortage of address space, in spite of many predictions to the contrary. Furthermore, the current model works at no cost to taxpayers.

Public policy issues associated with Internet governance

95. The Working Group on Internet Governance (WGIG) has identified what it considers to be key public policy areas for further investigation and discussion, represented in table 1: *i)* Issues relating to infrastructure and the management of critical Internet resources; *ii)* Issues relating to the use of the Internet; *iii)* Issues which are relevant to the Internet, but with impact much wider than the Internet and; *iv)* Issues relating to developmental aspects of Internet governance. Among its next steps, it will examine "some horizontal issues that affect every aspect of Internet governance"… "such as the economic and social aspects of the Internet" as well as "the capacity of existing Internet governance arrangements to address governance issues in a coordinated manner." Furthermore, the WGIG agreed that certain principles elaborated in the Geneva documents[71] needed further discussion in the context of Internet governance. These principles include the terms "multilateral," "transparent," and "democratic" as well as the notion of the "full involvement of governments, stakeholders and international organizations".

Table 1. Public Policy Areas Identified by the UN Working Group on Internet Governance (WGIG)

1/ INTERNET INFRASTRUCTURE AND MANAGEMENT OF CRITICAL RESOURCES		
"Issues relating to infrastructure and the management of critical Internet resources... matters of direct relevance to Internet Governance falling within the ambit of existing organisations with responsibility for these matters" (WGIG)		
Physical & secured infrastructure	Telecommunications infrastructure, broadband access, convergence with NGN	
	VoIP	Peering & interconnection
	Spectrum policy	*Technical standards**
Institutions: IEEE, IETF, ITU, W3C, Other private consortiums		
Logical infrastructure	Administration of Internet names	*Administration of IP addresses**
	*Administration of root server system**	*Administration of root zone files**
	*Technical standards**	*Multilingualization of Internet naming systems**
Institutions: ICANN, IETF, ISO, ITU, RIRs, Root Server Operators, WIPO		
2/ ISSUES RELATING TO THE USE OF THE INTERNET		
"While these issues are directly related to Internet Governance, the nature of global co-operation required is not well defined" (WGIG)		
Spam	Cybersecurity, cybercrime	Security of network and information systems
Critical infrastructure protection	Applicable jurisdiction, cross-border coordination	
*Exemptions for ISPs of third party liability**		National policies & regulations
Institutions: APEC, Council of Europe, ITU, OECD		
3/ ISSUES WITH WIDER IMPACT THAN THE INTERNET		
"Issues which are relevant to the Internet, but with impact much wider than the Internet, where there are existing organisations responsible for these issues" (WGIG)		
Competition policy, liberalization, privatization, regulations		Consumer, user protection, privacy
Electronic authentication	Unlawful content and practices	Access protection
Intellectual property rights	Dispute resolution	E-commerce and taxation of e-commerce
E-government and privacy	*Freedom of information and media**	
Institutions: APEC, CAHSI, Council of Europe, IETF, ITU, OECD, UN/CEFACT, UNCITRAL, UNCTAD, UNESCO, WIPO, WTO, Private consortiums		
4/ ISSUES WITH DEVELOPMENTAL ASPECTS		
"Issues relating to developmental aspects of Internet governance, in particular capacity building in developing countries" (WGIG)		
Affordable & universal access	Education, human capacity building	Internet leased line costs
National infrastructure development	*Cultural and linguistic diversity**	*Social dimensions and inclusion**
*Open-source and free software**	*Content accessibility**	
Institutions: ITU, UN ICTTF, UNESCO, World Bank		

*: The OECD has not conducted significant work in these areas.
Source: Working Group on Internet Governance, Preliminary report and Key Issues, http://www.wgig.org/docs/Clusters.pdf

OECD work on WGIG-designated public policy issues

96. Many of the priority issues for the WGIG are also priority areas for the OECD, specifically the OECD Committee for Information, Computer and Communications Policy (ICCP). The goal of Tables 2 to 5 is to highlight work which OECD has already conducted on designated public policy issues, as identified by the WGIG. The Committee on Information Computer and Communications Policy (ICCP) has been particularly active in Internet-related policy areas, including telecommunication policy (www.oecd.org/sti/telecom), security and privacy (www.oecd.org/sti/security-privacy), and broader information economy issues (www.oecd.org/sti/information-economy). Other OECD Committees that have worked on public policy issues that bear on Internet include the OECD Consumer Policy Committee in the course of its work on electronic commerce and consumer protection (www.oecd.org/sti/consumer-policy), the OECD Development Assistance Committee (www.oecd.org/dac/ict) in the course of its work on ICTs for development, and the OECD Committee on Fiscal Affairs (www.oecd.org/ctp) in the course of its work on electronic commerce and taxation.

Table 2. Issues relating to "infrastructure and the management of critical Internet resources"

The work conducted by the OECD on these issues is indicated using the headings identified by WGIG

PHYSICAL INFRASTRUCTURE	
Telecommunications infrastructure, broadband access, convergence with NGN	
"Communications Outlook 2005", *forthcoming*	2005
Recommendation of the OECD Council on Broadband Development	2004
The development of broadband access in rural and remote areas	2004
The implications of convergence for regulation of electronic communications (PDF, 276KB)	2004
Information Technology Outlook 2004	2004
Broadband audio-visual services: Market developments in OECD Countries	2004
Science, Technology and Industry Outlook 2004	2004
Broadband Driving Growth: Policy Responses (PDF, 23KB)	2003
OECD Communications Outlook 2003	2003
Maximising Broadband to Boost Economic and Social Development	2003
2nd Broadband Workshop, 4-5 June 2002, Seoul, Korea	2002
Broadband Access for Business (PDF, 257KB)	2002
The Development of Broadband Access in the OECD Countries (PDF, 387KB)	2001
ICT Standardisation in the New Global Context (PDF)	2000
Dublin Internet Workshop Session	1996
VoIP	
Review of the development and reform of the telecommunications sector in China (PDF, 535KB)	2003
Broadband and Telephony Services Over Cable Television Networks	2003
Trends in IP Technology (PDF, 380KB)	2002
Peering and interconnection	
Internet Traffic Exchange and The Development of End-to-end International Telecommunication Competition (PDF, 732KB)	2002
OECD Berlin workshop on "Internet Traffic Exchange"	2001
Interconnection and Local Competition (PDF, 186KB)	2001
Internet Traffic Exchange: Developments and Policy (PDF, 611KB)	1998
Spectrum policy	
Development of wireless local area networks in OECD countries	2003
Spectrum Allocation: Auctions and Comparative Selection Procedures (PDF, 233KB)	2002
MANAGEMENT OF CRITICAL INTERNET RESOURCES	
Administration of Internet names	
Generic top level domain names: market development and allocation issues (PDF, 300KB)	2004
Comparing domain name administration in OECD countries	2003
Internet Domain Name Allocation Policies (PDF, 389KB)	1997

Source: OECD, using the headings identified by WGIG.

Table 3. Issues relating to the use of the internet

The work conducted by the OECD on these issues is indicated using the headings identified by WGIG

Spam	
See also www.oecd.org/sti/spam. An OECD Task Force on SPAM was set up in 2004 to develop an anti-spam toolkit and marshal the efforts of government, business and civil society in the most comprehensive, strategic and inclusive response to date to the problems posed by spam.	2004
Cybersecurity, cybercrime	
See also www.oecd.org/sti/security-privacy	
Summary of Responses to the Survey on the Implementation of the OECD Security Guidelines	2003
Security of network and information systems	
OECD Guidelines for the Security of Information Systems and Networks: Towards a Culture of Security	2002
Critical infrastructure protection	
OECD Guidelines for the Security of Information Systems and Networks: Towards a Culture of Security	2002
Applicable jurisdiction, cross border coordination	
See also www.oecd.org/sti/consumer-policy.	
OECD Guidelines for Protecting Consumers from Fraudulent and Deceptive Commercial Practices Across Borders.	2003
OECD Guidelines on the Protection of Privacy and Transborder Flows of Personal Data	2003
National policies & regulations	
Telecommunications regulations: Institutional structures and responsibilities (PDF)	2000

Source: OECD, using the headings identified by WGIG.

Table 4. Issues with wider impact than the Internet

The work conducted by the OECD on these issues is indicated using the headings identified by WGIG

Competition policy, liberalization, privatization, regulations	
Indicators for the assessment of telecommunications competition (PDF, 190KB)	2003
Internet Traffic Exchange and the Development of End-To-End International Telecommunication Competition (PDF, 132KB)	2002
Consumer, user protection, privacy	
See also www.oecd.org/sti/consumer-policy	
OECD Guidelines for Protecting Consumers from Fraudulent and Deceptive Commercial Practices Across Borders	2003
Privacy Online: OECD Guidance on Policy and Practice	2003
OECD Guidelines on the Protection of Privacy and Transborder Flows of Personal Data	2002
Guidelines for Consumer Protection in the Context of Electronic Commerce	1999
Ministerial Declaration on the Protection of Privacy on Global Networks (PDF, 11KB)	1998
Electronic authentication	
Summary of Responses to the Survey of Legal and Policy Frameworks for Electronic Authentication Services and E-Signatures in OECD Member Countries (PDF, 94KB)	2004
Unlawful content - Access protection	
Building Trust in the Online Environment	2001
Intellectual property rights	
Patents, Innovation and Economic Performance: Conference Proceedings	2004
Cybersquatting : The OECD's experience and problems it illustrates with registrars (PDF, 129KB)	2002
Dispute resolution	
Building Trust in the Online Environment: Business-to-Consumer Dispute Resolution	2000
Improving dispute resolution for cross-border tax disputes. See also www.oecd.org/daf/ctpa	2003
E-commerce and taxation of e-commerce	
Electronic Commerce - Facilitating Collection of Consumption Taxes on Business-to-Consumer Cross-Border E-Commerce Transactions, OECD Centre for Tax Policy (PDF, 224KB)	2005
Implementation of the Ottawa Taxation Framework Conditions - 2003 Report, OECD Committee on Fiscal Affairs (PDF)	2003
Electronic Commerce for Development, OECD Development Center	2002
OECD-APEC Global Forum: Business Forum Agenda	2003
Summary Report of the OECD Emerging Market Economy Forum on Electronic Commerce (PDF, 127KB)	2001
OECD Indicators on Internet and Electronic Commerce	2000
Guidelines for Consumer Protection in the Context of Electronic Commerce	1999
Ottawa Ministerial Report on Electronic Commerce: Taxation Framework Conditions , OECD Centre for Tax Policy (PDF, 343KB)	1998
E-government and privacy	
Policy Brief: Checklist for e-Government Leaders, OECD Public Governance and Territorial Development Directorate (PDF, 199KB)	2003
The e-Government Imperative, OECD Public Governance and Territorial Development Directorate (PDF, 170KB)	2003
Policy Brief: Engaging Citizens Online for Better Policy-making, OECD Public Governance and Territorial Development Directorate (PDF, 185KB)	2003
Citizens as Partners: Information, Consultation and Public Participation in Policy-making, OECD Public Governance and Territorial Development Directorate (PDF, 1.1MB)	2001
The Hidden Threat to E-Government: Avoiding large government IT failures, OECD Public Governance and Territorial Development Directorate (PDF, 30KB)	2001

Source: OECD, using the headings identified by WGIG.

Table 5. Issues relating to developmental aspects of Internet governance

The work conducted by the OECD on these issues is indicated using the headings identified by WGIG

Affordable & universal access	
Regulatory Reform as a Tool for Bridging the Digital Divide (PDF, 262KB)	2005
Leveraging Telecommunications Policies for Pro-Poor Growth: Universal Access Funds with Minimum-Subsidy Auctions, OECD Development Co-operation Directorate (PDF, 337KB)	2004
Providing Low-Cost ICT Access to Low-Income Communities in Developing Countries - What Works? What Pays, OECD Development Center (PDF, 377KB)	2003
Universal service obligations and broadband (PDF, 176KB)	2003
Bridging the "Digital Divide": Issues and Policies in OECD Countries (PDF, 286KB)	2001
Understanding the Digital Divide	2001
Universal Service and Rate Restructuring in Telecommunications (PDF, 11MB)	1991
Conditional Access Systems: Implications for Access (PDF, 247KB)	1999
Universal Service in a Competitive Telecommunications Environment (PDF, 9MB)	1995
Education, human capacity building	
Seizing the Benefits of ICT in a Digital Economy	2003
OECD Information Technology Outlook 2004, ICT Skills and Employment	2004
OECD Global Forum on the Knowledge Economy: Policy Frameworks for ICTs, Innovation, and Human Resources	2002
Science, Technology and Industry Outlook - Drivers of Growth: Information Technology, Innovation and Entrepreneurship	2001
Internet leased line costs	
Access Pricing in Telecommunications, OECD Directorate for Financial and Enterprise Affairs (PDF, 110KB)	2004
Internet Traffic Exchange and the Development of End-To-End International Telecommunication Competition (PDF, 732KB)	2002
Building infrastructure capacity for electronic commerce: Leased line developments and pricing (PDF, 402KB)	1999
National infrastructure development	
Role of Infrastructure in Economic Growth and Poverty Reduction -- Lessons learned from PRSPs of 33 Countries, OECD Development Co-operation Directorate (PDF, 402KB)	2004
Other	
ICTs and Economic Growth in Developing Countries, OECD Development Co-operation Directorate, *forthcoming*	2005
Financing ICTs for Development: Efforts of DAC Members - Review of Recent Trends and its Contribution, OECD Development Co-operation Directorate (PDF, 1.6MB)	2005
ICT Donor Strategies Matrix, OECD Development Co-operation Directorate	2004

Source: OECD, using the headings identified by WGIG.

ACRONYMS/ABBREVIATIONS

TECHNICAL TERMS / PROTOCOLS

3G	Third-Generation Cell-Phone Technology
AUP	Acceptable Use Policy
ccTLD	country code Top Level Domain name (.fr, .ug, *etc.*)
CIDR	Classless Inter-domain Routing
DNS	Domain Name System
ENUM	Electronic Numbers
GSM	Global System for Mobile Communications
gTLD	generic Top Level Domain name
ICT	Information and Communication Technology
IMP	Interface Message Processors
IP address	Internet Protocol Address
ISP	Internet Service Provider
IXPs	Internet eXchange Points
LAN	Local Area Network
LIRs	Local Internet Registries
MMS	Multimedia Messaging Service
NATs	Network Address Translators
NGN	New Generation Network
NIC	Network Information Center
POPs	(Internet) Points-Of-Presence
PSTN	Public Switched Telephone Network
RFC	Request For Comments
SLD	Second Level Domain name (*e.g.* .co in sony.co.jp)
SMS	Short Message Service (cellular phone text messaging)
SSL	Secure Sockets Layer (Netscape; web security protocol)
sTLD	Sponsored generic Top Level Domain names (*e.g.* .museum, managed by a sponsor organisation)
uTLD	Unsponsored generic Top Level Domain names (*e.g.* .net, managed under gTLDs policies by ICANN)
TCP/IP	Transmission Control Protocol /Internet Protocol
TLD	Top Level Domain (*e.g.* .com), the last label on the right of a domain name
VSAT	Very Small Aperture Terminal, a type of ground station used to contact a communications satellite such as INMARSAT.
WAN	Wide Area Network
Wi-fi	Wireless fidelity, WLAN IEEE standard for broadband communication, also known as 802.11
Wi-Max	Wireless Inter-operability for Microwave Access IEEE 802.16
WLAN	Wireless Local Area Network
WWW	World Wide Web

ACRONYMS/ABBREVIATIONS/ORGANISATIONS

AfriNIC	African Network Information Center
APNIC	Asia Pacific Network Information Center
ARIN	American Registry for Internet Numbers
ARPA	Advanced Research Project Agency
BBN	Bolt, Beranek, & Newman (company)
DARPA	Defense Advanced Research Projects Agency
DoC	U.S. Department of Commerce
DoD	U.S. Department of Defence
GAC	Governmental Advisory Committee
IAB	Internet Architecture Board (previously Internet Advisory Board)
IANA	Internet Assigned Numbers Authority
ICANN	Internet Corporation for Assigned Names and Numbers
ICANN ALAC	At Large Advisory Committee
ICANN ASO	Address Supporting Organization
ICANN ccNSO	country code Name Supporting Organization
ICANN gNSO	generic Name Supporting Organization
ICANN RSSAC	Root Server System Advisory Committee
ICANN TLG	Technical Liaison Group
ICANN-UDRP	Uniform Dispute Resolution Policy (for names rights)
ICCB	Internet Configuration Control Board
ICCP	OECD Committee for Information, Computer and Communications Policy
IETF	Internet Engineering Task Force
InterNIC	Internet Network Information Center
ISOC	Internet Society
ITU	International Telecommunication Union
NCP	Network Control Protocol
NIC	Network Information Center
NSF	National Science Foundation
NSI	Network Solutions, Inc.
OECD	Organisation for Economic Co-operation and Development
RIPE NCC	Réseaux IP Européens – Network Control Centre
RIR	Regional Internet Registries
SRI	Stanford Research Institute
USC	University of Southern California
WGIG	United Nations Working Group on Internet Governance
WSIS	World Summit on the Information Society

NOTES

1 Computer Industry Almanac estimates the Worldwide Internet Population in 2004 at 934 million users http://www.clickz.com/stats/sectors/geographics/article.php/5911_151151.

2 IDC Black Book, December 2003.

3 OECD (2005), "Communications Outlook 2005", Chapter 5: Internet and Broadband Infrastructure, Directorate for Science, Technology and Industry – Committee for Information, Computer and Communications Policy, forthcoming.

4 Ibid.

5 Ibid.

6 OECD (2005), "Communications Outlook 2005". Based on Internet Software Consortium Surveys (http://www.isc.org/).

7 OECD (2005), "Communications Outlook 2005", Chapter 5: Internet and Broadband Infrastructure, Directorate for Science, Technology and Industry - Committee for Information, Computer and Communications Policy, forthcoming.

8 OECD (2003), "ICT and Economic Growth. Evidence from OECD Countries, Industries and Firms".

9 OECD (2004), "The Economic Impact of ICT: Measurement, Evidence And Implications" and OECD (2003), "ICT and Economic Growth. Evidence from OECD Countries, Industries and Firms".

10 Further developed in OECD (2005), "ICTs and Economic Growth in Developing Countries", Development Co-operation Directorate, DAC Journal, forthcoming.

11 For this report, the term developed economies includes Andorra, Australia, Austria, Belgium, Bermuda, Canada, Croatia, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, San Marino, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and the United States. All other countries are included in the developing classification.

12 ITU (2003), *"Trends in Telecommunications Reform 2003"*.

13 At the 2000 UN Millenium Summit, world leaders adopted the Millenium Declaration, which brought together a variety of development goals that member states have agreed to at various UN forums.

14 OECD (2001), "Internet Traffic Exchange and the Development of End-to-End International Telecommunication Competition", Directorate for Science, Technology and Industry – Committee for Information, Computer and Communications Policy.

15 OECD (2005), *"Regulatory Reform as a Tool for Bridging the Digital Divide"*, www.oecd.org/sti/telecom.

[16] STM-1, Source: Telegeography.

[17] OECD (2005), Communications Outlook 2005, forthcoming.

[18] OECD (2002), "*Internet Traffic Exchange and the Development of End-to-End International Telecommunication Competition",* www.oecd.org/sti/telecom.

[19] Global System for Mobile Communications.

[20] Uganda Communications Commission (2004), *Uganda's Approach to Universal Access & Communications* Development Funding, April.

[21] Nepal Wireless Networking Project, http://nepalwireless.net.

[22] By Ray Tomlinson at BBN and Larry Roberts.

[23] Through INTELSAT satellites, owned by a consortium of countries.

[24] Mainly through Vinton Cerf, a "founding-father" of the Internet.

[25] http://www.faqs.org/rfcs/rfc801.html.

[26] Resolvers are often part of the operating system or software on the user's computer.

[27] At the time called the DNS Network Information Center (NIC).

[28] Renamed the Internet Activities Board.

[29] Including XNS by Xerox, DECNet, and SNA by IBM for example.

[30] OECD (2002), "Internet Traffic Exchange and the Development of End-to-End International Telecommunication Competition", Directorate for Science, Technology and Industry – Committee for Information, Computer and Communications Policy, p 7.

[31] Internet eXchange points (IXPs) are the interconnection points of the Internet, where ISPs interconnect with each other.

[32] OECD (2001), "Internet Traffic Exchange and the Development of End-to-End International Telecommunication Competition", Directorate for Science, Technology and Industry – Committee for Information, Computer and Communications Policy.

[33] Vergnes, 2001.

[34] USD 50 and later, USD 35 per domain name.

[35] According to the NTIA, based on Internet Monthly Report: http://www.ntia.doc.gov/ntiahome/domainname/DN5NOTIC.htm.

[36] OECD (2004), Information Technology Outlook 2004, Chapter 1: Recent Developments and Outlook.

[37] OECD (2005), Communications Outlook, forthcoming.

[38] From 32-bit with IPV4.

[39] Which disaggregates some of the larger blocks of numbers.

[40] Which hide entire private networks behind a single address.

[41] IETF RFC 2916, http://www.ietf.org/rfc/rfc2916.txt.

[42] In February 2005, a sample taken using the Google search engine reported 50.2 million secure socket layer server link references (i.e. pages with "https" in the URL), of which 45.2% in English, 10.7% in Japanese and other widely used languages – the remaining 8,4% ("other") sites are in languages which each account for less than 0.8% of the total secure socket layer server link references.

[43] http://www.rfc-editor.org/rfc/rfc3490.txt.

[44] http://www.ntia.doc.gov/ntiahome/domainname/6_5_98dns.htm.

[45] http://www.ntia.doc.gov/ntiahome/domainname/background.htm.

[46] Memorandum of Understanding with the US Department of Commerce (DoC)/National Telecommunications and Information Administration (NTIA) of November 1998 reaffirmed in a number of Amendments (the latest in 2003) which expires in 2006.

[47] ICANN performs the IANA functions under contract to the US Department of Commerce. See http://www.ntia.doc.gov/ntiahome/domainname/iana.htm.

[48] As of early 2005, over 100 governments are involved in the GAC and 9 international organisations are involved as observers.

[49] http://www.ntia.doc.gov/ntiahome/domainname/nsi.htm.

[50] OECD (2004), *"Generic Top Level Domain Names: Market Development and Allocation Issues"*, Directorate for Science, Technology and Industry - Committee for Information, Computer and Communications Policy.

[51] Unsponsored TLDs (uTLDs) are managed under general gTLDs policies established by the Internet Corporation for Assigned Names and Numbers (ICANN). They include .com, .net, .org, .biz, .info, .name, .pro. Sponsored TLDs (sTLDs) are managed by a sponsor organisation which establishes policies and practices for the management of that sTLD. They include .edu, .mil, .gov, .int, .aero, .coop, .museum.

[52] http://www.icann.org/tlds/stld-apps-19mar04/stld-public-comments.htm.

[53] The prices quoted include the transaction fee that ICANN charges .NET registries of USD 0.75 per name per year.

[54] http://www.icann.org/tlds/net-rfp/applications/afilias.htm, http://www.icann.org/tlds/net-rfp/applications/coreplusplus.htm, http://www.icann.org/tlds/net-rfp/applications/denic.htm, http://www.icann.org/tlds/net-rfp/applications/verisign.htm.

[55] ICANN-UDRP, http://www.icann.org/udrp/udrp.htm.

[56] OECD (2005), Communications Outlook, forthcoming.

[57] OECD (1997), "*Information Infrastructures: Their Impact and Regulatory Requirements*", Directorate for Science, Technology and Industry - Committee for Information, Computer and Communications Policy.

[58] OECD (2002), "*Internet Traffic Exchange and the Development of End-To-End International Telecommunication Competition"*, Directorate for Science, Technology and Industry – Committee For Information, Computer and Communications Policy.

[59] OECD (2005), "Regulatory Reform as a Tool for Bridging the Digital Divide", forthcoming.

[60] OECD (2004), "Generic Top Level Domain Names: Market Development and Allocation Issues", Directorate for Science, Technology and Industry - Committee for Information, Computer and Communications Policy.

[61] www.centr.net

[62] UN ICT Task Force (2004), "Internet Governance: A Grand Collaboration", Edited collection of papers, March Echeberria, LATNIC, p 175.

[63] Open access to protocol specifications (RFCs).

[64] Others include Network Virtual Terminal Protocol (Telnet), Point-to-Point Protocol (PPP), or the Internet email protocol Post Office Protocol version 3 (POP3).

[65] OECD (2001), "The Internet and Business Performance".

[66] Or eXtensible Markup Language (XML), which offers Internet users a vehicle for sharing standardised data and for processing such data easily across different software applications.

[67] Netcraft (2005), February 2005 Web Server Survey.

[68] http://www.wgig.org/About.html.

[69] http://www.itu.int/ITU-T/tsb-director/itut-wsis/files/zhao-netgov01.doc.

[70] http://www.nro.net/documents/nro17.html.

[71] WSIS-03/GENEVA/DOC/0005