WSIS+10: Overall Review of the Implementation of the WSIS Outcomes

Action Line: C2. Information and communication infrastructure: an essential foundation for the Information Society

Lead Facilitator: ITU

The views expressed may not necessarily reflect the opinions of ITU or its Members.

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1 Introduction

This document presents a review of the progress made in the implementation of Action Line C2 since the first World Summit on the Information Society (WSIS) in 2003. It is based on the 10-Years Review Report Template in the *WSIS Forum 2012: Outcome Document*.[1]

As Action Line facilitator, the ITU has supported eight WSIS Action Line C2 Facilitation Meetings in the framework of WSIS Forums. The meetings have had Ministers, CEOs and other high-level representatives as speakers and panelists, exchanging ideas on best practices, emerging trends and recommendations. In addition, the Action Line facilitator has promoted infrastructure development through various activities:

- Development of global standards including IMT-2000 and IMT-Advanced for mobile broadband networks as well as relevant recommendations for broadband telephone (ADSL), fiber optic and next generation networks.
- Organized five "Connect Summits" aimed at mobilizing funds and new partnerships to attain the WSIS goals, including the development of infrastructure and also supported countries to develop national wireless broadband plans. Within the framework of the Connect the World initiative, ITU, with its partners, is involved in several projects on broadband wireless networks and developing ICT applications to provide free or low cost digital access for schools[2] and hospitals, and for underserved populations in rural and remote areas.[3] Within the context of the UN Convention on the Rights of Persons with Disabilities, the ITU has developed guidelines and toolkits to mainstream access and use of ICTs for the disabled.[4]

The next chapter summarizes main developments related to Action Line C2. Chapter 3 outlines recent developments and emerging trends, challenges and possible new priorities. Chapter 4 recommends possible revisions and new topics including post-2015 goals. Chapter 5 concludes. The Annex reviews developments for each bullet point listed under Action Line C2.

2 Review

There were twelve bullet points (a-l) under Action Line C2 in the WSIS Geneva Plan of Action. They are organized by theme (Table 5-1) and summarized below. Each bullet is covered in more detail in the annex.

Access to ICTs has improved dramatically over the last ten years primarily due to the deployment of wireless technology. Nevertheless there remain coverage gaps in many developing nations, primarily in rural areas. A rising number of countries have adopted universal service programs to extend coverage to commercially unattractive areas and reduce the digital divide. Convergence has grown with voice, data and video services increasingly shifting to next generation Internet Protocol (IP) networks. This has been accompanied by the introduction of new access devices such as smartphones and tablets, increasingly providing consumers the ability to access information anyplace, anytime and anywhere. This trend is placing increasing strains on the existing capacity of ICT networks. Broadband has emerged as a critical general purpose technology with powerful social and economic impacts. International

[1] p. 54. Available at: http://groups.itu.int/wsis-forum2012/Highlights/OutcomeDocument.aspx

[2] http://www.itu.int/ITU-D/sis/Connect_a_school/

[3] http://www.itu.int/en/ITU-D/Technology/Pages/ITU-McCaw-Foundation-Project.aspx

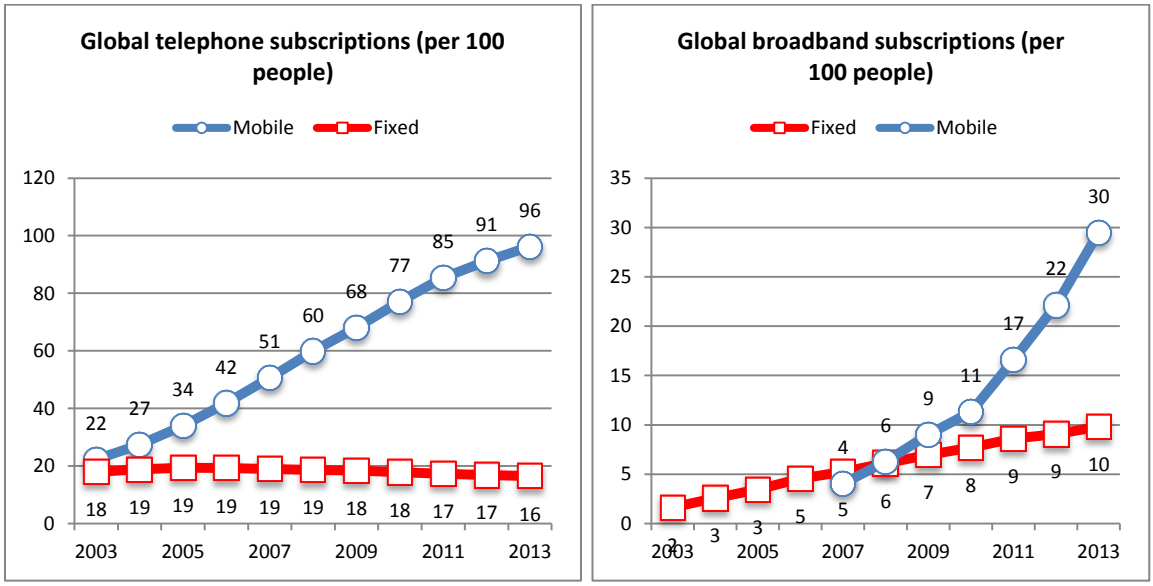
[4] http://www.itu.int/ITU-D/sis/PwDs/

efforts are seeking ways to enhance broadband connectivity in developing countries in order to support development goals.

2.1 Access to ICT

Access to ICT has improved significantly in the decade since WSIS in 2003, largely driven by wireless technology. Global mobile penetration has skyrocketed from just over a quarter in 2003 to almost 100 in 2013 far surpassing fixed telephone penetration which has been stagnant (Figure 2-1, left). The situation is similar for broadband where subscriptions to high-speed mobile networks far surpass those for wired networks (Figure 2-1, right).

Figure 2-1: Global telephone and broadband subscriptions (per 100 people)



Source: ITU.

International standards act as defining elements in the global infrastructure of ICTs. Conforming to international standards avoids costly market battles over different technologies. For companies from emerging economies, international standards create a level playing field which provides access to new markets. Standrds are an essential aid to developing countries in building their infrastructure and encouraging economic development, and through economies of scale, they can reduce costs for all: manufacturers, operators and consumers.

The first global mobile standard *IMT-2000* was developed by the ITU in 1999.[5] The ITU also developed standards for the fourth generation of wireless systems and in October 2010 it designated two technologies as fulfilling the high-speed requirements of *IMT-Advanced* (peak data rates of 100 Mbit/s for high mobility and 1 Gbit/s for low mobility).[6] Similarly, the ITU has been active in developing fixed broadband specifications including those for ADSL technology (G series of ITU-T Recommendations)[7] and Passive Optical Networks (PON) (ITU-T G.983 and ITU-T G.984 standards).

[5] There have been twelve revisions of Recommendation ITU-R M.1457. The latest is M.1457-11 of February 2013. See: ITU. February 2013. *Recommendation ITU-R M.1457-11: Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)*. http://www.itu.int/rec/R-REC-M.1457/e.

[6] "ITU paves way for next-generation 4G mobile technologies." *Press Release*, October 21, 2010. http://www.itu.int/net/pressoffice/press_releases/2010/40.aspx

[7] See" Study Group 15 at a Glance" at: http://www.itu.int/net/ITU-T/info/sg15.aspx

High-speed networks have assumed strategic importance for economic and social development. In response, the ITU and UNESCO announced the Broadband Commission for Digital Development at the opening press conference of the WSIS Forum 2010[8]. The multi-stakeholder Commission -- consisting of private sector leaders, government policy-makers, international agencies, academia and others -- works towards making broadband a development priority, identifies practical ways of achieving broadband growth and promotes the use of broadband as an enabler for achieving the UN's Millennium Development Goals (MDG). The Commission has adopted four broadband targets[9] to be achieved by 2015 (Table 2-1), and recommended actions are taken to achieve these targets. There is still much progress to be made by developing countries to reach the targets.

Table 2-1: Broadband Commission targets to be achieved by 2015

	Goal	Target	Status 2013
1	Making broadband policy universal	All countries should have a national broadband plan or strategy or include broadband in their Universal Access / Service Definitions	134 or 69% of all countries had a national plan, strategy, or policy
2	Making broadband affordable	Entry-level broadband services should be made affordable in developing countries through adequate regulation and market forces (for example, amount to less than 5% of average monthly income).	Developing countries where broadband cost less that 5% of average income: 48
3	Connecting homes to broadband	40% of households in developing countries should have Internet access	In the developing world, 28% of households have Internet access
4	Getting people online	Internet user penetration should reach 60% worldwide, 50% in developing countries and 15% in Least Developed Countries (LDCs).	Worldwide penetration: 39% Developing country penetration: 31% LDC penetration: 10%

Source: Adapted from Broadband Commission. 2013. *The State of Broadband 2013: Universalizing Broadband*. Geneva, Switzerland: ITU and UNESCO.

2.2 Broadband backbone infrastructure

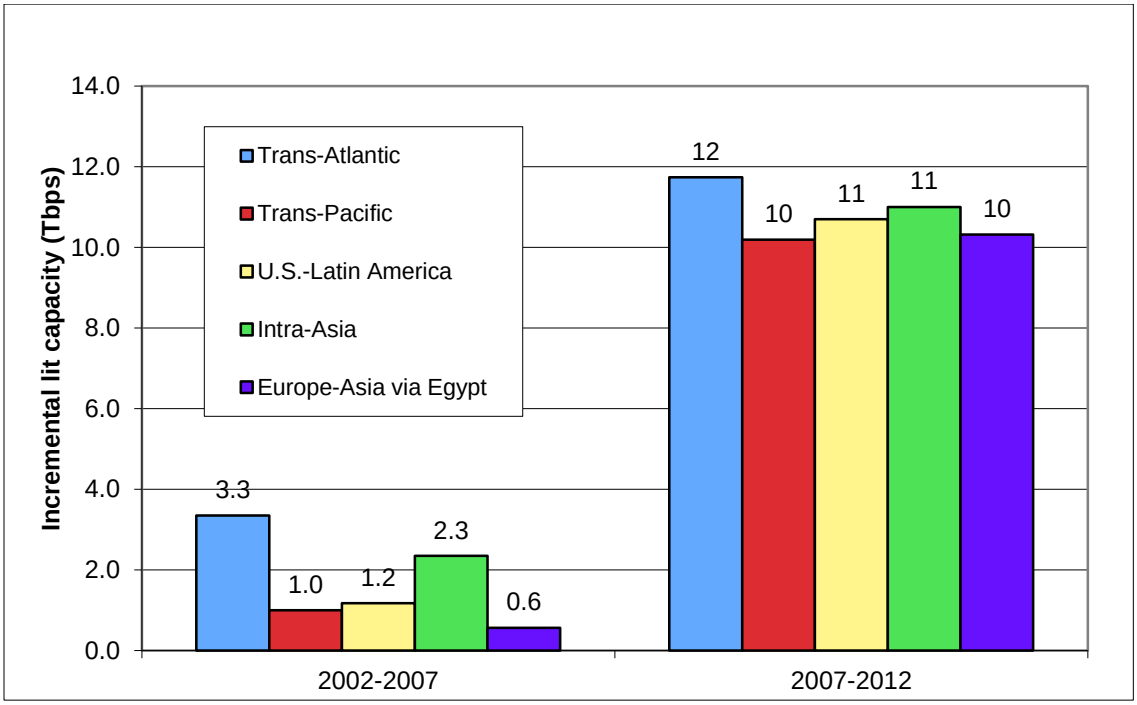
Global backbone infrastructure has grown rapidly over the last decade. International Internet bandwidth delivered over undersea fiber optic cables increased 53% a year between 2007 and 2012.[10] Some 54 Tbps of capacity was added between 2007 and 2012 (Figure 2-2) with demand in developing countries rising the fastest. Africa in particular has benefited from this growth with seven regional undersea cables alone deployed since 2009 adding 22 Tb/s of capacity (compared to just one cable in 2001).

[8] "ITU and UNESCO announce top-level global Broadband Commission." 2010. *Press Release*, May 10. http://www.itu.int/net/pressoffice/press_releases/2010/18.aspx#.UkamChYR924.

[9] The Broadband commission has a fifth broadband target to be achieved by *2020*, "Achieving gender equality in access to broadband."

[10] Telegeography. "International bandwidth demand is decentralising." 17 April 2013. http://www.telegeography.com/products/commsupdate/articles/2013/04/17/international-bandwidth-demand-is-decentralising/..

Figure 2-2: Incremental in use submarine cable capacity on major routes



Source: TeleGeography (www.telegeography.com).

Existing bottlenecks to backbone infrastructure include the lack of open access to international connectivity in some countries. Landlocked countries also face a challenge in ensuring terrestrial transit arrangements to undersea cables. The high cost of national backbone deployment is a bottleneck to the spread of broadband outside urban areas. This can be ameliorated through infrastructure sharing, an area where the ITU has advocated a number of principles in order to lower rollout costs.[11]

2.3 Convergence

The digitization of text, data, audio and video and subsequent transmission over packet-switched Internet Protocol (IP) network infrastructure has continued unabated over the last decade. This convergence of media has been accompanied by the introduction of new access devices such as smartphones and tablet computers which did not exist at the time of the first WSIS. As a result, users have unprecedented options for how, when and where they want to access digitized information and entertainment.

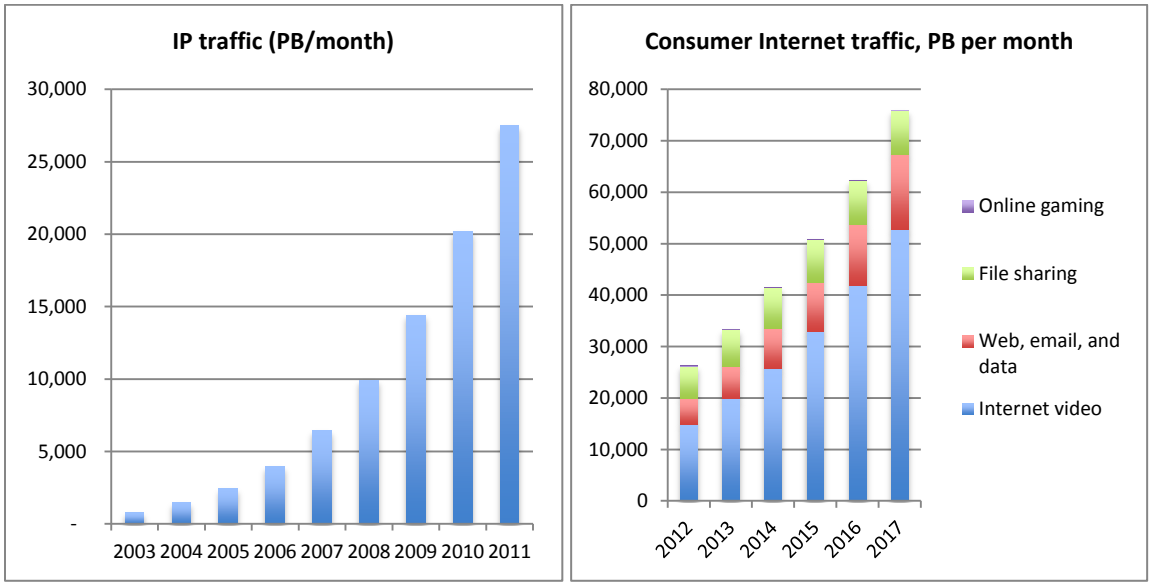
This migration to IP infrastructure platforms and spread of "smart" devices is generating a massive amount of traffic. It is estimated that IP traffic will grow by 21% a year over fixed networks and 68% over mobile networks between 2012-2017 with video accounting for the lion's share, growing from 57% of all traffic in 2012 to 69% by 2017 (Figure 2-3). This rapid increase in IP network traffic presents legal and technical challenges to ensuring that there is sufficient infrastructure capacity.

To accommodate the growth of converged data traffic over IP infrastructure, ITU has developed standards for Next Generation Networks (NGNs) including two fundamental recommendations: Y.2001, General overview of NGN and Y.2011, General principles and general reference model for next

[11] "ITU advocates infrastructure sharing to counter investment drought." 2008. *Press Release*, November 27. http://www.itu.int/newsroom/press_releases/2008/35.html.

generation networks.[12] It also plays a leading role in identifying policy and regulatory issues related to NGNs.[13]

Figure 2-3: Global consumer Internet traffic



Note: PB=Petabyte. Internet video: Includes short-form Internet video (for example, YouTube), long-form Internet video (for example, Hulu), live Internet video, Internet-video-to-TV (for example, Netflix through Roku), online video purchases and rentals, webcam viewing, and web-based video monitoring (excludes P2P video file downloads).
Source: ITU adapted from CISCO (http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360_ns827_Networking_Solutions_White_Paper.html)

2.4 Universal service

It is critical to ensure that all parts of the country--including remote and rural areas--as well as all citizens--including the elderly, disabled and other disadvantaged groups--have access to ICTs. Competitive mobile markets have significantly boosted access to telecommunications services. However there continue to be pockets of un-served, mainly in areas that are deemed to be commercially unattractive. A number of countries have adopted universal service policies to extend access and reduce the digital divide. In 2012 almost three quarters of nations had adopted a universal access/service policy and almost half had an operational universal service fund (Table 2-2).

[12] See "NGN" available at: http://www.itu.int/dms_pub/itu-t/oth/1D/0B/T1D0B0000010003PDFE.pdf

[13] See "Next Generation Networks" at: http://www.itu.int/osg/spu/ngn/

Table 2-2: Countries with universal service/access policies

Universal access/service policy adopted, 2012	73%	0% 100%
Definition of universal service/access exists, 2012	77%	0% 100%
Has your country established a Universal Service Fund?, 2012	59%	0% 100%
Regulator administrating USF, 2012	64%	0% 100%
National broadband plan adopted, 2012	74%	0% 100%
Operational Universal Service Fund, 2012	47%	0% 100%

ITU ICT-Eye: http://www.itu.int/icteye

There are also special groups that face challenges in accessing and using ICTs such as minorities, the elderly, and persons with impairments. Those with a disability form a significant group numbering around one billion people. A recent report found that ICTs accelerate the social and economic inclusion of persons with disabilities.[14] The United Nations Convention on the Rights of Persons with Disabilities (CRPD) adopted in December 2006,[15] features several dispositions related to ICT accessibility and 52 countries have ratified it. There are calls to enact a similar convention for the elderly.[16]

The *digital dividend* refers to the benefits of transitioning terrestrial broadcasting services from analog to digital.[17] This liberates radio spectrum for new services such as mobile broadband, of particular relevance for rural areas because analog broadcasting uses lower frequencies which have a wider transmission range resulting in lower costs for deploy new services. The 2007 ITU World Radiocommunication Conference identified candidate UHF bands for IMT-2000 services.

A number of governments are incorporating mobile technologies into their strategies for universalizing ICT access. One policy has been the dissemination of low cost notebook and tablet computers to children.[18] Another policy has been to leverage the growing availability of WLAN-enabled devices by providing free Wi-Fi access. Some governments have promoted Wi-Fi as a universalization strategy by offering free access to citizens. For example Mauritius has tapped its universal service fund to provide free Wi-Fi access throughout the country at various public locations.[19]

[14] ITU. 2013. *The ICT Opportunity for a Disability-inclusive Development Framework*. http://www.itu.int/en/action/accessibility/Pages/hlmdd2013.aspx.

[15] See "Article 9 - Accessibility" available at: http://www.un.org/disabilities/default.asp?id=269

[16] See "Strengthening Older People's Rights: Towards a UN Convention" available at: http://social.un.org/ageing-working-group/documents/Coalition%20to%20Strengthen%20the%20Rights%20of%20Older%20People.pdf

[17] ITU. 2012. *Digital Dividend: Insights for Spectrum Decisions*. http://www.itu.int/ITU-D/tech/digital_broadcasting/Reports/DigitalDividend.pdf

[18] See "Connect a School, Connect a Community" at: http://www.connectaschool.org/itu-module/22/625/en/schools/devices/1/

[19] ICTA. "Extending Access to the Internet under the USF: Bridging the Access Gap." *News Release*. 20 January 2012. http://www.icta.mu/mediaoffice/2012/news_wifi_en.htm

3 Developments and challenges

3.1 Recent developments and emerging trends

The ICT infrastructure environment has changed significantly over the last ten years. At the Geneva phase of WSIS, attention was still focused on basic connectivity given that telephone penetration was only a little over a fifth of the world's population. Since then, the introduction of competition, prepaid cards and reductions in device prices have increased telephone access through mobile phones. By 2013, global mobile subscription penetration stood at 128 per 100 inhabitants and 89 in developing nations.[20] Although access to telephony has increased dramatically, there still remain areas without coverage primarily in rural and remote areas, a challenge to be addressed by practical *universal service* policies.

Given the rapid take-up of mobile telephony for satisfying basic voice needs emphasis has shifted to *broadband*. This General Purpose Technology has cross-cutting impact throughout different sectors of the economy. The Broadband Commission was established in part to raise visibility and devise strategies for governments and industry to fund the deployment of high-speed networks which will be of upmost priority over the coming years.

New devices and *convergence*, particularly growing video access over IP networks, has triggered migration to IP networks and is generating explosive bandwidth demand. Most of these devices and services, did not exist at the time of the first WSIS. Smartphones and tablets started to become popular after 2005 and the popular video sharing site YouTube launched in 2005. By 2012, video accounted for 57% of IP traffic and smartphones accounted for around 55% of all mobile phones sold in Q3 2013. On the one hand, a variety of different spectrum frequencies has assisted in the deployment of mobile broadband but have also increased the complexity of allocation for regulators. Effective spectrum management will be essential to ensure that wireless broadband networks can meet growing demand.

3.2 Current and future challenges

Action line C2 has helped to develop a sound framework for realizing the goal of a globally interconnected Information Society. Nevertheless there are notable challenges for realizing this vision:

1. Access to basic telephony, primarily through mobile phones, has rapidly increased. But there are gaps especially in rural and remote areas. Furthermore, over half of the world's population is still not connected to the Internet.
2. Ongoing technological evolution has placed increasing pressure on legal, policy and regulatory frameworks to adapt to the changing environment.
3. The explosion in data traffic is straining networks. There is an urgent need to develop new technologies and standards to lower the cost of broadband backbone infrastructure. Policies to ensure network openness, sharing and competition are also needed to lower costs. Innovative business models and financing arrangements such as public private partnerships will be essential for funding broadband backbone development.
4. Background data is critical for planning broadband backbone networks and minimizing duplication. The knowledge of the current situation of regional and cross-border broadband networks is essential for identifying the missing links in order to connect the unconnected.
5. The spread of wireless broadband will require effective spectrum management including utilization of underused radio frequencies to ensure adequate capacity. The transition from

[20] Given that these figures include multiple subscriptions, lapsed subscriptions and machine subscriptions, the numbers can exceed 100. According to a mid-2012 survey of individuals in 21 countries representing over 60% of the world's population, 87% owned a mobile phone. See: "Cell Phones Nearly Universal in Much of the World." Pew Research Center. 4 February 2013. http://www.pewresearch.org/daily-number/cell-phones-nearly-universal-in-much-of-the-world/.

analogue to digital terrestrial broadcasting can help by benefitting consumers through more choice and quality in television services, and to free up radio spectrum for new services.
6. New technological and regulatory approaches to convergence between broadcasting and mobile services will be essential to ensure innovation and meeting user demand.
7. Development of affordable and easy-to-use devices is critical to expand ICT usage among lower income citizens and rural areas.

4 Recommendations

4.1 Possible revisions and new topics

There has been tremendous progress in the deployment of ICT infrastructure over the last ten years. Most of the world now has access to basic voice telephony services due to the prolific growth of mobile communications. Nevertheless there remain pockets where there is still no connectivity and these need to be filled through appropriate universal service programs. Increased connectivity and convergence of services is straining capacity. To meet this challenge, forward thinking spectrum management and policies to expand backbone networks are needed as well as reliable planning data and international standardization. Additionally, the impact of increasing climate fluctuation can be ameliorated through the application of ICTs for disaster relief.

Based on the current status of Action Line C2, the following topics for the future are suggested:

a. To enhance the coverage, quality, and affordability of broadband networks, infrastructure development utilizing converged services, enhanced spectrum management, and both wired and wireless technologies are essential.
b. Develop a well-planned, well-maintained, economic and efficient broadband backbone to ensure the delivery of Internet services.
c. Increase research and development, and deployment of new technologies, to provide reliable and affordable ICT infrastructure.
d. Utilize policy and financing mechanisms such as Universal Service Funds and Public Private Partnerships, to connect and cover rural and remote areas with affordable ICT infrastructure.
e. To attract private investment, competition policies, financing, and new business models need to be studied and deployed.
f. Policies and technologies need to be considered to ensure minorities, disadvantaged and disabled people are connected to ICT networks.
g. Proper data collection, and planning and actions based on such reliable data are essential to avoid duplication of efforts.
h. To develop affordable equipment and services with economy of scale, conformity and interoperability with international standards are fundamental.
i. Emergency telecommunication services should be secured through deploying ICT for disaster relief.

4.2 Action line facilitation and post 2015 goals and mechanisms

Ubiquitous infrastructure is a fundamental prerequisite for achieving the goal of digital inclusion. *Access* to such infrastructure must be *affordable* to encourage *usage*. *Quality* is critical for providing an acceptable user experience. Given these requirements, goals and targets for measuring accomplishment should revolve around access, usage, affordability and quality.

The Broadband Commission for Digital Development adopted four goals, defined targets to be achieved by 2015 and identified indicators for measuring these targets (Table 2-1). They can be adapted for tracking ICT infrastructure post-2015 goals. In moving from the 2015 timetable of the Broadband

Commission to post-2015 goals, the target of developing countries reaching the 2015 level of developed economies could be envisioned.

The Broadband Commission goals address access, usage and affordability. Another important aspect is the quality of infrastructure networks which reflects their capability to support advanced broadband applications and services. From the end user perspective, this is typically measured by upload and download speeds. Such data are collected by a number of regulators as well as other entities.[21] Similar to the Broadband Commission target, one could establish a target of developing countries reaching the level of developed economies.

Table 4-1: Suggested goals, targets and indicators for measuring Action Line C2 in the future

Goal	Target	Indicators
Making broadband affordable	Entry-level broadband services should be made affordable in developing countries	Percentage of households with Internet access Percentage of individuals using the Internet
Connecting homes to broadband	**X**% of households in developing countries should have Internet access	
Getting people online	Internet user penetration should reach **X**% worldwide, **X**% in developing countries and **X**% in Least Developed Countries (LDCs).	
Ensuring broadband quality	Quality of broadband networks in developing countries should match level of developed countries	Fixed-broadband subscriptions by speed

Note: Some indicators are currently not fully collected worldwide. Further consideration will be necessary to adapt such indicators. Also, some targets/indicators could be disaggregated by fixed and wireless networks.

5 Conclusions

The ICT world is a much changed place since the first WSIS in 2003. Basic access to telecommunications has increased tremendously thanks to the rapid take-up of wireless technology. Competitive markets, lower cost of deployment compared to wireline networks, falling device prices and no contract subscription has driven mobile penetration to almost 100 at the end of 2013, up dramatically from 22 in 2003. Nevertheless there remain a significant number of unconnected people with over four billion persons around the world still not using the Internet at the end of 2013.[22] In order to widen access, a number of countries have adopted universal access strategies such as extending telecommunications coverage to rural areas. Greater sharing of such strategies is needed to identify best practices in order to accelerate digital inclusion.

Convergence of telecommunications, broadcasting and the Internet has continued unabated over the last decade. Telephone and cable television networks are used to access the Internet while the Internet is delivering audio and video information and entertainment. New devices to access the Internet such as smartphones and tablets which did not exist at the time of the first WSIS allow users to access the

[21] Cisco (http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns1175/Cloud_Index_White_Paper.html).

[22] http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

Internet anytime and anyplace. However growing IP traffic is straining infrastructure networks, confronting policy makers, regulators, operators and consumers with technical, legal, financial and commercial challenges.

Broadband has emerged as a critical general purpose technology with beneficial social and economic impacts. The Broadband Commission has been established to increase the visibility of broadband in policy making and propose practical strategies for increasing access. It has proposed four key targets for monitoring the take-up of broadband worldwide. Effective regulatory frameworks, enhanced market liberalization, public private partnerships and expanded human capacity development will be needed for many developing countries to achieve the high-speed network targets.

Going forward, the world faces three key infrastructure challenges: connecting the unconnected, dealing effectively with ever growing IP traffic and promoting the widespread adoption of ever speedier broadband networks.

Table 5-1: Action Line C2 matrix of themes, cross linkages and status

Bullet	Theme	Cross reference to other WSIS Action Lines	Status
a) Governments should take action, in the framework of national development policies, in order to support an enabling and competitive environment for the necessary investment in ICT infrastructure and for the development of new services	All	C1: a C6: a C11: a	Not currently measured in a systematic way
b) In the context of national e-strategies, devise appropriate universal access policies and strategies, and their means of implementation, in line with the indicative targets, and develop ICT connectivity indicators.	Universal service	C1: a-c	73% of countries have adopted a universal service policy (2012)[23]
c) In the context of national e-strategies, provide and improve ICT connectivity for all schools, universities, health institutions, libraries, post offices, community centres, museums and other institutions accessible to the public, in line with the indicative targets.	Universal service	C3:d C4: c C8: b (See also B. 6.)	Level of achievement (developing countries):[24] Libraries: Low Museums: Medium Post offices: Low Schools: Low
d) Develop and strengthen national, regional and international broadband network infrastructure, including delivery by satellite and other systems, to help in providing the capacity to match the needs of countries and their citizens and for the delivery of new ICT-based services. Support technical, regulatory and operational studies by the International Telecommunication Union (ITU) and, as appropriate, other relevant international organizations ...	ICT access & Broadband backbone infrastructure	C6: a C11: a	International Internet bandwidth increased almost 3,000% from 2005-2013 reaching 137 Tbps[25]

[23] http://www.itu.int/net4/itu-d/icteye/Topics.aspx?TopicID=13

[24] http://www.itu.int/ITU-D/ict/publications/wtdr_10/

[25] Telegeography. 2013. *Global Internet Geography Capacity and Traffic Trends*.

Bullet	Theme	Cross reference to other WSIS Action Lines	Status
e) In the context of national e-strategies, address the special requirements of older people, persons with disabilities, children, especially marginalized children and other disadvantaged and vulnerable groups, including by appropriate educational administrative and legislative measures to ensure their full inclusion in the Information Society.	Universal service	C4: i, d C8: k	52 countries have ratified UN Convention on Rights of Persons with Disabilities which features ICT provisions. No such conventions exits for other groups.
f) Encourage the design and production of ICT equipment and services so that everyone, has easy and affordable access to them including older people, persons with disabilities, children, especially marginalized children, and other disadvantaged and vulnerable groups, and promote the development of technologies, applications, and content suited to their needs, guided by the Universal Design Principle and further enhanced by the use of assistive technologies.	Universal service	C3: c, g	Not currently measured in systematic way although many devices use graphical interfaces and have assistive technology built-in
g) In order to alleviate the challenges of illiteracy, develop affordable technologies and non-text based computer interfaces to facilitate people's access to ICT.	Universal service	C3:c, g C4: b, d	Not currently measured in systematic way although many devices use graphical interfaces
h) Undertake international research and development efforts aimed at making available adequate and affordable ICT equipment for end users.	Universal service	C3: c, g	Mobile handset average sale prices (Nokia) declined 60% between 2003-2012. PC prices (Lenovo, ex IBM PC) declined 38% between 2005-12. A number of countries have launched free laptop/tablet programs for children.
i) Encourage the use of unused wireless capacity, including satellite, in developed countries and in particular in developing countries, to provide access in remote areas,	Universal service & Broadband backbone infrastructure		A number of countries are making use of "digital dividend" by reallocating

Bullet	Theme	Cross reference to other WSIS Action Lines	Status
especially in developing countries and countries with economies in transition, and to improve low-cost connectivity in developing countries. Special concern should be given to the Least Developed Countries in their efforts in establishing telecommunication infrastructure.			analogue broadcasting spectrum for wireless broadband use
j) Optimize connectivity among major information networks by encouraging the creation and development of regional ICT backbones and Internet exchange points, to reduce interconnection costs and broaden network access.	Broadband backbone infrastructure	C6: c(i) C11:a	Over 100 economies still without IXPs; backbone capacity insufficient in some regions though hard data lacking
k) Develop strategies for increasing affordable global connectivity, thereby facilitating improved access. Commercially negotiated Internet transit and interconnection costs should be oriented towards objective, transparent and non-discriminatory parameters, taking into account ongoing work on this subject	Broadband backbone infrastructure	C11:a	Wholesale prices not monitored. Somewhat mitigated by increase in international capacity and development of IXPs. Nonetheless international IP transit remains costly in some markets, particularly landlocked countries and those without open access provisions.
l) Encourage and promote joint use of traditional media and new technologies	Convergence	C8: j C9: a	Video accounted for 57% of IP traffic in 2012

6 ANNEX: C2.Information and communication infrastructure: an essential foundation for the Information Society

6.1 a) Governments should take action, in the framework of national development policies, in order to support an enabling and competitive environment for the necessary investment in ICT infrastructure and for the development of new services

Recognizing the key impacts of ICTs across the economy, governments are increasingly incorporating ICT strategies as an important part of national development plans and related documents such as poverty reduction strategy papers and Millennium Development Goal (MDG) progress reports. These documents outline the role of ICT in national development and the government's vision and principles for the sector. Though there are no comprehensive international comparisons regarding the role of ICTs in overall national development strategy, there are several country examples.[26] In South Africa, the importance of ICT for development is recognized in the *National Development Plan 2030: Our Future - Make it Work*.[27] The plan notes that efficient infrastructure promotes economic growth and that digital inclusion will necessitate stronger broadband networks and lower prices. The government will support the establishment of national, regional and municipal fiber optic networks to provide the backbone for broadband access. The plan acknowledges the important role of private investment, complemented by public funds required to meet social objectives. The importance of effective policies, regulation and institutional arrangements are critical for achieving these goals.

ICT figures prominently in Colombia's national development plan covering the period 2010-14, subtitled *Prosperity for All* and with the overarching goals of more employment, less poverty and greater security.[28] ICT is identified as a key infrastructure for competitiveness. The plan lays out the role of the national government, through the Ministry of ICT, to support the development and efficient use of infrastructure in order to provide services and generate competition, quality and efficiency for the benefit of users. The government aims to expand coverage in remote areas to benefit vulnerable communities. It also guarantees technology neutrality meaning the free adoption of any technology permitting the development of efficient services, content and applications.

National development plans typically establish a road map for a country's vision of where it wants to be in the future. ICT is a critical cross-cutting general purpose technology and therefore its role in national development needs to be clearly articulated. This also helps to ensure top-level support and consensus for the ICT sector. Countries that have not yet incorporated ICT into their national development plans may wish to consider doing so.

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[26] For examples of how ICTs have been integrated into poverty reduction strategies see: ITU. *National e-Strategies for Development, Global Status and Perspectives, 2010, 2011*. http://www.itu.int/ITU-D/cyb/estrat/estrat2010.html.

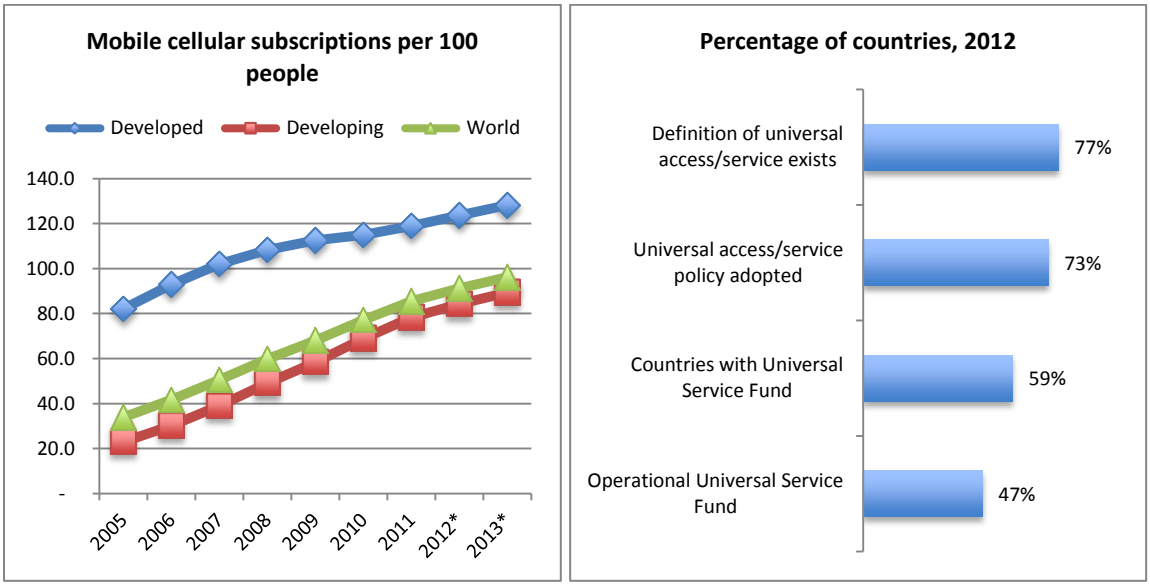
[27] http://www.npconline.co.za/MediaLib/Downloads/Downloads/Executive Summary-NDP 2030 - Our future - make it work.pdf

[28] https://www.dnp.gov.co/LinkClick.aspx?fileticket=J7HMrzUQfxY%3d&tabid=1238

6.2 b) In the context of national e-strategies, devise appropriate universal access policies and strategies, and their means of implementation, in line with the indicative targets, and develop ICT connectivity indicators

Competitive mobile markets have significantly boosted access to telecommunications services. In 2005 only a little over one in five people in developing economies had a mobile subscription; by 2013 this had risen to almost 90 per 100 people (Figure 6-1, left). However there continue to be pockets of underserved, mainly in areas that are deemed to be commercially unattractive.[29] A number of countries have adopted universal access/service policies to extend access and minimize the digital divide. In 2012 almost three quarters of nations had adopted a universal access/service policy (Figure 6-1, right).

Figure 6-1: Mobile penetration and universal access/service 2012



Note: * = Estimate.
Source: Adapted from http://www.itu.int/net4/itu-d/icteye/Topics.aspx?TopicID=13

Almost half the countries have operational universal service funds used to build out infrastructure in remote areas and enhance access for the underserved. In Chile the universal service fund has been used to provide high speed mobile Internet access to 1,474 rural communities.[30] The Rural Internet Network: All Chile Communicating ("RED DE INTERNET RURAL: TODO CHILE COMUNICADO") project uses a public private partnership (PPP) model. The lowest cost bid to provide service is funded by the universal service fund as well as local communities. In addition the winning operator is expected to provide additional investment. This PPP model generated some US$100 million of investment, half coming from the universal service fund and local governments and the remainder from private operators. Around one million households in addition to schools, kindergartens and health centers have benefited from this project which uses 3G technology and where retail prices are no higher than what is charged in regional capitals.

[29] An ITU-D Study Group is examining telecommunications/ICTs for rural and remote areas. See: http://www.itu.int/ITU-D/CDS/sg/rgqlist.asp?lg=1&sp=2010&rgq=D10-RGQ10.3.2&stg=2

[30] Subtel. 2010. PROYECTO BICENTENARIO "RED DE INTERNET RURAL: TODO CHILE COMUNICADO"

The Malaysia Communications and Multimedia Commission has taken a multi-pronged approach to utilization of its universal service fund. A number of projects have been funded covering broadband telecentres, expanded 2G mobile coverage and distribution of netbook computers to low income students.[31]

One challenge in tackling universal access/service is identifying relevant indicators. The percentage of households with telephone service has traditionally been used and is a more accurate measure than mobile subscriptions since the latter could include duplicate SIM cards, lapsed contracts and machine connections. Given the growing importance of broadband, another indicator for tracking universal access/service would be the percentage of households with a broadband subscription. Both of these are core indicators of the Partnership for Measuring ICT for Development.[32] This might be further disaggregated by rural and urban.

Though a growing number of countries have created universal funds, some have yet to be operationalized. A 2013 report by the GSM Association alluded to the challenge of making universal service funds efficient finding that a number of funds were inactive and some were not oriented to relevant technologies such as wireless and broadband (Table 6-1). Efforts will be needed to use the funds more efficiently.

Table 6-1: Review of universal service funds

Region	# funds surveyed	Activity level			Scope		
		Inactive	Limited activity	Moderate activity or active	Fund covers fixed line	Fund covers wireless	Fund covers broadband
Africa	21	7	5	9	21	11	4
Asia Pacific	16	4	0	12	15	7	6
Europe	9	2	4	3	8	0	3
Latin America	12	2	2	8	12	5	5
Middle East	3	1	1	1	3	2	2
North America	3	1	0	2	3	1	1
Total	**64**	**17**	**12**	**35**	**62**	**26**	**21**

Source: GSMA. 2013. Survey of Universal Service Funds.

A majority of countries have adopted a universal access/service policy and a number have introduced universal service funds as a way to finance ICT infrastructure and access in underserved communities. Countries need to review universal access policies to ensure they are inline with current trends and those still without a policy should consider adopting one. Strategies should ensure practical results that can be monitored and evaluated using indicators and cost effectiveness. If universal service funds are part of the strategy, they should be operationalized, strive to match receipts to disbursements and be used for relevant and quantifiable goals.

[31] MCMC. 2012. *Universal Service Provision Annual Report 2011*.

[32] Partnership on Measuring ICT for Development. *Core ICT Indicators*, 2010. http://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-ICT_CORE-2010-PDF-E.pdf.

Box 1: Supporting universal service through free Wi-Fi

At the time of the first WSIS, Wireless Local Area Networks (WLANs) or as popularly known, wireless fidelity (Wi-Fi) hot spots were not widespread nor were there a significant number of people with mobile devices that supported Wi-Fi. Since then, the number of hotspots and Wi-Fi devices has spread tremendously. Tablet computers and smartphones feature Wi-Fi connectivity. Another trend is the free provision of Wi-Fi in a number of countries. This ranges from municipal city networks to regulatory guidelines for the free provision of Wi-Fi. Often there are limits such as the number of hours per month or lower speeds but nonetheless these initiatives provide an option for Internet access particularly for low income users. This has interesting universal access implications where policies have typically been focused on subsidizing home telephone service or building out wired infrastructure in rural areas. In Malaysia, one of the universal service projects is deploying free Wi-Fi access in villages.

6.3 c) In the context of national e-strategies, provide and improve ICT connectivity for all schools, universities, health institutions, libraries, post offices, community centres, museums and other institutions accessible to the public, in line with the indicative targets

The WSIS Plan of Action refers to "B. Objectives, goals and targets" and under point 6, establishes connectivity targets relating to educational institutions, health facilities, libraries, post offices and museums to be achieved by 2015:

- b. to connect universities, colleges, secondary schools and primary schools with ICTs;
- d. to connect public libraries, cultural centres, museums, post offices and archives with ICTs;
- e. to connect health centres and hospitals with ICTs;

The ITU's 2010 *World Telecommunications/ICT Development Report*[33] elaborates further on the WSIS targets in reference to institutions that are publicly accessible by defining indicators and analyzing accomplishment as of the date of the publication. This section draws on that report to identify pertinent indicators for measuring the indicative targets. A related statistical framework for measuring the targets has also been published by the Partnership for Measuring ICT for Development.[34] That report amended some of the targets to improve their measurability by making them more statistically feasible. This included deleting universities. Cultural centres were not specified in the targets.

6.3.1 Libraries

Public libraries are an ideal public venue for providing Internet access. They typically provide free or low-cost services relative to other options and can offer a supportive setting for gaining skills relevant to livelihoods and well being, with a positive impact on socio-economic progress. This point is reiterated in studies citing the benefit of libraries for development:

> "Public libraries that offer access cultivate an environment for certain important development-focused activities, such as health, culture and

[33] ITU. 2010. *World Telecommunication/ICT Development Report*.

[34] Partnership for Measuring ICT for Development. 2011. *Measuring the WSIS Targets: A Statistical Framework*. http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wsistargets2011.aspx

language, and government services. Development agencies and governments should consider public libraries for information and technology access …"[35]

Three indicators have been identified for measuring public library connectivity:

1. Percentage of public libraries with access to the Internet, by type of access
2. Percentage of public libraries providing users with Internet access
3. Percentage of public libraries with a website

The International Federation of Library Associations and Institutions (IFLA) publishes bi-annual data on the percentage of libraries offering users Internet access.[36] The data are broken down by intervals rather than precise percentages. In 2009, 37% of reporting countries stated that between 81-100% of their public libraries offered Internet access, up from 30% two years earlier (Table 6-2). At the other extreme, 28% of reporting countries stated that less than 20% of their public libraries offered Internet access. According to the ITU, developed countries have a medium level of achievement and developing countries a low level of achievement.

Table 6-2: Percentage of public libraries offering Internet access

Access	2009		2007	
	#	%	#	%
81-100%	41	37.3	34	29.6
61-80%	10	9.1	9	7.8
41-60%	20	18.2	16	13.9
21-40%	8	7.3	11	9.6
≤20%	31	28.2	45	39.1
Total (N=)	110		115	
No data/unknown	12		1	

Source: IFLA.

6.3.2 Museums

Two indicators have been proposed for museum connectivity:

1. Percentage of museums with access to the Internet, by type of access
2. Percentage of museums with a website

One shortcoming with data on museums is there is no official international source for recent data on the number of museums let alone those with Internet access. The ITU carried out a survey in 2009. The results point to substantial differences across countries in the number of museums, their connectivity and the percentage of museums with a website (Table 6-3). According to the ITU, the level of accomplishment is high for developed economies and medium for developing ones.

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[35] Clark, M., Sey, A., & Sullivan, J. (2012). *Public access and development: The impact of public access venues and the benefits of libraries*. Seattle: Technology & Social Change Group, University of Washington Information School. https://digital.lib.washington.edu/dspace/bitstream/handle/1773/20918/Global%20Impact%20Study%20brief%201.pdf?sequence=1

[36] IFLA. 2010. *IFLA World Report 2010*.

Table 6-3: Museums with access to the Internet by type of connection, and with a website, selected countries, 2009*

Country	Number of museums	Number of museums with Internet access (any type of connection)	% of museums with Internet access (any type of connection)	Number of museums with Internet access (broadband only)	% of museums with Internet access (broadband only)	Number of museums with a website	% of museums with a website
Albania	28	27	96	18	64	12	43
Andorra	19	...	...	...	...	4	21
Bhutan	4	4	100	...	...	2	50
Bolivia	68	...	...	...	...	...	...
Bosnia and Herzegovina	26	16	62	12	46	13	50
Botswana	7	1	14	1	14	1	14
Brazil	2618	...	...	...	...	...	...
Brunei	1	...	...	...	...	1	100
Bulgaria	222	154	69	...	...	85	38
Croatia	225	191	85	...	...	140	62
Czech Republic	491	...	...	...	...	351	71
Denmark	124	124	100	124	100	123	99
Egypt	104	20	19	20	19	...	...
Hungary	671	279	42	227	34	230	34
Iraq	16	...	...	...	...	...	...
Korea (Rep.)	310	310	100	310	100	...	...
Latvia	128	115	90	...	...	45	35
Lesotho	1	...	...	...	...	...	0
Lithuania	106	106	100	7	7	67	63
Malta	33	19	58	19	58	23	70
Mexico	135	...	...	...	...	...	...
Singapore	8	8	100	8	100	8	100
St. Vincent and the Grenadines	1	1	100	1	100	0	0
Sweden	205	205	100	...	...	205	100
Thailand	1123	...	...	...	...	...	...
Turkey	188	188	100	188	100	10	5

Note: * Or latest available year. "...": data not available.
Source: ITU Survey on the WSIS Targets.

6.3.3 Post offices

The two indicators proposed to measure connectivity in post offices are:

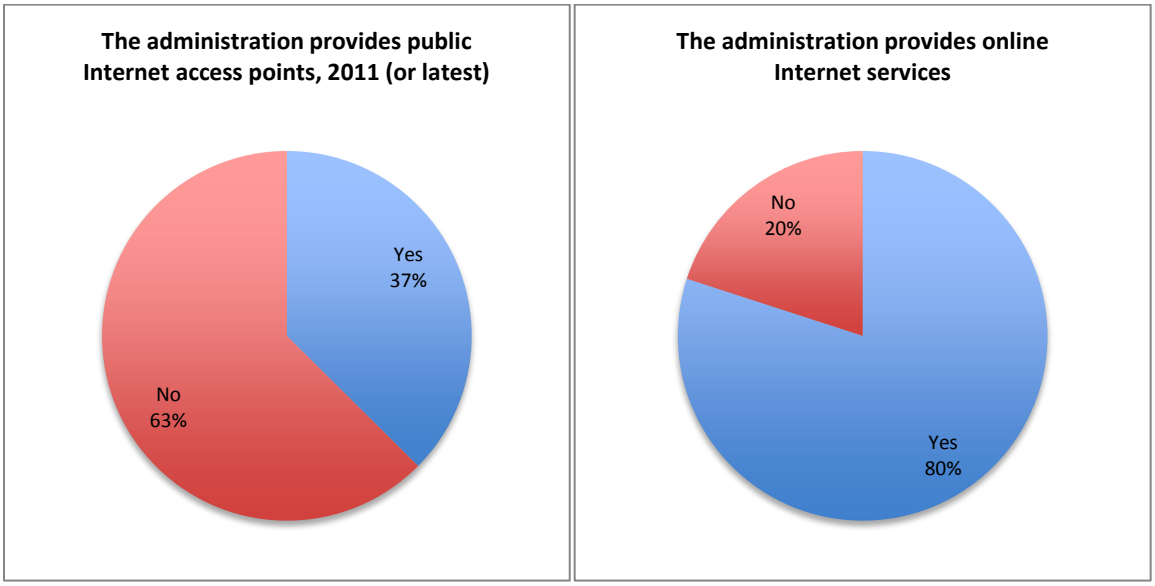
1. Percentage of post offices with access to the Internet, by type of access
2. Percentage of post office offering public Internet access

According to the Universal Postal Union (UPU) there were 663,000 post offices around the world in 2011.[37] The UPU publishes data on whether the administration offers public Internet access rather than the percentage of post offices where public Internet access is available. Therefore using these statistics it is not possible to know the extent of public Internet access at post offices in a country. Some 37% of countries reported providing public Internet access (Figure 6-2, left). The ITU reckons that the level of achievement is low in developing economies. The UPU also publishes data on the availability of online Internet services such as tracking,

[37] UPU. 2012. *Development of postal services in 2011*.

pricing information, post code lookup, product sales and e-mail services. Here, there is a far higher level of accomplishment compared to public Internet access, with 80% of administrations reporting they offer these services in 2011 (up from 60% in 2006) (Figure 6-2, right).

Figure 6-2: Postal administrations providing public Internet access and online Internet services, 2011



Source: Adapted from UPU.

6.3.4 Schools

The four indicators identified to monitor connectivity in primary and secondary schools are the following:

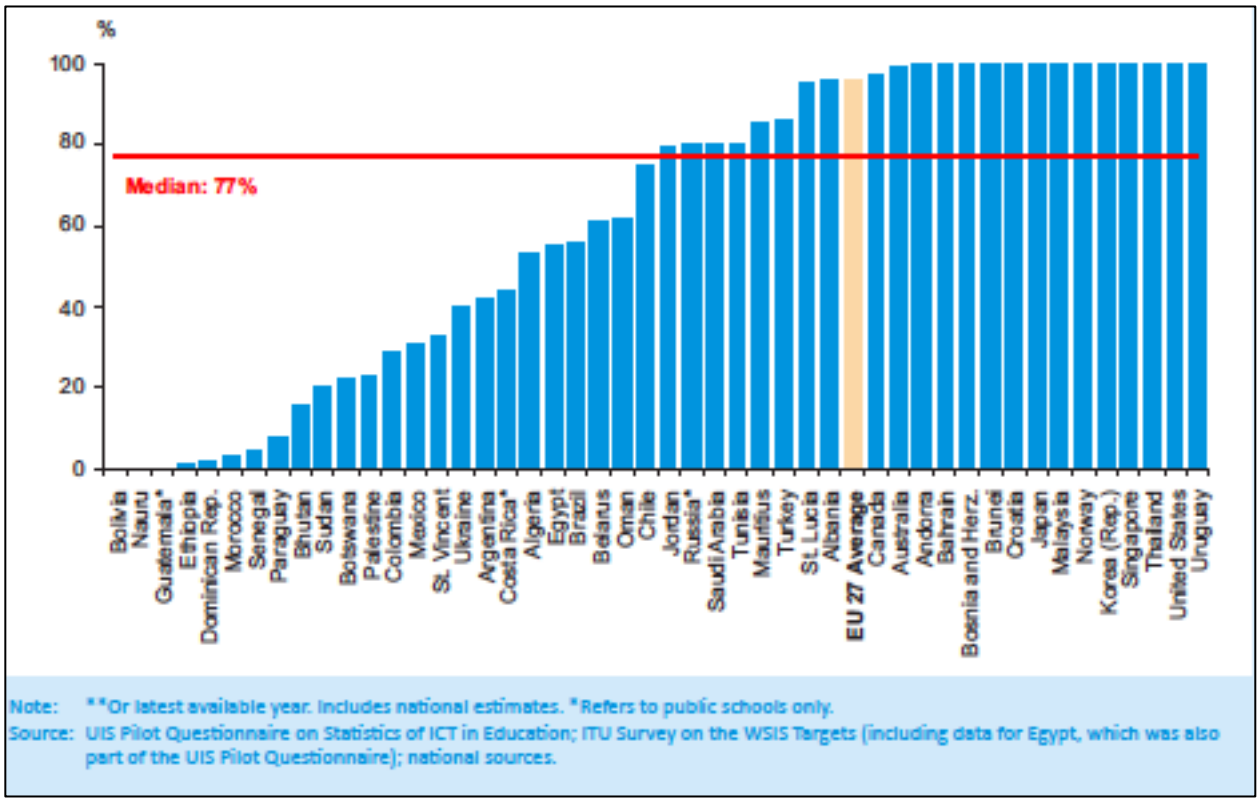
1. Proportion of schools with a radio used for educational purposes (for ISCED levels 1-3)
2. Proportion of schools with a television used for educational purposes (for ISCED levels 1-3)
3. Learners-to-computer ratio (for ISCED levels 1-3)
4. Proportion of schools with Internet access (for ISCED levels 1-3), by type of access (narrowband, broadband)

Some 77% of primary and secondary (ISCED levels 1-3) of countries reporting data were connected to the Internet in 2008-09 (Figure 6-3). However this figure is based on limited data and the ITU considers the level of achievement low in developing countries. UNESCO publishes data on the availability of various ICTs in schools but thus far the data are only available for the Arab States and Latin America and the Caribbean regions.[38] The ITU Connect a School, Connect a Community (CSCC) initiative aims to promote broadband for schools worldwide, including leveraging schools to serve as community ICT centres for rural and marginal urban areas. CSCC aims to raise awareness among governments and has created a toolkit to facilitate school ICT planning and implementation.[39]

[38] http://stats.uis.unesco.org/unesco/ReportFolders/ReportFolders.aspx

[39] http://www.itu.int/en/ITU-D/Digital-Inclusion/Youth-and-Children/Pages/CSCC.aspx

Figure 6-3: Proportion of schools with Internet access, 2008-09



Note: **Or latest available year. Includes national estimates. *Refers to public schools only.
Source: UIS Pilot Questionnaire on Statistics of ICT in Education; ITU Survey on the WSIS Targets (including data for Egypt, which was also part of the UIS Pilot Questionnaire); national sources.

6.3.5 Health

Three indicators have been defined for monitoring ICT and health:

1. Proportion of public hospitals with Internet access, by type of access
2. Proportion of public health centres with Internet access, by type of access
3. Level of use of computers and the Internet to manage individual patient information

The percentage of health institutions with access to the Internet ranged from two percent to 100 percent in selected countries (Table 6-4). The ITU reckons that the level of target achievement is high in developed economies and low to medium in developing economies.

Table 6-4: Percentage of health institutions with access to the Internet, 2009**

	Any type of connection	Broadband only
Andorra	100	100
Bhutan	100	...
Bolivia	2	1
Botswana	97	27
Croatia	100	100
Czech Republic	70	48
Djibouti	14	14
Egypt	6	1
Finland	100	...
Hungary	100	100
Korea (Rep.)	100	100
Latvia	99	39
Lesotho	6	...
Lithuania	100	65
Mexico	5	...
Nauru	100	100
New Zealand	100	47
Paraguay	17	4
Singapore*	100	...
Slovak Republic	77	77
St. Vincent and the Grenadines	3	3
Sweden	100	...
Thailand	91	...

Note: * Hospitals only. ** Or latest available year. "..." Data not available.
Source: ITU Survey on the WSIS targets.

6.3.6 Observations

Though there has been progress over the last decade, the level of connectivity in most facilities open to the public remain low in developing economies. The two most relevant are schools and public libraries. Therefore countries might wish to focus resources on extending public Internet access in those institutions.

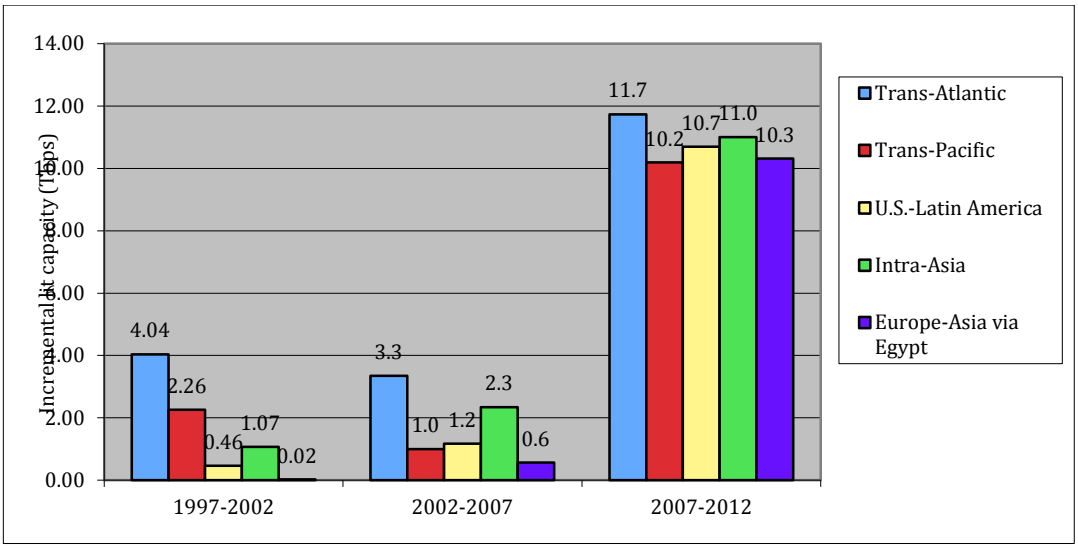
6.4 d) Develop and strengthen national, regional and international broadband network infrastructure, including delivery by satellite and other systems, to help in providing the capacity to match the needs of countries and their citizens and for the delivery of new ICT-based services. Support technical, regulatory and operational studies by the International Telecommunication Union (ITU) and, as appropriate, other relevant international organizations in order to:

i. broaden access to orbital resources, global frequency harmonization and global systems standardization;
ii. encourage public/private partnership;
iii. promote the provision of global high-speed satellite services for underserved areas such as remote and sparsely populated areas;
iv. explore other systems that can provide high-speed connectivity.

International backbone broadband infrastructure has grown rapidly. Telecom market research firm TeleGeography reported that international Internet bandwidth delivered over undersea fiber optic

cables increased 53% a year between 2007 and 2012.[40] Some 54 Tbps of capacity was added between 2007 and 2012 (Figure 6-4) with demand in developing countries rising the fastest.

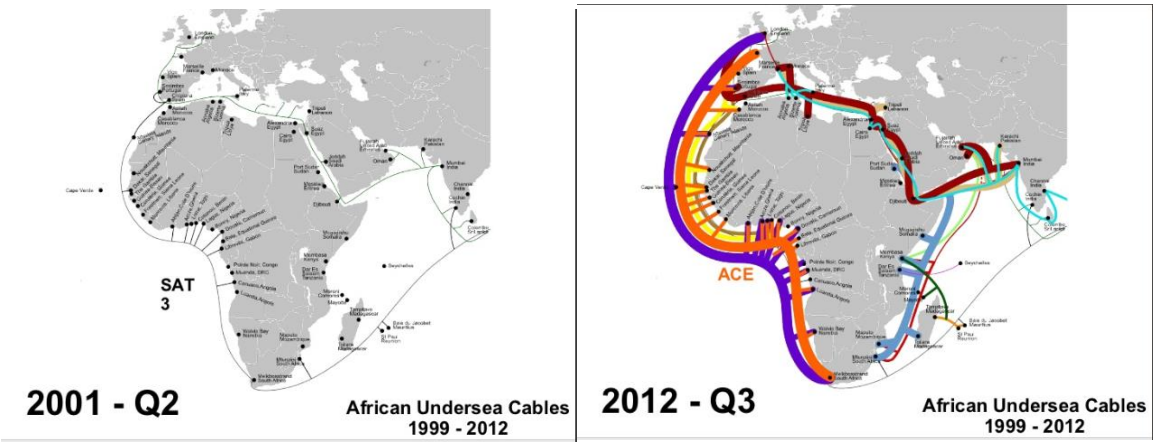
Figure 6-4: Incremental in use submarine cable capacity on major routes



Source: TeleGeography/www.telegeography.com.

Africa in particular has benefited from this growth with seven regional undersea cables alone deployed since 2009 adding 22 Tb/s of capacity compared to just one cable in 2001 (Figure 6-5). Existing bottlenecks are more in the way of access to some of these cables particularly when they lack open access provisions. Landlocked countries also face a challenge in ensuring terrestrial transit arrangements to such cables.

Figure 6-5: Growth in submarine fiber optic cables in Africa



Source: http://manypossibilities.net/african-undersea-cables/

The development of national backbones is difficult to measure due to a lack of internationally comparable metrics.[41] While many developing countries have deployed broadband backbones in

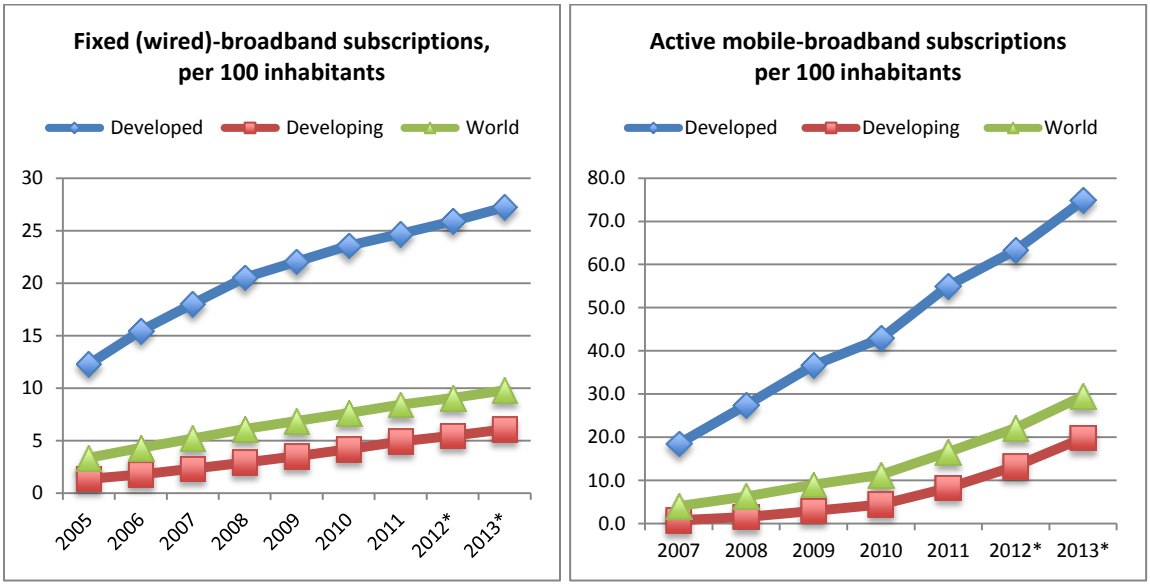
[40] See http://www.telegeography.com/products/commsupdate/articles/2013/04/17/international-bandwidth-demand-is-decentralising/ .

[41] http://www.itu.int/en/ITU-D/Statistics/Documents/events/wtim2012/010-E_doc.pdf

urban areas it has been a challenge, both financially and technically, to extend these backbones throughout the country.

Local access broadband subscriptions have grown significantly. Fixed (wired) broadband subscriptions rose over 200% between 2005 and 2013 to 696 million. Nonetheless, penetration remains low in developing nations at only six fixed (wired) broadband subscription per 100 inhabitants in 2013 (Figure 6-6, left). The rise in mobile broadband subscriptions has been impressive from less than 300 million in 2007 to 2.1 billion by 2013. Global penetration stood at 30 in 2013, up from only four in 2007; one in every four inhabitants in developing countries has a mobile broadband subscription (Figure 6-6, right).

Figure 6-6: Fixed (wired) and active mobile broadband subscriptions per 100 people



Note: * Estimate.
Source: ITU.

Broadband networks have shown impressive growth over the last decade. Capacity over submarine fiber optic networks has increased rapidly. Landlocked countries face challenges to assure adequate access to these undersea networks. Many countries have embarked on deploying trunk broadband networks although there remain significant gaps in some particularly to reach rural areas. These remote areas are often served by satellite networks. Local access broadband subscriptions have risen, particularly for mobile broadband given the ease in which it can be deployed compared to fixed broadband. The distribution and quality of these networks varies however.

6.5 e) In the context of national e-strategies, address the special requirements of older people, persons with disabilities, children, especially marginalized children and other disadvantaged and vulnerable groups, including by appropriate educational administrative and legislative measures to ensure their full inclusion in the Information Society

It is critical to integrate all parts of the population into the information society in order to minimize the digital divide. This include vulnerable groups such as the elderly, disabled, children and disadvantaged communities who, for different reasons, may have difficulty accessing and using ICT. This goal needs to have top-level support and be incorporated in relevant laws and regulations.

6.5.1 Older people

There is no specific UN convention creating a legal framework recognizing the special needs and rights of elderly people. People aged over 60 years are expected to increase from around 600 million in 2000 to over two billion in 2050 when some 80% will be living in developing countries. Given a rapidly aging world, there is support for such a convention which would ideally incorporate text on digital inclusion for older people.[42]

In the absence of international legal guidelines regarding ICT and elderly people, some national governments have implemented their own programs aimed at enhancing ICT access for the elderly. For example the Australian government funds the *Broadband for Seniors* project which provides citizens aged 50 years and over with free access to computers and the Internet as well as training "to help build their confidence in using new technology."[43] Launched in 2008, Broadband for Seniors is available at around 2,000 kiosks across the country with a quarter million users.

6.5.2 Persons with disabilities

The United Nations Convention on the Rights of Persons with Disabilities (CRPD) was adopted in December 2006.[44] It features several dispositions related to ICT accessibility. Article 9 on Accessibility states:

> "To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas. These measures, which shall include the identification and elimination of obstacles and barriers to accessibility, shall apply to... b) Information, communications and other services, including electronic services and emergency services."[45]

The Convention also calls on States Parties to take appropriate measures to monitor the implementation, to provide appropriate assistance and support for accessing information including the Internet and to promote the development and dissemination of assistive ICT technologies and systems at an early stage to minimize costs.

Some 52 countries have ratified the convention. There have been several monitoring reports regarding the ICT provisions of the convention.[46] The 2012 report found that 67% of the ratifying countries has incorporated at least some aspects of the convention in their national laws and regulatory frameworks (Table 6-5). However only around a third had the capacity to actually implement the dispositions. Some 45% reported an average level of the ICT accessibility implementation.

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[42] See "Strengthening Older People's Rights: Towards a UN Convention" at http://social.un.org/ageing-working-group/documents/Coalition to Strengthen the Rights of Older People.pdf

[43] http://australia.gov.au/people/seniors

[44] http://www.un.org/disabilities/default.asp?id=269

[45] http://www.un.org/disabilities/default.asp?id=269

[46] G3ict. 2012. "CRPD 2012 ICT Accessibility Progress Report." http://g3ict.org/resource_center/CRPD_2012_ICT_Accessibility_Progress_Report.

Table 6-5: Overall degree of compliance with CRPD ICT Accessibility provisions

Survey Data Clusters	Yes
Leg 1 - Countries' Commitments	67%
Leg 2 - Countries' Capacity for Implementation	32%
Leg 3 - Countries' Implementation and Impact	45%

Source: CRPD 2012 ICT Accessibility Progress Report.

6.5.3 Children

Ensuring the inclusion of children has several dimensions. In addition to ensuring access, it is also important to safeguard children from harmful content. Further, there is a need to guarantee equal access for girls[47] who need to be engaged and introduced to ICTs starting from their childhood and early stages of education.[48]

6.5.4 Other disadvantaged and vulnerable groups

One challenge is the identification of "other disadvantaged and vulnerable groups" which will differ from country to country. In Malaysia, such groups are defined in the context of universal service targets and referred to as "underserved group within the community" and defined as "a group of people linked by similar characteristics from a socio-cultural or economic perspective within a served area, which does not have collective and/or individual access."[49] This would include Persons with Disabilities (PWD), Children under Protection, Women under Rehabilitation and Low-cost Housing Residents.

One particular disadvantaged group in a number of countries are indigenous people "who both in developing and developed countries, often experience the greatest disparity in access to the educational opportunities afforded by information and communication technologies (ICTs)."[50]

6.6 f) Encourage the design and production of ICT equipment and services so that everyone, has easy and affordable access to them including older people, persons with disabilities, children, especially marginalized children, and other disadvantaged and vulnerable groups, and promote the development of technologies, applications, and content suited to their needs, guided by the Universal Design Principle and further enhanced by the use of assistive technologies

Most manufacturers follow general ergonomic and usability features to make the devices easy to use for a variety of users. The emergence of graphical user interfaces has also made the devices easier to use through simple point and click interfaces. Many free applications and services are available. The adverting sponsored model of the Internet makes numerous websites available

[47] http://www.un.org/womenwatch/daw/csw/csw51/statements/CH/UNITAR%20ICT%20event.pdf

[48] WSIS Forum 2012: Outcome Document. p. 64.

[49] MCMC. 2012. Universal Service Provision Annual Report.

[50] http://iite.unesco.org/files/policy_briefs/pdf/en/indigenous_people.pdf

for free as well as free cloud-based office productivity applications. Similarly downloadable software such as OpenOffice offer a full suite of applications for free.

An inexpensive laptop for every child was popularized by then MIT Lab researcher Nicholas Negroponte. A prototype of the computer was shown at the World Summit on the Information Society in 2005. Describing the benefit of low-cost computing devices, former UN Secretary-General Kofi Anan said "[c]hildren will be able to learn by doing, not just through instruction - they will be able to open up new fronts for their education, particularly peer-to-peer learning" adding that the idea was inspiring with real potential for student's social and economic development in developing countries.[51] The One Laptop per Child (OLPC) aimed for a price under US$100. Further they were designed for children with software developed by pedagogical experts and with developing country environments in mind through rugged construction. They were deployed in a number of countries including Uruguay where each of the nation's 395,000 primary school students received a laptop by October 2009 under the national OLPC project, Plan Ceibal.[52]

Universal design has been defined as: "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design."[53] Therefore products are designed from the beginning with consideration for different users including male and female, disabled, youth and elderly, etc. These ideas are incorporated in the Principles of Universal Design elaborated by the Center for Universal Design at North Carolina State University with seven core ideas (Table 6-6).

Table 6-6: The Principles of Universal Design

EQUITABLE USE	The design is useful and marketable to people with diverse abilities.
FLEXIBILITY IN USE	The design accommodates a wide range of individual preferences and abilities.
SIMPLE AND INTUITIVE USE	Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
PERCEPTIBLE INFORMATION	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
TOLERANCE FOR ERROR	The design minimizes hazards and the adverse consequences of accidental or unintended actions.
LOW PHYSICAL EFFORT	The design can be used efficiently and comfortably and with a minimum of fatigue.
SIZE AND SPACE FOR APPROACH AND USE	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or

[51] http://news.bbc.co.uk/2/hi/technology/4445060.stm

[52] http://laptop.org/en/children/countries/uruguay.shtml

[53] http://www.washington.edu/doit/Stem/ud.html

	mobility.

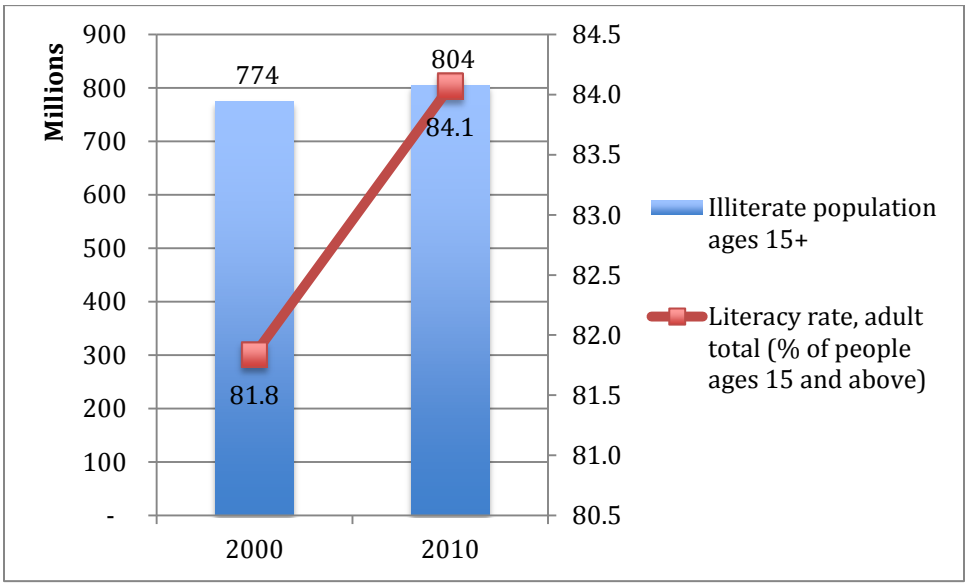
Source: http://www.ncsu.edu/ncsu/design/cud/pubs_p/docs/poster.pdf

The World Wide Web Consortium (W3C) helps to develop standards for web pages and applications to make them accessible to a global audience through internationalization and support for special groups including disabled and elderly.[54] The W3C Web Content Accessibility Guidelines (WCAG) aim at making web sites more accessible for those with disabilities.[55] Similarly its Web Accessibility Initiative (WAI) aims to make online content easy to use for the elderly. [56]

6.7 g) In order to alleviate the challenges of illiteracy, develop affordable technologies and non-text based computer interfaces to facilitate people's access to ICT

There are some 800 million illiterate people in the world, a figure that has increased since 2000 (Figure 6-7).[57] This is a sizeable group for which special computer interfaces are required to facilitate access to ICTs. Computers, tablets and smartphones now widely use graphical user interfaces which can help overcome illiteracy to some extent. Research is also being carried out to investigate text-free interfaces and identify successful design principles.

Figure 6-7: Number of illiterate people in the world, 2000 and 2010



Source: Derived from World Bank data (SE.ADT.LITR.ZS, SP.POP.TOTL, SP.POP.0014.TO.ZS).

[54] http://www.w3.org/standards/webdesign/

[55] http://www.w3.org/WAI/intro/wcag.php

[56] http://www.w3.org/WAI/older-users/

[57] The literacy rate "...is the percentage of the population age 15 and above who can, with understanding, read and write a short, simple statement on their everyday life. Generally, 'literacy' also encompasses 'numeracy', the ability to make simple arithmetic calculations." See: http://data.worldbank.org/indicator/SE.ADT.LITR.ZS

For example researchers at Microsoft have been working on interfaces for illiterate users. They worked with illiterates in Bangalore, India slums who provided feedback for refining design principles.[58] The researchers developed several applications such as hygiene (Figure 6-8), job search and a city map. The work resulted in a number of principles for effective text-free computer interfaces: a) Avoid text (but using numbers may be okay); b) Use semi-abstracted graphics, and increase photorealism with deeper interaction; c) Pay attention to subtle graphical cues. User response may depend on psychological, cultural, or religious biases; d) Provide voice feedback for all functional units and e) provide "help" on all screens.

Figure 6-8: Text-free user interfaces

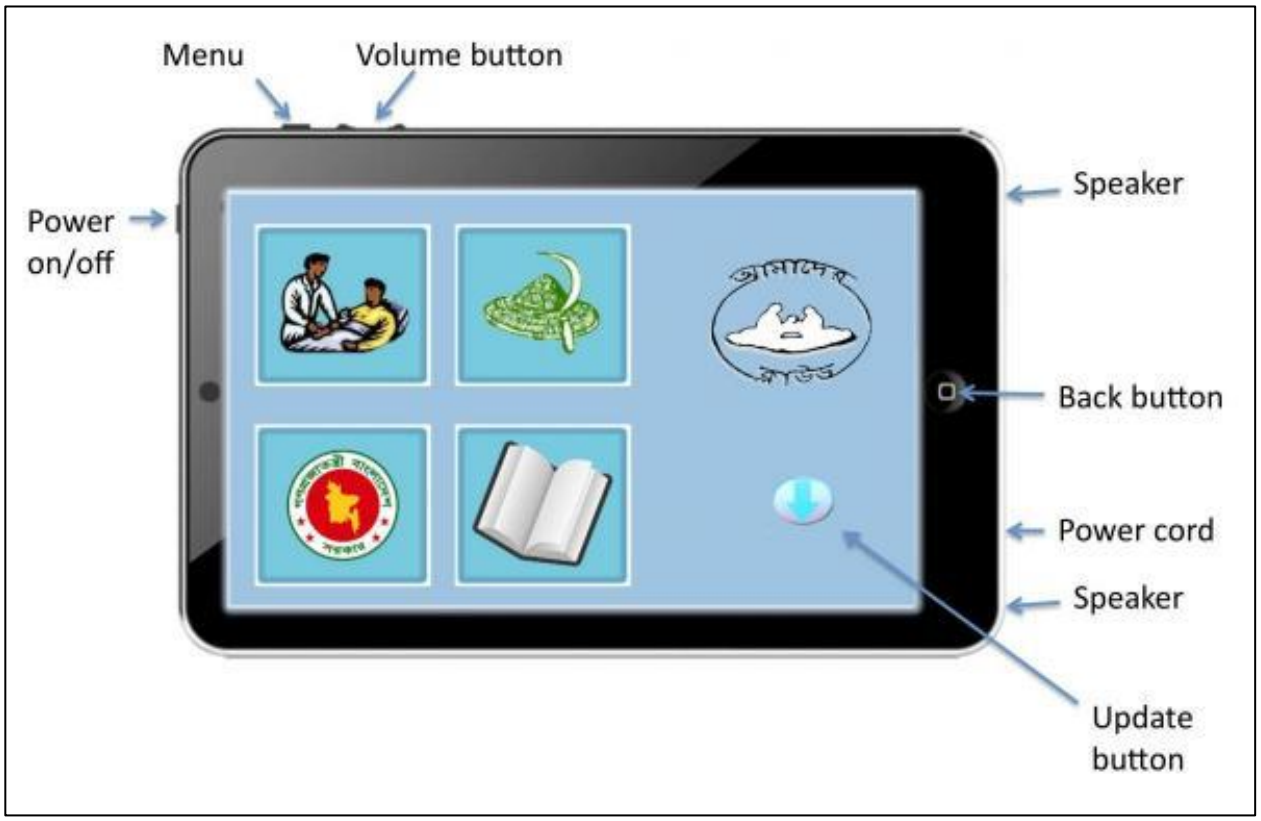
Source: http://www.moma.org/interactives/exhibitions/2008/elasticmind/#/267/

A project in Bangladesh, where more than half of the population is illiterate, combined cloud computing and tablets to test their impact. The US$100 Android-based tablet (Figure 6-9) designed by a local company Amadeyr Could Limited (ACL) were used to pilot the Digits To All (DTA) project in 2011. Some 130 tablets were distributed to four communities in the Gazipur district to semi literate and illiterate people. Featuring multimedia content developed by ACL, user input was captured over the cloud for analysis. All content was designed to be as audiovisual as possible to overcome the illiteracy barrier. The touch screen of the tablet is operated by seeing pictures and hearing instructions given in the local language. In order to gauge the impact of the pilot, knowledge about various health and agriculture related topics was tested before and after the intervention. The results found on average a one quarter to one third increase in understanding about the topics. [59]

[58] Medhi, Indrani, Aman Sagar, and Kentaro Toyama. 2007. "Text-free User Interfaces for Illiterate and Semiliterate Users." Inf. Technol. Int. Dev. 4 (1) (October): 37–50. doi:10.1162/itid.2007.4.1.37.

[59] http://amadeyr.org/en/node/28

Figure 6-9: ACL tablet



Source: http://rising.globalvoicesonline.org/files/2011/10/tab_overviewbig.jpgBangladesh

There is pioneering investigation ongoing to make ICTs more accessible for illiterate people. Much of the effort is conducted by research labs and NGOs. It is not clear how many of the principles is embedded in existing graphical user interfaces of popular operating systems. Greater collaboration between NGOs, governments, the private sector and the global development community such as wider dissemination and discussion of results and elaboration of international guidelines would be useful. One challenge is whether text-free interfaces perpetuate illiteracy and if efforts should instead be devoted to raising literacy through targeted educational programs.

6.8 h) Undertake international research and development efforts aimed at making available adequate and affordable ICT equipment for end users

Competition among device vendors, rise of inexpensive offshore manufacturing locations, the need to reach bottom of the pyramid users and continual hardware improvements have led to ongoing price reductions for ICT equipment. The average selling price of Nokia mobile phones (the world's second largest vendor[60]) fell 60% between 2003 and 2012 (Figure 6-10, left). Nokia's 105 model launched in 2013 features a color screen, FM radio and long battery life and retails for €15 (US$19).[61] Used handsets, either resold or passed on to family members, also

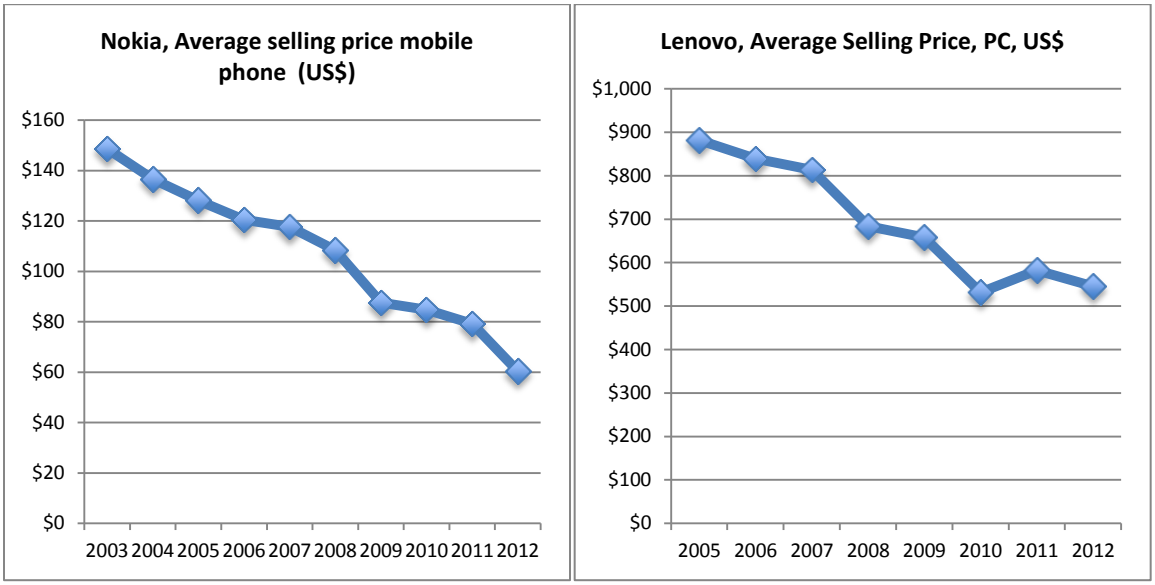
[60] "Growth Accelerates in the Worldwide Mobile Phone and Smartphone Markets in the Second Quarter, According to IDC." Press Release, July 25, 2013. http://www.idc.com/getdoc.jsp?containerId=prUS24239313.

[61] Nokia. 2013. *Form 20-F 2012*. p. 54

contribute to lower costs for basic mobile handsets. The price of a simple cellphone is therefore rarely a barrier to take-up anymore. While inexpensive simple mobile handsets are widely available, the same is not true for smartphones. In 2012 Google claimed that ongoing technical improvements are driving down the price of smartphones which could reach US$20 in a dozen years.[62] Large mobile operators cannot wait that long and have called on the GSMA to support a US$50 smartphone.[63]

Similarly, the price of computers have declined. The average selling price of Lenovo computers, the world's largest vendor, have declined 38% since its purchase of IBM's Personal Computing Division in 2005 (Figure 6-10, right). Though the average price remains high for many in developing countries, as the case with mobile phones, Lenovo's average price provides an indicative reflection of computer price trends and cheaper, unbranded PCs are available.

Figure 6-10: Mobile phone and PC prices, US$



Note: In the left chart, US$ amount converted by annual average exchange rate. In the right chart, Lenovo's reported desktop and notebook sales, reported in US$, are divided by shipments reported by Gartner.
Source: Adapted from Nokia Form 20-F, Lenovo Annual Reports and Gartner Press Releases.

The introduction of tablets is lowering the cost of entry-level computing devices. Coupled with price reductions in branded equipment produced by global manufacturers, the availability of open operating system platforms such as Android, is resulting in lower cost tablet computers. Take India where tablet sales increased over 900% in 2012.[64] Over 70% of the market is in the sub US$250 segment dominated by local vendors and unbranded imports from China. The price of tablets is approaching the US$100 mark. OLPC introduced a $149 tablet named XO in 2013.[65]

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[62] http://mwdaily.mobileworldlive.com/wednesday/offline/download.pdf

[63] http://mwdaily.mobileworldlive.com/wednesday/offline/download.pdf

[64] http://www.idc.com/getdoc.jsp?containerId=prIN24158413

[65] Dignan, Larry. 2013. "One Laptop Per Child Launches XO Tablet via Walmart." *ZDNet*, July 17. http://www.zdnet.com/one-laptop-per-child-launches-xo-tablet-via-walmart-7000018175/.

Semiconductor manufacturer Intel claims that its new chip will result in Android-based tablets of around US$100.[66]

The cost of computers for the educational sector are falling. This has arguably been triggered by the One Laptop Per Child (OLPC) initiative which originally sought to produce a low-cost netbook for under US$100. Though they never quite reached that price, some 2.5 million have been distributed to children in 60 countries.[67] Similarly, there are a number of national programs to distribute free computers to children. This includes Thailand's One Tablet per Child (OTPC) program which is distributing a free tablet computer to each primary and junior secondary student.[68] At the same time, countries are striking partnerships with computer hardware and software vendors to provide lower cost applications and computers for students.

Though the price of ICT equipment, particularly smartphones and computers, remain a barrier for low income populations in developing countries, other factors such as lack of awareness, interest or education are growing in importance. These barriers will likely loom larger and present more of a challenge in the future as the cost of ICT equipment continues to fall. At the same time, the cost of embedded software and patents rather than hardware will increasingly place limits on how far ICT device prices can fall.

6.9 i) Encourage the use of unused wireless capacity, including satellite, in developed countries and in particular in developing countries, to provide access in remote areas, especially in developing countries and countries with economies in transition, and to improve low-cost connectivity in developing countries. Special concern should be given to the Least Developed Countries in their efforts in establishing telecommunication infrastructure

There are two ways that wireless capacity is unused. The first is that radio spectrum is available but not allocated. In the second case, some services are using wireless capacity which could be more efficiently used. This latter instance has been associated with the so-called *digital dividend,* coined to refer to the benefits of transitioning terrestrial broadcasting services from analog to digital. Consumers will benefit from greater broadcasting choice and quality and the transition liberates radio spectrum for new services such as mobile broadband. The latter is of particular relevance for rural areas because analog broadcasting uses lower frequencies which have a wider transmission range resulting in lower costs for deploying mobile broadband networks. The 2007 ITU World Radiocommunication conference identified UHF bands for International Mobile Telecommunications (IMT) including 698-806 MHz in ITU Regions 2 (Americas) and 3 (Asia) and 790-862MHz in Region1 (Africa and Europe and Middle East).[69]

There are two ways that the digital dividend can be applied. The first is by reusing existing analog broadcasting frequencies. The second is by using the "white spaces", the small slices of frequency used to minimize interference between spectrum assignments.

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[66] Crothers, Brooke. 2013. "$100 Android Tablets with New Chip Coming, Says Intel." CNET, September 10. http://news.cnet.com/8301-1001_3-57602335-92/$100-android-tablets-with-new-chip-coming-says-intel/.

[67] http://www.businesswire.com/news/home/20130807006244/en/Government-Uruguay-Distribute-Laptop-Child-Designed-XO

[68] http://www.thaigov.go.th/en/news-room/item/71389-one-tablet-pc-per-child-education-for-all.html

[69] http://www.umts-forum.org/content/view/2466/303/

Since 2008, a number of countries have moved to exploit the digital dividend by digitizing broadcasting and reusing the vacated frequency (Table 6-7).

Table 6-7: Digital dividend in selected economies

Country	Analog TV switch-off	Frequency allocated	Allocation
Australia	2013	694 – 820 MHz allocated to mobile broadband services	Auction of licenses in 2012
Finland	2007	790 – 862 MHz allocated to mobile broadband services Re-allocation of PMSE services to 700 MHz band	
France	2011	790 – 862 MHz allocated to mobile broadband services	Auction of licenses in December 2011
Germany	2008	Migration of broadcasting from 790 – 862 MHz	Auction of licenses in December 2010
India	2015	698 – 806 MHz allocated to mobile broadband services	
Japan	2011	710 – 780 MHz allocated to mobile broadband services	
Korea	2012	Frequency plan for 698 – 806 MHz to be developed	698 – 806 MHz allocated to mobile broadband services
Spain	2010	790 – 862 MHz allocated to mobile broadband services	Auction of licenses in July 2011
Sweden	2007	790 – 862 MHz allocated to mobile broadband services	Auction of licenses in February 2011
UK	2012	790 – 862 MHz allocated to mobile broadband services	Auction of licenses planned in 2012
USA	2009	698 – 806 MHz allocated to mobile broadband services, mobile TV and public safety services	Auction of licenses in 2008 and before

Source: Digital Dividend: Insights for spectrum decisions.

In Singapore there have been a number of pilots using television white spaces.[70] The sector regulator launched a public consultation on a proposed regulatory framework in June 2013.

The rapid spread of mobile communications and the deployment of broadband wireless networks is placing high demand on the efficient allocation of radio spectrum. This includes

[70] Huang, Ryan. 2013. "Singapore Launches Public Consultation of TV White Spaces." ZDNet, June 17. http://www.zdnet.com/sg/singapore-lunches-public-consultation-of-tv-white-spaces-7000016884/.

spectrum that is available but unallocated as well as spectrum that can be more efficiently used. Governments need to ensure methods to allocate spectrum that is already available when needed so as to promote the deployment of wireless broadband networks. A number of countries are also deploying digital dividend spectrum-- radio frequency originally allocated to analog broadcasting--for mobile broadband with the benefits of wider coverage. Spectrum has traditionally required harmonized frequency allocation for universally compatible equipment to reduce equipment costs and support international roaming. The growing number of different frequency bands being used for mobile broadband is placing strains on this system. Developments such as Dynamic Spectrum Sharing may require a rethink of traditional regional and global harmonization frameworks to enable the dynamic use of any available radio spectrum whenever and wherever required by users.[71]

6.10 j) Optimize connectivity among major information networks by encouraging the creation and development of regional ICT backbones and Internet exchange points, to reduce interconnection costs and broaden network access

The 2012 World Conference on International Telecommunications called on Member States to "create an enabling environment for the implementation of regional telecommunication traffic exchange points"[72] in order to enhance the quality and reliability of networks and reduce costs. However unlike international backhaul networks, there is not much information about the status of regional exchange points. The ITU is developing a knowledge base of terrestrial backbone networks that would assist with better understanding of regional ICT backbones.[73]

Internet Exchange Points (IXPs), locations where Internet Service Providers (ISPs) exchange domestic traffic, help to reduce the cost of international bandwidth because national traffic does not need to be sent abroad. Quality is also enhanced with IXPs. A study of Kenya and Nigeria found that the deployment of IXPs significantly reduced latency.[74] IXPs can also attract international content providers willing to cache data which further increases performance and reduces international connectivity costs.

According to Packet Clearing House, there were around 400 IXPs in the world in June 2013 (Figure 6-11). More than 60 per cent of them were located in Europe or North America. Africa, which was home to only 6 per cent of the world's IXPs, is a region where such exchanges would dramatically improve the web experience through better performance. An African Union project aims to establish IXPs in African countries that do not have any as well as five regional traffic exchange points.[75]

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[71] "The Dynamic Spectrum Alliance: A New Global Initiative to Help Governments Address Wireless Data Growth and Close the Digital Divide." 2013. Business Wire, June 18. http://www.businesswire.com/news/home/20130618005310/en/Dynamic-Spectrum-Alliance-Global-Initiative-Governments-Address

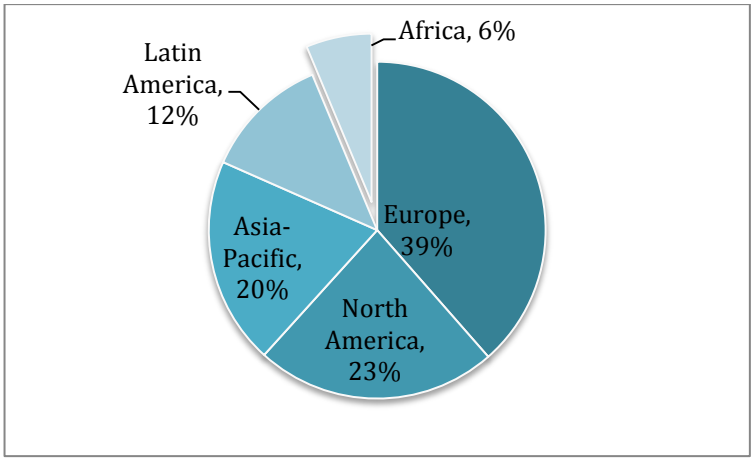
[72] http://www.itu.int/osg/wcit-12/highlights/dec13-14.html#.UpNZW5GZOMI

[73] http://www.itu.int/en/ITU-D/Technology/Documents/InteractiveTransmissionMaps/Misc/MapFrameworkMethodology.pdf

[74] See http://www.internetsociety.org/news/new-study-reveals-how-internet-exchange-points-ixps-spur-internet-growth-emerging-markets .

[75] See http://www.africa-eu-partnership.org/successstories/axis-–-developing-african-internet-system .

Figure 6-11: Distribution of IXPs by region, June 2013



Source: Packet Clearing House, see https://prefix.pch.net/applications/ixpdir/summary/growth-region/?sort1=bandwidth&sort2=_percent_change&order=desc .

Regional ICT backbones and creation of IXPs can manage Internet traffic more effectively, reducing the need for expensive international bandwidth and improving performance. Despite their benefit, there are still around 100 mainly developing economies that do not yet have IXPs.[76]

6.11 k) Develop strategies for increasing affordable global connectivity, thereby facilitating improved access. Commercially negotiated Internet transit and interconnection costs should be oriented towards objective, transparent and non-discriminatory parameters, taking into account ongoing work on this subject

International communication flows involve two networks: one on the sending end and one on the receiving end. The receiving network needs to be remunerated to compensate for routing the communications to its end users. Under international voice communications reciprocal accounting rates were agreed between each network provider. The system that has evolved for international Internet connectivity is different due to the lead developed countries had in deploying data networks, creating content and instituting traffic routing. This has resulted in developing countries often paying the full cost of a circuit for transmission of Internet data flows using scarce foreign exchange. This practice imposes extra costs on developing countries since they are also paying for the cost of Internet traffic coming back into their own countries. It has been estimated that non-US ISPs were subsidizing US Tier-1 ISPs up to USD 5 billion per year in the early part of the 2000s.[77]

The ITU has been studying charging arrangements for international internet connectivity since 1998. This started with ITU-T Study Group 3 (SG3) identifying differences between Internet and international voice cost arrangements models. Members of SG3 agreed that it was inappropriate to apply the existing voice telephone cost model but agreement could not be reached about whether the existing transit model resulted in fair cost compensation among operators.

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[76] https://prefix.pch.net/applications/ixpdir/summary

[77] http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/discussion_papers/Eric_lie_international_interconnection.pdf

In June 2000, SG3 developed a draft recommendation establishing negotiating principles for international internet traffic that included the possible need for compensation between the providers carrying the traffic. Given the lack of consensus, the Chairman of SG3 decided to submit the draft Recommendation directly to the World Telecommunication Standardization Assembly (WTSA) where it was adopted as Recommendation D.50.[78] The voluntary recommendation calls for the two operators to achieve mutual agreement and does not suggest a specific model. It does recommend that the operators take into account the possibility of compensation based on traffic, routing, coverage and costs. WTSA also saw a need for on-going studies about the subject. The United States and Greece expressed reservations and stated that they would not apply it in their international charging arrangements.

In the subsequent Study Period 2000-2004, SG3 continued to analyze technical and economic aspects related to international internet connectivity. In June 2004, SG3 adopted an annex to Recommendation D.50 which contained additional guidelines relevant to bilateral commercial agreements on the issue. SG3 also encouraged the international community to address the high cost of international internet connectivity for the least developed countries by supporting efforts such as regional traffic aggregation and capacity building. This effort would aim to maximize the retention of local and national traffic within these regions and thus reduce dependence on international communications links.

SG3 decided to establish two Rapporteur Groups. The first on International Internet Connectivity (IIC) is in charge of developing further guidelines for Recommendation D.50 and the second deals with examining the possibility of using traffic flow as a main factor of negotiation for IIC.

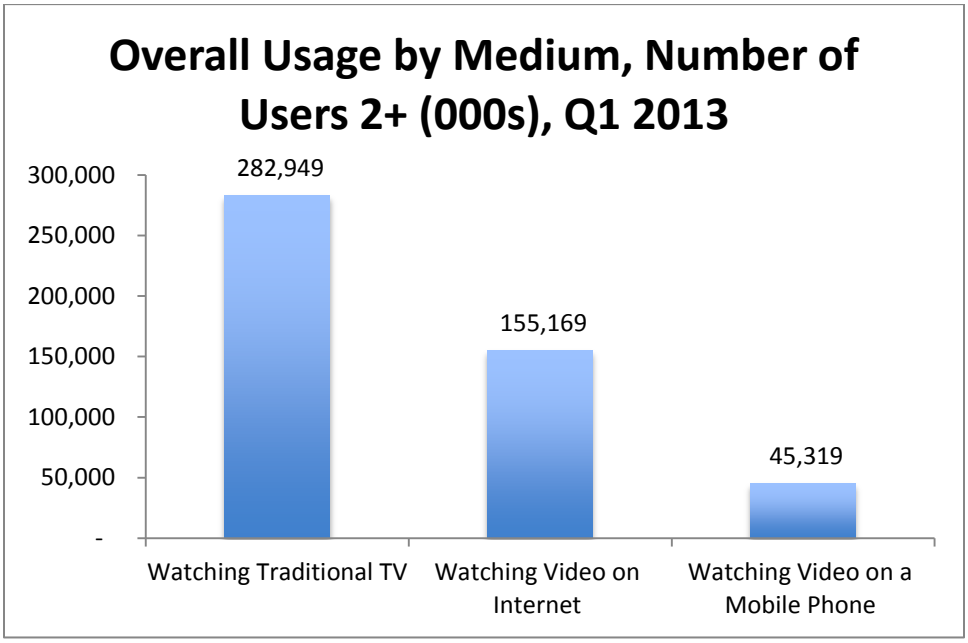
Based on the proposals from those Rapporteur Groups, SG3 adopted a guideline complementing Recommendation D.50. Proposals have been submitted to the effect that that the traffic flows referred to in D.50 should be measured by using data that can be obtained from routers using the BGP protocol. The matter was explored in some detail at a workshop on 24 March 2011 and in April 2011 a Supplement to Recommendation D.50 was adopted, on General Considerations for traffic measurement and options for International Internet Connectivity.

6.12 l) Encourage and promote joint use of traditional media and new technologies

Synergies between traditional media and new technologies have resulted in traditional media migrating to new technologies: newspapers and magazines on the Internet, Internet radio stations and Internet video. Another development is the availability of traditional media in formats for different devices such as computers, tablets and smartphones. At the same time, traditional devices such as televisions are becoming "smarter" with the ability to receive Internet programming. This has created unprecedented options for users in how and when they want to access media. Take the United States where three quarters of Internet users watch video on a computer and around twenty percent of mobile users watch video on their mobile phone (Figure 6-12).

[78] http://www.itu.int/rec/T-REC-D.50/e

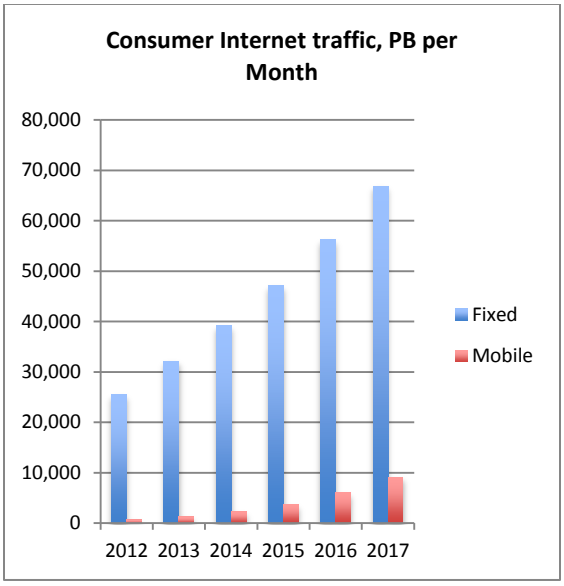
Figure 6-12: TV use by medium, United States, Q1 2013

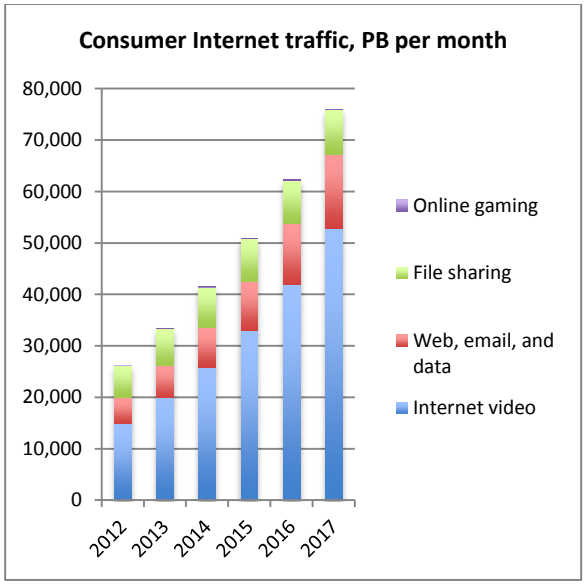


Source: Nielsen. June 2013. *A Look Across Screens: The Cross-Platform Report.*

The migration of media across platforms and devices presents a number of technical and legal challenges. Initial strategies were that audio and video capabilities on new technology devices such as mobile phones and small computers would be enabled through terrestrial or satellite reception chips such as the Digital Video Broadcasting - Handheld standard (DVB-H). However recent trends have been toward IP-based solutions with content delivered over the Internet to fixed and mobile broadband networks. This is generating a massive amount of traffic that will severely strain network capacities. Cisco reckons that IP traffic will grow by 21% a year over fixed networks and 68% over mobile networks between 2012-2017 with video accounting for the lion's share, growing from 57% of all traffic in 2012 to 69% by 2017.

Figure 6-13: Global Consumer Internet Traffic





Note: PB=Petabyte. Internet video: Includes short-form Internet video (for example, YouTube), long-form Internet video (for example, Hulu), live Internet video, Internet-video-to-TV (for example, Netflix through Roku), online video purchases and rentals, webcam viewing, and web-based video monitoring (excludes P2P video file downloads).
Source:
http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360_ns827_Networking_Solutions_White_Paper.html

The full benefits of cross platform are constrained by different laws and commercial practices that are increasingly outdated in a global, IP media world. In some instances, video programming can only be used on mobile devices if the user has an underlying traditional television subscription. Some Internet content is geographically controlled so it cannot be used across borders. At the same time rising IP traffic, particularly video, will require on going increases in network capacity and efficiency.

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