ITU Asia-Pacific Regional Development Forum

29 April 2013
Phnom Penh, Cambodia

BACKGROUND PAPER

Session 3: Creating a Smarter, Safer and Greener Society

Session objective: While the endeavor to deploy broadband infrastructure and applications worldwide continues with significant success, there is growing recognition for the needs of creative and innovative ICT strategies for sustainable and inclusive development. The role of technological innovation as an enabler of development and socio-economic growth is now widely recognized. To encourage and support this, policymakers have turned their attention to initiatives that foster innovation and entrepreneurship. It is believed that business creators and the investors who fund them can play an important role in creating new industries and revitalizing national economies. To encourage this, both developed and developing countries have launched many national and regional public initiatives to encourage these activities. These strategies, manifested in policies and programs, are aimed at harnessing the full potentials of ICTs to improve the lives of people with greater emphasis on socio-economic outcomes. In the buildup to Smarter, Safer and Greener society, public-private-peoples' partnerships (4Ps) are essential encompassing multiple sectors or stakeholders. This Session aims to brainstorm on initiatives to ensure creating smarter, safer and greener society leveraging on partnerships.

1.0   Creating a Smarter Society

Information and Communications Technology (ICT) now serves as a key infrastructure for building the global information society, a role where it is perceived essential for development.

"1. Broad access to telecommunications/ICTs is essential for the world's collective economic, social and cultural development, and the building of a global information society. This access brings new opportunities for interaction amongst people, for sharing of the world's knowledge resources and expertise, for transforming people's lives and for contributing to the global development agenda.
2. Such opportunities should be fully exploited, with the aim of fostering sustainable development, poverty alleviation, job creation and reducing vulnerability, especially for poor and marginalized populations, including women, children, indigenous peoples and persons with disabilities…….." – Hyderabad Declaration, World Telecommunication Development Conference (WTDC, 2010)

In practice, countries have embarked upon e-strategies i.e., Digital Economy (Australia), Ubiquitous Society / Digital Society (e.g. Japan, Republic of Korea), Digital Agenda (Europe), Intelligent Nation (Singapore), Smart / Digital City (e.g. Seoul, Shanghai, New York) to harness the potential of ICT in building smart society. These strategies are aimed at improving the lives of people with greater emphasis on socio-economic outcomes through innovatively collecting, processing
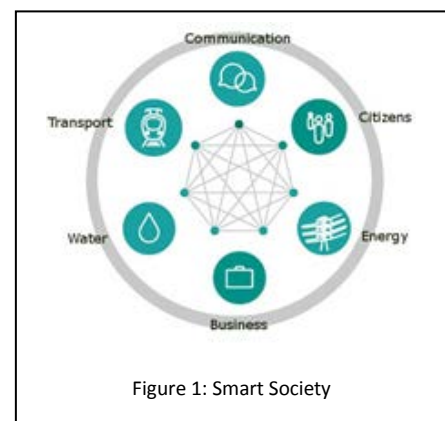

Figure 1: Smart Society

and using data for improved businesses, enhanced citizen engagement, better healthcare, better governance, expanded education and improved human resource skills, creation of jobs and tele-working, better management of utilities (e.g. transport, water, energy), improved logistics and food security while ensuring safer and greener environment. The telecommunication/ICT serves as a golden thread in the framework powering innovation and improving efficiency.

One of the ITU-D strategic goals (2012-2015) includes:

"Expand the benefits of the information society to the membership in cooperation with public and private stakeholders, and promote the integration of the use of telecommunication/ICT into the broader economy as a driver of development, innovation, well-being, growth and productivity globally."

The role of ICT in the broader socio-economic context to build an information society was recognized by the World Summit on Information Society (2003, 2005). Time and again, it has been re-emphasized by the ITU Members in the Plenipotentiary Conference 2010 (PP10 Res. 137, Res. 139, Res. 140) including specific components linked with Infrastructure, Security and Applications (PP 10 Res. 174, Res. 175, Res. 182, Res. 183, Res. 184) and other World Conferences.

Many international (UN-HABITAT: Sustainable Cities Programme, The World Bank: Eco2-Cities, APEC: Low Carbon Model Town, EU: Smart Cities and Communities Initiative) and industry organizations (Siemens: Green Cities, IBM: Smarter Planet, GE: Masdar Smart City, Toshiba: Smart Community, Cisco: Smart Connected Communities, LG-CNS: Smart Green City) are advancing the smart city agenda. The ITU-T has recently established a Focus Group on Smart Sustainable Cities, which will act as an open platform for smart-city stakeholders – such as municipalities; academic and research institutes; non-governmental organizations (NGOs); and ICT organizations, industry forums and consortia – to exchange knowledge in the interests of identifying the standardized frameworks needed to support the integration of ICT services in smart cities.[1]

Technologies driving smart networks and services cannot be rolled out effectively without appropriate enabling frameworks, data management capabilities, numbering, addressing and standards. The ITU has been effectively creating standards through various ITU-T study groups and focus groups, notable amongst those in the context of smart society are ITU-T SG 5 (*Environment and Climate Change*), ITU-T SG 13 (*Future Networks: It also includes NGN*), ITU-T SG 15 (*Transport and Access*) ITU-T SG 16 (*lead study group on ubiquitous and Internet of Things applications*) and ITU-T SG 17 (*Security*) as well as focus groups on Smart Sustainable Cities, Machine to Machine communication,

Figure 2: Smart Scenarios
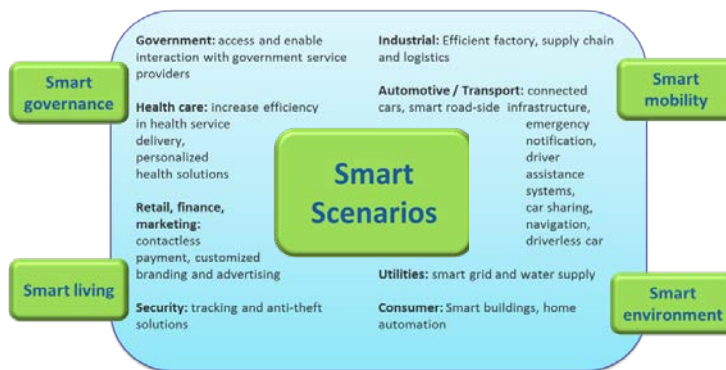
Car Communication, Innovation to Standards, Smart Cable Television etc. During WTSA 2012, ITU's membership has called on ITU's Telecommunication Standardization Sector (ITU-T) to expand its work on e-health, software-defined networking (SDN) and e-waste. In addition, members have called for the establishment of a Review Committee to ensure that ITU-T's structure continues to meet the needs of the continually evolving and convergent ICT landscape, particularly as collaboration with vertical markets increases. This will help to enable such innovations as e-health, intelligent transport systems, smart grid, mobile money and e-learning.

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[1] ITU: Smart cities: Seoul – a case study. ITU-T Technology Watch Report, February 2013, http://www.itu.int/en/ITU-T/techwatch/Pages/smart-city-Seoul.aspx

Intelligent transport systems (ITS) can clear our cities of debilitating pollutants and traffic jams. In connected cities you will be directed directly to the nearest available parking space, GPS enabled systems will make traffic flow better and intelligent ambient lighting will appear only when and where it's needed. ITS can also be applied to public transport, to respond more efficiently to customer needs as well as providing the means for electric cars to act as distributed energy storage in network downtime. In this cross-over area of ICT and Transport, ITU is actively exploring standards and as well as hosting an annual workshop, the Fully Networked Car@Geneva Motor Show, convenes a Collaboration on ITS.

Increased broadband access will help to create a level playing field of opportunities for the world's under privileged. Teleworking, already happening today, will increase as universal access is implemented, enabling more flexible and efficient working conditions. ITU-T standards for access and transport facilitate the vast majority of broadband connections around the world.

ICTs are now understood to play a pivotal role in increasing efficiency and quality in delivery of health care, and reducing risk and suffering, particularly among the most vulnerable communities in developing countries. However, in e-health unfortunately standardized solutions are rare. Interoperability is a key determinant of e-Health's efficient and equitable rollout. ITU-T is leading the development of standards in several areas of e-health.

Smart management of water is another pertinent issue. Participants in an ITU workshop held for the benefit of government and private-sector ICT leaders in the Nile River Basin have agreed a Call to Action which charges ITU with mobilizing its global membership to enable 'smart' water management. The 'smart' integration of ICTs in water networks adds communications, and thus monitoring, analysis and control capabilities to networks, thereby increasing efficiency and reliability in water supplies, enriching agriculture and health, and reducing water consumption and waste.

Appropriate enabling environment is the key to such initiative, often starting with a policy statement that is then manifested in legislations, national development plans, strategies and regulations. These policies are now a part of national agenda and often require co-working with other regulators and stakeholders. Over 145 governments have today adopted or are planning to adopt a national policy, strategy or plan to promote broadband.   (Refer background paper for Session 1), clearly demonstrating the rising awareness and need. Mobile broadband with an accelerated growth rates accords tremendous potential to take the benefits to individuals. By end 2011, there were 105 countries with more mobile cellular subscriptions than inhabitants. Leveraging on this potential, the ITU has launched an initiative m-Powering Development for a Better Tomorrow, aimed at extending the benefits of mobile telephony to all strata of society, in order to build a truly inclusive information society, with special focus on remote rural and underserviced areas. By providing improved, reliable, modern teleconnectivity, it will be possible to harness the advantages offered by wireless technologies, at affordable rates in local currencies. Examples of mobile focus can also be witnessed in the work of international organisations (e.g. WHO, GSMA, FAO, UNESCO, others) and national entities.

ITU's Global Symposium for Regulators (GSR) 2011, in the best practice guidelines focused on identifying innovative regulatory approaches that policy makers and regulators can take to advance the deployment of broadband networks, encourage innovation and extend digital literacy to enable digital inclusion of all in a broadband world. GSR participants focused their attention on M-banking services and the role of regulators, Wireless broadband spectrum pricing, Satellite regulation, Open access regulation, Setting national broadband policies, strategies and plans, Financing universal access/service, E-waste and recycling and the role of regulators, Protecting rights, such as intellectual property, of all stakeholders in a digital ecosystem and Regional initiatives to foster broadband connectivity.   The Global Symposium for Regulators 2012 (GSR12) Best Practice Guidelines focused on regulatory approaches to foster access to digital opportunities through cloud services.

One of the most important components of the smart society is the availability of adequate spectrum as mobile broadband continues to show accelerated growth. Increasingly digital dividend is seen as a potential for making more efficient use of the spectrum though its use can vary.

The [World Radio Communications Conference 2012](#) in addition to the use of the 790-862 MHz in Regions 1 and 3, considered further spectrum allocations to the mobile service, including International Mobile Telecommunications (IMT) to facilitate the development of terrestrial mobile broadband applications in the frequency band 694 – 790 MHz. This issue has been placed on the WRC-15 Agenda together with the need to consider additional spectrum allocations for the mobile service. The Conference addressed several items related to topical technological subjects in order to consider the need for any regulatory action to foster the development and deployment of those advanced wireless systems. These included software-defined radio (SDR), cognitive radio systems (CRS), short-range devices (SRD), etc. Further, the ITU Radio Communications Assembly 2012 agreed on the detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-Advanced (IMT-Advanced).

It is quite evident that building up the smart society is a cross-sectoral and not just an ICT Sector agenda and includes several stakeholders including multiple government departments, local administrations and municipal authorities, multiple regulators and industry. However, the pervasive nature of ICT as a common golden thread enabling the ecosystem creates enhanced opportunity for and bestows great responsibility on the ICT sector. The enhanced use of ICT in a convergence environment generates multiple streams of revenues and services requiring cross-sectoral outlook, national vision and international cooperation.

The scope of users of ICT services would grow from mere voice and data subscribers to include the global citizenship as the basket of services expand. The users of these services are no longer limited to the ICT subscriber but can come from consumers of other services (e.g. health, entertainment, education, government). In smart society, more than one national regulatory framework would be touched upon by single service (e.g. m-Banking, e-government, e-health, e-education, security) calling for co-regulation or cross-sectoral regulatory cooperation. Cloud based services such as social media, while facilitating effective and quick communication, has raised several privacy, copyright and inappropriate content concerns requiring international cooperation. Not only does it require remedial measures but also necessitates large scale consumer awareness on the processes and implications. The role of consumer awareness is also closely linked to enhancement of human skills as ICT literacy skills (e.g. Using computer and smart phones, accessing Internet, linguistic capabilities) is becoming a must to engage in the smart society and use the services.

Information society / smart society require skilled human work force and ICT- aware users. It has the potential to save costs, generate revenue and increase employment opportunities through teleworking and access to the ICT services. While providing the opportunity, it can also serve as a significant barrier to the have-nots as the stakes are much larger, thereby making the universality of ICT human skills and capacity a much more compelling agenda in smart society compared to the traditional telecommunications/ICT world. Realizing the importance, ICT Skills or Capability forms one of three sub-indices (other two being ICT access and ICT use) that constitute the ICT Development Index (IDI). Human capacity development also forms an integral part of the smart society agenda. This is also evident in global practices as well as the current strategic direction set by the WTDC-10. Enhancing relevant human resource skills forms an expected outcome of all the Asia Pacific Regional Initiatives (WTDC 10 Res. 17).

The ITU has several programs to build human capacity in ICT at global (ITU Academy), regional and national level. One of the major initiatives is the ITU Centres of Excellence network, which provides trainings through face to face and online courses on a regional basis with support from multiple partners, building human capacity and skills. The ITU is also working with Members to enhance the capability of national ICT training centres to meet the challenging requirement of ICT aware citizenship. ITU-T's bridging the standardization gap initiative aims hosts many capacity building events around the world disseminating knowledge of ITU-T practices and topics with the aim of better involving developing country audiences. The initiative has proven very successful with over 40 new countries having participated in our work since 2007.

This daunting task requires prioritization at the national level in policies and programs as well as the support of multiple agencies based on respective areas of specialisation.

1.1   Creating a Safer Society

The advent of smart networks on one side boosts innovation and enables a complete bouquet of ICT services ((e.g., e-Government, e-Business, e-Learning, e-Health, e-Employment, curtailing crime, e-Environment, e-Agriculture, m-government, etc.) and applications (e.g. social media)

Figure 3: Adoption of Cybersecurity Legislation / regulation

that has empowered institutions (private and public) as well as individuals by enhancing mass engagement in the larger socio-economic landscape while on the other raised security, privacy and interoperability concerns of a complex nature. With greater dependency of critical services on ICTs and the distributed global nature of new networks and applications (e.g. cloud computing, social media applications), security and privacy issues are high on the agenda, nationally and internationally. The Global Symposium for Regulators 2012 (GSR12) Best Practice Guidelines on regulatory approaches to foster access to digital opportunities through cloud services expresses a careful balance between the need to facilitate growth of such networks and ensure user confidence. A large number of countries have adopted cybersecurity related legislation / regulation (Figure 3) and have created Computer Incidence Response Teams (CIRTs) to create an effective response.
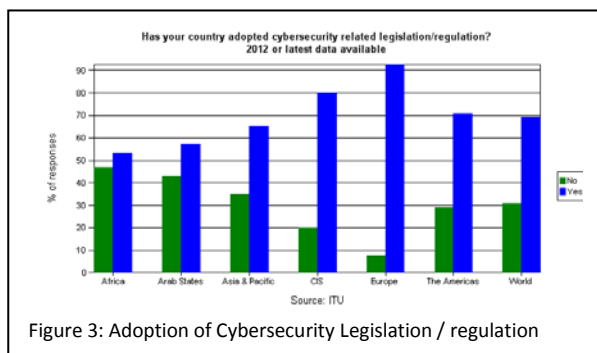

Figure 4: National Cybersecurity Strategy Model

ITU National Cybersecurity Strategy Guide mentions "A coordinated multi-sector response provides the only plausible route to building public confidence and trust in the use of ICTs". In the execution of national cybersecurity strategy model (Figure 4), it is important to engage stakeholders including executing arm of the Government, legislative arm of the Government, Judiciary, Critical Infrastructure Owners and Operators, Law Enforcement, Intelligence Community, Vendors, Academia, International Partners and Citizens.
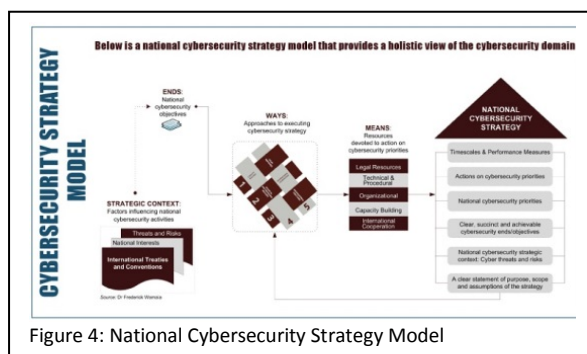
Cybersecurity has been an important area of focus for the UN General Assembly and on this issue, it has expressed itself in five major Resolutions. The world leaders participating in WSIS entrusted the ITU with the role of sole Moderator/Facilitator of Action Line C5, "Building confidence and security in the use of ICTs." On 17 May 2007, ITU Secretary-General Dr. Hamadoun I. Touré launched the ITU Global Cybersecurity Agenda (GCA), which is a framework for international multi-stakeholder cooperation on cybersecurity aimed to build synergies with current and future initiatives and partners towards a safer and more secure information society. The GCA encourages collaboration with and between all relevant partners and builds on existing initiatives to avoid duplicating efforts (ITU 2010). The 2010 Plenipotentiary Conference in Resolutions 130 and 174 reaffirmed the importance of the GCA and ITU's role in public policy issues related to the illicit use of ICTs respectively. Within ITU, the GCA aggregates cybersecurity activities in the three sectors. Some of the major partnerships in this regard include those with IMPACT, UNODC and Symantec. The importance of security was re-emphasized during WCIT 12, wherein Article 5A was inserted in the International Telecommunication Regulations[2] to deal with security and robustness of networks. ITU-T Study Group 17, which is responsible for building confidence and security in the use of Information and Communication Technologies (ICTs), includes studies relating to cybersecurity, security management, countering spam and identity management, security architecture and framework, protection of personally identifiable information, and security of applications and services for the Internet of Things, smart grid, smartphone, IPTV, web services, social network, cloud computing, mobile financial system, and telebiometrics.

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[2] Final Acts of WCIT 12 were signed by 89 ITU Member States in Dubai (http://www.itu.int/osg/wcit-12/highlights/signatories.html)

In Asia-Pacific region, network security frameworks remain an important strategic area of focus requiring greater efforts in building legislative / regulatory frameworks, technical solutions, international cooperation and human capacity building. The ITU has been assisting Members through expertise on regulatory, technical advice and building capacity. As a region with great social and geographic diversity, the varying needs and capacity to address those necessitates enhanced dialogue and assistance where required. The requirement of assistance for establishing Pacific CIRT, technical assistance to CIRTs, building capacity of multiple stakeholders, closer international coordination are specific tasks to quote as non-exhaustive examples.

The role of Telecommunications in saving lives from disaster is well recognized; by enhanced preparedness and better response. The ITU through all the three Sectors have actively been working in this area and assisting the Membership through better coordinated radio frequencies, effective telecommunication standards, enabling policies & regulations (e.g. National Emergency Telecommunication Plans) and instituting multi stakeholder partnerships (ITU Framework for Cooperation in Emergencies (IFCE)). ITU was a driving force in drafting and remains active in promoting the ratification and implementation of the Tampere Convention which seeks to break regulatory barriers for the cross-border movement of telecommunication resources (equipment and human) in the aftermath of disasters.

Innovative ICT applications and converged network infrastructure require facilitation through frameworks that can create a development model that is not only smart and safe but sustainable. It is important for the ICT4D model to take into account disaster management. ITU has recently launched the Smart Sustainable Development Model to build the disaster management capability in the ICT4D model (Figure 5). The objective of this initiative is to link rural telecommunications/ICT development for general communications, business, education, health, and banking to disaster risk reduction and disaster management initiatives. In so doing this would ensure the optimal use of technology, avoid duplication and lower the level of investment into ICT, since the same ICT infrastructure used to support rural development would also be used for public safety. The population trained to use ICT is made possible by the development of a natural linkage between ICT4D and ICT4DM through an innovative approach.
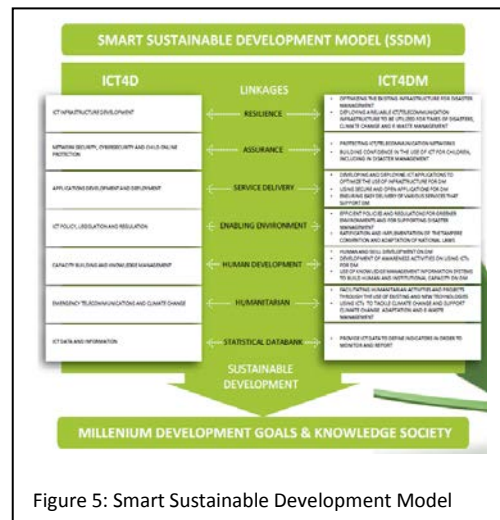

Figure 5: Smart Sustainable Development Model

This is even more important for the Asia-Pacific region, which is the most disaster-prone area of the world and is also the most seriously affected one. Almost 2 million people were killed in disasters between 1970 and 2011, representing 75 per cent of all disaster fatalities globally[3]. During the WTDC 2010, ITU Members recognized Emergency Telecommunications as a regional priority for Asia-Pacific for the next development cycle 2011-2014. The ITU continues to serve the demand in the region for assistance in developing national plans, creating tools, raising awareness, building capacity and assisting with equipment when disaster strikes. ITU-T also has a focus group on Focus Group on Disaster Relief Systems, Network Resilience and Recovery.

1.2   Creating a Greener Society

The role of information and communication technologies in creating a greener society has increased over the years. For that reason, ITU has become more active in contributing to the climate change negotiations under the United

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[3] The Asia-Pacific Disaster Report 2012 (UNESCAP, UNISDR)
http://reliefweb.int/sites/reliefweb.int/files/resources/29288_apdr2012finallowres.pdf

Nations Framework Convention on Climate Change (UNFCCC). The convention seeks to stabilize greenhouse gas concentrations at a level that would prevent dangerous human induced intereference with the climate system.

"As the ICT industry markets increase sharply, their roles in daily lives have become more significant. According to SMARTer 2020, the estimated emissions from the ICT industry in 2011 were 0.9GtCO2e which is 1.9% of all global GHG emissions. By 2020, it is estimated that 1.3GtCO2e emissions will be from the ICT industry as the use of ICT devices and services increases." At such rates, the ICT industry's footprint would comfortably exceed that of a sector such as airlines.

Although its own emissions[4] are rising, ICT's largest influence is expected to be through enabling increased energy efficiencies and energy use reductions in other sectors. In this context, the Smart 2020 report also found that the scale of this ICT-enabled opportunity was found to be a massive 7.8 GTonnes of CO2 by 2020, equivalent to 15% of all emissions under BAU projection."

It is important that the ICT community have appropriate frameworks in place to contribute positively to the future society. Interestingly, the toolkit also mentions findings of Accenture's study of 275 global Fortune 1 000 companies[5] analysing business and sustainability. *"Performance metrics shows that the top 50 companies ranked on sustainability outperform the bottom 50 by 16% when it comes to shareholder returns over a three year period. Over five years, the results are even more skewed in favour of the best sustainability performers: the top 50 outperform the bottom 50 and middle 50 peers by 38% and 21%, respectively. So the best sustainability performers make more money. Of course, it is not clear which is cause and which is effect here, but it's still a great reason to get involved in sustainability."*

- [ITU Toolkit on environmental sustainability for the ICT sector](#)

With up to 70 per cent of the world's population residing in urban areas, and cities accounting for 60-80% of global energy consumption, ICTs contribution to making the cities of the future cleaner, safer and better places to live is extremely important. Given that an estimated 70 per cent of the world's population will live in cities by 2050, sustainable urbanization has become a key policy point to administrations across the world. ICTs have a crucial role to play by increasing environmental efficiency across industry sectors and enabling such innovations as intelligent transport systems (ITS), smart buildings, cloud computing and "smart" water, energy and waste management.

"One of ITU's most high-profile successes in recent years was a universal charger standard for mobile phones[6]. This standard has the support of all the major vendors and is already available in the market. Since it defines the end connectors to the mobile and the charger, and has virtually zero off-load energy consumption, this standard alone is estimated to save 13.6 million tonnes of Co2 and 84,000 tonnes of e-waste a year."[7]

In the same vein, ITU-T Recommendation L.1001 (External universal power adapter solutions for stationary information and communication technology devices)[8] establishes technical specifications for a universal power adapter (UPA) designed to serve the vast majority of ICT devices. The standard will substantially reduce the number of power adapters that need to be manufactured by widening their application to more devices, enabling

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[4] An organization is responsible for greenhouse gas (GHG) emissions in a number of ways, either directly by burning fuel or processing chemicals, or indirectly by purchasing energy from other sources. ICT companies need to be aware of where and how their emissions are counted. This should then drive their emission reduction strategies, against which they should be accountable through their sustainability reporting. See Annex of

[5] Berthon, B., Abood, D.J., and Lacy, P., Can business do well by doing good?, Accenture, 2010, www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Outlook_Can_Business_Do_Well_by_Doing_Good_Sustainability.pdf.

[6] ITU-T L.1000: Universal power adapter and charger solution for mobile terminals and other hand-held ICT devices

[7] Malcolm Johnson, Director, Telecommunication Standardization Bureau, ITU

[8] ITU-T L.1001: External universal power adapter solutions for stationary information and communication technology devices

their reuse and extending their lifetime, as well as cutting energy consumption and reducing the volume of e-waste.

There are three main interlinkages[9] between climate change and Telecom Service Providers:
• Adaptation: the impact of climate change on service providers as well as the changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change;
• Mitigation: the contribution of service provider emissions to climate change; and
• Transformation: the role of service providers in helping other sectors to reduce GHGs.
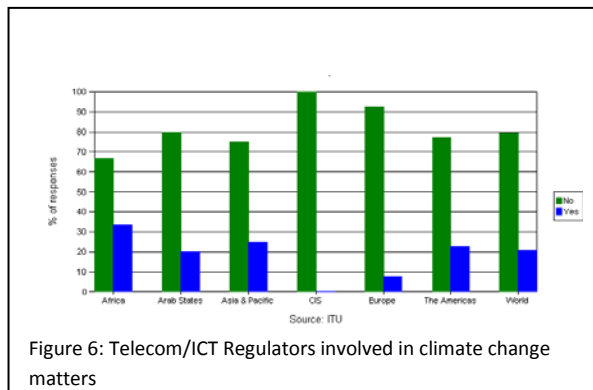

Figure 6: Telecom/ICT Regulators involved in climate change matters

However, active engagement of ICT regulators in this area is still emerging (Figure 6). The role at national level can vary from formal engagements such as equipment standards, environmental clearances, infrastructure sharing etc. to less formal ones such as code of conduct, labeling, voluntary agreements, consumer awareness etc.

Further, the issue involves also an important area of work for a wide range of stakeholders at the international and national level. The list of international organisations and wealth of other resources related to ICTs and Environment is available at the ITU Global Portal on ICTs, Environment and Climate Change[10].

Significant work has been going on in the area of standards development (ITU-T Study Group 5 - Environment and Climate Change), policy development at national and enterprise level, monitoring of climate change, measurement and assessment methods (ITU-T Methodology to assess the environmental impact of ICT in cities).

In order to raise awareness and build capacity, "Smart Sustainable Cities" is the theme of the 8th ITU Symposium on ICTs, the Environment and Climate Change to be held in Turin, Italy, 6-7 May 2013 and of the 3rd ITU Green Standards Week to be held in Madrid, Spain, 16-20 September 2013. These events will bring together a global selection of specialists in the field – from top policy makers to thought leaders in business, engineering, standardization and research – to critique recent efforts in the development of smart cities and to determine the best path forward in the task of leveraging ICTs to enhance cities' environmental sustainability.

Furthermore, in support of the "World Environment Day" (WED) and to follow up on the Paris Call to Action on "Smart Sustainable Cities[11]", ITU has launched the 3rd Green ICT Application Challenge[12] to uncover innovative ICT approaches and applications towards addressing global environmental issues in cities and urban areas.

1.3   Conclusion

The current focus of countries is expanding from mere infrastructure deployment to including much larger scope of services encompassing the entire society in a responsible manner. As e-strategies are being developed to move towards a smarter, safer and greener society there exist gaps (policy, regulatory, technology and human skills) that need to be addressed in a timely manner.

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[9] Trends in Telecommunication Reform 2010-11, CLIMATE CHANGE, ICTS AND REGULATION, *Author: Stephen Young, Founder, ICT and Climate Change*

[10] ITU Global Portal on ICTs, Environment and Climate Change, http://www.itu.int/en/ITU-T/climatechange/resources/Pages/default.aspx

[11] 2nd ITU Green Standards Week – Paris Call to Action, http://www.itu.int/dms_pub/itu-t/oth/4B/04/T4B040000180001PDFE.pdf

[12] 3rd ITU Green ICT Application Challenge, http://www.itu.int/en/ITU-T/climatechange/greenict/2013/Pages/default.aspx