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Technological innovations and knowledge-networked societies: new sources of sustainable and inclusive development

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Note by the secretariat

Summary

Information and communications technologies (ICT) contribute to national prosperity and well being as never before. As recognized in the outcome document of the recently concluded United Nations Conference on Sustainable Development (Rio+20), communications technologies, including connection technologies, are powerful facilitators in the flow of information across societies, promoting knowledge exchange and building capacity for sustainable development. Cutting-edge developments and the trends that have emerged therefrom are bringing unprecedented opportunities to store, share, adapt, interpret and create information at all levels of society.

The widespread positive potential effects of ICT innovation on economic and social development in Asia and the Pacific provide an impetus for policymakers to take action to ensure that the benefits of ICT are shared by all. In this regard, more remains to be done to narrow the digital divide and its associated divides, which are holding back the emergence of a knowledge-networked society for all in the region. At the same time, stakeholders should recognize that limitless access to information, ideas, knowledge and applications poses immense challenges. As the promise of an increasingly knowledge-networked society grows, so, too, does the peril that policies may fail to deal with the complex interfaces that arise when technological innovation thrusts greater opportunities only on some groups of people, or when innovation promotes potentially harmful individual and group behaviours. To make use of ICT and leverage it to its full potential for improving human development, different approaches and tailored strategies are needed based on country- and region-specific contexts. Driven by holistic public policies that recognize broadband as a meta-infrastructure underpinning all other infrastructure, a new social compact between governments, business leaders and intergovernmental organizations is needed to define how public and private actors share the benefits and risks of bringing future and near-future technological innovations to all. The Committee may wish to consider these issues and provide the secretariat with further guidance on the issues raised.

* E/ESCAP/CICT(3)/L.1.

** The late submission to conference services is due to the need for expert consultations, which were held in Colombo in September 2012.

Contents

I. Introduction

1. Information and communications technologies (ICT) contribute to national prosperity and well being as never before, with fixed and mobile broadband in particular driving an increasingly knowledge-networked society. As recognized in the outcome document of the recently concluded United Nations Conference on Sustainable Development (Rio+20), communications technologies, including connection technologies, are powerful facilitators in the flow of information across societies, promoting knowledge exchange and building capacity for sustainable development.[1] Cutting-edge developments and the trends that have emerged therefrom, such as the Internet of Things, big data and cloud computing, are bringing unprecedented opportunities to store, share, adapt, interpret and create information at all levels of society. As these developments have potentially transformative impacts, systemic economic and social risks remain high. In an era of continuous hyperconnectivity, the global interdependence of knowledge-networked societies and heightened risks of instabilities, require increasingly transnational solutions that are often beyond

[1] See General Assembly resolution 66/288.

the capacity of individual governments to address, thereby necessitating intergovernmental, cross-sectoral and cross-disciplinary approaches.

2. Home to several global ICT leaders, notably Japan, the Republic of Korea, Singapore and Hong Kong, China, the Asia-Pacific region is also characterized by unparalleled disparities. Over the past decade, the digital divide has widened rather than narrowing, and in the very technologies that are the most powerful tools in the transformation to a knowledge economy — fixed and mobile broadband Internet. With globalization creating ever more complex linkages between countries, regions and continents, the Asia-Pacific region faces formidable challenges in evolving a paradigm that meets its regional needs. This involves not only adapting to an environment in which ICT is pervasive, but also blending the digital innovations that are developing around the world into region-specific adaptation processes that are oriented to more inclusive and sustainable development. Despite the challenges, present and near-future ICT advances hold much promise that e-solutions will build e-resilience, which will help societies not only recover more rapidly from exogenous shocks, but also create, adapt and adopt knowledge that widens choices and promotes more informed and inclusive decision-making in support of sustainable development.

II. The transformative power of ICT

3. Rapid technological innovations in recent years have ushered in a new era of techno-driven growth. The Asia-Pacific region has emerged as the world leader in the production of ICT goods and services, with ever larger shares of employment, export revenues and economic growth generated by the sector. ICT has emerged as a source of dynamism and innovation that has enabled greater productivity in virtually every sector of the economy while fundamentally changing how individuals and communities interact, communicate and organize themselves. High-speed communication networks today are having a transformative economic impact similar to that of the development of transport networks and investment flows a few decades ago.

4. Through improved Internet interoperability, demand for new services and content is growing, which in turn is fuelling further connectivity and integration among economies and people across the region. Businesses now benefit from improved access to affordable systems that enable them to obtain information in a timely manner (such as email, calendars, document management, accounting), and the efficiency gains have allowed small and medium-sized enterprises (SMEs) to expand into previously untapped markets. More accessible and timely information is benefiting consumers by allowing them to make informed choices among an ever growing number of producers across the region. Mobile money is bringing reliable financial services to the rural poor, and universities and research centres are more connected than ever, accelerating the exchange of scientific and technical knowledge. Social media and crowdsourcing are playing an important role in disaster management, and individuals find themselves empowered to broadcast ideas and connect in ways that were unheard of just a few years ago.

5. As ICT is a rapidly moving and ever changing sector of the economy, its transformative potential is immense. Mobile phones, for example, are now rapidly moving towards near ubiquity — from 31 to 84 subscriptions per 100 inhabitants on average, in just the last six years. This underlines the significant role that ICTs have played in bringing inclusiveness and empowerment to hitherto marginalized people. Broadband is following the

path paved by mobile phones, slowly spreading from the well-connected urban centres to the less connected, if not completely unconnected, rural villages and towns, bringing much deeper and more meaningful levels of connectivity across the region. This enhanced connectivity enables the rapid and effortless exchange of information across the region, and spurs economic growth, social activity and innovation that is growing at a startling pace. The near-future ICT innovations that are discussed in the next section all rely on broadband as the essential infrastructure; in other words, broadband is a meta-infrastructure that, by supporting, enabling and spurring further ICT innovation, brings transformative changes to existing infrastructures. Broadband enables a wide range of new technologies and, unlike developments in other industries, ICT innovations move rapidly from concept to reality, extending far beyond mere improvements to existing technology or incremental tools to support efficiencies. The innovative technologies on the horizon will fundamentally alter how communities, individuals and businesses interact, creating new capabilities that extend to every aspect of human activity.

III. Key technology trends for knowledge-networked societies

6. Although the mobile phone has proven to be a vital tool for increased economic and social development in Asia and the Pacific, more content-rich ways of connecting are required in order to build increasingly knowledge-networked societies. In this regard, the diffusion of fixed and mobile broadband across the region is expected to unleash a wave of near-future and future innovations that rely on new ways of creating, interpreting and sharing information. Those that are expected to have a significant impact on the region's sustainable development objectives are discussed below: (a) sensor-based computing and the Internet of Things; (b) big data and open data; (c) cloud computing; (d) convergence between content, telecommunications and media; and (e) high-value manufacturing. Country-specific examples have been used in order to illustrate practical applications. At the heart of all these ICT developments is the accelerating convergence between the digital and physical worlds for which new policymaking processes will be needed.

A. Sensor-based computing and the Internet of Things

7. The proliferation of connected sensors and cameras, ubiquitous wireless networks, communications standards, clever analytics software and the activities of humans themselves are spawning networks, known also as smart systems, that will impact nearly every aspect of human activity. The Republic of Korea has been one of the first countries in the region to recognize this with its emphasis on the development of its U-society ("U" as in "ubiquitous network"), which, among other priorities, is focused on intelligent transportation, logistics and public utilities through the ubiquitous use of radio-frequency identification (RFID)[2] tags. As sensors become smaller and more versatile, they are increasingly finding their way into a wider range of objects, from aircraft engines and buildings to mobile phones and farm animals. Infrastructures are also becoming smarter; an example is that of networked power meters that bring new opportunities for more efficient use of resources. Likewise, smart cities in which more and more systems are monitored for the efficient use of resources are taking hold in the region. RFID tags allow every imaginable object to be electronically identified and tracked, and in essence to

[2] Radio-frequency identification (RFID) uses electromagnetic chips, also called RFID tags, that are attached to objects for the purpose of automatic identification and tracking.

become part of a larger distributed communications network — the Internet of Things.

8. Following the great east Japan earthquake in 2011, a Japanese manufacturer began using tiny sensors to build mobile phone cases that could monitor radiation levels. Integrated into the "jacket" of the mobile phone, this existing technology used in an innovative new way allows users to view real-time radiation levels, as well as a map that works with the global positioning system of the smart phone to display measured radiation levels over time. In May 2012, Japanese mobile phone operator SoftBank Corp. launched the world's first smart phone with an in-built radiation dosimeter; in the future, sensors embedded in mobile phones and other objects could be used to address a host of public safety and development challenges. Autonomous vehicles or vehicles with driver assistance technology, for example, could significantly reduce the approximately 700,000 deaths that occur each year in Asia and the Pacific as a result of road accidents, most often due to human error,[3] especially as this number is expected to rise with the number of automobiles in the region, which is growing rapidly. Some experts estimate that autonomous cars could reduce deaths from road accidents by up to 50 per cent.[4]

9. Another sector that has been substantially transformed by the Internet of Things is the tourism sector. It is estimated that 85 per cent of travelers use the Internet to plan travel and conducted on average 55 searches before making a final purchase. The information gap that existed before the advent of widespread Internet commerce, and which was being filled by tour operators, has all but disappeared. The consumer now has nearly limitless choice and, consequently, bargaining power never seen before. These changes are just the beginning, but despite this potential, as is often the case with cutting-edge developments, it is not the technology itself that is holding back the roll-out of innovative new products, but, rather, the framework within which traditional societies operate. In the case of autonomous cars, it is the behaviour of human drivers and pedestrians and the way modern roads are constructed that will hinder innovation. In the tourism sector, human behaviour and the nature of the Internet necessitate layers of Internet security and information verification procedures, and this will hold back the full potential of innovation.

B. Big data and open data

10. The digital revolution has blanketed cities with a vast network of electronic devices, such as sensors, mobile phones, computers and global positioning devices. The flood of data created by the interaction of these devices creates unique opportunities to save lives, reduce poverty and enhance growth. Transforming extremely large data sets into meaningful information reveals trends and patterns that will be useful to policymakers in the fields of health, education, agriculture and financial services. Data collected through mobile devices and the Internet, for example, could help policymakers understand population health trends or identify deadly outbreaks of disease. Likewise, data gleaned from mobile payments for agricultural products could help governments predict food production trends in order to reduce waste and spoilage or more deeply understand the consumption patterns of the poor and thus allocate resources more effectively. Utilizing the data created by mobile

[3] See E/ESCAP/MCT.2/8.

[4] *The Economist*, "Driverless cars: Look, no hands", 4 September 2012. Available from www.economist.com/blogs/babbage/2012/09/driverless-cars.

phones in particular can improve policymakers' understanding of vulnerable populations and allow governments to respond quickly to the emergence of new trends.

11. The benefits of big data can only be achieved, however, if government agencies and private sector operators are committed to releasing these massive data sets for use by government, industry, entrepreneurs, academia and the general public. The concept of open data is taking hold around the world, as governments increasingly open up access to core public data sets, such as those related to population, transport, weather, government expenditures, household income, location of schools, health facilities and more. Government acting as a data catalyst allows researchers, web and software developers and entrepreneurs to generate new insights and produce value in the broader economy. Open Data is not without challenges, however, as policymakers must be aware of security, privacy and consumer protection issues, all of which are areas in which the appropriate regulatory frameworks are struggling to keep pace with the new way that data are being disseminated. Nevertheless, user-centric solutions derived from data analytics that are targeted, relevant and customized offer compelling possibilities for providing better access to health, education and financial services for people living in poverty.

C. Cloud computing

12. Cloud computing, which is the move from product-based to service-based information technology delivery using the Internet to distribute remote processing or storage, continues to be adopted in the region, making the universal availability of reliable and affordable broadband a precondition. Cloud computing opens up a wide range of opportunities across all sectors, stimulating greater economic and social connectedness, and drives innovation in information, content and services, involving the creation of new or improved value chains and networks. For example, cloud computing services are gaining popularity with consumers who use webmail, hosted music, and photo storage and applications. Cloud computing offers the potential to effect substantial savings in costs related to on-premise infrastructure, and this is driving some governments in the region to adopt "G-clouds" (government cloud computing) as a key component of their overall ICT programme. For example, the Government of Singapore has opted to develop, in partnership with Singapore Telecommunications (SingTel), a G-cloud that will open the gateway for government e-services to be delivered more quickly, at lower prices and on demand at any time anywhere, including mobile devices. The G-cloud will be developed for all Singaporean government bodies and is expected to deliver the many benefits of cloud computing, including automation and rapid scalability of G-cloud resources.

13. Despite the potential benefits of G-clouds, three overarching issues impede widespread adoption of this technology and represent a challenge for policymakers. First, interoperability remains a challenge when using more than one supplier. This issue could be addressed by exploring hybrid services that seamlessly integrate private and public cloud networks, and encouraging the development of industry standards that would make it easier to change from one supplier to another. Second, safeguarding the stored data is an important issue that continues to raise concerns in cloud computing, particularly in the face of rising threats that characterize contemporary connectivity. The possibility of major breakdowns that could wipe out data makes users, particularly institutional users, reluctant to adopt cloud services for data storage. Similarly, safeguarding the confidentiality of data is an unresolved

issue that will require solutions both on the technological as well as the legislative front. Finally, issues surrounding identity assurance remain unresolved as cyber-security software struggles to keep pace with the increased sophistication of hackers in cyberspace. Cloud computing will therefore need to include hacker-proof identity verification software that provides sophisticated and safe ways to identify approved users, as well as the individuals in cyberspace who will transact with those users. These challenges, centred largely around trust, will require appropriate regulatory frameworks as well as increased intergovernmental cooperation in order to create regional standards for a technology that has no national borders.

D. Convergence of content, telecommunications and media

14. The convergence of content, telecommunications and media is increasingly drawing together two interconnected worlds — the physical world and its digital reflection. ICT has become an integral part of human society, unleashing a wave of mass digital communication, with information and knowledge potentially available to anyone, anywhere and at any time in ways that transcend the previous linear mode of communication and knowledge transfer. The challenge, therefore, is to develop hardware that seamlessly integrates various technology platforms and to create ICT devices that are simple, intuitive and user-centric, including broadband-enabled smart phones. Doing so will enhance the ICT experience for a wider group of people, including those living in rural areas. The aim is to make the underlying technology essentially invisible, with content taking centre stage in the interaction with the user. This seamless knowledge-intensive interaction of technologies — broadband, video, audio, personal computer — has come to find a particularly useful application in videoconferencing, whereby users in different cities can communicate face-to-face through voice and video as if they were sitting in the same room. Similarly, throughout Asia and the Pacific, hundreds of entrepreneurs offer language instruction to individuals across the globe via videoconferencing tools, such as Skype, and payment for such services is often conducted via secure, Internet-based money transfer services, completing a business cycle that simply did not exist a decade ago. As ICT and the media become increasingly intertwined, technologists will be aided more and more by domain experts in every field, from architects to social scientists, and new forms of interaction will stimulate deeper engagement and new forms of learning.

E. High value manufacturing

15. Advances in ICT-enabled manufacturing continue to have a major economic and social impact, with robotics and three-dimensional printing just two of many examples of high value technologies that are changing the way people live and work. Rapid innovation in the field of autonomous systems and agile robotics (drones) and the increasing proliferation thereof will transform product manufacturing and associated supply chains, accelerating the process towards automated factories. In addition, drones will have applications in search and rescue, reconnaissance, disaster management and emergency response. Three-dimensional printing, also known as additive manufacturing, harnesses the power of digital technologies to create highly customizable objects in a wide range of applications, spanning bioscience, aerospace, construction, automotive manufacturing and the creative industries. This technology holds immense potential in a number of areas that contribute to building e-resilience among local communities, including more effective disaster response and recovery through the rapid construction of emergency

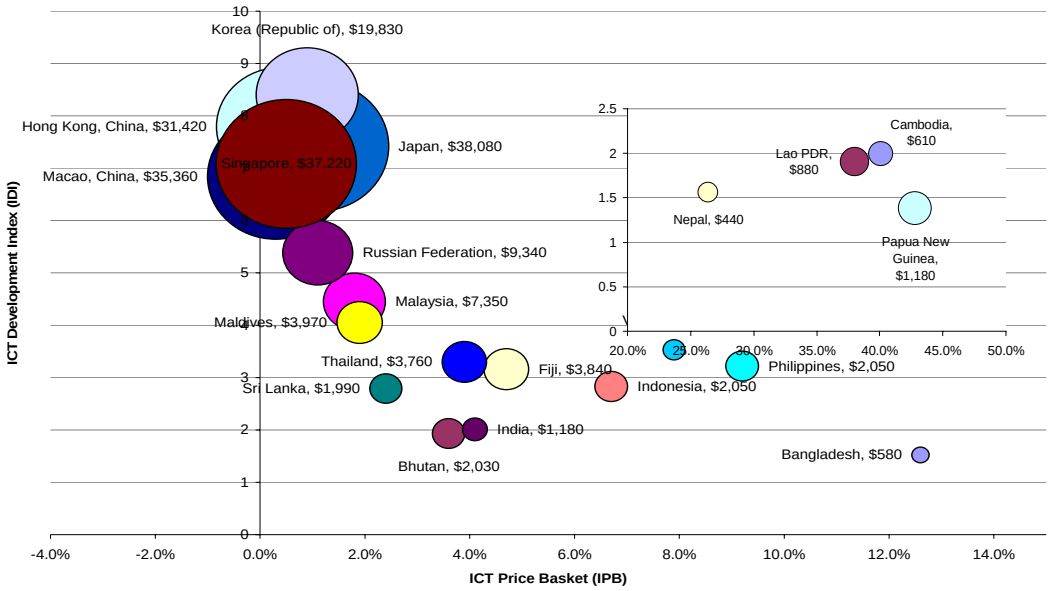
shelters and the large-scale reconstruction of urban areas that have been damaged or destroyed.

IV. The growing digital divide in Asia and the Pacific

16. With regard to the technological advancements reviewed above, aspirations must be grounded in reality: progress and benefits have been spread unevenly across the Asia-Pacific region. As countries in the region are at various stages of economic development, a fact that is unavoidably reflected in ICT uptake, some countries have benefited more than others.

17. Indeed, although the region benefits from having the most advanced country in the world in terms of ICT infrastructure and human capacity, the Republic of Korea,[5] closely followed by (a) Hong Kong, China, (b) Japan and (c) Singapore, it also has such countries as Papua New Guinea, which ranks among the lowest.[6]

Figure
Relationships between connectivity, usage prices and income in selected economies, 2009



Sources: Data from International Telecommunication Union, *Measuring the Information Society 2011* (Geneva: International Telecommunication Union, 2011). Available from www.itu.int/net/pressoffice/backgrounders/general/pdf/5.pdf.

Notes: The ICT Price Basket (IPB) is a composite basket based on the user prices for fixed-telephony, mobile-cellular telephony and fixed-broadband Internet services, computed as a percentage of average income level.

The ICT Development Index (IDI) is a composite index combining 11 indicators related to the level of networked infrastructure and access to ICT, the level of ICT use in society and the level of ICT skills.

The size of each country bubble is proportional to the gross national income (GNI) per capita of that country. The GNI per capita for each country is indicated on the chart in United States dollars, 2009.

[5] According to the ICT Development Index (IDI) in 2011.

[6] International Telecommunication Union, *Measuring the Information Society 2011* (Geneva: International Telecommunication Union, 2011). Available from www.itu.int/net/pressoffice/backgrounders/general/pdf/5.pdf, page 29.

18. The figure shows the relationship between ICT connectivity, per capita incomes and ICT usage prices as calculated in indices of the International Telecommunication Union. As expected, there is a strong correlation between ICT development and per capita incomes; ICT prices and per capita incomes, however, have an inverse relationship. This reflects the regressive nature of the sector across the income spectrum. The figure also shows that, as the price index increases, the ICT Development Index falls sharply, which suggests that, in those countries that already have the lowest per capita income levels and the lowest ICT development indices, ICT prices increase exponentially, four- or fivefold (inset countries in the figure). This underlines the close association between poverty, low ICT connectivity and high user prices that appears to be strongest in those countries where the population is least able to afford access to ICTs.

V. A new social compact

19. The widespread positive effects of ICT innovation on economic and social development in Asia and the Pacific provide an impetus for policymakers to take action to ensure that the benefits of ICT are shared by all. However, much remains to be done to narrow the digital divide and address underlying causes of persistent poverty and inequality. In this regard, broadband in particular can be used to capitalize on the innovative ICT opportunities that are emerging in the region. At the same time, stakeholders should recognize that limitless access to information, ideas, knowledge and applications poses immense challenges. As the promises grow, so do the perils, and making use of ICT and leveraging it to its full potential in order to improve human development require different approaches and tailored strategies based on country- and region-specific contexts. Merely taking problem-solving strategies from other parts of the world and fitting them to Asia-Pacific conditions cannot be a long-term, sustainable solution. Therefore, a new social compact in ICT between government and commercial interests is needed to harness broadband connectivity in a meaningful way — a way that provides new pathways for inclusive and sustainable development. In this regard, the Meaningful Broadband Initiative of the Digital Divide Institute, hosted at Chulalongkorn University in Bangkok, provides an interesting model as it seeks to establish meaningful broadband ecosystems that continually adapt next-generation technologies to the needs of all of segments of society. The new social compact could rest on five pillars of innovation at the national, subregional and regional levels, namely: (a) broadband infrastructure as a meta-infrastructure that underpins other ICT, as well as transport, energy and communication infrastructure networks; (b) leadership in business and government for societal change; (c) a new genre of public-private partnerships (PPP) that combine commercial goals with public policy objectives; (d) regulators as a mediator between the public and private sectors in a new broadband era that is raising new issues of security, privacy, spectrum management and intellectual ownership; and (e) ethical and social implications of new technologies.

20. The potential policy options and available business models are numerous, and providing value to diverse stakeholders with diverse interests is invariably highly challenging. In the development of a new social compact, therefore, ICT and broadband developments would need to be seen in a holistic way that takes into account regional and global perspectives. They cannot be evaluated in isolation from other key technologies that are evolving and converging in new ways. The combination of nanotechnology, bioscience,

robotics and ICT will unleash a whole new wave of change and creative disruption. In many cases, ICT will provide the "intelligent" backbone, bio-chemistry the tangible aspect, and nanotechnology the mechanical and engineering dimensions. All are mutually supportive, and the interplay between technologies will accelerate innovation, thus ICT policy should embrace these wider ramifications by taking into account other emerging new technologies.

21. In summary, there is no single overarching approach for driving ICT investment and uptake to achieve sustainable economic development in Asia and the Pacific. Landlocked and least developed countries in the region will require markedly different policy, legal and regulatory approaches to implementation compared to the developed countries of the region. Driven by holistic public policies that recognize broadband as a meta-infrastructure that underpins all other infrastructure, the new social compact could provide an impetus for governments, the private sector and intergovernmental organizations to work together to bring the benefits of affordable, reliable and universal broadband to all while also sharing the risks. More specifically, the new social compact should enable governments and the private sector to leverage technological innovation to address societal challenges facing the region.

VI. ICT and associated opportunities and challenges related to socioeconomic development

22. It is clear that much work remains to be done before all of Asia and the Pacific — the poor and wealthy, rural and urban dwellers, youth and the aged, men and women — can enjoy the full benefits of ICT and the region can claim that innovations in ICT have led unequivocally to improved human development. In comparison with other technologies, ICT offers significant opportunities to promote economic and social progress owing to its cross-cutting nature. ICT innovations operating within a socioeconomic developmental framework can strengthen the capacity of governments to provide health, education and environmental services for inclusive and sustainable development.

A. Health services

23. In health services, ICT are increasingly providing higher-quality personalized services to everyone, regardless of location, while at the same time delivering cost savings for patients and society at large. Broadband-enabled hospitals in urban centres throughout the region are beginning to provide online and mobile access to personal health information that collates scattered patient data for safer and more effective patient assessments. Furthermore, hospitals are taking advantage of patients' personal smart phones and tablets to disseminate information, manage appointments and improve on-time management. These smart devices, once linked to the hospital's network, can be used for more effective medical monitoring, early diagnosis and prevention of illnesses and diseases. With time and supportive public policies, the benefits of m-health are expected to go beyond urban areas and may prove to be particularly beneficial to patients in rural areas. Access to the knowledge and expertise of faraway specialists would improve health services in rural areas that might otherwise be untouched by modern medicine. Despite the much touted potential of these services, the extent to which they make a difference to the rural poor has yet to emerge, but, as broadband connectivity becomes more affordable, reliable and ubiquitous, the potential of these

technological innovations can be expected to start to make a real difference in people's lives.

24. There are particular benefits for the ageing, as evidenced by a growing body of case studies in developed countries. Ambient Assisted-Living (AAL) technologies, through the use of remote monitoring and alarms, address potential hazards, such as falls or illnesses, that face the ageing. Smart phones that enable m-health services, such as remote monitoring of pill intake and social networking for increased societal integration and less isolation, have all been shown to facilitate home living for longer periods of time, thus reducing pressure on public health services and expenditures. This is of particular importance for the Asia-Pacific region as, over the next 25 years, the old-age dependency ratio will nearly triple. Chronic disease and some form of disability, including dementia, will affect a large portion of the ageing population in Asia and the Pacific. With younger people working in urban areas, the largest cohorts of aged persons with disabilities are in the rural areas, many are women and poor, which make them particularly vulnerable to triple discrimination. Nevertheless, since the region's future aged are from a generation that incorporated ICTs in their daily lives at a much younger age than the present generation of aged, these technologies are scalable and customizable, and they will take on greater importance in the years to come as the aged population living alone in Asia and the Pacific grows. It is also important to recognize that such initiatives can increase the productive contribution that the ageing can make as "silver consumers" to the economy. This is particularly the case in the tourism sector, where Asia's ageing are expected to be the most rapidly growing segment of this employment-generating sector of the region's developing economies.

B. Educational services

25. In Asia and the Pacific, not unlike other regions, the adoption of ICT in education has not yet reached the widespread proliferation that was imagined a decade ago. The reasons for this are manifold: fragmented and overlapping decision processes and inappropriate roll-out strategies (top-down approach without regard to local characteristics, insufficient funding, insufficient administrative and technical support, inappropriate training and lack of pertinent ICT knowledge of teaching staff) among others. Nevertheless, ICT in education holds enormous potential. Forward-looking policy approaches to e-learning should enable access to educational materials for an unprecedented number of people, regardless of their location, and deliver information and teaching materials where and when they are needed. This applies, for instance, in countries with less developed fixed and mobile broadband infrastructure and wide geographical expanse, such as Australia, China, India, Indonesia and the Philippines. In Thailand for example, the Government has launched the "one tablet per child" programme, which is expected to provide up to 800,000 tablets for elementary school students in 2012, providing a new way to deliver content-rich educational material, the benefits of which are expected to be of particular importance in rural areas. A new social compact could encourage ICT for learning by embedding e-education and m-education at all stages of life, from primary to higher education as well as in the community and workplace. At the same time, it is necessary to recognize that e-education and m-education are not a panacea and that, without trained teachers, comprehensive curricula and an enabling learning environment, the benefits of ICT in the education sector will be limited.

C. Government services

26. ICT plays an important role in modernizing government services, and effective interaction and accountability between public administrations, citizens and businesses are essential to building knowledge-networked societies. E-government enables information to be accessed and shared in new ways, thus strengthening individual and institutional capacities that foster participatory decision-making and multi-stakeholder discussions on issues that affect all citizens. Reaching a wider public audience through e-government also promotes more transparent interactions between citizens and government. In addition to the benefits of increased transparency and accountability, governments in Asia and the Pacific are increasingly aware of the significant cost savings that can be achieved by moving from the traditional method of providing government services to more efficient e-government services, or m-services as people become more social and mobile. Viet Nam, for example, is in the midst of a five-year plan to provide more public services online, including the online processing of all passport applications by 2015, as well as online tender announcements, bid invitations and bid results for State-funded projects. The plan aims to boost cooperation between the public and private sectors and links the online services of the treasury, tax and customs offices, and banks. Viet Nam's move towards an integrated e-government platform could lead to annual savings of up to $1.5 billion.

27. Despite the benefit of moving towards an e-government platform and the ambition of the region to move in that direction, it should be recognized that, on average, only 5.1 per cent of the population in Asia-Pacific developing countries has access to broadband Internet, a critical requirement for accessing e-government services. Therefore, other avenues that employ ICT to provide government services more effectively to a broader audience should also be explored, such as the innovative initiative of Sri Lanka whereby it has set up a call centre, known as the 1919 Government Information Centre (GIC), as a means of providing information related to government services for those who do not have access to the Internet. The call centre is open 365 days a year and provides information in three languages on a wide range of government services from birth and citizenship registration to education, health and housing. The lack of broadband connectivity in many areas and the continuing digital divide necessitate a multi-pronged approach to delivering e-services, with mobile phone voice services acting as a major communication channel in less connected rural areas.

28. As part of the new social compact, governments of the region could take on the role of "innovation leader" in e-services by exemplifying new usage and business models, including pilot programmes, in order to provide leadership in the realm of ICT and broadband innovation. Doing so could incentivize the public to adopt ICT into their daily lives, thus accelerating the overall economic and social benefits of ICT, which have been well documented. For example, for basic government services, such as registration of automobiles, bill payments and marriage licence applications, if governments are able to provide the services online, in simplified, user-friendly and time-saving formats, individuals would quickly see the cost-benefit savings and invest in becoming fully e-literate.

29. In order for the region to fully embrace e-services, however, the diffusion of high-speed broadband throughout Asia and the Pacific must be accelerated. In this context, policymakers may also consider taking a leadership role in developing infrastructure and trans-sector policies. The perception of quality in the provision of health-care, education, energy and other government

services has deteriorated over the past few decades, and governments are now looking at the potential synergies between the building of roads, sewerage systems, water and gas pipe networks, as well as telecommunications and electricity networks, as a means of creating a cross-sectoral approach that moves away from the current silo approach of deploying government services. A key element of a trans-sector initiative and the new social compact is incorporating open access principles in order to use other infrastructures effectively and efficiently for the deployment of a range of government services.

D. Mobile money

30. Mobile money highlights how the mobile phone has promoted enhanced inclusiveness and the empowerment of the poor in simple and affordable ways. By allowing for the quick and direct (supplier direct to consumer, or person to person (p2p)) and safe transfer of money via mobile phones, the intermediary is eliminated. The formal banking system has always been ill-equipped to act as an intermediary for the poor, as transactions of small amounts result in relatively high transfer fees which the poor can ill afford. Mobile money tools were pioneered in Africa, notably Kenya, and are highly relevant to Asia and the Pacific, where mobile phone penetration is high and 95 per cent of businesses are SMEs. In Cambodia, mobile money transfer service provider WING allows any customer, whether individual or business, to transfer, deposit and withdraw money from each other's account and with anyone else's account in Cambodia, as well as pay bills and top up their pre-paid mobile phone. Later in 2012, WING is expected to launch a mobile wallet service whereby users will simply hold their mobile phone over a terminal to complete transactions for everyday items, such as groceries. This near field communication (NFC) technology is already established in the developed countries of the region, such as Japan and Australia, and represents a vast opportunity for consumers and businesses alike in the developing countries of the region, in particular the least developed. In Cambodia, it is estimated that 74 per cent of the population in urban and semi-urban areas has mobile phones, and NFC technology could enable thousands of Cambodians to "leapfrog" past the use of credit cards, given that the penetration of mobile phones in the country is much higher than that of credit cards. The use of credit cards has not gained currency in Cambodia, partly due to unfamiliarity with the concept and the necessity for a traditional bank account. Paying for items with a mobile phone, a device with which most Cambodians are familiar and use every day, could be more easily accepted across the country. This potential "leapfrogging" to the so-called m-wallet transaction, bypassing a means of commerce that is used extensively throughout the developed world, underscores the importance of adaptive policies and technologies that take into account the unique cultural, economic and social circumstances of countries in Asia and the Pacific.

31. Using the wide distribution networks that mobile phone operators enjoy in developing countries, mobile phones are also increasingly used to facilitate international remittances. In the Philippines, cash remittance service provider Smart Padala offers a secure and convenient way for the large number of overseas Filipino workers to regularly transfer money to family members in the Philippines. The individual residing and working abroad initiates the transfer by making a cash-in payment at one of Smart Padala's international remittance partners and then sending a text message that indicates the recipient and the amount of the transfer. The receiving individual then cashes out the remittance at any Smart Padala establishment anywhere in the country. This form of m-remittance thus provides a critical tool for the unbanked, who formerly relied

on less secure forms of international remittance, and does so at significantly lower cost in comparison with formal bank transfers, which can range from 2.5 to 25 per cent of the amount transferred. Mobile phones offer countless other ways to improve access to financial services and reach the unbanked, and there is scope for m-remittance to evolve into m-payments on a wide scale, as the example of Cambodia above shows. The opportunities for financial inclusion are numerous, and realizing these opportunities for a more resilient Asia-Pacific region will require further regulatory work in order to balance the advantages of flexibility and simplicity with the need to protect consumers.

E. Environment

32. Cutting-edge innovations, as discussed above, are increasingly opening up tremendous possibilities for new, improved and more efficient traffic, water and energy management systems. As the region's development paradigm moves towards achieving sustainable goals, advances in sensor technology, for example, will provide more detailed and readily available data for advanced monitoring and efficient management of environmental resources. A good example of this can be seen in India, where, as part of the Mumbai Urban Transport Project (MUTP), more than 600 hi-tech remotely operable zoom cameras monitor about 220 junctions in downtown Mumbai, while a geographic information system (GIS) displays traffic flows and congestion levels at the city's police headquarters. The cameras detect the intensity of traffic and feed data into computers, allowing for real-time adjustment of traffic signals based on traffic patterns and potential trouble spots, such as accidents or particularly busy intersections. Traffic flows are continuously monitored, and real-time adjustment of traffic flows reduces greenhouse gas emissions. An added benefit is increased productivity resulting from less traffic congestion.

33. The opportunities for ICT to create a more sustainable future are truly limitless. The Cleanweb, which utilizes the Internet, social media and mobile communications to more effectively produce and deliver clean technologies, such as wind and solary energy, and biofuels, may be the next evolutionary stage in the transformative power of the Internet. In many of these industries, major technological breakthroughs have been achieved; however, the scale of these technologies and the speed of rollout can be significantly increased by the Internet and ICT.

34. Collective data gathering through mobile phones could be used in densely populated areas to complement other sensor data. Next-generation unmanned aerial vehicles (UAVs or drones) could be leveraged to allow effective monitoring of remote areas where other means of data gathering are not feasible, and autonomous cars could reduce congestion and save fuel. Furthermore, the same methods and approaches used in the environmental sector to create a more sustainable future can equally be applied for biodiversity monitoring, management and conservation.

F. Disaster management

35. Complex societal behaviours emerge from the accelerated pace of technological change. Some are intelligent — for example, those related to the emergence of smart systems and societies in the region's megalopolises. However, behaviours that heighten risks can also emerge, not least because of the sheer rapidity of innovation and the short time spans that people are afforded to understand and foresee consequences. In a hyperconnected world,

risky behaviours can have serious multiplier effects, and impact can be felt in places that are far removed from the original source of the instability, such as financial markets, food supply chains and power grids. One of the most vivid examples is perhaps the 2011 great east Japan earthquake.

36. Technological innovation can play a leading role in helping Asia and the Pacific better prepare for and minimize the risk of these types of megadisasters. For example, ICT can wirelessly connect large numbers of sensors and distribute outputs in real time, enabling people to be properly informed before, during and after a disaster. An early warning system for tsunamis must be accessible by disaster management experts, scientists, and field experts outside the disaster area so that appropriate aid can be provided quickly. A flood monitoring system needs embedded water level sensors that are able to detect a sudden rise to dangerous levels. A warning system for large dam failures would benefit from ICT-enabled tools for seismic disaster monitoring. In addition to early warning and monitoring systems, ICT can play a significant role in disaster preparedness and management through social media and computer simulations. Microblogging, crowdsourcing and online social media tools, such as Twitter and Facebook, which are often accessed via broadband-enabled mobile devices, stimulate new information flows and connectedness. During the Philippine floods of August 2012, stranded citizens used their mobile devices to contact emergency agencies and workers via Twitter, relaying information about their location, the condition of the surrounding area and other relevant details as means of facilitating the overall rescue effort. In the realm of digital training, interactive online games and other computer simulation tools are used to engage national agencies in more realistic training environments for more effective disaster response.

VII. Issues for consideration

37. Against the above background, the Committee may wish to consider the following and guide the secretariat on the way forward:

(a) In collaboration with international organizations, regional think tanks, such as the Digital Divide Institute, which is hosted at Chulalongkorn University in Thailand, promote a new social compact for broadband connectivity between governments and the private sector that would rest on the five pillars of innovation at the national, subregional and regional levels;

(b) Dialogue needs to be fostered among key stakeholders, including industry, governmental actors, institutions of higher education, research centres and civil society, in order to realize current and near-future ICT innovations that alleviate poverty, build inclusiveness and encourage investments in low-carbon-emitting ICT infrastructure;

(c) Organizations and competencies across Asia and the Pacific should be mapped in order to pool expertise and stimulate collaboration in different areas of ICT innovation;

(d) Public-private partnerships (PPP) should be explored as a means of spurring innovation in research and development, capacity-building and deployment in order to ensure that innovations in ICT are developed in a holistic manner that takes into account the unique economic and social conditions of the Asia-Pacific region.

VIII. Conclusion

38. Innovation in ICT is occurring in all economic sectors across Asia and the Pacific, transforming the delivery of basic services, creating new industries, driving productivity gains, and enhancing livelihoods across the region. The proliferation of affordable broadband-enabled digital devices, such as personal computers, smart phones and tablets, and the growth of ICT innovations highlighted in the present document are accelerating a new wave of creative disruption and reconfiguring societal connectivity around knowledge networks. From the Internet of Things to big data and cloud computing, the digitization of society demands that policy priorities and practices be realigned to reflect the need to reverse widening gaps between the rich and poor and a massive upgrading from cellular telephony to data and knowledge-services in which the full power of the Internet of Things will come to the enterprises, governments and people of the region. A new social compact is needed between government and business leaders that defines how public and private actors share the costs and risks of bringing the benefits of technological advances to all.