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INFORMATION, COMMUNICATION AND SPACE TECHNOLOGY APPLICATIONS FOR THE ACHIEVEMENT OF THE MILLENNIUM DEVELOPMENT GOALS AND THE GOALS OF MAJOR WORLD SUMMITS: TRENDS, CHALLENGES AND ISSUES

(Item 5 of the provisional agenda)

Note by the secretariat

SUMMARY

The present document discusses the rapid development trends in information, communication and space technology since the Second Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific in 1999. It examines the opportunities arising from the increasing convergence of these fields, which has enabled a range of broadband applications and spurred economic growth and globalization. It further examines the development, set by major world summits, committing countries to poverty alleviation, environmentally sound sustainable development, building a knowledge society and a safer world. It scrutinizes the challenges and issues involved in leveraging the efforts of countries in the region to effectively utilize these technologies towards realizing the Millennium Development Goals and goals set by the World Summit on the Information Society, the World Summit on Sustainable Development and the World Conference on Disaster Reduction.

The senior officials are invited to share their views on how to contribute to and gain from regional cooperation in space-based information and communication technologies for reaching internationally agreed development goals.

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I. INTRODUCTION

1. In 1990, almost one in three people in Asia were surviving on less than one dollar a day. Since then the region has experienced the fastest economic growth rate in the world, and the figure has now improved to close to one in five. However, the region is currently home to approximately two thirds of the world's poor. Food security, education, health, empowerment and inclusion, environment, natural disasters and natural resources are all closely linked to poverty and thus poverty alleviation continues to be the core challenge facing the region.

2. The First Ministerial Conference on Space Applications for Development in Asia and the Pacific held in Beijing in 1994 captured the contemporary challenges and emphasized integration of emerging space technology applications into the overall processes of sustainable development. The Second Ministerial Conference held in 1999 in New Delhi further confirmed that direction. The framework of the Regional Space Applications Programme for Sustainable Development in Asia and the Pacific (RESAP) advocated by the ministerial conferences brought into focus all the themes of space applications to address poverty alleviation, managing globalization and sustainable development in an operationally integrated fashion. The success of RESAP could be visualized in terms of networking the space and user agencies in the region; networks of education and training establishments; efforts in capacity-building; and regional cooperative mechanisms.

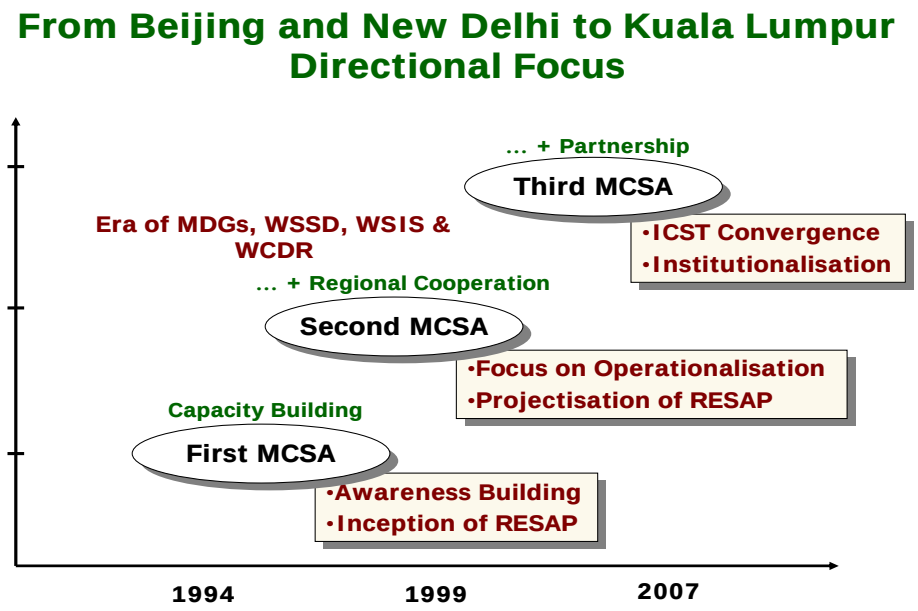
3. The period after the Second Ministerial Conference on Space Applications has seen dramatic advances in both technology and applications, and the advent of various global development initiatives. Information and Communication Technology (ICT) has demonstrated an increasing convergence with space technology. Effective utilization of satellite based information and communication technology applications rely on an appropriately developed ICT environment, with appropriate technical, institutional and policy aspects. It will also create more opportunities and markets for the development and application of other ICT branches. ESCAP has recognized this synergy by creating a subprogramme on information, communication and space technology (ICST) with a divisional unit to assist members to develop an enabling environment to take advantage of such opportunities.

4. The positive role of ICST in helping to achieve development objectives was recognized at the Millennium Summit (2000), the World Summit on Sustainable Development (2002), the World Summit on the Information Society (2003 and 2005) and the World Conference on Disaster Reduction (2005). Many developing countries have successfully harnessed ICST in their efforts towards development; however, significant deficiencies remain in many countries in regard to national ICST capacity. This has been a major constraint to large-scale operationalization of space-based systems and services. The purpose of the present paper is to review trends in ICST applications and policies, in relation to major social and economic issues facing the region in the context of the increasingly globalized economy.

II. INFORMATION, COMMUNICATION AND SPACE TECHNOLOGY TRENDS

5. In the early 1990s, space technology applications were operational in limited areas, and only in a few countries of the region. Awareness building in the developing countries of the region was therefore the focus of the First Ministerial Conference on Space Applications for Development, which was based on the development policies endorsed by Agenda 21.[1]

6. With the quest to achieve sustainable development receiving worldwide attention, efforts were largely concentrated on integrating the applications of remote sensing and geographic information systems (GIS) for sustainable development planning. The focus of RESAP on capacity-building was essentially aimed at creating an enabling environment for space technology applications. The Second Ministerial Conference broadened the purview of RESAP to include communications, navigation and other space technology applications, while putting greater focus on moving space technology applications from experimental or intermittent use to everyday use – a process generally referred to as *operationalization*. The period after the Second Ministerial Conference has been characterized, in many countries, by an enabling environment with telecommunications deregulation, public-private infrastructure and service partnerships, and rapid growth of the private sector.



A. Space segment of ICT, major technological advances and emerging applications

7. The major technological advances could be captured in three parallel and well-established trends. The first is convergence, wherein the boundary between ICT and space technology has

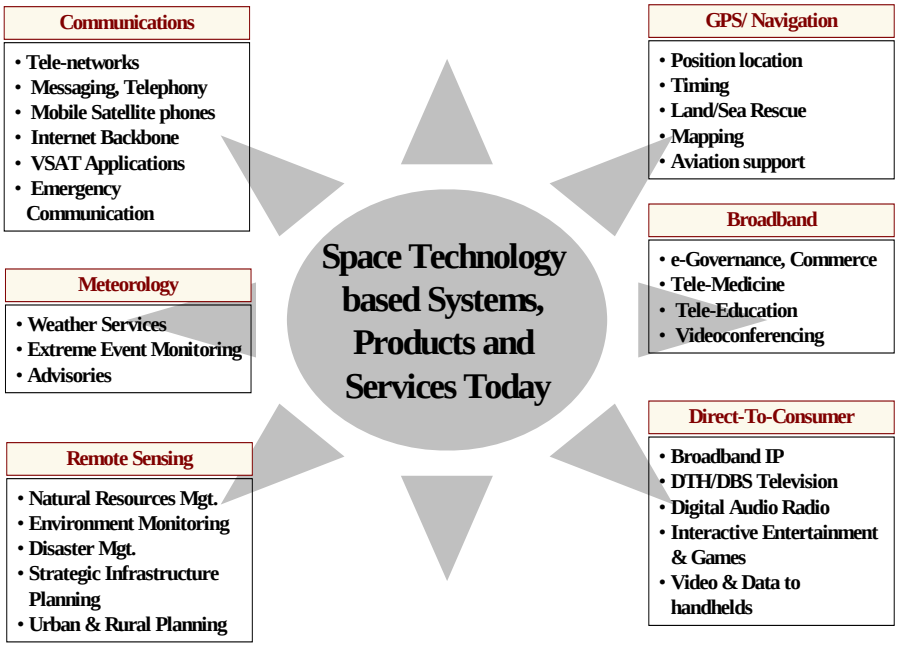
[1] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992*, vol. I, Resolutions Adopted by the Conference (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1, annex II.

disappeared. The second trend is the emergence of broadband, enhancing the capacities for the delivery of services. The third is the new wave of global transparency and information empowerment. Space technology, in addition to being an integral part of the technologically convergent regime, of which ICT is a product, has made valuable contributions in driving these trends. It plays both complementary and supplementary roles to conventional technologies in the different types of applications. While the satellite remote sensing, global navigation satellite system (GNSS) and meteorological information provide the "contents" to information services, satellite communication with its vast reach provides the "conduit". Space technology has been particularly instrumental in providing the means to extend the reach of ICT services to remote and isolated regions.

8. Numerous space-based technologies have experienced considerable advances. For example, the capabilities of communication satellites have increased more than 100 times with the advent of powerful Ku and Ka transponders. Similarly, EO has underdone phenomenal advances in terms of improvements in spatial, spectral and temporal resolution, convergence with geo-informatics technologies such as satellite positioning, and superior methods of calibration, validation and data assimilation. The resultant products and services have included routine mapping of the Earth's surface some 100 times more accurate than in 1994. A similar quantum of improvement has occurred in the ability to produce digital maps, predict El Niño and La Niña, and forecast the formation and movement of tropical cyclones or typhoons. These advances have had incalculable beneficial social impacts and as a result, space technology has transitioned from an optional emerging tool to universally critical infrastructure for national development. The satellite performance which has advanced by two orders since 1994 is known as the 100 times syndrome.

9. These technological advances have made possible the operationalization of numerous space-based systems, products and services which are now taken for granted in many parts of the world (Fig 2.2). For example, mobile satellite phones, very small aperture terminal applications and emergency mobile communications have emanated from SatCom, while the emergence of e-commerce, e-governance, tele-education, e-health and videoconferencing have largely been the result of broadband applications. GNSS based services in positioning, search and rescue, mapping and aviation support are becoming popular. Improved weather services, such as the monitoring of extreme weather events and product-specific farm advisories, are made possible by the combination of more sophisticated meteorological satellites, models, computing and communication facilities. Remote sensing has moved beyond its traditional role of mapping natural resources, environment, infrastructure and hazard zonation, to making geo-spatial data infrastructure and services one important pillar supporting the information society.

Contemporary Space Technology Applications

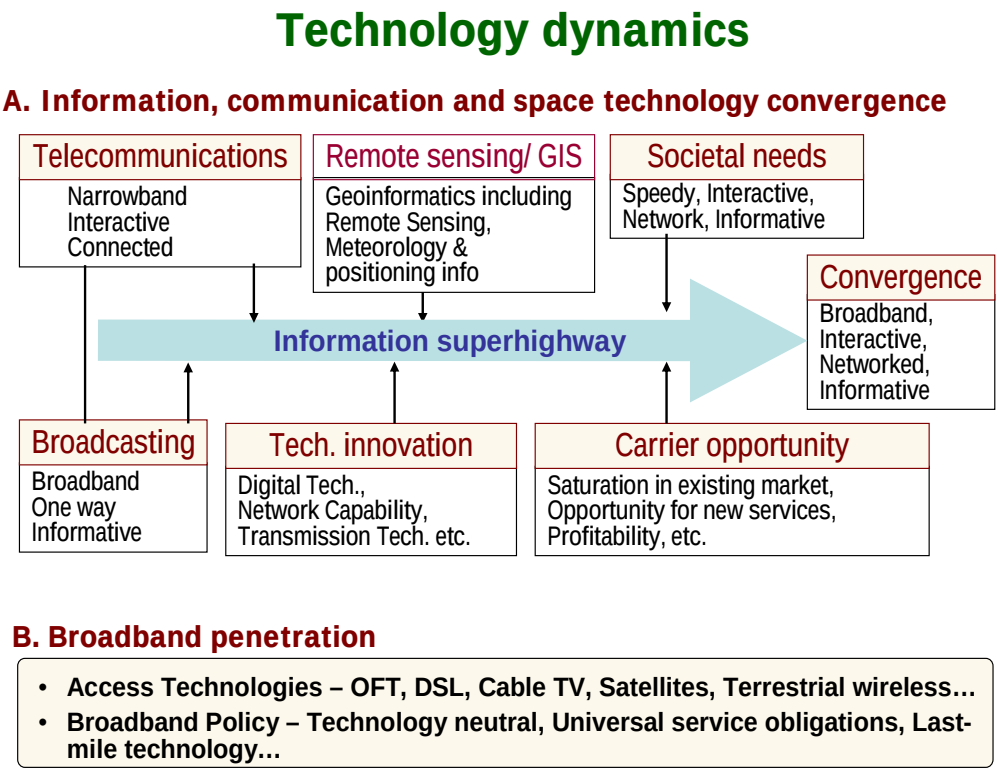


B. New paradigms - convergence of ICT and space technologies, broadband and transparency

10. The ICT penetration continues influencing culture, politics and the economy around the world. The convergent environment with both wired and wireless delivery channels, facilitated by terrestrial and space-based systems do provide an effective means for accelerating the provision of basic information services at a lower cost using appropriate technologies. The region struggles to provide the necessary last mile connectivity to remote rural villages, least developed countries and small island nations. Space technology applications have touched every facet of human life and helped modern society to cope with its problems of sustainable development by providing valuable inputs into natural resources management, preservation of the environment, global connectivity, entertainment, education, health services, disaster management and information management.

11. It has been observed that the integration of space technology with other aspects of information and communication technology has made ICST applications more accessible and affordable, particularly in countries where appropriate national policies and an enabling ICT environment and public-private partnerships support and encourage such activities and initiatives. However, in many countries, such benefits have not been obvious. In such cases, positioning conducive policies, enabling institutionalized arrangements, and encouraging viable public-private partnerships are crucial to permit full access to relevant ICST applications and services, and derive maximum benefits from them. It is therefore necessary to achieve a balance between space technology and ICT applications based on their comparative advantages in a particular region.

12. Advances in the convergence of space and ICT technologies have led to dramatic new applications. Many of these applications are already a reality in some countries – and are potentially realizable in many other countries in the near future. The main elements of this convergence are illustrated in Fig 2.3. Breakthroughs in digital technologies – including improved networking and transmission capabilities – combined with advances in geo-informatics, for example, are leading to the establishment of new direct-to-home (DTH) and direct-to-office services based on remote sensing and GIS. In a more general sense, new access technologies, such as digital subscriber lines, Cable TV, and wireless, have played enabling roles in the creation of commercial opportunities in numerous broadband services for almost all walks of life.



13. Satellite communication-based services outperform other communication services wherever rapid and easy installation is called for. This is because they can bypass network congestion and provide high-quality, large bandwidth connectivity, and be redeployed to other locations when and where needed. With the advent of broadband, content can be of higher quality and thus have a greater impact. In addition, broadband means that radio, television, and similar media can be delivered everywhere, without the boundaries formerly associated with broadcasting. Wireless broadband (brought to computers and phones) makes such capabilities even more accessible. The use of hybrid-broadband techniques, consisting of copper wire, optical fibre and satellites, provides many solutions for bridging the digital divide.

14. In addition to the continuing advances in the broadcasting and navigation segments, satellite broadband as a solution has advantages in places where optical-fibre is not available. While optical fibre will continue to serve as the backbone of the Internet and to dominate transoceanic broadband capacity, satellites will play a major role in large geographical areas where terrestrial infrastructure is not cost-efficient, and economic and social sectors are less developed.

15. Emerging technological advances are beginning to have an impact on satellite design and thus on new services (Fig 2.4). The next generation of capabilities is likely to bring space-based systems and space-enabled ICT services associated with the information superhighway much closer to the community, making space technology a part of more people's everyday lives. Developments in satellite communications are a good example of this. The increasing use of higher frequencies (such as Ka band), the use of on-board processing, and the advent of flexible, high power spot beams, all help to reduce the cost of application systems. This combined with greater penetration by hybrid networks, such as satellite plus cellular and WiMAX, is creating more flexibility to design optimum, cost-effective communication solutions for a wider variety of markets.

16. Over the last one and a half decades, Earth observation (EO) technologies have undergone phenomenal changes. Coarse, medium and hyperspectral sensors and platforms have been developed by major space agencies in response to science and environment related issues. High-resolution imaging, like SatCom, moved to the commercial arena. Constellations of smaller, faster and cheaper satellite missions are emerging as promising tools to capture real-time data on natural disasters and also to continuously monitor them. Disaster monitoring constellations (DMCs) also provide unique opportunities for cooperation. A DMC led by Surrey Satellite Technology Ltd. with the partnership of Algeria, China, Nigeria, Turkey and the United Kingdom of Great Britain and Northern Ireland is in the pipeline. Each of the partners has its own satellite and provides images to non-partners free-of-charge in response to disasters. In this connection, China's proposed small-satellite constellation is a milestone for regional cooperation. There is another school of thought on the construction of DMCs, that brings in the concept of intelligent, autonomous and event-driven missions. Missions involving formation flying and event triggers, developed by NASA, are an attempt to monitor moving targets like cyclones and typhoons. Some of the intelligent missions, such as EO-1, have demonstrated the ability to capture floods, volcanic activity and other surface anomalies autonomously. NASA's Global Earthquake Satellite System is an example of building a DMC to predict earthquakes well in advance.

17. The next generation of EO satellites thus displays such features as ultra-high resolution (sub-meter); hyper-spectral and multi-parametric synthetic aperture radar capabilities; thematic constellations of agile satellites with autonomous missions; precision products and personalized EO based services. Many countries and international cartographic organizations have recognized the importance of investment in Spatial Data Infrastructure, which has encouraged and facilitated the emergence of geo-informatics as a major global enterprise. It is expected that such missions would facilitate large-scale operationalization of remote sensing and GIS in the region.

Next generation capabilities

- **Next generation fixed satellite service (FSS)**
  - Higher frequency – Ka band
  - On board processing
  - Greater power/ more flexible spot beams
- **Next generation movable satellite service (MSS)**
  - Moving to "broader band"
  - Smaller lighter user terminals
  - Dynamic allocation of spot beams
  - Hybrid networks (Satellite plus cellular, WiFi, etc)
- **Next generation Earth observation**
  - Ultra-high resolution (sub-meter), hyper-spectral and multi-parametric synthetic aperture radar (SAR)
  - Thematic Constellation of Agile Satellites, Autonomous Missions
  - Precision Products, Personalized Services
  - Advanced atmospheric sounders, radiometers, profilers, Precipitation Radars
  - Formation flights and sensor-web
- **Next generation satellite navigation**
  - Location based services
  - Augmented Aviation services

Source: Satellite Industry Association (SIA), US - 2006

18. Weather forecasting and climate research have long depended on satellite systems. These activities have benefited greatly from improved satellite instruments and ground networks, including automated weather stations, vertical-profiling and Doppler weather radars. They have also benefited from ever improving computing capabilities and advanced modeling, along with the corresponding improvements in meso-scale numerical prediction, storm surge modeling, seasonal outlooks and longer-range weather forecasts. Further incremental improvements are likely over the coming decades.

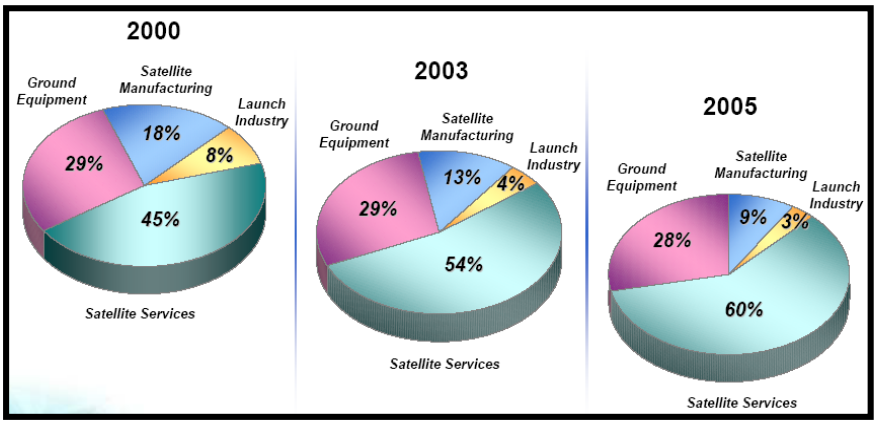
19. The last decade saw satellite positioning systems moving from the military to the civilian domain, as illustrated by the emergence of the Galileo GNSS and the Global Positioning System (GPS) service, which was originally developed for military use. It is widely anticipated that GNSS will galvanize the creation of many location-based services, and also aid in augmenting aviation and other transport services dramatically.

III. INVESTMENT TRENDS

20. World satellite industry revenue, consisting of revenue from satellite services, satellite manufacturing, the launch industry and the sale of ground equipment, is an important indicator of investments in space technology. For the period 2000-2005, world satellite industry revenue grew from US$ 64.2 billion to 88.1 billion, with an average annual growth of 6.7 per cent. The satellite services share of total revenue increased from 45 per cent in 2000 to nearly 60 per cent in 2005, with a

13 per cent growth rate. DTH TV services increased 14 per cent in 2005; mobile data services revenue increased by 8 per cent; revenue for global commercial satellite remote sensing increased approximately 18 per cent in 2005. The growth in global commercial satellite remote sensing was largely driven by evolving business opportunities, strategic applications, and expanding civil and commercial imagery markets including online mapping services. Transponder agreement revenues grew 4 per cent in 2005. Increased satellite-capacity utilization offset the declines in lease prices in several markets as overall utilization grew from 58 per cent in 2004 to 61 per cent by 2006. The trend therefore clearly indicates increasing satellite industry revenue, the emergence of newer services, and growth in capacity utilization (Fig 3.1).

Growing demands for services since the Second Ministerial Conference on Space Applications



Technology	2000	2005	Portfolio of the Services
FSS	9.1	9.8	VSAT services, Remote Sensing & transponder agreements
DBS	18.3	41.3	DBS/DARS = DTH TV, DARS & Broadband
MSS	1.5	1.7	MSS= Mobile telephone & mobile data

Source: Satellite Industry Association (SIA), US - 2006

21. Revenue for the global satellite communications industry grew from US$ 50 billion in 1999 to an estimated US$ 90 billion in 2006. The Asian and Pacific region is now the largest regional market for satellite communications. This region continues to grow at a somewhat faster rate than any other region. Space-enabled ICT infrastructure in the region is growing very fast. For example, the IPSTAR satellite with 90 spot beams Ku band having 2-way handling capacity of 45 Gbps; MEASAT series and several other domestic SatCom services are expected to populate the newer services. There is also a trend towards the introduction of more bandwidth efficient technologies and the development of new services that require more bandwidth. Nevertheless, extreme disparities exist in the region. Much of the Asian and Pacific region has limited terrestrial infrastructure, though optical fibre and microwave wireless telecommunications system installation is proceeding at a rapid pace in several economies. While many people are already connected, there is tremendous opportunity for connecting an additional 1-2 billion people in the region. There is a great opportunity for satellite communications to offer rapidly deployable, scalable and cost-competitive infrastructure.

22. While the rapid proliferation of high-resolution commercial remote sensing satellites has opened a multibillion-dollar market, China's efforts on a disaster monitoring constellation, India's constellations of cartographic resources and ocean satellites, Japan's ALOS satellite, Thailand's planned THEOS satellite, and many other polar orbiting environmental satellites from major space agencies, are likely to provide major opportunities for applications oriented towards public benefit. At the international level, the evolving Global Earth Observation System of Systems (GEOSS) is yet another major opportunity for EO to provide more benefits to society. Three Earth Observation summits, in 2003, 2004 and 2005, agreed on the GEOSS 10-year implementation plan and the establishment of the intergovernmental Group on Earth Observation (GEO), which now consists of more than 60 countries and 40 participating organizations. The GEOSS 10-year implementation plan[2] defined specific targets within nine societal benefit areas: disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity. This is a major paradigm shift within EO from technology development to a focus on applications and services. While GEOSS is making great efforts to increase synergy and convergence among EO agencies, it provides opportunities for the region to leverage the efforts on poverty alleviation, environmentally sound sustainable development and disaster reduction.

23. While investment from government agencies is still responsible for the majority of satellite systems launched, commercial investment is growing rapidly while government expenditure is declining. In 2005, government purchases accounted for 71 per cent of space manufacturing revenues, down from 82 per cent in 2004. The trend is also evident in launch figures, of 39 commercial launches in 2005, 46 per cent were for private customers and 54 per cent were for government customers. The corresponding figures for 2004 were 37 per cent and 63 per cent, respectively.[3]

24. Investment trends in the space industry cannot be analysed fully without taking into account ICT trends. The most significant of these has been a major shift away from public ownership and public investment in telecommunication and ICT since the 1990s, towards private-sector ownership and funding, and deregulation. Multilateral development banks and overseas development aid agencies have shifted their loans and grants away from the public sector and have been placing more emphasis on the private sector and the promotion of a competitive environment.[4] Recent years have seen falling direct investment in public ICT sectors and the introduction of a number of new policy instruments, including public-private partnerships, designed to maintain or improve the accessibility of communication services to sectors of the population disadvantaged by their remote location or poverty. The delivery of universal service obligations in an environment of accelerating telecommunications deregulation is likely to remain a challenge that will preoccupy service providers

[2] Available online at < http://www.earthobservations.org/docs/10-Year%20Implementation%20Plan.pdf>

[3] Fultron Corporation, "State of the Industry Report", June 2006.

[4] Sean O. Siochru and Bruce Girard, "Innovative technologies and community ownership: a new model of ICT access for the rural poor" (New York, UNDP, 2005).

and Governments in coming years. Conversely, those countries retaining monopoly or protected communication services face the challenge of lack of incentives to introduce new technologies, while the absence of a competitive market and high licence fees discourage new entrants.

IV. COST EFFECTIVENESS

25. Competition and technological advances are lowering the cost of ICST systems, products and services. According to a report by Euroconsult around 175 to 200 communication satellites are likely to be launched during the period 2001-2010. A report by Northern Sky estimates that demand for satellite bandwidth will grow from 33.5 Gbps in 2002 to 218.8 Gbps by 2007; the cost of satellite broadband services is likely to be reduced by half by 2013. The price of ground equipment also continues to decline. The cost of a VSAT was around US$ 1,100 in 2005, down from about US$ 10,000 in 1998.[5] The economic benefit of better communications is also becoming more quantified. A recent European Union survey estimated that satellite broadband benefit/cost ratio is 1.69: 1 for Europe as a whole, and 1.32: 1 for presently unconnected areas.[6] Considering the demography, geography and degree of room for improvement in Asia and the Pacific, the corresponding ratio for the region could be even higher. The increasing cost effectiveness of ICST systems, products and services is likely to profoundly effect approaches to governance, education, health care and economic development in the future.

26. Despite the cost of commercial EO satellite imagery – typically between US$ 1,000 and 4,000 for a single scene with ground resolution between 1 and 10 metres – there are many example of cost-effective application of remote sensing and GIS in development projects in the region, in fields such as water resources management, infrastructure, fisheries, agriculture and reclaiming environmentally degraded land. In many cases the investment for obtaining and utilizing these satellite data and products represents only a small portion of the total project cost, while additional benefits accrue in the form of improved benchmarking, monitoring and evaluation. An example is the World Bank funded project in Uttar Pradesh, India, undertaken to reclaim wastelands and restore agricultural productivity to sodic soils,[7] using remotely sensed data combined with ground water quality reports and socio-economic indicators. The remote sensing, mapping, geographic information system and associated infrastructure comprised 2 per cent of the total project cost. Since the launch of Google Earth in mid 2005, online geospatial information services have developed so rapidly that some countries began to consider possible government's responsibility in provision of basic such services to ensure healthy development of this industry. It has been estimated that the market for Internet-based spatial information services is worth billions of dollars a year.

[5] Richard T. Kusiolek, "VSAT Broadband applications – a perspective", APSCC Newsletter (Winter 2005).

[6] European Space Agency, "Technical assistance in bridging the digital divide: a cost-benefit analysis for broadband connectivity in Europe", October 2004.

[7] V. Jayaraman and S.K. Shrivastava, "Poverty mapping and monitoring using information technology: Learning and perspectives from India", paper presented at the Ad Hoc Expert Group Meeting on Poverty Mapping and Monitoring Using Information Technology, Bangkok, 18-20 August 2003.

27. Affordability has always been an issue with regard to the use of space technology applications, especially in least developed countries. However the importance and perceived benefits of space applications are such that even the least developed countries are now making significant investments. For example, Bangladesh is expanding its water and information network pilot project into a nationwide GIS-based network. The aim of this network is to disseminate flood forecasts and water information to local people by radio, TV and cellular phones as well as through the Internet. The countries of the Mekong River Commission are investing in remote-sensing data and technology transfer to the Mekong River Commission for the monitoring of rice crops, floods, irrigation water management and agricultural drought.

28. Satellite communications have been viewed in many areas as a relatively expensive and lower-bandwidth supplement to terrestrial wired or microwave connectivity. It has been a challenge for the industry and government regulators to overcome such perceptions. Growth in Ku band is a trend that could help in this endeavour. In some countries, deregulation and increased competition have put downward pressure on prices. In addition, a new generation of Internet Protocol communications satellites has just begun to operate, promising significant increases in bandwidth availability at greatly reduced prices. For broadband connection, the price of some kinds of satellite terminals have fallen below US$ 1,000. If governments can work with service providers to increase access to such services, the opportunity for affordable costs would be great.

29. The cost of Internet and telephone services in the region experienced a significant dip during the period 1998-2003. However, connectivity costs remain higher than the world average, especially in the Pacific and Central Asian subregions, though appropriate regulatory environments, new technologies, and more efficient use of bandwidth have significantly reduced the costs in some economies. To make ICST services and applications affordable to poor communities, various resource-sharing mechanisms at the community level need to be considered, such as shared connectivity through wireless local loop or community e-centres to reduce bandwidth costs, shared information platforms for multiple applications and services to reduce unnecessary duplication. Today's satellite communication technology may support such resource-sharing functions.

V. INFORMATION, COMMUNICATION AND SPACE TECHNOLOGY AND INTERNATIONALLY AGREED DEVELOPMENT GOALS

30. The major mandate of the United Nations in the field of development is to assist the developing members in achieving internationally agreed development goals. Over the past six years, the Millennium Summit, the World Summit on Sustainable Development, the World Summit on the Information Society and the World Conference on Disaster Reduction unified global development efforts by setting goals for the alleviation of poverty, and for ensuring environmentally sound sustainable development, a knowledge society and a safer world. Each of these landmark summits recognized the important role of ICST in helping to achieve these goals.

31. Asian and Pacific countries have already made substantial progress towards achieving the Millennium Development Goals (MDGs), particularly those related to poverty alleviation. The proportion of people living on an income of less than US$ 1 a day fell from 31 per cent in 1990 to 20 per cent in 2002. The absolute number of poor also fell, from 931 million to 679 million.[8] Nevertheless, if current trends continue, many countries will remain "off track" for the achievement of some MDGs, including those for health, education, community empowerment and social inclusion, environment and natural resources and vulnerability to natural disasters. A 2005 ESCAP/UNDP report highlighted the uneven progress towards achieving these goals and the need for more emphasis on developing skills and institutional capacity – especially those related to the delivery of health, education and other vital services to the poor.[9] The region also faces considerable challenges in sustaining the progress made so far, particularly in addressing the inequalities resulting from rapid economic growth and also dealing with various communicable diseases and natural disasters.

32. The Jakarta Declaration on Millennium Development Goals in Asia and the Pacific: the Way Forward 2015[10] and the 2005 World Summit Outcome[11] recognized that various interventions, including regional cooperation for ICT infrastructure development, for example in Pacific island developing countries, and for early warning systems for natural disasters, are critical for achieving the goals. The developing countries of the region have been making investments in the development of ICT infrastructure to improve the quality and delivery of vital services for realizing the goals of major global summits. In fact, goal 8 calls for public-private partnerships to harness the community centric applications of ICTs, while the Plan of Action of the World Summit on the Information Society[12] emphasizes ICT applications in support of sustainable development, public administration, business, education and training, health, employment, environment and agricultural sciences.

A. ICST and the Millennium Development Goals

33. An International Telecommunication Union report[13] of ICST potential and global best practices has demonstrated the links between ICT and the Millennium Development Goals. Space applications have also established their operational reliability in areas of education, health, empowerment and environmental sustainability. Against the backdrop of an emerging knowledge society in the globalized economy, economic opportunities for the poor and marginalized will depend on their acquiring and maintaining skills and knowledge, gaining and maintaining access to information and empowerment, and connecting with a wider market. The space technology segments

[8] See E/ESCAP/1363, para. 5.

[9] ESCAP and UNDP, *A Future Within Reach: Reshaping Institutions in a Region of Disparities to Meet the Millennium Development Goals in Asia and the Pacific* (United Nations publication, Sales No. E.05.II.F.27).

[10] A/60/313, annex.

[11] General Assembly resolution 60/1 of 16 September 2005.

[12] A/C.2/59/3, annex, chapter I, section B.

[13] ITU, *World Telecommunications Development Report 2002: Reinventing Telecoms* (Geneva, ITU, 2002).

of ICT are important for realizing the goals of major summits, especially those related to reducing poverty; infant, child mortality and maternal mortality rates; providing access to reproductive health services; implementing strategies for sustainable development and reversing the loss of environmental resources; making progress towards gender equality and empowering women by eliminating gender disparities. It is important to highlight that addressing these goals are more challenging in underserved areas and this is where space technology plays a key role.

B. ICST and the World Summit on the Information Society

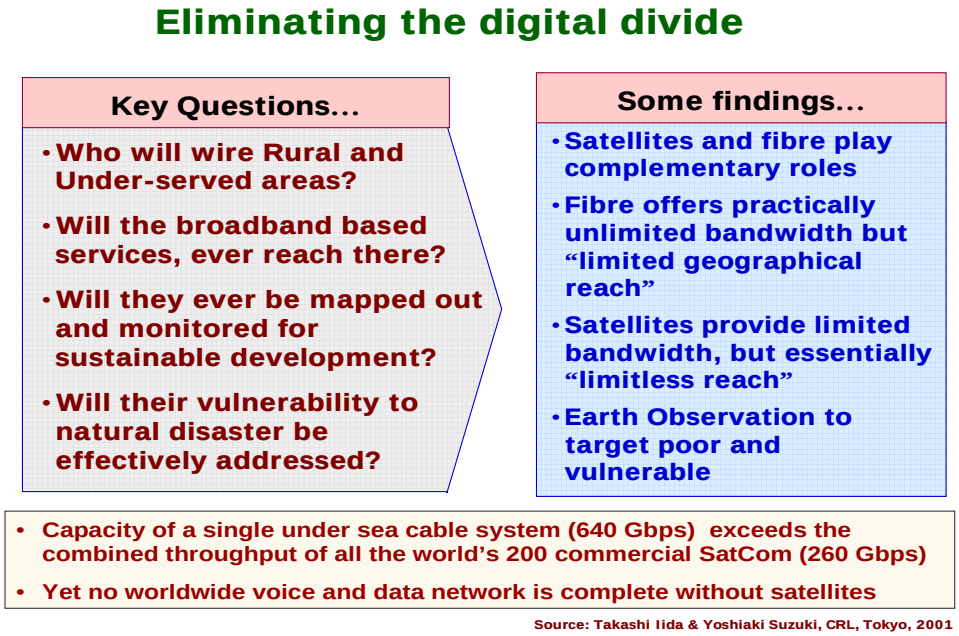
34. In the Declaration of Principles of the World Summit on the Information Society,[14] the representatives declared their commitment to build a people-centred, inclusive and development-oriented information society, where everyone can create, access, utilize and share information and knowledge. The Declaration of Principles lays out a vision for the information society in which the challenge is to harness the potential of ICT to promote the development goals of the Millennium Declaration. The Plan of Action is focused on measurable objectives or "access targets" such as connecting villages, schools and clinics with ICTs. The Declaration proposes that to reach these objectives, Governments should develop e-strategies and public-private partnerships to extend access to ICTs. Expansion of ICT infrastructure will in turn enable people to have access to information and knowledge.

35. Space technology provides an enabling infrastructure for realizing the goals of World Summit on the Information Society: it addresses "last mile" outreach and helps to establish connectivity; it also provides valuable information, content and services supporting the information society. While awareness campaigns are necessary to highlight these services and their institutional viability, emphasis also needs to be placed on newer services which harness the applications emanating from satellite broadband, as well as the ability to empower people through information. In the context of bridging the digital divide, several questions arise in relation to the role of space-enabled ICT (Fig 5.1).

36. In the search for answers to these questions, it is important to note that satellite and fibre play complementary roles: fibre offers practically unlimited bandwidth but limited geographical reach; satellite provides limited bandwidth but essentially limitless reach.[15]

[14] A/C.2/59/3, annex, chapter I, section A.

[15] "Satellite broadband solves Digital Divide, Hughes Network Systems' Executive Mike Cook, Tells House Small Business Committee" Wireless Satellite and Broadcasting Newsletter, July 2001.



37. The Regional Action Plan towards the Information Society in Asia and the Pacific[16] further emphasized the importance of ICST enabled knowledge-based disaster management, which relies heavily on integrated information, knowledge, decision supporting tools and networking systems for coordinated multi-hazard management.

C. ICST and the World Summit on Sustainable Development

38. The World Summit on Sustainable Development provided a framework for managing natural resources in a way that supports economic development, while safeguarding the opportunities and rights of future generations. The Plan of Implementation[17] adopted by the Summit touched on: poverty eradication; changing to sustainable patterns of production and consumption; protecting and managing the natural resource base of economic and social development; sustainable development in a globalizing world; health and sustainable development; and regional issues.

39. ICST – especially remote sensing and GIS – is an important tool helping stakeholders to manage natural resources and ecosystems (see text box). Its role has been seen in the following areas: evolving the suitable policies and plans that resulted in efficient management of the natural resources; providing contextual and vital information support which helped in bringing out effective interventions/implementation strategies that led to the immediate success as well as improved the state of natural resources; enabling certain key services that help directly to support the livelihoods of the stakeholders.

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[16] ESCAP, *Regional Action Plan towards the Information Society in Asia and the Pacific* (United Nations publication, Sales No. E.06.II.F.20).

[17] Plan of Implementation of the World Summit on Sustainable Development (*Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum), chap. I, resolution 2, annex).

40. Since the first days of RESAP, space technology applications for sustainable development have been at the core of regional cooperative efforts. Promoting large-scale operationalization of remote sensing and GIS technologies, by government, private agencies, NGOs and at the community/stakeholder level is one of the main objectives of RESAP II. The use of remote sensing and GIS as information support to "Green" governance and towards the implementation of international protocols and conventions holds considerable significance. Recently, the focus has been on the concepts of carbon emission trading and the clean development mechanism. As per the Kyoto Protocol[18] guidelines, the developed nations could acquire carbon credits by investing in energy efficiency mechanisms in developing countries. It is therefore important to promote remote sensing applications and GIS in order to diagnose and identify low carbon sink zones as potential areas for increased agriculture/aforestation, thereby maximizing the benefits of carbon credits.

Box. Examples of operational space applications in line with the Johannesburg Plan of Implementation

Planning and policymaking:

Ecosystem mapping: targeting environmentally fragile areas and the incidence of poverty and create land reclamation programmes;

Land-use mapping/crop suitability classification: developing better cropping systems to help agricultural enterprises to raise their income;

Watershed development: enabling enhanced agricultural productivity and reduced environmental degradation by gathering improved information on land, water and drainage, among others;

Water resources management: mapping of surface/subsurface features and irrigated lands, among others.

Information support for policy interventions/implementation:

Disaster reduction: employing a multi-hazard approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation, preparedness, early warning, response and recovery;

Disaggregated poverty mapping: better targeting of the poor, poverty alleviation through development of natural resources.

Information support for livelihoods:

Fishing: identification of potential areas for fishing, weather information etc.;

Farming: crop suitability, crop-related information for insurance and subsidies.

[18] FCCC/CP/1997/7/Add.1, chap. I, decision 1/CP.3, annex.

D. ICST and the World Conference on Disaster Reduction

41. The World Conference on Disaster Reduction, held in Kobe, Japan, in January 2005, captured a collective vision to mitigate natural disasters by mainstreaming sustainable development, multi-hazard prevention strategies and well-knit institutional infrastructure for early warning systems. The framework envisaged paradigm shifts from crisis management to risk reduction; from unidimensional to multidimensional risk assessment; from an agency-specific issue to government-wide issues; from sectoral issues to community-wide issues. The post Conference scenario under the Hyogo Framework for Action[19] 2005-2015 has witnessed stronger linkages among international, regional, national and local-level disaster management agencies. The Framework has also led to the creation of platforms at various levels through networking and partnerships. The approach to disaster reduction, propounded by ESCAP, is based on the universally accepted fundamental concept of "living with risk". The key elements include strategic planning (political will and participation of all stakeholders; knowledge management), community-based disaster risk management, promulgating good practices (including those based on space technology applications), promotion of subregional networking and mechanisms and public-private partnership for disaster reduction.[20, 21]

42. Space technology, even within the limited extent of operationalization, especially in developing countries of the region, has demonstrated operationally a variety of critical applications in early warning, risk assessment, impact mapping, preparedness and mitigation measures, and emergency communication (Fig 5.2). The near real-time ability of EO satellites to capture natural disaster information and to gather information on the terrain, geophysical and weather-related factors pertaining to vulnerability and risk makes it a powerful tool for the production of knowledge products. It is also a powerful tool for the enrichment of the knowledge base that a country should have to manage its efforts towards natural disaster reduction. In practical terms, however, in some instances a mismatch remains between the potential and existing capability of these technologies, on the one hand, and the less developed institutional, policy and technological frameworks in developing countries of the region, on the other. The Intergovernmental Panel on Climate Change, while highlighting the increasing vulnerability of the region, indicated the growing trend towards weather and geological disasters. It is important that large-scale operationalization of space technology in risk assessment and disaster reduction be promoted.

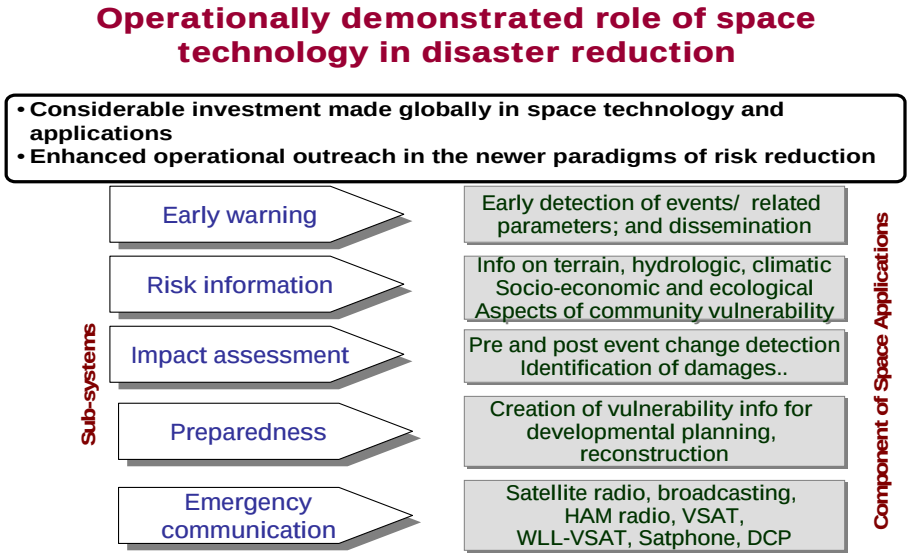
43. Among the major initiatives taken up by ESCAP as a part of a regional strategy on disaster reduction, the secretariat has devoted substantial effort to regional cooperative mechanisms (RCM) to improve national and regional capacity to (a) assess hazards/risks, (b) promote preparedness and risk reduction, (c) establish multi-hazard national and regional disaster early warning systems, (d) enable

[19] A/CONF.206/6 and Corr.1, chap. I, resolution 2.

[20] International Strategy for Disaster Reduction, "Elements for a Road Map Towards the Implementation of the Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters", May 2005.

[21] See E/ESCAP/1362, para. 56.

rural communication kiosks to function as community-based disaster reduction centres, and (e) to develop linkages to the initiatives and regional risk management programmes of ASEAN, the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), and SAARC.



E. ESCAP regional strategy on ICST for reaching the development goals

44. The regional road map for achieving the MDGs in the ESCAP region (E/ESCAP/63/2), endorsed by the Commission at its sixty-third session, in May 2007, [22] aims at assisting countries to reach the targets by 2015, or earlier where feasible. The road map presented five types of products and services through regional partnership, namely knowledge and capacity development; expertise; resources; advocacy; and regional cooperation in delivering regional public goods for dealing with cross-border issues, such as environmental hazards, natural disasters and communicable diseases. Major deliverables include normative studies on prevention, early warning and management of natural disasters.

45. The theme study prepared for the Commission on the development of health systems to achieve the MDGs[23] examined how poverty alleviation could be addressed by investing in health and noted that advances in ICST presented opportunities for improving access to health systems and offered Governments a means to cope with increasing demand for health-care services and help reshape the future of health-care delivery. Recommended key actions at the national level included integrating ICST to improve access to e-health services for vulnerable and remote populations.

46. The types of ICST-based activities that may be carried out in pursuit of the relevant internationally agreed development goals are listed in the table.

[22] See Commission resolution 63/4 of 23 May 2007.

[23] United Nations publication, Sales No. E.07.11.F.12.

47. It is important to recognize the role of space technology in realizing the goals of international summits. For the MDGs, the role of space technology is catalytic to operationalize key applications as a part of the strategy towards poverty alleviation. For the World Summit on Sustainable Development, it has an enabling role by virtue of bringing an enabling participatory approach for natural resources and environmental management, transparency and "green" governance. Towards implementing the World Summit on the Information Society and the World Conference on Disaster Reduction, the Hyogo Framework for Action, the role becomes larger and truly critical as highlighted in the key applications.

48. ESCAP recognizes the role of ICST in implementing regional strategic frameworks towards achieving internationally agreed development goals. The agenda representing the aspirations of member and associate member countries, being pursued by ESCAP, includes the following activities:[24, 25]

Table. Types of ICST applications used for achieving internationally agreed development goals

Summits	Role types	Key applications	Remarks
MDGs	Catalytic	Community e-Centre (CeC), e-health, Tele-education, Natural resources management, Poverty mapping, Risk assessment etc.	Applications, not stand alone, but as part of poverty alleviation programme
WSSD	Enabling	Natural resources management, environment monitoring, disaster risk assessment etc. – helps understand the nexus between environmental degradation and poverty	Integrated as natural resources and environment management strategy
WSIS	Critical	CeC, Telemedicine, Tele-education, e-governance, e-commerce, e-strategies etc.; empowering the rural poor	Integrated as part of infrastructures development
WCDR	Critical	Inputs to Early Warning, Risk assessment, Damage assessment, Emergency communication, CeC, etc. building resilience and coping mechanisms for the poor and the vulnerable	Dovetailed with disaster reduction strategies

(a) Strengthening national capacity for building an enabling policy environment for promoting the application of ICST;

[24] See the report of the Intergovernmental Consultative Committee on the Regional Space Applications Programme for Sustainable Development on its tenth session, Bangalore, India, 21-22 October 2004.

[25] Report of the Intergovernmental Consultative Committee on the Regional Space Applications Programme for Sustainable Development on its Twelfth Session and the High-level Expert Group Meeting on the Preparations for the Third Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, Daejeon, Republic of Korea, 17-19 October 2006.

(b) Strengthening human resources and national capacity for the use of ICST for sustainable social and economic development;

(c) Creating awareness and building capacity in, and monitoring of the use of, the forthcoming broadband services and applications;

(d) Strengthening regional cooperation through an improved cooperative mechanism for disaster management;

(e) Strengthening regional coordination functions and links with related agencies and programmes through a thematic approach and concrete result oriented activities;

(f) Building a network of the networks comprising tele-education/tele-medicine, natural resources and environment, and disaster management, under the overarching strategy of poverty alleviation.

VI. OTHER ISSUES

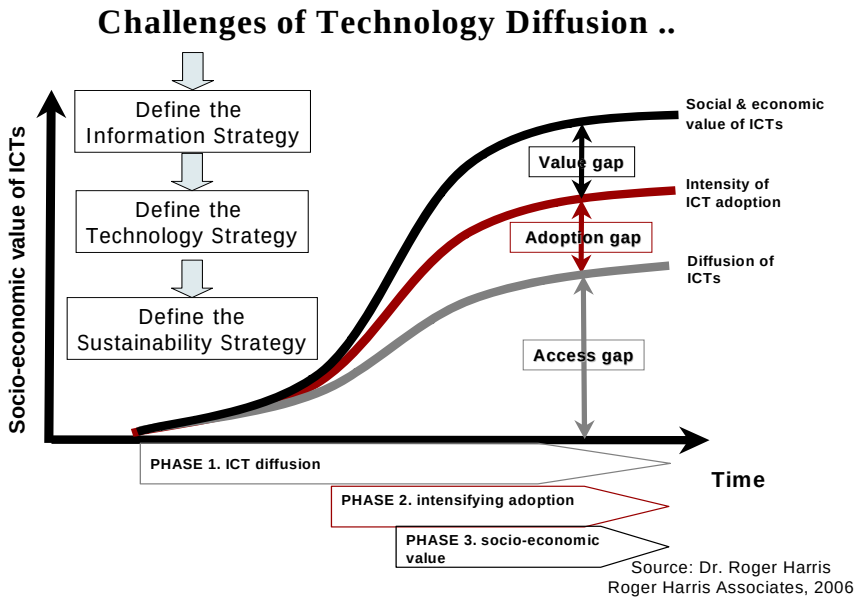
49. Many issues discussed during the second Ministerial Conference pertaining to integrating space technology applications with development planning are still relevant today. However, technological advances in ICST, including convergence, broadband and global transparency, emerging applications, and the increasing role of private agencies, have added new dimensions to these issues. While the social and economic goals and targets of the region are captured well in the MDGs, the World Summit on the Information Society, the World Summit on Sustainable Development and the World Conference on Disaster Reduction, in general the immense potential of ICST in achieving these goals has yet to be realized.

A. Challenges in diffusion and large-scale operationalization of information, communication and space technologies

50. Impediments to large-scale operationalization of ICST applications include geopolitical realities as well as the status of social and economic development. The Asia-Pacific region, home to more than 60 per cent of the world's population and about 75 per cent of the world's poor, presents striking contrasts between continent-sized nations, city States and Pacific island nations separated by vast stretches of ocean; between some of the world's richest and poorest nations; and between market-dominated, State-planned and mixed economies that themselves exhibit an uneven mix of agrarian, industrialized and knowledge-based service industries. With such extreme diversity, the major impediments in the use of ICST in the region have perennially been the constrained institutional capability, the digital divide, inadequate infrastructure, low levels of education, and the paucity of trained personnel and investment.

51. There is no global prescription for diffusion and large-scale operationalization of ICST applications. Initial conditions such as cultural context, institutional environments, and political and community leadership vary widely, as demonstrated in a recent UNDP report on ICT capabilities and its effect on development.[26] This survey of nine representative countries in South-East and South Asia illustrated the considerable diversity across the region with an aggregate index ranging from 0.76 (Malaysia) to 0.16 (Viet Nam) highlighting poor utilization of ICT capabilities. Another UNDP report demonstrates the high potential of ICT and its rather poor utilization for achieving the internationally agreed development goals.[27] The real challenge is therefore to enhance utilization through large-scale operationalization of ICT and space technology applications.

52. In a study on the diffusion of ICT,[28] three types of gaps were identified: access, adoption and value (Fig 6.1). In order to pinpoint these gaps, it is important to perform greater in-depth analysis of the unique socio-economic environments that impede the adoption of ICT.



53. Access to ICST products and services is the first stage of diffusion, followed by adoption and value, which would lead to enhanced socio-economic value of ICTs. Unless all three stages are achieved, diffusion of ICTs will continue to be problematic. Large-scale operationalization of space technology applications must address the access, adoption and value gaps to some extent. Operationalization begins with the requirement for particular products and services, and requires

[26] UNDP, *Regional Human Development Report: Elements for a road map towards the implementation of the Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters* (Bangkok, UNDP, 2005).

[27] UNDP, "ICT for poverty alleviation: Necessary but insufficient" (Bangkok, UNDP, 2005).

[28] Roger Harris, Presentation at Meeting of Experts in Preparation for the Third Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, Bangkok, 3-4 August 2006.

appropriate strategies for supplying the necessary information and infrastructure on a sustainable basis.

54. The potential economic benefit from effective space-technology applications depends not only on the quality of information it provides, but also how it is put to use. For example, vulnerability assessments in disaster-prone areas will have greater potential to mitigate future losses if the way the information is made available encourages stakeholders to act. Focusing on the way information will be used by the client can help to design information products that are "actionable", that is giving guidance for action, such as early harvest or moving people to safer places. Further encouragement by policy and regulatory instruments may also be necessary to embed best practices in utilizing present capabilities arising from ICST, especially in relation to building resilience to disasters.

55. Best practices in the region demonstrate that only those ICST-based community-centric projects that have worked on the ground are those which are characterized by strong policy support, better connectivity with affordability and inclusiveness, delivery of demand-driven marketables as well as public services, gender sensitivity and appropriate institutional networks. The real issue is: (a) to enable ICST-based interventions designed to foster sustainable development and empower people, including women and vulnerable groups; (b) to build capacity and skills; (c) to assist small and medium-sized enterprises; (d) to reduce poverty; and (e) to reinforce popular participation and informed decision-making at all levels. The technological, institutional and policy-related aspects must be synergized in support of ICST activities in areas relevant to the MDGs.

56. It would be important to ensure that the needs of women and socially vulnerable groups be considered in the design of ICST applications and to apply a gender mainstreaming framework. With the increasing number of e-social service programmes being developed in member countries, participation of and feedback from user groups such as women and vulnerable groups could ensure that these regional efforts are developed in an effective way.

57. The digital divide encompasses not only the lack of appropriate information, but also a lack of local content. The rollout of ICTs requires appropriate local content, paying attention to cultural and linguistic diversity, to make it meaningful in the context of local conditions. Local content development is an expanding field which also needs to be addressed.

B. Capacity-building

58. Institutional capacity is a must to address access, adoption and value gaps in the utilization of ICST products and services in developing countries. All the steps necessary for making ICST services operational in support of development depend upon possessing and maintaining capacity: converting EO satellite data into useful information and services, establishing infrastructure, training stakeholders to use the services effectively, integrating national endeavours with international systems. This is still where developing countries, especially LDCs, need to be supported.

59. Another important issue is the scaling up of successful pilot projects to large-scale operational programmes. The challenge of day-to-day operations at full scale is quite different and requires different skills than those involved in demonstrating small-scale and experimental projects. While some developing countries in the region have done well in this regard, such transitions have yet to make a dent, especially in LDCs and landlocked and island countries.

60. The Committee on Earth Observation Satellites has highlighted this issue with regard to operationalization of EO products in disaster management and the findings hold true for other space applications. Capacity-building is also a key element of GEOSS, and GEO has commissioned its Capacity Building Committee to oversee and monitor the activities of the participating agencies. Sentinel Asia is also focusing on capacity-building and networking among disaster management agencies. In addition, developing countries of the region have embarked on their own independent efforts to build space infrastructure capability. Countries planning to build their space application infrastructure need support for capacity-building in terms of expert advice and exchange of information and expertise. For example, West Asia regularly experiences earthquakes, promoting developing countries in the region, such as the Islamic Republic Iran, to work on developing the region's space-based institutional infrastructure for better preparedness. While working on a network of networks, it is worth integrating these efforts in the next phase of RESAP.

61. Along with the diverse products and services provided by major EO satellite information providers, local service providers will play a more important role in providing localized final products and services with locally accessible information, tools and practices. For many less capable users, operational applications of space information depend on the capacity of these local service providers. One capacity-building effort is to encourage local service providers to make such services widely available.

62. Governments are in a strategic position to encourage the adoption of ICST through their policies and strategies by establishing the necessary infrastructure and by creating an enabling environment for the diffusion and adoption of ICST and for investment promotion. Some actions would be direct and physical like the setting up of ICT infrastructure, including Internet connectivity, while others would be strategic, policy-oriented and regulatory. Furthermore, they must adopt the e-government mode of functioning. Institutional and procedural reform is a basic requirement for successful transition to the information society. The absence of integrated national ICT plans in many countries is leading to a fragmented approach to ICT adoption and suboptimal use of resources. The countries of the region should develop national ICT action plans that cover all economic and social sectors and are integrated into national socio-economic development plans.

C. Regional cooperation

63. Globalization provides opportunities for increased access; to ICT applications yet, this access has not developed evenly access the region. Regional cooperation, the major driver of RESAP implementation, holds the key to expanding operational applications of ICST, especially in LDCs and

landlocked and island nations. China and India, the countries with the largest numbers of extremely poor people, are very strong in various aspects of ICST and receive the associated socio-economic benefits. Both countries have engaged the region partly through RESAP, offering to share the benefits of many of their developments in the spirit of regional harmony. Such offers have been gratefully taken up in numerous cases. In other cases, the potential for increased cooperation remains significant.

64. The sensible way to build regional networks and enhance national capacities in ICST applications is for RCMs to be owned by multiple stakeholders, to be dynamic and flexible, and to make use of linkages to existing ESCAP and United Nations initiatives. ESCAP could consider enhancing cooperation between subregional organizations such as ASEAN, BIMSTEC, SAARC, the Pacific Islands Forum and others, to address common issues specific to the countries of the subregions, and strive to reduce unnecessary duplication and to fill gaps. The recasting of RESAP may start by bringing better synergy and convergence among dialogue forums, the Asia-Pacific Regional Space Agency Forum (APRSAF), Asia-Pacific Multilateral Cooperation in Space Technology and Applications, Asia-Pacific Space Cooperation Organization, the Asia-Pacific Satellite Communication Council and related initiatives. In the context of RESAP implementation, the efforts on encouraging operational use of space technology for disaster management are converging to form a distinct regional cooperative framework. Similar focus is needed for other applications of relevance to the goals of world summits.

65. Despite the rapid development of EO technology, it is technically impossible for an individual satellite to provide the information for operational disaster management. A constellation, or constellations, of satellites are necessary to provide information which meet all temporal, spatial and spectral requirements. In the Asia-Pacific region, major efforts are under way to address this issue. The constellation of small satellites for disaster and environmental monitoring, initiated by China, could only be fully realized through regional/international cooperation.

66. International cooperation has been recognized as an important strategy towards improving access to EO products, especially for developing countries and in response to emergencies. The Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters is a major step in this direction; it was initiated in 2000 to ensure that organizations dealing with major disasters would have immediate access to EO satellite data from participating space agencies.[29] The initiative of the United Nations Office for Outer Space Affairs towards the establishment of a United Nations Platform for Space-based Information for Disaster Management and Emergency Response (SPIDER) is another effort to provide universal access for all countries and relevant international and regional organizations to all types of space-based information and services in order to support the full disaster management cycle. Sentinel Asia, initiated through

[29] European Space Agency, Centre National d'Etudes Spatiales, Canadian Space Agency, National Oceanic and Atmospheric Administration, Indian Space Research Organization, Argentine Space Agency and the Japan Aerospace Exploration Agency.

APRSAF with the support of JAXA and others, is an important regional initiative focused on providing access to better space-enabled products in a context specific to the region. In a network of networks, all these efforts add strength.

D. Public-private partnership

67. Millennium Development Goal 8 calls for public-private partnership. The Plan of Action of the World Summit on Sustainable Development emphasizes ICT applications in support of sustainable development. The Plan of Action of the World Summit on the Information Society envisions connecting at, among others, villages, schools and clinics with ICT. To ensure effective implementation of the outcomes of the summits, cooperation between stakeholders needs to be enhanced, for instance by promoting national, regional and international multi-stakeholder partnerships, including public-private partnerships.

68. Promoting large-scale operationalization of ICST applications by government, private agencies and NGOs and at the community level through public-private partnerships is of great significance. To improve access to information, Governments should develop strategies and adopt policies on public-private partnerships that encourage private sector participation to extend affordable ICT access to underserved areas such as remote rural areas and small islands.

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