



Economic and Social Council

Distr.: General
24 September 2012

Original: English

Economic and Social Commission for Asia and the Pacific

Committee on Information and Communications Technology

Third session

Bangkok, 20-22 November 2012

Item 5 of the provisional agenda*

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

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

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>Page</i>
I. Introduction	2
II. The transformative power of ICT	3
III. Key technology trends for knowledge-networked societies	4
A. Sensor-based computing and the Internet of Things	4
B. Big data and open data	5
C. Cloud computing	6
D. Convergence of content, telecommunications and media	7
E. High value manufacturing	7
IV. The growing digital divide in Asia and the Pacific	8
V. A new social compact	9
VI. ICT and associated opportunities and challenges related to socioeconomic development	10
A. Health services	10
B. Educational services	11
C. Government services	12
D. Mobile money	13
E. Environment	14
F. Disaster management	14
VII. Issues for consideration	15
VIII. Conclusion	16
Figure Relationships between connectivity, usage prices and income in selected economies, 2009	8

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.

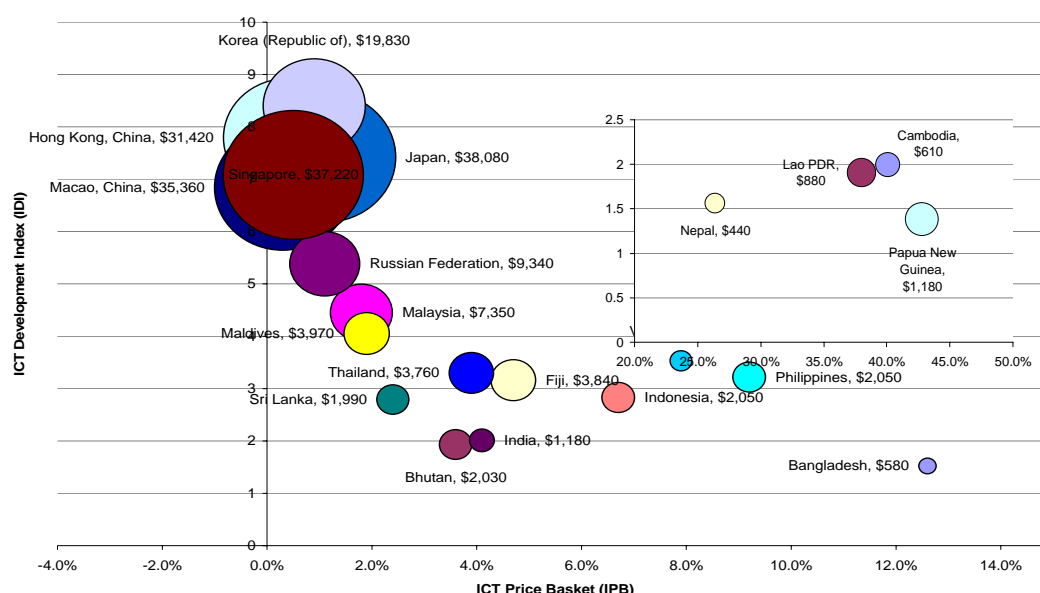
IV. The growing digital divide in Asia and the Pacific

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).

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